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(54) **Immersion pump with integrated float switch**

(57) An immersion pump comprising a casing (2) having an immersed chamber (4), an impeller (6) mounted to the inside of said immersed chamber (4), a motor

(5) linked to the casing (2) and operating the impeller (6), said motor (5) being controlled by a float (13) placed within said casing (2).

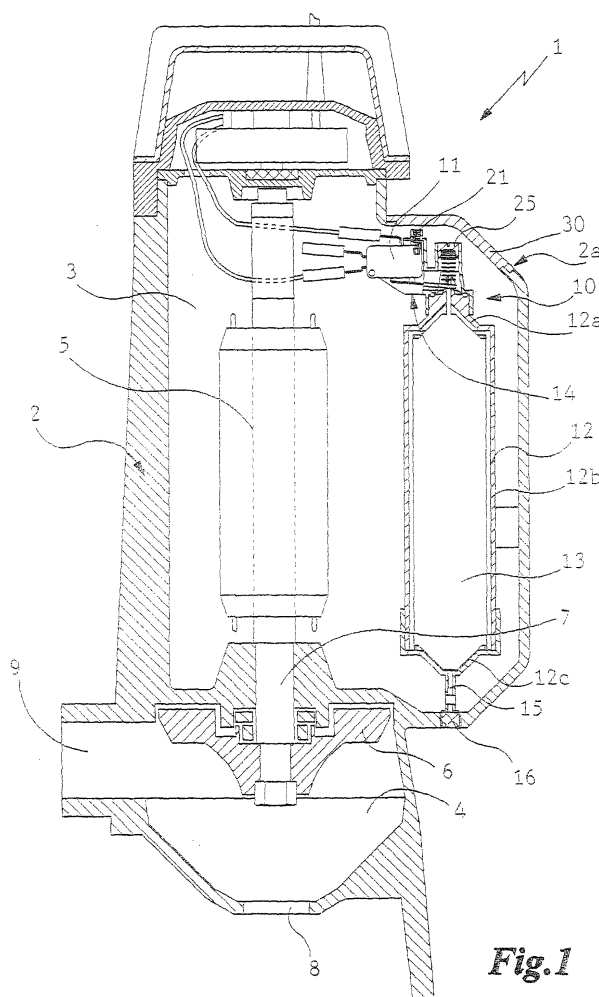


Fig.1

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Description

[0001] The present invention relates to an immersion pump of the type comprising the features set forth in the preamble of claim 1.

[0002] It is known that these devices, particularly used in the domestic field, are generally mounted at the inside of pits the water level of which is wished to be checked. Usually these pumps are employed to eliminate part of the liquid when the pit is filled too much, due to abundant rainfalls, for example.

[0003] Pumps thus used consist of a casing having a first tightly sealed chamber enclosing a generally electric motor. This motor operates an impeller mounted within a second chamber formed in the lower portion of the casing, which chamber, in opposition to the preceding one, is in connection with the liquid to be sucked in which the pump is at least partly immersed. When the motor is active the impeller conveys this fluid to an appropriate exhaust duct.

[0004] Switching on and off of the motor takes place depending on the level of such a liquid. When this level exceeds a maximum threshold the pump must start working in order to eliminate the liquid in excess and subsequently it stops working when the fluid goes under a second predetermined level. Usually the second level is selected to be to an appropriate distance from said maximum threshold, so as to avoid continuous switching on and off of the pump caused by small oscillations of the fluid level.

[0005] The above is usually accomplished by devices that, while having the most varying configurations, all involve use of a float external to the pump body.

[0006] The float, placed in the pit, is linked to a point of the pump casing by a cable or a lever. Therefore, the maximum distance between said point of the casing and the float is established by the length of the utilized cable or lever. Consequently, upon increasing of the water level the float rises with the liquid and covers an arc of a circumference of a radius corresponding to said length. Thus, it will be possible to establish a connection between the fluid liquid and the angle of inclination of said cable or lever. Known devices use switches connected to the pump motor which open and close depending on this angle of inclination.

[0007] Sometimes these solutions involve the possibility of adjusting the liquid-height values at which the pump must start and stop working by acting on the utilized cable or lever length or by varying the angles of maximum and minimum inclination of said cable or lever.

[0008] These devices using a float external to the pump body have however some drawbacks.

[0009] First of all they are not fully reliable since the float may accidentally be blocked, by foreign bodies or the pit walls themselves for example, to a level that does not correspond to the liquid height.

[0010] In addition, use of an outer float involves an

important bulkiness and difficulties in installation. Actually, when the pump is placed in a pit a thing to be taken into account is the space inside the pit that is necessary for correct operation of the whole device of which the float is part, at the different levels of the liquid to be sucked. Also to be noted is the fact that adjustment of the values of the liquid height at which the pump must start and stop working can be only obtained by complicated processes or processes giving inaccurate results or at all events not very practical for a user.

[0011] In the light of the above, it is an object of the present invention to provide a compact immersion pump having a limited operating bulkiness.

[0012] Another main object of the present invention is to make available an immersion pump in which switching on and off of same depending on the level of the fluid to be sucked are thoroughly reliable.

[0013] It is an auxiliary object of the invention to devise an immersion pump enabling an easy and accurate adjustment of the fluid levels at which the motor must be started and stopped.

[0014] The technical task mentioned and the objects specified are substantially achieved by an immersion pump in accordance with the features set forth in the appended claims.

[0015] The description of a preferred but non-exclusive embodiment of an immersion pump is now given hereinafter by way of non-limiting example and illustrated in the accompanying drawings, in which:

- Fig. 1 is a longitudinal section of a pump in accordance with the invention;
- Fig. 2 is a longitudinal section of a detail to an enlarged scale of the pump in Fig. 1, in a first operating condition; and
- Fig. 3 shows a longitudinal section of a detail to an enlarged scale of the pump in Fig. 1, in a second operating condition.

[0016] With reference to the drawings, the immersion pump in accordance with the invention has been generally identified by reference numeral 1.

[0017] The pump comprises a casing 2 arranged to be at least partly immersed in the liquid to be pumped.

Casing 2 has an immersed chamber 4 and a tightly sealed chamber 3.

[0018] Connected with said casing 2 is a motor 5, an electric motor for example, intended for operating the pump. Motor 5 is advantageously located within the tightly sealed chamber 3, so as to be suitably insulated from the liquid to be pumped.

[0019] The immersed chamber 4 holds an impeller 6 mounted to a shaft 7 coming out of motor 5. When said motor is in operation, it moves the impeller 6 urging the liquid to be pumped, which has entered the immersed chamber 4 through a suction port 8, towards a delivery port 9. The delivery port 9 will be connected with an appropriate exhaust duct, not shown in the drawings.

[0020] Pump 1 further comprises means for operating the motor depending on the level of the liquid to be pumped, generally identified by 10 and essentially defined by a liquid-level checking device. This means in the pump of the invention is housed within casing 2. It comprises a switch 11 operatively active on the motor, a level chamber 12 and a float 13.

[0021] The level chamber 12 extends in a substantially vertical direction within casing 2. Preferably it is housed in the tightly sealed chamber 3 from which it is conveniently insulated, and can be either connected with a small plenum chamber (not shown) housed in casing 2 or directly connected with the atmosphere surrounding the pump, through an appropriate duct for example, not shown as well.

[0022] The level chamber 12 has an upper portion 12a, a central portion 12b having constant transverse and preferably circular sections, and a bottom region 12c. In addition, chamber 12 is in fluid connection with the liquid to be pumped through a duct 15 bringing the bottom region into communication with the outside of casing 2. A filter 16 is mounted at the entrance of duct 15 to prevent foreign bodies from entering the chamber together with the fluid.

[0023] Float 13 too has an elongated conformation in a substantially vertical extension direction. In particular the ratio, called "slenderness ratio", between the sizes typical of the vertical extension of the float and those of its transverse extension is preferably higher than two. Float 13 has constant transverse sections, its shape preferably matching the shape of the central portion 12b of the level chamber 12.

[0024] Said float 13, held in the level chamber 12, is movable within the latter in a substantially vertical direction. Upon variation of the level of the fluid to be pumped, it can take a series of positions comprising a first limit position, shown in Fig. 2, and a second limit position, shown in Fig. 3, preferably at a lower location than the first one.

[0025] Means enabling operation of the switch by the float, generally denoted by 14, allows motor 5 to be switched on and off on varying of the level of the liquid to be pumped. Said means 14 is mounted within casing 2 and comprises a switch-control device, denoted by 17 in Figs. 2 and 3, and means 18 for adjusting the distance between the two limit positions of float 13.

[0026] The switch-control device 17 has the function of closing said switch when float 13 is in the first limit position and of opening it when the float is in its second limit position. This control device 17 comprises a key 19 operatively active on said switch 11 and movable in a vertical direction between a switching-on position, shown in Fig. 2, closing the switch, and a switching-off position, shown in Fig. 3, opening the switch. A lever 20 connected at a first point 20b with float 13 and at a second point 20c with switch 11 or any other element within casing 2, is disposed in such a manner that it abuts, at its central portion 20a, against said key 19. In addition,

lever 20 and key 19 are such mounted that the former pushes the latter to its switching-on position when float 13 is in said first limit position, whereas it brings said key back to the switching-off position when float 13 is in said second limit position.

[0027] Means 18 for adjusting the distance between the two limit positions of float 13 in turn comprises an adjusting screw 21 for said distance. In fact, by utilizing solutions belonging to the known art and therefore not further described, it is for instance possible, by this screw 21, to adjust the length of the key stroke and consequently the distance between the switching-on and switching-off positions of said key 19.

[0028] The adjusting screw 21 is such arranged that it can be easily accessible from the outside. This accessibility can be for example achieved by providing the casing 2 portion which is close to said screw 21 with an opening equipped with a closure element 30 enabling tightness.

[0029] The immersion pump in accordance with the present invention not only offers the possibility of adjusting the relative distance between the two limit positions of float 13, but also enables the level of the liquid to be pumped to which such positions correspond to be defined at will.

[0030] This is allowed by the use of a counter-element 22 exerting a return force on float 13 which is substantially opposite to the thrust that said float receives from the fluid. A spring 23 engaged between the float 13 and said level chamber 12 may be advantageously adopted as the counter-element 22.

[0031] Also provided is means 24 for adjusting the amount of said return force, which means comprises a set screw 25 operatively active on spring 23 so as to modify preloading thereof depending on the screwing-down degree. In the same manner as previously described with reference to the adjusting screw 21, the set screw 25 is advantageously such disposed that it is easily accessible from the outside. In particular this screw 25 faces portion 2a of the casing 2 wall in which said opening is formed.

[0032] Operation of the immersion pump in accordance with the invention, previously described mainly as regards structure is as follows.

[0033] As above said, the pump lends itself to be placed within a pit the water level of which is wished to be checked. When said level is particularly low the liquid does not enter the level chamber 12 and, as a result, the float is in its second limit position, as shown in Figs. 1 and 3. Under this condition, lever 20 does not engage the key 19 of switch 20 that therefore keeps its switched-off position. Thus the motor is not in operation.

[0034] As its level increases, the liquid begins entering the level chamber 12 through duct 15, surrounds the lower portion of float 13 and pushes it upwardly. This thrust is however countered by the force exerted in the opposite direction by spring 23. As a result of this, float 13 does not move until the liquid thrust equals preload-

ing of the spring 23 itself. A given value of the liquid level herein defined as "balance value" for convenience, will correspond to this equality.

[0035] When this value is overcome, float 13 begins being lifted by the liquid, thus pressing down on key 19 through lever 20. At the end of a short stroke, float 13 comes to its first limit position to which the switching-on position of the switch key 19 corresponds.

[0036] The pump motor 5 is thus set in operation and impeller 6 begins pushing the fluid towards the exhaust duct. Due to the pump action, the liquid level and the float therewith go down until key 19 is caused to come back to the switching-off position. Under this condition the pump will stop being active.

[0037] The pump in accordance with the invention offers the possibility of adjusting said balance value at will, by modifying preloading of spring 23 through the respective set screw 25, easily accessible from the outside. It should be noted that use of a float 13 of vertical extension and high slenderness ratio enables this value to be selected within a very wide range. In addition, use of a float 13 having a constant section and use of a linear-response spring 23 ensure a direct proportionality between the rotation angles of the set screw 25 and said balance value.

[0038] By acting on the adjusting screw 21 determining the amplitude of the float stroke between the two float limit positions, it is also possible to previously establish the relative distance between the liquid level causing switching-on of the pump and the liquid level causing switching-off of the latter.

[0039] The invention achieves important advantages.

[0040] First of all, placing means 10 for operating motor 5 within the pump body enables manufacture of a compact device which is characterized by an operating bulkiness surely smaller than in known solutions.

[0041] In addition, the pump in accordance with the invention ensures a completely reliable connection between switching on/switching-off of same and the fluid level. In fact, by virtue of its placement, float 13 cannot be submitted to interferences caused by foreign bodies.

[0042] The fact that float 13 does not interact with the fluid present in the pit but it interacts with the fluid inside the level chamber 12 offers another important advantage. In fact, the float behaviour in this manner is not affected by the whirling or wave motions of the fluid within the pit.

[0043] The immersion pump in accordance with the invention has a further advantage, i.e. it enables selection of the values of the liquid level to which the motor must start or stop working within a very wide range.

[0044] In addition, these values can be adjusted in a precise and simple manner. It should be understood that further advantages also result from the direct proportionality between the rotation angles of the set screw 25 and the level of the liquid corresponding to the balance value.

Claims

1. An immersion pump comprising:

- a casing (2) to be at least partly immersed in a liquid to be pumped, said casing (2) comprising an immersed chamber (4), said immersed chamber (4) having a suction port (8) and a delivery port (9);
- a motor (5) linked to said casing (2);
- an impeller (6) operated by said motor (5) and mounted to the inside of the immersed chamber (4), said impeller (6) being adapted to push out of the delivery port (9), the liquid to be pumped entering the immersed chamber (4) from the suction port (8); and
- means (10) for operating the motor (5) depending on the level of the liquid to be pumped,

characterized in that said means (10) for operating the motor (5) is housed within the casing (2).

2. An immersion pump as claimed in claim 1, **characterized in that** said means (10) for operating the motor (5) comprises a level-checking device having:

- a switch (11) operatively active on the motor (5);
- a level chamber (12) formed within said casing (2), said chamber being in fluid communication with the liquid to be pumped, said chamber having a bottom region (12c), a central portion (12b) and an upper portion (12a);
- a float (13) put within the level chamber (12), said float (13) being movable within said level chamber (12); and
- switch-operating means (14) for causing operation of the switch (11) by the float (13), mounted within said casing (2).

3. An immersion pump as claimed in claim 2, **characterized in that**:

- said level chamber (12) has a substantially vertical extension direction;
- said float (13) is movable within said level chamber (12) in a substantially vertical direction, said float (13) being movable on varying of the level of the fluid to be pumped between a first and a second limit positions; and
- said level chamber (12) is in fluid communication with the liquid to be pumped at its bottom region (12c).

4. An immersion pump as claimed in claim 3, **characterized in that** the central portion (12b) of said level chamber has sections transverse to said extension direction that are substantially constant.

5. An immersion pump as claimed in claim 4, **characterized in that** said transverse sections have a substantially circular conformation.
6. An immersion pump as claimed in claim 3, **characterized in that** said float (13) has an elongated conformation in a substantially vertical extension direction, said float (13) preferably having a slenderness ratio higher than two.
7. An immersion pump as claimed in claim 6, **characterized in that** said float (13) has sections transverse to its extension direction that are substantially constant.
8. An immersion pump as claimed in claim 4, **characterized in that** the shape of said float (13) substantially matches the shape of said central portion (12b) of the level chamber.
9. An immersion pump as claimed in claim 3, **characterized in that** said means (11) for causing operation of the switch (11) by the float (13) comprises:
 - a switch-control device (17) for closing the switch (11) when the float (13) is in said first limit position and opening the switch (11) when the float (13) is in said second limit position;
 - means (18) for adjusting the distance between the two limit positions of the float (13).
10. An immersion pump as claimed in claim 9, **characterized in that** said switch-control device (17) comprises:
 - a key (19) operatively active on said switch (11) and movable in a vertical direction between a switching-on position closing the switch (11) and a switching-off position opening the switch (11);
 - a lever (20) linked at a first point to the float (13) and at a second point to the inside of said casing (2), said lever (20) being positioned in such a manner that it abuts against said key (19) pushing it to its switching-on position when the float (13) is in said first limit position and bringing it back to the switching-off position when the float (13) is in said second limit position.
11. An immersion pump as claimed in claim 9, **characterized in that** said means (18) for adjusting the distance between the two limit positions of the float (13) comprises an adjusting screw (21) for said distance, said screw (21) being accessible from the outside of said casing (2).
12. An immersion pump as claimed in claim 2, **characterized in that** it comprises a counter-element (22) operatively active between the float (13) and said level chamber (12), said counter-element (22) exerting a return force on the float (13) which is substantially opposite to the thrust that said float receives from the fluid.
13. An immersion pump as claimed in claim 12, **characterized in that** it comprises means (24) for adjusting the amount of said return force.
14. An immersion pump as claimed in claim 13, **characterized in that** said counter-element (22) comprises a spring (23) engaged between the float (13) and said level chamber (12).
15. An immersion pump as claimed in claim 14, **characterized in that** said means (24) for adjusting the amount of the return force comprises a set screw (25) operatively active on said spring (23) in order to determine preloading of same, said set screw (25) being accessible from the outside of said casing (2).
16. A device for checking the level of a liquid, to be combined with an immersion pump according to one or more of claims 1 to 15.

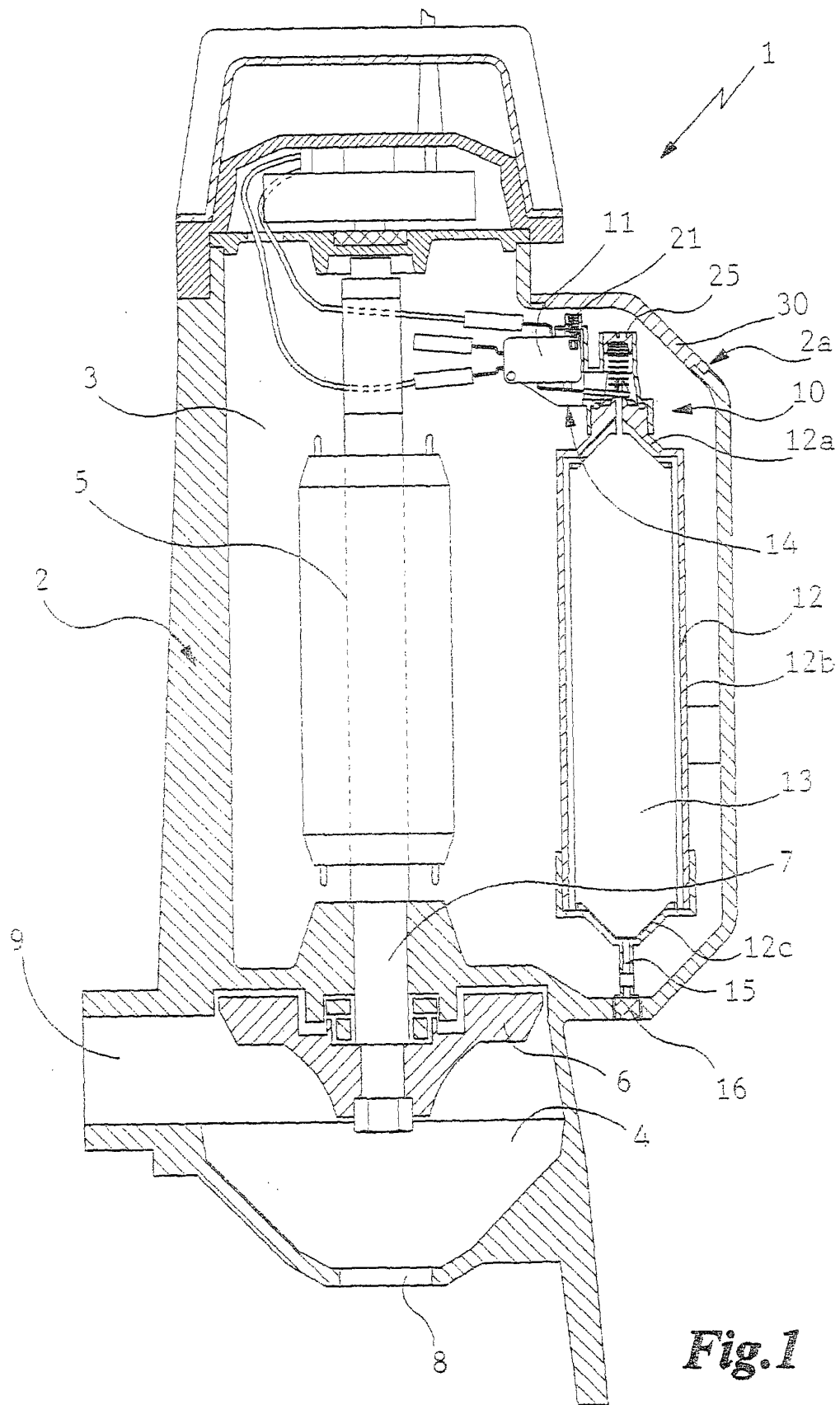


Fig.1

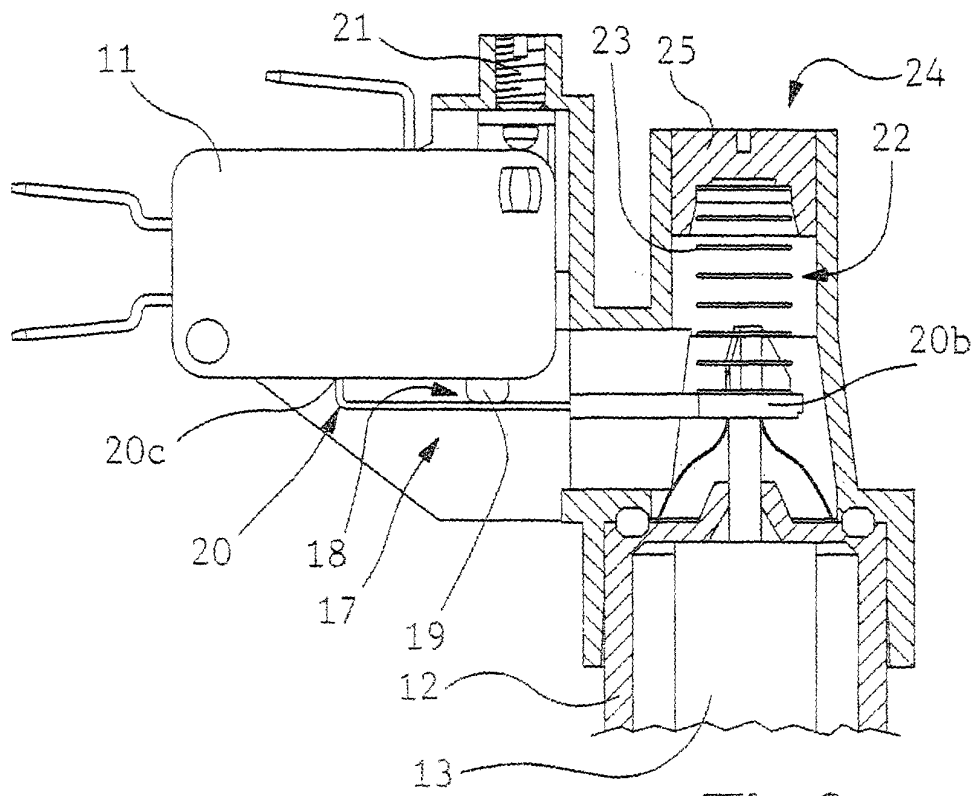


Fig. 2

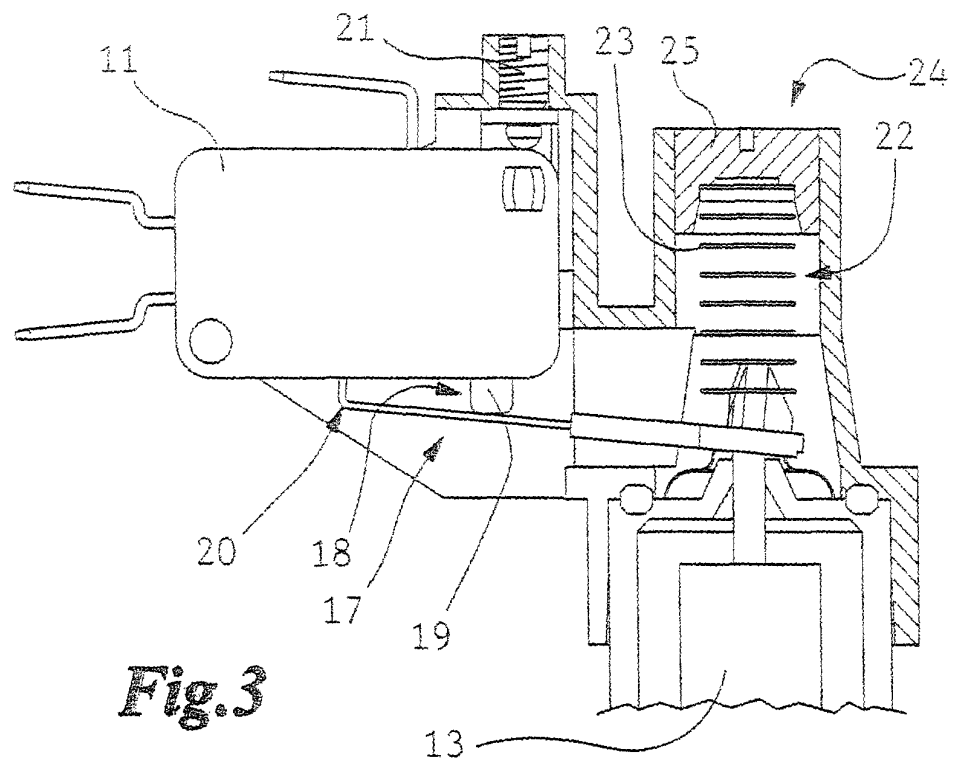


Fig. 3



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EUROPEAN SEARCH REPORT

Application Number
EP 00 83 0143

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.7)
X	DE 198 02 227 A (ELEKTRA BECKUM AG) 17 September 1998 (1998-09-17) * column 2, line 67 - column 5, line 16; figure 1 * * column 4, line 49 - line 56 *	1-8, 16	F04D13/08 F04D15/02
X	US 3 316 845 A (SCHUMANN A.F.) 2 May 1967 (1967-05-02) * the whole document *	1, 4, 6-8, 16	
X	DE 36 07 466 A (BLUM ALBERT) 24 September 1987 (1987-09-24) * abstract; figures 1, 2 *	1-4, 6-8, 16	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			F04D
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
THE HAGUE		25 July 2000	Ingelbrecht, P
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 00 83 0143

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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25-07-2000

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