

Description

This invention relates generally to pressure responsive switches and deals more particularly with a switch device for detecting when the pressure differential between relative high and low pressures exceeds a preselected level, the device comprising a housing having high and low pressure ports for receiving the respective high and low pressures, which is sensitive to a pressure differential between low and high sides of a fluid system.

A device of the above type is described for example in US-A-2782272.

Various types of fluid systems are equipped with switches that are actuated when there is an excessive pressure differential between two parts of the system. Although existing switches of this type have functioned well for the most part, they have not been wholly without problems. The useful life of some existing pressure differential switches is relatively short, particularly for switches used in high pressure service and those subjected to transient shock or spike loads. Some devices must be connected in one particular orientation to the high and low pressures and can be severely damaged if connected in a reverse fashion. When the pressures to which the switch is exposed vary over a wide range, it is difficult to accurately maintain the differential set point, and the sensitivity of the device suffers accordingly. Another serious problem has been to prevent deterioration of the components of the switch when corrosive fluids are being handled.

Existing switch devices are usually arranged such that the pressure sensitive components travel a relatively long distance in order to assure proper actuation of the switch when the set differential pressure is exceeded. This long travel increases the wear on the various parts, particularly where seal elements and/or linkages are employed. Additionally, in some cases it is difficult if not impossible to vary the set point of existing devices while they are in service under pressure.

According to the present invention a switch device for detecting when the pressure differential between relative high and low pressures exceeds a preselected level comprises a housing having high and low pressure ports for receiving the respective high and low pressures, and is characterised in that the housing defines a piston chamber therein between the ports, a piston being provided in the piston chamber, said piston having opposed faces exposed to the respective high and low pressure ports to urge it towards the low pressure port under the influence of the pressure differential between the high and low pressures; in that a shaft is supported for rotation in the housing, said shaft having a lever arm and a switch arm extending outwardly from the shaft at spaced apart locations; in that means are provided coupling the piston with the lever arm so as to cause the

shaft to rotate in a first direction on movement of the piston towards the low pressure port; in that resilient means are provided, exerting a biasing force on the shaft urging the shaft to rotation in the opposite direction, the resilient means resisting movement of the piston towards the low pressure port when the pressure differential is below the preselected level but yielding to permit rotation of the shaft in the first direction when the pressure differential exceeds the preselected level; and in that switch means are provided, actuated by the switch arm upon rotation of the shaft in the first direction, the switch means thereby being actuated when the pressure differential exceeds the preselected level.

Such a switch device is capable of functioning effectively over a wide range of pressures and a wide range of pressure differentials. The device can be constructed to withstand pressures up to approximately 3000 psi (20.685×10^6 N/m²) with either port connected with the high pressure side of the system. The unit is also constructed in modular fashion so that the components can be changed to permit a wide variation in the differential set point and to accommodate pressures up to 10,000 psi (60.895×10^6 N/m²).

A switch device of the character described can readily absorb severe transient shock loads without damage and the travel of the pressure responsive components can be limited without adversely affecting proper actuation of the switch.

Preferably the construction is such that the pressurized fluid medium is isolated from the critical components of the unit so that corrosive fluids can be readily handled.

A switch device of the character described may be quickly and easily assembled and disassembled and can be designed to present no danger from excessive pressure buildup.

In the accompanying drawings, which form a part of the specification and are to be read in conjunction therewith, and in which like reference numerals are used to indicate like parts in the various views:

Fig. 1 is an elevational view of a pressure differential switch device constructed according to a preferred embodiment of the present invention;

Fig. 2 is a sectional view taken generally along line 2—2 of Fig. 1 in the direction of the arrows;

Fig. 3 is a sectional view taken generally along line 3—3 of Fig. 1 in the direction of the arrows;

Fig. 4 is a sectional view taken generally along line 4—4 of Fig. 1 in the direction of the arrows;

Fig. 5 is a sectional view taken generally along line 5—5 of Fig. 4 in the direction of the arrows; and

Fig. 6 is a sectional view similar to Fig. 4, but

with a reduced size piston substituted for the larger piston shown in Fig. 4.

Referring now to the drawings in detail, reference numeral 10 generally designates a high pressure differential switch constructed in accordance with the present invention. Switch 10 has a housing 12 which includes a block or body 14 secured to a base plate 16 by a plurality of screws 18 (Fig. 4). A hollow switch housing 20 is secured to one side of body 14 by screws 22, while a hollow spring housing 24 is mounted to the opposite side of the body by screws 26. With particular reference to Fig. 4, body 14 is provided with a low pressure port 28 which is internally threaded in order to receive a low pressure conduit 30 which connects with the low pressure side of a fluid system. Port 28 communicates with a low pressure chamber 32 formed in body 14 internally of housing 12.

A cover plate 34 is screwed at 36 to the open side of body 14. Body 14 and cover plate 34 cooperate to present a space 37 adjacent to chamber 32 which receives a perforated disc 38. Integral with the periphery of disc 38 is a short cylinder 40 which presents therein a cylindrical piston chamber 42. Disc 38 has a plurality of openings 44 which provide fluid communication between low pressure chamber 32 and piston chamber 42. An internally threaded high pressure port 46 is formed in cover plate 34. Threaded into port 46 is a high pressure conduit 48 which leads to the high pressure side of the fluid system. Port 46 communicates with piston chamber 42 on the end opposite disc 38. A seal ring 50 provides a seal between body 14, plate 34, and cylinder 40.

A piston 52 is mounted closely in piston chamber 42 and is sealed to cylinder 40 by a seal ring 54 carried in an annular groove on the periphery of piston 52. A plunger 56 has a pin portion which is fitted in an opening formed in the face of piston 52 which is adjacent disc 38. Plunger 56 projects from piston 52 through a central opening in disc 38 and into the low pressure chamber 32. The end of plunger 56 remote from piston 52 has a rounded head portion.

Referring now particularly to Fig. 5, body 14 has a cylindrical horizontal bore 58 which extends between switch housing 20 and spring housing 24 and which intersects with the bottom portion of chamber 32. A shaft 60 extends through bore 58 and is supported for rotation by a pair of needle bearings 62 mounted in bore 58 at locations adjacent housings 20 and 24. A lever arm 64 is mounted on shaft 60 with an opening formed in the lever arm receiving the shaft. A set screw 66 is threaded into arm 64 and tightened against a flat surface of shaft 60 to mount the lever arm on the center of the shaft. On each side of the lever arm 64, an annular seal element 68 provides a seal between shaft 60 and body 14. Seal elements 68 are located between arm 64

and each bearing 62, and each seal element is mounted on shaft 60 between a pair of back-up rings 70 which are sleeved around shaft 60. Seal elements 68 permit shaft 60 to turn about its longitudinal axis while still providing effective seals which isolate the fluid pressure in chamber 32 from bearings 62 and the components located in housings 20 and 24. As shown in Fig. 4, the round head portion of plunger 56 contacts lever arm 64 at a location near the outer end of the lever arm. Bearings 62 are held in place between back-up rings 70 and bearing retainers 72 which are fitted against the sides of body 14 at locations within housings 20 and 24 and secured by screws 73.

With particular reference to Fig. 3, one end of the shaft 60 extends through an opening formed in a horizontal lever 74 which is located in spring chamber 24. A set screw 76 is threaded into lever 74 and tightened against shaft 60 in order to secure the lever on the shaft. A sleeve 77 (Fig. 5) serves as a spacer which extends from bearing retainer 72 to lever 74. A lower spring retainer 78 is mounted on the outer end of lever 74 by means of a screw 80 which is threaded into the lever and spring retainer. Retainer 78 receives the lower end of a compression spring 82 the upper end of which engages an upper spring retainer 84. The upper surface of retainer 84 abuts the lower end of a screw 86 having a projecting pin portion 86a fitting through retainer 84. Screw 86 is threaded through a fitting 88 which is in turn screwed to the top end of spring housing 24. A seal between fitting 88 and housing 24 is provided by an O-ring 90. Screw 86 is enclosed within a cap 92 which is threaded onto fitting 88 and sealed thereto by an O-ring 94.

As shown in Figs. 2 and 5, switch housing 20 contains a vertical switch arm 96 which is mounted on the end of shaft 60 opposite lever 74. A set screw 98 is threaded into arm 96 and against shaft 60. The upper end of arm 96 carries a threaded pin 100 which projects beyond the side of the arm and has a flat end which contacts a plunger 102 of a switch 104. Switch 104 is secured within switch housing 20 by screws 106 and has conductor wires 108 which lead out of the switch housing through a conduit 110 threaded into the top of the switch housing. A threaded opening in one side of switch housing 20 is normally closed by a plug 112. Switch 104 is shown only as an example. It may, in fact, be a multiplicity of types of switches, (for example, a hermetically sealed switch) to accommodate various electrical loads and environmental conditions. Switch housing would change accordingly.

As shown in Fig. 5, switch housing 20 and spring housing 24 are each provided with a drain opening 114 in their bottom surfaces. Each drain port 114 is fitted with a porous disc 116 which permits venting of fluid pressure from within the switch housing and the spring housing.

In use, the biasing force exerted on arm 74 by spring 82 maintains shaft 60 in the rotative position shown in Fig. 4 so long as the pressure differential between the high and low sides of the fluid system, as sensed at ports 46 and 28, is below a preselected level which is determined by the setting of spring 82. In this position, the interaction between arm 64 and plunger 56 holds piston 52 against cover plate 34 since the pressure differential across the piston is insufficient to overcome the force of spring 82. However, the spring force is overcome if the pressure differential rises sufficiently. In this event, the force exerted on the right face of the piston through high pressure port 46 is greater than the spring force plus the force exerted on the left face of the piston through low pressure port 28, low pressure chamber 32, and openings 44. Piston 52 is then moved to the left until it bottoms against disc 38. The rounded head of plunger 56 pushes against lever arm 64 to rotate shaft 60 in a counter clockwise direction as viewed in Fig. 4.

Such rotation of shaft 60 carries switch arm 96 in a direction causing pin 100 to release plunger 102, thereby actuating switch 104. When actuated, switch 104 turns on or off appropriate equipment which counteracts or otherwise responds to the effects of the excessive pressure differential.

The pressure differential resulting in actuation of the switch can be adjusted by adjusting the force of spring 82. This can be accomplished by removing cap 92 and threading screw 86 into or out of fitting 88 to move upper spring retainer 84 toward or away from the lower spring retainer 78. Since the interior of spring housing 24 is completely isolated from the fluid pressure by seal ring 68, adjustment of the spring force can be undertaken while the unit is in service and exposed to high fluid pressure. It is also to be noted that seal rings 68 isolate bearings 62 and the components within switch housing 20 and spring housing 24 from the fluid medium and thus shield the critical components of the switch assembly from corrosive fluids and other damaging fluids employed in the fluid pressure system being monitored. In addition, abrupt transient shock loads or spike loads in the fluid system are not applied to the critical components of the switch assembly, due to the limited piston travel.

The travel of piston 52 is minimal, preferably approximately 10/1000 inch, (0.25 mm), although the travel can vary. Such small travel of the piston reduces the wear on it and seal ring 54, and also results in small rotational movement of shaft 60 in order to reduce the wear on the components associated with the shaft, especially seal elements 68. Preferably, the point of contact between plunger 56 and lever arm 64 is only about half as far from the centre of shaft 60 as the point of contact

between pin 100 and plunger 102 of switch 104. Consequently, a mechanical advantage is obtained whereby the movement of piston 52 is translated into twice as much movement of pin 100. Proper actuation of switch 104 is thus assured when the set pressure differential is exceeded. The small piston travel also results in a small volume displacement of fluid in piston chamber 42, a feature which is particularly important in low volume systems where a large fluid volume is not available.

It has been found that switch 10 is capable of maintaining an accurate differential set point with widely varying system pressures. For example, a 5 psi (34×10^3 N/m²) pressure has been maintained with system pressures which vary in the range of from 0 to approximately 3000 psi (20×10^6 N/m²). Seals 54 and 68 are able to withstand pressures up to 3000 psi (20×10^6 N/m²) without appreciable leakage. In the event there is leakage past seal 68, drain ports 114 and discs 116 serve to vent the leaking fluid so that there is no danger of pressure build-up in the switch or spring housings.

Switch 10 has a modular construction which permits any number of spring, piston, and shaft combinations to be employed. For example, Figure 6 illustrates a relatively small piston 152 which replaces piston 52 and a relatively small perforated disc 138 having a thickened cylinder 140 which is sealed to piston 152 by an O-ring 154. Due to the reduced area of the faces of piston 152, a higher differential pressure range can be achieved with the same spring 82. Of course, pistons of various sizes can be used in combination with springs of various strengths to achieve virtually any desired differential pressure setting.

From the foregoing, it will be seen that this invention is one well adapted to attain all the ends and objects hereinabove set forth together with other advantages which are obvious and which are inherent to the structure.

Claims

1. A switch device (10) for detecting when the pressure differential between relative high and low pressures exceeds a preselected level, the device (10) comprising a housing (14) having high (46) and low (28) pressure ports for receiving the respective high and low pressures, characterised in that the housing defines a piston chamber (42) therein between the ports, a piston (52) being provided in the piston chamber (42), said piston (52) having opposed faces exposed to the respective high (46) and low (28) pressure ports to urge it towards the low pressure port (28) under the influence of the pressure differential between the high and low pressures; in that a shaft (60) is supported for rotation in the housing (14), said shaft having a lever arm (64) and a switch arm (96) extending outwardly from the shaft (60) at



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spaced apart locations, in that means (56) are provided coupling the piston (52) with the lever arm (64) so as to cause the shaft (60) to rotate in a first direction on movement of the piston (52) towards the low pressure port (28), in that resilient means (82) are provided, exerting a biasing force on the shaft (60) urging the shaft to rotate in the opposite direction, the resilient means (82) resisting movement of the piston (52) towards the low pressure port (28) when the pressure differential is below the pre-selected level but yielding to permit rotation of the shaft (60) in the first direction when the pressure differential exceeds the preselected level; and in that switch means (104) are provided; actuated by the switch arm (96) upon rotation of the shaft (60) in the first direction, the switch means (104) thereby being actuated when the pressure differential exceeds the pre-selected level.

2. A switch device (10) according to claim 1, including a pair of seal elements (68) sealing the shaft in the housing (14) at locations on opposite sides of the lever arm (64) to isolate the switch arm (96) and resilient means (82) from the fluid in the ports (28, 46).

3. A switch device (10) according to claim 2, including a pair of bearings (62) mounted in the housing (14) and providing rotative support for the shaft (60) at locations on opposite sides of the lever arm (64) each seal element (68) being located between the lever arm (64) and the respective bearings (62) to isolate the bearings (62) from the fluid in the ports (28, 46).

4. A switch device (10) according to claim 2, or claim 3, including means (114) for venting the housing (14) at locations outwardly of the seal elements (68).

5. A switch device (10) according to any of claims 1 to 3, including means (86) accessible exteriorly of the housing (14) for adjusting the biasing force exerted on the shaft (60) by the resilient means (82), thereby to adjust the pre-selected pressure differential.

6. A switch device (10) according to any of claims 1 to 4, wherein the resilient means (82) includes a lever (74) extending outwardly from the shaft (60) and a spring (82) applying a force to the lever (74) at a location outwardly of the shaft (60), thereby urging the shaft (60) in the opposite direction.

7. A switch device (10) according to claim 6, including a first spring retainer (78) mounted on the lever (74); a second spring retainer (84) spaced from the first retainer (78) with the spring (82) extending therebetween; and means (86) for effecting movement of the second retainer (84) toward and away from the first retainer (78) thereby to adjust the force applied to the lever (74) by the spring (82).

8. A switch device (10) according to any of claims 1 to 7, wherein the coupling means (56) includes a plunger (56) carried on the piston (52) and projecting therefrom toward the low pressure port (28), the plunger (56) contacting

the lever arm (64) at a location radially outwardly of the shaft (60).

9. A switch device (10) according to claim 8, wherein the switch arm (96) engages the switch means (104) at a location more distant from the shaft (60) than the point of contact between the plunger (56) and lever arm (64).

10. A switch device (10) according to any of claims 1 to 9, wherein a low pressure chamber (32) is formed in the housing (14) between the low pressure port (28) and the piston (52).

Patentanprüche

1. Schaltvorrichtung (10), mit welcher das Überschreiten einer vorgewählten Druckhöhe durch den Differenzdruck zwischen relativ hohen und relativ niedrigen Drücken ermittelbar ist, wobei die Vorrichtung (10) ein Gehäuse (14) aufweist, das mit einer Hochdrucköffnung (46) und einer Niederdrucköffnung (28) für den Einlaß der entsprechenden hohen und niedrigen Drücke versehen ist, dadurch gekennzeichnet, daß das Gehäuse im Inneren zwischen den Öffnungen eine Kolbenkammer (42) definiert, wobei in der Kolbenkammer (42) ein Kolben (52) angeordnet ist, der entgegengesetzte Seiten aufweist, welche der Hochdrucköffnung (46) bzw. der Niederdrucköffnung (28) zugekehrt sind, um den Kolben unter der Wirkung des Differenzdruckes zwischen dem hohen und dem niedrigen Druck gegen die Niederdrucköffnung (28) zu bewegen; daß im Gehäuse (14) ein Schaft (60) drehbar angeordnet ist, wobei der Schaft einen Hebelarm (64) und einen Schaltarm (96) aufweist, die sich vom Schaft (60) an mit Abstand voneinander gelegenen Stellen wegerstrecken; daß eine Einrichtung (56) vorgesehen ist, welche den Kolben (52) mit dem Hebelarm (64) kuppelt, so daß der Schaft (60) bei einer Bewegung des Kolbens (52) gegen die Niederdrucköffnung (28) in einer ersten Richtung rotiert; daß eine elastische Einrichtung (82) vorgesehen ist, welche auf den Schaft (60) eine Vorspannkraft ausübt, um den Schaft (60) zur Drehung in der entgegengesetzten Richtung zu veranlassen, wobei die elastische Einrichtung (82) einer Bewegung des Kolbens (52) gegen die Niederdrucköffnung (28) entgegenwirkt, wenn der Differenzdruck unterhalb der vorgewählten Druckhöhe ist, aber nachgibt, um eine Drehung des Schaftes in der ersten Richtung zu gestatten, wenn der Differenzdruck die vorbestimmte Höhe überschreitet; und daß eine Schalteinrichtung (104) vorgesehen ist, die durch den Schaltarm (96) bei einer Drehung des Schaftes (60) in der ersten Richtung betätigbar ist, wobei die Schalteinrichtung (104) dadurch betätigt wird, daß der Differenzdruck die vorbestimmte Druckhöhe übersteigt.

2. Schaltvorrichtung (10) nach Anspruch 1, dadurch gekennzeichnet, daß sie ein Paar von Dichtelementen (68) aufweist, welche den Schaft im Gehäuse (14) an auf gegenüber-



liegenden Seiten des Hebelarmes (64) gelegenen Stellen abdichten, um den Schaltarm (96) und die elastische Einrichtung (82) vom Fluid in den Öffnungen (28, 46) zu isolieren.

3. Schaltvorrichtung (10) nach Anspruch 2, dadurch gekennzeichnet, daß sie ein Paar von Lagern (62) aufweist, die im Gehäuse (14) montiert sind und eine Drehlagerung für den Schaft (60) an auf gegenüberliegenden Seiten des Hebelarmes (64) gelegenen Stellen bilden, wobei jedes Dichtelement (68) zwischen dem Hebelarm (64) und dem zugeordneten Lager (62) angeordnet ist, um die Lager (62) vom Fluid in den Einlässen (28, 46) zu isolieren.

4. Schaltvorrichtung (10) nach Anspruch 2 oder 3, dadurch gekennzeichnet, daß eine Einrichtung (114) zum Entlüften des Gehäuses (14) an außerhalb der Dichtelemente (68) gelegenen Stellen vorgesehen ist.

5. Schaltvorrichtung (10) nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß eine von der Außenseite des Gehäuses (14) zugängliche Einrichtung (86) vorgesehen ist, um die von der elastischen Einrichtung (82) auf den Schaft (60) ausgeübte Vorspannkraft einzustellen und um dadurch den vorgewählten Differenzdruck einzustellen.

6. Schaltvorrichtung (10) nach einem der Ansprüche 1 bis 4, dadurch gekennzeichnet, daß die elastische Einrichtung (82) einen Hebel (74), der sich vom Schaft (60) nach außen erstreckt, und eine Feder (82) aufweist, die auf den Hebel (74) an einer außerhalb des Schaftes (60) gelegenen Stelle eine Kraft ausübt, wodurch der Schaft (60) in der entgegengesetzten Richtung beaufschlagt wird.

7. Schaltvorrichtung (10) nach Anspruch 6, gekennzeichnet durch einen am Hebel (74) befestigten ersten Federhalter (78); einen mit Abstand vom ersten Federhalter (78) angeordneten zweiten Federhalter (84), wobei die Feder (82) sich dazwischen erstreckt; und eine Einrichtung (86) zum Bewegen des zweiten Halters (84) gegen den ersten Halter (78) und von diesem weg, wodurch die auf den Hebel (74) von der Feder (82) aufgebrachte Kraft einstellbar ist.

8. Schaltvorrichtung (10) nach einem der Ansprüche 1 bis 7, dadurch gekennzeichnet, daß die Kupplungseinrichtung (56) einen Plunger (56) aufweist, der vom Kolben (52) getragen ist und sich von diesem gegen die Niederdrucköffnung (28) erstreckt, wobei der Plunger (56) den Hebelarm (64) an einer radial außerhalb des Schaftes (60) gelegenen Stelle berührt.

9. Schaltvorrichtung (10) nach Anspruch 8, dadurch gekennzeichnet, daß der Schaltarm (96) die Schalteinrichtung (104) an einer Stelle berührt, die vom Schaft (60) weiter entfernt ist als der Berührungspunkt zwischen dem Plunger (56) und dem Hebelarm (64).

10. Schaltvorrichtung (10) nach einem der Ansprüche 1 bis 9, dadurch gekennzeichnet,

daß im Gehäuse (14) zwischen der Niederdrucköffnung (28) und dem Kolben (52) eine Niederdruckkammer (32) ausgebildet ist.

5 Revendications

1. Dispositif de commutation (10) destiné à détecter si la pression différentielle entre une pression relativement haute et une pression relativement basse dépasse un niveau prédéterminé, le dispositif (10) comprenant un carter (14) avec un raccord à haute pression (46) et un raccord à basse pression (28) pour recevoir les pressions respectives haute et basse, caractérisé en ce que le carter définit une chambre de piston (42) entre les raccords, un piston (52) étant prévu dans la chambre de piston (42), ledit piston (52) ayant des faces opposées exposées aux raccords respectifs à haute (46) et basse (28) pressions pour le pousser vers le raccord à basse pression (28) sous l'influence de la pression différentielle entre les pressions haute et basse; en ce qu'un arbre (60) est supporté pour tourner dans le carter (14), ledit arbre portant un bras de levier (64) et un bras de commutateur (96) dirigés vers l'extérieur de l'arbre (60) dans des positions espacées; en ce qu'un dispositif (56) est prévu pour accoupler le piston (52) avec le bras de levier (64) pour faire tourner l'arbre (60) dans un premier sens du mouvement du piston (52) vers le raccord à basse pression (28); en ce qu'un dispositif élastique (82) est prévu pour exercer une force de rappel sur l'arbre (60) poussant l'arbre à tourner dans le sens opposé, le dispositif élastique (82) résistant au mouvement du piston (52) vers le raccord à basse pression (28) quand la pression différentielle est inférieure au niveau prédéterminé, mais cédant pour permettre la rotation de l'arbre (60) dans le premier sens quand la pression différentielle dépasse le niveau prédéterminé, et en ce qu'un commutateur (104) est prévu, actionné par le bras de commutateur (96) sous l'effet de la rotation de l'arbre (60) dans le premier sens, le commutateur (104) étant actionné quand la pression différentielle dépasse le niveau prédéterminé.

2. Dispositif de commutation (10) selon la revendication 1, comprenant une paire d'éléments d'étanchéité (68) assurant l'étanchéité de l'arbre dans le carter (14) dans des positions sur les côtés opposés du bras de levier (64) pour isoler le bras de commutateur (96) et le dispositif élastique (82) du fluide dans les raccords (28, 46).

3. Dispositif de commutation (10) selon la revendication 2, comprenant une paire de paliers (62) montés dans le carter (14) et assurant le support de l'arbre (60) pour qu'il puisse tourner, dans des positions sur les côtés opposés du bras de levier (64), chaque élément d'étanchéité (68) étant situé entre le bras de levier (64) et le palier respectif (62) pour isoler



les paliers (62) du fluide dans les raccords (28, 46).

4. Dispositif de commutation (10) selon la revendication 2 Ou la revendication 2, comprenant un dispositif (114) pour évacuer le carter (14) dans des positions à l'extérieur des éléments d'étanchéité (68).

5. Dispositif de commutation (10) selon l'une quelconque des revendications 1 à 3, comprenant un dispositif (86) accessible par l'extérieur du carter (14) pour régler la force de rappel exercée sur l'arbre (60) par le dispositif élastique (82) de manière à régler la pression différentielle prédéterminée.

6. Dispositif de commutation (10) selon l'une quelconque des revendications 1 à 4, dans lequel le dispositif élastique (82) comporte un levier (74) dirigé vers l'intérieur de l'arbre (60) et un ressort (82) qui applique une force sur le levier (74) dans une position à l'extérieur de l'arbre (60), poussant ainsi l'arbre (60) dans la direction opposée.

7. Dispositif de commutation (10) selon la revendication 6, comprenant un premier arrêt de ressort (78) monté sur le levier (74); un

second arrêt de ressort (84) espacé du premier arrêt (78) avec le ressort (82) disposé entre eux; et un dispositif (86) pour approcher et écarter le second arrêt (84) du premier arrêt (78) pour régler ainsi la force appliquée au levier (74) par le ressort (82).

8. Dispositif de commutation (10) selon l'une quelconque des revendications 1 à 7, dans lequel le dispositif d'accouplement (56) comporte un plongeur (56) supporté par le piston (52) et en faisant saillie vers le raccord à basse pression (28), le plongeur (56) étant en contact avec le bras de levier (64) dans une position extérieure radialement de l'arbre (60).

9. Dispositif de commutation (10) selon la revendication 8, dans lequel le bras de commutateur (96) engage le commutateur (104) dans une position plus distante de l'arbre (60) que le point de contact entre le plongeur (56) et le bras de levier (64).

10. Dispositif de commutation (10) selon l'une quelconque des revendications 1 à 9, dans lequel une chambre à basse pression (32) est formée dans le carter (14) entre le raccord à basse pression (28) et le piston (52).



* C L M S *