

Jan. 21, 1969

N. J. BEHNE ETAL

3,422,845

MOUNTING AND OPERATING MECHANISM FOR SWITCHES

Filed Aug. 19, 1966

Sheet 1 of 3

FIG. 1.

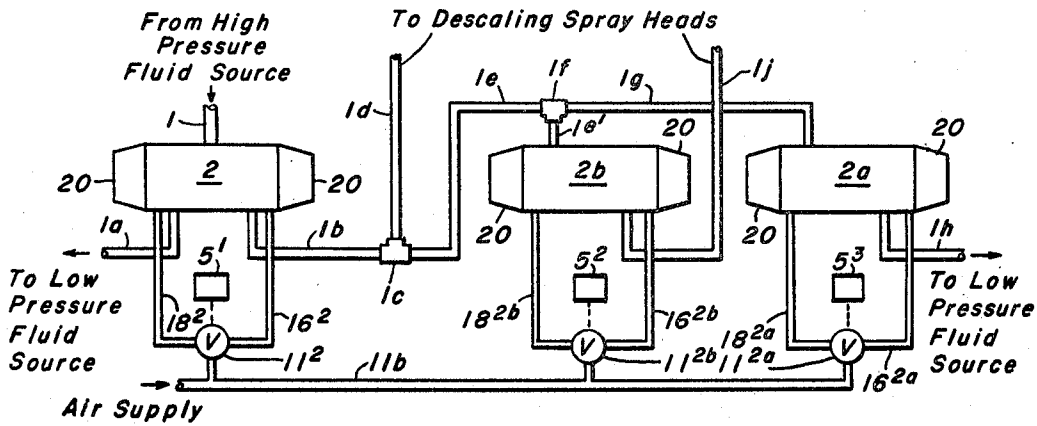
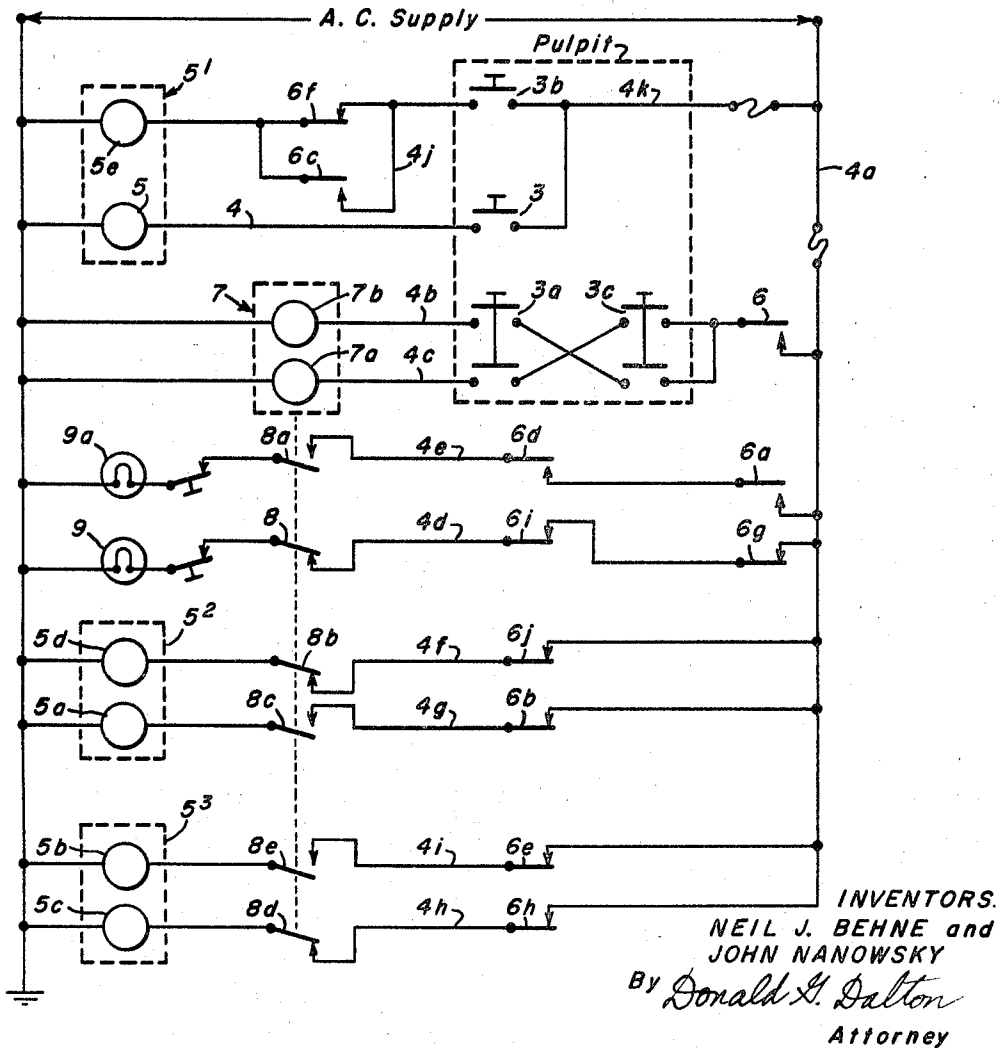


FIG. 2.



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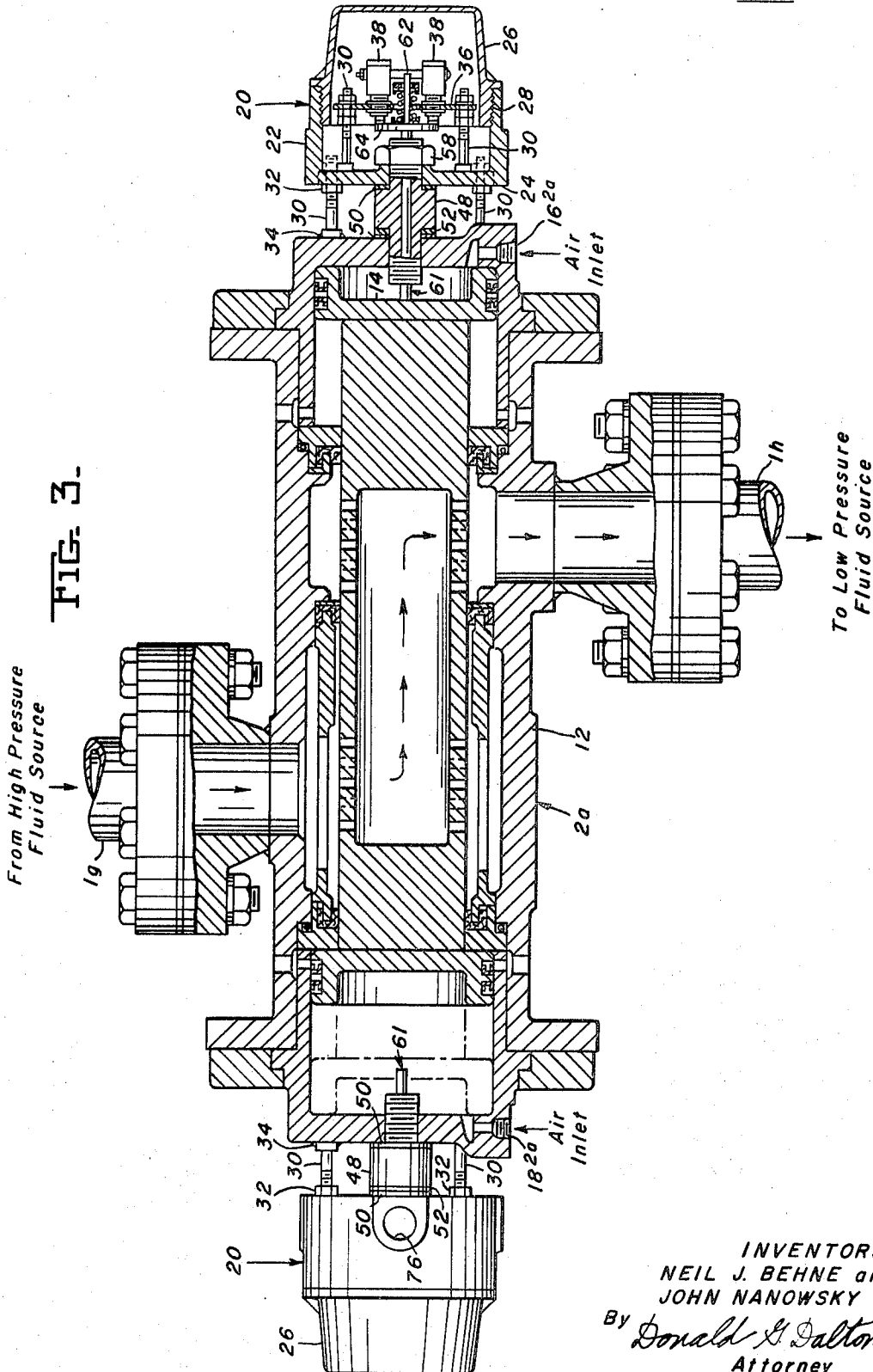
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FIG. 5.

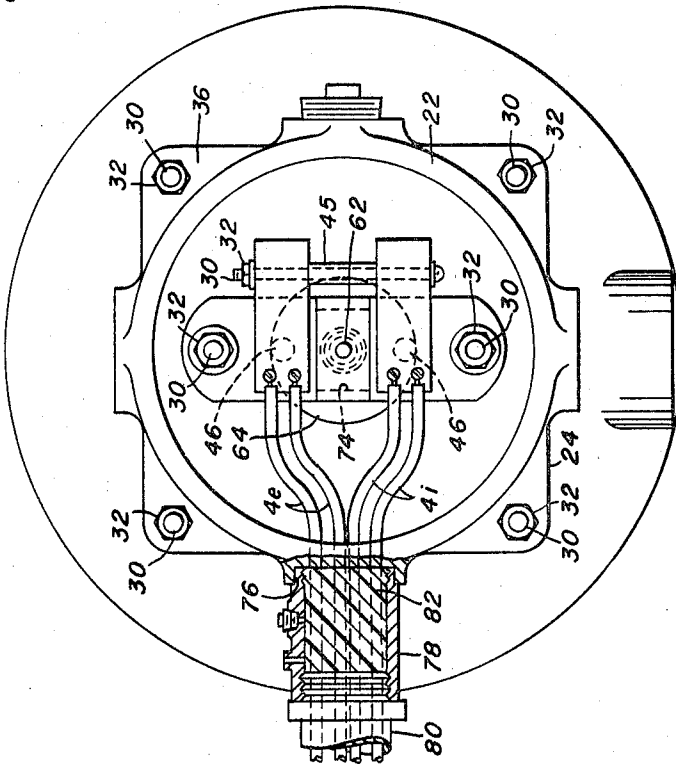
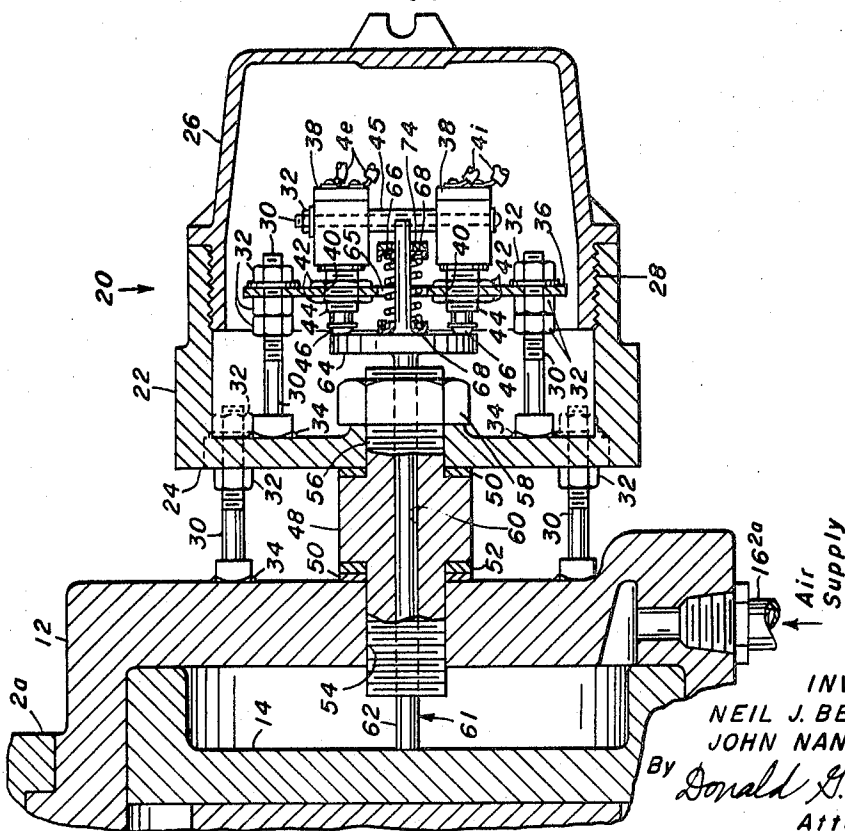


FIG. 4.



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MOUNTING AND OPERATING MECHANISM FOR SWITCHES

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12 Claims

Int. Cl. F16k 31/363, 37/00; H01h 35/38

ABSTRACT OF THE DISCLOSURE

For a fluid operating system having a valve provided with a valve body and a valve member in the valve body, a mounting and operating mechanism is provided having a switch body, means for securing the switch body to the valve body, switch mounting means mounted within the switch body, a switch on the switch mounting means and having contact means, connecting means sealed to the valve body and the switch body and provided with guide means, and operating means reciprocable in the guide means while permitting fluid flow therethrough and equalization of fluid in the valve body and the switch body. The operating means is movable by the valve member to actuate the contact means, and biasing means are associated with the operating means for biasing the operating means in a direction opposite to the direction of movement of the operating means by the valve member.

BACKGROUND OF THE INVENTION

The present invention relates to limit switches, and, more particularly, to an improved mechanism for mounting limit switches on and operating limit switches by valves and to associated circuits.

In conventional automated work lines fluid operating systems are utilized which require the use of an electrical signal to indicate the position of a valve disposed in such a fluid operating system. Heretofore, limit switches were installed on the valve so that the contacts of the limit switch were opened and closed by the mechanical movement of the valve itself. Many conventional valves are not adapted for the operation of a limit switch in this manner. For example, in some cases all moving parts of the valve are completely enclosed, thereby limiting the use of these moving parts as a means to actuate the limit switches. In such a case it is customary to insert an operating rod through suitable packing in the valve enclosure or body and to fasten this operating rod to the piston or plunger of the valve. Such operating rod extends beyond the valve enclosure and is provided with tripping dogs secured thereto to actuate the contacts of the associated limit switch. One of the disadvantages of the above conventional means for mounting a limit switch on a valve is that additional structural support for the limit switch is required in order to mount it in a position where the contacts of the limit switch can be actuated by the operating rod. In addition, if more than one limit switch is utilized the installation of a plurality of tripping dogs on the operating rod becomes cumbersome and bulky. Furthermore, the fluid-tight seal between the slidable operating rod and the valve body is difficult to maintain, thereby producing fluid leakage at the operating rod seal and resultant erratic valve operation. A still further defect of the conventional mounting apparatus is that the exposed rod seal and the actuating mechanism for the limit switch do not function reliably in either a dusty, wet or otherwise contaminated atmosphere.

Objects of the invention

It is the general object of the present invention to avoid

and overcome the foregoing and other difficulties of and objections to prior art practices by the provision of an improved mechanism for mounting a limit switch on and operating a limit switch by a valve in a fluid system and of its associated circuit, which improved mounting and operating mechanism:

- (1) Eliminates additional conventional support;
- (2) Requires very little additional space when added to the valve housing;
- (3) Permits the limit switch itself to operate in a media which is at the same temperature and pressure as the components of the valve with attendant elimination of troublesome seals and close tolerances between the operating rod and valve housing;
- (4) Is operable while completely submerged in a fluid;
- (5) Is adapted for use in hazardous locations; and
- (6) Can be readily mounted on substantially all conventional valves.

Brief summary of the invention

The aforesaid objects of the present invention, and other objects which will become apparent as the description proceeds, are achieved by providing a mounting and operating mechanism for a switch used in conjunction with a valve in a fluid operating system, the valve being provided with a valve body and a valve member in the valve body. This mounting and operating mechanism has a switch body, means for securing the switch body to the valve body, switch mounting means within the switch body, a switch on the switch mounting means and having contact means, and connecting means sealed to the valve body and the switch body and provided with guide means. Operating means are reciprocable in the guide means while permitting fluid flow therethrough and equalization of fluid in the valve body and the switch body. The operating means is movable by the valve member to actuate the contact means. Biasing means are associated with the operating means for biasing the operating means in a direction opposite to the direction of movement of the operating means by the valve member.

A circuit of this invention is provided for interlocking a plurality of fluid valves, including a first fluid valve movable between a first valve operating position and a second first valve operating position, a second fluid valve communicable with the first first valve and movable between a first second valve operating position and a second second valve operating position, and a third fluid valve communicable with the first fluid valve and movable between a first third valve operating position and a second third third valve operating position. This circuit has a first operating means connected to the first fluid valve for moving the first fluid valve between the first first valve operating position and the second first valve operating position. Relay means are energizable by movement of the first fluid valve between the first first valve operating position and the second first valve operating position. A second operating means is connected to the second fluid valve and is operable by the relay means to move the second fluid valve between the first second valve operating position and the second second valve operating position. A third operating means is connected to the third fluid valve and is operable by the relay means to move the third fluid valve between the first third valve operating position and the second third valve operating position.

For a better understanding of the present invention reference should be had to the accompanying drawings, wherein like numerals of reference indicate similar parts throughout the several views and wherein:

Brief description of the several views of the drawings

FIGURE 1 is a schematic drawing of a fluid system

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utilizing the improved mounting and operating mechanism and associated fluid system circuit;

FIGURE 2 is a schematic wiring diagram of the solenoid operated fluid system circuit showing two header operation with the descaling valve in the descaling position, the header valve open and the bypass valve closed and the two header light energized;

FIGURE 3 is a side elevational view partially in vertical section of the bypass valve of the fluid system of FIGURE 1 and a pair of improved mounting and operating mechanisms;

FIGURE 4 is an enlarged fragmentary vertical sectional view of the right hand mounting and operating mechanism shown in FIGURE 3;

FIGURE 5 is a vertical sectional end view of the operating mechanism of FIGURE 4 with its cones removed.

Although the principles of the present invention are broadly applicable to valves in fluid systems, the present invention is particularly adapted for use in conjunction with an improved means for mounting and operating limit switches on such a valve, and with an associated circuit and hence it has been so illustrated and will be so described.

Detailed description

With specific reference to the form of the present invention illustrated in the drawings, and referring particularly to the fluid system or circuit shown in FIGURE 1, high pressure fluid, such as water at about 1500 p.s.i., from a high pressure fluid source is fed by fluid line 1 to a first fluid valve, such as a descaling valve 2, movable between a first valve operating position, such as a descaling position communicating with a descaling line 1b, and a second first valve operating position, such as a diverting position communicating with a diverting line 1a. The descaling valve 2 operated by a first operating means, such as a descaling valve solenoid 5¹ (FIGURES 1, 2), feeds the high pressure water either through the diverting line 1a to a low pressure fluid source or through the descaling line 1b and through a T 1c to two header lines 1d and 1e. The header line 1d leader to descaling spray heads (not shown) on a hot strip mill (not shown). The header line 1e contains a T 1f extending on one side through a line 1g to a second fluid valve, such as a bypass valve 2a, leading to the low pressure fluid source. This T 1f is connected on the other side through inlet line 1e' to a third fluid valve, such as a header valve 2b. An outlet line 1j from header valve 2b extends to the descaling spray heads (not shown). Such bypass valve 2a and header valve 2b are either open and closed or closed and open respectively.

If it is necessary to limit the water flow to the spray heads (not shown) to prevent too rapid cooling on certain metal products being processed on the hot strip mill (not shown), the header valve 2b is closed and the bypass valve 2a open.

FLUID SYSTEM CIRCUITS

Two header to one header operation

If the operator wishes to change from the two header operation shown in FIGURE 2 to one header operation, the following steps must be taken. Since the header valve 2b and bypass valve 2a are not intended for operation under pressure, the operator must first change the descaling valve 2 from communication with the descaling line 1b to communication with the diverting line 1a. Closure of a diverting push button 3 (FIGURE 2) in line 4 connects a descaling valve diverting solenoid coil 5 of the descaling valve solenoid 5¹ to a suitable voltage supply indicated by the legend "AC supply" with resultant energization of the descaling valve diverting solenoid coil 5, resultant movement of valve (FIGURE 1) to open inlet line 18², a fluid supply manifold 11b connected to an air supply, and attendant movement of the descaling valve 2 to the diverting position (FIGURE 1).

This descaling valve solenoid 5¹ is a first operating

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means connected to the descaling valve 2 for causing movement of the descaling valve 2 between the first valve operating position, for example descaling position, and the second first valve operating position, such as the diverting position.

When the descaling valve 2 reaches the diverting position in communication with the diverting line 1a, the descaling valve 2 closes the normally open descaling valve limit switch contact 6 (FIGURE 2) in line 4a. This closure prepares a relay energization circuit for energizations.

The operator then depresses a one header push button 3a in lines 4b, 4c, thus deenergizing a trip coil 7b of a relay means, such as a relay 7, in line 4b, and energizing the close coil 7a of the relay 7 in line 4c. The relay 7 then closes and latches in so that it remains in this position even after the one header push button 3a is released.

The relay 7 may be either energized by closure of the descaling valve limit switch contact 6 by movement of the descaling valve 2 from the diverting position to the descaling position or merely prepared for energization thereby as shown in FIGURE 2. The relay 7 is operatively associated, as hereinafter explained with the header valve 2b and the bypass valve 2a. Contacts 8, 8a etc. on this relay 7 then cause the following operations.

A normally closed contact 8 of relay 7 in line 4d (FIGURE 2) opens thus turning off the white light or two header light 9. A normally open contact 8a of relay 7 in line 4e closes thereby preparing the blue light or one header light 9a and a one header circuit for energization when other conditions are met. A normally closed contact 8b of relay 7 in line 4f opens with attendant deenergization of a header valve open solenoid coil 5d of a header valve solenoid 5². A normally open contact 8c of the relay 7 in line 4g closes, thus energizing a header valve close solenoid coil 5a of the header valve solenoid 5² in line 4g. A normally closed contact 8d of relay 7 in line 4h opens thus deenergizing a bypass valve close solenoid coil 5c of bypass valve solenoid 5³ and a normally open contact 8e of relay 7 in line 4i closes, thereby energizing a bypass valve open solenoid coil 5b of bypass valve solenoid 5³.

The header valve close solenoid coil 5a (FIGURE 2) moves header valve 2b toward the closed position and the bypass valve open solenoid coil 5b moves the bypass valve 2a toward the open position. When the header valve 2b reaches the fully closed position, the normally open header valve close limit switch contact 6a in line 4e closes the normally closed header valve close limit switch 6b in line 4g is opened, thus deenergizing the header valve close solenoid coil 5a. When the bypass valve 2a reaches the fully open position, the normally open bypass valve open limit switch contact 6d in line 4e closes and the normally closed bypass limit switch contact 6e in line 4i opens with the attendant deenergization of the bypass valve open solenoid 5b.

The header valve solenoid 5² (FIGURE 2) is a second operating means connected to header valve 2b and is operable by the relay 7 to move the header valve 2a between a first second valve operating position, for example, open position, and a second second valve operating position, such as closed position. The bypass valve solenoid 5³ is a third operating means connected to the bypass valve 2a and is operable by the relay 7 to move the bypass valve 2a between a first third valve operating position, such as open position, and a second third valve operating position, for example closed position.

Simultaneously closure of the normally open bypass valve open limit switch contact 6d (FIGURE 2) in line 4e and the normally open header valve close limit switch contact 6a in line 4e energizes the blue light or one header light 9a thus indicating one header operation. Further, the normally open header valve close limit switch contact 6c in line 4j closes thus preparing the descaling valve 2 for return to the descaling position (i.e. in communication with fluid line 1a in FIGURE 1) by the descaling valve

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descaling solenoid coil 5e. It should be noted that the normally closed bypass valve close limit switch contact 6f in line 4k and the normally open header valve close limit switch contact 6c in line 4j are used to prevent the descaling valve 2 from being changed from the diverting line 1a to the descaling line 1b unless either the header valve 2b or the bypass valve 2a is closed. This is necessary to prevent damage to the pump (not shown). The operator then presses the descale push button 3b in line 4k thus energizing descaling solenoid coil 5e and the spray spray heads (not shown) are on one header operation.

One header to two header operation

In order to change back to two header operation the operator must again change the descaling valve 2 (FIGURE 1) to the diverting position in communication with diverting line 1a and press the two header push button 3c (FIGURE 2) in lines 4b, 4c thus energizing a trip coil 7b of the relay 7 in line 4b. The relay 7 then opens and remains open even after the two header push button 3c is released. The contacts 8, 8a etc. on this relay 7 then causes the following operations.

The normally open contact 8a (FIGURE 2) of the relay 7 in line 4c reopens turning off the blue light or one header light 9a. The normally closed contact 8 of the relay 7 in line 4d recloses preparing the white light or two header light 9 for energization when other conditions are met. The normally open contact 8e of the relay 7 in line 4i reopens and the normally closed contact 8d of the relay 7 in line 4h recloses thus energizing the bypass valve close solenoid coil 5c in line 4h with attendant movement of the bypass valve 2a to the closed or solid line position shown in the left hand portion of FIGURE 3. The normally closed contact 8b of the relay 7 in line 4f recloses energizing the header valve open solenoid coil 5d in line 4f with resultant movement of the header valve 2b toward the open position.

When the bypass valve 2a (FIGURE 1) reaches the fully closed position, the bypass valve close limit switch contacts 6f (FIGURE 2) in line 4k, 6g in line 4d, and 6h in line 4h are actuated. When the header valve 2b reaches the fully open position, the header valve open limit switch contact 6i in line 4d and 6j in line 4f are actuated.

The normally closed header valve open limit switch contact 6j (FIGURE 2) in line 4f opens, thus deenergizing the header valve open solenoid coil 5d in line 4f. The normally closed bypass valve close limit switch contact 6h in line 4d and the normally closed bypass valve close limit switch contact 6g in line 4d close, thus energizing the white light 9 for indicating two header operation. Further, the normally closed bypass valve close limit switch contact 6f in line 4k now closes, thereby preparing the descaling valve 2 for return to the descaling position (in communication with fluid line 1b). The operator then presses the descale push button 3b in line 4k thus energizing descaling valve descaling solenoid coil 5e with attendant return of the descaling valve 2 to the descaling position. The spray heads (not shown) are now on two header operation.

In order to describe the improved mounting and operating mechanism reference is now made to FIGURES 3 and 4.

Mounting and operating mechanism

The essential parts of the bypass valve 2a (FIGURES 3, 4) with respect to the present invention are a valve body 12 and a valve member, such as a piston 14 (FIGURES 3,4) reciprocable in the valve body 12 by means of fluid, such as compressed dry air. This fluid enters the valve body 12 at 16^{2a} (FIGURES 3, 4) to move the piston 14 to the fluid closed position shown in dotted lines in

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FIGURE 3, and enters at 18^{2a} (FIGURE 3) to the fluid open position shown in solid lines in FIGURE 3.

The improved mounting and operating mechanisms 20 of this invention (FIGURES 3-5) each have a switch body 22, which switch body 22 in turn has a basal portion 24 (FIGURES 3-5) and a removable cover portion 26 secured to the basal portion 24 in hermetic engagement at threads 28 by screw lubricant similar to No. STL12 lubricant manufactured by Crouse Hinds Company, Syracuse, New York. For the purpose of securing the switch body 22 to the valve body 12, mounting means, such as a plurality of fasteners or bolts 30 (FIGURES 3-5) are secured by nuts 32 to the basal portion 24 and to the valve body 12, as by welding at 34. Within the switch body 22 are provided switch mounting means, such as a base 36 mounted on bolts 30 by nuts 32 (FIGURES 4, 5), which bolts 30 are in turn secured to the basal portion 24, by nuts 32 welded to the basal portion 24 at 34.

Switches, such as the microswitches 38, are mounted in apertures 40 (FIGURE 4) in the base 36 by means of nuts 42 on a threaded portion 44 of each such microswitch 38. A support spacer 45 (FIGURES 4, 5) is secured between the microswitches 38 by a bolt 30 and nut 32. Each microswitch 38 has contact means, such as normally open bypass valve open limit switch contact 6d and normally closed bypass valve open limit switch contact 6e (not shown in FIGURES 3-5), which contacts 6d, 6e are operated by plungers 46. Connecting means, such as the bushing 48 (FIGURES 3, 4) is sealed by means of gaskets 50 (FIGURE 4) and a washer 52 in threaded apertures 54, 56 in the valve body 12 and switch body 22 respectively. A nut 58 secures the bushing 48 in the threaded aperture 56 in the basal portion 24 of the switch body 22. The bushing 48 is provided with guide means, suitably a clearance aperture 60 (FIGURE 4). Operating means 61, such as the plunger 62 carrying the disc 64 is reciprocable in the clearance aperture 60 while permitting fluid flow therethrough and equalization of fluid in the valve body 12 and in the switch body 20. The operating means 61 is movable by the piston 14 during the last portion of the piston stroke to the right or open solid line position, as viewed in FIGURE 3, to actuate the above-mentioned contacts 6d, 6e (FIGURE 2) of the microswitches 38.

Biasing means, such as the springs 66 (FIGURE 4), are disposed between spring holders 68 and about the plunger 62, which plunger 62 extends through a hole 65 in the base 36. The spring holders 68 abut against the disc 64 and a stop 74 (FIGURES 4, 5) which is an extension of the base 36. The springs 66 bias the operating means 61 in a direction opposite to the direction of movement of the disc 64 by the piston 14, thereby resetting the microswitches 38 in their normal positions when the piston 14 moves to the left, as viewed in FIGURE 3, to the closed dotted line position.

For the purpose of providing a hermetic switch body 22, the entrance 76 (FIGURE 5) for the lines 4c, 4i is provided with a fluid-tight seal formed suitably by a conduit seal 78 and a conduit 80 containing the lines 4c, 4i, the conduit seal 78 being filled with a sealant, such as Chico compound 82, a product manufactured by Crouse Hinds Company, Syracuse, New York.

Alternative embodiments

It will be understood by those skilled in the art that alternatively the descaling valve 2, bypass valve 2a and header valve 2b may be connected together by suitable piping and connections (not shown) to provide the alternative combinations of operation shown in the table below where (X) indicates operation and (—) indicates nonoperation.

Descaling valve 2		B pass valve 2a		Header valve 2b	
Descalce	Divert	On	Off	On	Off
X	—	X	—	X	—
X	—	—	X	X	—
X	—	X	—	—	X
X	—	—	X	—	X
—	X	X	—	X	—
—	X	—	X	X	—
—	X	X	—	—	X
—	X	—	X	—	X

Summary of the achievements of the objects of the invention

It will be recognized by those skilled in the art that the objects of the present invention have been achieved by providing an improved mechanism for mounting a limit switch on and operating a limit switch by an operating valve in a fluid system and an associated circuit, which improved mounting and operating mechanism is supported on the valve enclosure or housing by a plurality of fasteners secured to the valve housing thereby eliminating addition conventional support; is relatively short in length thus requiring very little additional space when added to the valve housing; becomes an integral part of the valve, thus permitting the limit switch itself to operate in a media which is at the same temperature and pressure as the components of the valve with attendant elimination of seals and close tolerances between the operating rod and valve housing; has a fluid-tight enclosure for the limit switch element, thus permitting operation of such limit switches while completely submerged in a fluid, has an explosion proof enclosure, thereby adapting it for use in hazardous locations; and can be readily mounted on substantially all conventional valves.

While in accordance with the patent statutes, preferred and alternative embodiments of the present invention have been illustrated and described in detail, it is to be particularly understood that the invention is not limited thereto or thereby.

We claim:

1. For a fluid operating system having a valve provided with a valve body and a valve member in said valve body, a mounting and operating mechanism having:

- (a) a switch body;
- (b) means for securing said switch body to said valve body;
- (c) switch mounting means mounted within said switch body;
- (d) a switch on said switch mounting means and having contact means;
- (e) connecting means sealed to said valve body and said switch body and provided with guide means;
- (f) operating means reciprocable in said guide means while permitting fluid flow therethrough and equalization of fluid in said valve body and said switch body;

(1) said operating means being movable by said valve member to actuate said contact means; and

(g) biasing means associated with said operating means for biasing said operating means in a direction opposite to the direction of movement of said operating means by said valve member.

2. The mechanism recited in claim 1 wherein said switch body has a basal portion and a removable portion.

3. The mechanism recited in claim 1 wherein said switch body is fluid tight.

4. The mechanism recited in claim 1 wherein said means for securing said switch body to said valve body is a plurality of fasteners.

5. The mechanism recited in claim 1 wherein said switch mounting means is a base and a plurality of fasteners.

6. The mechanism recited in claim 1 wherein said connecting means is a bushing provided with an aperture.

7. The mechanism recited in claim 1 wherein said operating means is a rod carrying a disc.

8. The mechanism recited in claim 1 wherein said biasing means is a spring.

9. In combination for a fluid operating system:

(a) a valve provided with a valve body and a valve member in said valve body;

(b) a switch body;

(c) means for securing said switch body to said valve body;

(d) switch mounting means mounted within said switch body;

(e) a switch on said switch mounting means and having contact means;

(f) connecting means sealed to said valve body and said switch body and provided with guide means;

(g) operating means reciprocable in said guide means while permitting fluid flow therethrough and equalization of fluid in said valve body and said switch body;

(1) said operating means being movable by said valve member to actuate said contact means; and

(h) biasing means associated with said operating means for biasing said operating means in a direction opposite to the direction of movement of said operating means by said valve member.

10. A circuit for interlocking a plurality of fluid valves, including a first fluid valve movable between a first valve operating position and a second first valve operating position, a second fluid valve communicable with said first fluid valve and movable between a first second valve operating position and a second second valve operating position, and a third fluid valve communicable with first fluid valve and movable between a first third valve operating position and a second third valve operating position, said circuit having:

(a) a first operating means connected to said first fluid valve for moving said first fluid valve between said first first valve operating position and said second first valve operating position;

(b) relay means energizable by movement of said first fluid valve between said first first valve operating position and said second first valve operating position;

(c) a second operating means connected to said second fluid valve and operable by said relay means to move said second fluid valve between said first second valve operating position and said second second valve operating position; and

(d) a third operating means connected to said third fluid valve and operable by said relay means to move said third fluid valve between said first third valve operating position and said second third valve operating position.

11. The circuit recited in claim 10 wherein said second operating means is operable by said relay means to permit flow through said second fluid valve, and said third operating means is operable by said relay means to close said third fluid valve.

12. The circuit recited in claim 10 wherein said second operating means is operable by said relay means to close said second fluid valve and said third operating means is operable by said relay means to permit flow through said third fluid valve.

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HENRY T. KLINKSIEK, *Primary Examiner.*

U.S. Cl. X.R.

200—61.86, 82; 251—63.5

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,422,845

January 21, 1969

Neil J. Behne et al.

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 43, after "first" insert -- first --; line 45, "first first" should read -- first fluid --. Column 3, line 31, "a first" should read -- a first first --; line 40, "leader" should read -- leads --; line 48, "an dheader" should read -- and header --; line 71, "valve" should read -- valve 2 --. Column 4, line 2, "first" should read -- first first --; line 47, "closes" should read -- closes and --; line 53, after "bypass" insert -- open --. Column 5, line 5, "divertiing" should read -- diverting --; line 10, after "descaling" insert -- valve descaling --; line 35, "recloses" should read -- recloses thus --; line 50 "4d" should read -- 4h --. Column 7, in the Table, in the heading to the third and fourth column thereof, "B pass valve 2a" should read -- Bypass valve 2a --.

Signed and sealed this 24th day of March 1970.

(SEAL)

Attest:

Edward M. Fletcher, Jr.

Attesting Officer

WILLIAM E. SCHUYLER, JR.

Commissioner of Patents