United States Patent [19]

Scott

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[54] **CAM-ACTUATED MAGNETIC VALVE**

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[52] **U.S. Cl.** **251/65,** 251/258

[51] **Int. Cl.** **F16k 31/08,** F16k 31/52

[58] **Field of Search** 251/65, 258, 261, 291

[56] **References Cited**

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[57] **ABSTRACT**

A mechanical arrangement is provided for mounting a magnetically-operated valve (which is adapted to control a fluid) in a housing having cam-actuating means associated therewith, so that the valve can be operated by the cam-actuating means, in the same fashion as a cam-actuated electrical limit switch.

7 Claims, 5 Drawing Figures

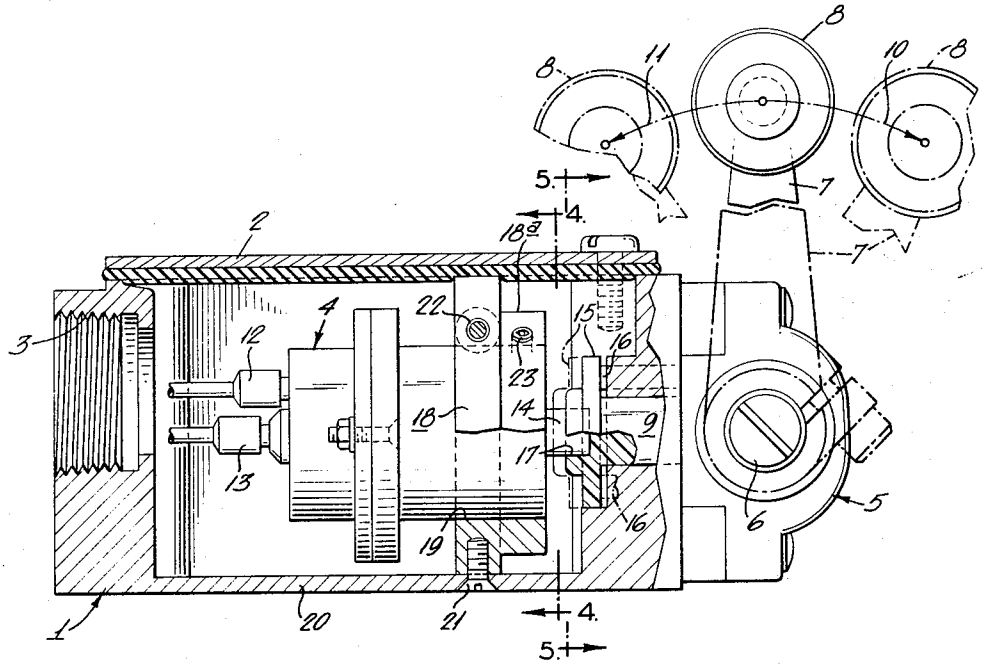


FIG. 1.

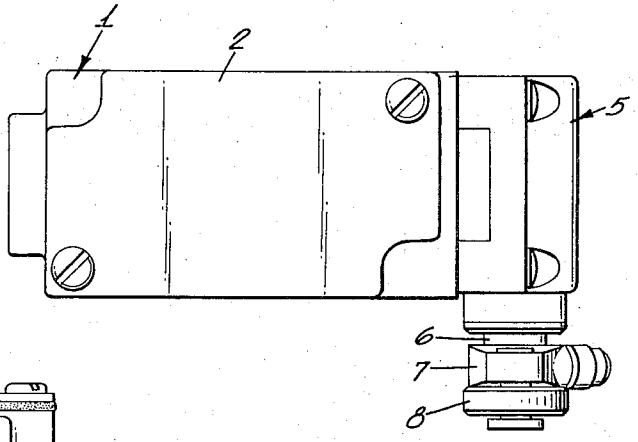
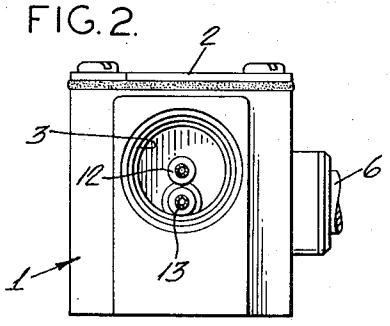


FIG. 2.



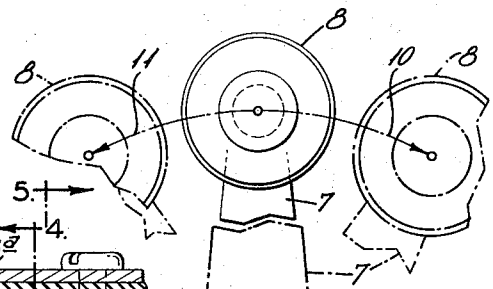


FIG. 3.

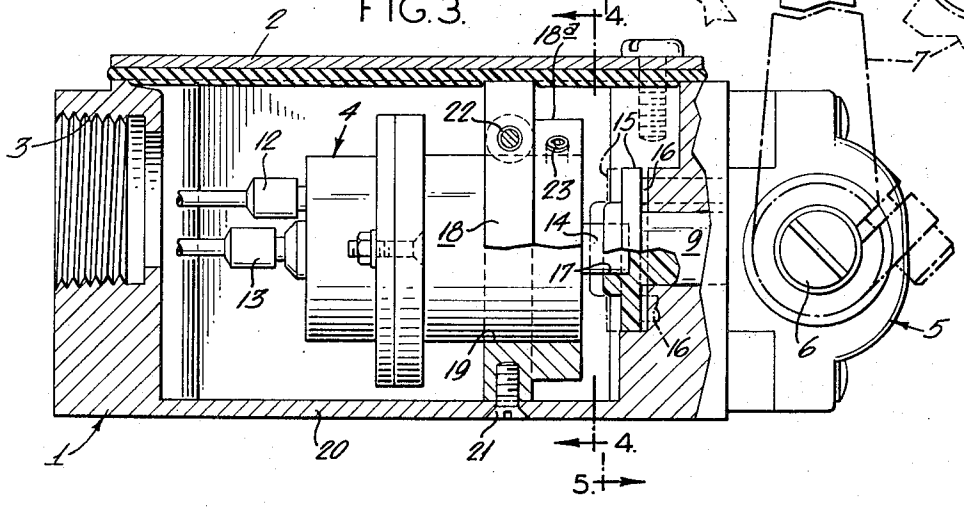


FIG. 4.

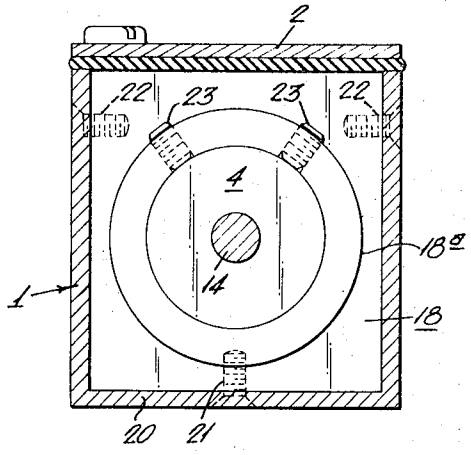
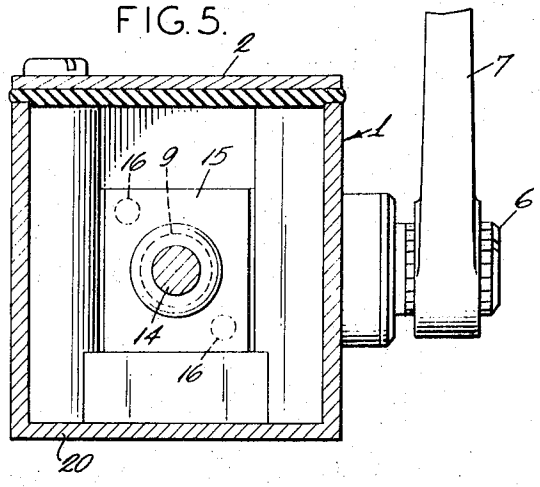


FIG. 5.



CAM-ACTUATED MAGNETIC VALVE

This invention relates to a magnetically-operated fluid valve, and more particularly to an arrangement which enables such a valve to be mechanically actuated by means of a cam, in the manner of a cam-actuated electrical limit switch.

In fluidic control systems, it is often desired to make a single, specific event occur automatically, for example in response to the position of some mechanical element which is being controlled. This may be done using an on-off fluid valve which is controlled automatically, as by means of a cam. Thus, the valve might be used to maintain some status only while it is "on," or, with flip-flop or counter circuits of fluidic type, to change a status when the valve is turned "on."

Magnetically-operated fluid (pneumatic) valves of on-off type have been developed, and have proven to have a very long operating life; such valves are designed for manual operation, by means of a push button. Cam-actuating means have been developed (for automatic, mechanical actuation of electrical limit switches), and have proven to be very reliable and rugged.

An object of this invention is to provide a cam-actuated magnetic valve.

Another object is to provide a limit switch of pneumatic type.

A further object is to provide a fluid valve which is adapted to be operated in the same manner as a cam-actuated electrical limit switch.

An additional object is to provide a pneumatic-type limit switch device which combines the proven reliability and ruggedness of a known and standard cam-actuating means with the long operating life of a magnetically-operated pneumatic valve.

The objects of this invention are accomplished briefly, in the following manner: A pneumatic valve, which includes as a part thereof a magnetically-active movable member for operating the same, is mounted in a standard switch housing, having cam-actuating means at one end thereof, by means of a collar which surrounds the valve and is fastened to the housing. A guide plate couples the movable operating member of the valve to the movable plunger of the cam-actuating means, for movement of the former by the latter. A locking means is provided for locking the valve body in a desired, adjusted position with respect to the mounting collar.

A detailed description of the invention follows, taken in conjunction with the accompanying drawing, wherein:

FIG. 1 is a top or plan view of a complete device according to this invention;

FIG. 2 is an end view of the device;

FIG. 3 is a side elevation of the complete device, one side wall of the housing being broken away to show the interior thereof;

FIG. 4 is a sectional view taken on line 4—4 of FIG. 3; and

FIG. 5 is a sectional view taken on line 5—5 of FIG. 3.

Referring now to the drawing, a metallic housing, denoted generally by numeral 1, is essentially a square prism in outer configuration, being hollow to provide interior space for the magnetically-operated valve utilized in this invention. Housing 1 is of a standard, commercially-available type conventionally used for a

cam-actuated electrical limit switch, and is of substantially square cross-section in a plane transverse to its length.

Three of the four side walls of housing 1 are solid metal (one of these three side walls having been broken out in FIG. 3 to show interior details), and the top wall is closed (when the device is assembled) by means of a removable cover 2 which is held in place by screws and which is gasketed on its inner face to provide an air-tight seal. One end wall of the housing 1 is provided with a threaded opening 3 which enables a threaded connector to be seucred to the housing, for making fluid connections to the valve 4 inside the housing. This will be described later in more detail.

Secured to the other end of housing 1 (opposite opening 3) is a double-acting, spring-loaded camming assembly denoted generally by numeral 5. The assembly 5 is of a well-known construction (being standard for cam-actuated electrical limit switches), so will not be described in detail herein. The camming assembly 5 is provided with an operating shaft 6 which extends outwardly from the housing within which the camming assembly is located, and outwardly with respect to housing 1. In this connection, it is pointed out that the assembly 5 is contained in a housing of its own which is fastened to the housing 1 at one end of the latter. An actuator arm 7 of standard type, which extends in a radially outward direction with respect to shaft 6, is secured at its inner end to the outer end of this shaft. A roller 8 is journaled for rotation on the outer end of arm 7.

The valve 4 may typically be a "6080 045 Push-button Magnetic Valve," manufactured by Pitney-Bowes Fluidic Controls of Glenbrook, Conn. The internal construction of such a valve is disclosed in Ignatjev U.S. Pat. No. 3,625,473, dated Dec. 7, 1971, and entitled "Permanent Magnet Valve with Magnetic Operator." This valve is adapted to control a fluid and is a completely sealed unit of cylindrical outer configuration; it has two fluid connectors 12 and 13 extending outwardly from one end face thereof. The connectors 12 and 13 provide for the connection of one-sixteenth -inch I.D. tubing to the valve 4. Both of the connectors 12 and 13 are accessible through the opening 3 in housing 1; connector 12, which is used to provide a fluid supply or input to valve 4, is located approximately on the center line of opening 3, as illustrated in FIG. 2.

Internally, the valve 4 has a movable armature of ferromagnetic material which is arranged to open or close an internal fluid coupling between a supply port (connected to connector 12) and an output or signal port (connected to connector 13). For operating the valve, the valve assembly includes an actuating cylindrical permanent magnet 14, which extends outwardly from the valve housing proper at the end of the latter opposite to connectors 12 and 13 and which is mounted for movement toward and away from the valve housing, in the direction of the length of housing 1. The actuating magnet 14 is spring-loaded, to bias it away from the valve housing (i.e., toward the right in FIG. 3). The valve 4 is normally closed (which is to say that the coupling between the supply port and the signal port, inside the valve, is normally closed), but when the magnet 14 is moved toward the valve housing (i.e., toward the left in FIG. 3), the internal, movable armature is attracted to the magnet to open the coupling between the supply port and the signal port. The valve 4 is snap-

acting; when the magnet **14** moves to a position sufficiently close to the valve housing (say to a point one-sixteenth inch therefrom), the normally-closed valve snaps open. When the magnet **14** is allowed to return to its original position, under the urging of its return spring, the valve snaps closed (the latter action, the returning of the armature to its original position wherein it closes the coupling between the supply port and the signal port, is effected by a permanent magnet fixedly mounted inside the valve housing). It should be apparent that when the valve is open, the signal port (and the output connector **13**) is connected to the supply port (and the input connector **12**); the opening and closing of the valve **4** occur sharply, without signal noise. Thus, the valve can deliver sharp, noise-free signals to fluidic circuitry (e.g., a fluid logic system) connected to connectors **12** and **13.**

A rigid guide plate **15,** formed for example from the hard thermoplastic material known as Delrin, is used to couple the camming assembly **5** to magnet **14,** thereby to operate (snap open) the valve **4.** At one side (to wit, the right-hand side in FIG. **3**), the guide plate **15** has an integral central stub shaft **9** which is mounted for sliding movement in the end wall of housing **1.** The central portion of guide plate **15** is of substantially square configuration; a pair of laterally-offset plungers **16** (which are actuated by the camming assembly **5**) bear against the square side face of plate **15,** near the edges thereof and beyond the shaft **9.** At its outer side, the plate **15** is of cylindrical configuration, and has a shallow cylindrical recess **17** which snugly receives the outer or right-hand end of magnet **14.** Thus, when the camming assembly **5** moves one of the plungers **16** toward the left in FIG. **3** (in response to rotation of arm **7** in direction **10,** for example), this lateral motion of the actuated plunger is transmitted through guide plate **15,** moving magnet **14** toward the left (i.e., toward the body of valve **4**) and snapping the valve **4** open. When the arm **7** returns to its original position, the actuated plunger **16** is allowed to move back toward the right to its original position (under the urging of a return spring in assembly **5**), permitting magnet **14** to move back toward the right (away from the valve body, under the urging of its return spring), causing the valve **4**to snap closed. Thus, the device of the invention serves as a cam-actuated pneumatic limit switch. One of the plungers **16** is moved toward the left when arm **7** rotates in direction **10,** and the other plunger is moved toward the left when arm **7** rotates in direction **11.**

As previously mentioned, the valve **4** has a cylindrical outer configuration. For mounting the valve **4** in the housing **1,** a valve collar **18** is utilized. Collar **18** has a central bore **19** which receives the body (that is, the outer cylindrical wall) of valve **4,** and has a square outer configuration which matches rather closely the inner walls of housing **1,** including the inner wall of cover **2** when the latter is in position. Three clearance holes are drilled in the housing **1** for mounting of the collar **18,** one in the bottom wall **20** of the housing (at the lateral center of this wall) and one in each of the two side walls of the housing body, near the tops of these respective side walls. See FIG. **4.** A mounting screw passes through each of these clearance holes and threads into a corresponding tapped hole in collar **18;** the bottom mounting screw **21** is illustrated in FIG. **3,** as well as one of the two side mounting screws **22.** Thus, the only modification of the standard housing **1** which is required is the drilling of the three clearance holes for the valve collar mounting screws **21, 22.**

The valve collar **18** has an integral cylindrical end extension **18***a* whch threadedly carries a pair of circumferentially-spaced set screws **23** whose inner ends bear against the cylindrical outer wall of the body of valve **4.** These set screws are so located as to both be accessible from the top of the housing **1,** when cover **2** is removed. See FIG. **4.**

The procedure required for assembling the penumatic limit switch of the invention will now be given. First, the original guide plate is replaced with the new plate **15.** Then, the valve **4** is inserted into the valve collar **18.** Next, the subassembly of valve and valve collar is secured in the housing **1** by means of the three mounting screws **21, 22** which are inserted through the clearance holes in the housing. Finally, the position of the valve **4** with respect to the collar **18** is adjusted for proper valve actuation and over-travel. The valve is secured in the desired position by means of the two locking set screws **23** provided in the collar extension **18***a*.

It is pointed out that the construction of the present invention provides ease of field installation and adjustments. Also, such construction requires a minimum amount of modification of the standard cam-actuated electrical limit switch housing. Overall, the invention provides an arrangement by means of which a magnetically-operated pneumatic valve can be easily installed in a modified standard cam-actuated electrical limit switch housing, thereby to provide a cam-actuated pneumatic limit switch.

The invention claimed is:

1. In combination, an elongated housing, a plunger mounted in one end of said housing and arranged for sliding movement lengthwise thereof, a camming assembly including an angularly-rotatable actuating arm therefor mounted at said one end of said housing and acting on said plunger to move the same in one direction when said actuating arm is rotated, said actuating arm being located outside of said housing; a fluid valve provided with a movable magnetic member for operating the same, a collar adapted to surround the body of said valve and to fit within said housing, means for fastening said collar to the body of said valve, means for securing said collar in position within said housing, and means for mechanically coupling said plunger to said member, thereby to move said member in said one direction for operation of said valve.

2. Combination of claim **1,** wherein said fastening means is adjustable, to provide for positional adjustment of the valve body with respect to the housing and thereby also of said member with respect to said plunger.

3. Combination defined in claim **1,** wherein said valve is of cylindrical outer configuration and said housing is of substantially square transverse cross-section, said collar being adapted to surround the cylindrical body of said valve and having a square outer configuration such as to fit within said housing.

4. Combination set forth in claim **3,** wherein said fastening means is adjustable, to provide for positional adjustment of the valve body with respect to the housing and thereby also of said member with respect to said plunger.

5. Combination of claim **1,** wherein said coupling means comprises a rigid plate-like member one face of

which is engaged by said plunger and the opposite face of which engages said member.

6. Combination set forth in claim 5, wherein said fastening means is adjustable, to provide for positional adjustment of the valve body with respect to the housing and thereby also of said member with respect to said plunger.

7. Combination set forth in claim 5, wherein said valve is of cylindrical outer configuration and said housing is of substantially square transverse cross-section.

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