Oct. 29, 1963 W. A. RAY 3,108,616

HEAT MOTOR OPERATED VALVE

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FIG. 1.

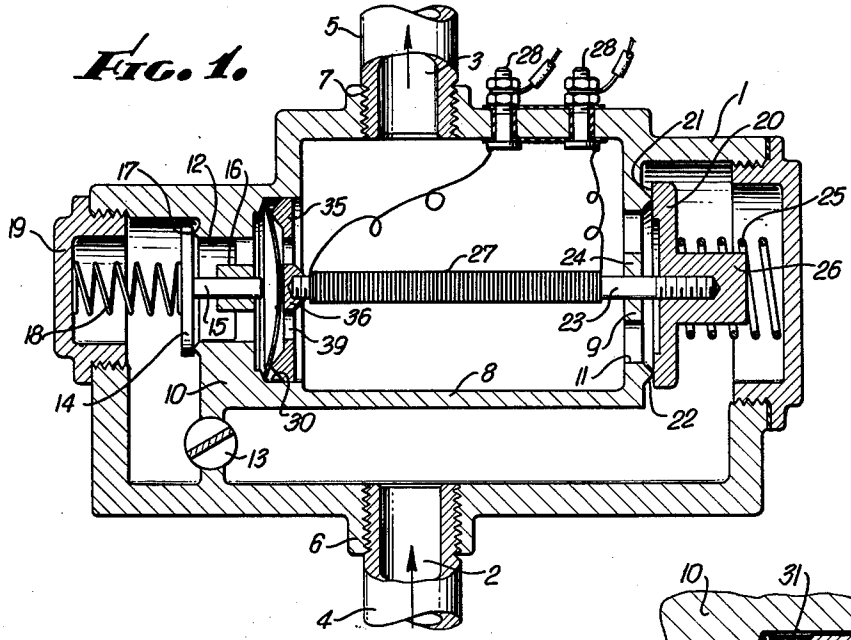


FIG. 3.

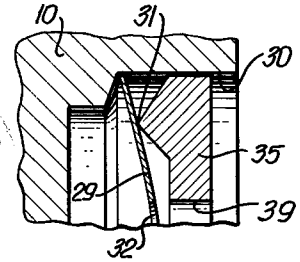
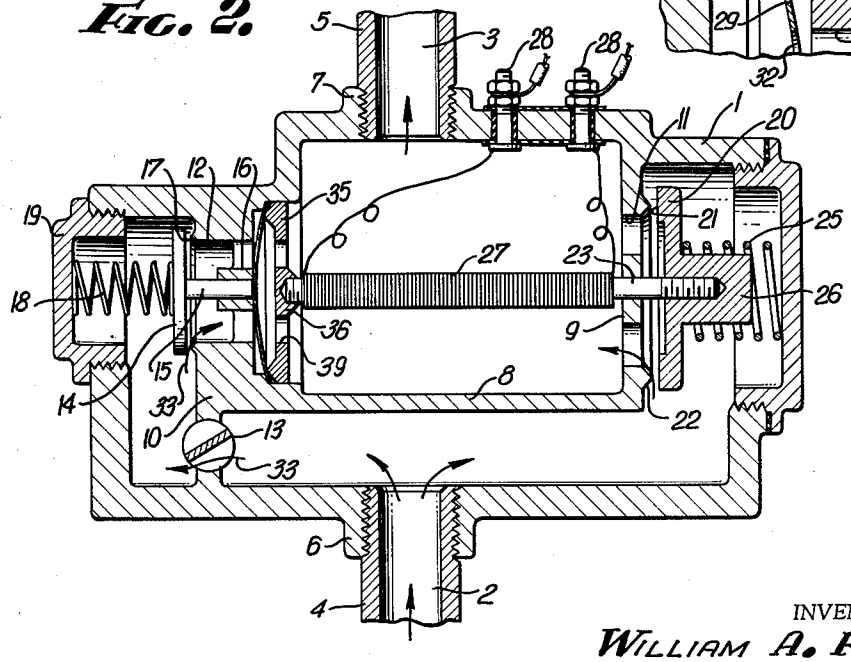


FIG. 2.



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HEAT MOTOR OPERATED VALVE

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This invention relates to valves, and especially those arranged to be operated by a heat motor. The heat motor may employ a member capable of expanding when heated; a bar of appropriate metal or alloy is an example of such a member.

It is one of the objects of this invention to improve in general valves operated by such motors, and particularly by simplifying the structure of such valves.

It is another object of this invention to provide a valve of this character, capable of providing a predetermined low flow rate, so as to use the valve for supplying gaseous fuel to a burner for "low-fire" condition.

It is still another object of this invention to provide a "low-fire" position which is immediately attained from fully closed position when the heat motor member reaches a definite length.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of one embodiment of the invention. For this purpose, there is shown a form in the drawings accompanying and forming a part of the present specification, and which drawings, unless described as diagrammatic, or unless as otherwise indicated, are true scale. This form will now be described in detail, illustrating the general principles of the invention; but it is to be understood that this detailed description is not to be taken in a limiting sense, since the scope of this invention is best defined by the appended claims.

Referring to the drawings:

FIG. 1 is a longitudinal sectional view of a valve structure incorporating the invention, the valve being in closed position;

FIG. 2 is a view similar to FIG. 1, with the valve in open position; and

FIG. 3 is an enlarged detail fragmentary sectional view illustrating a phase in the operation of the snap-action device.

The valve includes a valve body 1 having an inlet passage 2 and an outlet passage 3. These passages are formed by pipes or conduits 4 and 5 that are threadedly engaged in appropriate bosses 6 and 7, formed on the exterior of the valve body 1.

Interposed between the inlet passage 2 and the outlet passage 3 is a wall structure 8. This wall structure 8 has right-angled portions 9 and 10 opposite each other. The portion 9 is provided with a port 11 which, when open, establishes communication between the inlet passage 2 and the outlet passage 3.

Similarly, a port 12 in the wall portion 10 is arranged to pass fluid from the inlet passage 2 through the wall 10 and to the outlet passage 3.

The port 12 is arranged to provide low-fire gaseous fuel to a fuel burner. The degree of low-fire may be controlled by an adjustable plug 13, located in the wall structure 8.

A closure structure for the port 12 includes a disc 14 and a stem 15. This stem 15 is guided in a central hub 16 supported within the port 12. The right-hand surface of the disc 14 is adapted to engage a seat 17 disposed around port 12. It is urged to closed position by a compression spring 18. The left-hand end of the spring 18 is seated on the inner wall of a cap 19 threaded into an appropriate threaded aperture in the body 1.

The port 11 is arranged to be closed by closure structure 20 having an annular surface 21 adapted to contact

a valve seat 22 surrounding the port 11. This valve closure 20 is mounted on the threaded end of an expansible rod 23 which is guided by a boss or hub 24, appropriately supported within the port 11. A compression spring 25 surrounds the stem 26 of the closure structure 20 and urges the closure structure 20 toward closed position.

The rod 23 at its left-hand end carries a ring 35. This ring 35 has a central hub 36 into which is threaded the left-hand end of the rod 23. The rod 23 may be made of any appropriate metal or alloy which has a satisfactory coefficient of expansion. It is adapted to be heated by a heating unit or element 27 supplied with electrical energy through the binding posts 28 insulatingly supported on the top wall of the body 1.

When heat is applied to the rod 23 the initial expansion is toward the left, urging the ring 35 toward the left to operate a snap-action device for opening the valve closure structure 14, whereby an intermediate low-fire condition is obtained.

For this purpose, a resiliently flexible disc 29 has an edge fitting into a bore 30 which also serves as a guide for the periphery of ring 35. This disc is adapted to be engaged near its periphery along an annular area by the annular knife-edge projection 31 formed on the left-hand side of the ring 35. The disc 29 is also provided with one or more apertures 32 to permit the passage of gas past the disc, and the ring 35 has one or more apertures 39 to permit this gas to pass through the ring.

In the normal or closed position, the disc 29 is confined at its edges so as to be dished toward the right, as illustrated in FIG. 1. In this position, there is a substantial clearance between the right-hand end of the stem 15 and the disc 29. However, as the rod 23 expands, the projection 31 urges the disc 29 to and through a central position, and after that position is reached, there is a snap-action causing the disc 29 immediately to assume the position of FIG. 2, and against hub 16, which limits the movement of the disc 29 leftward. In this position, it contacts the stem 15 and urges the closure structure 14—15 toward the left, opening the port 12 and against the force of the spring 18. Disc 29 is purposely so designed that less force is required to move it through the central position, than to move closure structure 20 against the force of spring 25. Accordingly, during expansion of the rod 23, the low-fire valve closure 14 is opened first. Spring 18 is made weak enough to be operated by movement of disc 29 to the left, past its central position.

Continued heating of the rod 23 will cause the valve closure 20 on the right-hand side of the device to be urged rightward against the force of the compression spring 25. This position is illustrated in FIG. 2.

It is possible to modulate the opening of the valve closure 20 by adjusting the current passing through the heating unit 27.

Cooling of the rod 23, due to deenergization of the unit 27 first causes the valve closure 20 to seat; then, as the cooling continues, the spring 18 produces a sufficient force to urge the closure 14 to the closed position in FIG. 1. This spring force required to reverse the position of disc 29 is somewhat less than the force of spring 25 to seat closure 20.

By adjusting the position of the plug valve 13, it is possible to determine the rate of flow in this low-fire position and before the valve closure 20 is lifted from its seat. In this low-fire position, the gaseous fuel from inlet passage 2 passes the valve 13, as illustrated by the arrows 33, and thence pass through the port 12 and the openings 32 in the disc 29 to the outlet passage 3.

The inventor claims:

1. In a valve structure: a valve body having an inlet passage and an outlet passage; said body having a wall

separating the passages; said wall having a pair of ports, each defining a valve closure seat; a heat motor within the body, and including a rod capable of longitudinal expansion upon the application of heat; first and second closures respectively cooperating with said seats; a snap-action device interposed between one end of the rod and the first closure and arranged to be operated when the rod expands to a definite value; and means coupling the other end of the rod and the second closure for moving said second closure to open position upon further expansion of the rod.

2. In a valve structure: a valve body having an inlet passage and an outlet passage; said body having a wall separating the passages; said wall having a pair of ports, each defining a valve closure seat; a heat motor within the body, and including a rod capable of longitudinal expansion upon the application of heat; first and second closures respectively cooperating with said seats; a snap-action device interposed between one end of the rod and the first closure and arranged to be operated when the rod expands to a definite value; means coupling the other end of the rod and the second closure for moving said second closure to open position upon further expansion of the rod; and springs respectively opposing opening movement of the closures, the force required to operate the snap-action device being weaker than the spring urging the second closure to closed position, whereby the snap-action device operates in advance of the second closure, to open said first closure.

3. In a valve structure: a valve body having an inlet passage and an outlet passage; said body having a wall separating the passages; said wall including spaced apart portions, with ports respectively in said portions and in alignment with each other; first and second closure structures respectively cooperating with said ports; first and second resilient means respectively to urge the closure structures to closed position; an electrically heated rod having ends adapted respectively to operate said closure structures; and a snap-action device interposed between one end and the first closure structure; the force required to operate the snap-action device being less than the force of the resilient means urging the second closure structure to closed position, whereby the first closure structure is operated to open position before the second closure is operated.

4. The combination as set forth in claim 3, in which the first closure structure includes a stem, and the snap-action device is a disc capable of being dished in opposite directions through a central position, and a ring carried by the rod, and having a contacting surface for engaging the disc near its periphery to move the center of the disc toward said stem, and ultimately to snap the disc to its extreme dished position.

5. The combination as set forth in claim 3, with supplemental valve means controlling the flow of fluid past said first closure structure.

6. The combination as set forth in claim 3, in which the snap-action device includes a limit to its valve opening movement, whereby the second closure structure assumes a position corresponding to the degree of expansion of the rod.

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