June 17, 1941. F. C. GRISWOLD 2,245,974

ATOMIZING NOZZLE

Original Filed June 7, 1938 2 Sheets-Sheet 1

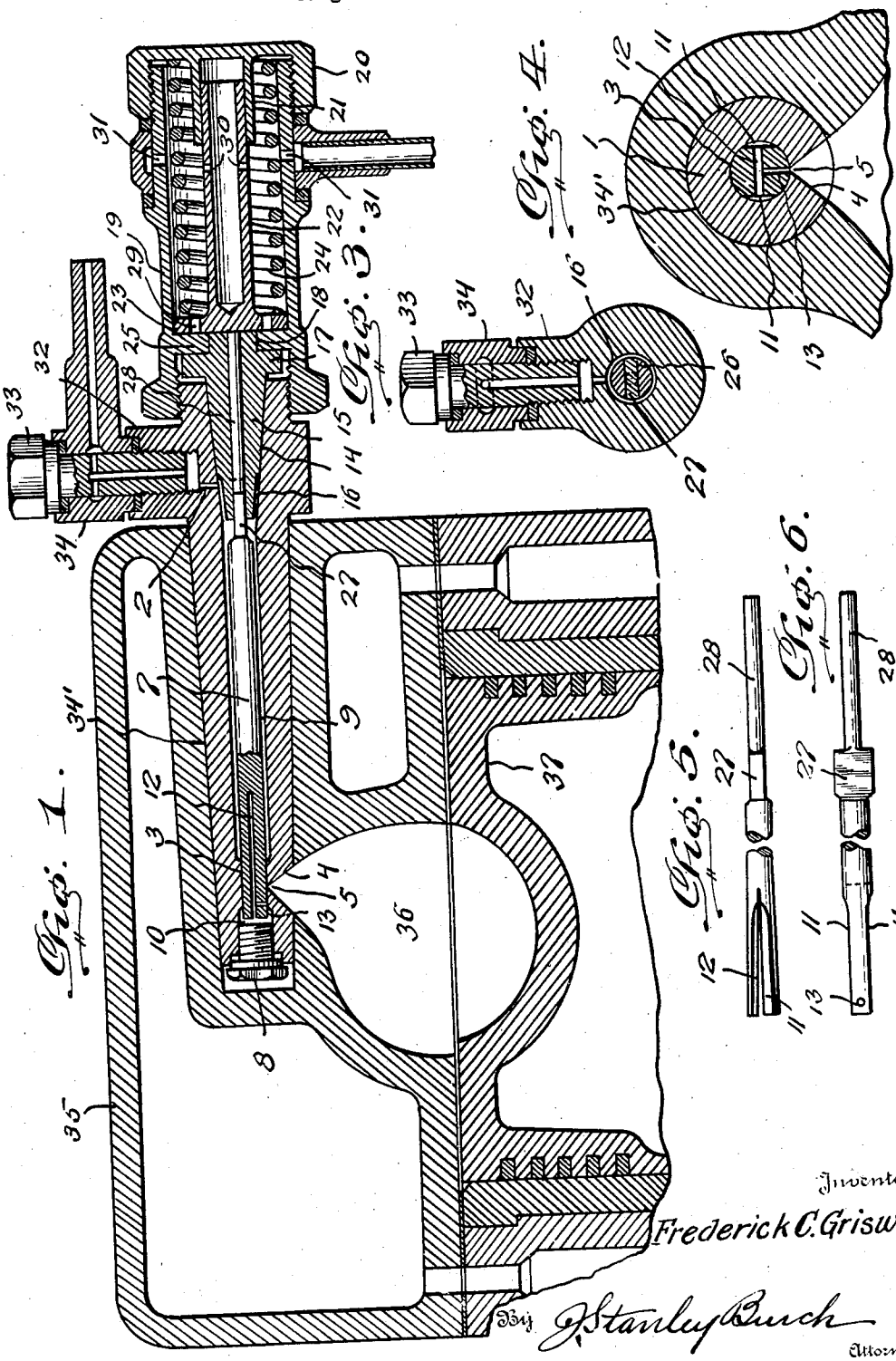


Fig. 1.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

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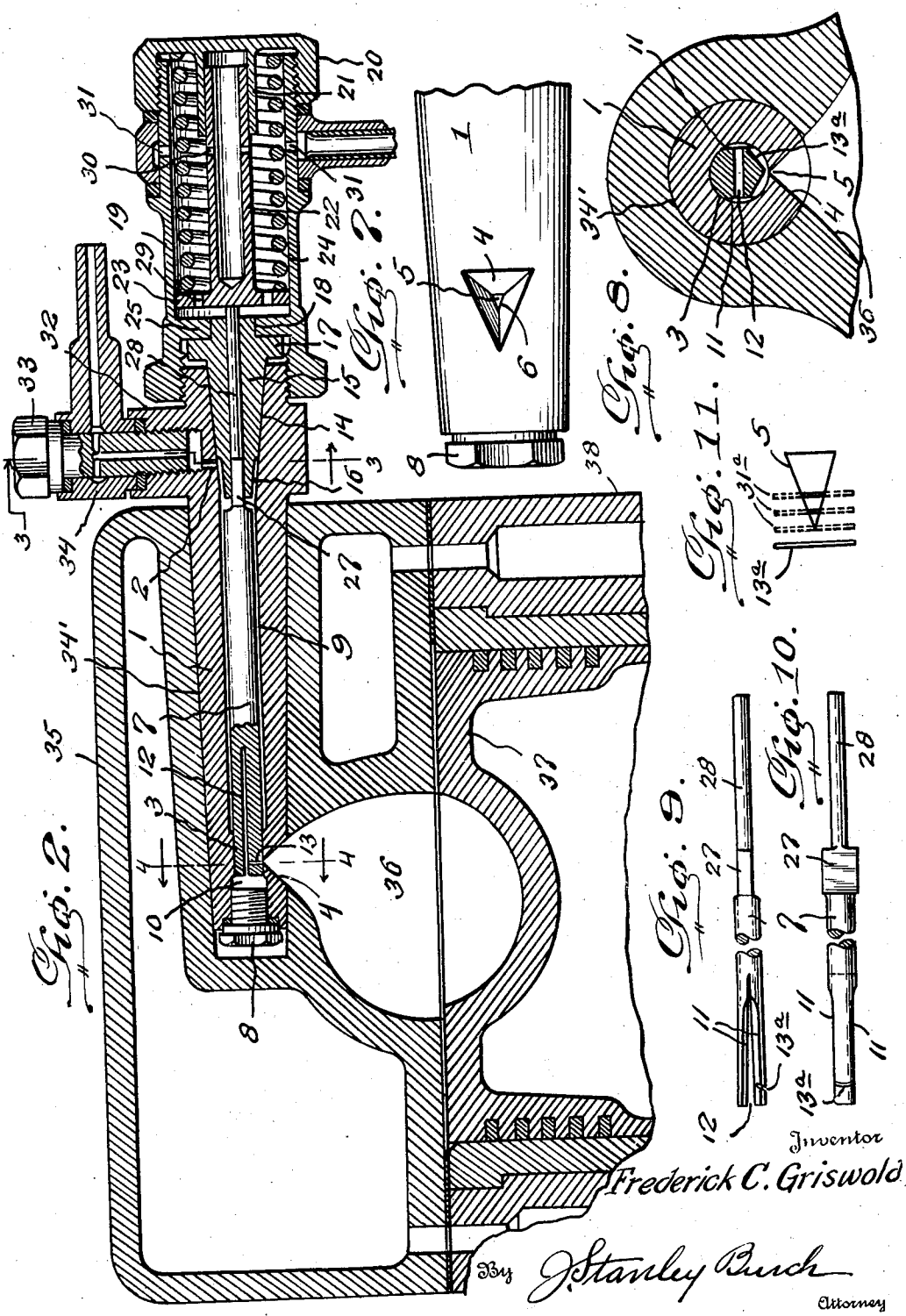


Fig. 2.

Fig. 3.

Fig. 8.

Fig. 11.

Fig. 9.

Fig. 10.

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ATOMIZING NOZZLE

Frederick C. Griswold, Port Jefferson, N. Y.

Continuation of application Serial No. 212,234, June 7, 1938. This application January 27, 1940, Serial No. 316,034

6 Claims. (Cl. 299—107.6)

This invention relates to fluid fuel atomizing nozzles for internal combustion engines, and the present application is a continuation of my prior application Serial Number 212,234, filed June 7, 1938.

The present nozzle is particularly adapted for engines having small piston displacement, such as automotive engines, in which the amount of fuel injected for light loads is less than one drop to each impulse stroke. This extremely small amount of fuel must be forced through an orifice under several thousand pounds of pressure to the square inch, which requires an orifice of extremely small area. After the fluid fuel passes through the orifice, it is in the form of a spray, and it is very important that the spray remain in suspension until consumed by combustion. In compression ignition engines, only atoms of fuel injected into the combustion chamber that are small enough to gasify within the time of combustion are useful. If atoms of fuel are allowed to accumulate in the port leading to the orifice or on the walls of the combustion chamber, they are a loss and cause premature explosions, as well as fouling the nozzle, the combustion chamber, the pistons, and the piston rings with carbon, and causing a smoky exhaust and offensive odor.

Most of the nozzles with which I am familiar either have a pintle or valve which forms a core in the orifice, or the orifice is made by drilling a minute hole in a cap, the cap being subjected to fluid pressure which is controlled by a valve. All nozzles of the type just described have cavities in which fuel remains after ejection because the orifice is not formed directly by the valve and, as the pressure is gradually built up behind the orifice, there is insufficient pressure at the beginning and at the ending of the atomization period to thoroughly atomize the fuel.

The primary object of the present invention, therefore, is to provide an improved atomizing nozzle which effectively overcomes the defects of prior nozzles enumerated above. In carrying out my invention, I provide a nozzle including a body having a discharge port and provided with a bearing surface for a movable valve member, which bearing surface is disposed at right angles to the axis of the discharge port, and which discharge port is tapered from this bearing surface so as to flare outwardly therefrom and produce a knife edge at the bearing surface or at the minute orifice formed by the smaller inner end of the port. I have found that fluids forced under high pressure through an orifice having sharp outer walls and formed and closed under pressure, will be completely atomized into minute atoms so that there will be no drops or dribble. In fact, atomization is perfect from the start to the finish of the atomization period. By flaring the port outwardly from the orifice, fluid may not impinge on the port and accumulate for being blown into the combustion chamber at the next ejection without being atomized and for passing through the engine without burning.

With the above and other objects in view, the present nozzle consists in the novel form, combination and arrangement of parts hereinafter more fully described, shown in the accompanying drawings and claimed.

In the drawings:

Figure 1 is a fragmentary vertical sectional view through the head end of an engine cylinder equipped with an atomizing nozzle constructed in accordance with the present invention, the movable valve member being in closed position.

Figure 2 is a similar view with the movable valve member in open position.

Figure 3 is a transverse section on line 3—3 of Figure 2.

Figure 4 is an enlarged fragmentary section on line 4—4 of Figure 2.

Figure 5 is a side view, partly broken away, of the movable valve member forming part of the nozzle shown in Figure 1.

Figure 6 is an inverted plan view of the valve member shown in Figure 5.

Figure 7 is an enlarged inverted plan view of the discharge end portion of the nozzle, showing the form of the discharge port in the body of the nozzle.

Figure 8 is a view similar to Figure 4 with a modified form of movable valve member substituted in the nozzle for the form of valve member shown in Figures 1, 2 and 4 to 6 inclusive.

Figure 9 is a view similar to Figure 5 of the movable valve member shown in Figure 8.

Figure 10 is a view similar to Figure 6 of the valve member shown in Figure 9; and

Figure 11 is a diagrammatic plan view showing the manner in which the outlet port of the movable valve member shown in Figures 8 to 10 inclusive cooperates with the discharge port of the nozzle body.

Referring in detail to the drawings, the present atomizing nozzle includes a hollow body 1 having a fluid inlet 2 and provided with a wall affording an inner bearing surface 3, said wall having an outwardly flared discharge port 4 at said bearing surface 3. The discharge port 4 flares outwardly from the bearing surface 3 to provide a minute orifice 5 and a knife edge 6 at the inner end of said port 4. A movable valve member 7 is seated by pressure against the bearing surface 3 and controls the discharge port 4. Due to this form and arrangement, the fluid fuel will pass through the orifice in the form of a spray, and the spray will remain in

suspension until consumed by combustion. No atoms of fuel can accumulate in the port leading to the orifice or on the walls of the combustion chamber for becoming lost, or causing premature explosions and fouling the nozzle, combustion chamber, pistons, and piston rings with carbon, or for causing a smoky exhaust with an offensive odor. In other words, fluid is completely atomized into minute atoms and there are no drops or dribbles. Atomization is perfect from start to finish of the atomization period, and no fluid can accumulate in and around the port for being blown in the combustion chamber at the next ejection without being atomized and without burning.

In the embodiment illustrated, the valve member 7 is in the nature of an elongated slide valve, and the discharge port 4 consists of a lateral opening in the body 1. The hollow body 1 of the nozzle is shown as externally tapered, its bore being closed at the inner end of the body by means of a screw plug 8. This bore may have a reduced portion near its inner end which is machined to produce the bearing surface 3.

From the bearing surface 3 to the fluid inlet 2, the bore of the body 1 is of slightly larger diameter than that of the movable valve member 7 so as to provide a pressure chamber 9 therebetween which is in constant communication with the fluid inlet 2. Also, a constant pressure space 10 is provided between the inner end of the valve member 7 and the closed end of the body 1, and means is provided to place the chamber 9 and the space 10 in constant communication with each other. The latter communication may be provided for by cutting away the opposite sides of the valve member 7 as at 11 and by providing the inner end portion of the valve member 7 with a central longitudinal slot 12. By thus slotting the valve member 7, its inner end portion is bifurcated to provide a pair of leg portions which are tensioned to normally spring apart and snugly seat against the bearing surface 3. One bifurcation or leg portion of valve member 7 is provided with a lateral outlet port 13 in constant communciation with the pressure space 10 and movable into and out of registry with the discharge port 4 of the nozzle body 1. The outlet port 13 of the valve member 7 is shown as a transverse opening in one bifurcation of said valve member in Figures 1, 2 and 4 to 6 inclusive, which opening communicates at its inner end with the longitudinal slot 12 of valve member 7.

It will be noted that the discharge port 4 is of triangular form and that the orifice 5 at the inner end of this port is of similar form so that a gradual increase in volume of the fluid spray discharged is effected as the valve member 7 opens by the action of the fluid pressure thereon.

However, as shown in Figures 8 to 11 inclusive, the outlet port of the movable valve member may take the form of a transverse slot 13*a* provided in one bifurcation or leg of the valve member, and this slot may have inclined end portions which converge at the orifice 5 as shown clearly in Figure 8. In this way, the slot or port 13*a* will cooperate with the orifice 5 so as to gradually effect an increase in the volume of fluid sprayed from the nozzle as the valve member 7 opens, while at the same time the thickness of this flared spray will not be increased so as to prevent the danger of discharging relatively large particles of fluid. This will be evident from the diagrammatic view shown in Figure 11 wherein the port 13*a* is disposed parallel with and moves toward the base of the triangular orifice 5 as the valve member 7 opens. It will be evident that in addition to the spring pressure afforded by tensioning the bifurcations of valve member 7 to spring apart, the fluid pressure will act on the walls of the slot 12 so as to provide for pressure-seating of said bifurcations against the bearing surface 3.

At the outer end of the body 1, the bore of the latter is flared as at 14 to snugly receive an externally tapered hollow guide 15 which is provided with a cylindrical axial bore. The inner end of this guide 15 is reduced so as to provide a space between the same and the bore of the body 1 at this point as at 16 and thereby afford constant communication between the pressure chamber 9 and the fluid inlet 2. At its outer end, the guide 15 has an external annular flange 17 and a tubular extension 18.

As before indicated, the opening movement of valve member 7 is effected by the action of the pressure of the fluid thereon, and spring means is provided for yieldingly moving the valve member 7 toward the closed end of the body 1 so as to bring the outlet port 13 or 13*a* of the valve member 7 out of registry with the discharge port 4 of the nozzle body. This spring means includes a housing 19 which is screwed onto the outer end of the nozzle body 1 and which is closed at its outer end by a screw cap 20. The cap 20 is provided with a central inwardly projecting tubular guide 21 which slidably receives the stem 22 of a plunger 23 slidably fitted in the housing 19. A coil spring 24 is disposed in the housing 19 between the plunger 23 and the cap 20 so as to urge the plunger 23 toward the nozzle body 1. The central hollow extension 18 of the guide 15 projects through an annular flange 25 provided internally of the housing 19, which flange 25 engages the flange 17 of guide 15 so as to draw the latter tightly in the tapered bore portion 14 of the body 1 when the housing 19 is threaded onto the latter.

The inner end of guide member 15 is transversely slotted as clearly shown at 26 in Figure 3, which slot receives a flat tang 27 formed on the outer end of the valve member 7. In this way, the valve member 7 is restrained against axial turning with the ported bifurcation thereof disposed toward the discharge port 4. Integral with and projecting outwardly from the tang 27 is a stem 28 slidably projecting through the guide 15 and engaging the plunger 23. Thus, the spring 24 acts upon the plunger 23 which in turn engages stem 28 and causes movement of the valve member 7 to closed position wherein the port 13 or 13*a* is out of registry with the discharge port 4 as shown in Figure 1. Flange 25 properly limits the closing movement of valve 7, and it will be seen that when the fluid fuel pressure on the valve member 7 exceeds the strength of the spring 24, the valve member 7 will be moved to open position wherein the port 13 or 13*a* is brought into registry with the discharge port 4. The greater the fluid fuel pressure, the greater the opening movement of the valve member 7. As soon as the fluid fuel pressure is reduced below that of the strength of spring 24, the latter will act to close the valve member 7 by shifting it to a position wherein the port 13 or 13*a* is out of registry with the discharge port 4 as shown in Figure 1.

To prevent any trapping of air or fluid which might interfere with the free movement of the plunger 23, the latter is provided with a number

of openings 29 and the stem 22 is also provided with openings 30, while the housing 19 has escape ports 31 outwardly of said plunger 23.

In order to connect the body 1 with its inlet port 2 in proper communication with a pipe or conduit conveying fluid fuel under pressure to the nozzle, the body 1 is provided with a lateral nipple 32 communicating with the port 2 and receiving a ported bolt 33 which secures an inlet fitting 34 in proper association with the nipple 32.

As an example of the use of my atomizing nozzle, I have shown it as located within a water jacketed chamber 34' provided in the cylinder head 35 of an internal combustion engine, the discharge port 4 of the body 1 being registered with the inlet of a combustion chamber 36 which may be partly formed in the head 35 and partly in the piston head 37 of the piston disposed in the associated cylinder 38.

From the foregoing description, it is believed that the construction and operation, as well as the advantages of the present invention, will be readily understood and appreciated by those skilled in the art. It is pointed out, however, that various changes may be resorted to in the construction, form and arrangement of the several parts without departing from the spirit and scope of the invention as claimed, and it is apparent that the invention is susceptible of many different embodiments or modifications.

What I claim as new is:

1. A fluid atomizing nozzle comprising a bored body having a fluid inlet near one end and closed at the other end, the bore of said body providing a bearing surface near said closed end of said body, said body further having a lateral outwardly flared discharge port at said bearing surface, a slide valve having one end spaced from said closed end of the body to provide a pressure space and being snugly slidably fitted near said one end in said bearing surface, means providing constant communication between said fluid inlet and said pressure space, said slide valve having a lateral outlet port in constant communication with said pressure space, spring means for normally forcing said slide valve toward the closed end of said body with said lateral port of the slide valve out of registry with said lateral discharge port of the body, said slide valve being shiftable axially away from the closed end of said body by the pressure of the fluid thereon for bringing the lateral port of the slide valve into registry with said lateral port of the body, the bore of said body being flared at the end thereof adjacent said fluid inlet, a tapered cylinder snugly fitted and secured in said flared bore portion of the body and having a transverse slot at its smaller end, a flat tang on one end of the slide valve slidably fitting in said slot of the tapered cylinder to restrain the slide valve against axial rotation, and a piston extending from said tang slidably extending through said cylinder, said spring means acting on said piston.

2. In a nozzle for atomizing fluid fuel and injecting the atomized fuel into the combustion chamber of an internal combustion engine, and wherein the fluid fuel is forced through a minute orifice of the nozzle under high pressure, a hollow body having a fuel inlet and provided with a wall affording an inner bearing surface, said wall having a discharge port at said bearing surface of triangular form in cross-section, said discharge port flaring outwardly from said bearing surface to the outer surface of said wall to provide a minute orifice and a knife edge at the inner end of said port and to present no ledge and no wall surfaces parallel with the axis of said port on which atoms of fuel may accumulate, and a movable valve member constantly engaged with and seated by pressure against and movable on said bearing surface, said movable valve member having on outlet port movable into and out of registry with said discharge port of the body and adapted to co-operate with the latter to form a fan-shaped spray of the fuel discharged through said discharge port into the combustion chamber.

3. In a nozzle for atomizing fluid fuel and injecting the atomized fuel into the combustion chamber of an internal combustion engine, and wherein the fluid fuel is forced through a minute orifice of the nozzle under high pressure, a hollow body having a fuel inlet and provided with a wall affording an inner bearing surface, said wall having a discharge port at said bearing surface, said discharge port flaring outwardly from said bearing surface to the outer surface of said wall to provide a minute orifice and a knife edge at the inner end of said port and to present no ledge or wall surfaces parallel with the axis of said port on which atoms of fuel may accumulate, and a movable valve member constantly engaged with and seated against and movable on said bearing surface, said movable valve member having an outlet port movable into and out of registry with said discharge port of the body, said orifice being of triangular form, and said outlet port consisting of a very narrow slot in the movable valve member disposed parallel with the base of said triangular orifice to form a very thin fan-shaped spray of the fuel discharged through said discharge port into the combustion chamber and to vary the spread of said spray as the movable valve member moves from the apex toward the base of said orifice.

4. The structure as defined in claim 2, wherein said movable valve member comprises a solid cylindrical rod having an end portion thereof centrally longitudinally slotted to provide similar bifurcations tensioned to normally spring apart for snug frictional engagement with said bearing surface.

5. The structure as defined in claim 2, wherein said lateral outlet port comprises a very narrow transverse slot in the movable valve member adapted to co-operate with said discharge port to form a very thin fan-shaped spray of the fuel discharged through said discharge port in the combustion chamber.

6. The structure as defined in claim 2, wherein said movable valve member comprises a slide valve formed of a solid cylindrical rod having an end portion thereof centrally longitudinally slotted to provide similar bifurcations tensioned to normally spring apart for snug frictional engagement with said bearing surface, and wherein said outlet port of the movable valve member comprises a very narrow transverse slot in one of the said bifurcations.

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