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(54) Title: FLUID VALVE ASSEMBLY

(57) Abstract: A valve assembly for a fluid distribution system that enables service to be performed on a secondary fluid control element connected to the valve while the fluid distribution system remains operational. The valve assembly is closed to fluid flow prior to connection to any secondary fluid control element. The engagement of a secondary fluid control element into the valve assembly gradually opens the valve to fluid flow subject to the status of the secondary fluid control element. The secondary fluid control element may be removed from the valve assembly while the distribution system remains operational without significant leakage from the system.

FLUID VALVE ASSEMBLY

[0001] This application claims priority from two United States provisional patent applications: serial number 61/065,366 filed February 11, 2008, and serial number 61/130,533 filed May 30, 2008.

FIELD OF THE INVENTION

[0002] The present invention relates to the field of fluid flow control in fluid distribution systems. More particularly, the valve of the invention is employed in fluid distribution systems that are normally under continuous operational pressure. The valve of the invention is designed to enable removal and replacement of an attached fluid control element without significant leakage while the fluid system remains under pressure.

BACKGROUND OF THE INVENTION

[0003] Certain fluid distribution systems are commonly kept under pressure at all times with the internal fluids either standing in wait to be released or flowing through one or more pathways. Valves may be incorporated in such systems to control whether, or through which path, fluid flows at any given moment.

[0004] A common difficulty in such systems is removing and/or replacing fluid control elements in the system. While under operating pressure the system cannot be serviced without either taking elaborate steps to catch the fluids that will spill from the system during service, or shutting down the system altogether to remove or replace a fluid control element. In many cases it is impossible to remove or replace a fluid control

element unless the system is taken off line and fluid flow stopped while the system is serviced.

[0005] It would be beneficial to industry in general to have the capability to remove or replace elements in fluid control systems without the necessity of shutting down the system for service. The present invention is a fluid valve designed to permit removal/replacement service to be performed on elements of a fluid control system while it remains operational in other respects.

SUMMARY OF THE INVENTION

[0006] The present invention is a fluid flow control valve assembly that enables removal or replacement of secondary flow control elements within a fluid distribution system while that system remains operational. The valve of the invention responds to removal of a fluid control element from the valve by closing automatically as the control element is removed, suspending fluid flow through the valve.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] For the purpose of illustrating the invention, there is shown in the drawings a form that is presently preferred; it being understood, however, that this invention is not limited to the precise arrangements and instrumentalities shown.

[0008] Fig. 1 is a perspective view of the valve assembly.

[0009] Fig. 2 is an exploded view of a first embodiment of the valve assembly.

[0010] Fig. 3 is a section view of the lower body and valve stem of the valve assembly.

[0011] Figs. 4A and 4B is a top plan view of the valve stem fit into the lower body of the valve assembly.

[0012] Fig. 5 is a section view of the stem spring and valve stem within the lower body of the valve assembly.

[0013] Fig. 6 is a section view of the valve stem cap and seal within the valve assembly.

[0014] Fig. 7 is a section view of the upper body joined to the valve assembly.

[0015] Fig. 8 is a complete section view of one embodiment of the valve assembly.

[0016] Fig. 9 is an exploded view of a second embodiment of the valve assembly.

[0017] Fig. 10 is a section view of the complete second embodiment of the valve assembly.

[0018] Fig. 11 is a section view of the complete second embodiment of the valve assembly.

[0019] Fig. 12 is a section view of the complete second embodiment of the valve assembly.

[0020] Fig. 13 is a section view of the complete second embodiment of the valve assembly.

DETAILED DESCRIPTION OF THE INVENTION

[0021] The valve assembly of the invention is designed to permit replacement of fluid control elements attached to the valve in fluid distribution systems without shutting down the system; that is, the control element can be serviced while the system remains on line and operational. An example of one such system would be a fire suppression sprinkler system such as those installed in homes, offices and industrial buildings. The fluid

control element in a sprinkler system is the sprinkler head. In such systems there are heat sensors distributed on numerous sprinkler heads installed on pipe fittings throughout a building. When a heat sensor, commonly a glass tube, is subjected to such heat as might be caused by a fire, it breaks and a fire suppressing spray emanates from the sprinkler head.

[0022] If no provision is made to service the system while it remains operational, a fire suppression system would have to be shut down while one or more of the sprinkler heads is removed or replaced. The valve of the present invention makes it possible to service the sprinkler heads while the system remains under pressure. This description and the accompanying drawings use the fire suppression system as the detailed example for putting the invention to use, though it is understood that the valve of the invention can be employed in a wide range of fluid distribution systems.

[0023] Reference should be made to the accompanying illustrations in which like reference numerals indicate like elements. Referring to the illustrations, Fig. 1 shows a perspective of the valve assembly 10 of the invention. The valve assembly 10 would be connected to a fitting (not shown) in a fluid distribution system – in the illustrated example, a fire suppression sprinkler system. In normal operation, the valve assembly is filled with fluid that either flows through the valve when it is "open" or is stopped within the valve when it is "closed." The sprinkler head (shown in phantom in Fig. 1) may be connected to and disconnected from the valve assembly 10 without removing the system from operation and without significant leakage.

[0024] Fig. 2 is an exploded view of a first embodiment of the valve assembly 10 in which the major elements of the assembly are shown in relation to each other. The valve

assembly comprises an upper body 20 and lower body 24 that are threaded together when the assembly is complete. Within the valve body is a valve stem 28 that fits into a cylindrical space within the lower body 24. A stem spring 36 fits around the valve stem 28 and a stem cap 32 is fitted to the valve stem 28 (by threaded connection in the illustration). The stem cap 32 seats against a surface within the lower body 24 to close the valve.

[0025] The valve stem 28 has one or more fluid ports 29 in its upper region so that fluid can enter the valve stem 28 and flow down through the valve assembly 10 when the valve is "open." When the valve is "closed" the fluid port(s) 29 in the valve stem 28 are blocked from receiving fluid by the stem cap 32 seating against a sealing surface within the valve, as described below. A sprinkler 40, not an element of the valve assembly itself, is shown in Fig. 2 with a threaded connection segment by which it is attached to the lower body 24 of the valve assembly.

[0026] Fig. 3 shows the basic configuration of the valve stem 28 within the lower valve body 24. The lower body 24 has a fluid reservoir 27 in its upper extent. The valve stem 28 protrudes into the reservoir 27 when the valve is open. Below the reservoir 27 is a narrower mid-channel 23 into which the upper portion of the valve stem 28 fits. The lower portion of the valve stem 28 extends into a lower channel 22 in the valve body 24. The valve stem 28 is free to move vertically within the two interior channels 22, 23 of the valve body 24 to open and close the valve to fluid flow. The arrows in Fig. 3 indicate the direction of fluid flow through the valve.

[0027] The insertion and retention of the valve stem 28 into the lower valve body 24 is illustrated in Figs. 3 and 4a, 4b. In Figs. 3 and 4a, 4b the lower valve body is shown to

have tabs 21 at the entry of the mid-channel 23 from the reservoir 27. The tabs 21 extend partially around the circumference of the mid-channel entry in two places, as shown in Fig. 3, leaving slots 26 between them. The valve stem 28 has tabs 25 spaced apart around the outer circumference of the valve stem. These tabs 25 fit through the slots 26 between the tabs 21 in the valve body 24, also illustrated in Fig. 4a, 4b. A simple rotational twist to the valve stem once it is inside the lower valve body misaligns the tabs 25 and slots 26 so that the valve stem 28 is retained inside the lower valve body 24.

[0028] Fig. 5 shows the assembly of the stem spring 36 into the lower valve body 24. The stem spring 36 occupies a space between the outer surface of the valve stem 28 and the inner surface of the mid-channel 23. The spring is inserted through one of the slots 26 (Fig. 4b) at the entry of the mid-channel 23 and wound down into the lower valve body 24. Once fully inserted the stem spring is retained within the mid-channel by the tabs 21 at the entry of the mid-channel 23 in the valve body. At its lower end, the stem spring 36 rests against the stem tabs 25 on the valve stem 28. The space in which the spring 36 is confined compresses the spring and keeps the valve stem 28 seated in a closed position within the valve unless acted upon by an upward force.

[0029] Fig. 6 shows the assembly of the stem cap 32 on to the valve stem 28 to complete the inner works of the valve assembly 10. In Fig. 6 the stem cap 32 is shown to be threaded on to the upper end of the valve stem 28, although other methods of attachment are possible. A sealing element 33, such as an o-ring, washer or other sealing mechanism, seals the under surface of the stem cap 32 to the inner surface of the fluid reservoir 27 inside the lower valve body 24. In this manner, any fluid flow past the stem cap down through the valve is prevented when the valve is closed.

[0030] In Fig. 7 the upper body 20 of the valve assembly is shown connected to the lower body 24. A threaded connection is shown though it should be understood that other connection methods may be employed. As illustrated, the upper body 20 of the valve assembly has a threaded upper region, which is for connection to a fitting on a fluid supply line (again, other connection methods may be used). In the described example, a fire suppression sprinkler system, the fluid supply would come from a network of water pipes through ceiling and walls of a protected facility. The divided valve body assembly makes it possible to remove the lower valve body 24 – including the operating works of the valve – from the upper body section 20 if the operating works were to fail or require maintenance. This maintenance would require the shutdown of the fluid distribution system or that part of the system that contained the subject valve assembly.

[0031] However, Fig. 8 illustrates how the valve assembly of the invention enables maintenance or replacement of a fluid control element, in the example case the sprinkler head 40, without shutting down the fluid distribution system. Prior to the connection of a sprinkler head to the valve assembly, the valve is held closed by the force of the valve spring 36 pushing down on the valve stem, seating the sealing element 33 against the lower surface of the fluid reservoir inside the valve body 24. While the valve assembly remains closed the fluid distribution system may remain operational in all other respects.

[0032] Fig. 8 indicates that the sprinkler head 40 is being screwed into the lower valve body 24 of the valve assembly. As the sprinkler head 40 is screwed into the assembly, it engages the lower terminus of the valve stem 28 and begins to push it up. As the valve stem 28 rises, the fluid port(s) 29 enter the fluid reservoir 27 of the valve body 24 permitting fluid to enter the valve stem 28 and travel down toward the sprinkler head 40.

In normal circumstances the sprinkler head 40 is in a "safe" condition (the heat sensor is intact) and fluid cannot escape from the sprinkler. Therefore, when a valve of the invention has no sprinkler head (or other fluid control element) connected to it, the valve is closed and fluid cannot escape the system. Only the connection of an element like the sprinkler engages the valve stem and opens the valve such that further movement of the fluid is under the control of the added element (e.g., the sprinkler head 40). Maintenance of the fluid control elements or pathways of the distribution system is therefore possible while the system remains operational.

[0033] It should be understood that the sprinkler head 40 is simply one example of a fluid control element that may be connected to the valve assembly of the invention. Any number of other fluid controls may be present. A spigot, for example, is another possibility. A closed spigot could be connected to the valve assembly while a fluid system remained operational and fluid would remain confined within the valve until the spigot was opened. This feature would permit removal and replacement of faulty spigots as necessary while the system was functional. Numerous other possibilities exist where the addition of the valve assembly of the invention to any branch of a fluid control system would enable maintenance of a fluid control element (sprinkler, spigot, secondary fluid controls) in that branch without system shutdown.

[0034] An alternative embodiment of the invention is illustrated in Figs. 9-13. Fig. 9 is an exploded view of the alternative embodiment valve assembly. In this embodiment, the valve body is divided into three parts: the upper valve body 120, the mid-body 124, and the lower body 125. The valve stem 128, stem spring 136, and stem cap 132 are common to both embodiments of the invention and assemble in like fashion, as shown in Fig. 10.

[0035] In this alternative embodiment, the operating works of the valve assembly are contained in the mid-body 124 of the valve. The lower valve body 24 of the first embodiment is divided into the mid-body 124 and lower body 125 sections in the alternative embodiment. Fig. 10 illustrates the assembly of the sprinkler head 40 with the lower valve body 125 prior to making the connection with the closed valve mid-body section 124.

[0036] In Fig. 11 the combined sprinkler/lower body is shown just being threaded together with the mid-body 124 valve assembly. As first engagement is made, the valve stem is closed with the stem cap 132 sealed to the inner surface of the mid-body reservoir by the sealing element 133. As the sprinkler/lower body assembly is threaded on to the valve mid-body 124, see Fig. 12, the sprinkler engages the lower extent of the valve stem and progressively pushes it up, opening the valve to fluid flow through the valve ports and stem. No fluid can escape the valve assembly, however, since the lower body 125 is already fully engaged with the closed sprinkler head 40. Fig. 13 shows the complete assembly of the sprinkler head 40, and entire valve assembly in which the valve is fully open and held open by the engagement to the sprinkler head 40.

[0037] This embodiment of the valve assembly is also usable with other fluid control elements like spigots and secondary fluid control elements like sprinkler heads. One advantage of the alternative embodiment is that the prior assembly of the secondary fluid control element (e.g., sprinkler head) with the lower valve body 125 provides a complete seal as the valve begins to open and prevents any fluid from seeping through the threads (as shown) on the secondary control element. Another advantage is that the combination

of the mid-body 124 and lower body 125 bulk around the valve stem make for a much stronger assembly less prone to damage from external forces.

[0038] Other advantages and physical forms of the invention may be apparent to those skilled in the art. The above description has been generally limited to the single example of a fire suppression sprinkler system but the uses of the valve assembly of the invention is not intended to be so limited. Reference must be made to the following claims for determination of the full scope of protection afforded the invention.

WE CLAIM:

1. A valve assembly for enabling service to fluid control elements in fluid distribution systems comprising:

a valve body comprising a lower body section and upper body section;

operating works of the valve contained in -said lower body section, said operating works comprising a valve stem having a fluid port for fluid to enter and flow through the valve stem, and a stem spring to retain the valve in a closed position in the absence of an outside force;

said upper body section having a connection to a fluid distribution system;

said valve assembly being arranged such that connection of a secondary fluid control element into said lower body section causes the secondary fluid control element to engage the valve stem and push it open, permitting fluid from the distribution system to flow through the valve, and removal of the secondary fluid control element causes the valve stem to return to a closed position, stopping fluid flow through the valve.

2. The valve assembly of claim 1 further comprising:

a fluid reservoir interior to the lower valve body section.

3. The valve assembly of claim 2 further comprising:

a stem cap disposed at a first end of the valve stem and within the fluid reservoir of the lower body section.

4. The valve assembly of claim 3 further comprising:

a seal element compressible between the stem cap and an interior surface of said fluid reservoir, preventing fluid flow into the valve stem when the fluid port of the valve stem is retracted from the fluid reservoir by force of the stem spring.

5. The valve assembly of claim 4 further comprising:

a second end of the valve stem extending into a connection channel in the lower body section of the valve assembly for engagement by said secondary fluid control element when said secondary element is connected to the valve assembly.

6. A valve assembly for enabling service to fluid control elements in fluid distribution systems comprising:

a valve body comprising an upper and lower body section, said lower body section comprising a fluid reservoir having an interior surface, a valve stem having a fluid port, a stem spring and a stem cap;

said valve stem disposed within said lower body section and retained in a closed position by said spring whereby said fluid port is separate from said fluid reservoir, said valve stem further extending into a connection channel through the lower body section through which connection to a secondary fluid control element is made;

said cap being attached to a first end of said valve stem and retained in a closed position by said spring whereby a seal is compressed between said cap and said interior surface of the fluid reservoir preventing fluid from entering the valve stem;

said lower body section being connected to an upper body section;

said upper body section connecting the valve assembly to a fluid distribution system;

said valve assembly being arranged such that the connection of a secondary fluid control element into the connection channel of the lower body section engages a second end of said valve stem, said engagement causing the valve stem to push into the fluid reservoir of the valve assembly whereby fluid flows into the fluid port in the valve stem and through the valve into the secondary fluid control element, and further such that removal of the secondary fluid control element from the lower body section connection causes the valve stem to retract from the fluid reservoir, closing the valve.

7. A valve assembly for enabling service to fluid control elements in fluid distribution systems comprising:

a valve body comprising a lower body section, a mid-body section connected at a first end to said lower body section, and an upper body section connected to said mid-body section;

operating works of the valve contained in said mid-body section, said operating works comprising a valve stem having a fluid port for fluid to enter and flow through the valve stem, and a stem spring to retain the valve in a closed position in the absence of an outside force;

said upper body section having a connection to a fluid distribution system;

said valve assembly being arranged such that connection of a secondary fluid control element into said lower body section causes the secondary fluid control element

to engage the valve stem and push it open, permitting fluid from the distribution system to flow through the valve, and removal of the secondary fluid control element causes the valve stem to return to a closed position, stopping fluid flow through the valve.

8. The valve assembly of claim 7 further comprising:

a fluid reservoir interior to the valve mid-body section.

9. The valve assembly of claim 8 further comprising:

a stem cap disposed at a first end of the valve stem and within the fluid reservoir of the mid-body section.

10. The valve assembly of claim 9 further comprising:

a seal element compressible between the stem cap and an interior surface of said fluid reservoir, preventing fluid flow into the valve stem when the fluid port of the valve stem is retracted from the fluid reservoir by force of the stem spring.

11. The valve assembly of claim 10 further comprising:

a second end of the valve stem extending into a connection channel in the lower body section of the valve assembly for engagement by said secondary fluid control element when said secondary element is connected to the valve assembly.

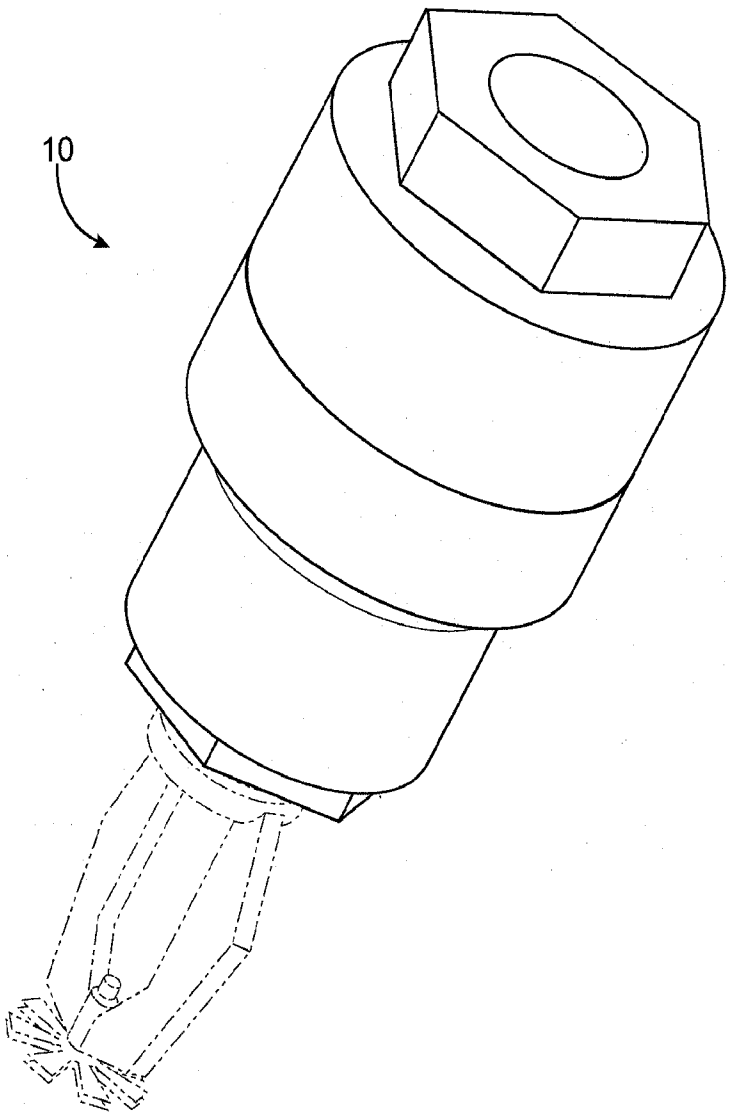

FIG. 1

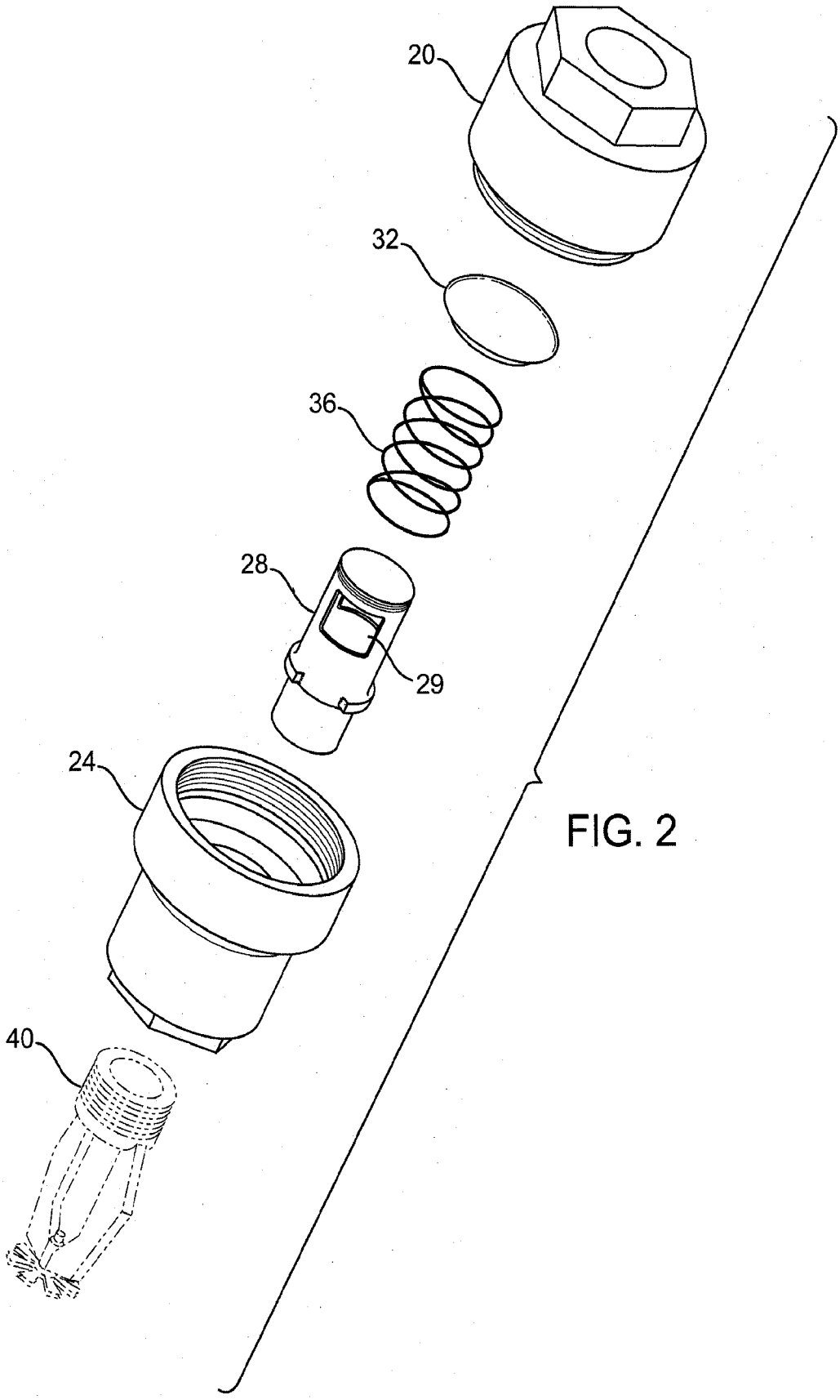

FIG. 2

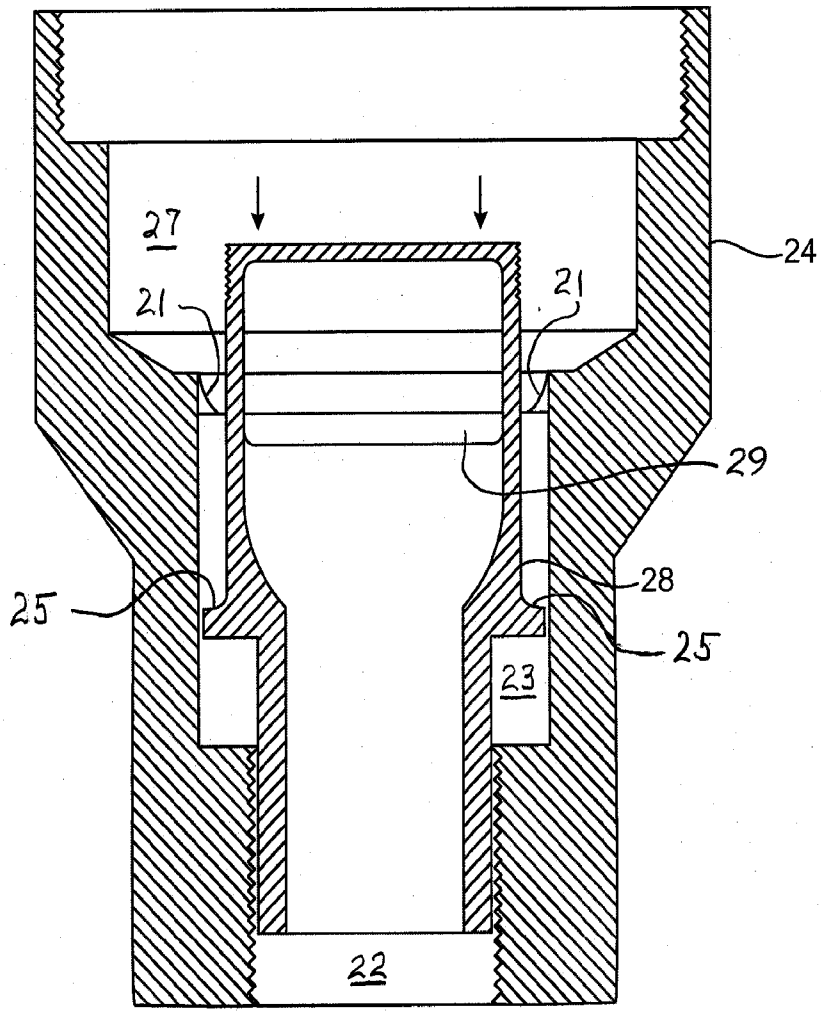

FIG. 3

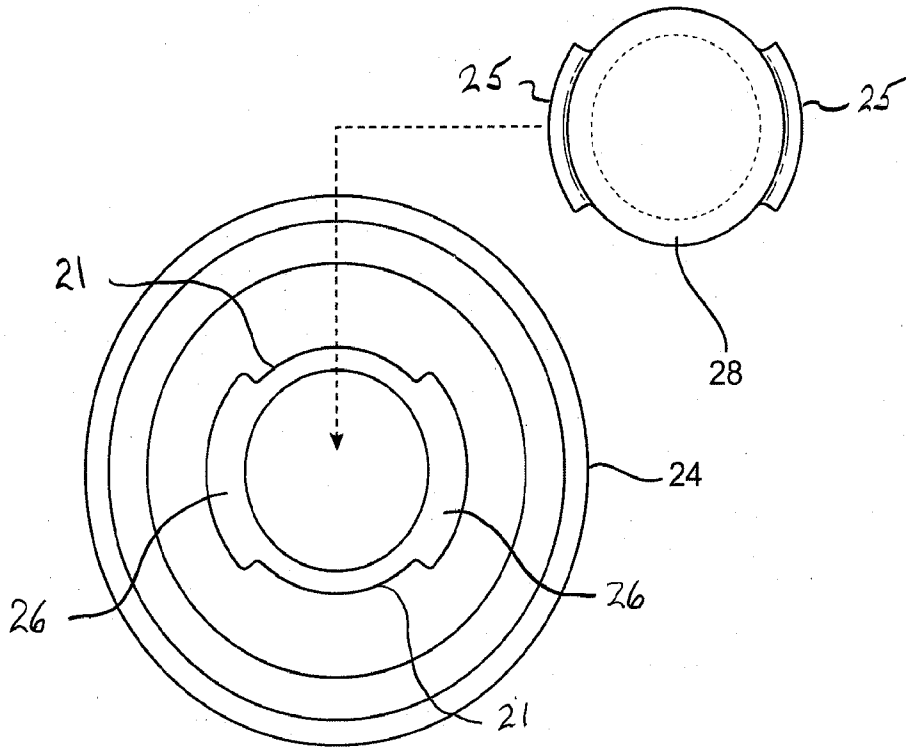

FIG. 4a

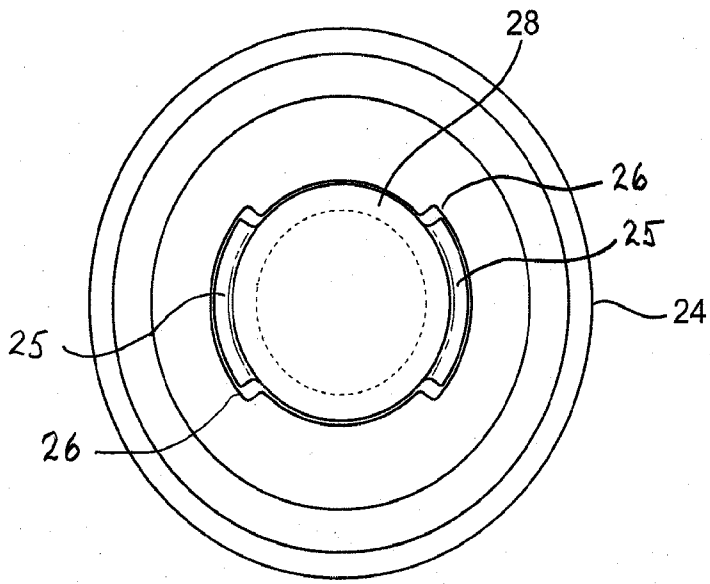

FIG. 4b

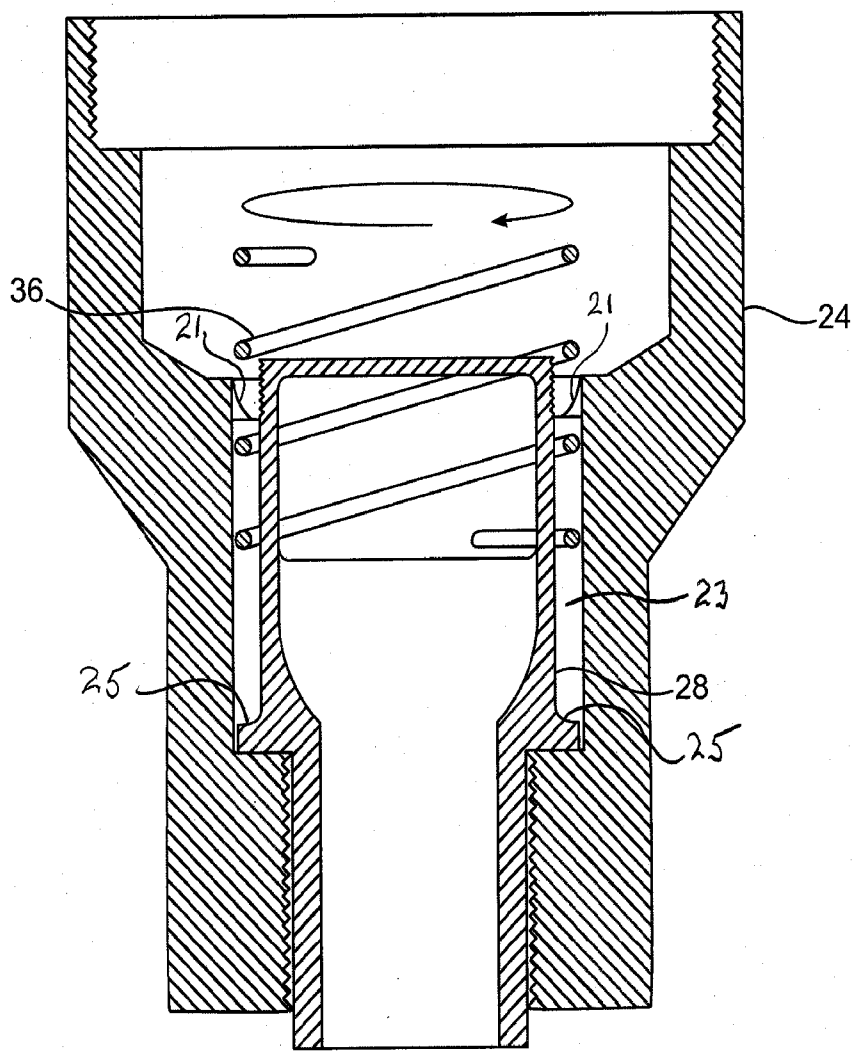

FIG. 5

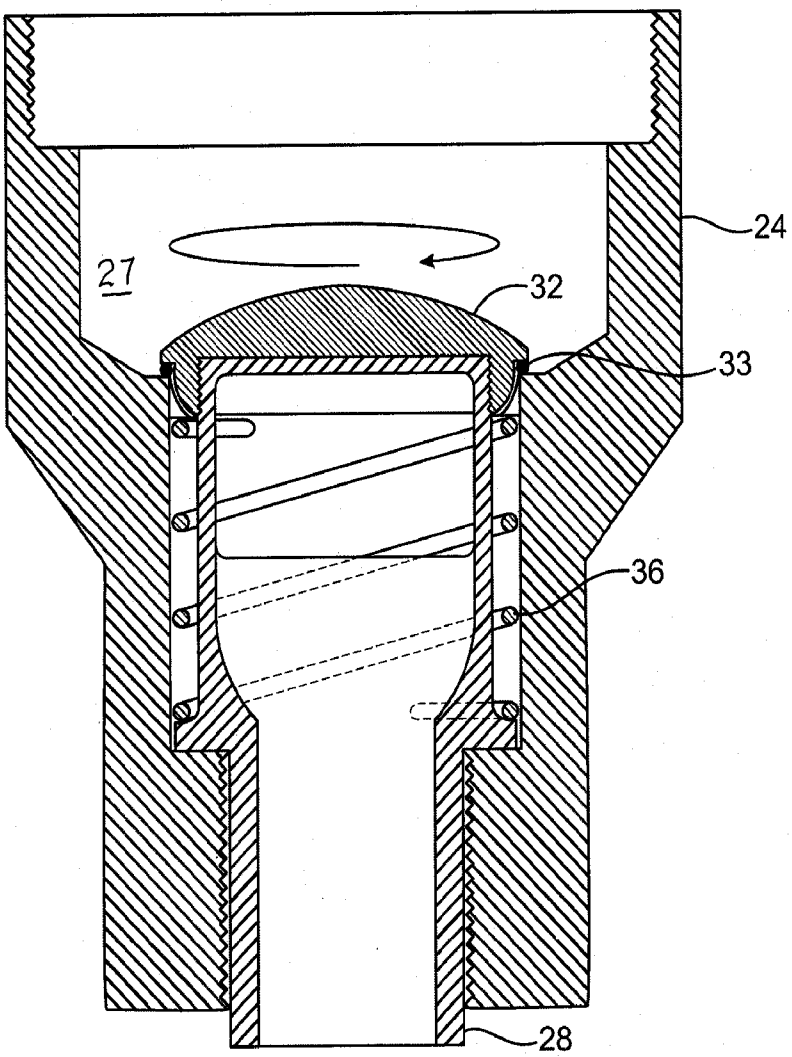

FIG. 6

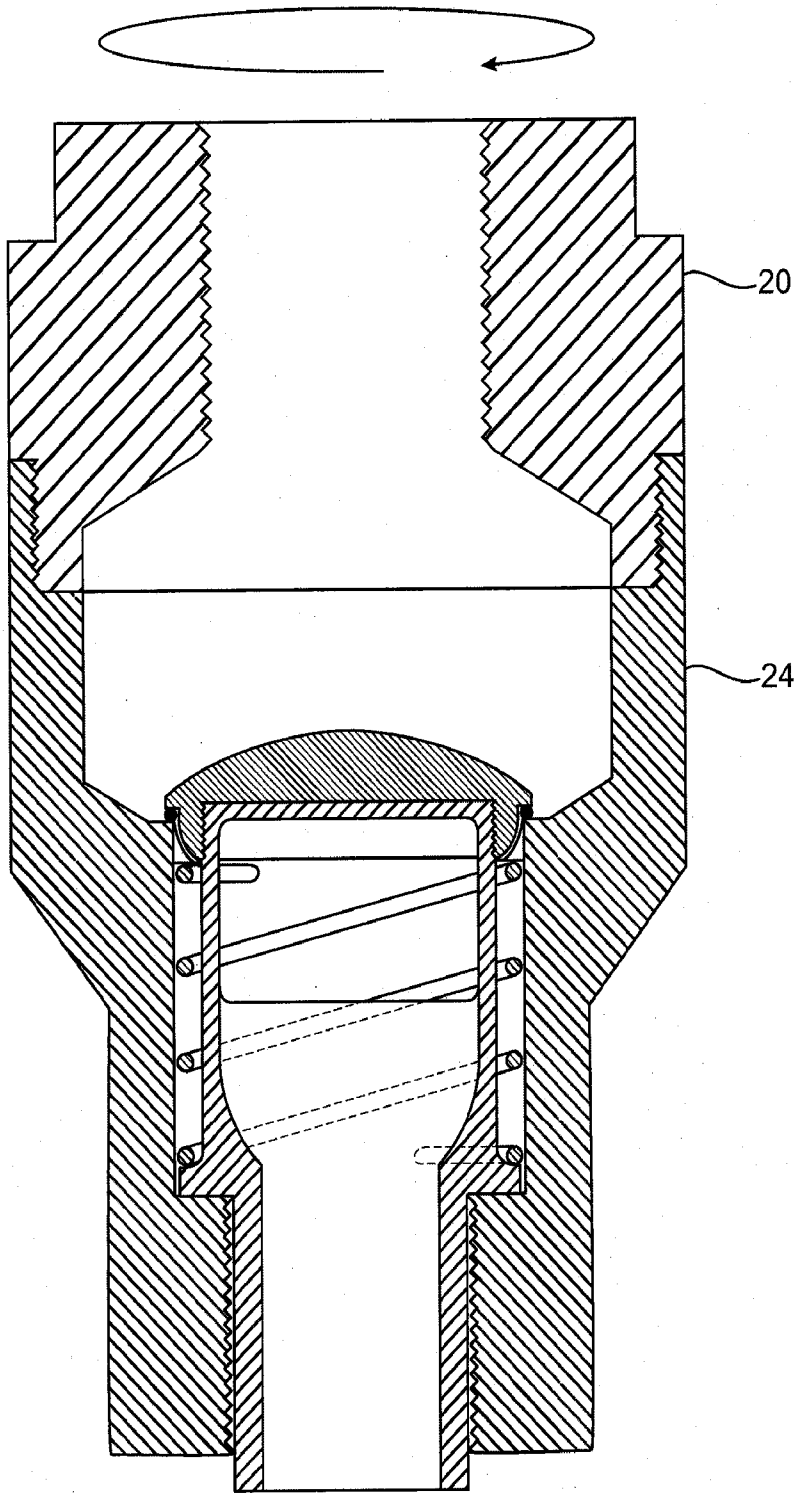

FIG. 7

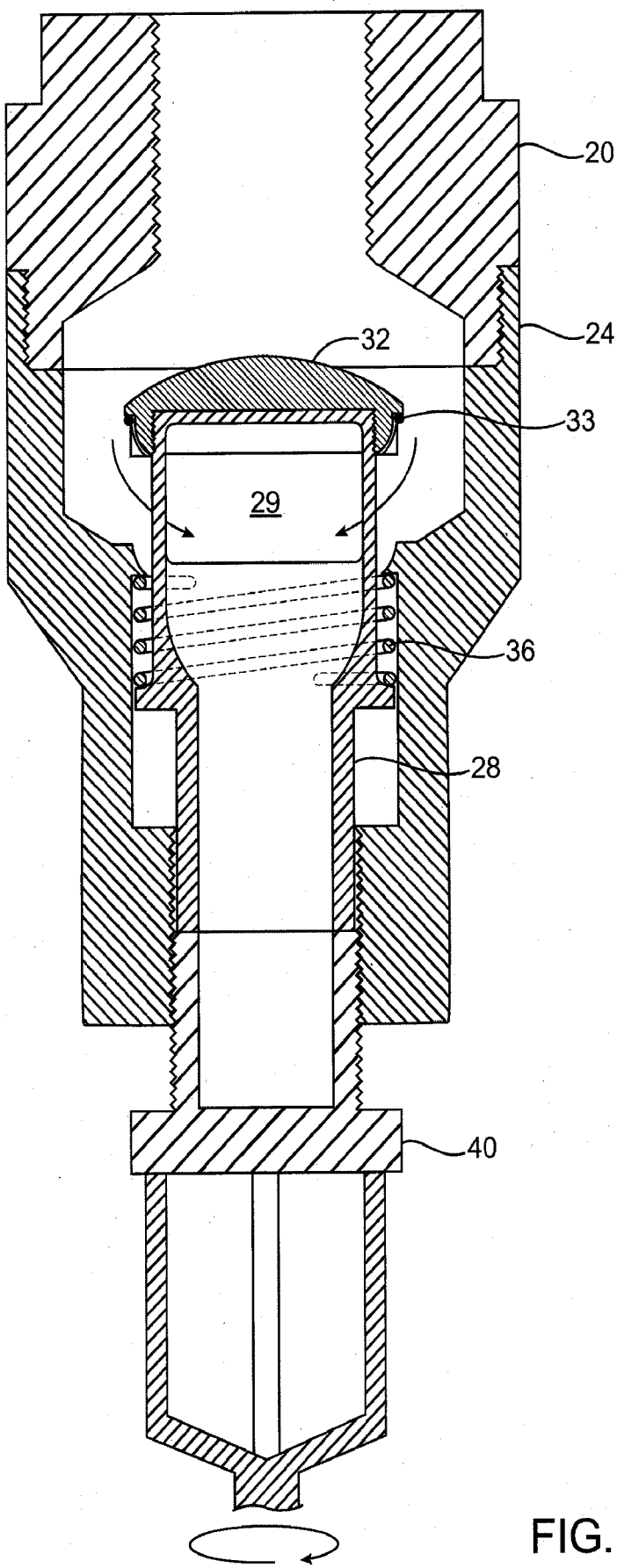

FIG. 8

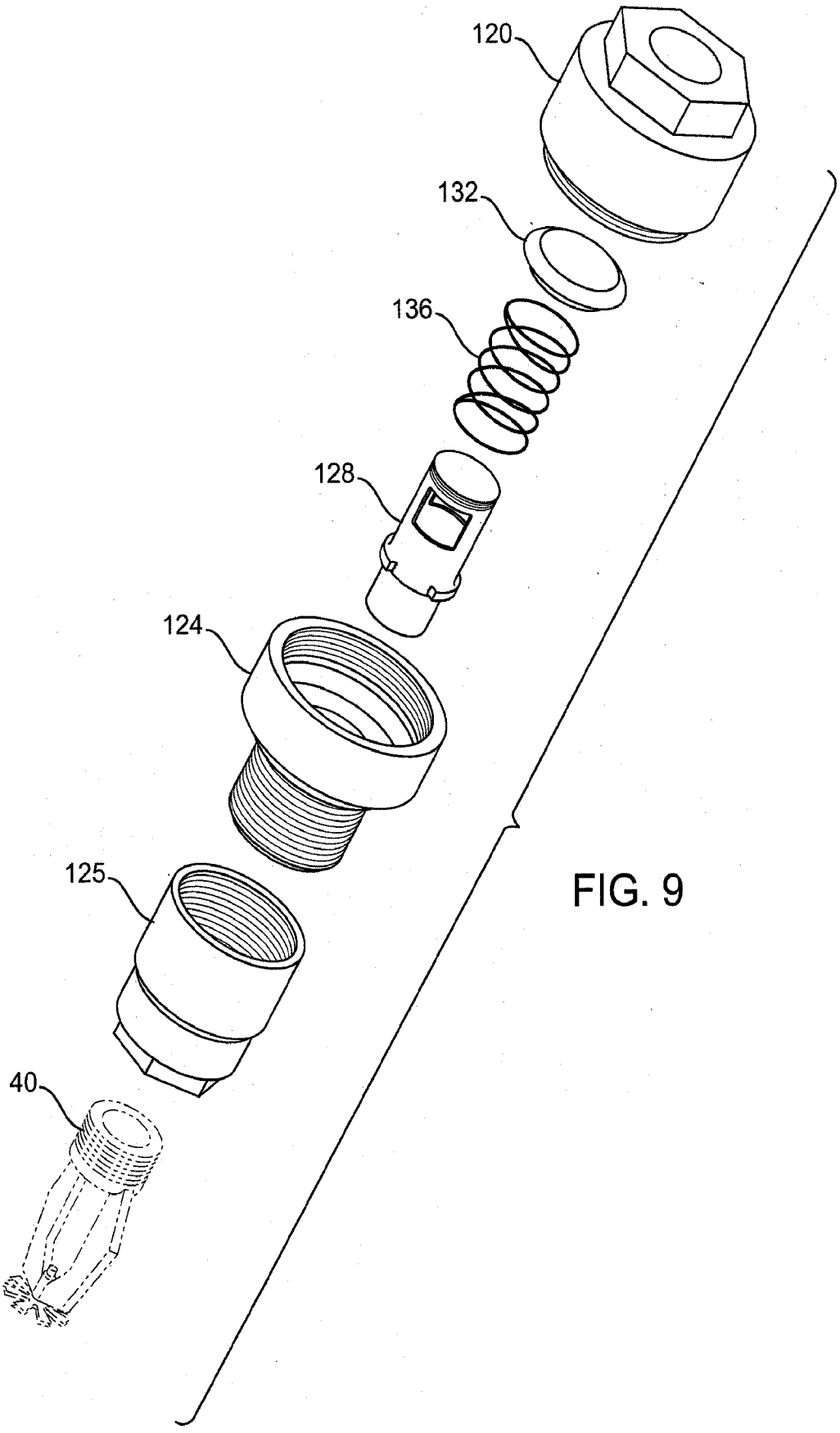

FIG. 9

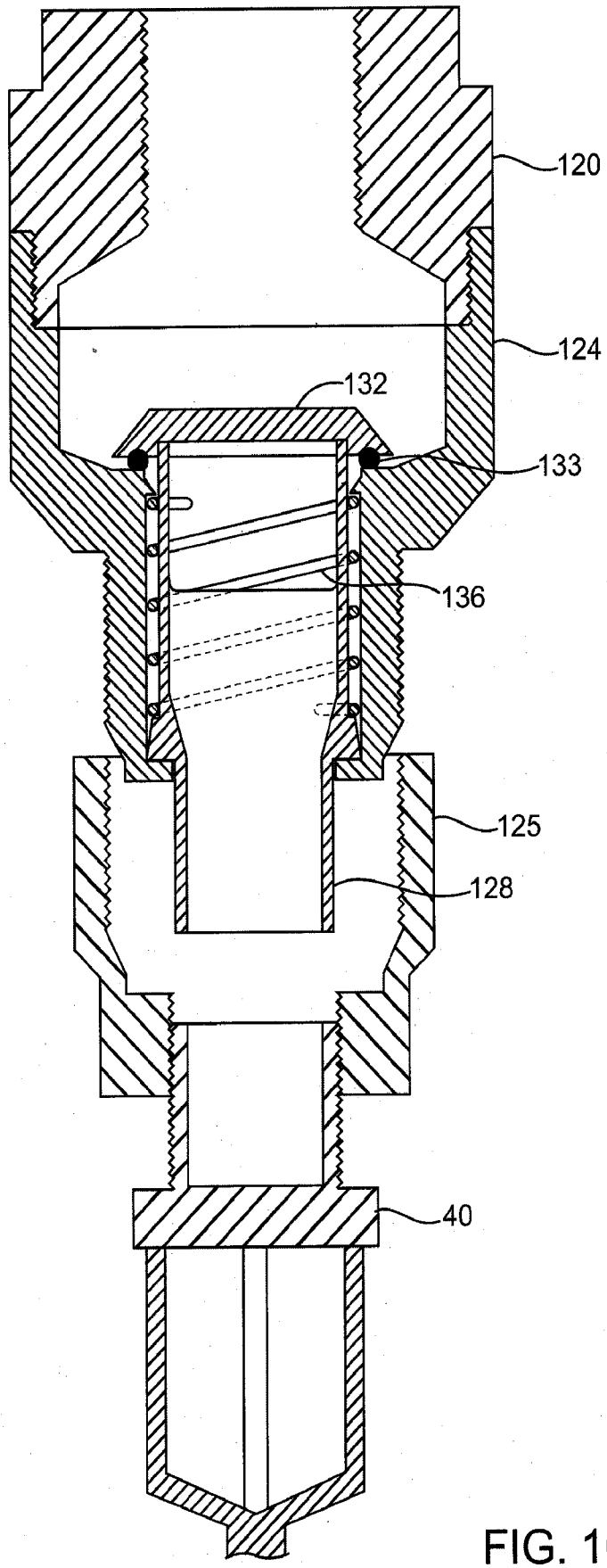

FIG. 10

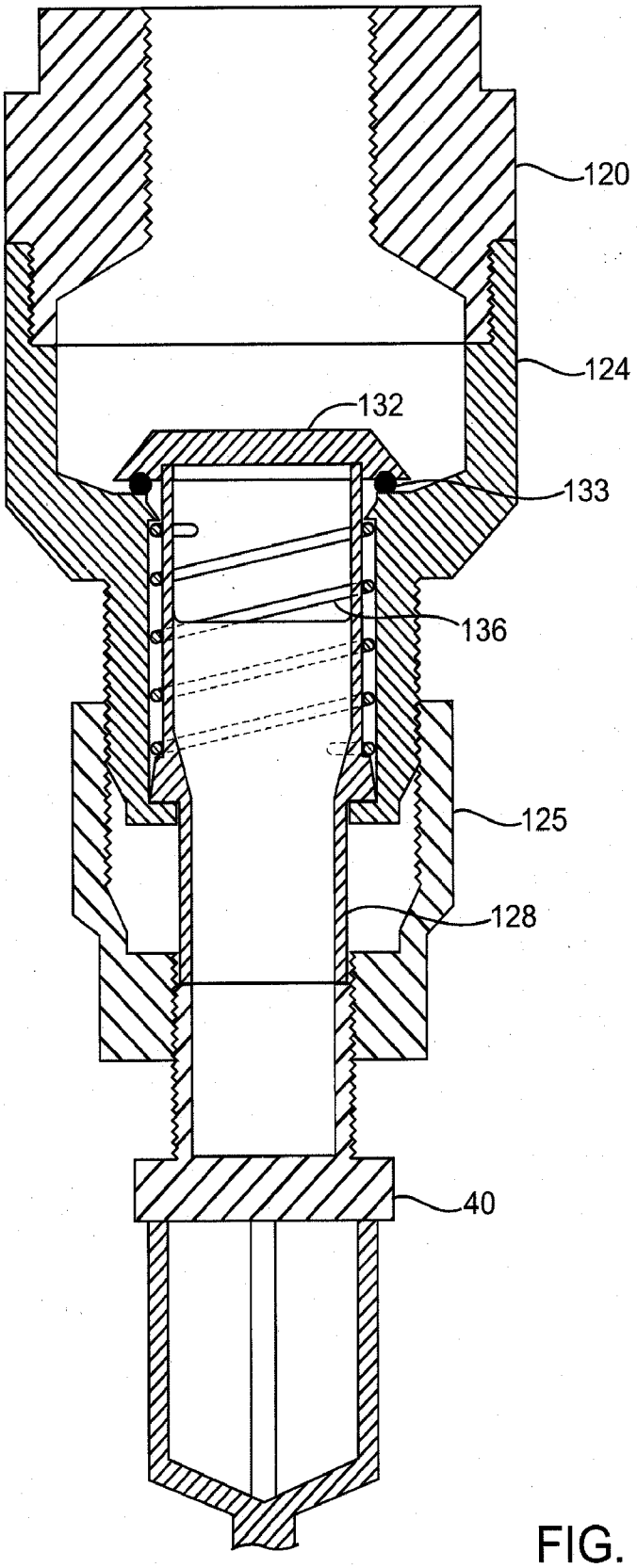

FIG. 11

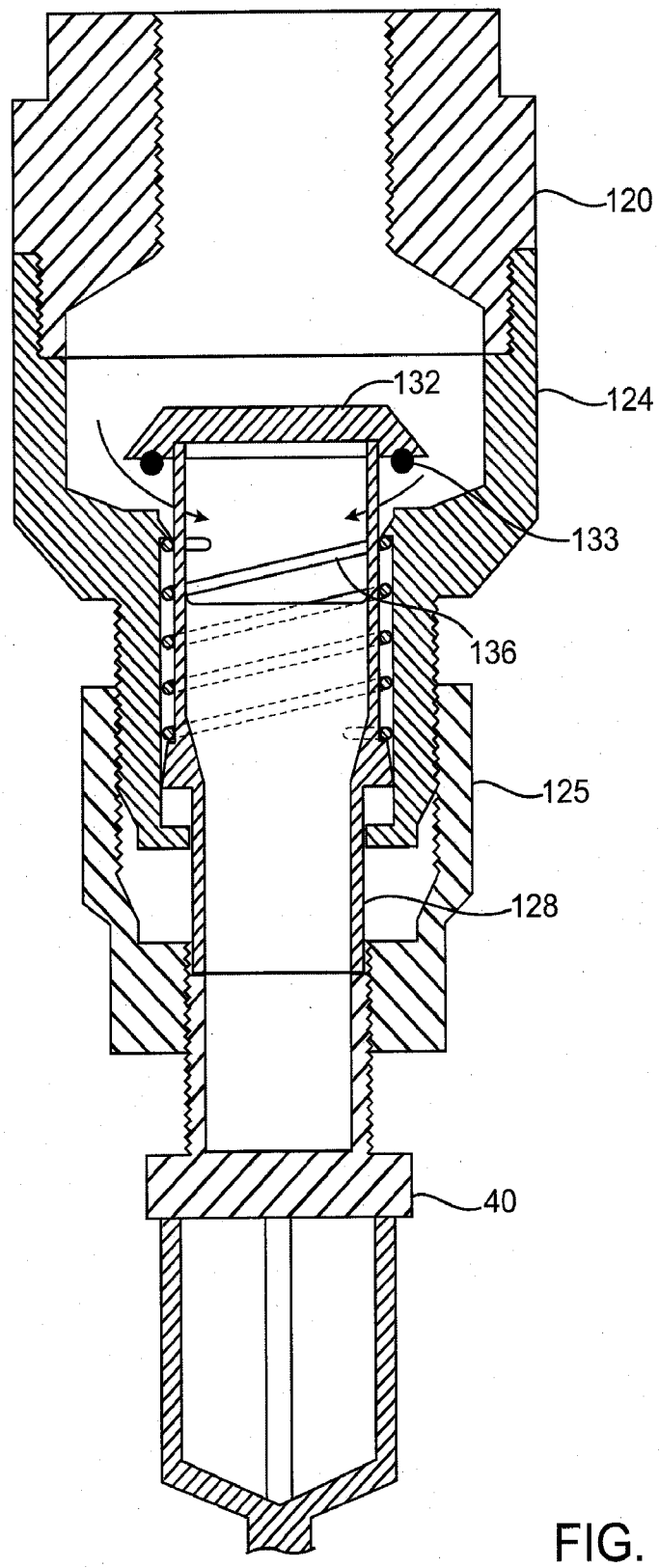

FIG. 12

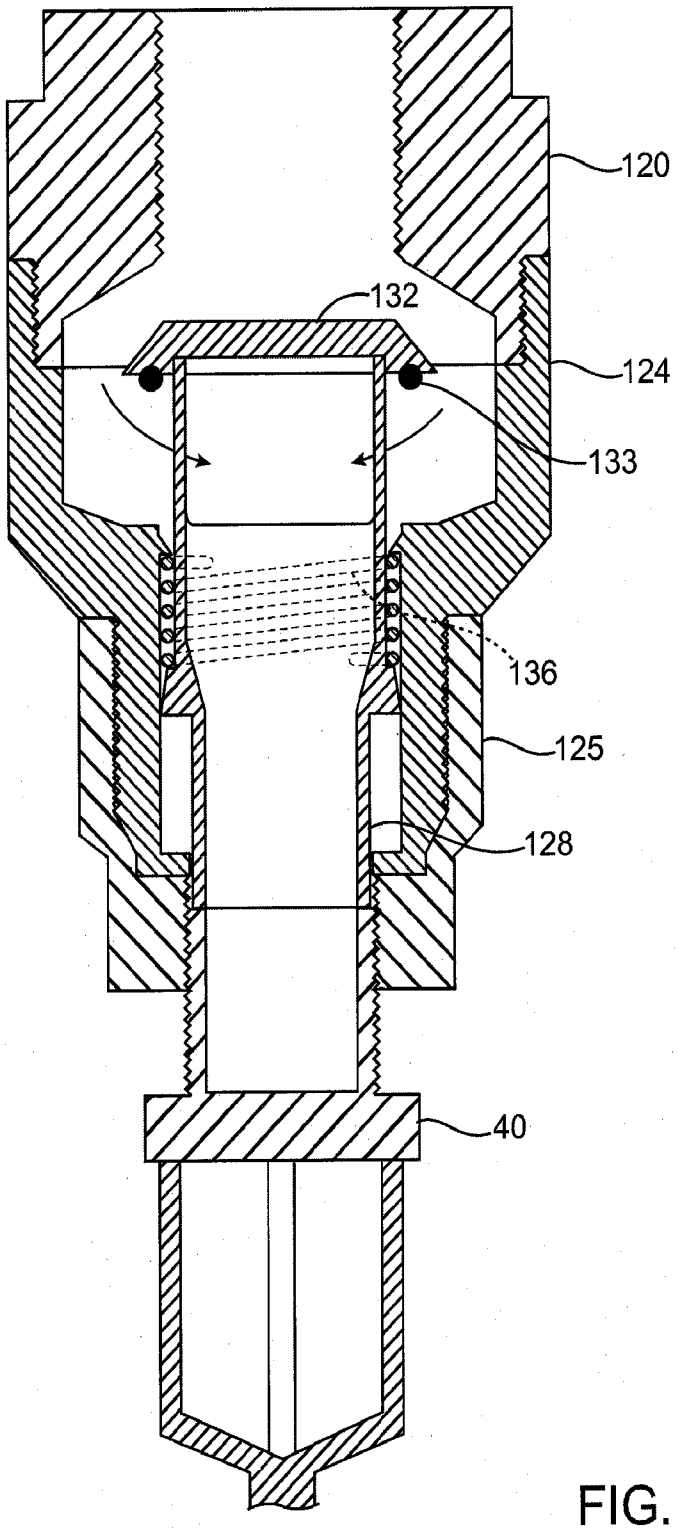

FIG. 13