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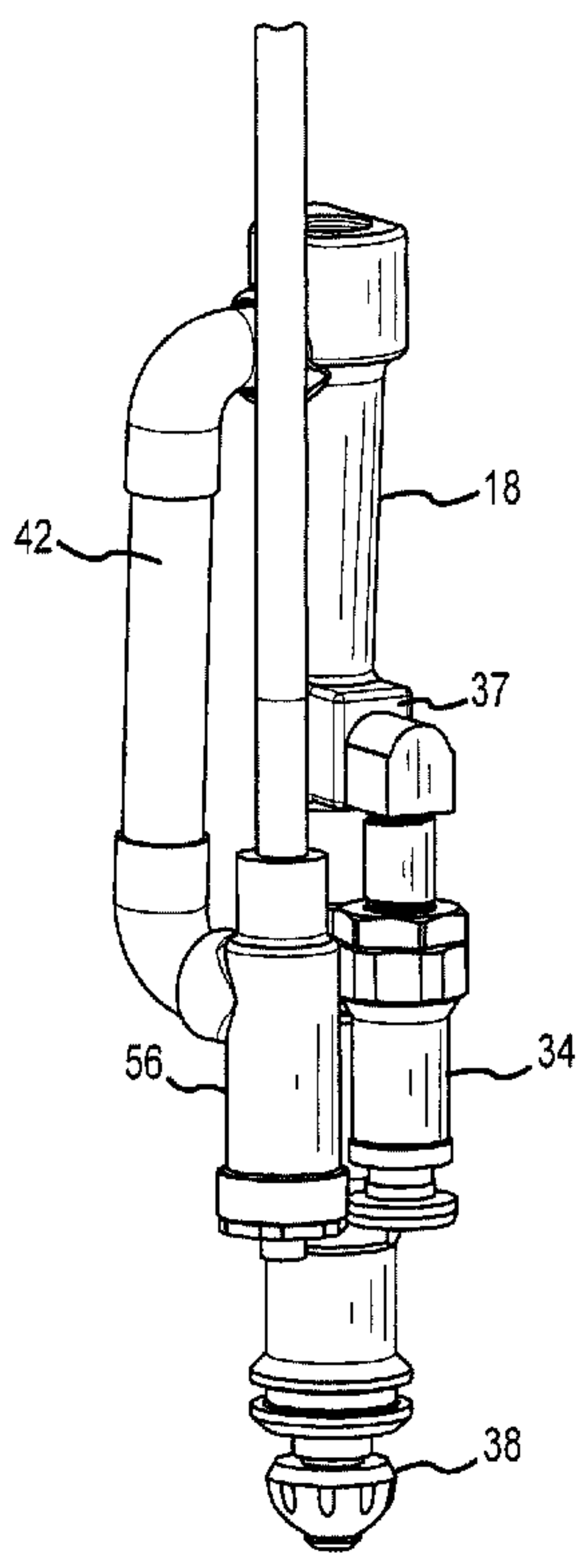


(57) Abrégé/Abstract:
A freeze resistant sanitary hydrant is provided that employs a reservoir for storage of fluid under the frost line or in an area not prone to freezing. To evacuate this reservoir, a venturi is provided that is able to function in hydrant systems that employ a vacuum breaker.

ABSTRACT

A freeze resistant sanitary hydrant is provided that employs a reservoir for storage of fluid under the frost line or in an area not prone to freezing. To evacuate this reservoir, a venturi is provided that is able to function in hydrant systems that employ a vacuum breaker.

SANITARY HYDRANT

FIELD OF THE INVENTION

Embodiments of the present invention are generally related to contamination proof hydrants that employ a venturi that facilitates transfer of fluid from a self-contained water storage reservoir.

BACKGROUND OF THE INVENTION

Hydrants typically comprise a head interconnected to a water source by way of a vertically oriented standpipe that is buried in the ground or interconnected to a fixed structure, such as a roof. To be considered "freeze proof" hydrant water previously flowing through the standpipe must be directed away from the hydrant after shut off. Thus many ground hydrants 2 currently in use allow water to escape from the standpipe 6 from a drain port 10 located below the "frost line" 14 as shown in Fig. 1.

Hydrants are commonly used to supply water to livestock that will urinate and defecate in areas adjacent to the hydrant. It follows that the animal waste will leach into the ground. Thus a concern with freeze proof hydrants is that they may allow contaminated ground water to penetrate the hydrant through the drain port when the hydrant is shut off. More specifically, if a vacuum, i.e., negative pressure, is present in the water supply, contaminated ground water could be drawn into the standpipe and the associated water supply line. Contaminants could also enter the system if pressure of the ground water increases. To address the potential contamination issue, "sanitary" yard hydrants have been developed that employ a reservoir that receives water from the standpipe after hydrant shut off.

There is a balance between providing a freeze proof hydrant and a sanitary hydrant that is often difficult to address. More specifically, the water stored in the reservoir of a sanitary hydrant could freeze which can result in hydrant damage or malfunction. To address this issue, attempts have been made to ensure that the reservoir is positioned below the frost line or located in an area that is not susceptible to freezing. These measures do not address the freezing issue when water is not completely evacuated from the standpipe. That is, if the reservoir is not adequately evacuated when the hydrant is turned on, the water remaining in the reservoir will effectively prevent standpipe water evacuation when the hydrant is shut off, which will leave water above the frost line.

To help ensure that all water is evacuated from the reservoir, some hydrants employ a venturi system. A venturi comprises a nozzle and a decreased diameter throat. When fluid flows through the venturi a pressure drop occurs at the throat that is used to suction water from the reservoir. That is, the venturi is used to create an area of low pressure in the fluid inlet line of the hydrant that pulls the fluid from the reservoir when fluid flow is initiated. Sanitary hydrants that employ venturis must comply with ASSE-1057, ASSE-0100, and ASSE-0152 that require that a vacuum breaker or a backflow preventer be associated with the hydrant outlet to counteract negative pressure in the hydrant that may occur when the water supply pressure drops from time-to-time which could draw potentially contaminated fluid into the hydrant after shut off. Internal flow obstructions associated with the vacuum breakers and backflow preventers will create a back pressure that will affect fluid flow through the hydrant. More specifically, common vacuum breakers and backflow preventers employ at least one spring-biased check valve. When the hydrant is turned on spring forces are counteracted and the valve is opened by the pressure of the fluid supply, which negatively influences fluid flow through the hydrant. In addition an elongated standpipe will affect fluid flow. These sources of back pressure influence flow through the venturi to such a degree that a pressure drop sufficient to remove the stored water from the reservoir will not be created. Thus to provide fluid flow at a velocity required for proper functioning of the venturi, fluid diverters or selectively detachable backflow preventers, i.e., those having a quick disconnect capability, have been used to avoid the back pressure associated with the vacuum breakers of backflow preventers. In operation, as shown in Fig. 2, the diverter is used initially for about 45 seconds to ensure reservoir evacuation. Then, the diverter is disengaged so that the water will flow through the backflow preventer or vacuum breaker. The obvious drawback of this solution is that the diverter must be manually actuated and the user must allow water to flow for a given amount of time, which is wasteful.

Further, as the standpipe gets longer it will create more backpressure, i.e., head pressure, that reduces the flow of water through the venturi, and at some point a venturi of any design will be unable to evacuate the water in the reservoir. That is, the amount of time it takes for a hydrant to evacuate the water into the reservoir depends on the height/length of the standpipe as well as the water pressure. The evacuation time of roof hydrants of embodiments of the present invention, which has a 42" standpipe, is 5 seconds at 60 psi. The evacuation time will increase with a lower supply pressure or increased standpipe length or diameter. Currently existing hydrants have evacuation times in the 30 second range.

Another way to address the fluid flow problem caused by vacuum breakers is to provide a reservoir with a "pressure system" that is capable of holding a pressure vacuum that is used to suction water from the standpipe after hydrant shut off. During normal use the venturi will evacuate at least a portion of the fluid from the reservoir. Supply water is also allowed to enter the reservoir which will pressurize any air in the reservoir that entered the reservoir when the reservoir was at least partially evacuated. When flow through the hydrant is stopped, the supply pressure is cut off and the air in the reservoir expands to created a pressure drop that suctions water from the standpipe into the reservoir. If the vacuum produced is insufficient, which would be attributed to incomplete evacuation of the reservoir, water from the standpipe will not drain into the reservoir and water will be left above the frost line.

Other hydrants employ a series of check valves to prevent water from entering the reservoir during normal operations. Hydrants that employ a "check system" uses a check valve to allow water into or out of the reservoir. When the hydrant is turned on, the check valve opens to allow the water to be suctioned from the reservoir. The check also prevents supply water from flowing into the reservoir during normal operations, which occurs during the operation of the pressure vacuum system. When the hydrant is shut off, the check valve opens to allow the standpipe water to drain into the reservoir. One disadvantage of a check system is that it requires a large diameter reservoir to accommodate the check valve. Thus a roof hydrant would require a larger roof penetration and a larger hydrant mounting system, which may not be desirable.

Another issue associated with both the pressure vacuum and check systems is that there must be a passageway or vent that allows air into the reservoir so that when a hydrant is turned on, the water stored in the reservoir can be evacuated. If the reservoir was not exposed to atmosphere, the venturi would not create sufficient suction to overcome the vacuum that is created in the reservoir.

SUMMARY OF THE INVENTION

It is one aspect of embodiments of the present invention to provide a sanitary and freeze proof hydrant that employs a venturi for suctioning fluid from a fluid storage reservoir. As one of skill in the art will appreciate, the amount of suction produced by the venturi is a function of geometry. More specifically, the contemplated venturi is comprised of a nozzle with an associated throat. Water traveling through the nozzle creates an area of low pressure at or near the throat that is in fluid communication with the reservoir. In one embodiment, the configuration of the nozzle and throat differs from existing products. That is, the contemplated nozzle is configured such that the venturi will operate in conjunction with a vacuum breaker, a double check backflow preventer, or a double check backflow prevention device as disclosed in U.S. Patent Application Publication No. 2009/0288722 without the need for a diverter. Preferably, embodiments of the present invention are used in conjunction with the double check backflow prevention device of the ‘722 publication as it is less disruptive to fluid flow than the backflow preventers and vacuum breakers of the prior art.

While the use of a venturi is not new to the sanitary yard hydrant industry, the design features of the venturi employed by embodiments of the present invention are unique in the way freeze protection is provided. More specifically, current hydrants employ a system that allows water to bypass a required vacuum breaker. For example, the Hoeptner Freeze Flow Hydrant employs a detachable vacuum breaker and the Woodford Model S3 employs a diverter. Again, fluid diversion is needed so that sufficient fluid flow is achieved for proper venturi functions. The venturi design of sanitary hydrants of the present invention is unique in that the venturi will function properly when water flows through the vacuum breaker or double check backflow preventer–no fluid diversion at the hydrant head is required. This allows the hydrant to work in a way that is far more user friendly, because the hydrant is able to maintain its freeze resistant functionality without requiring the user to open a diverter, for example. Embodiments of the present invention are also environmentally friendly as resources are conserved by avoiding flowing water out of a diverter.

It is another aspect of the embodiments of the invention is to provide a hydrant that operates at pressures from about 20 psi to 125 psi and achieves a mass flow rate above 3 gallons per minute (GPM) at 25 psi, which is required by code. One difficult part of optimizing the flow characteristics to achieve these results is determining the nozzle diameter. It was found that a throat diameter change of about 0.040 inches would increase the mass flow rate by 2 GPM. That same change, however, affects the operation of the venturi. For example, hydrants with a nozzle diameter of 0.125 inches will provide acceptable reservoir evacuation but would not have the desired mass flow rate. A 0.147 inch diameter nozzle will provide an acceptable mass flow rate, but reservoir evacuation time was sacrificed. In one embodiment of the present invention a venturi having a nozzle diameter of about 0.160 inches is employed.

It is another aspect of the present invention to provide a nozzle having an exit angle that facilitates fluid flow through the venturi. More specifically, the nozzle exit of one embodiment possesses a gradual angle so that fluid flowing through the venturi maintains fluid contact with the surface of the nozzle and laminar flow is generally achieved. In one embodiment the exit angle is between about 4 to about 5.6 degrees. For example, nozzle exit having very gradual surface angle, e.g. 1-2 degrees, will evacuate the reservoir more quickly, but would require an elongated venturi. Thus, an elongated venturi may be used to reduce back pressure associated with the venturi, but doing so will add cost. The nozzle inlet may have an angle that is distinct from that of the exit to facilitate construction of the venturi by improving the machining process.

It is thus one aspect of the present invention to provide a sanitary hydrant, comprising: a standpipe having a first end and a second end; a head for delivering fluid interconnected to said first end of said standpipe; a fluid reservoir associated with said second end of said standpipe; a venturi positioned within said reservoir and interconnected to said second end of said standpipe, said venturi comprised of a first end, which is interconnected to said standpipe, and a second end associated with a fluid inlet valve with a throat between said first end and said second end of said venturi; a bypass tube having a first end interconnected to a location adjacent to said first end of said venturi and a second end interconnected to a bypass valve, said bypass valve also associated with said second end of said venturi, wherein when said bypass valve is opened, fluid flows from said inlet valve, through said bypass tube, through said standpipe, and out said hydrant head; and wherein when said bypass valve is closed, fluid flows through said venturi, thereby creating a pressure drop adjacent to said throat that communicates with said reservoir to draw fluid therefrom.

It is another aspect to provide a method of evacuating a sanitary hydrant, comprising: providing a standpipe having a first end and a second end; providing a head for delivering fluid interconnected to said first end of said standpipe; providing a fluid reservoir associated with said second end of said standpipe; providing a venturi positioned within said reservoir and interconnected to said second end of said standpipe, said venturi comprised of a first end, which is interconnected to said standpipe, and a second end associated with a fluid inlet valve with a throat between said first end and said second end of said venturi; providing a bypass tube having a first end interconnected to a location adjacent to said first end of said venturi and a second end interconnected to a bypass valve, said bypass valve also associated with said second end of said venturi, wherein when said bypass valve is opened, fluid flows from said inlet valve, through said bypass tube, through said standpipe, and out said hydrant head; and wherein when said bypass valve is closed, fluid flows through said venturi, thereby creating a pressure drop adjacent to said throat that communicates with said reservoir to draw fluid therefrom initiating fluid flow through said head by actuating a handle associated therewith; actuating a bypass button that opens the bypass valve such that fluid is precluded from entering said venturi; actuating said bypass button to close said bypass valve; flowing fluid through said venturi; evacuating said reservoir; ceasing fluid flow through said hydrant; and draining fluid into said reservoir.

The hydrants of embodiments of the present invention may be used with double check backflow preventers. Thus it is one aspect of the present invention to provide a double check valve for interconnection to a sill cock associated with an outside water source that prevents backflow into the water supply. Backflow can occur as a result of a siphon condition wherein a vacuum exists within the check valve, the sill cock or the water source that is apt to suction water in a hose, or in the interconnected check valve into the water supply. A backflow condition may also occur when the fluid pressure within the hose is greater than that of the water supply. For example, if the hose was taken to a roof of a building, the resulting head pressure may be greater than the supply pressure. In addition, a temporary loss or interruption in supply pressure may create a pressure differential that would create a backflow situation. The embodiments of the present invention also provide freeze protection wherein water inside the sill cock is allowed to freely drain from the double check valve after supply pressure is removed.

Embodiments of the present invention employ a valve body that includes an inlet check valve and an outlet check valve positioned within a valve body and a valve cap. The inlet check valve includes an inlet check seal and is biased from the outlet check valve via a spring (or other similar resiliently deflectable member). The inlet check seal cooperates with a main seal that is positioned between the valve body and the valve cap of the double check valve. The outlet check valve is comprised of an outlet check body with an outlet check seal that selectively engages a seat provided in the valve body. The outlet check body and the inlet check body are preferably selectively interconnected to each other, which will be described in further detail below. A hose plunger, which is adapted to selectively engage a hose, is preferably slidingly interconnected to the double check valve and is biased by a compressive member, such as a spring (or other similar resiliently deflectable member), that is associated with the seat of the valve body. The hose plunger includes a centralized hub that engages an outlet check spring (or other similar resiliently deflectable member) that is associated with the outlet check body. This combination of components is sufficient to prevent backflow and to provide self-draining (e.g. promote freeze resistance) without the need of a third check valve to control fluid flow through the vents. Detailed descriptions of the functionality of certain embodiments of the present invention will be provided below.

It is thus another aspect of the present invention to provide a check valve that omits or is devoid of components employed in prior art systems, thus rendering embodiments of the present invention easier and less expensive to manufacture, lighter, less complex, less prone to malfunction, and easier to repair. More specifically, embodiments of the present invention omit additional valves but continue to provide the same functionality of check valves of the prior art, such as the V-444 described above. That is, a system is provided that more effectively employs less than three valves and preferably two valves, thereby allowing size, weight and failure reduction. For example, it is contemplated that the double check valve of embodiments of the present invention are about 1/3 the size (preferably an about 70% reduction) of the V-444 check valve, which reduces bulk, weight and facilitates installation. Preferably, the check valve of one embodiment of the present invention is approximately 1.2 inches in length (an about 44% reduction) and approximately 1.4 inches in diameter (an about 26% reduction) and weighs about 130 grams (an about 35% reduction). In one embodiment, this reduction in size and weight is attributed to the omission of a spool and a stem that controls flow out of the vents of the V-444 check valve. To achieve this, embodiments of the present invention allow for drainage from a point other than through vents in a valve body, for example, drainage from the outlet of the double check valve as opposed to primarily through vents provided in a valve body, as is done by the V-444 check valve. In addition, the present invention employs a fixed inlet valve and a fixed outlet valve as opposed to the complicated valving scheme employed by the V-444, wherein a movable spool alters the configuration of the internal volume of the valve depending on flow condition.

It is still yet another aspect of the present invention to provide a check valve that meets the American Society of Safety Engineers (ASSE) regulations. More specifically the check valve of embodiments of the present invention meets the requirements of ASSE 1052.

It is another aspect of the present invention to provide a valving system that is dual use. More specifically, embodiments of the present invention possess the capabilities of an in-line valve as disclosed in Tripp and the ability to provide automatic self draining when a hose is disconnected from the valve. The double check valve, preferably, employs normally opened inlet and outlet check valves, which allows for complete and automatic drainage. When a hose is interconnected to the dual check valve, the inlet and outlet check valves close, and will open when the faucet is turned on, for example. Normally opened (present invention) and normally closed (in-line) valves are different and are regulated separate ASSE standards. Normally opened check valves are regulated by ASSE 1052 and in-line valves are regulated by ASSE 1022. ASSE 1022 concerns backflow prevention devices that protect potable water supplies that serve beverage dispensing equipment. ASSE 1022 requires that two independently acting check valves be used that are biased to a normally closed position. Conversely, ASSE 1052 concerns basic performance requirements and test procedures for backflow preventors that are designed to interconnect to a hose. ASSE 1052 valving systems are designed to protect against backflow due to back siphonage and low-head backpressure, under the high hazard conditions present at a hose threaded outlet. ASSE 1052 also requires that the inlet and outlet check valves be biased closed. Embodiments of the present invention comply with ASSE 1052 when a hose is interconnected thereto and provide needed automatic drainage when the hose is disconnected, a technological advancement over the prior art and an improvement over prior art devices similar to Tripp.

Accordingly, it is one aspect of the present invention to provide a backflow prevention device for interconnection to a sill cock that includes a valve body with threads that are adapted to receive a hose, the valve body also having an inlet volume and an outlet volume separated by an internally-disposed wall, a lower surface of the wall defining a valve seat, the valve body further including a vent that provides a flow path between the outside of the valve body and the inlet volume; a seal positioned with the valve body in a volume located adjacent to the inlet volume, the seal adapted to selectively block the vent; a valve cap interconnected to the valve body that is positioned within the volume that maintains the seal against the valve body, the valve cap having threads for interconnection to a sill cock of a faucet; an inlet check valve comprising: an inlet check spring positioned within the inlet volume, wherein the spring contacts an upper surface of the wall, an inlet check body positioned within the inlet check spring, an inlet check seal interconnected to the inlet check body that is adapted to selectively engage the seal, thereby opening and closing an aperture of the seal to control fluid flow from the valve cap into the inlet volume; a drain spring positioned within the outlet volume that contacts the seat and a plunger that is adapted to engage a hose; an outlet check valve comprising: an outlet check body positioned within the drain spring, an outlet check seal interconnected to the outlet check body that is adapted to selectively engage the seat to either open a flow path between the inlet volume and outlet volume, or isolate the outlet volume from the inlet volume, thereby preventing fluid from flowing from an interconnected hose into the sill cock; and an outlet check spring positioned about the outlet check body that contacts a portion of the outlet check body and a hub of the plunger.

More generally, it is an aspect of the present invention to provide a backflow prevention device, that includes a valve body with a fixed inlet volume and a fixed outlet volume, the valve body also having a vent for allowing fluid from inside the valve body to escape; a valve cap; a seal positioned between the valve cap and the valve body; an inlet check valve positioned within the inlet volume; and an outlet check valve positioned within the outlet volume.

In addition, it is an aspect of the present invention to provide a backflow prevention device including a body with a fixed inlet volume and a fixed outlet volume, the body also having an aperture; a cap; a primary means for sealing positioned between the cap and the body; an inlet means for selectively preventing flow of fluid positioned within the inlet volume; and an outlet means for selectively preventing flow of fluid positioned within the outlet volume.

Further, one of skill in the art will appreciate upon review of this disclosure that it is another aspect of the present invention to provide a water delivery system including a faucet associated with a water supply; a valve associated with the faucet that is adapted to selectively control the flow of fluid from the water supply through the faucet; and a double check valve associated with the faucet that prevents fluid from entering the water supply and that allows fluid within the faucet to drain therefrom when the valve is in the off position, the double check valve comprising: a valve body with a fixed inlet volume and a fixed outlet volume, the valve body also having a vent for allowing fluid from inside the valve body to escape, a valve cap, a seal positioned between the valve cap and the valve body, an inlet check valve positioned within the inlet volume, and an outlet check valve positioned with the outlet volume.

It is also an aspect of the present invention to provide a backflow prevention device that employs a housing having a passageway configured for the transport of a fluid therethrough, the housing having an inlet and an outlet, the passageway encompassing a valve system consisting essentially of: a first check valve disposed in the passageway that allows fluid to flow through the passageway in the direction from the inlet to the outlet; and a second check valve disposed in the passageway that allows fluid to flow through the passageway in the direction from the inlet to the outlet; a diaphragm disposed in the passageway adapted to engage at least one of the first check valve and the second check valve; a vent in fluid communication with the passageway and located between the first and second check valves, the vent selectively isolated from the passageway by the diaphragm, the vent adapted to permit fluid located between the first and second check valves to exit the housing through the vent, whereby the backflow prevention device permits substantially all fluid to drain completely from the device.

It is still yet an aspect of the present invention to provide a backflow prevention device that includes a housing having first and second ends and including a means for connecting to a fluid inlet line at the first end and for connecting a fluid outlet line to the second end; a central cavity within the housing; wherein the housing includes a valve system consisting essentially of first and second drain valves and is devoid of a third drain valve, the first drain valve located within the housing between the central cavity and the fluid inlet line to permit drainage of fluid from the fluid inlet line to the fluid outlet line end of the housing when the fluid outlet line is not connected thereto, and the second valve located within the housing between the central cavity and the fluid inlet line to control flow between the fluid inlet line and the central cavity, whereby the backflow prevention device permits substantially all fluid to drain completely from the device.

The Summary of the Invention is neither intended nor should it be construed as being representative of the full extent and scope of the present invention. Moreover, references made herein to "the present invention" or aspects thereof should be understood to mean certain embodiments of the present invention and should not necessarily be construed as limiting all embodiments to a particular description. The present invention is set forth in various levels of detail in the Summary of the Invention as well as in the attached drawings and the Detailed Description of the Invention and no limitation as to the scope of the present invention is intended by either the inclusion or non-inclusion of elements, components, etc. in this Summary of the Invention. Additional aspects of the present invention will become more readily apparent from the Detail Description, particularly when taken together with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate embodiments of the invention and together with the general description of the invention given above and the detailed description of the drawings given below, serve to explain the principles of these inventions.

Figs. 1A-1C are a depiction of the operation of a hydrant of the prior art;

Figs. 2A-2Care a series of figures depicting the use of a flow diverter of the prior art;

Fig. 3 is a cross section of a venturi of the prior art;

Fig. 4 is a perspective view of a venturi system employed by the prior art;

Fig. 5 is a perspective view of one embodiment of the present invention;

Fig. 6 is a detailed view of the venturi system of the embodiment of Fig. 5;

Fig. 7 is a perspective view similar to that of Fig. 6 wherein the reservoir has been omitted for clarity;

Fig. 8 is a cross sectional view of a venturi system that employs a bypass tube of one embodiment of the present invention;

Fig. 9 is a cross sectional view of a bypass valve used in conjunction with the embodiment of Fig. 5 shown in an open position;

Fig. 10 shows the bypass valve of Fig. 9 in a closed position;

Fig. 11 is a top perspective view of one embodiment of the present invention showing a bypass button and an electronic reservoir evacuation button;

Fig. 12 is a graph showing sanitary hydrant comparisons;

Fig. 13 is a perspective view of a venturi system of another embodiment of the present invention;

Fig. 14 is a detailed cross sectional view of Fig. 13 showing the check valve in a closed position when the hydrant is on;

Fig. 15 is a detailed cross sectional view of Fig. 13 showing the check valve in an open position when the hydrant is off;

Fig. 16 is a cross sectional view showing a hydrant of another embodiment of the present invention;

Fig. 17 is a detail view of Fig. 16;

Fig. 18 is a detail view of Fig. 17

Fig. 19 is a cross section of another embodiment of the present invention;

Fig. 20 is a table showing a comparison of various hydrant assemblies and the operation cycle of each;

Fig. 21 is a perspective view of a double check valve of one embodiment of the present invention;

Fig. 22 is an exploded perspective view of the double check valve shown in Fig. 21;

Fig. 23 is a cross-sectional view of Fig. 22;

Fig. 24 is a cross-sectional view of Fig. 1 showing an open flow configuration wherein the double check valve is interconnected on one end to a sill cock and opened on the other end;

Fig. 25 is a cross-sectional view of Fig. 21 showing a no flow configuration wherein the double check valve is interconnected to a sill cock and a hose;

Fig. 26 is a cross-sectional view of Fig. 21 showing a closed flow configuration wherein the double check valve is interconnected to a sill cock and a hose;

Fig. 27 is a cross-sectional view of Fig. 21 showing a double check valve in a siphon condition;

Fig. 28 is a cross-sectional view of Fig. 21 showing the double check valve exposed to back siphonage;

Fig. 29 is a cross-sectional view of Fig. 21 showing the double check valve subsequent to hose removal;

Fig. 30 is a cross-sectional view of Fig 21 showing the double check valve during testing;

Fig. 31 is a valve cap of an alternate embodiment of the present invention; and

Fig. 32 is a valve cap of an alternate embodiment of the present invention.

It should be understood that the drawings are not necessarily to scale, but that relative dimensions nevertheless can be determined thereby. In certain instances, details that are not necessary for an understanding of the invention or that render other details difficult to perceive may have been omitted. It should be understood, of course, that the invention is not necessarily limited to the particular embodiments illustrated herein.

To assist in the understanding of one embodiment of the present invention the following list of components and associated numbering found in the drawings is provided herein:

#	Component
2	Hydrant
4	Head
5	Handle
6	Standpipe
10	Drain port
14	Frost line
18	Venturi
22	Diverter
26	Vacuum breaker
30	Siphon tube
34	Check valve
36	Outlet
37	Venturi vacuum inlet and drain port
38	Hydrant inlet valve
42	Bypass
46	Bypass button
50	Casing cover
54	Piston
56	Bypass valve
57	Control rod
58	Secondary spring operated piston

#	Component
59	Bottom surface
60	EFR button
64	LED
68	Screen piston
72	Reservoir
76	Check valve piston
80	Vent
102	Double check valve
104	Hose
106	Inlet check valve
110	Outlet check valve
114	Valve body
118	Valve cap
122	Vent
126	Outlet
130	Inlet
134	Main seal
138	Inlet check seal
142	Threads
146	Knurls
150	Hose plunger
154	O-ring
158	Wrench flats
162	Annular jut
166	Inlet check body
170	Hooked surface
174	Inlet check spring
178	Seat
180	Passage
182	Drain spring

#	Component
186	Outlet check body
190	Hollow portion
194	Slot
198	Stop
202	Outlet check seal
204	Outlet check spring
208	Cylindrical portion
212	Protrusion
216	Hub
218	Upper surface
220	Lip
224	Stop
228	Thumb screw hole
232	Hose washer
234	Fluid
236	Ring
240	Groove

DETAILED DESCRIPTION

The venturi 18 and related components used in the hydrants of the prior art is shown in Figs. 3 and 4 and functions when the hydrant issued in conjunction with a vacuum breaker and a diverter. The diverter is needed to allow the venturi to work properly in light of the flow obstructions associated with the vacuum breaker. A typical on/off cycle for this hydrant (see also Fig. 2) requires that the user open the hydrant to cause water to exit the diverter 22 and not the vacuum breaker 26. As the water flows out of the diverter 22, a vacuum is created that draws water through a siphon tube 30 and check valve 34, which evacuates the reservoir (not shown). Flowing water through the diverter 22 for about 30 to 45 seconds will generally evacuate the reservoir. Next, as shown in Fig. 2, the diverter 22 is pulled down to redirect the water out of the vacuum breaker 26. The vacuum breaker 26 allows the hydrant 2 to be used with an attached hose and/or a spray nozzle as the vacuum breaker 26 will evacuate the head when the hydrant 2 is shut off, thereby making it frost proof. When the water is flowing out of the vacuum breaker 26 the venturi 18 will stop working and the one-way check valve 34 will prevent water from entering the reservoir. Once the hydrant is shut off, the water in the standpipe 6 will drain through a venturi vacuum inlet and drain port 37 that is in fluid communication with the reservoir similar to that disclosed in U.S. Patent No. 5,246,028 to Vandepas. The check valve 34 is also pressurized when the hydrant is turned off because the shut off valve 38 is located above the check valve 34.

A venturi assembly used in other hydrants that employ a pressurized reservoir also provides a vacuum only when water flows through a diverter. A typical on/off cycle for a hydrant that uses this venturi configuration is similar to that described above, the exception being that a check valve that prevents water from entering the reservoir is not used. When the diverter is transitioned so water flows through the vacuum breaker, the backpressure created thereby will cause water to fill and pressurize the reservoir, which prevents water ingress after hydrant shut off. As the reservoir is at least partially filled with water during normal use, the user needs to evacuate the hydrant after shut off by removing any interconnected hose and diverting fluid for about 30 seconds, which will allow the venturi to evacuate the water from the reservoir.

A hydrant of embodiments of the present invention shown in Figs. 5-11 which may employ a venturi with an about $^1/_8$" diameter nozzle. To account for the decrease in mass flow and associated back pressure that affects the functionality of the venturi described above, a bypass 42 is employed. More specifically, the bypass 42 maintains the flow rate out of the hydrant head 4 and allows for water to be expelled from the head 4 at the expected velocity. Fluid bypass is triggered by actuating a button 46 located on the casing cover 50 as shown in Fig. 11. When the hydrant is turned on the user pushes the bypass button 46 that will in turn move a bypass piston 54 of a bypass valve 56 into the open position as shown in Fig. 9. This will allow water to bypass the venturi 2 and re-enter the standpipe above the restriction caused by the venturi. The increased flow rate is greater than could be achieved with a venturi alone, even if the diameter of the venturi nozzle was increased.

While the bypass allows the mass flow rate to increase greatly, it also causes the venturi to stop creating a vacuum that is needed to evacuate the reservoir. Before normal use, the bypass piston 54 is closed as shown in Fig. 10. Similar to the system described in Fig. 16 below, the venturi 18 and associated bypass 42 are associated with a control rod 57 that is associated with the hydrant handle 5. Opening of the hydrant transitions the control rod 57 upwardly, which pulls the venturi 18 and associated bypass 42 upwardly and opens the hydrant inlet valve 38 to initiate fluid flow. Conversely, transitioning the hydrant handle 5 to a closed position will move the venturi 18 and associated bypass 42 downwardly such that a secondary spring operated piston 58 of the bypass valve 56 well contact a bottom surface 59 of the reservoir. As the secondary spring piston 58 contacts the bottom surface 59, the bypass valve 54 moves to a closed position as shown in Fig. 10. Moving the handle 5 to an open position to initiate fluid flow through the hydrant head will separate the secondary spring operated piston 58 from the bottom surface 59 of the reservoir which allows the bypass piston 54 to move to an open position as shown in Fig. 9 when the bypass button 46 is actuated.. When the bypass 42 is in the closed position, water is forced to flow through the venturi causing a vacuum to occur, thereby causing the reservoir to be evacuated each time the hydrant is used. After water flows from the vacuum breaker for a predetermined time, the user will actuate the bypass button 46 which opens the bypass valve 56 to divert fluid around the venturi 2. The secondary spring operated piston 58, which is designed to account for tolerances making assembly of the hydrant easier. The secondary spring operated piston 58 also makes sure the hydrant will operate properly if there are any rocks or debris present in the hydrant reservoir.

The venturi 18 of this embodiment can be operated in a 7' bury hydrant with a minimum operating pressure of 25 psi. The other major exception is the addition of the aforementioned bypass valve 56 that allows the hydrant to achieve higher flow rates.

In operation with a hose, initially the hose is attached to the backflow preventer 26 or the bypass button is pushed to that the venturi will not operate correctly and the one way check valve 34 will be pressurized in such a way to prevent flow of fluid from the reservoir. After the hydrant is shut off, the hose is removed from vacuum breaker 26. Next the hydrant 2 is turned on and water flows through the vacuum breaker 26 for about

30 seconds. When there is no hose attached, and the bypass has not been activated, the venturi 18 will create a vacuum that suctions water from the reservoir 72 and making the hydrant frost proof. Thus when the hydrant is later shut off, the check valve piston will move up and force open the one way check valve 37 to allow water in the hydrant to drain into the reservoir. This operation will also reset the bypass valve 56 into the closed position.

Some embodiments of the present invention will also be equipped with an Electronic Freeze Recognition (EFR) device as shown in Fig. 11. The EFR includes a button 60 that allows the user to ascertain if the water has been evacuated from the standpipe 6 properly and if the hydrant is ready for freezing weather. The device uses a circuit board in concert with a dual color LED 64 as shown in Fig. 11 to warn the operator of a potential freezing problem. When the EFR button 60 is pushed and the LED 64 glows red it indicates that the hydrant has not been evacuated properly. This informs the operator that the water in the reservoir is above the frost line, and the hydrant needs to be evacuated by the method described above. A green LED 64 indicates the hydrant has been operated properly and the hydrant is ready for freezing weather.

Flow rates for hydrants of embodiments of the present invention compare favorably with existing sanitary hydrants on the market, see Fig. 12. The prior art models are compared with hydrants that use a vacuum breaker and hydrants that use a double check backflow preventer. The venturi and related bypass system will meet ASSE 1057 specifications.

Another embodiment of the present invention is shown in Figs. 13-15 that does not employ a bypass. Variations of this embodiment employ an about 0.147 to an about 0.160 diameter nozzle, which allows for a flow rate of 3 gallons per minute at 25 psi and evacuation of the reservoir at 20 psi. As this configuration meets the desired mass flow characteristics, a bypass is not required to obtain the mass flow rate, and therefore this hydrant can be produced at a lower cost. This embodiment also employs a dual-use check valve. The check valve is closed by a spring when the hydrant is turned on as shown in Fig. 14 to prevent water from filling the reservoir. Again, when water is flowing through the double check backflow preventer a suction can still be produced to pull water from the reservoir through this check valve. When the hydrant is turned off, a screen piston 68 moves up when it contacts the bottom surface 59 of the reservoir which forces the check valve 34 into the open position as shown in Fig. 15. This allows the water in the hydrant to drain into the reservoir, thereby making the hydrant freeze resistant. Other embodiments of the present invention employ a venturi to evacuate a reservoir, but do not need a diverter to operate correctly. More specifically, a venturi is provided that will evacuate a reservoir through a double check backflow preventer.

Figs. 16-18 show a hydrant of another embodiment of the present invention that is simpler and more user friendly than sanitary hydrants currently in use. This hydrant is limited to a 5' bury depth and a minimum working pressure of about 40 psi, which maximizes the venturi flow rate potential, while still being able to evacuate the reservoir as water flows through a double check. A one-way check valve 34 is provided that is forced open when the hydrant is shut off as shown in Fig. 17.

In operation, this venturi system operates similar to those described above with respect to Figs. 5-11. More specifically, the venturi is interconnected to a movable control rod 57 that is located within the standpipe 6. The handle 5 of the hydrant is thus ultimately interconnected to the venturi 18 and by way of the control rod 57. To turn on the hydrant, the user moves the handle 5 to an open position, which pulls the control rod 57 upwardly and opens the inlet valve 38 such that water can enter the venturi 18. Pulling the venturi upward also removes the check valve 34 upwardly such that the screen piston 68 moves away from the bottom surface 59 of the hydrant 2. To turn the hydrant off, the handle 5 is moved to a closed position which moves the control rod 57 downwardly to move the venturi 18 downwardly to close the inlet valve 38. Moving the venturi downwardly also transitions the screen piston 68 which opens the check valve 34. To allow for evacuation reservoir a vent 80 may be provided on an upper surface of the hydrant.

Generally, this hydrant functions when a hose is attached to the backflow preventer. When the hose is attached, the venturi will not operate correctly and the pressure acting on the one way check valve 34 will prevent water ingress into the reservoir 72. After the hydrant is shut off, the hose is removed from vacuum breaker, the hydrant must be turned on so that the water can flow through the double check vacuum preventer for about 15 seconds. That is, when there is no hose attached, the venturi will create a vacuum sufficient enough to suction water from the reservoir 72, and making the hydrant frost proof. When the hydrant is later shut off, the check valve piston 26 will move up and force the one way check valve to an open position which allows the water in the hydrant to drain into the reservoir 72.

Fig. 19 shows yet another hydrant of embodiments of the present invention that is designed specifically for mild climate use (under 2' bury) and roof hydrants. The outer pipe of the roof hydrant is a smaller 1½ diameter PVC, instead of the 3" used in some of the embodiments described above. This hydrant uses a venturi without a check valve in concert with a pressurized reservoir, a diverter is not used. The operation is the same as described above with respect to hydrant with a pressurized reservoir, with the evacuation of the reservoir being completed after the user detaches the hose.

Fig. 20 is a table comparing the embodiments of the present invention, which employ an improved venturi of that employ a bypass system, with hydrants of the prior art manufactured by the Assignee of the instant application. The embodiment shown in Fig. 7, for example, provides an increased flow rate, has an increased bury depth, and can operate at lower fluid inlet pressures. The evacuation time is discussed over the prior art.

While various embodiments of the present invention have been described in detail, it is apparent that modifications and alterations of those embodiments will occur to those skilled in the art. However, it is to be expressly understood that such modifications and alterations are within the scope and spirit of the present invention, as set forth in the following claims. Further, the invention(s) described herein is capable of other embodiments and of being practiced or of being carried out in various ways. In addition, it is to be understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting. The use of "including," "comprising," or "having" and variations thereof herein is meant to encompass the items listed thereafter and equivalents thereof as well as additional items. For example, aspects of inventions disclosed in U.S. Patent and Published Patent Application Nos. 5632303, 5590679, 7100637, 5813428, and 20060196561, which generally concern backflow prevention, may be incorporated into embodiments of the present invention. Aspects of inventions disclosed in U.S. Patent Nos. 5701925 and 5246028, which generally concern sanitary hydrants, may be incorporated into embodiments of the present invention.

Aspects of inventions disclosed in U.S. Patent Nos. 6532986, 6805154, 6135359, 6769446, 6830063, RE39235, 6206039, 6883534, 6857442 and 6142172, which generally concern freeze-proof hydrants, may be incorporated into embodiments of the present invention. Aspects of inventions disclosed in U.S. Patent and Published Patent Application Nos. D521113, D470915, 7234732, 7059937, 6679473, 6431204, 7111875, D482431, 6631623, 6948518, 6948509, 20070044840, 20070044838, 20070039649, 20060254647 and 20060108804, which generally concern general hydrant technology, may be incorporated into embodiments of the present invention.

Referring now to Figs. 21-32, a double check valve 102 that is used with embodiments of the present invention is provided that includes an inlet check valve 106 and an outlet check valve 110 positioned in a valve body 14. The valve body 114 receives a valve cap 118 that is adapted for interconnection to a sill cock of a faucet, for example. The valve body 114 also includes a plurality of vents 122 that allow for drainage of fluids from the sill cock, the inlet check valve 106 and/or outlet check valve 110 depending on the pressure gradient within the double check valve 102. Embodiments of the present invention thus allow fluid within the sill cock to drain from the double check valve to prevent freezing. Back flow is prevented such that when pressure at an outlet 126 of the double check valve is greater than the pressure at the inlet 30, which is in communication with a fluid supply, a main seal 134 (or diaphragm) will cooperate with an inlet check seal 138 to prevent back flow from entering the fluid supply. Excess water then will be trapped within the inlet check valve 106 or outlet check valve 110 (when a hose is interconnected to the check valve), or be drained from the vents 122. If no hose is interconnected, trapped fluid is able to drain from the inlet and outlet valves as well.

Referring now to Fig. 21, a double check valve 102 of one embodiment of the present invention is shown. Preferably, the components of double check valve 2, which will be described in further detail below, are constructed of a rigid material commonly used in the plumbing arts, such as brass. However, one skilled in the art will appreciate other suitable materials may be utilized without deviating from the scope of the invention. The double check valve 102 includes a valve body 114 that is interconnected to a valve cap 118. The valve cap 118 is the inlet 130 of the double check valve 102 and employs a plurality of threads 142 (or a bayonet fitting), positioned on its outer and/or inner surface thereof, for interconnection to a sill cock of a faucet. The valve body 114 is preferably a cylindrical member that may include a knurled 146 outer surface that aids in the interconnection of the double check valve 102 to a fluid source. The double check valve 102 also includes a plurality of vents 122 that allow fluid and/or air to escape from the internal volume thereof. The valve body 114 also includes a plurality of threads 142 positioned about an outlet 126 of the double check valve 102. A hose plunger 150 is selectively interconnected to the valve body 114 and is designed to coincide with the outlet 126 of the double check valve 102 when a hose 104 is interconnected thereto.

Referring now to Figs. 22 and 23, exploded views of one embodiment of the present invention are provided. An o-ring 154 is positioned within the valve cap 118. One of skill in the art will appreciate the sealing function provided by the o-ring 154 may be performed by a flat seal or any other sealing member, or combination thereof, without departing from the scope of the invention. The valve cap 118 may also include a plurality of wrench flats 158 for securely interconnecting the double check valve 102 to a sill cock, for example. The valve cap 118 also includes an annular jut 162 that interfaces with the main seal 134 of the double check valve 102. Between the main seal 134 and the valve body 114 resides an inlet check body 166 that includes a lower end with a protruding, or hooked surface 170. The inlet check body 166 receives the inlet check seal 138 on one end and an inlet check spring 174 on the other end. The inlet check spring 174 rests on an internal wall, or seat 78, provided within the valve body 114. Alternatively, the inlet check spring 174 may contact and outlet check body 186. The seat 78 defines a passage 180 that allows fluid to flow from the inlet check valve 106 to the outlet check valve 110. The valve body 114 also includes threads 142 that receive a hose.

The seat 78 is also associated with a drain spring 182 that is positioned about the outlet check body 186. The outlet check body 186 includes a hollow portion 190 having a slot 194 bounded by a stop 198. The stop 198 cooperates with the hooked surface 170 of the inlet check body 66, thereby operably interconnecting the inlet check body 166 and the outlet check body 186. The outlet check body 186 includes an outlet check seal 202 and an outlet check spring 204positioned about a cylindrical portion 208 thereof. Finally, the outlet check body 186 includes a lower protrusion 212 that is snap fit within a hub 216 of the hose plunger 150.

An upper surface 118 of the hose plunger 150 is engaged to the drain spring 182 wherein its lower portion is adapted to contact a hose. The hose plunger 150 also includes a lip that engages an inner surface of the valve body 114 when a hose is interconnected thereto that prevents further insertion of the hose plunger 150 into the double check valve when the hose is interconnected. The hose plunger 150 of one embodiment of the present invention is a snap fit within the valve body 114 such that the lip 220 of the hose plunger 150 engages a stop 224 provided adjacent to the outlet of the valve body 114 when a hose is not interconnected to the valve body 114.

Referring now to Fig. 24, the double check valve 102 of one embodiment is shown during an open flow condition. Here, the valve cap 118 is shown interconnected to the valve body 114. The valve cap 118 may include a thumbscrew aperture 228 to receive a thumbscrew that allows a user to tightly (an often permanently) affix the double check valve 102 onto a sill cock. A main seal 134 is positioned between the annular jut 162 of the valve cap 118 and the valve body 114. Embodiments of the present invention interference fit the valve cap 118 onto the valve body 114. One skilled in the art, however, will appreciate that the valve cap 118 may be screwed, welded or otherwise interconnected to the valve body 114. An o-ring 154 resides within the valve cap 118 and is adapted to provide a seal between the sill cock and the valve cap 118.

Fig. 24 shows an open flow condition wherein the supply pressure exists but no hose is interconnected to the double check valve 102. The hose plunger 150 is biased by the drain spring 182 such that the lip 220 of the hose plunger 150 contacts the stop 224 of the valve body 114. Supply pressure forces the main seal 134 to deflect downwardly, which blocks fluid flow through the vents 22. This configuration is substantially different from the V-444 configuration described above. During an open flow condition with no interconnected hose, the V-444 valve will allow fluid to escape out of the vents that wastes water. Supply pressure also forces the inlet check body 166 downwardly, which compresses the inlet check spring 174. The supply pressure in this configuration is sufficient enough to transition the outlet check seal 202downwardly and to compress the outlet check spring 204 to separate the outlet check seal 202and seat 78.

Referring now to Fig. 25, the double check valve 102 is shown with the hose 104 interconnected during a non-flow condition. In this configuration, connection of the hose 4, which includes a hose washer 132, forces the hose plunger 50, and thus the hub 216 thereof, axially upward. The upward motion of the hose plunger 150 compresses the outlet check spring 104, which forces the outlet check body 186 upwardly such that the outlet check seal 202engages the seat 78. Thus, interconnection of the hose 104 completely isolates the outlet check valve 110 from the inlet check valve 106. If any back flow causing pressure rise in the hose 104 occurs, the seal between the outlet check seal 202and its seat 78 will prevent fluid from entering the fluid source, unless those components have failed (for example, debris lodged between the outlet check seal 162 and the seat 7 that allows for fluid infiltration). Since there is no flow from the fluid supply, the inlet check spring 174 and the inlet check body 166 will be positioned upwardly so that the inlet check seal 138 is engaged to the main seal 134. Thus, the inlet check valve 106 is isolated from the valve cap 118 that is interconnected to the fluid source. The inlet check valve 106 is, however, in fluidic communication with the vents 122 wherein any fluid pressurized by the transitioning outlet check body 186 will exit therethrough.

Referring now to Fig. 26, a closed flow condition is shown wherein the hose (not shown) is interconnected to the valve body 114 and the fluid supply has been opened. Here, supply pressure deflects the inner diameter of the main seal 134 downwardly such that the main seal 134 blocks the vents 22. Supply pressure also acts on the inlet check seal 138 to force it downwardly which compresses the inlet check spring 174. As described above, since the hose is interconnected to the valve body 14, the hose plunger and the outlet check body 186 will be shifted upwardly. The inlet check body, however, will contact the outlet check body 186 and force it downwardly, thereby counteracting the outlet check seal and opening the passage 180 between the inlet check valve 106 and the outlet check valve 110.

Referring now to Fig. 27, a non-flow configuration wherein a siphon has occurred is shown subsequent to the removal of supply pressure with the hose (not shown) interconnected to the valve body 114. A siphon condition may be caused when gravity-induced flow of the water in the hose pulls a vacuum after the supply pressure has been shut off. The vacuum within the inlet check valve 106 and the outlet check valve causes the main seal 134 and the outlet check body 186 to deflect towards the outlet of the double check valve 102. The outlet check body 186 translates downwardly until it contacts the hub 216 of the hose plunger 150. The inlet check spring 174 pushes the inlet check body 166 upwardly. However, the hooked surface 170 of the inlet check body 166 will engage with the stop 198 of the outlet check body 86, thereby limiting the range of motion of the inlet check body 166 and preventing the inlet check seal 138 from closing the main seal 134. That is, during a siphoning condition, the inlet check seal 138 will not be able to fully flatten the main seal 134. As a result, the deflected main seal 134 will be prevented from completely blocking the vents 22. A path between the inlet check seal 138 and the internal surface of the inlet check valve 106 will allow air from the outside of the double check valve 102 to enter through the vents 122 to break the vacuum which allows the outlet check spring 204to relax and engage the outlet check valve 110 on the seat 78. This in turn will allow the inlet check body 166 to transition upwardly to engage the inlet check seal 138 onto the main seal 134 to isolate the inlet check valve 106 and the outlet check valve 110 from the valve cap 118 as shown in Fig. 25.

Referring now to Fig. 28, a back siphonage situation is shown. Here, the hose (not shown) is interconnected to the valve body 114 and a vacuum has occurred at fluid supply that could cause contaminated fluid from the hose or double check valve 102 to enter the fluid supply. In operation, the hose forces the hose plunger 150 upwardly that compresses the drain spring 182. The hub 216 of the hose plunger 150 also moves upwardly and forces, via the outlet check spring 104, the outlet valve check body 186 to move upwardly so that outlet check seal 202engages the seat 78. The vacuum in the valve cap 118 pulls the inlet check seal upwardly to engage the main seal 134. Thus the outlet check valve 110 is isolated from the inlet check valve 106 and the inlet check valve 106 is isolated from the cap valve 118 which is interconnected to the fluid supply, and no fluid from the hose and/or the double check valve can enter the fluid supply.

Referring now to Fig. 29, draining of the double check valve 102 is illustrated. After the hose is removed, the drain spring 182 expands and forces the hose plunger 150 downwardly such that the lip 220 of the hose plunger 150 contacts the stop 224 of the valve body 114. The hub 216 of the hose plunger 150 will also contact the protrusion

212 of the outlet check body 186 and pull the outlet valve body 186 downwardly, which removes the outlet check seal 202from the outlet check seat 78. The stop 198 of the outlet check body 186 will contact the hooked surface 170 of the inlet check body 166 and pull the inlet check seal 138 from the main seal 134. Thus, a free flow path from the inlet check valve 106 into the outlet check valve 110 and out of the hose plunger 150 is provided. Water in the sill cock will also be able to flow through the valve cap 118 and through the inlet check valve 6, the outlet check valve 110 and out of the hose plunger 150. Fluid may also drain through the plurality of vents provided.

Referring now to Fig. 30, the double check valve 102 is shown during a test. More specifically, it is one aspect of the present invention that the double check valve 102 of embodiments of the present invention can be easily tested in the field to ensure that it is in proper working condition. Here, the hose (not shown) is interconnected to the threads 142 of the valve body 114 that forces the hose plunger 150 upwardly and compresses the drain spring 182. The hub 216 is also forced upwardly which compresses the outlet check spring 204and forces the outlet check seal 202 against seat 78. If the double check valve 102 is working properly the outlet check valve 110 should be isolated from the vents 22. Fluid 234 is then added via the hose and into the outlet 126 of the double check valve 102. If the integrity of the outlet check valve 202 and the seat 78 are adequate, no fluid will enter the inlet check valve 106. Conversely, if the integrity between the outlet check seal 202 and the seat 78 is broken, fluid 234 will fill the inlet check valve 6, and will exit from the plurality of vents 22. The inlet check spring 174 will force the inlet check body 166 upwardly to place the inlet check seal 138 in contact with the main seal 134 to prevent any fluid from entering the water source during this test.

Referring now to Figs. 31 and 32, valve caps 118 of alternate embodiments of the present invention are provided. Here, the annular jut 62, which interfaces with the main seal 134 and ring 136, which interfaces with a groove 240 provided on the valve body 114 are substantially the same as those described above. However, the inlet portion 130 of the valve cap 118 includes a plurality of exterior threads 142 for threading onto sill cocks and have inwardly threads 142. Inspection of Figs. 31 and 32 will show that the inlets 130 of these valve caps 118 are of different diameters, thereby succinctly illustrating the scalability of the present invention.

One of skill in the art will appreciate that the valve described and shown herein may be interconnected to the sill cock via a bendable or telescoping member to provide the ability to selectively locate the valve. Alternatively, or in addition, valves as described may possess telescoping functionality as shown in U.S. Design Patent No. D491,253 to Hansle. The valve may also employ a timer, flow regulation capabilities, etc. to control the flow of fluid therefrom. The valve may employ more than one outlet, which each may include valving as described, and may employ a combination of materials as described in Tripp. Further, the valve may be directly integrated into the sill cock instead of interconnected thereto. The system described herein may include a visual or audible alarm to notify the instance of a valve failure.

What is claimed is:

1. A sanitary hydrant, comprising:

a standpipe having a first end and a second end;

a head for delivering fluid interconnected to said first end of said standpipe;

a fluid reservoir associated with said second end of said standpipe;

a venturi positioned within said reservoir and interconnected to said second end of said standpipe, said venturi comprised of a first end, which is interconnected to said standpipe, and a second end associated with a fluid inlet valve with a throat between said first end and said second end of said venturi;

a bypass tube having a first end interconnected to a location adjacent to said first end of said venturi and a second end interconnected to a bypass valve, said bypass valve also associated with said second end of said venturi,

wherein when said bypass valve is opened, fluid flows from said inlet valve, through said bypass tube, through said standpipe, and out said hydrant head; and

wherein when said bypass valve is closed, fluid flows through said venturi, thereby creating a pressure drop adjacent to said throat that communicates with said reservoir to draw fluid therefrom.

2. The hydrant of claim 1, further comprising a check valve associated with said venturi that selectively allows access to the internal volume of said reservoir.

3. The hydrant of claim 1 wherein further comprising a freeze recognition button that allows the user to ascertain if the water has been evacuated from the standpipe after flow of fluid from the hydrant is ceased.

4. The hydrant of claim 3 wherein said freeze recognition button is associated with a visual indicator.

5. The hydrant of claim 1 wherein a double check valve is associated with said head of said hydrant.

6. A method of evacuating a sanitary hydrant, comprising:

providing a standpipe having a first end and a second end;

providing a head for delivering fluid interconnected to said first end of said standpipe;

providing a fluid reservoir associated with said second end of said standpipe;

providing a venturi positioned within said reservoir and interconnected to said second end of said standpipe, said venturi comprised of a first end, which is interconnected to said standpipe, and a second end associated with a fluid inlet valve with a throat between said first end and said second end of said venturi;

providing a bypass tube having a first end interconnected to a location adjacent to said first end of said venturi and a second end interconnected to a bypass valve, said bypass valve also associated with said second end of said venturi, wherein when said bypass valve is opened, fluid flows from said inlet valve, through said bypass tube, through said standpipe, and out said hydrant head; and wherein when said bypass valve is closed, fluid flows through said venturi, thereby creating a pressure drop adjacent to said throat that communicates with said reservoir to draw fluid therefrom;

initiating fluid flow through said head by actuating a handle associated therewith;

actuating a bypass button that opens the bypass valve such that fluid is precluded from entering said venturi;

actuating said bypass button to close said bypass valve;

flowing fluid through said venturi;

evacuating said reservoir;

ceasing fluid flow through said hydrant; and

draining fluid into said reservoir.

7. The method of claim 6 further comprising interconnecting a hose to said head with a backflow preventer therebetween.

8. The method of claim 6, further comprising a check valve associated with said venturi that selectively allows access to the internal volume of said reservoir.

9. The hydrant of claim 1 further comprising actuating a freeze recognition button; and

ascertaining if the water has been evacuated from the standpipe after flow of fluid from the hydrant is ceased.

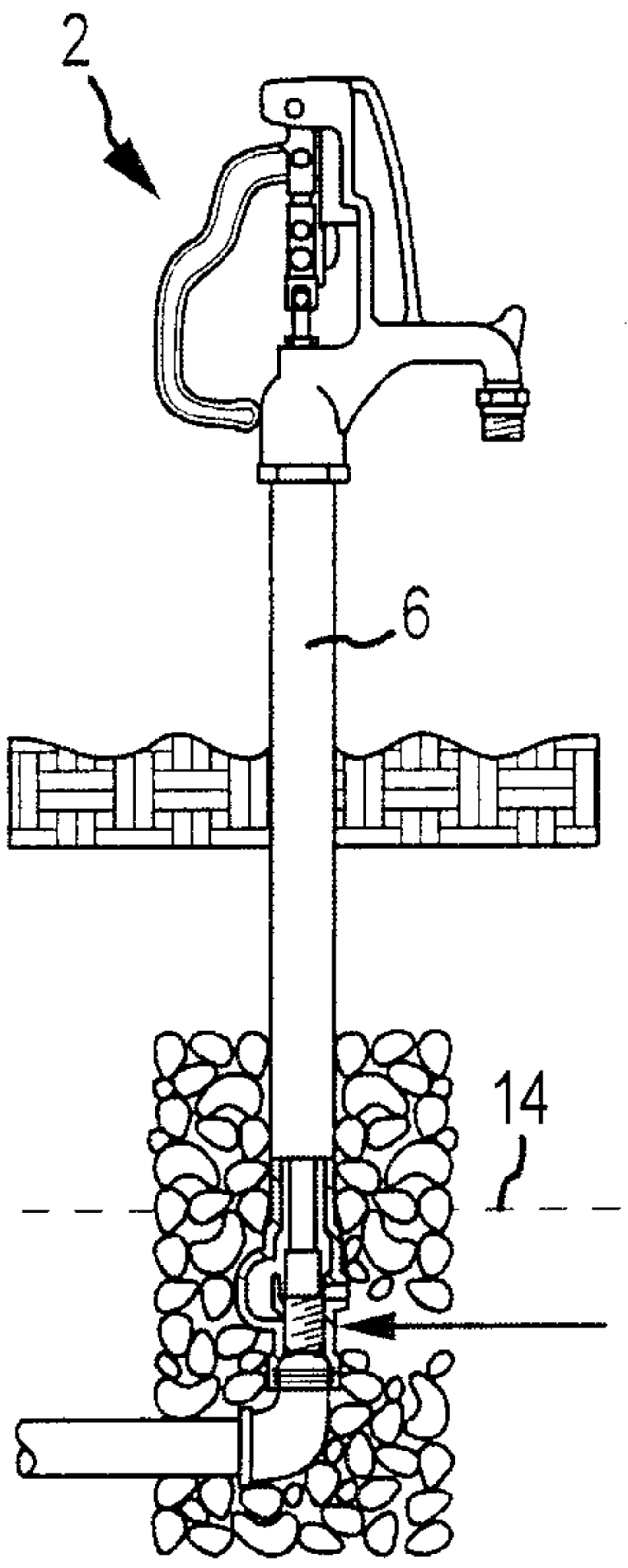


FIG.1A
(PRIOR ART)

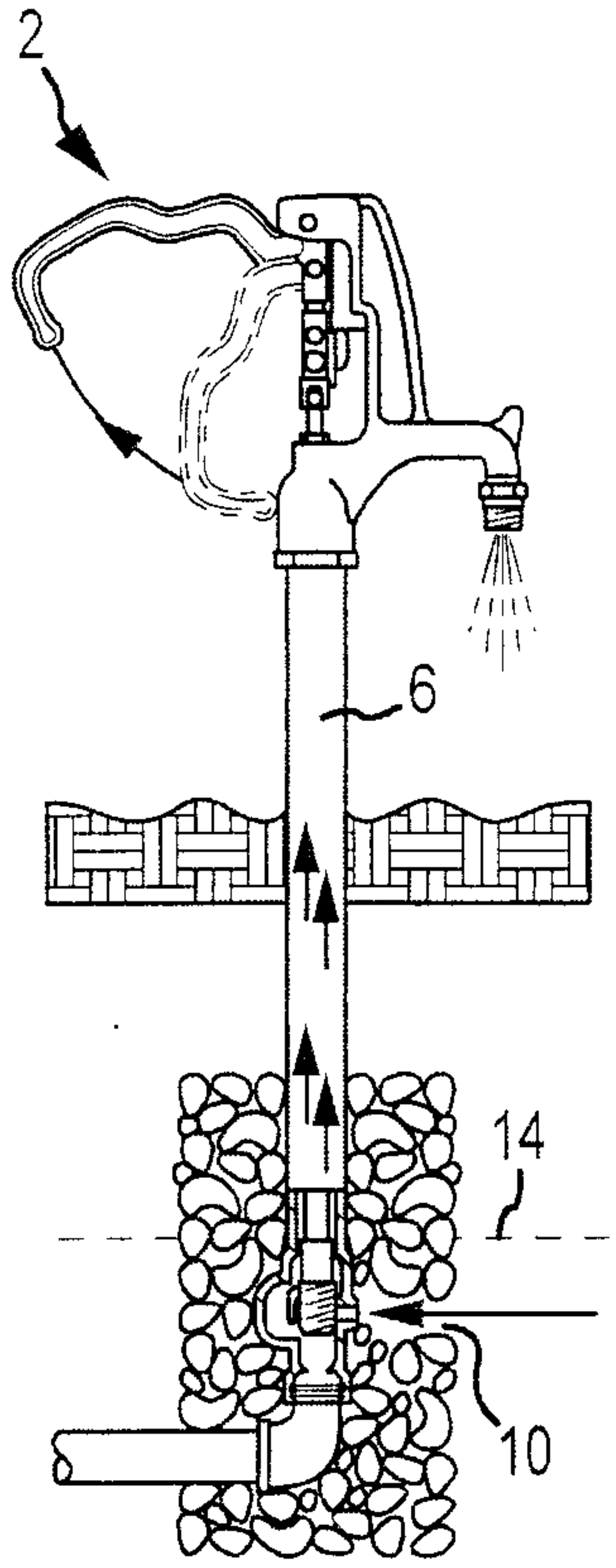


FIG.1B
(PRIOR ART)

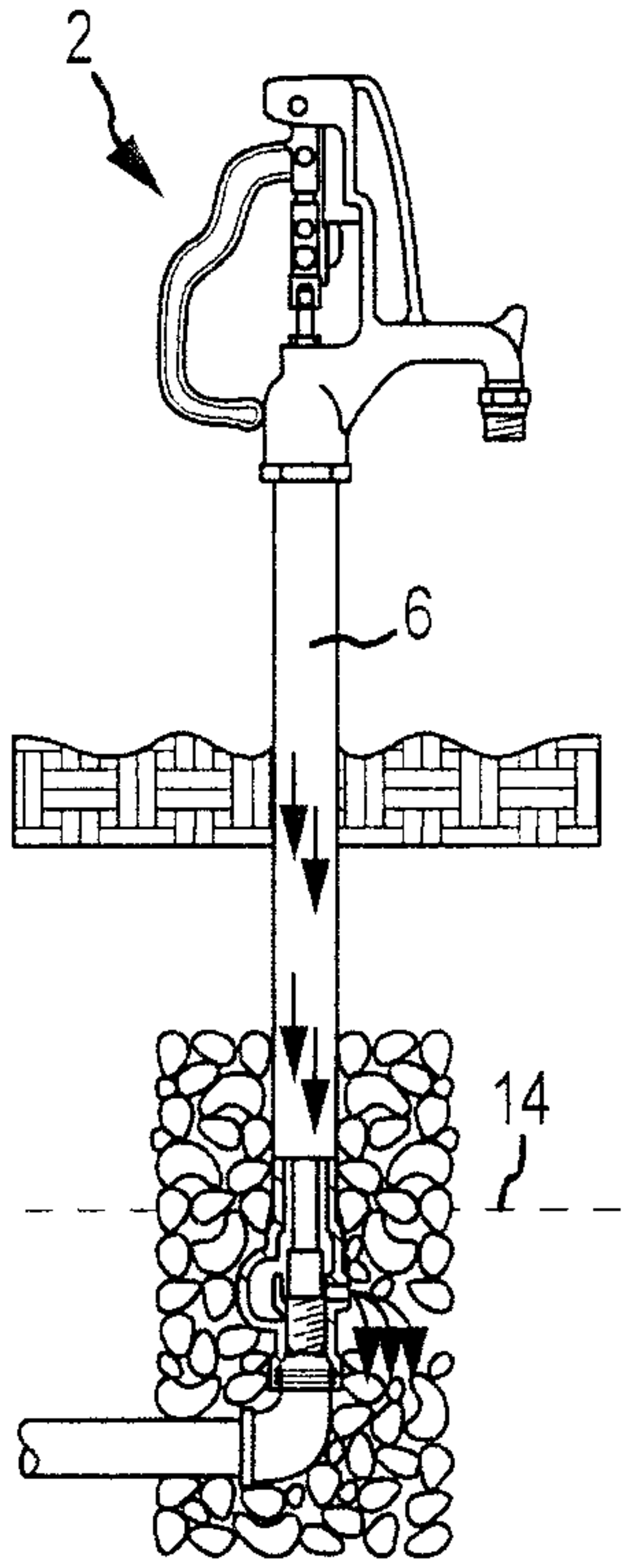


FIG.1C
(PRIOR ART)

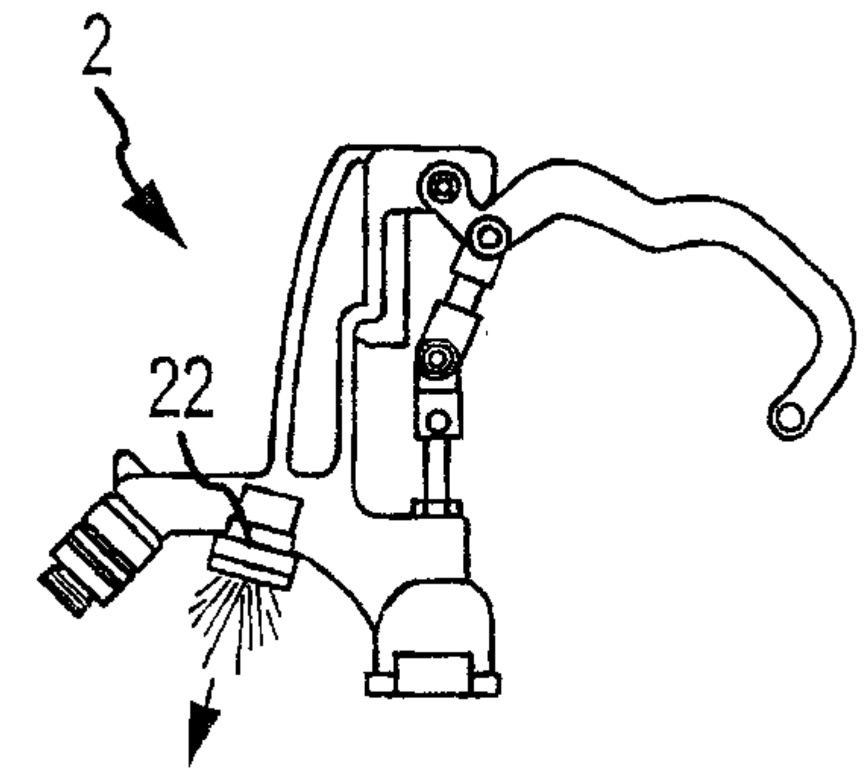


FIG.2A
(PRIOR ART)

WHEN THE HYDRANT IS OPENED TO AN ON POSITION, WATER WILL FLOW THROUGH THE DIVERTER SPOUT.

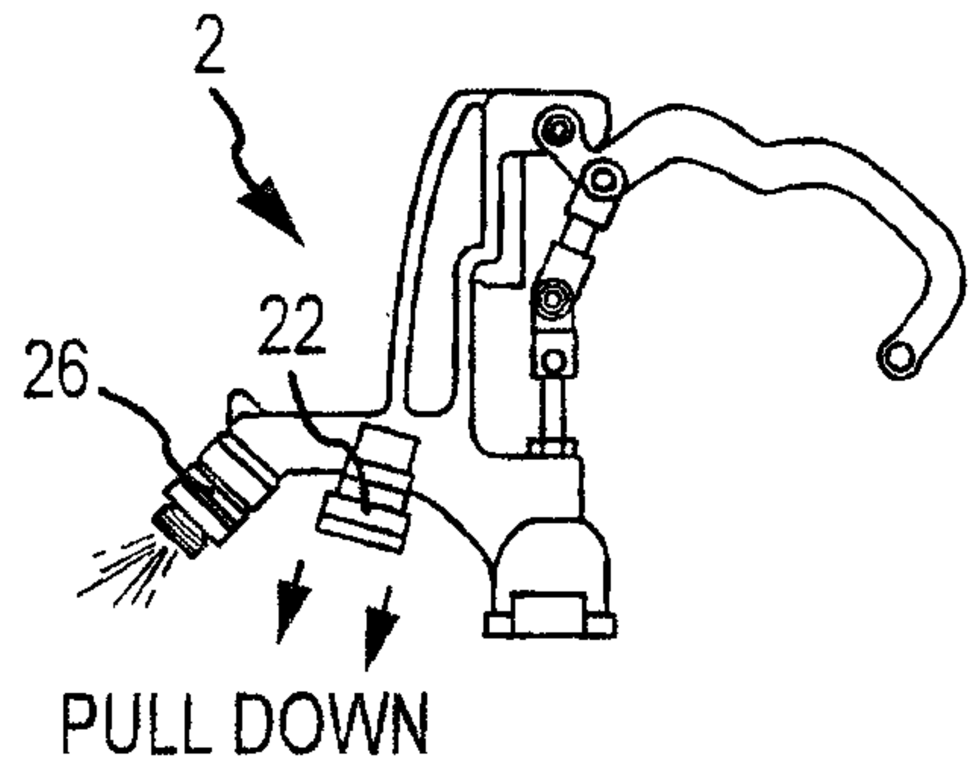


FIG.2B
(PRIOR ART)

BY PULLING DOWN ON THE DIVERTER SLEEVE DURING FLOW, WATER WILL BE DIVERTED THROUGH THE BACKFLOW PREVENTER (BFP), AND ALLOW USE WITH A HOSE.

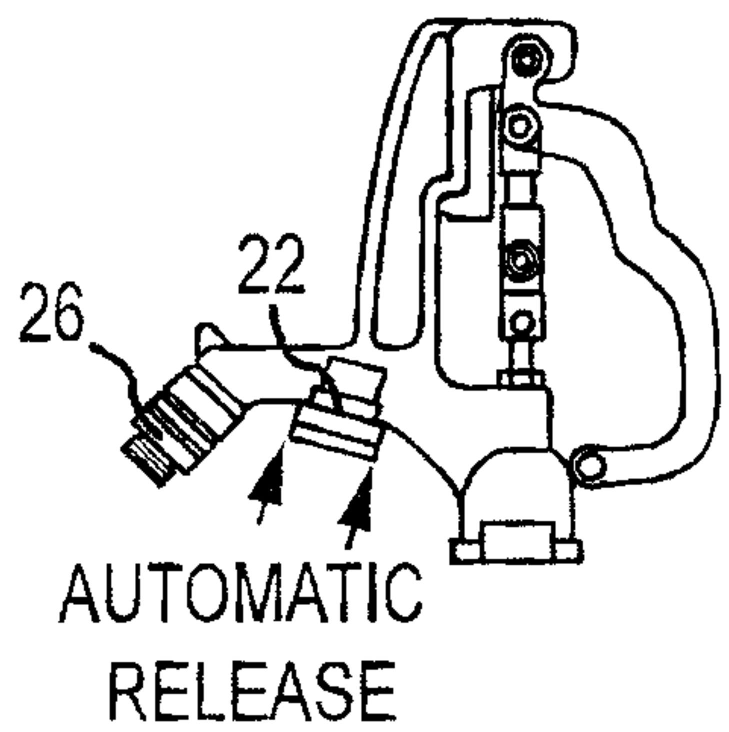


FIG.2C
(PRIOR ART)

WHEN THE HYDRANT IS CLOSED TO AN OFF POSITION, THE DIVERTER WILL AUTOMATICALLY RELEASE, ALLOWING THE HYDRANT TO DRAIN INTO THE RESERVOIR. THE HYDRANT WILL DRAIN EVEN IF A PRESSURIZED OR NON PRESSURIZED HOSE IS ATTACHED.

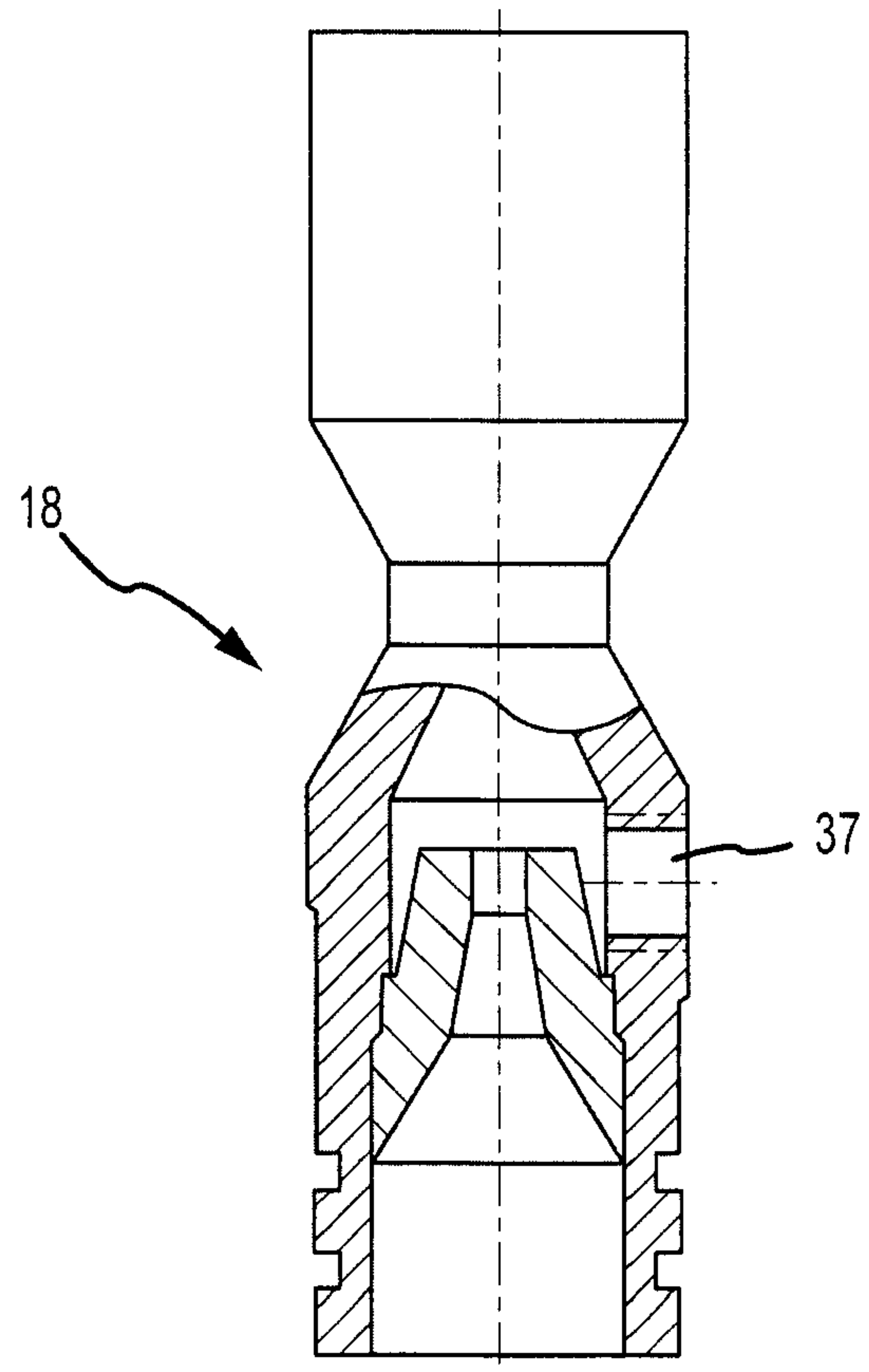


FIG.3
(PRIOR ART)

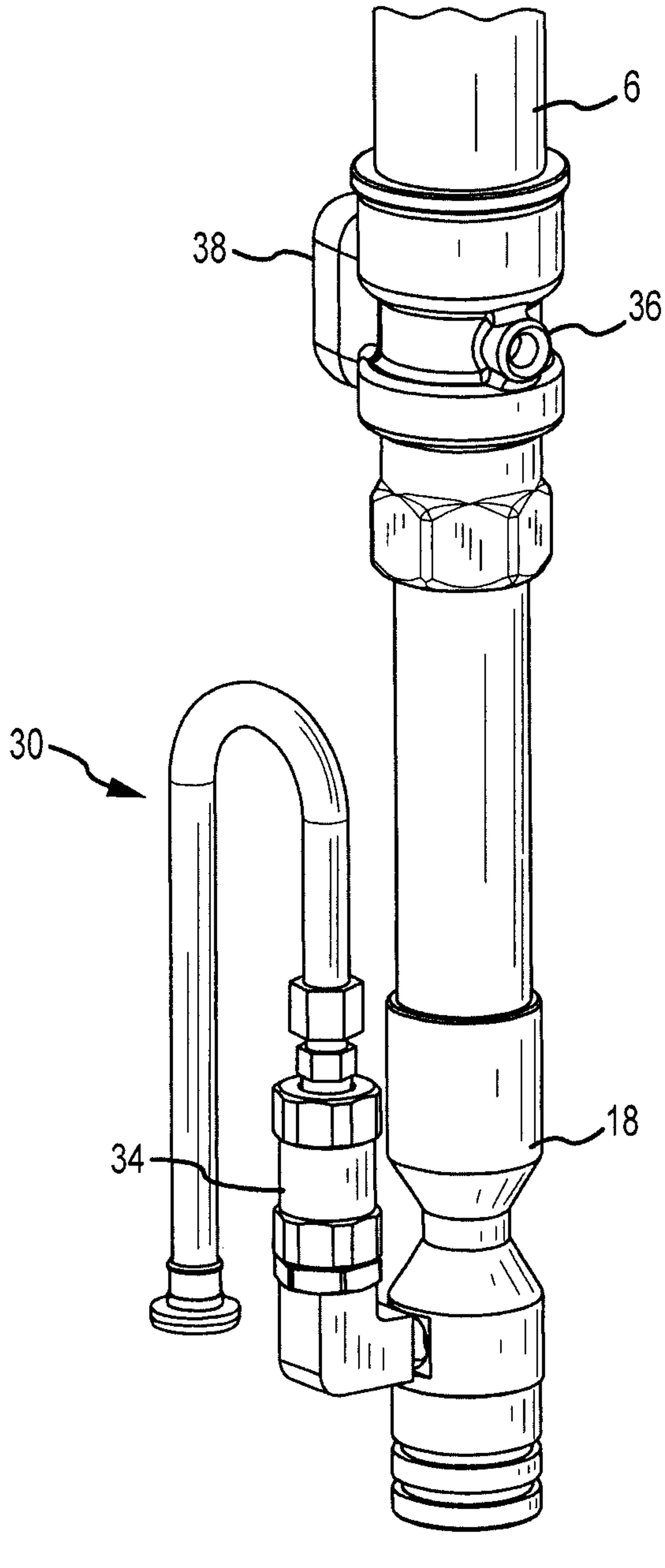


FIG.4
(PRIOR ART)

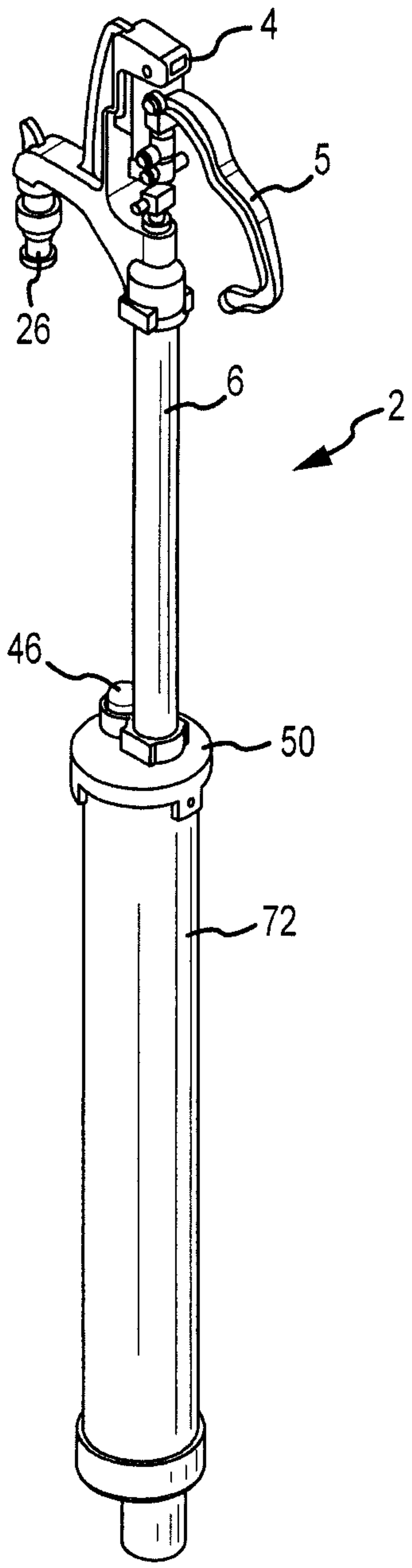


FIG.5

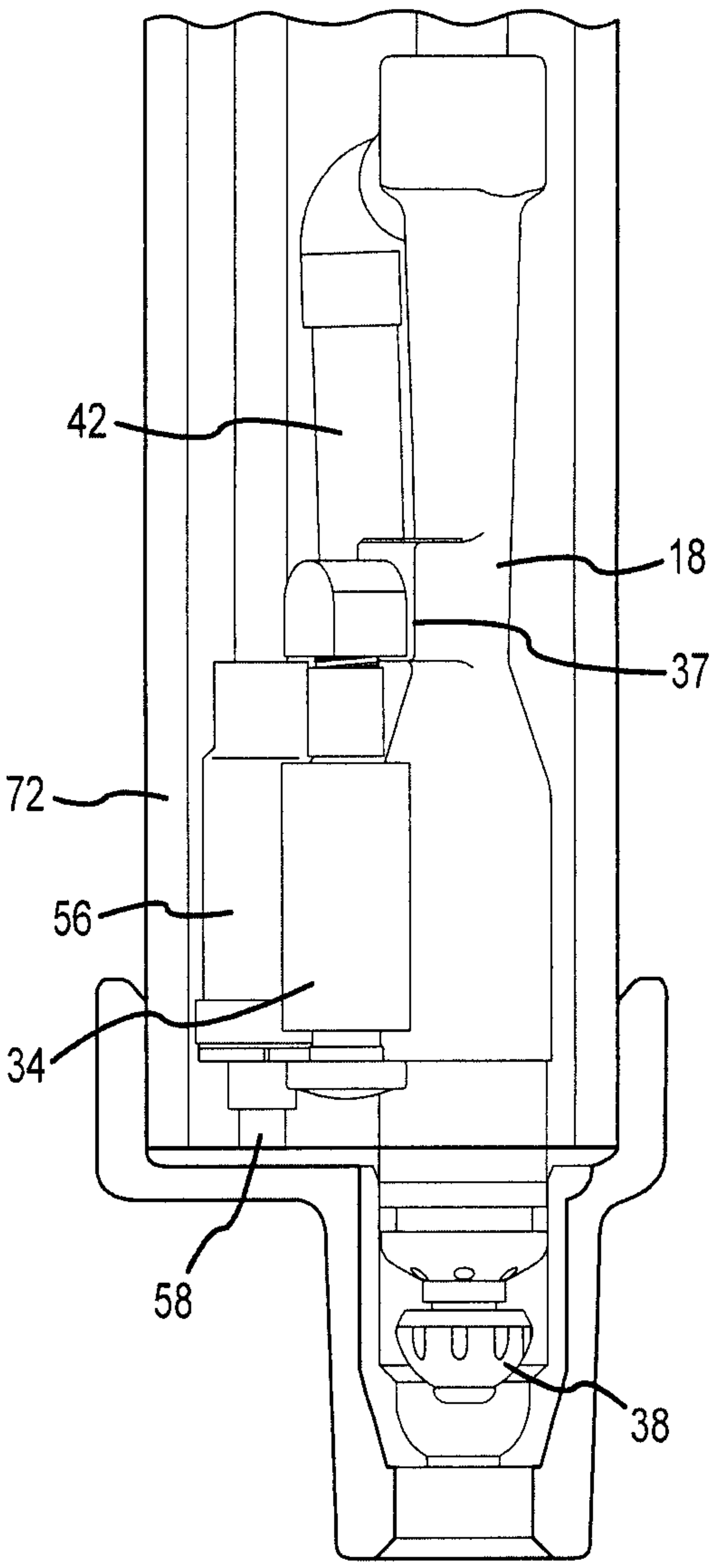


FIG.6

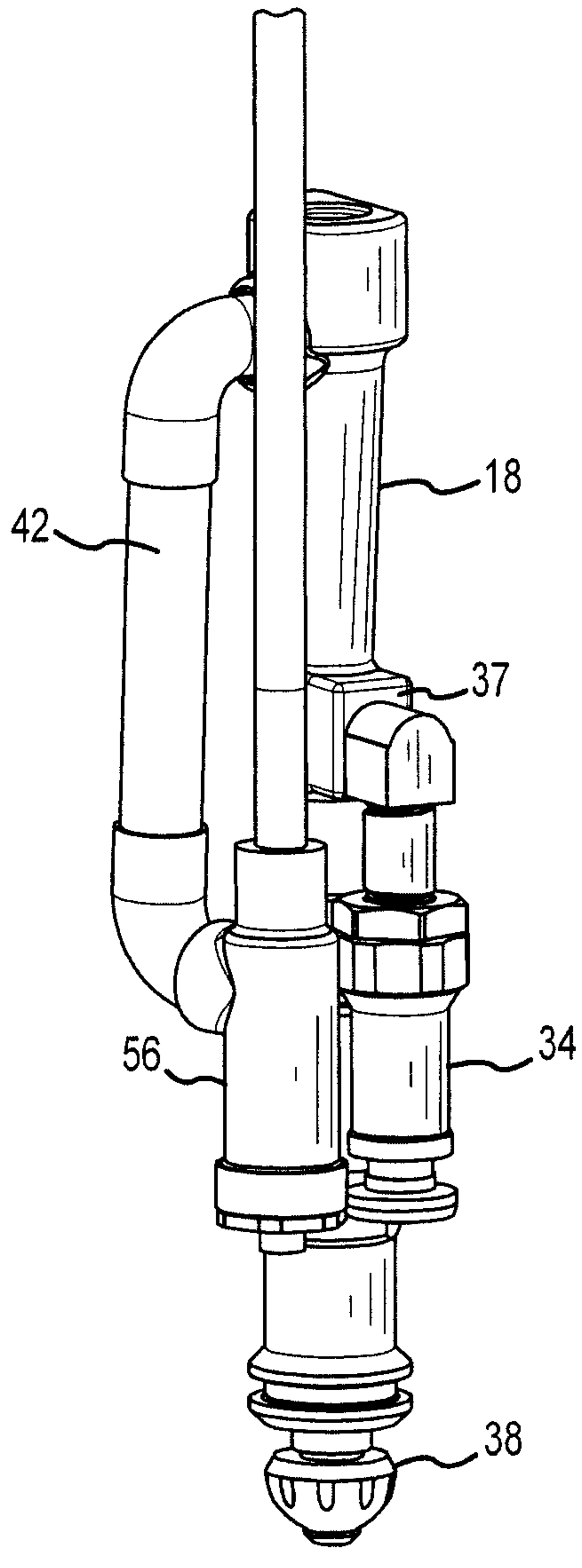


FIG.7

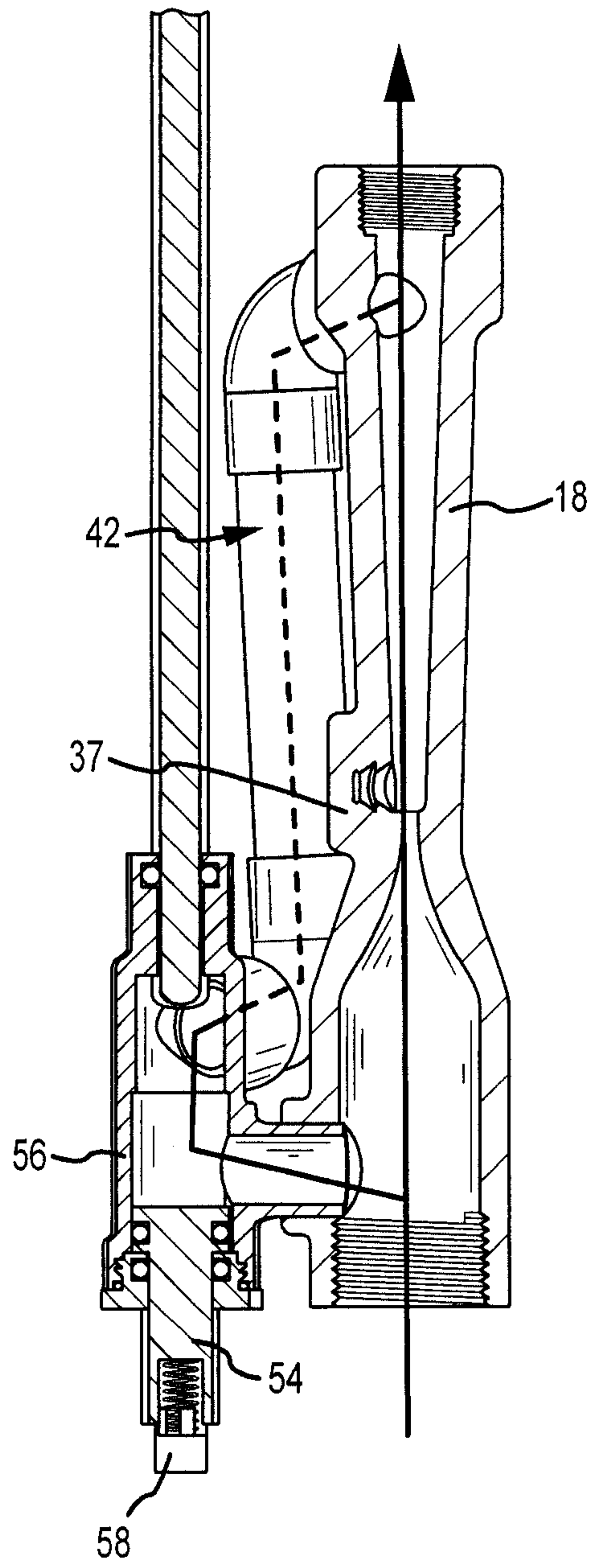


FIG.8

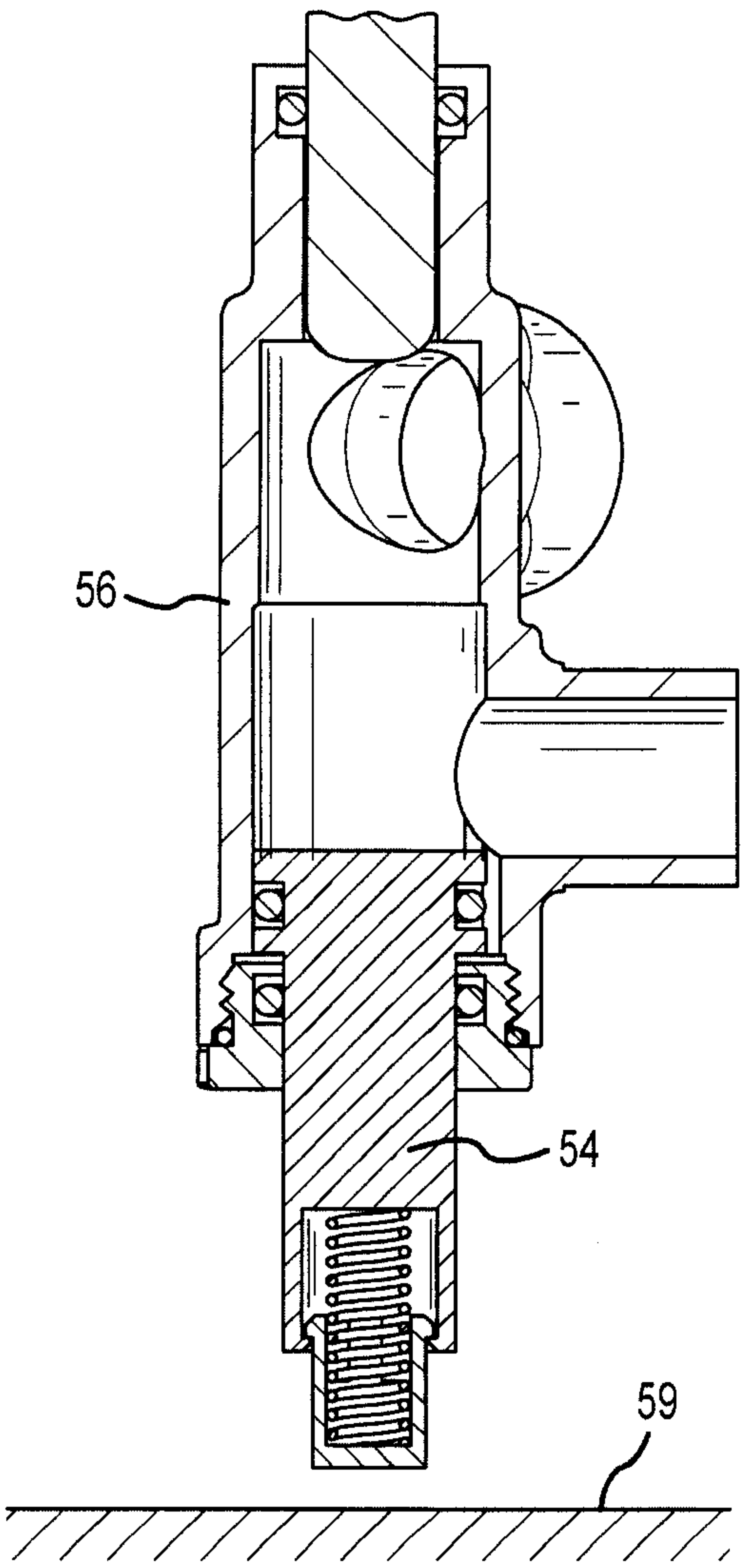


FIG.9

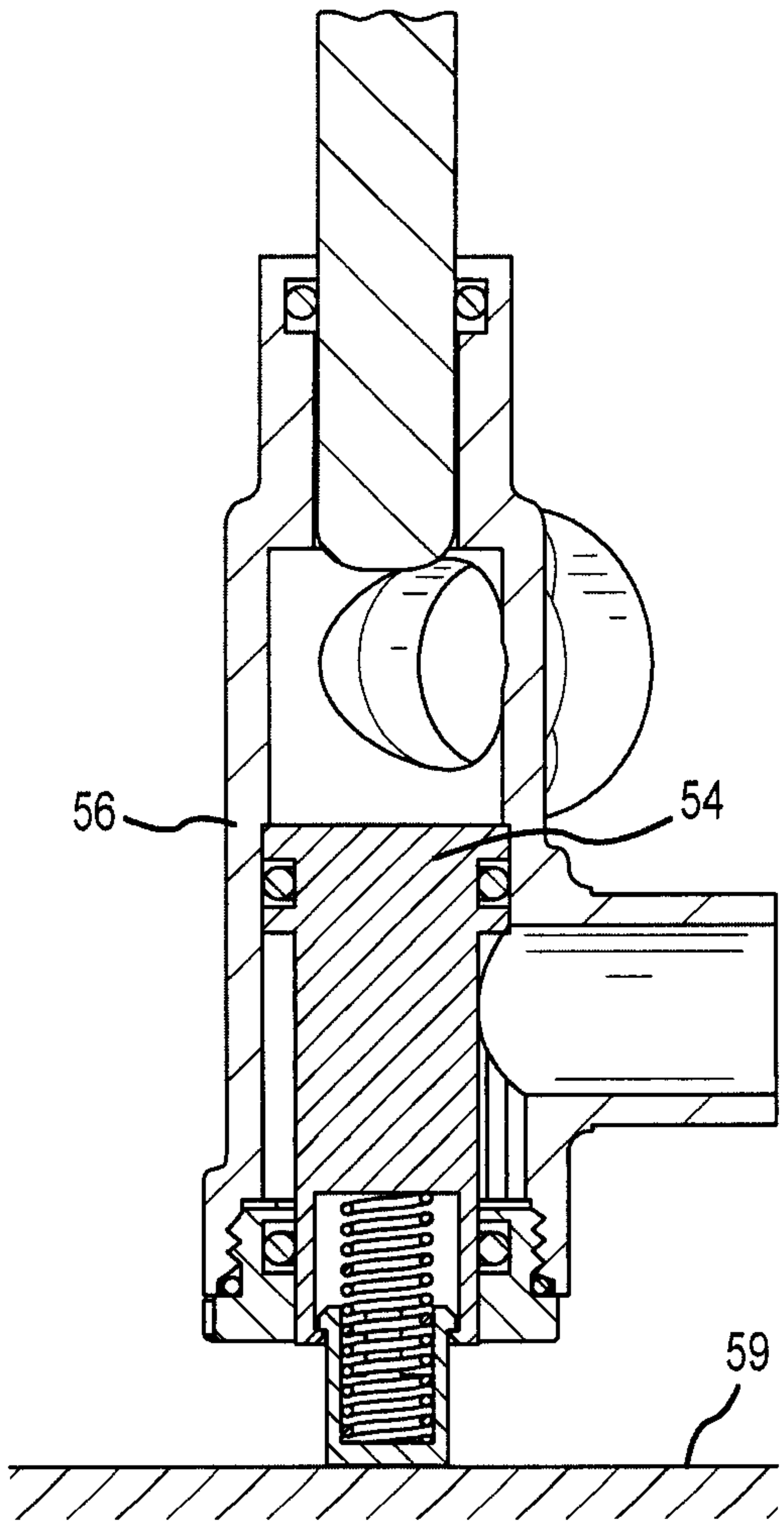


FIG.10

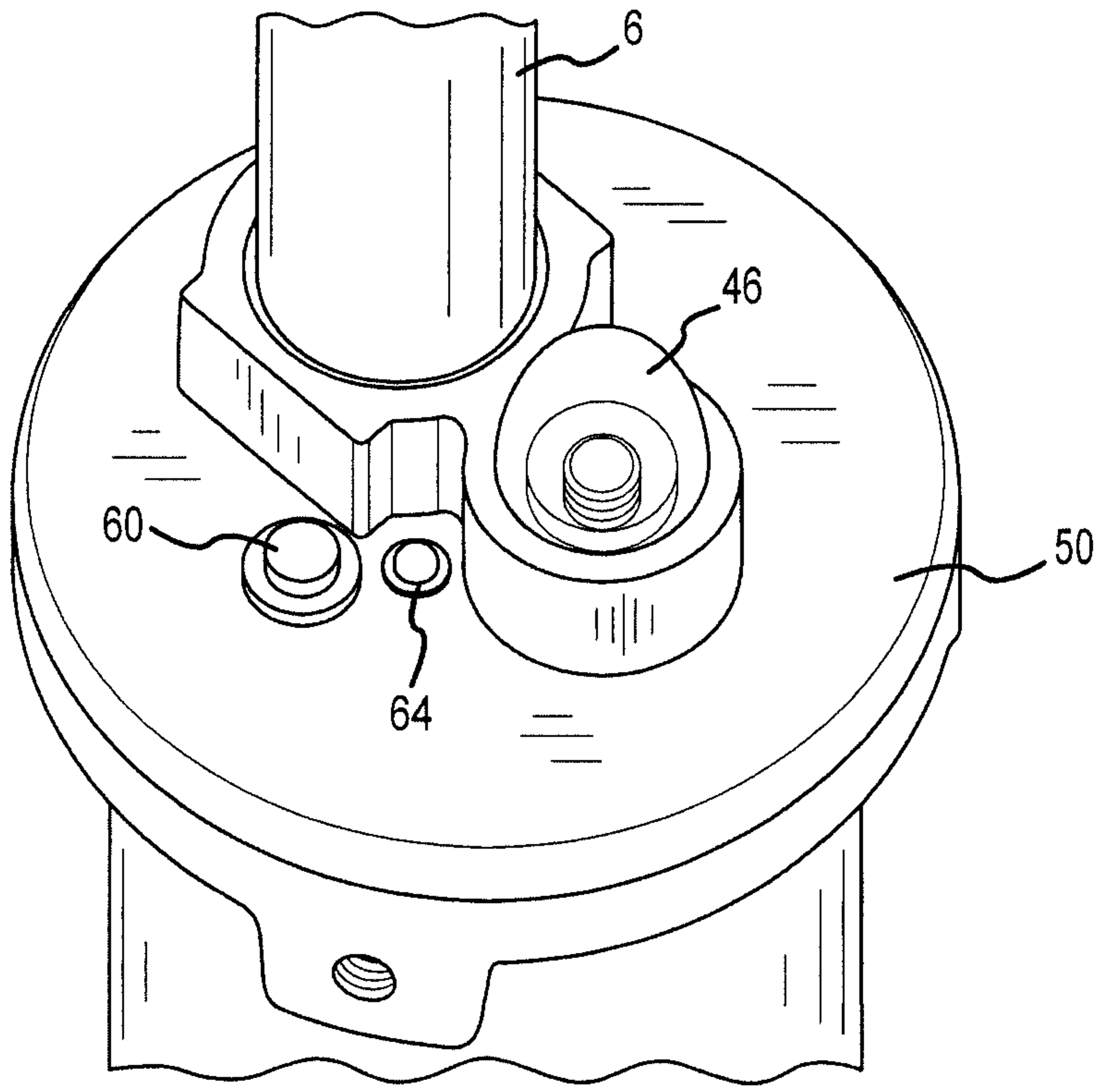


FIG.11

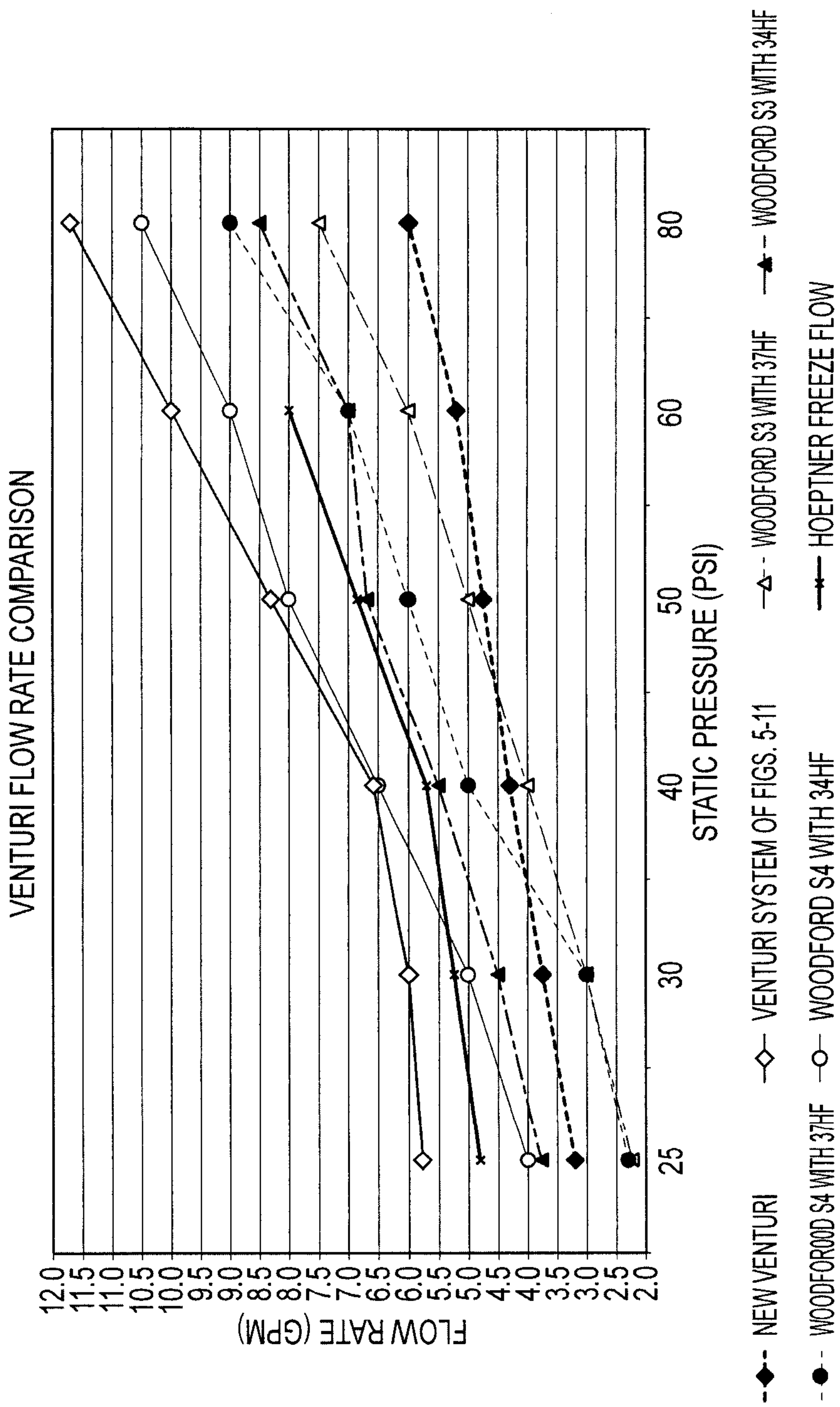

VENTURI FLOW RATE COMPARISON
FLOW RATE (GPM)
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
25
30
40
50
60
80
STATIC PRESSURE (PSI)
NEW VENTURI
VENTURI SYSTEM OF FIGS. 5-11
WOODFORD S3 WITH 37HF
WOODFORD S3 WITH 34HF
WOODFOROOD S4 WITH 37HF
WOODFORD S4 WITH 34HF
HOEPTNER FREEZE FLOW

FIG.12

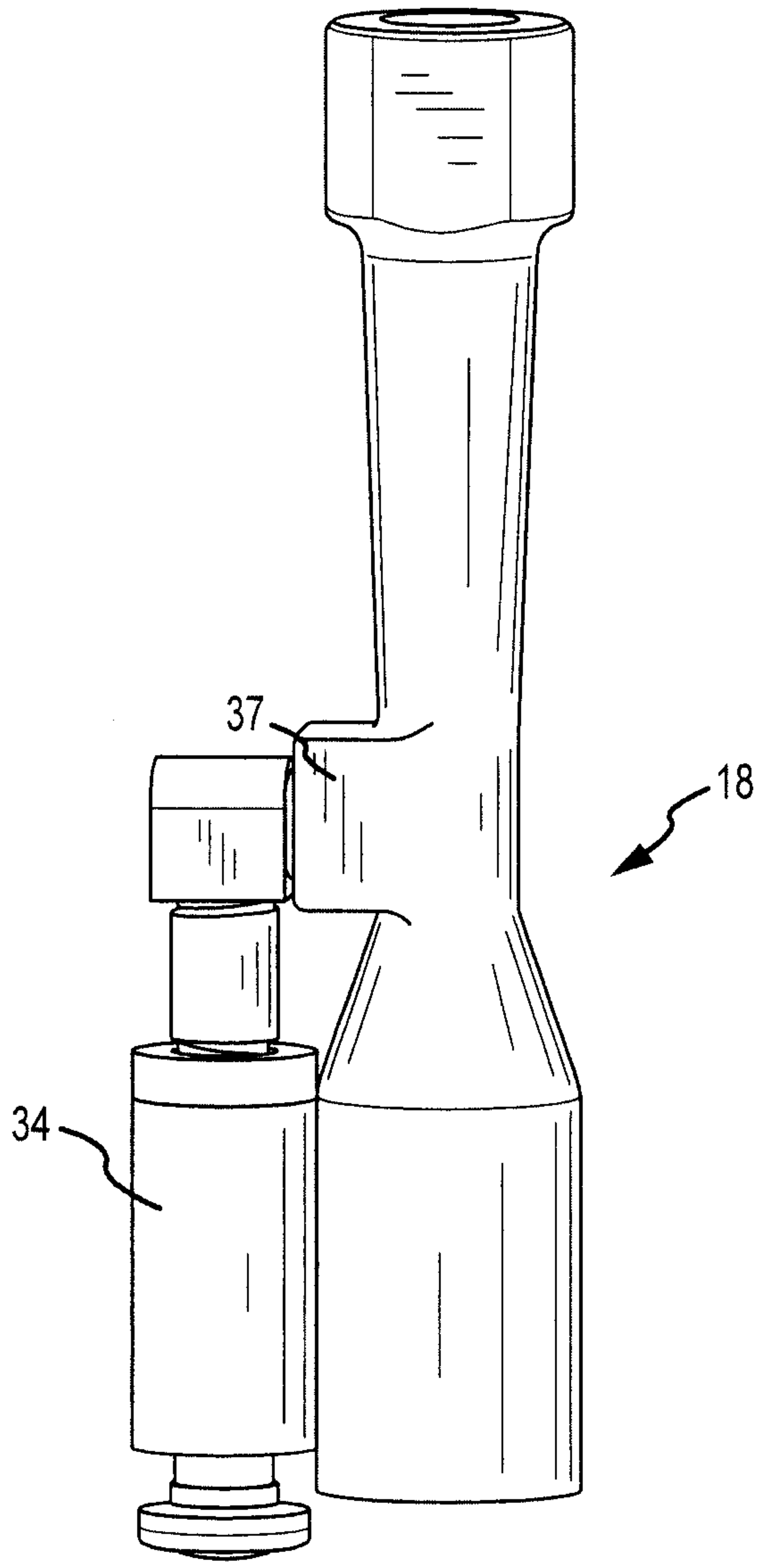


FIG.13

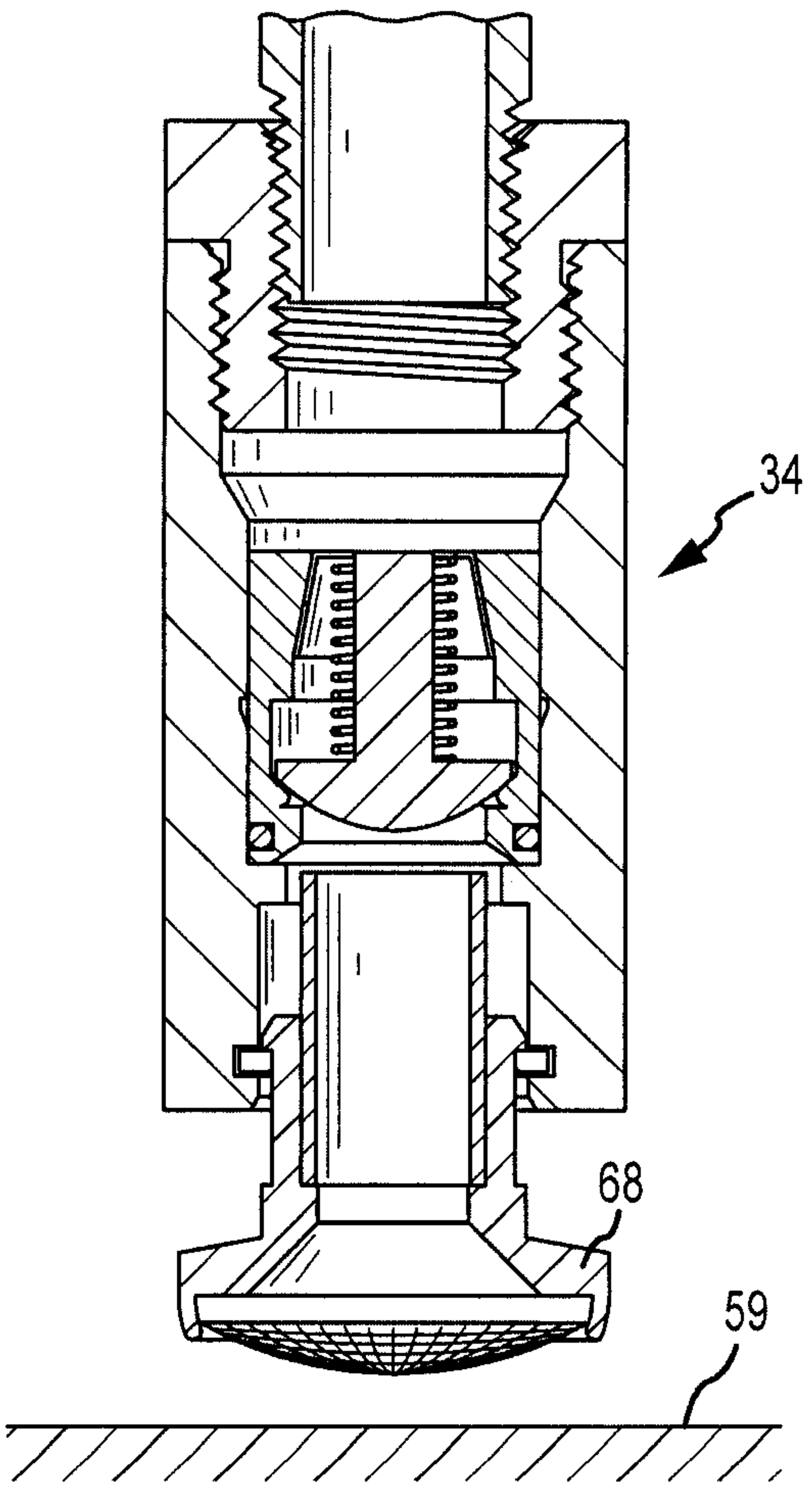


FIG.14

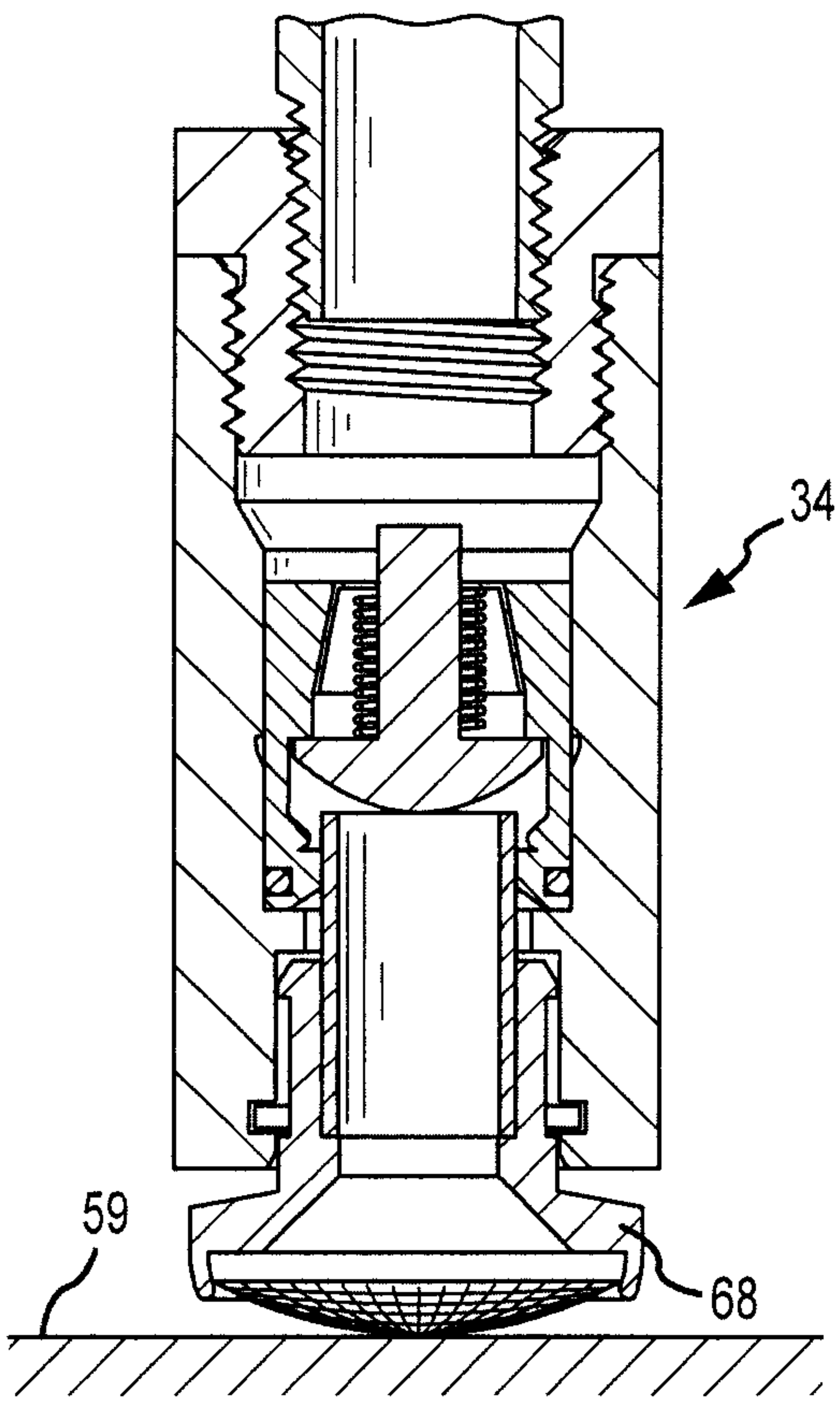


FIG.15

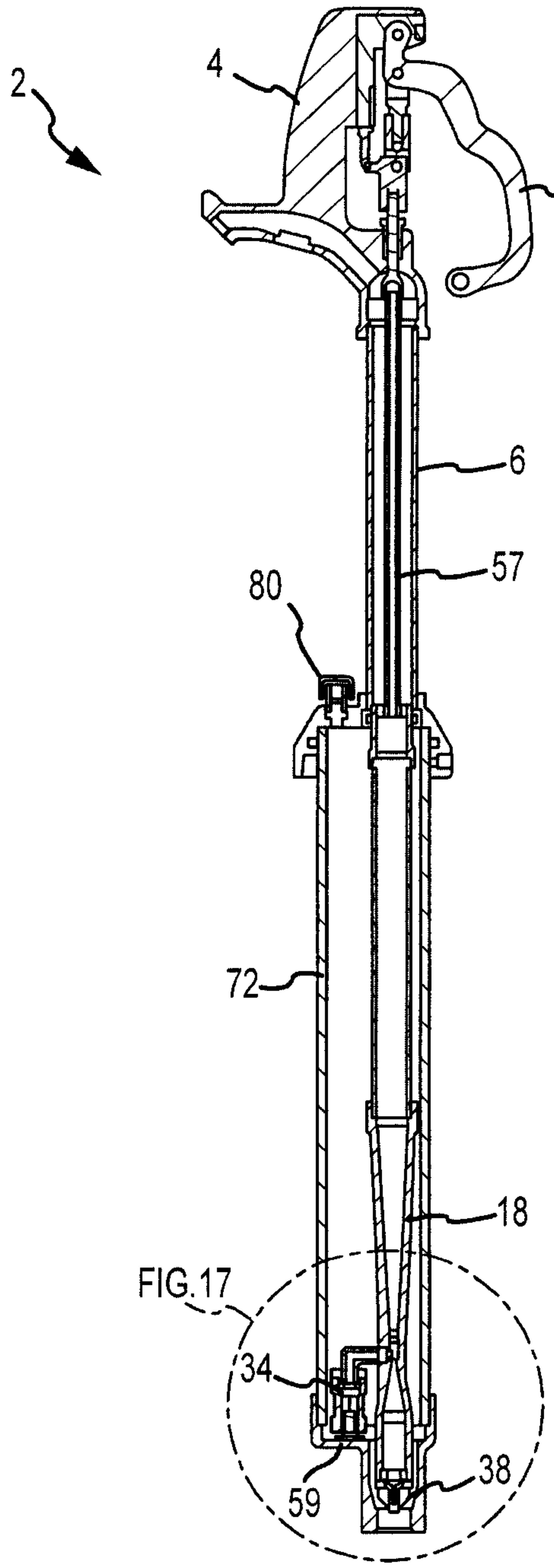


FIG.16

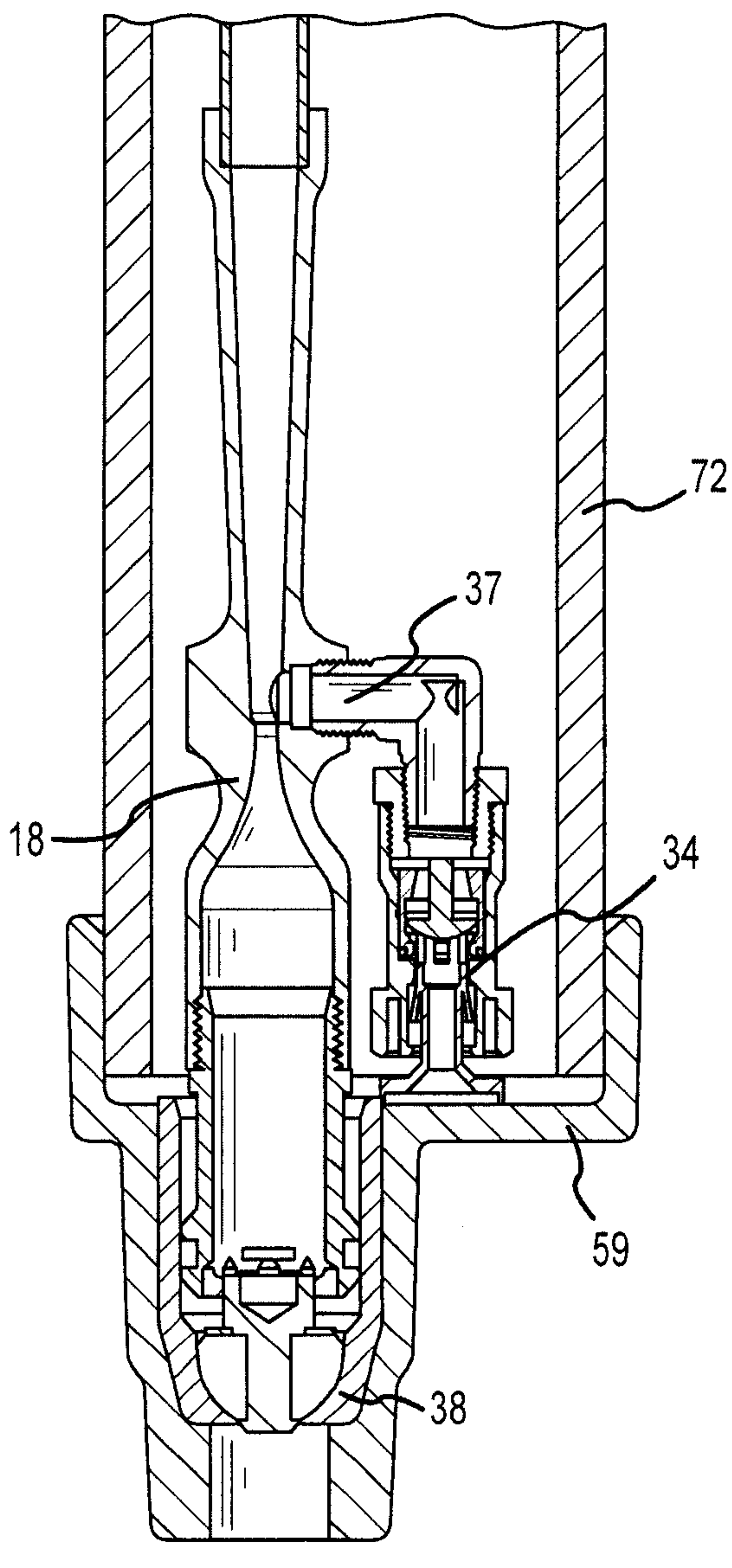


FIG.17

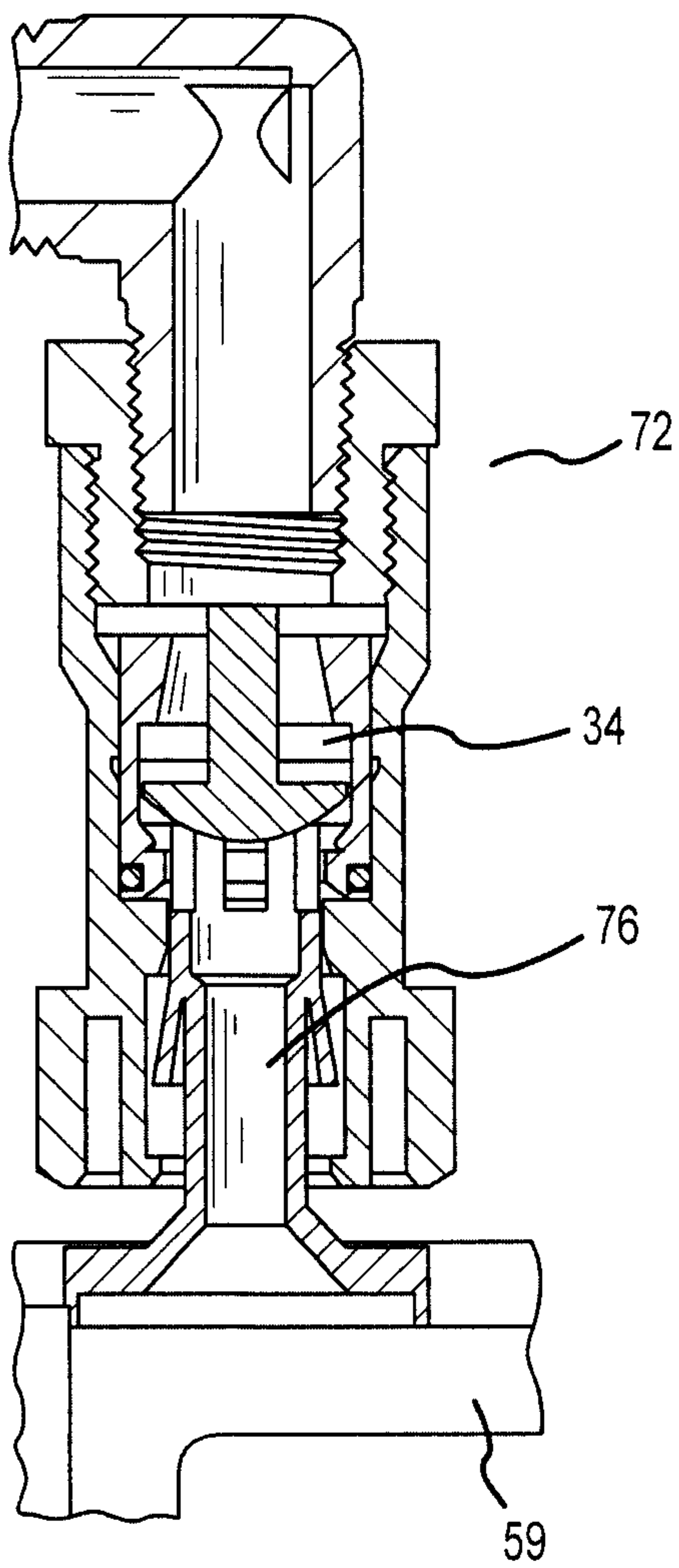


FIG.18

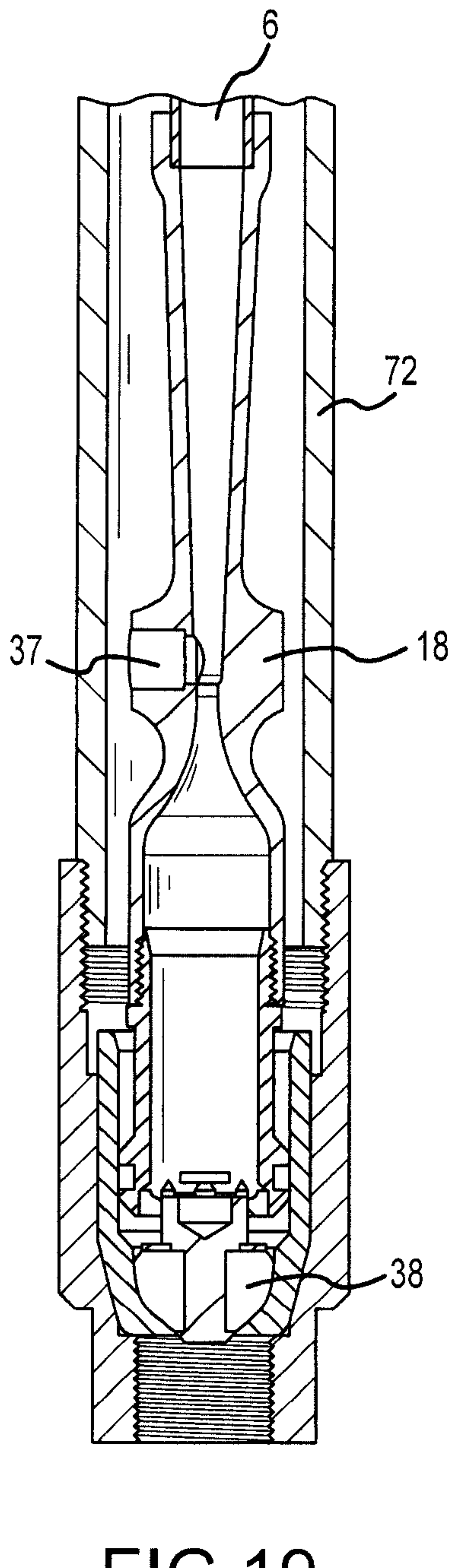


FIG.19

	WOODFORD S3	WOODFORD S4H	FIGS.5-11	FIGS.16-18	FIG.19
VACUUM BREAKER USED TO PASS ASSE 1057	34HF	34HF	DC50HF	DC50HF	DC50HF
OPERATION CYCLE	1) TURN ON AND EVACUATE 30 SECONDS 2) RUN THOROUGH HOSE 3) SHUT OFF	1) TURN ON RUN THROUGH HOSE 2) SHUT OFF 3) TURN ON AND EVACUATE 30 SECONDS 4) SHUT OFF	1) TURN ON RUN THROUGH HOSE 2) SHUT OFF AND REMOVE HOSE 3) TURN ON AND EVACUATE 30 SECONDS 4) SHUT OFF	1) TURN ON RUN THROUGH HOSE 2) SHUT OFF AND REMOVE HOSE 3) TURN ON AND EVACUATE 15 SECONDS 4) SHUT OFF	1) TURN ON RUN THROUGH HOSE 2) SHUT OFF AND REMOVE HOSE 3) TURN ON AND EVACUATE 30 SECONDS 4) SHUT OFF
DRAIN TO RESERVOIR WITH HOSE ATTACHED	YES	YES	NO	NO	NO
WORK WITH SPRAY NOZZLE ATTACHED	YES	YES	YES	YES	YES
OPERATIONAL STEP OF WHEN TO EVACUATE RESERVOIR, WITH HOSE ATTACHED	FIRST OR LAST	LAST	LAST	LAST	LAST
SPECIAL INSTRUCTIONS	EVACUATE RESERVOIR ONLY THROUGH DIVERTER	EVACUATE RESERVOIR ONLY THROUGH DIVERTER	EVACUATE WITHOUT HIGH FLOW BUTTON PUSHED OR HOSE ATTACHED	EVACUATE WITHOUT HOSE ATTACHED	EVACUATE WITHOUT HOSE ATTACHED
PVC RISER	4"	3"	3"	3"	11/2"
FLOW RATE @ 60 PSI (1057 APPROVED HYDRANT	7	7	8.4	6.2	6
HEAD USED	WOODFORD Y2	WOODFORD S4H	WOODFORD Y34	WOODFORD W34	WOODFORD Y34
# OF O-RINGS IN DESIGN	3	2	5	3	2
# OF STATIC SEAL O-RINGS IN DESIGN	2	2	1	0	0
MAXIMUM BURY DEPTH	7'	7'	7'	5'	2'
MINIMUM OPERATION PRESSURE	20 PSI	20 PSI	20 PSI	40 PSI	25 PSI
ADA COMPLAINT	NO	YES	NO	NO	NO
INLET SIZE	1"	1"	3/4"	1/2"	1/2"
TIME TO EVACUATE RESERVOIR @ MAX BURY AND MIN PSI	45	45	30	15	30

FIG.20

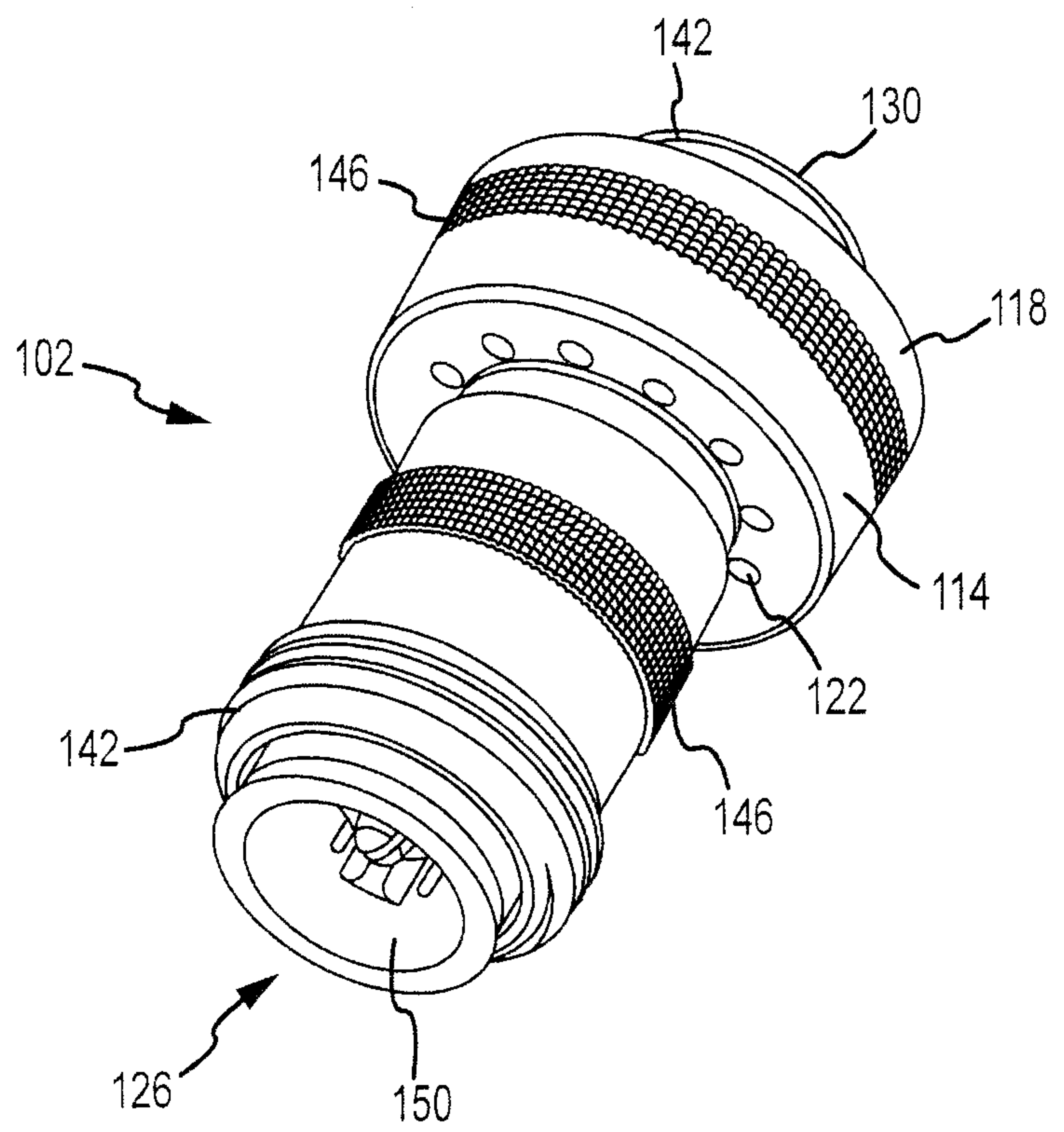
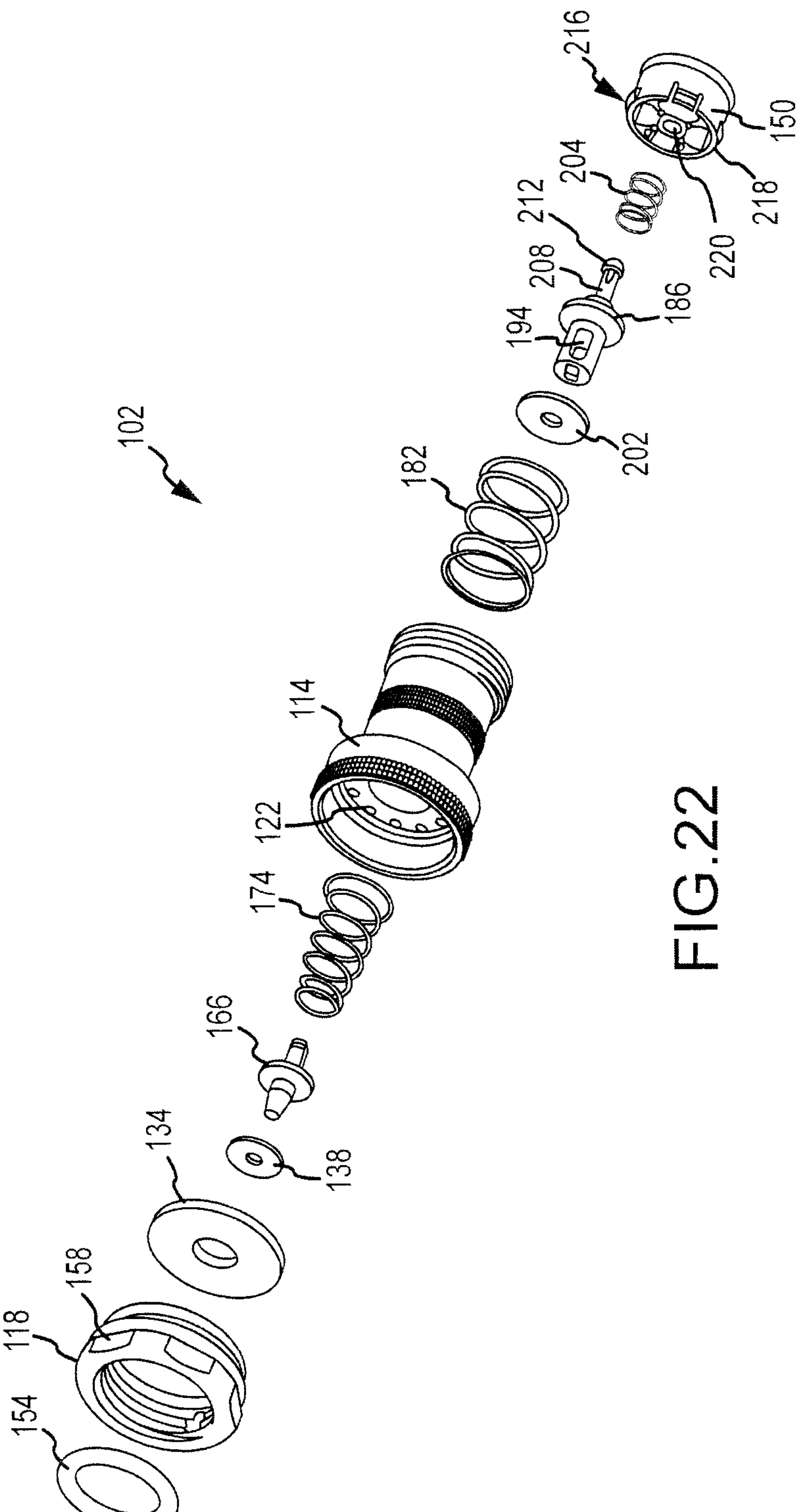


FIG.21


102
216
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118
154

FIG.22

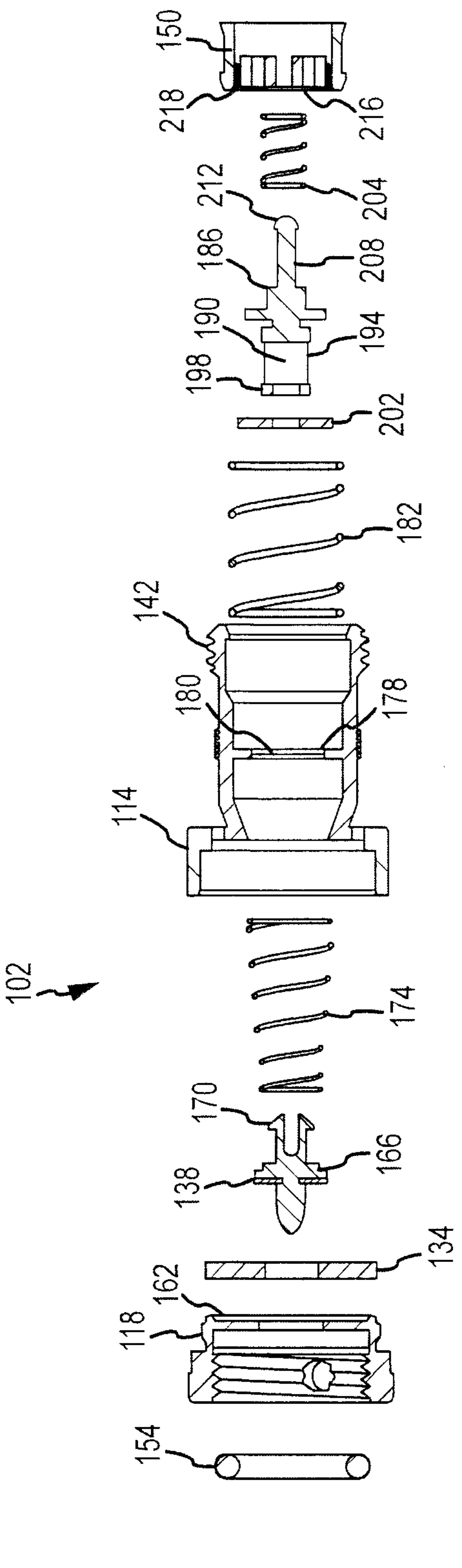
150
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FIG.23

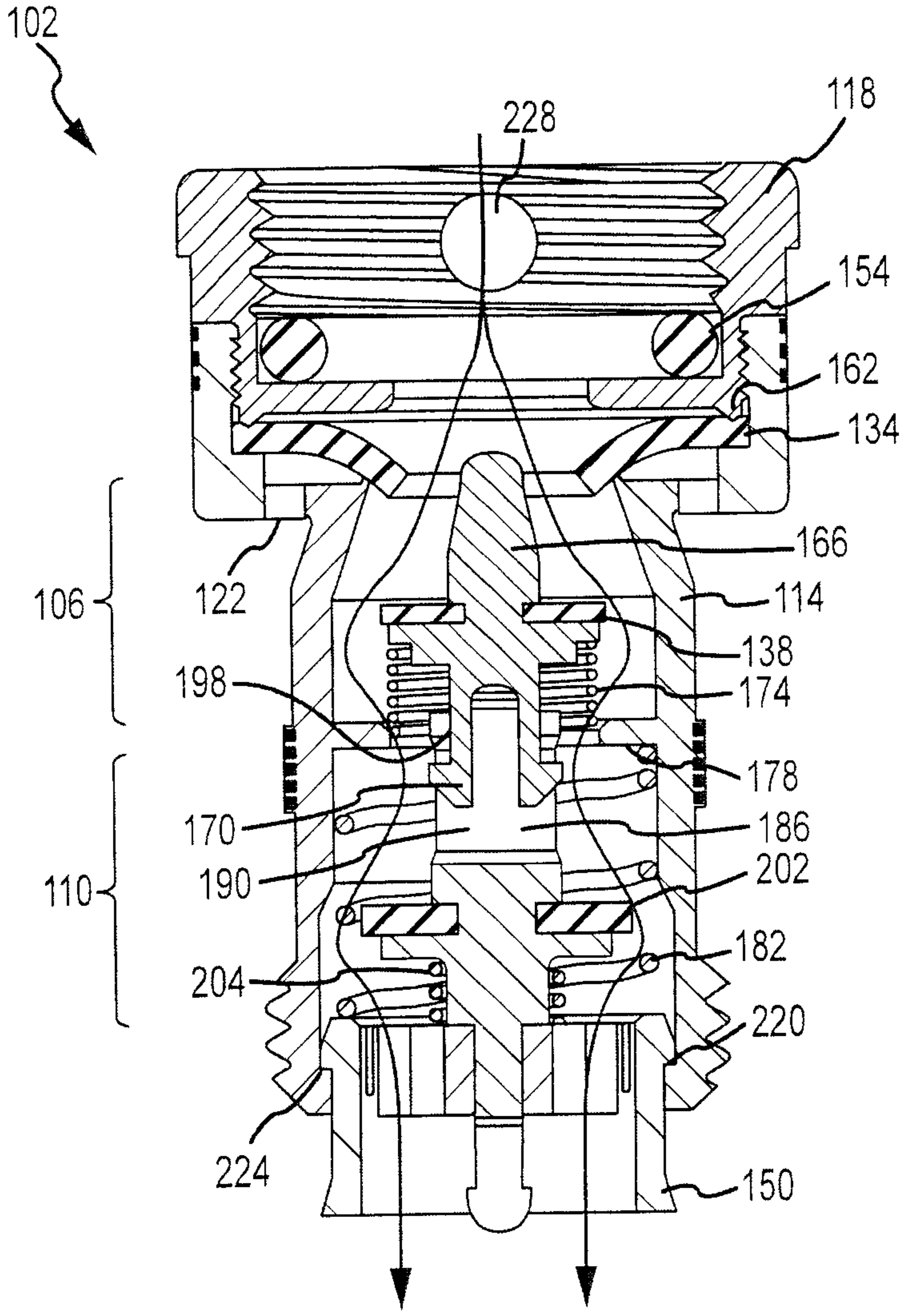
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FIG.24

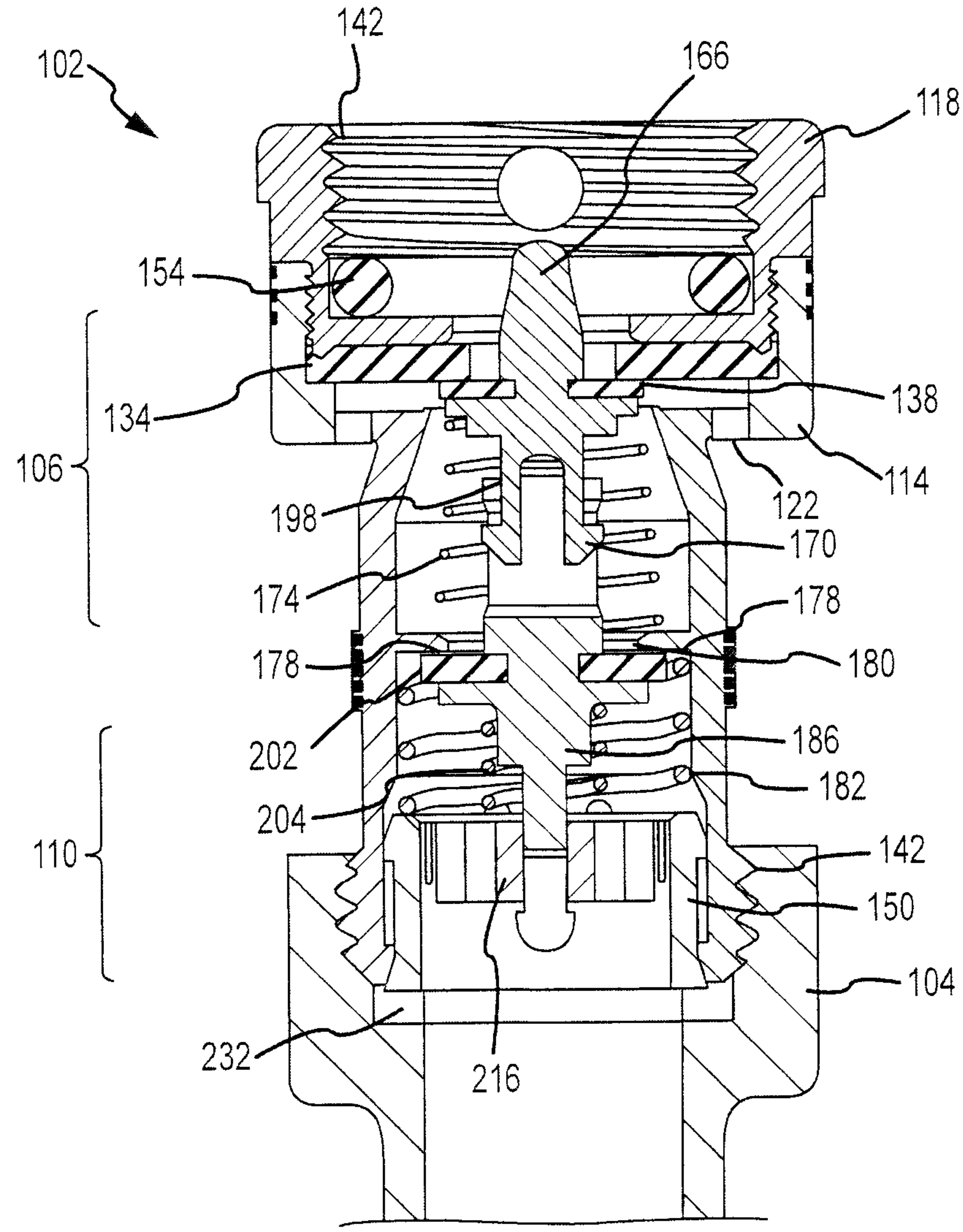
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FIG.25

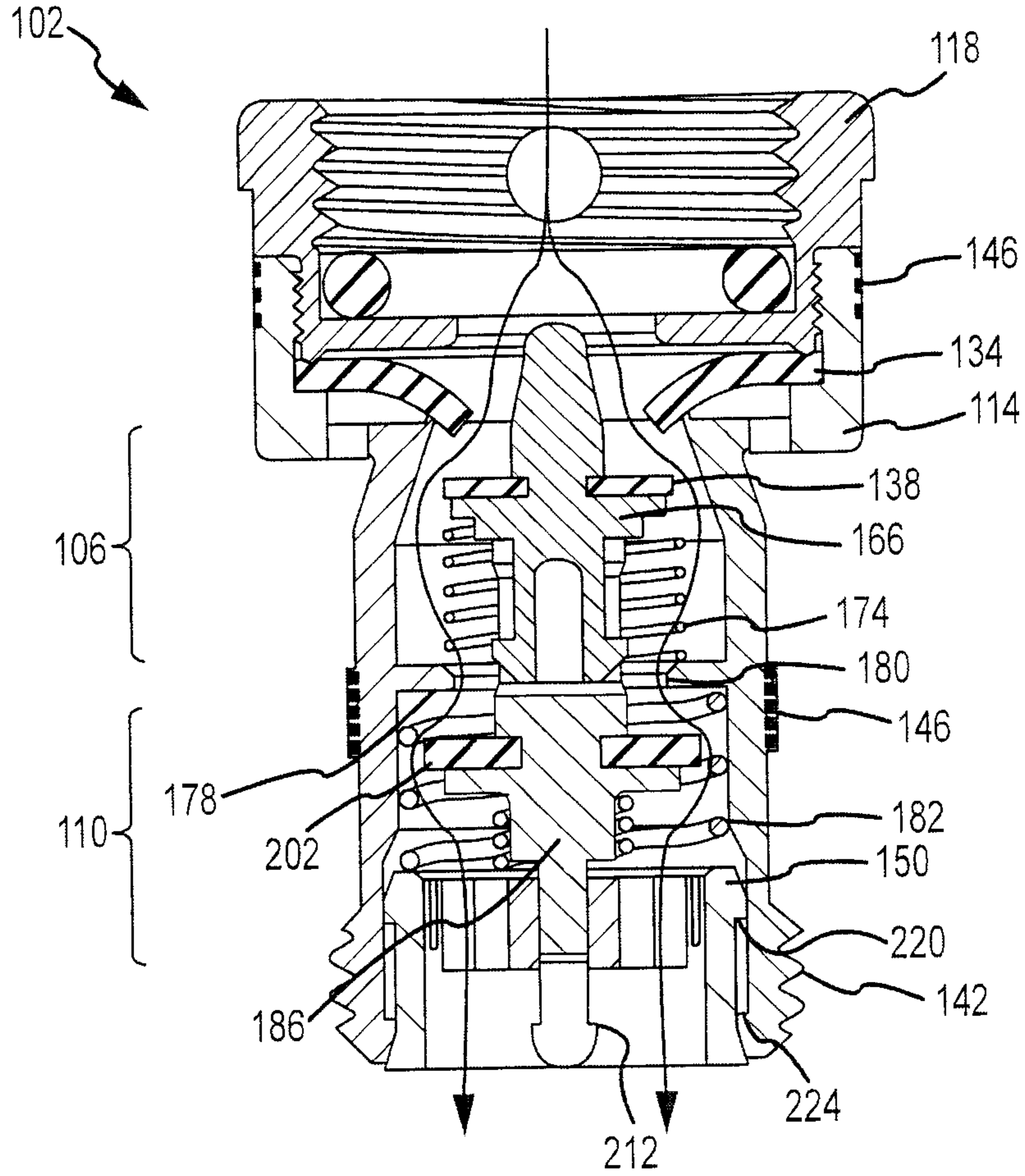
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FIG.26

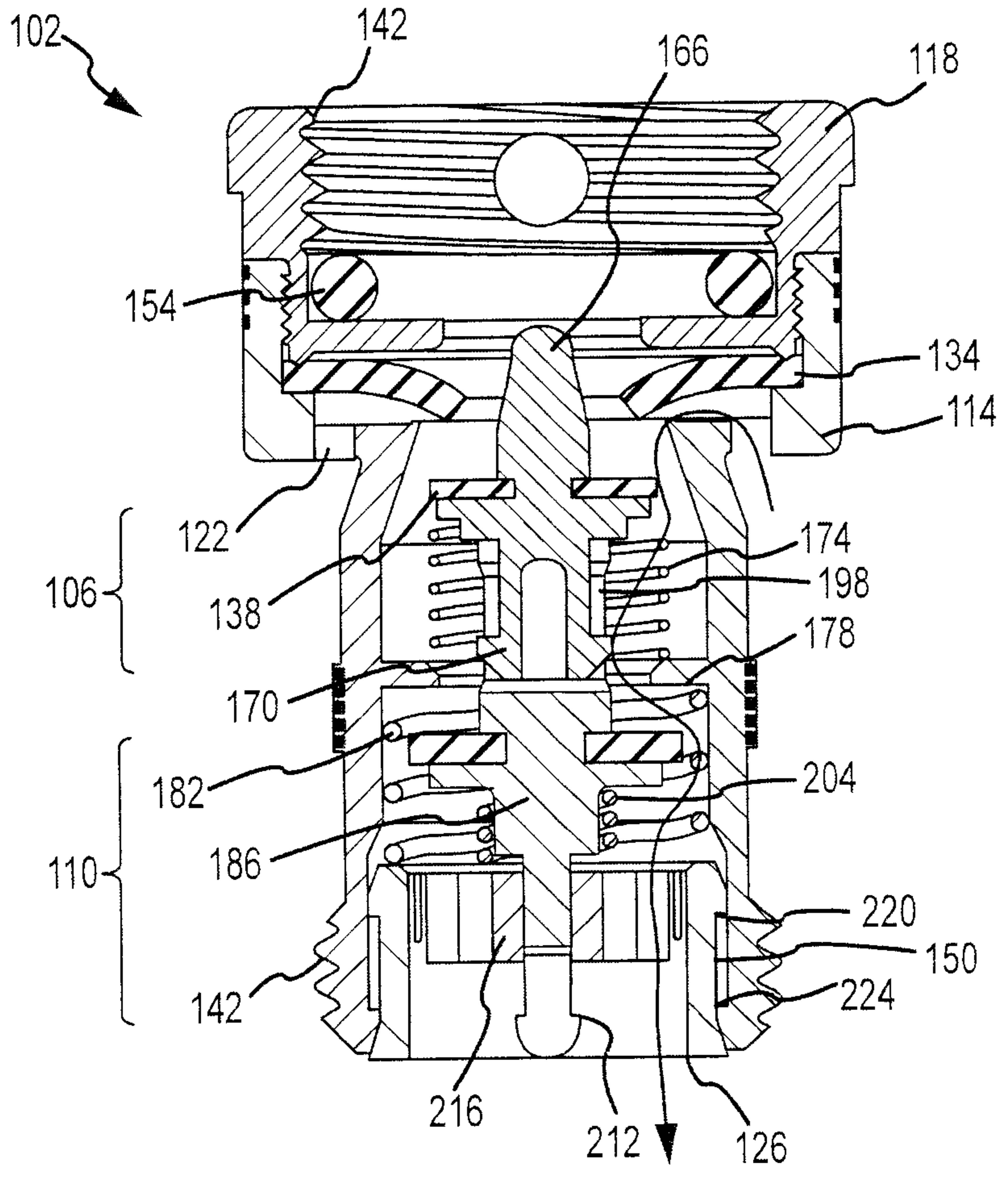
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FIG.27

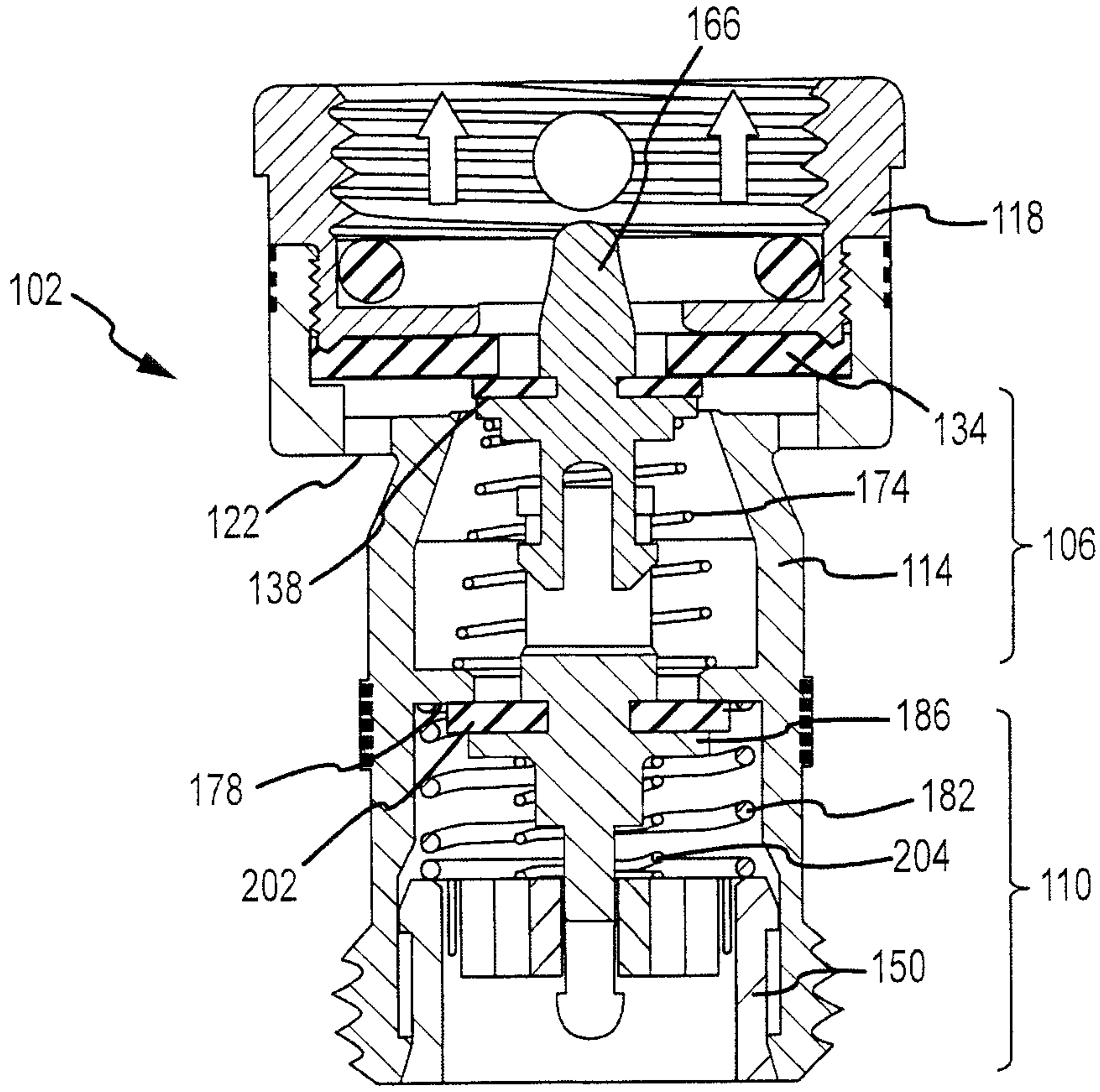

FIG.28

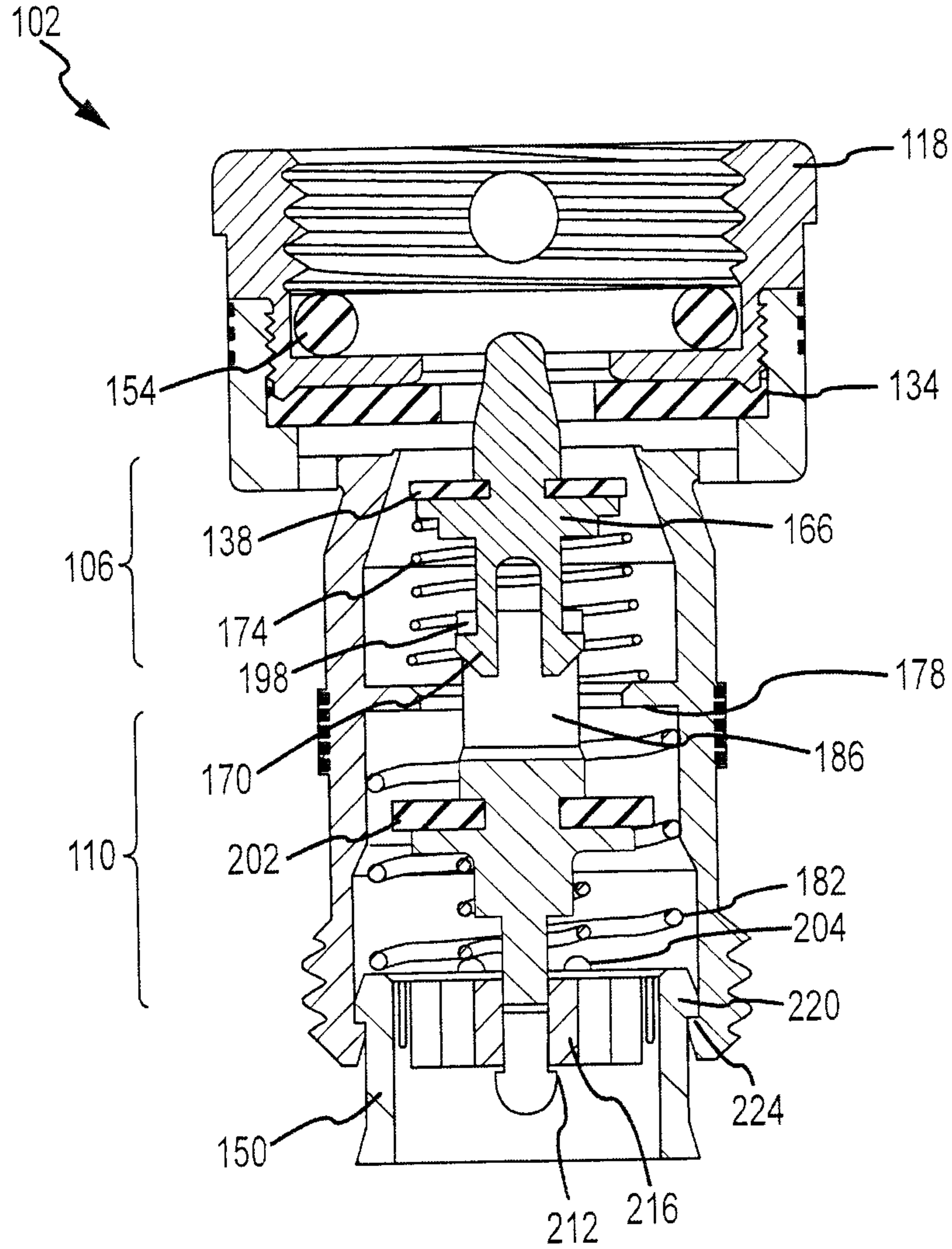
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FIG.29

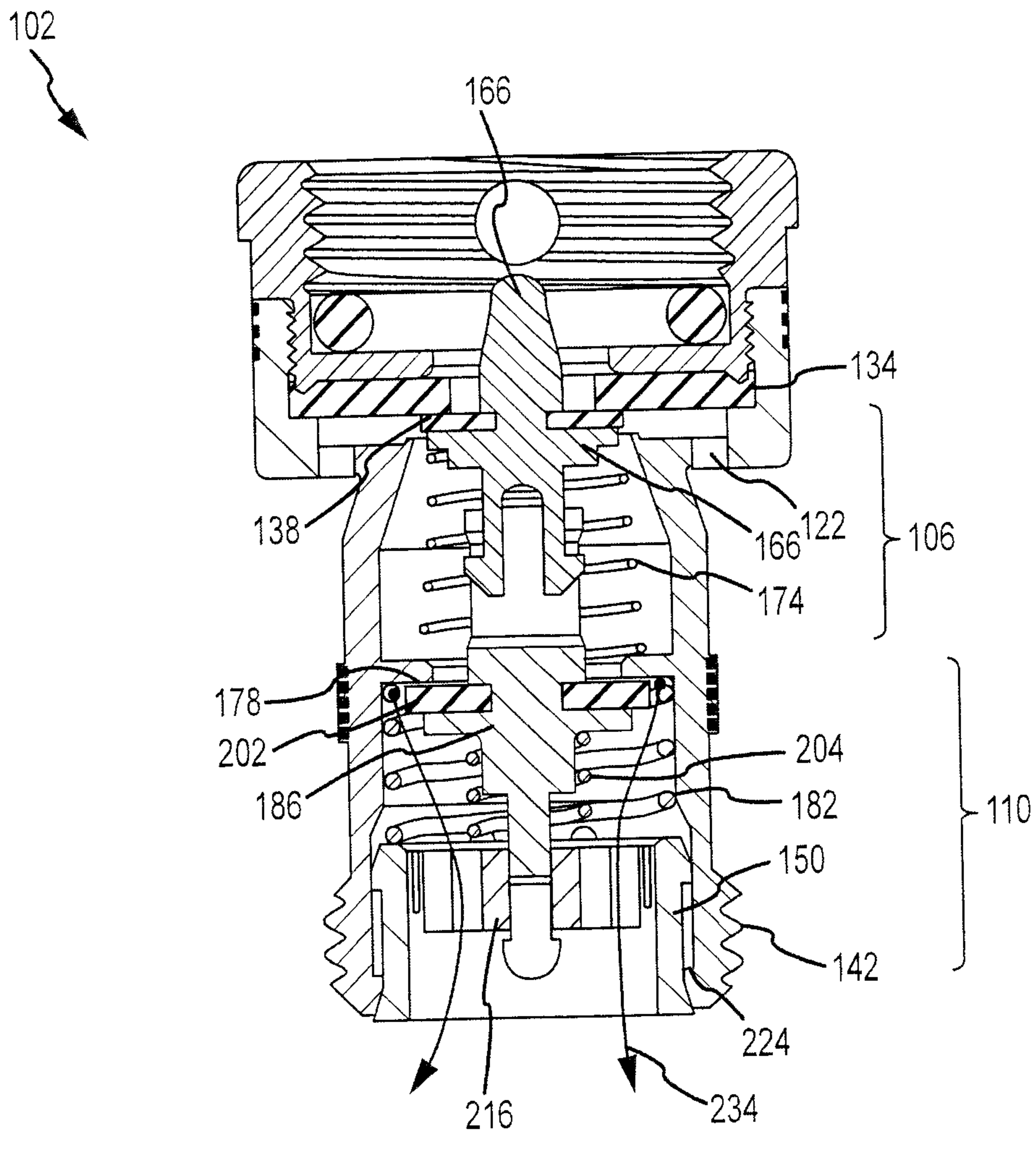
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FIG.30

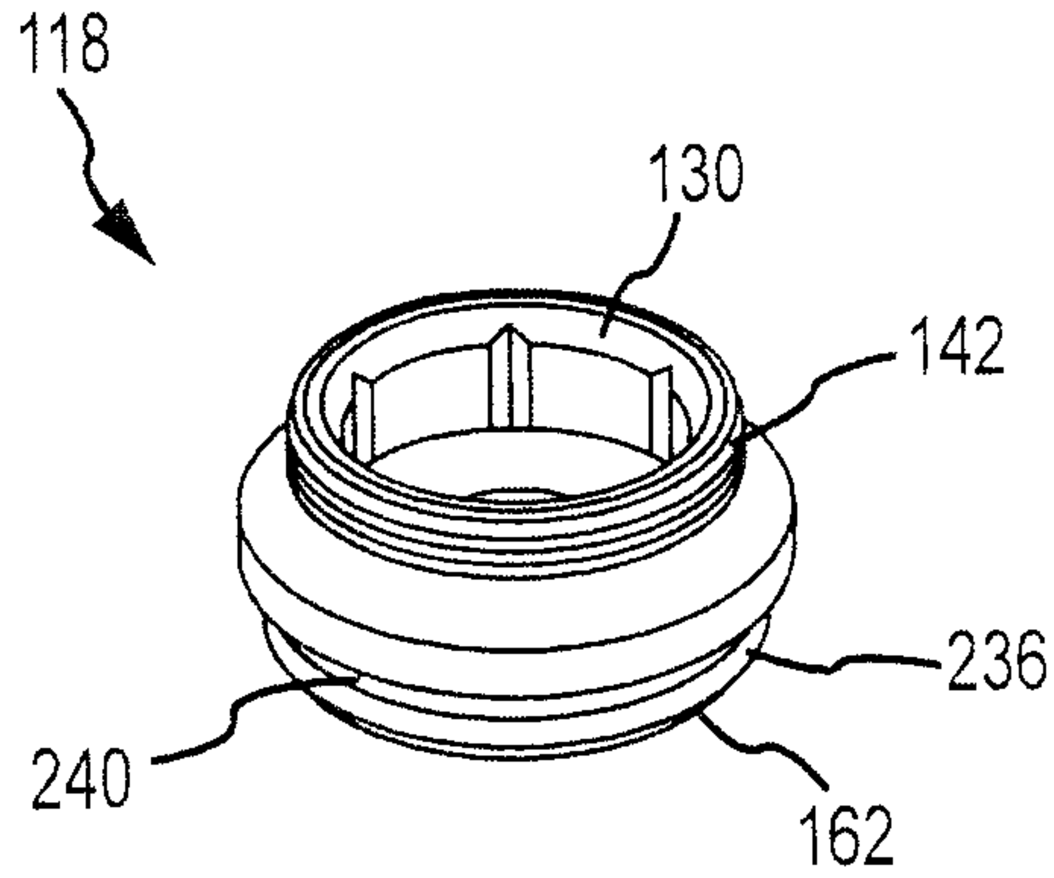


FIG.31

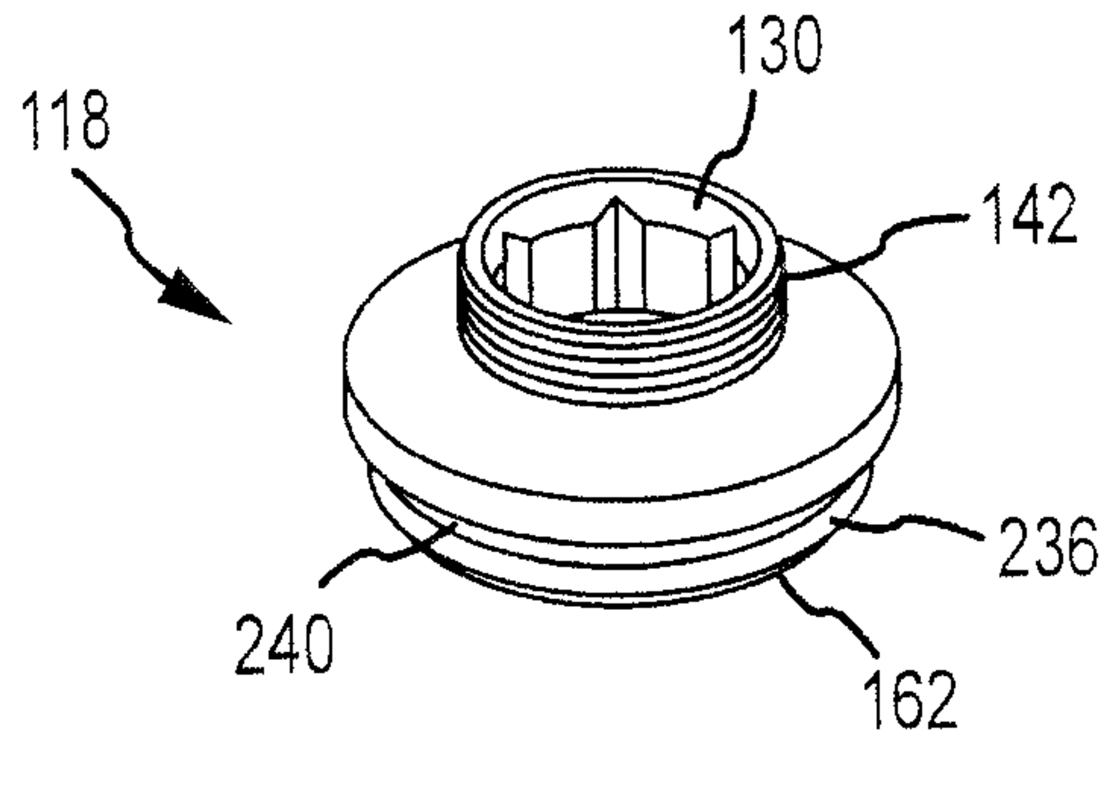
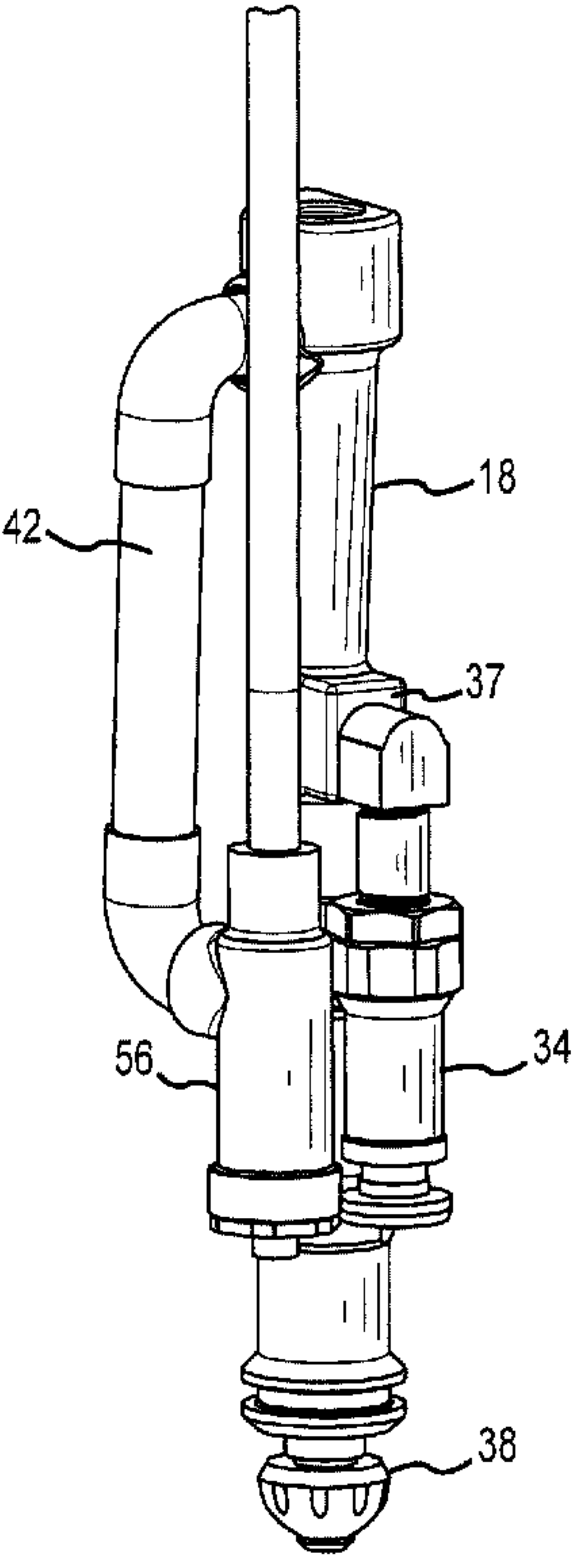


FIG.32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