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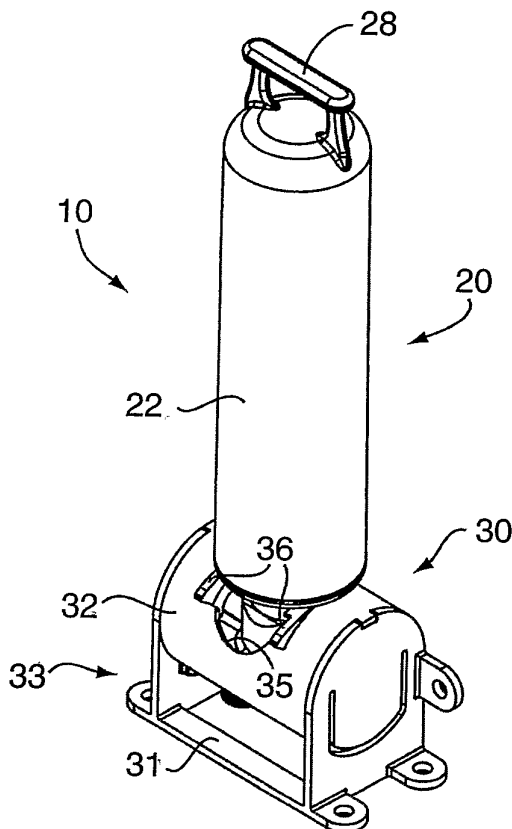
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(54) Title: SPOOL VALVE MANIFOLD INTERCONNECT FOR A FILTER SYSTEM



(57) Abstract: A filter cartridge and spool valve manifold assembly includes a filter cartridge and a spool valve manifold. The filter cartridge includes a filter element and inlet/outlet portion in fluid communication with the filter element. The inlet/outlet portion has a cartridge inlet port and a cartridge outlet port. The spool valve manifold includes a housing and a body. The housing has a housing inlet port and a housing outlet port adapted for fluid communication with a fluid supply system. The body is located within the housing and configured to rotate around a first axis relative to the housing. The inlet/outlet portion of the filter cartridge is fluidly coupled to the body via insertion of the inlet/outlet portion into the body in a direction perpendicular to the first axis.



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SPOOL VALVE MANIFOLD INTERCONNECT FOR A FILTER SYSTEM**Related Applications**

This application is a continuation-in-part of commonly owned U.S. Provisional Patent Application Serial No. 60/681,649, filed May 16, 2005, of Tubby, entitled "SPOOL VALVE INTERCONNECT FOR A FILTER SYSTEM," the disclosure of each is herein incorporated by reference to the extent not inconsistent with the present disclosure.

BACKGROUND OF THE DISCLOSURE

[0001] The present disclosure relates in general to a system operatively positioned in a fluid supply system comprising a manifold assembly and a replaceable fluid filter cartridge containing filter media, the manifold assembly having the capability for facilitating the removal of a first replaceable fluid filter cartridge and then having the capability for facilitating the installation of another replaceable fluid filter cartridge therein in a fluid supply system and, in particular, to a spool valve manifold assembly that facilitates the quick and easy removal and installation of the replaceable fluid filter cartridges from and into the manifold assembly.

[0002] Manifold assemblies having the capability for facilitating the removal of a first fluid filter cartridge and then having the capability for facilitating the installation of another replaceable fluid filter cartridge in a fluid supply system for industrial, commercial and consumer use are widely known throughout the industry. For example, most modern refrigerators, which provide drinking water and produce ice, and beverage dispensing machines, such as coffee makers and soda dispensers, use an internal fluid filtration system having replaceable fluid filter cartridges for filtering certain contaminants from the fluid, such as, water.

[0003] Given the use of relatively small amount of filter media contained within the compact replaceable fluid filter cartridges, frequent replacement of the replaceable fluid filter cartridges within the fluid filtration system is required. Therefore, these filtration systems are typically equipped with replacement filter cartridges that can be disengaged from a filtration system and replaced.

[0004] Unfortunately, such fluid filtration system may not always be placed in the most accessible location or at the most desirable orientation for a user to remove the old fluid filter cartridge and install a new one. Further compounding the problem of removing the old fluid

filter cartridge from the fluid supply system is that the flow of fluid from the system must be shut off prior to removal of the replacement fluid filter cartridge.

[0005] An example of a prior art filter and valve apparatus providing for replacement of an encapsulated filter is disclosed in U.S. Patent No. 6,579,455 to Muzik et al. Muzik discloses a gate-type valve, wherein a receptacle disk for receiving a filter is rotatably coupled to an upper plate having fluid supply inlet and outlet ports. The receptacle disk includes through passages for receiving inlet and outlet ports of the filter. When there is no filter inserted into these passages, the passages are not aligned with the fluid supply inlet and outlet ports of the upper plate. After insertion of the filter into the receptacle disk, the filter and the receptacle disk can be rotated around the longitudinal axis of the filter to align the inlet and outlet ports of the filter with the inlet and outlet ports of the fluid supply.

[0006] U.S. Patent No. 4,979,530 to Breda and U.S. Patent No. 6,457,698 to Wichmann disclose spool valves.

[0007] One disadvantage of the prior art is that the valves can become hard to operate due to the sealing O-rings taking a compression set over time. Because of this compression set, a high breaking force to initially move the valve is required.

[0008] Thus, there is a need for an inexpensive, reliable device that can provide for the quick and easy replacement of filter cartridges in a fluid filtration system. There is a further need for a device that can integrate the replacement of the filter cartridge with the opening and closing of the valve and that can be operated with a minimum of force.

SUMMARY OF THE DISCLOSURE

[0009] One representative embodiment of the present disclosure includes a spool valve manifold for use with a fluid filter cartridge having an inlet/outlet portion that includes a cartridge inlet port and a cartridge outlet port. The spool valve manifold includes a valve housing having a housing inlet port and a housing outlet port and a valve body located within the valve housing and configured to rotate around a first axis relative to the valve housing. The valve body is configured to receive the inlet/outlet portion of the filter cartridge via insertion of the inlet/outlet portion into the valve body in a direction perpendicular to the first axis. The housing inlet port and the cartridge inlet port are in fluid communication via a first fluid flow path and the housing outlet port and the cartridge outlet port are in fluid communication via a second fluid flow path when the valve body is at a first rotational

position relative to the valve housing. The housing inlet port and the cartridge inlet port are not in fluid communication and the housing outlet port and the cartridge outlet port are not in fluid communication when the valve body is at a second rotational position relative to the valve housing.

[0010] Another representative embodiment of the present disclosure includes a filter cartridge and spool valve manifold assembly having a filter cartridge and a spool valve manifold. The filter cartridge includes a filter media element and inlet/outlet portion in fluid communication with the filter element. The inlet/outlet portion has a cartridge inlet port and a cartridge outlet port. The spool valve manifold includes a housing and a body. The housing has a housing inlet port and a housing outlet port adapted for fluid communication with a fluid supply system. The body is located within the housing and configured to rotate around a first axis relative to the housing. The inlet/outlet portion of the filter cartridge is fluidly coupled to the body via insertion of the inlet/outlet portion into the body in a direction perpendicular to the first axis.

[0011] In one aspect of the present disclosure, the housing inlet port and the housing outlet port are in fluid communication via a third fluid flow path when the valve body is at the second rotational position relative to the valve housing.

[0012] In another aspect of the present disclosure, the housing inlet port and the housing outlet port are not in fluid communication when the valve body is at the second rotational position relative to the valve housing.

[0013] In even another aspect, the valve housing further may include an insertion cam component configured to cooperate with a complementary insertion cam component on the filter cartridge.

[0014] In a further aspect, the valve housing further may include an ejection cam component configured to cooperate with a complementary ejection cam component on the filter cartridge.

[0015] In even another aspect, the spool valve manifold further may include a first seal located between the valve body and the valve housing and configured to prevent fluid leakage from the first fluid flow path and a second seal located between the valve body and the valve housing and configured to prevent fluid leakage from the second fluid flow path.

[0016] In another aspect, the spool valve manifold may also include a third seal located between the valve body and the valve housing and configured to prevent fluid leakage from the third fluid flow path.

[0017] In one aspect, the angle between the first and second rotational positions may be less than 90 degrees.

[0018] In a further aspect, the filter cartridge includes a handle at an end of the filter cartridge that is opposite the inlet/outlet portion.

[0019] In one aspect, a bracket is coupled to the valve housing and configured to mount the spool valve manifold to an appliance.

[0020] In even a further aspect, a bracket is rotatably mounted adjacent the spool valve and configured to slidably hold the filter cartridge as the body rotates from the first to the second rotational position.

[0021] Other objects and advantages of the disclosure will be apparent from the following description, the accompanying drawings and the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] Figure 1 is a perspective view of a fluid filter cartridge and spool valve manifold assembly according to a representative embodiment of the present disclosure, with the assembly shown in a first rotational position;

[0023] Figure 2 is a side view of the fluid filter cartridge and spool valve manifold assembly according to the representative embodiment of Figure 1;

[0024] Figure 3 is a front view of the fluid filter cartridge and spool valve manifold assembly according to the representative embodiment of Figure 1;

[0025] Figure 4 is an exploded perspective view of the fluid filter cartridge and spool valve manifold assembly according to the representative embodiment of Figure 1;

[0026] Figure 5 is a perspective view of the fluid filter cartridge and spool valve manifold assembly, according to a representative embodiment of Figure 1, with the assembly shown in a second rotational position;

[0027] Figure 6 is a side view of the fluid filter cartridge and spool valve manifold assembly according to the aspect of Figure 5;

[0028] Figure 7 is a front view of the fluid filter cartridge and spool valve manifold assembly according to the aspect of Figure 5;

[0029] Figure 8 is a side view of the fluid filter cartridge and spool valve manifold assembly according to the aspect of Figure 5, with the fluid filter cartridge shown removed from the assembly;

[0030] Figure 9 is a cross-sectional side view of a portion of a fluid filter cartridge according to one representative embodiment of the present disclosure;

[0031] Figure 10 is a partial cross-sectional side view of a portion of a fluid filter cartridge inserted into a spool valve manifold assembly according to a representative embodiment of the present disclosure, with the filter cartridge and valve body in a first rotational position;

[0032] Figure 11 is a perspective view of a portion of the fluid filter cartridge and spool valve manifold assembly, with the valve housing shown partially transparent, and with the fluid filter cartridge and the valve body shown in the first rotational position;

[0033] Figure 12 is a partial cross-sectional side view of a portion of a fluid filter cartridge inserted into a spool valve manifold assembly according to a representative embodiment of the present disclosure, with the fluid filter cartridge and the valve body in a second rotational position;

[0034] Figure 13 is a perspective view of a portion of the fluid filter cartridge and spool valve manifold assembly, with the valve housing shown partially transparent, and with the fluid filter cartridge and the valve body in a second rotational position;

[0035] Figure 14 is a schematic cross-sectional side view of the representative embodiment of Figure 1, showing one aspect of the insertion and ejection cam components, with the fluid filter cartridge and the valve body in a first rotational position;

[0036] Figure 15 is a schematic cross-sectional side view of the representative embodiment of Figure 1, showing one aspect of the insertion and ejection cam components, with the fluid filter cartridge and the valve body in a second rotational position

[0037] Figure 16 is a perspective view of the fluid filter cartridge and spool valve manifold assembly shown with an optional mounting enclosure;

[0038] Figure 17 is a perspective view of the fluid filter cartridge and spool valve manifold assembly shown with a representative keying system;

[0039] Figure 18 is a perspective view of the fluid filter cartridge and spool valve manifold assembly shown in Figure 17 showing the filter cartridge having a representative keying system about to be inserted into the spool valve manifold;

[0040] Figure 19 is a partial perspective view of a representative fluid filter cartridge and spool valve manifold assembly having a representative keying system in the installed/operative position;

[0041] Figure 20 is a partial perspective view of a representative fluid filter cartridge and spool valve manifold assembly having a representative keying system in the first rotational position prior to being installed in the operative position or being withdrawal from the operative position;

[0042] Figure 21 is a partial perspective view of another representative fluid filter cartridge and spool valve manifold assembly having a representative keying system in the installed/operative position;

[0043] Figure 22 is a partial perspective view of a representative fluid filter cartridge and spool valve manifold assembly having a representative optional inlet valve in the second rotational position prior to being installed;

[0044] Figure 23 is a partial perspective view of a representative fluid filter cartridge and spool valve manifold assembly having a representative optional inlet valve in the first rotational position after being installed;

[0045] Figure 24 is a schematic cross-sectional side view of the representative embodiment of Figure 23, showing one aspect of the optional inlet valve, with the fluid filter cartridge and the valve body in a first rotational position or the installed position;

[0046] Figure 25 is a schematic cross-sectional side view of the representative embodiment of Figure 23, showing one aspect of the optional inlet valve, with the fluid filter cartridge and the valve body in a second rotational position or the uninstalled position; and

[0047] Figure 26 is a schematic cross-sectional side view of the representative embodiment of Figure 23, showing a high pressure condition, with the fluid filter cartridge and the valve body in a first rotational position and the a poppet valve in the closed condition.

[0048] These and other features of the subject disclosure will become more readily apparent to those having ordinary skill in the art from the following detailed description of the representative embodiments.

DETAILED DESCRIPTION OF REPRESENTATIVE EMBODIMENTS

[0049] As discussed hereinabove, the present disclosure overcomes several disadvantages associated with the prior art fluid filter systems. The advantages and other features of the

fluid filter systems, comprising a representative manifold assembly and a representative replaceable fluid filter cartridge containing filter media, disclosed herein, will become more readily apparent to those having ordinary skill in the art from the following detailed description of the representative embodiments taken in conjunction with the drawings which set forth some representative embodiments of the present disclosure.

[0050] Referring now to the drawings wherein like reference numerals identify similar structural elements and/or features of the subject disclosure, there is illustrated in Figures 1-3 a representative fluid filter cartridge and a representative spool valve manifold assembly constructed in accordance with an exemplary, representative embodiment of the subject disclosure and designated generally by reference numeral 10. Filter cartridge and spool valve manifold assembly 10 includes a fluid filter cartridge 20 and a spool valve manifold 30. As will be explained below, filter cartridge and spool valve manifold assembly 10 is shown in Figures 1-3 in a first rotational position.

[0051] As best illustrated in Figure 4, filter cartridge 20 generally includes a representative sump 22 and a representative filter cover or inlet/outlet portion 24. As is known in the art, a filter element 23 (see Figure 9) is located within sump 22. The representative filter cartridge 20 may also include handle 28.

[0052] Spool valve manifold 30 includes a representative valve housing 32 and a representative valve body 34. Valve body 34 rotates around axis a-a relative to valve housing 32. Spool valve manifold 30 is shown mounted within bracket 31 and this spool valve manifold/bracket subassembly will be referred to as mounted spool valve manifold 33. Valve housing 32 of spool valve manifold 30 may be snap mounted to bracket 31, although other assembly methods as known to persons of ordinary skill in the art could be used. Bracket 31 may be used to mount spool valve manifold 30 to the wall of an appliance (not shown) adjacent inlet and outlet ports of the fluid supply system (not shown). Valve housing 32 and bracket 31 typically remain stationary.

[0053] In the illustrated representative assembled configuration, representative seals 25 and 26 are located between inlet/outlet portion 24 and valve body 34 and representative seals 40, 42 and 44 are located between valve housing 32 and valve body 34. Tube connectors 50, 52, as known in the art, are used to connected spool valve manifold 30 to the fluid supply system. Other means of connecting tubing to the valve housing can be used such as the welded tubing

attachment method that is disclosed in U S Patent No. 6,857,670 B2, the disclosure of which is herein incorporated by reference to the extent not inconsistent with the present disclosure.

[0054] Figures 5-7 show filter cartridge and spool valve manifold assembly 10 in a second rotational position. As best illustrated by comparing Figure 2 to Figure 6, filter cartridge 20 rotates relative to bracket 31 in the direction of arrow A (around axis a-a of Figure 4) when moving from the first rotational position as illustrated in Figure 2 to the second rotational position as illustrated in Figure 6. In the representative embodiment illustrated in Figures 1-7, movement of filter cartridge 20 in the direction of arrow A may be accomplished by pulling on handle 28 in the direction of arrow B. Also, in the representative embodiment illustrated in Figures 1-7, movement of filter cartridge 20 in the direction of arrow A causes filter cartridge 20 to move in the direction of arrow C. Movement in the direction of arrow C is perpendicular to the direction of axis a-a. This is due to a camming action between filter cartridge 20 and cams 36 (best illustrated in Figure 4).

[0055] As will be described below, filter cartridge 20 is operatively coupled to valve body 34. Thus, when filter cartridge 20 rotates, valve body 34 also rotates. As filter cartridge 20 is rotated from the first rotational position to the second rotational position, cams 36 cause filter cartridge 20 to be ejected from valve body 34 and correspondingly from mounted spool valve manifold 33, thereby disconnecting filter cartridge 20 from spool valve manifold 30. Figure 8 shows filter cartridge 20 removed from mounted spool valve manifold 33.

[0056] In the representative embodiment illustrated in Figures 1-8, the angle through which filter cartridge 20 rotates relative to bracket 31 is approximately 45 degrees. This angle could be more or less than 45 degrees, with an angle of less than 90 degrees expected to be suitable for most applications, although an angle of more than 90 degrees would lie within the scope of the disclosure.

[0057] As best illustrated in Figure 9, one representative filter cartridge 20 has an inlet/outlet portion 24 at the top end thereof for the ingress and egress of fluid into interior chamber of filter cartridge 20 and into filter element 23. Filter element 23 may include any suitable filter media as is known in the art. Inlet/outlet portion 24 includes a representative cartridge outlet port 27 having a central through bore through which filtered fluid may exit filter cartridge 20. Cartridge outlet port 27 may be generally aligned with a central axis of filter cartridge 20. Circumferentially surrounding cartridge outlet port 27 are representative cartridge inlet ports 29, formed as arcuate through bores through which unfiltered fluid may enter filter cartridge

20. Inlet/outlet portion 24 is configured as a quick connect/disconnect fitting for mating with spool valve manifold 30. A person of ordinary skill in the art would appreciate that other inlet and outlet configurations lie within the scope of the disclosure.

[0058] Cartridge inlet port 29 of inlet/outlet portion 24, as best illustrated in Figure 9, channels the incoming unfiltered fluid to the outer circumferential surface of filter element 23. The unfiltered fluid then travels radially inward through the filter media and is filtered in the process. The filtered fluid exits filter element 23 through cartridge outlet port 27.

[0059] Inlet/outlet portion 24 and other portions of filter cartridge 20, such as sump 22, may be formed of any suitable material known to persons of ordinary skill in the art, including, but not limited to, for example, molded 20% talc-filled polypropylene homopolymer or isoplast. Typically, a suitable material would be a standard National Standard Foundation (NSF) approved material.

[0060] Representative O-rings or other seals 25, 26 (as best illustrated in Figures 4 and 9) may be located around the outer circumference of cartridge inlet ports 29 and cartridge outlet ports 27. As best illustrated in Figure 10, when filter cartridge 20 is installed in spool valve manifold 30, seals 25, 26 are located between inlet/outlet portion 24 and the complementary filter cartridge mounting surfaces 38 of spool valve manifold body 34. Seals 25, 26 isolate and prevent leakage between an unfiltered fluid flow path 60 and a filtered fluid flow path 62. Seals 25, 26 may be formed from nitrile rubber (NBR) or ethylene-propylene-diene rubber (EPDM) elastomers or other suitable materials known to persons of ordinary skill in the art.

[0061] Figure 10 shows filter cartridge 20 inserted into valve body 34 of spool valve manifold 30 in the first rotational position. An opening 35 in the wall of valve housing 32 accommodates the insertion of filter cartridge 20 into valve body 34. Opening 35 is sized to accommodate the movement of filter cartridge 20 from the first rotational position to the second rotational position. In the first rotational position, cartridge inlet port 29 is in fluid communication with a housing inlet port 39 and cartridge outlet port 27 is in fluid communication with a housing outlet port 37. Unfiltered fluid from the fluid supply system (not shown) flows into housing inlet port 39 and into filter cartridge 20 via unfiltered fluid flow path 60 and cartridge inlet port 29. Filtered fluid flows from filter cartridge 20 and out through housing outlet port 37 to the fluid supply system (not shown) via cartridge outlet port 27 and filtered fluid flow path 62.

[0062] As illustrated in Figures 4 and 10, a plug 54 may be provided to simplify the manufacture of valve body 34 and close off unfiltered fluid flow path 60 from the atmosphere, as would be understood by a person skilled in the molding manufacturing art.

[0063] As illustrated in Figures 4 and 10 and as best illustrated in Figure 11, seals 40 and 42 isolate unfiltered fluid flow path 60 from filtered fluid flow path 62. Specifically, seal 40 is located between valve housing 32 and valve body 34 and surrounds unfiltered fluid flow path 60 at this juncture. Seal 42 is located between valve housing 32 and valve body 34 and surrounds filtered fluid flow path 62 at this juncture. Seals 40 and 42 may be positioned within grooves as is known in the art.

[0064] Figure 12 shows inlet/outlet portion 24 of filter cartridge 20 inserted into spool valve manifold 30 in the second rotational position. In this second rotational position, housing inlet port 39 is in fluid communication with a housing outlet port 37 without being in fluid communication with filter cartridge 20. Unfiltered fluid from the fluid supply system (not shown) flows into housing inlet port 39 and out through housing outlet port 37 via bypass fluid flow path 64 (also shown in Figure 11). Thus, unfiltered fluid from the fluid supply system (not shown) never reaches filter cartridge 20. Rather, in the second rotational position, filter cartridge 20 is isolated from the fluid supply system. Bypass fluid flow path 64 allows unfiltered fluid to flow directly to housing outlet port 37. This allows fluid to be supplied to a user downstream of filter cartridge and spool valve manifold assembly 10 even if filter cartridge 20 is not filtering the fluid supply. Thus, the flow of fluid downstream of filter cartridge and spool valve manifold assembly 10 need never be disrupted.

[0065] As illustrated in Figures 4 and 10 and as best illustrated in Figures 11 and 13, seal 44 prevents bypass fluid flow path 64 from leaking to the atmosphere. As can be seen in Figure 11, seals 40 and 42 also prevent fluid from bypass fluid flow path 64 from entering unfiltered fluid flow path 60 and filtered fluid flow path 62. In this particular representative embodiment of the present disclosure, seal 44 also provides a secondary seal for unfiltered fluid flow path 60 and filtered fluid flow path 62 that prevents leakage to the atmosphere should either of seals 40 or 42 fail. Specifically, seal 44 is located between valve housing 32 and valve body 34 and surrounds bypass fluid flow path 64. Seal 44 is also extended around unfiltered fluid flow path 60 and filtered fluid flow path 62. Seal 44 is shown positioned with a groove as is known in the art. As with seals 25 and 26, seals 40, 42 and 44 may be formed

from NBR or EPDM elastomers or other suitable materials known to persons of ordinary skill in the art.

[0066] Figures 14 and 15 show a representative filter cartridge 20 inserted into spool valve manifold 30 in the first rotational position and the second rotational position, respectively. Inlet/outlet portion 24 of filter cartridge 20 includes lug 21. Valve housing 32 includes insertion cam 48. Lug 21 and insertion cam 48 may be referred to as insertion cam components. Lug 21 interacts with insertion cam 48 when valve body 34 with filter cartridge inserted is rotated from the second rotational position (as illustrated in Figure 15) to the first rotational position (as illustrated in Figure 14). As filter cartridge 20 is rotated from the second rotational position to the first rotational position, lug 21 rides on insertion cam 48 causing cartridge 20 to be advanced into and sealingly mated with valve body 34. The interaction of the insertion cam components causes filter cartridge 20 to be moved opposite to the direction of arrow C (see Figure 8). Thus, Figure 14 shows filter cartridge 20 fully seated within valve body 34, while Figure 15 shows filter cartridge 20 inserted into valve body 34, but not yet sealingly engaged with valve body 34. In the representative embodiment shown, two lugs 21 are provided, one on each side of inlet/outlet portion 24. Correspondingly, two insertion cams 48 are complementarily located on valve housing 32. One of ordinary skill in the art would appreciate that a lug or other surface portion could be provided on valve housing 32 and a corresponding cam portion could be provided on filter cartridge 20.

[0067] Figures 14 and 15 also show the interaction between ejection cam 36 and a shoulder surface 46 of filter cartridge 20. Ejection cam 36 is provided on valve housing 32. Ejection cam 36 and shoulder surface 46 may be referred to as ejection cam components. When filter cartridge 20 is rotated from the first rotational position (Figure 14) to the second rotational position (Figure 15) the interaction between ejection cam 36 and shoulder surface 46 slidably ejects filter cartridge 20 in the direction of arrow C (see Figure 8) from valve body 34. This interaction breaks the seal between inlet/outlet portion 24 and valve body 34. As with the insertion cam, one of ordinary skill in the art would appreciate that a lug or surface portion could be provided on valve housing 32 and a corresponding cam portion could be provided on filter cartridge 20.

[0068] Valve housing 32, valve body 34 and bracket 31 may be formed of any suitable materials known to persons of ordinary skill in the art, including, but not limited to, isoplast

or molded polypropylene. Bracket 31 may also be formed from glass-filled polypropylene or other reinforced plastics for additional strength.

[0069] Referring back to Figures 1-8, a representative optional handle 28 is shown provided on filter cartridge 20 at an end opposite to the inlet/outlet portion 24 of filter cartridge 20. Handle 28 may be grasped by a user to assist in rotating filter cartridge 20 from the first rotational position to the second rotational position, and vice versa, and also for slidably removing the disengaged filter cartridge from mounted spool valve manifold assembly 33. Handle 28, because of its position at the far end of filter cartridge 20, reduces the force required to break the sealing engagement between filter cartridge 20 and valve body 34. One of ordinary skill in the art would appreciate that a handle or other means of grasping filter cartridge 20 could be located at other positions along the length of filter cartridge 20 and still provide a mechanical advantage for overcoming any compression set of the seals.

[0070] For instance, referring to Figure 16, an enclosure 70 for filter cartridge and spool valve manifold assembly 10 is shown. Enclosure 70 may be mounted to a wall or a door of an appliance or other device. Enclosure 70 includes a door 72 rotationally mounted to box 74 in the vicinity of mounted spool valve manifold assembly 33. A handle 76 is provided on one side of door 72 and one or more brackets 78 are provided on the other side of door 72. Brackets 78 are sized to slidably accommodate filter cartridge 20.

[0071] To insert filter cartridge 20 into mounted spool valve manifold assembly 33, a user would open door 72 as illustrated in Figure 16 and slidably insert filter cartridge 20 into brackets 78 such that lug 21 of filter cartridge 20 is positioned within valve housing 32 and inlet/outlet portion 24 is positioned with valve body. In this rotational position (i.e. the second rotational position), housing inlet port 39 is in fluid communication with housing outlet port 37 via bypass fluid flow path 64. Upon rotating and closing door 72, filter cartridge 20 is slidably driven into sealing engagement with valve body 34 by the interaction of lug 21 with insertion cam 48 as filter cartridge 20 is rotated into the first rotational position. In this first rotational position, as described above, housing inlet port 39 is in fluid communication with cartridge inlet port 29 via fluid flow path 60 and housing outlet port 37 is in fluid communication with cartridge outlet port 27 via fluid flow path 62, thereby allowing fluid from the fluid supply system to be filtered through filter cartridge 20. To remove filter cartridge 20 from mounted spool valve manifold assembly 33, door 72 is rotated open, thereby slidably driving filter cartridge 20 away from valve body 34 and

breaking the sealing engagement of filter cartridge 20 with valve body 34 by the interaction of shoulder surface 46 and ejection cam 36.

[0072] Due to the simple action of installing the filter cartridge 20 into the mounted spool valve manifold assembly 33, the mounted spool valve manifold assembly 33 can easily be mounted in any orientation and location in or on an appliance or other appropriate device, as would be understood by those skilled in the art. This allows manufactures, such as, for example, appliance manufactures multiple configurations to best suit their application without the need for costly changes to the filter system.

[0073] While it may appear that it would be possible to prevent a cartridge from being inserted into the spool valve manifold by having different lug 21 sizes, shapes and locations and combinations thereof along with complimentary insertion cams 48 to effectuate such prevention of an unapproved cartridge from being used in the system, not all such modifications would be optimal and might lead to other issues, as the cartridge lug features are presently believed to be shaped to provide optimum insertion and removal force for the cartridge. By making changes significant enough to prevent an unapproved cartridge from being installed into the manifold, it is presently believed that the cartridge lug shape would have to be changed so that the insertion forces would be significantly increased and the presently believed results would be increased difficulty for operation by the user to activate the valve. It is also presently believed that the forces to un-install the cartridge would also be increased and thus, the system would most likely become more difficult to use by an average user.

[0074] Also due to the limited geometry of the cartridge lugs, there would be a very limited number of combinations that would fit thus minimizing the effectiveness of the design for multiple combinations.

[0075] The filter cartridge 20 and the spool valve manifold interface each include complimentary key structures. Such complimentary key structures are specifically designed so that only specific type of filter cartridge having the one specific complimentary key structure pattern, out of a plurality of possible key complimentary structure pattern(s) available for such use, can be installed in the spool valve manifold interface(s) having the matching specific complimentary key structure.

[0076] One representative system includes a keying system achieved by a mechanical system, as illustrated in Figures 17-21, where the various keying features of the filter

cartridge have to align and mate correctly with various keying features on the spool valve manifold interface located on the spool valve manifold, the keying features being selected from any operable combination of a plurality of sizes, shapes and locations and combinations thereof with respect to protrusions and depressions formed on the filter cartridge 20 and the spool valve manifold 30, as would be known to those skilled in the art. Mechanical keying systems, such as those disclosed in US Patent Nos. 6,458,269 and 6,949,189 B2, entitled Keyed Filter Assembly, owned by the assignee of the present application disclose exemplary approaches that are similar to and could be applicable to possible specific embodiments of the present disclosure and are herein incorporated by reference to the extent not inconsistent with the present disclosure.

[0077] One representative mechanical keying system 80 is illustrated in Figures 17-21. These Figures illustrate the basic principle of the concept and are not intended to disclose all possible combinations of the plurality of various of protrusions and depressions and other operable combinations that can be formed in the interfacing component of the cartridge and in the corresponding receiving component of the spool valve manifold, as would be understood by those skilled in the art.

[0078] Figures 17, 18 and 20 illustrate the concept and in the lining up of the keying structures 82, 84 that have been formed on an appropriate component of the filter cartridge and the spool valve manifold respectively. Specifically, as illustrated, a relatively larger protrusion 86 is formed on one side of the filter cartridge neck 88 and a relatively smaller protrusion 90 is formed on the other side of the filter cartridge neck 88 and complementary sized depressions or cut-outs 91, 92 are formed on the corresponding portion of the spool valve manifold (Figures 19 and 20) such that, when the lug 21 is inserted into the insertion cam 48, the filter cartridge is operatively inserted into the spool valve manifold, as best illustrated in Figures 19 and 21.

[0079] As would be understood by those skilled in the art, the sizes shapes and numbers of complementary protrusions/depressions can be nearly infinitely varied with a limit being the practical consequences of having too many complementary members on any one filter or cartridge/spool valve manifold combination.

[0080] Keying systems that perform the selective interfacing function can also be obtained through the use of other non-mechanical technologies such as, but not limited to, RFID tags, magnetic readers and bar code readers and other operative systems known in the art. In these

non-mechanical types of keys, electronics would be used to control the activation of the solenoid valves that are used to control the flow of water from the filter cartridge to the end appliance or dispenser, as evidenced by the disclosure contained in US Patent Application Publication No. US 2006/0060512 A1, entitled, System For Monitoring the Performance of Fluid Treatment Cartridges, published March 23, 2006, the disclosure of which is incorporated herein by reference to the extent not inconsistent with the present disclosure, as would be understood by those skilled in the art.

[0081] One possible optional inlet component that can be incorporated into the manifold assembly of the present disclosure provides a mechanism for converting the system to a “shut-off” style system when a filter cartridge is not installed in the spool valve manifold. This optional component (a modified inlet) utilizes a poppet valve that is controlled by a cam surface on the valve spool valve manifold. When the spool valve manifold is turned to the filter cartridge un-install position, the poppet valve will close thus arresting the flow of fluid through the spool valve manifold. When the spool valve manifold is turned to the filter mode position (filter installed position), the poppet valve will be forced open to allow fluid to flow through the spool valve manifold and into the filter cartridge.

[0082] As illustrated in Figures 22-26, the modified inlet assembly 100 is configured as a “floating” assembly. The floating assembly is spring loaded such that, as internal pressure in the filter cartridge and the spool valve manifold increase, the inlet subassembly will start to push away from the spool valve manifold and the poppet valve will start to close. Once a predetermined pressure is reached at the inlet, the inlet subassembly will be pushed away from the spool valve manifold a distance sufficient for the poppet valve to seat (close) and thus shutoff the fluid flow into the spool valve manifold and subsequently into the filter cartridge.

[0083] The spool valve manifold 30 component of the liquid filter cartridge and spool valve manifold assembly 10, according to the present disclosure, presently preferably, comprises three sections; those being the inlet assembly 100, the filter interconnect structure 102 and the outlet assembly 104. The inter-relationship of these three sub-components controls the flow of fluid, presently preferably, water into and out of the filter cartridge 20. In the illustrated representative embodiment, the inlet assembly 100 is a sprung element. By the term, “sprung element,” we mean that, as the filter cartridge 20 is installed into and removed from the

manifold assembly 30, the inlet assembly 100 will traverse up and down with the movement of the filter cartridge neck or stem 88.

[0084] As illustrated, the spool valve manifold inlet assembly 30 comprises a representative outlet assembly 102; a representative inlet assembly 100, a representative inlet return spring 106 and a representative inlet return stop 108.

[0085] As illustrated in Figures 22-26, one presently preferred embodiment of the inlet assembly 100, according to the present disclosure, comprises a representative inlet 110, a representative inlet connector 112, a representative poppet valve 114, a representative poppet valve spring 116, a representative collet 118 a representative collet retainer 120, and representative sealing structure or o-rings 122.

[0086] Inlet assembly 100 comprises a head interface section 123, for interfacing with the filter interconnect structure (Head) 124, and comprises inlet connector 112 for receiving sealing structure, such as, for example, an o-ring 125, operatively positioned therein, an inlet poppet valve 114 having a spring operatively positioned thereon for biasing the poppet valve 114 toward the filter cartridge 20, when a filter cartridge is positioned in the liquid filtration system is operatively positioned in the spool valve manifold assembly 10.

[0087] As best illustrated in Figures 25-26, an inlet return spring 106 is provided and operatively interfaces with the inlet assembly 100, as will be described in more detail below.

[0088] Since the inlet assembly 100 is a sprung element, the inlet assembly 100 will also traverse up and down due to fluid pressure when the cartridge is installed in the manifold assembly 30. Specifically, the poppet valve 114 is always engaged with the filter cartridge poppet interface 126 when the filter cartridge is installed and the poppet valve 114 is biased in the open position. However, as the fluid pressure of the liquid filtration system (not shown) is increased, the inlet assembly 100 will start to move up and away from the filter cartridge 20. As the liquid pressure increase is continued, the inlet assembly 100 will move far enough away from the filter cartridge 20 that the poppet valve 114 will close, thus shutting off the inlet liquid pressure, as illustrated in Figure 26.

[0089] To have a fluid filtration system with a mechanism that allows the filter to translate in and out (click-in / click-out), it has been found that at least one of the ports that control water flow (inlet or outlet port) into or out of the system must be allowed to "float."

[0090] In a static condition (i.e. the fluid filtration system is full of fluid or water, but the outlet port is closed, so that no water can move through the fluid filtration system), water is

trapped in every volumetric cavity that can contain water (this is basically between every pressurized O-ring).

[0091] Therefore, in order to translate the filter cartridge forward, these volumetric cavities need to be able to translate with the filter (this basically requires that a column of water be moved without changing its volume).

[0092] If the inlet 110 of the present disclosure were not allowed to move/translate/float, the column of water that is trapped between the filter O-rings would not be able to translate and would have to be compressed. If these columns of water were required to compress in order to effectuate filter translation, as the filter cartridge is pushed forward during un-install, the force to compress the water that is trapped between the filter O-rings would be extremely high due to hydraulic pressure required to compress water.

[0093] Therefore, the benefits derived from the optional "floating" inlet have been found to be quite desirable to the successful operation of this particular representative embodiment of the present disclosure. While we have illustrated the inlet as the "floating" component, it should be understood that the outlet or other valve sub assembly that enables water to be displaced without compressing the water could also be utilized as the "floating" component.

[0094] This phenomenon of the inlet assembly 100 floating according to the amount of fluid pressure in the system transforms the system of the present disclosure into an automatic liquid shut-off system. As illustrated in Fig. 26, the liquid pressure increases past a selected, predetermined desired maximum operating system pressure, the poppet valve 114 will be closed thereby closing the poppet valve inlet 130 and automatically shutting-off liquid flow to the filter cartridge 20 by the movement of the inlet assembly 100 away from the filter cartridge 20. Once the liquid pressure decreases to a level that is within the selected, operating pressure of the system, the poppet valve inlet 130 will open, see Fig. 24, thereby allowing the fluid to flow into and through the filter cartridge 20 exiting the liquid filtration system via the outlet 110, as illustrated in Fig. 24.

[0095] Because the liquid filtration system (not shown) and utilized with the present disclosure is capable of automatically controlling the operating pressure limits, some unique system safety features directly result therefrom. For example, if the liquid filtration system were to experience a water spike (i.e. water hammer) or high pressure, the downstream components of the inlet assembly (i.e. head, bracket, filter cartridge, outlet assembly, etc) would not be subjected to this water spike or high pressure, greater than about 100psi.

Specifically, as the illustrated in Figure 26, the inlet assembly 132 has moved more distant from the poppet valve 114, as compared to Figure 25, thereby moving the poppet valve seat out of contact with the spool valve manifold 10 and thus preventing the flow of liquid into or out of filter cartridge.

[0096] Due to this unique and innovative safety feature, the downstream components of the manifold assembly 30 and filter cartridge 20 do not need to be constructed to withstand such high pressure events. Not being required to construct the down stream components to withstand such a high pressure would enable the liquid filtration system manufacturer to realize a significant cost savings in the types of material that need to be used and the strength of those materials used. Fluid filter systems, manufactured in accordance with the present disclosure, could now be built with lower price commodity materials and relatively thin wall sections, as compared to the materials and wall thickness now common in such systems. Utilization of lower price commodity materials and relatively thin wall sections would dramatically reduce the cost of each component from a material cost and a manufacturing cost perspective.

[0097] Thus, it is possible to produce a plurality of representative fluid filter systems in accordance with the present disclosure, as described above, which can be customized to whatever pressures limits to which the manufacture desires that the overall fluid filter system should be controlled. As should be understood, shut-off pressures are controlled by the inlet return/compression spring 106 and by changing the characteristics of this inlet return/compression spring 106 the opening pressure and the shutoff pressure can be varied, in accordance with known principles.

[0098] The poppet valve 114 of the inlet assembly 100 has the ability to shutoff flow at high pressures and reset itself or return to normal flow operation once the pressure level falls back below a predetermined maximum limit. This predetermined maximum limit can be simply modified by adjusting the strength of the inlet return spring, as would be known to those skilled in the art.

[0099] Although the present disclosure has been described and illustrated with respect to example embodiments, it is apparent that modifications and changes can be made thereto without departing from the spirit and scope of the presently disclosed fluid filtration system comprising a fluid filtration assembly and a replaceable fluid filter cartridge containing filter media, the fluid filtration assembly having the capability for facilitating the removal of a first

replaceable fluid filter cartridge and then having the capability for facilitating the installation of another replaceable fluid filter cartridge therein in a fluid supply system and, in particular, to the spool valve manifold assembly that facilitates the quick and easy removal and installation of the replaceable fluid filter cartridges from and into the fluid filtration assembly as defined in the following claims.

What is claimed is:

1. A spool valve manifold for use with a filter cartridge having an inlet/outlet portion that includes a cartridge inlet port and a cartridge outlet port, the spool valve manifold comprising:
 - a valve housing having a housing inlet port and a housing outlet port; and
 - a valve body operatively positioned within the valve housing and being configured to rotate around a first axis relative to the valve housing, the valve body being configured to receive the inlet/outlet portion of the filter cartridge via insertion of the inlet/outlet portion into the valve body in a direction about perpendicular to the first axis, such that, when the valve body is at a first rotational position relative to the valve housing the housing inlet port and the cartridge inlet port are in fluid communication via a first fluid flow path and the housing outlet port and the cartridge outlet port are in fluid communication via a second fluid flow path, and when the valve body is at a second rotational position relative to the valve housing, the housing inlet port and the cartridge inlet port are not in fluid communication and the housing outlet port and the cartridge outlet port are not in fluid communication.
2. The spool valve manifold of claim 1, wherein when the valve body is at the second rotational position relative to the valve housing, the housing inlet port and the housing outlet port are in fluid communication via a third fluid flow path.
3. The spool valve manifold of claim 1, wherein when the valve body is at the second rotational position relative to the valve housing the housing inlet port and the housing outlet port are not in fluid communication.
4. The spool valve manifold of claim 1, wherein the valve housing further comprises:
 - an insertion cam component configured to cooperate with a complementary insertion cam component on the filter cartridge.
5. The spool valve manifold of claim 1, wherein the valve housing further comprises:
 - an ejection cam component configured to cooperate with a complementary ejection cam component on the filter cartridge.
6. The spool valve manifold of claim 2, further comprising:
 - a first seal located between the valve body and the valve housing and configured to prevent fluid leakage from the first fluid flow path;
 - a second seal located between the valve body and the valve housing and configured to prevent fluid leakage from the second fluid flow path; and

a third seal located between the valve body and the valve housing and configured to prevent fluid leakage from the third fluid flow path.

7. A spool valve manifold for use with a filter cartridge having an inlet/outlet portion that includes a cartridge inlet port and a cartridge outlet port, the spool valve manifold comprising:

a valve housing having a housing inlet port and a housing outlet port;

a valve body operatively positioned within the valve housing and being configured to rotate around a first axis relative to the valve housing, the valve body being configured to receive the inlet/outlet portion of the filter cartridge via insertion of the inlet/outlet portion into the valve body in a direction about perpendicular to the first axis, such that, when the valve body is at a first rotational position relative to the valve housing the housing inlet port and the cartridge inlet port are in fluid communication via a first fluid flow path and the housing outlet port and the cartridge outlet port are in fluid communication via a second fluid flow path, and when the valve body is at a second rotational position relative to the valve housing, the housing inlet port and the cartridge inlet port are not in fluid communication and the housing outlet port and the cartridge outlet port are not in fluid communication; and wherein the filter cartridge further comprises:

an inlet assembly for traverse up and down due to fluid pressure fluctuations when the cartridge is installed in the manifold assembly, the inlet assembly including a poppet valve for always being engaged with the filter cartridge poppet interface when the filter cartridge is installed and the poppet valve is biased in the open position, as the fluid pressure is sufficiently increased, the inlet assembly will move far enough away from the filter cartridge such that the poppet valve will close, thereby shutting off the inlet liquid pressure.

8. A spool valve manifold for use with a fluid filter cartridge having an inlet/outlet portion that includes a cartridge inlet port and a cartridge outlet port, the spool valve manifold comprising:

a valve housing having a housing inlet port and a housing outlet port;

a valve body located within the valve housing and configured to rotate around a first axis relative to the valve housing, the valve body configured to receive the inlet/outlet portion of the filter cartridge, such that, when the valve body is at a first rotational position relative to the valve housing the housing inlet port and the cartridge inlet port are in fluid

communication via a first fluid flow path and the housing outlet port and the cartridge outlet port are in fluid communication via a second fluid flow path, and when the valve body is at a second rotational position relative to the valve housing, the housing inlet port and the cartridge inlet port are not in fluid communication and the housing outlet port and the cartridge outlet port are not in fluid communication; and keying structure, operatively positioned on the spool valve manifold and the fluid filter cartridge and being effective, if the keying structure on the spool valve manifold and the fluid filter cartridge are complementary, to facilitate the operative interconnection of the valve manifold and, if the keying structure on the spool valve manifold and the fluid filter cartridge are not complementary to prevent the operative interconnection of the valve manifold and the fluid filter cartridge.

9. The spool valve manifold of claim 8, wherein the valve body is configured to receive the inlet/outlet portion of the filter cartridge via insertion of the inlet/outlet portion into the valve body in a direction about perpendicular to the first axis.

10. The spool valve manifold of claim 8, wherein the valve housing further comprises:
an insertion cam component configured to cooperate with a complementary insertion cam component on the filter cartridge.

11. The spool valve manifold of claim 8, wherein the valve housing further comprises:
an ejection cam component configured to cooperate with a complementary ejection cam component on the filter cartridge.

12. A filter cartridge and spool valve manifold assembly comprising:
a filter cartridge including a filter element and inlet/outlet portion in fluid communication with the filter element, the inlet/outlet portion having a cartridge inlet port and a cartridge outlet port; and

a spool valve manifold including a housing and a body, the housing having a housing inlet port and a housing outlet port adapted for fluid communication with a fluid supply system, the body located within the housing and configured to rotate around a first axis relative to the housing, such that the inlet/outlet portion of the filter cartridge is fluidly coupled to the body via insertion of the inlet/outlet portion into the body in a direction about perpendicular to the first axis.

13. The assembly of claim 12, such that when the body is at a first rotational position relative to the housing, the housing inlet port and the cartridge inlet port are in fluid communication via a first fluid flow path and the housing outlet port and the cartridge outlet

port are in fluid communication via a second fluid flow path, and when the body is at a second rotational position relative to the housing the housing inlet port and the cartridge inlet port are not in fluid communication and the housing outlet port and the cartridge outlet port are not in fluid communication.

14. The assembly of claim 13, wherein when the body is at the second rotational position relative to the housing, the housing inlet port and the housing outlet port are in fluid communication via a third fluid flow path.

15. The assembly of claim 12, wherein at least one of the spool valve manifold and the filter cartridge includes an insertion cam.

16. The assembly of claim 12, wherein at least one of the spool valve manifold and the filter cartridge includes an ejection cam.

17. The assembly of claim 13, wherein, when the body rotates from the first to the second rotational position, the filter cartridge is ejected from the body.

18. The assembly of claim 13, wherein, when the body rotates from the second to the first rotational position, the filter cartridge is moved into the body.

19. The assembly of claim 13, wherein, during rotation, an angle through which the filter cartridge rotates relative to a bracket is less than about 90.

20. The assembly of claim 12, further comprising:

a bracket rotatably mounted adjacent the spool valve manifold and configured to slidably hold the filter cartridge as the body rotates from the first to the second rotational position.

1/15

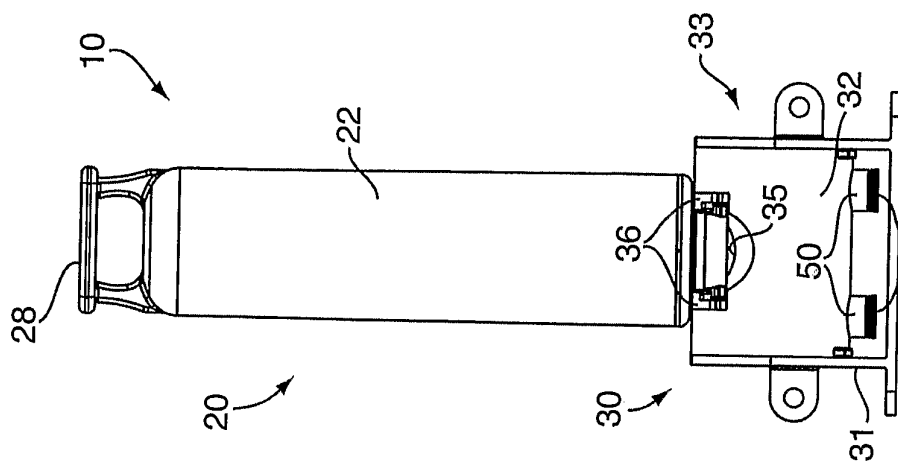


Fig. 3

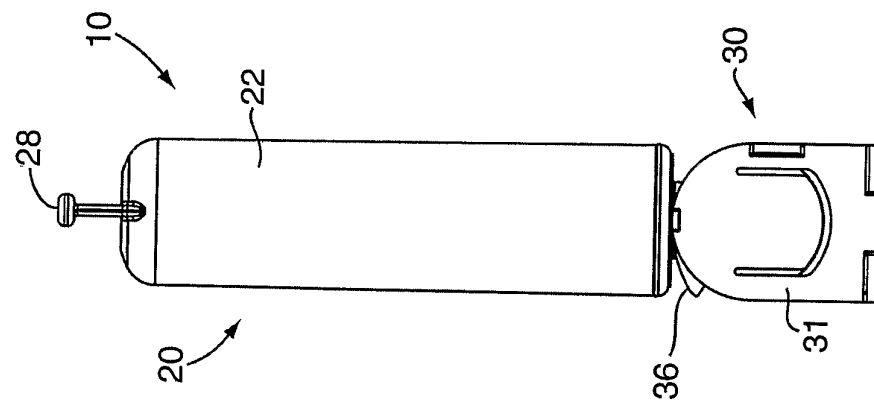


Fig. 2

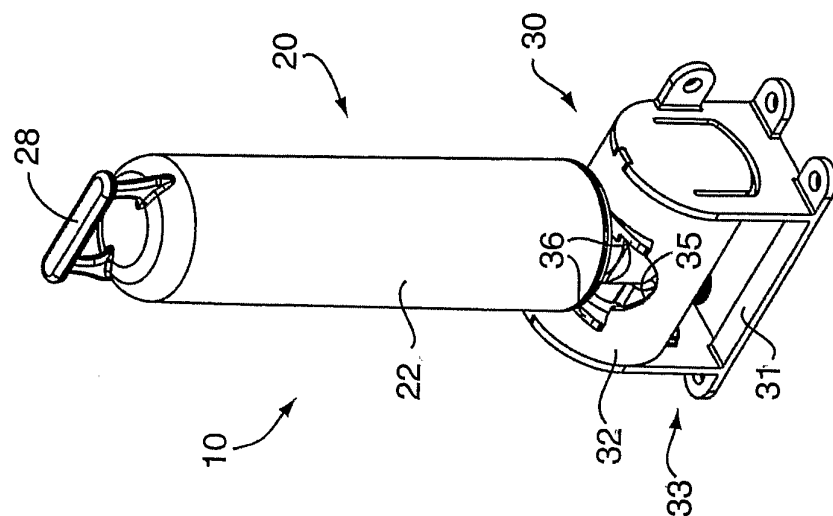


Fig. 1

2/15

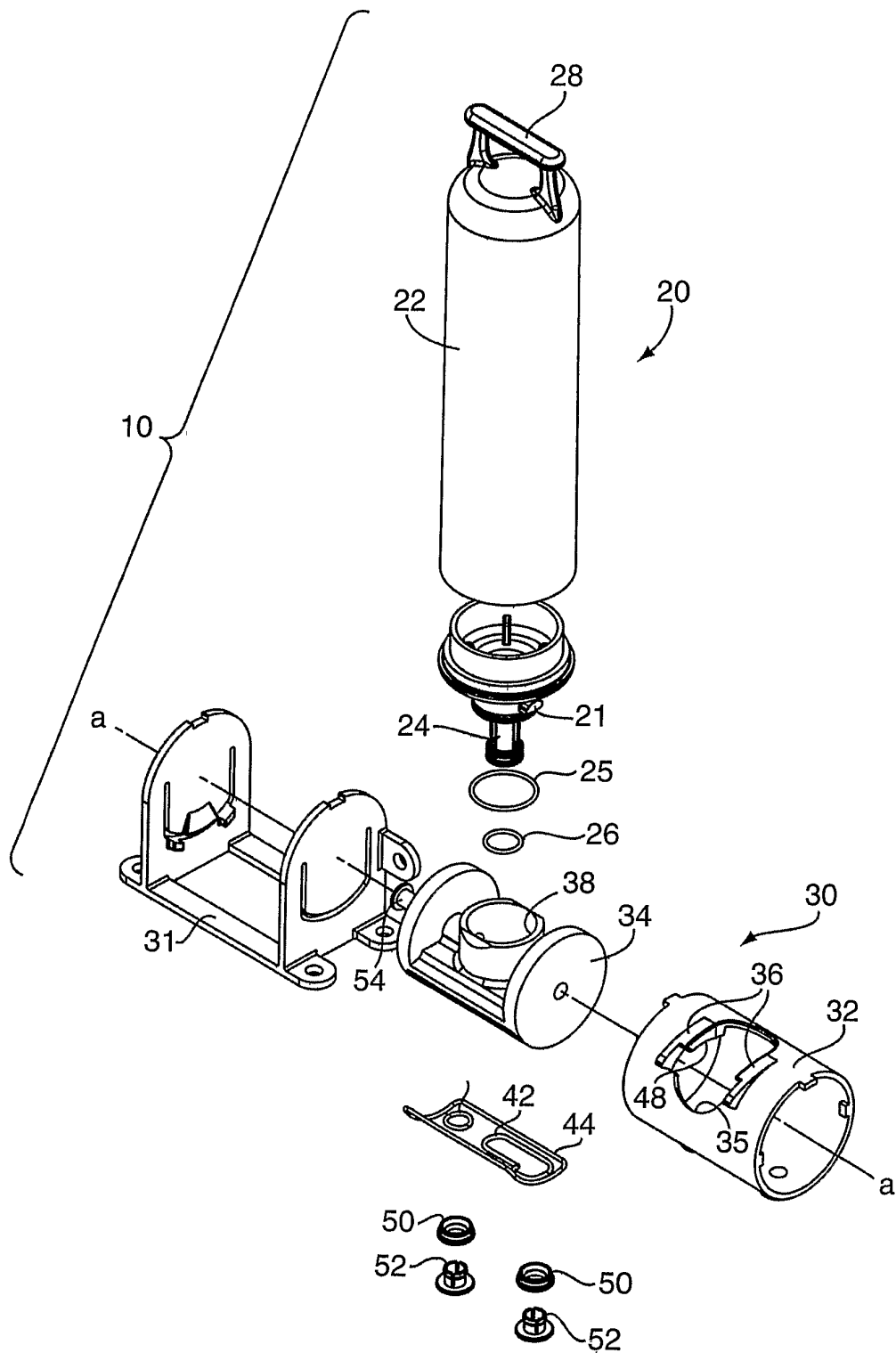
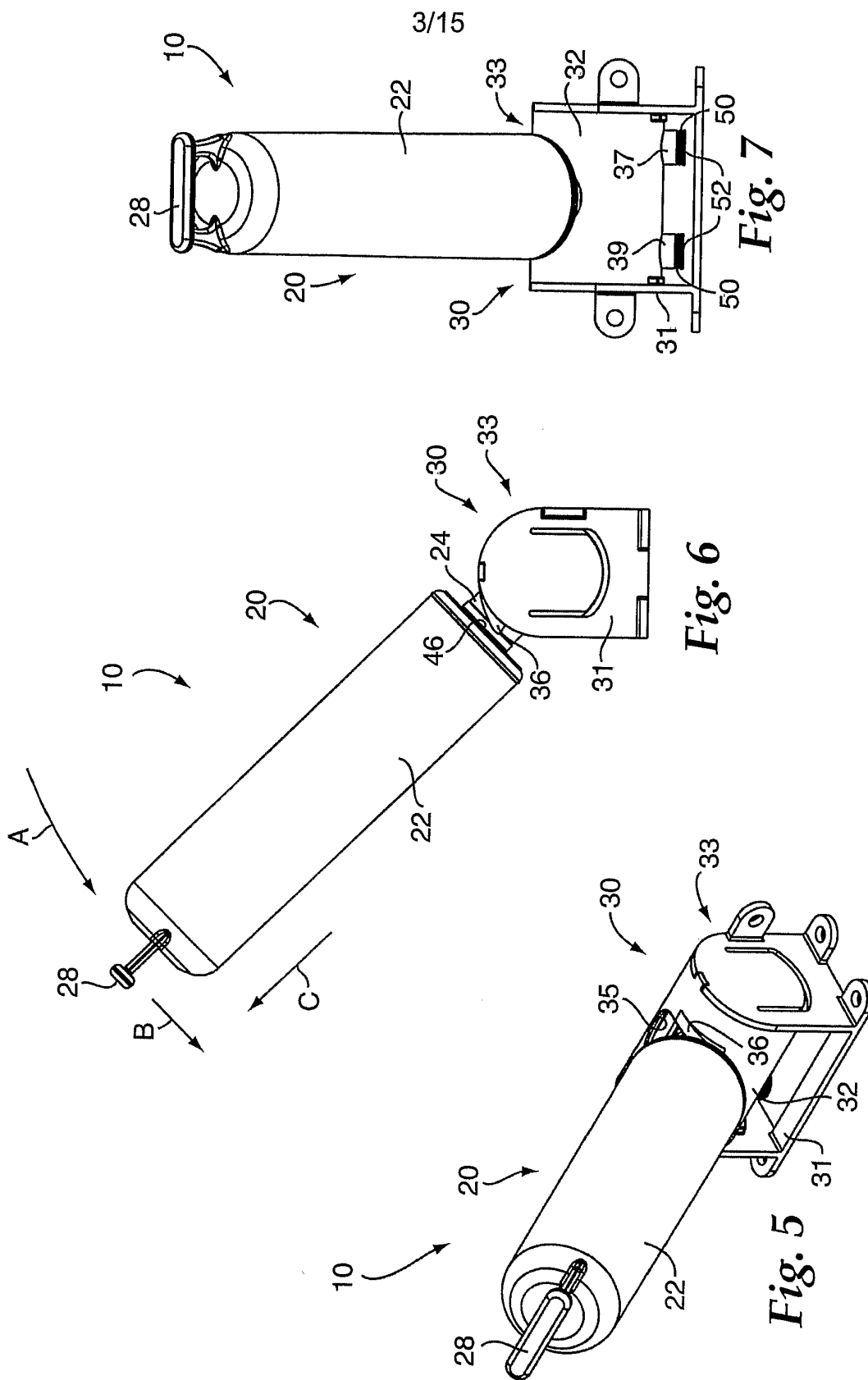


Fig. 4



3/15

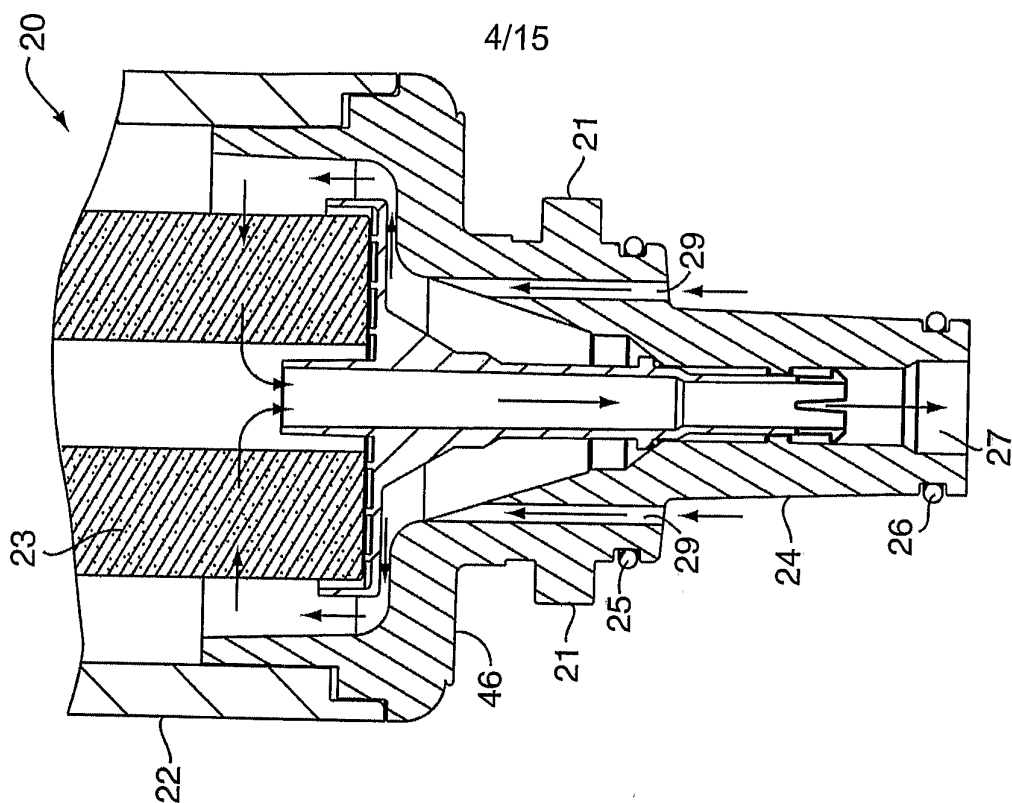


Fig. 9

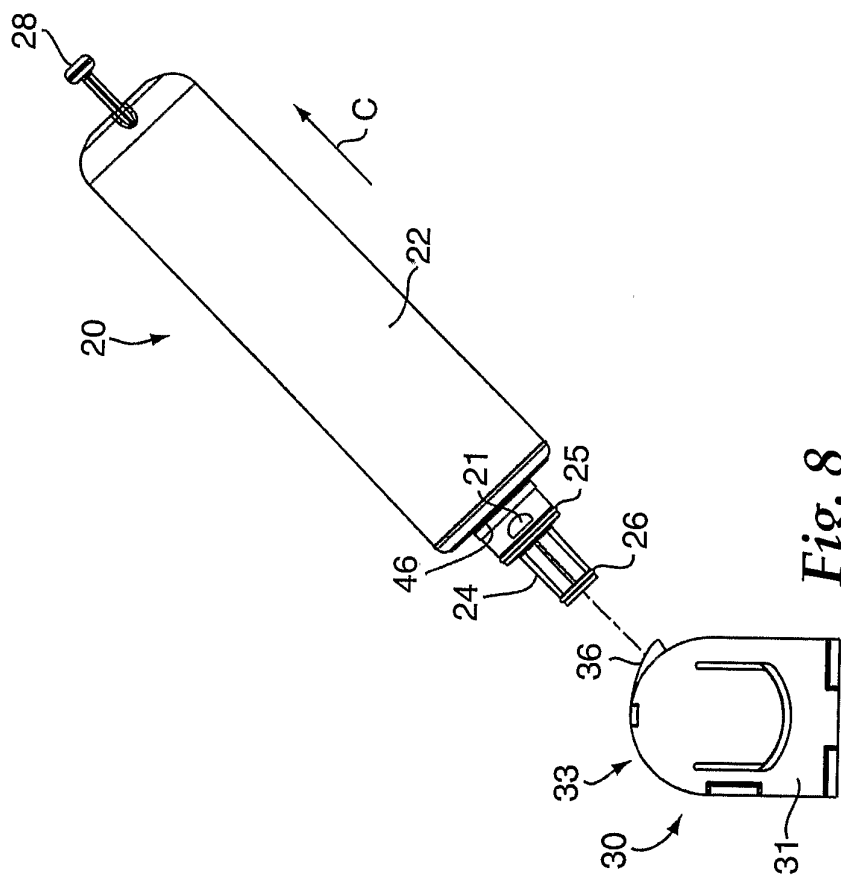


Fig. 8

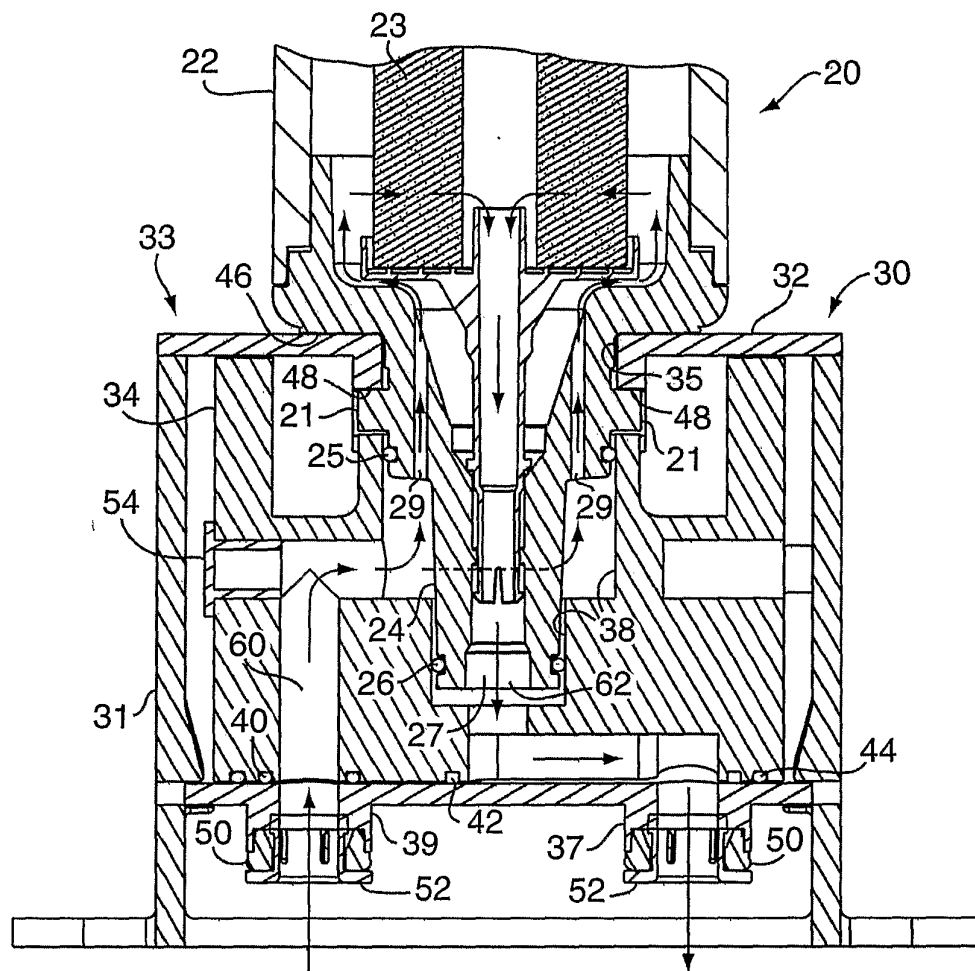


Fig. 10

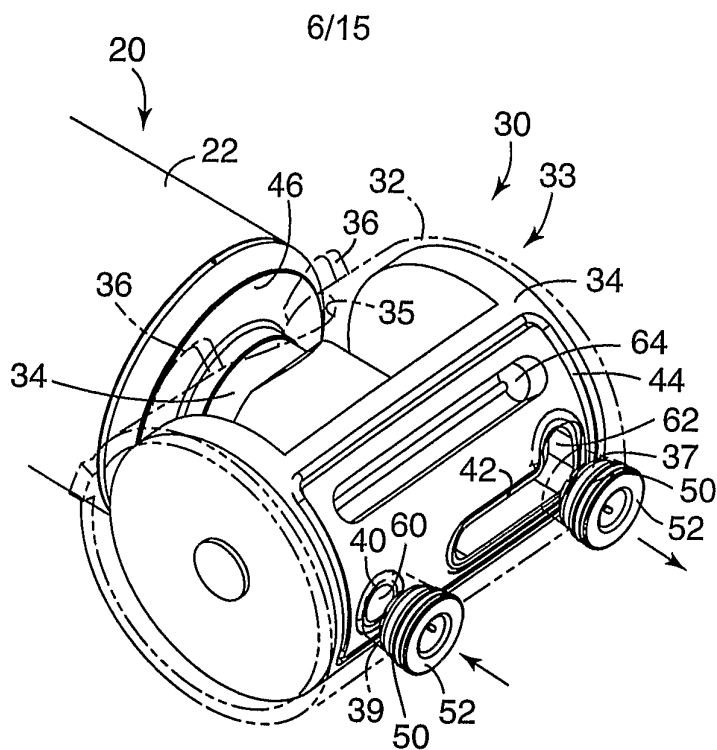


Fig. 11

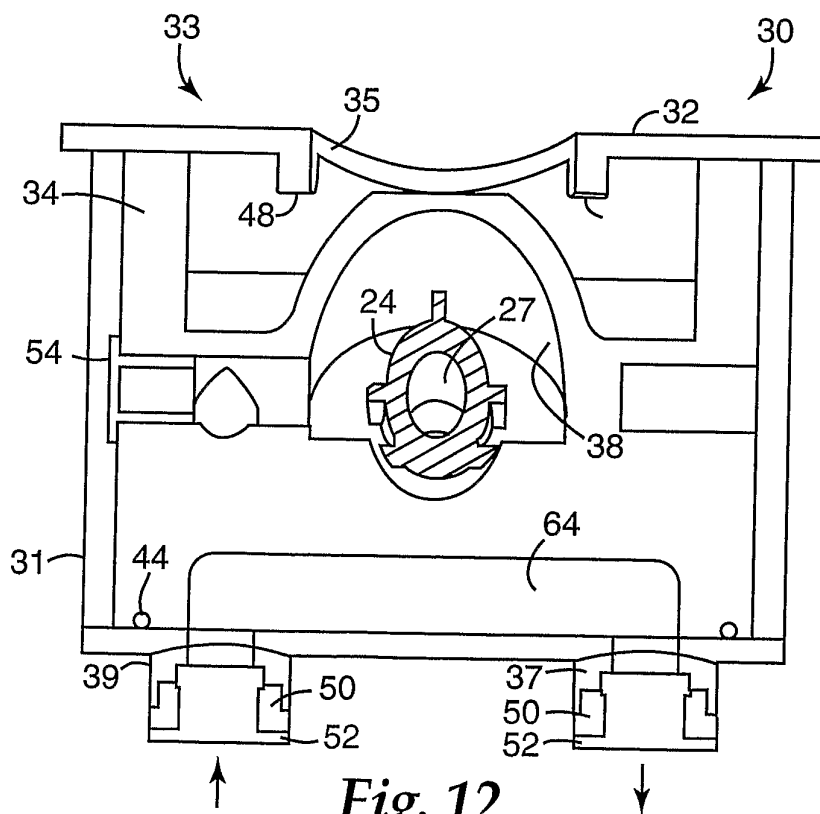


Fig. 12

7/15

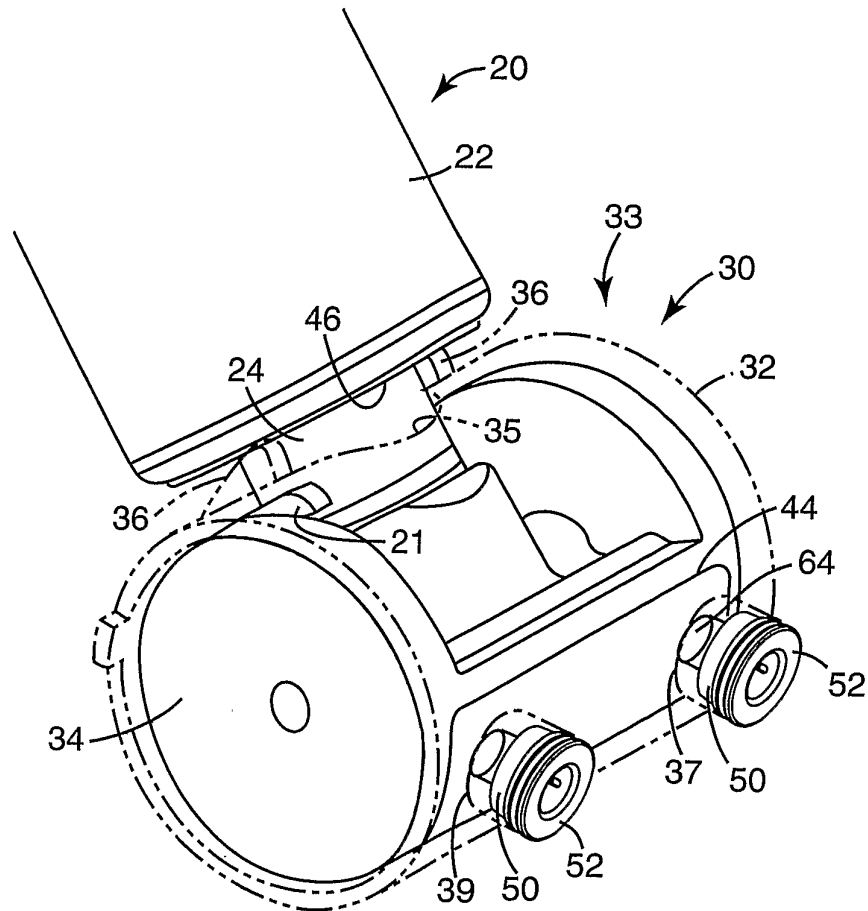
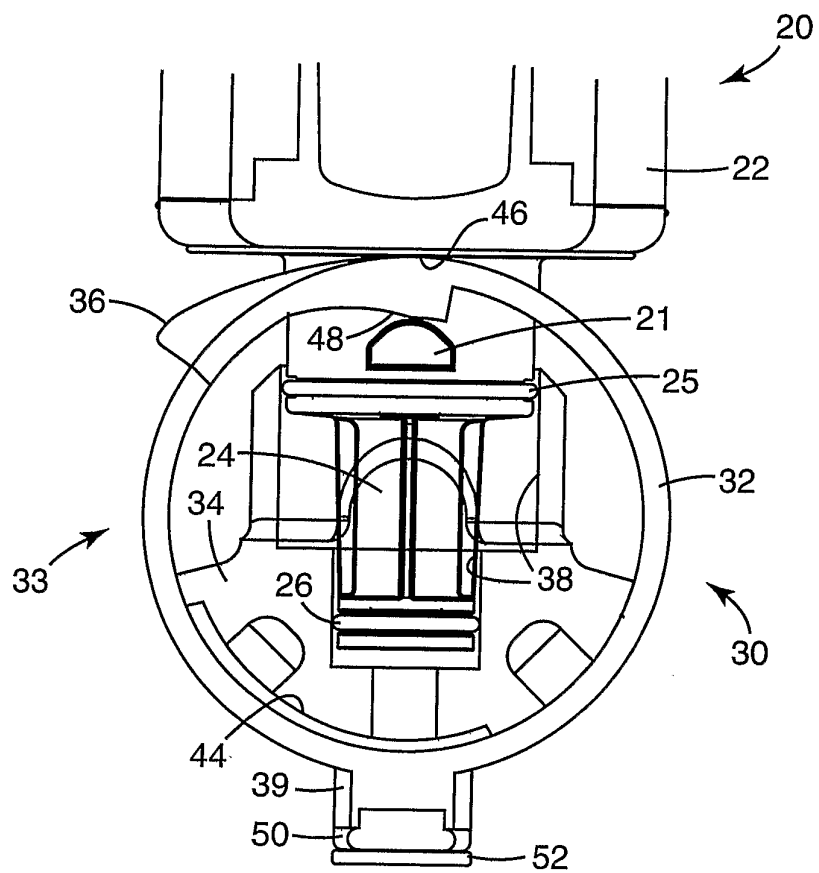
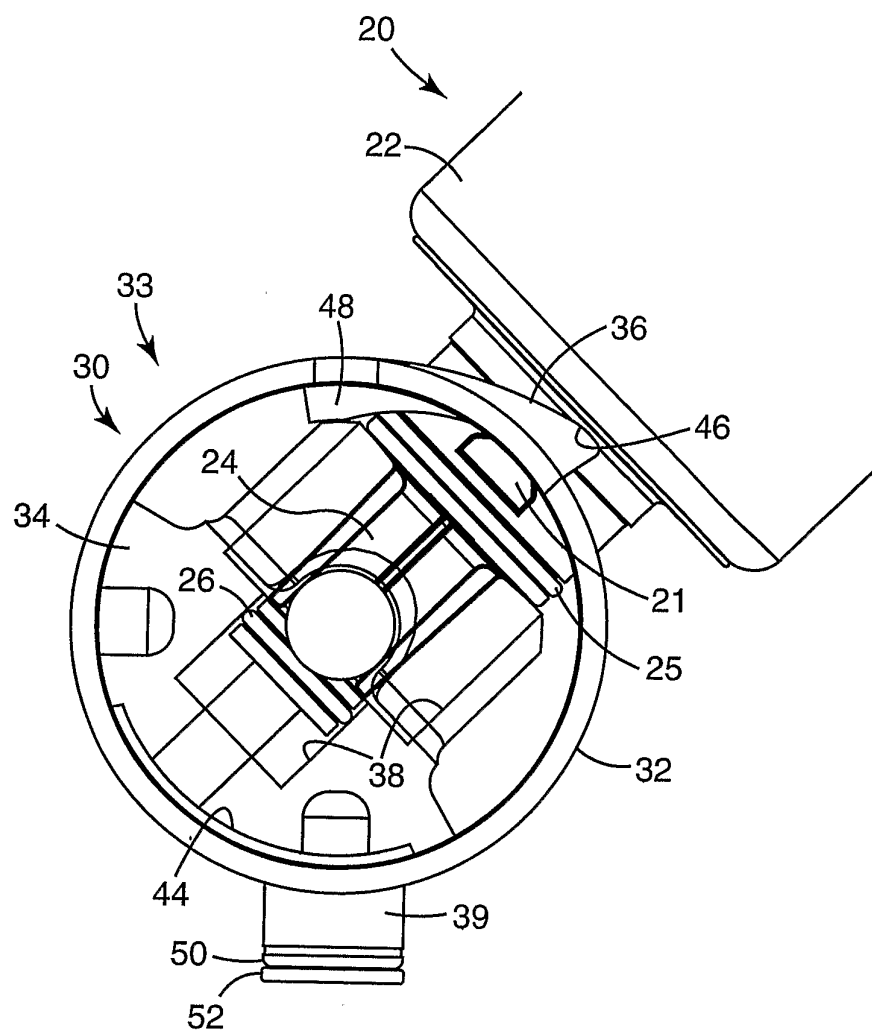


Fig. 13

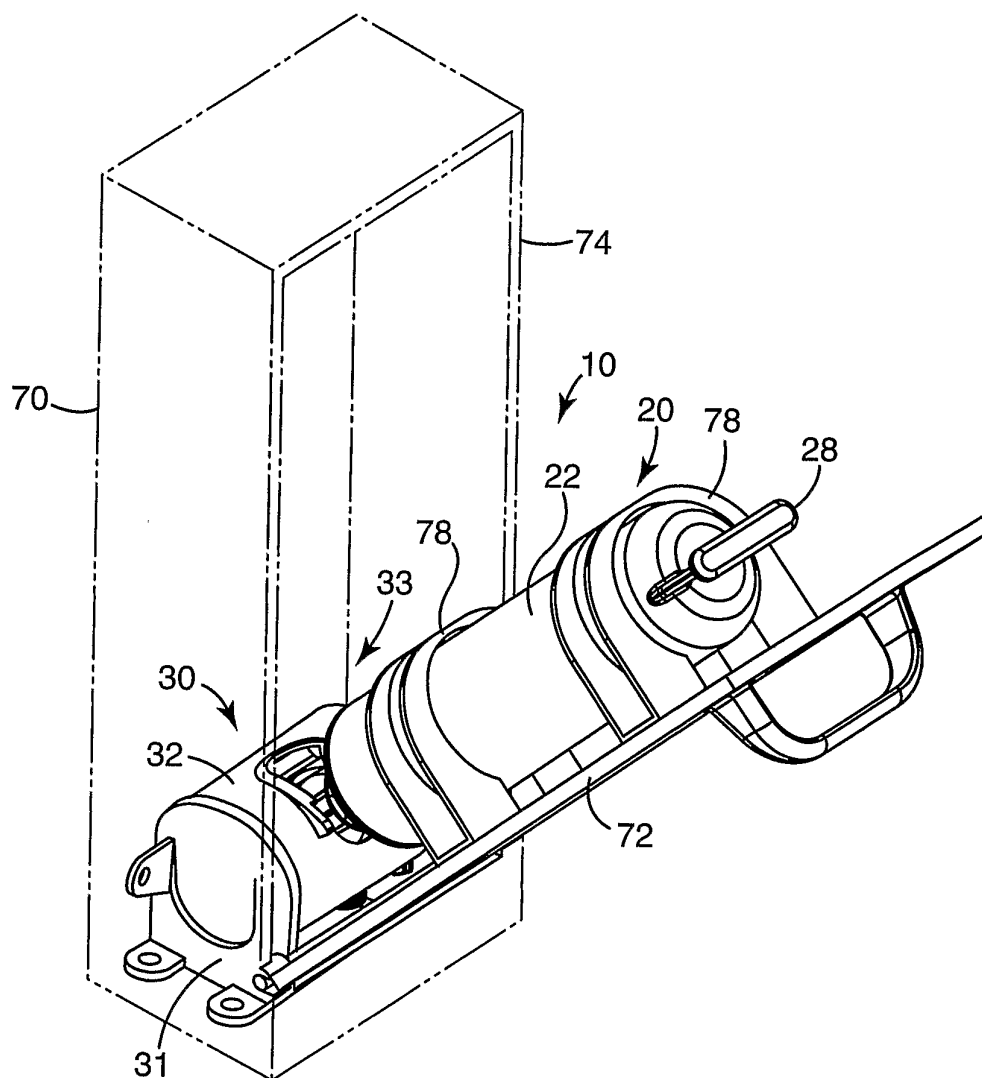
8/15

*Fig. 14*

9/15

*Fig. 15*

10/15

*Fig. 16*

11/15

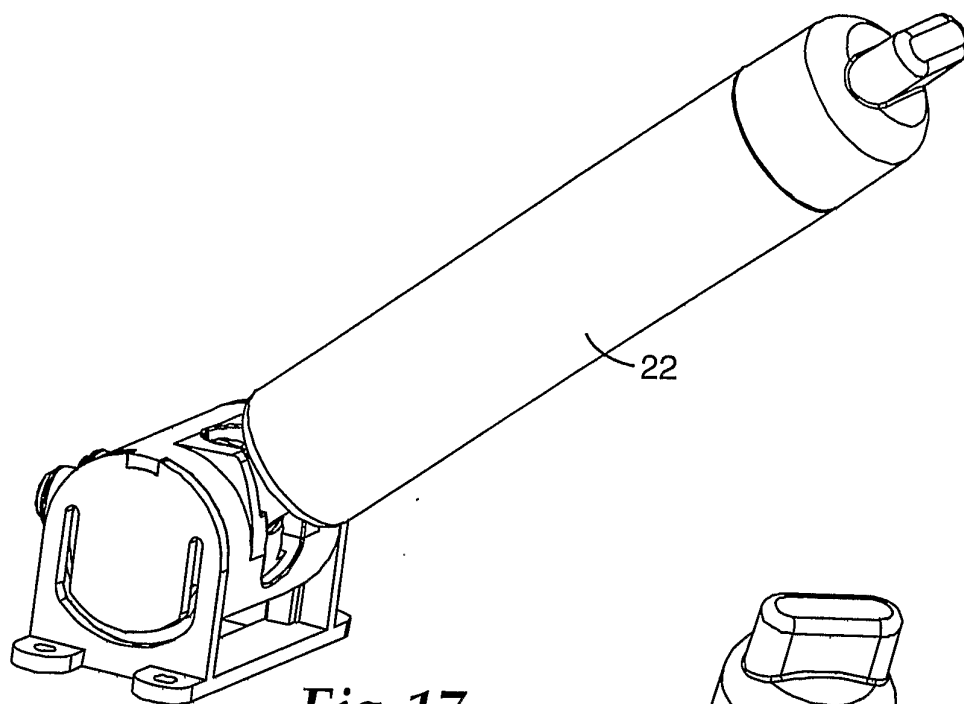


Fig. 17

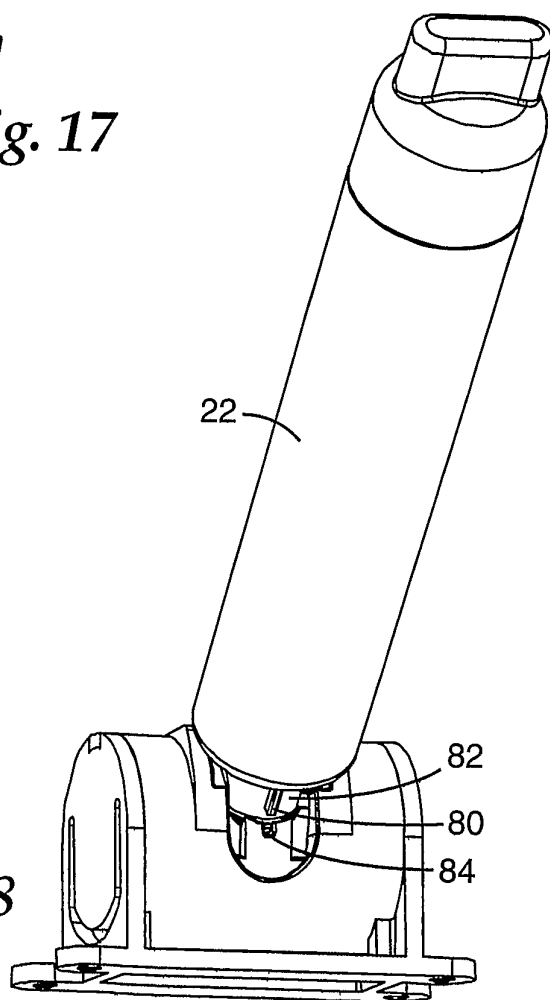


Fig. 18

12/15

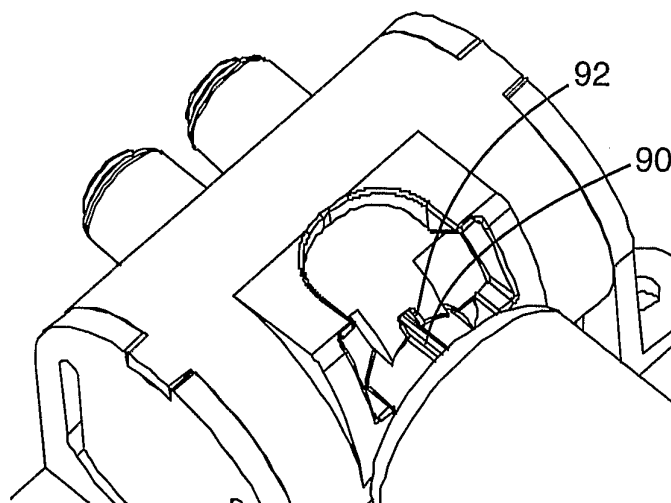


Fig. 19

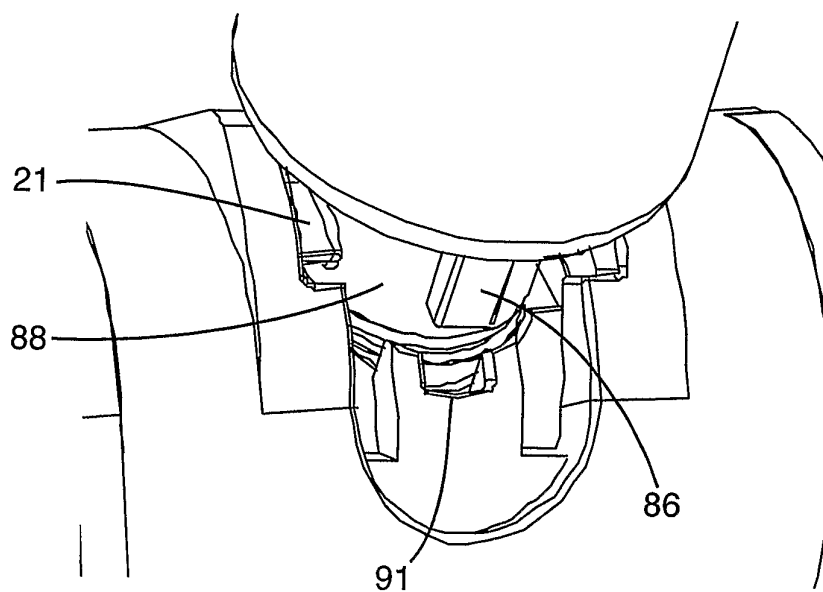


Fig. 20

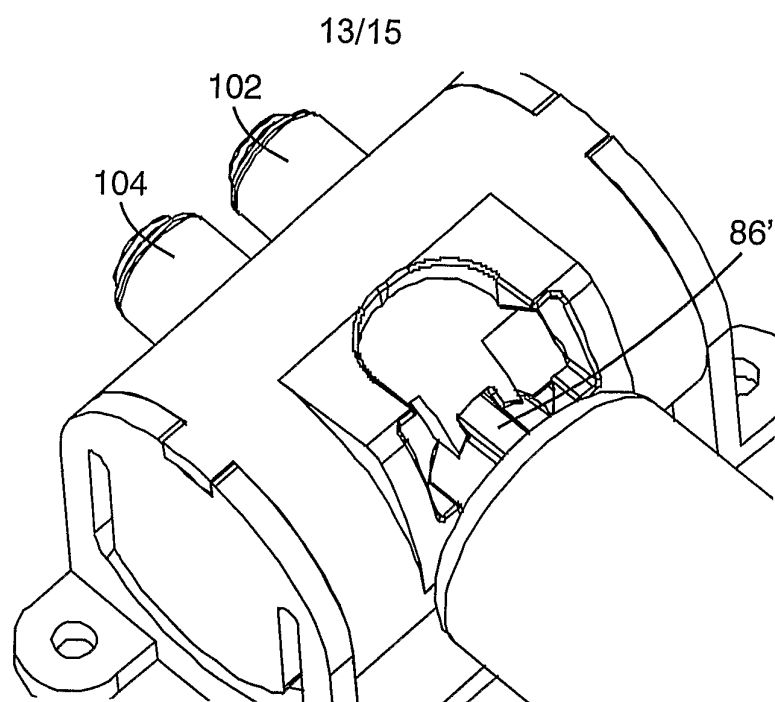


Fig. 21

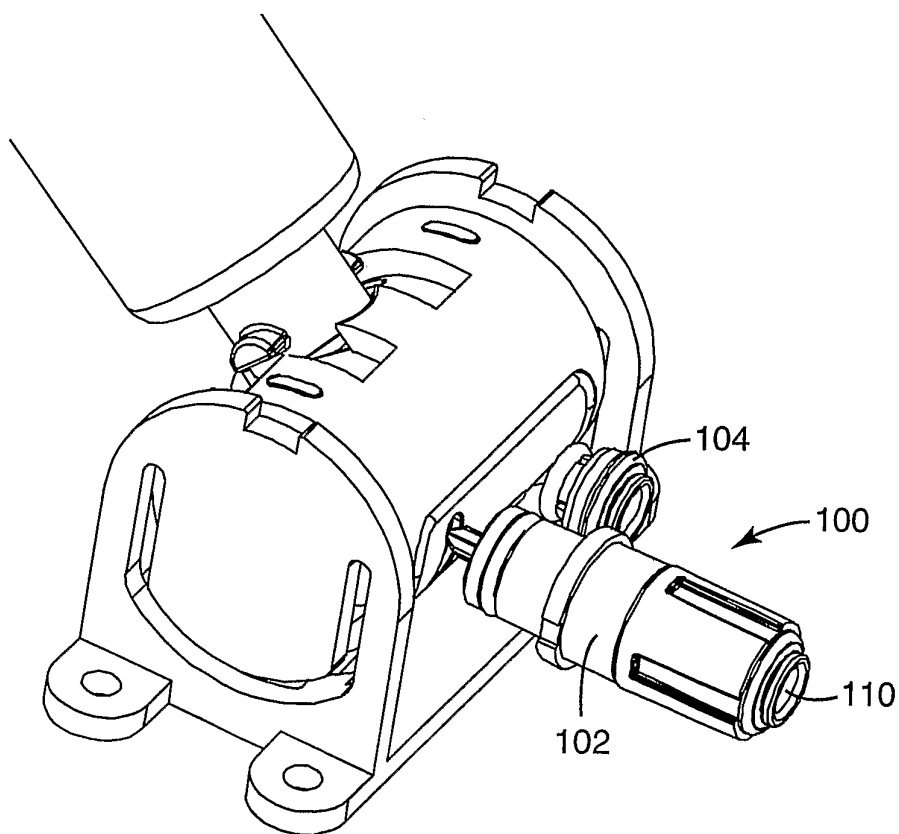


Fig. 22

14/15

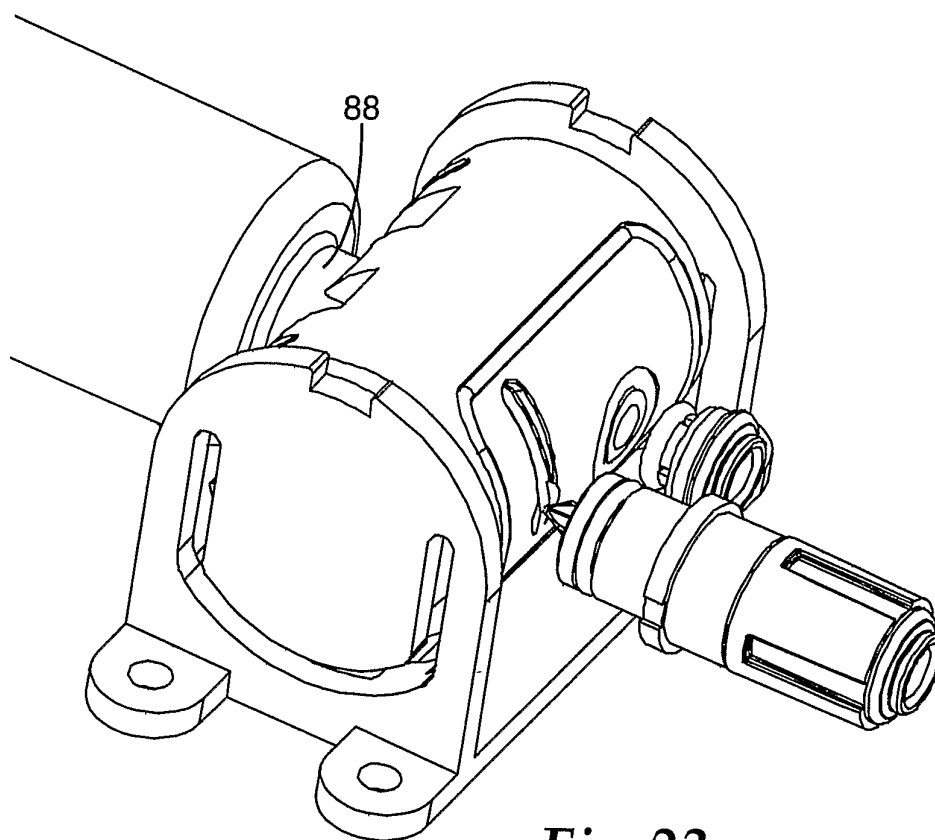


Fig. 23

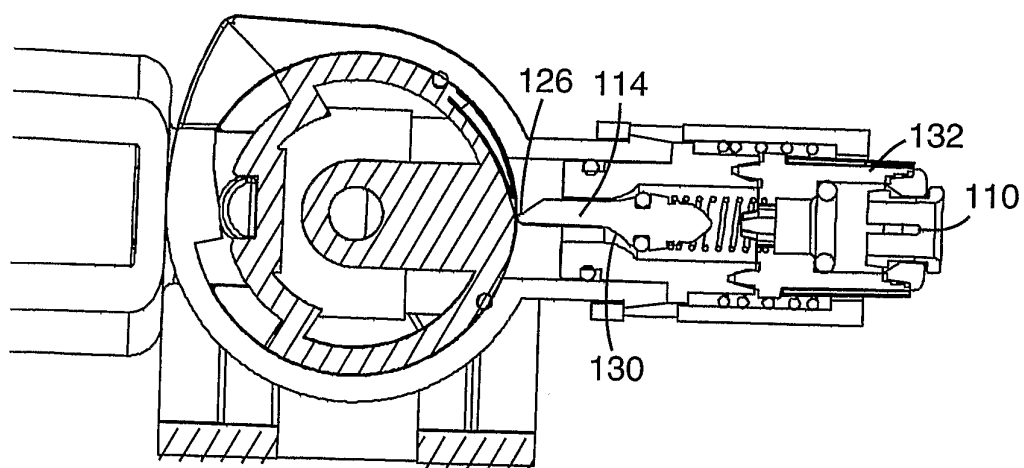
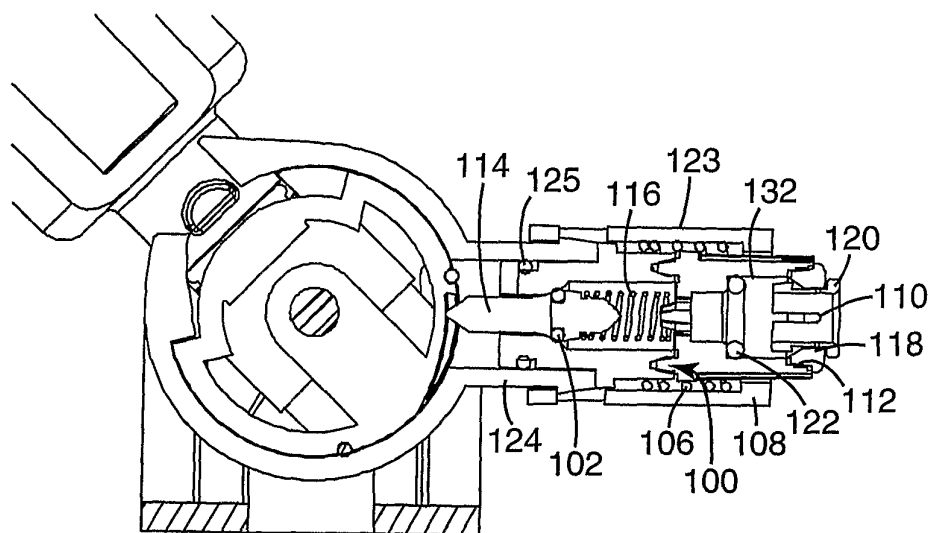
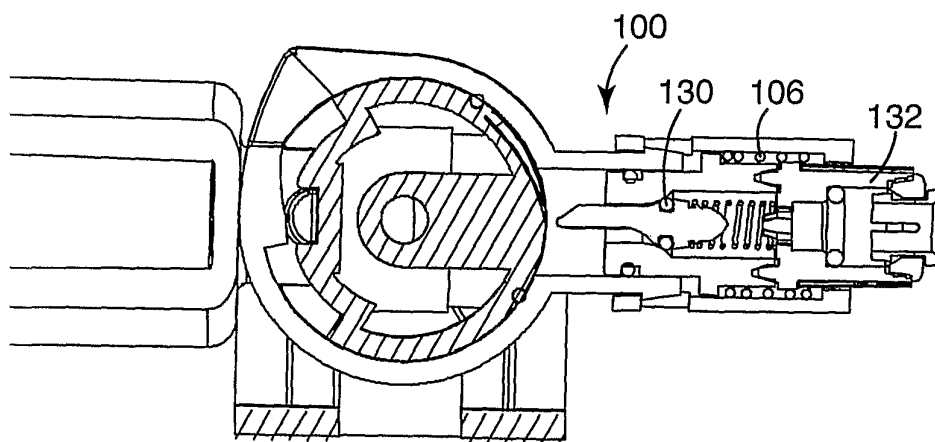


Fig. 24

15/15

*Fig. 25**Fig. 26*