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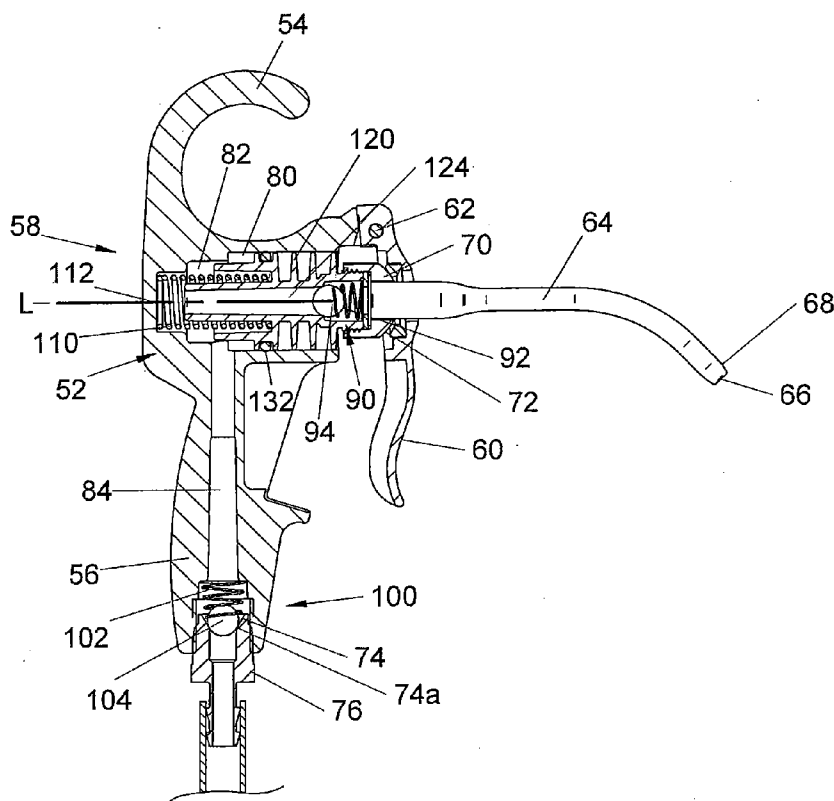
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[Continued on next page]

(54) Title: OILER PUMP



(57) Abstract: An oiler pump comprises a housing defining a cylinder and a chamber, a manually displaceable piston received in the cylinder, a spring in the chamber between the housing and the piston, a first one-way check valve on a first end of the piston, a second one-way check valve on the housing, and a fluid displacement member substantially completely filling the chamber when the piston is in a retracted position and to substantially completely open the chamber when the piston is in the first position. The fluid displacement member is formed by an outer skirt member and an inner guide member formed integrally with the piston member. The fluid displacement member increases the priming height and efficiency of the pump by reducing the volume area in the chamber in the fully compressed state which might accumulate gas to zero.



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[0001] TITLE OF THE INVENTION

[0002] OILER PUMP

5 **[0003]** CROSS REFERENCE TO RELATED APPLICATIONS

[0004] This application claims benefit of and priority to U.S. nonprovisional patent application serial no. 11/639,072, filed on December 14, 2006, the entire contents of which are incorporated herein by reference for all purposes.

10

[0005] STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0006] Not applicable.

15 **[0007]** REFERENCE TO APPENDIX

[0008] Not applicable.

[0009] BACKGROUND OF THE INVENTION

20 **[0010]** Field of the Invention. The present application relates to the fluid pumping arts and, more particularly, to a hand pump for manually pumping fluids from a reservoir. The preferred embodiment will be described in connection with a manual pump gun used in combination with a utility oiler for dispensing lubricating fluids onto workpieces during machining operations such as tapping and threading pipes and the like. It is to be appreciated, however, that the preferred embodiments are applicable in a wide range of applications beyond use with industrial lubricants such as in chemical processing applications, food service applications and anywhere there is a need to manually transfer fluids by pumping from a reservoir into a desired area.

[0011] Description of the Related Art.

[0012] Many metal working procedures require some form of lubricating fluid delivered to the workpiece and/or to the tool by a pump or the like from an auxiliary source. Examples include hand threading applications where a tool such as a cutting die is rotated around a stationary pipe, usually using a ratcheting head holding the tool. Other examples include automated and semi-automated threading operations wherein power driven threading equipment rotates a tubular workpiece such as a pipe or the like relative to one or more die heads mounted on the threading equipment and carrying one or more cutters or reamers for removing metal from the workpiece as it rotates relative to the tooling. It is important of course to provide a sufficient amount of cooling and/or lubricating fluids to help prevent damage to the tooling resulting in high quality and accurate threads or other patterns imparted onto the workpiece. It is also important to wash the work area free from chips, filings, and the like by providing a fluid which can be selectively delivered under a modest pressure.

[0013] Portable oil dispensers have been provided heretofore for use with pipe threading apparatus, for example. One such oil dispenser has been available from The Ridge Tool Company of Elyria, Ohio under the latter's product designation no. 418 Oiler, comprising a bucket for providing a reservoir for thread cutting oil, a drip pan removably mounted on the bucket

for receiving chips and oil from the thread cutting apparatus and separating the oil for return to the reservoir in the bucket, and a hand-held trigger operated pump connected to the bucket by a flexible hose and operable by a threading machine operator to dispense oil onto a workpiece being threaded. The bucket
5 typically includes a bulkhead fitting for connecting a reservoir area of the bucket in flow communication with a manually operated pump and, preferably, a strainer for straining oil during pumping thereof from the reservoir area in order to prevent chips of metal or other materials from entering into the manual pump.

10 **[0014]** FIGURE 1 is an isometric view of a prior art pump 10 well accepted and known in the art. As will be appreciated from that figure, the pump 10 includes a handle 12 by which the pump is held and manipulated by a user, a dispensing nozzle or tube 14, and a trigger 16 which is manually operable to pump oil from the reservoir area of an associated bucket (not
15 shown) through the nozzle 14 and onto a workpiece. The pump typically also includes an upper hook 18 by which the pump can be supported adjacent the work area. A flexible hose 20 is attached to the pump 10 using a suitable threaded coupling element 22 by which means the hose 20 delivers oil to pump 10 in response to actuation of the trigger 16.

[0015] FIGURES 2a and 2b illustrate cross-sectional views of the pump 10 of FIGURE 1 shown with the trigger 16 in a relaxed (FIG. 2a) and in an actuated (FIG. 2b) position. As can be seen in those figures, the pump 10 includes a housing 24 shaped to form the handle 12 on a lower end thereof and the hook 18 on an upper portion. A fluid passageway 26 is defined by the housing 24 and extends between the threaded coupling element 22 and the dispensing nozzle 14. A piston member 28 is slidably received within the fluid passageway 26 and is biased generally against the handle 12 by a spring member 30 acting on a proximal end of the piston 28 to urge the piston to the right as viewed in the figure.

[0016] With continued reference to those figures, the prior art pumps of the type described typically include first and second one-way check valve devices 32 and 38 operable in a manner well known in the art to draw lubricating fluid from the associated reservoir (not shown) through the flexible hose 20, into the fluid passageway 26 and ejected onto the workpiece through the dispensing nozzle 14. In the prior art pump 10 illustrated, the check valve assemblies 32, 38 include a steel check ball 34, 40, respectively biased against suitable check ball seats 36, 42 formed on the distal end of the piston member 28 and on a side of the threaded coupling element 22 opposite from the flexible hose 20.

[0017] One disadvantage of the prior art pump 10 illustrated in the figures is a modest degree of vulnerability to decrease the efficiency through the passage of metal chips and other particles from the reservoir and into the fluid passageway 26. The metal particles have, at times, become lodged
5 between the steel check balls 34, 40 and their respective seats 36, 42 thus preventing a complete and efficient fluid seal there between.

[0018] It is to be observed that the upper end of the fluid passageway 26 adjacent the piston member 28 and in the region of the spring member 30 is rather large as compared against the remainder of the passageway. This has, at
10 times, lead to some difficulty in priming the pump during initial use and in reducing the ability of the pump to pull lubricating fluids up through the hose 20 to a specified height which is convenient to the user.

[0019] More particularly, the pump 10 of the prior art may become partially or fully filled with gas such as air when the device is opened during
15 such operations such as cleaning or disassembling the unit. Under these conditions, the ability of the pump to pull oil up through the hose to a specified height is significantly different from that of a pump which is fully filled with a liquid such as oil. As the piston member 28 of the pump is actuated between the positions illustrated in FIGURE 2a and 2b, the volume of the fluid
20 passageway 26 is modulated causing a pumping action. Squeezing the trigger

decreases the volume thus allowing lubricating fluid to be drawn into the fluid passageway through the lower check valve 38. When the trigger 16 is released, the piston is urged to move from the position illustrated in FIGURE 2b to the position illustrated in FIGURE 2a by the base of the spring 30. As can be seen
5 by comparison of those figures, the volume displaced by the piston between the fully extended position (FIG. 2a) and the fully retracted position (FIG. 2b) is relatively large relative to the overall volume of the fluid passageway 26 defined between the opposed check valve assemblies 32, 38. A large amount of air can be accumulated in this volume with significant negative
10 consequences on performance of the Pump.

[0020] It is therefore an object of the present application to provide a fluid pump of the type which is not easily susceptible to performance degradation due to particles or the like becoming lodged therein during normal use.

15 **[0021]** It is a further object of the present application to provide a fluid pump of the type which is easily primed regardless of whether it is first operated from a "dry" condition filled with air or other gasses.

[0022] It is yet a further object of the present application to provide a manually operated fluid dispenser of the type which can pull or otherwise draw

fluid or other oils from an associated reservoir up to at least the shoulders or waist of a user during normal use thereof.

[0023] These and other objects and advantages of the fluid pump of the present application will become apparent to those skilled in the art upon a reading and understanding of the drawings and specification to follow below.

[0024] BRIEF SUMMARY OF THE INVENTION

[0025] The fluid pump of the present application provides a unique manually operable oiler which overcomes the difficulties encountered in prior art oilers and provides improved performance over prior oilers during priming of the pump, during use of the pump elevated heights relative to the reservoir, and with regard to pump efficiency while pumping fluids having metal particles or other debris entrained therein.

[0026] In one form, a fluid pump is provided including a housing defining a cylinder and a chamber in fluid communication with the housing.

The fluid pump includes a manually displaceable piston received in the cylinder. The piston has a distal end, a proximal end, and a fluid payout conduit extending between the distal end and the proximal end. The piston is slidable with the cylinder between first and second positions relative to the housing. A spring is provided in the chamber and is received therein between the housing and the proximal end of the piston. The spring biases the piston

towards the first position. A first one-way check valve is disposed on the distal end of the piston and is in fluid communication with the fluid payout conduit defined through the piston. A second one way check valve is disposed on the housing and is in fluid communication with the chamber. For purposes
5 of enabling enhanced priming capabilities and suction capabilities, a fluid displacement member is provided for substantially completely filling the chamber when the piston is in the second position and for substantially completely emptying the chamber when the piston is in the first position. In that way, the volume difference in the passageway is defined by the housing as
10 determined when the piston is at the first and second positions is substantially enhanced over prior art pumps.

[0027] In accordance with a further aspect of the present application, the fluid displacement member includes an annular member surrounding the spring. The annular member is preferably movable with the piston and, in one
15 embodiment, is formed integrally with the piston.

[0028] In accordance with a further aspect of the present application, the fluid displacement member is a cylindrical spring disposed within the space defined by the spring biasing the piston towards the first position. Preferably, the cylindrical member is movable with the piston and, in one embodiment, is
20 formed integrally with the piston.

[0029] In accordance with yet a further aspect of the present application, the fluid displacement member includes an annular member surrounding the spring together with a cylindrical member disposed within the inner cylindrical hollow spaced defined by the spring biasing the piston towards the first position. Preferably, the annular member and cylindrical member are movable with the piston and, in one embodiment, are formed integrally with the piston.

[0030] In accordance with yet a further aspect of the present application, the cylinder defined by the housing includes a rough cylinder surface adapted to receive a plastic piston therein. The plastic piston carries an elastic o-ring having a low durometer.

[0031] Yet still further in accordance with another aspect of the present application, each of the one-way check valves includes a rubber ball member and a circular seat. The rubber ball member has a low durometer and is adapted to permit metal chips and other materials which might become entrained in the fluid to be received in the body of the ball thus permitting the ball to substantially seal around the seat portion of the check valve.

[0032] These and other advantages and objectives of the present application will become apparent to those of ordinary skill in the art.

[0033] BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0034] FIGURE 1 is a schematic perspective view of an oiler in accordance with the prior art;

[0035] FIGURES 2a and 2b are cross-sectional views of a manual pump
5 of the prior art oiler shown in FIGURE 1;

[0036] FIGURE 3 is a cross-sectional view of a fluid pump formed in accordance with the present application shown in a relaxed condition;

[0037] FIGURE 4 is cross-sectional view of the fluid pump of FIGURE 3 shown in an actuated position;

10 [0038] FIGURES 5a and 5b are perspective and cross-sectional views, respectively, of a piston member received in the fluid pump shown in FIGURES 3 and 4; and,

[0039] FIGURE 6a is a cross-sectional view of a threaded fitting member with an integrated ball seat and a lead-in taper adjacent the ball seat in
15 accordance with the prior art; and,

[0040] FIGURE 6b is a cross-sectional view of a threaded fitting member with an integrated ball seat and lead-in taper adjacent the ball seat in accordance with a preferred embodiment of the application.

[0041] DETAILED DESCRIPTION

[0042] [0029] Referring now to the drawings wherein purposes are for illustrating the preferred embodiments only and not for purposes of limiting same, the subject pump 50 is shown in cross section in FIGURES 3 and 4. A novel piston member for use therein is shown in perspective and cross-sectional views in FIGURES 5a and 5b, and a novel fitting with an integrated check valve having an improved lead-in tapered region adjacent the ball seat area is shown in FIGURE 6b. Turning first to FIGURES 3 and 4, the subject pump 50 includes a main body member 52 with a curled hook portion 54 at the top thereof and an elongate handle portion 56 defined at the lower end thereof opposite from the hook portion 54. As appreciated by those skilled in the art, the hook portion 54 enables the subject pump 50 to be hung or otherwise suspended from an associated article or at an associated place such as on an associated threading machine or the like for convenience of the user. The handle portion 56 has a size and shape adapted for easy gripping by an operator.

[0043] A central region 58 of the main body member 52 defines an internal passageway adapted to receive the piston member of FIGS. 5a, 5b and, further, carries an outer trigger member 60 on a suitable roll pin 62 or the like. As shown in the figure, the trigger member 60 is manually operable to pivot about the roll pin 62 between the position illustrated in FIGURE 3 whereat the

pump is illustrated in an unactuated or relaxed state and the position shown in FIGURE 4 whereat the pump is illustrated in an actuated or compressed state.

[0044] A spout 64 extends through a suitably arranged opening formed in the trigger member 60 substantially as shown. The spout 64 preferably defines
5 a fluid conducting conduit or channel for permitting oil or the like pumped from the main body member 52 to flow onto an associated workpiece through an open tip 66 located at the distal end 68 of the spout. The opposite end of the spout 64 includes a fluid connector member 70 for threaded engagement onto a piston member 120 slidably received within a cylinder defined by the main
10 body portion 52 and operable in a manner to be described in greater detail below. As shown, the fluid connector member 70 has a radiused convex shoulder surface 72 adapted to provide a smooth curved engagement region for contact with a plastic wear adapter 72a carried on the trigger member 60 as shown. The wear adapter 72a can be formed on or by the trigger member as
15 desired.

[0045] With still further continued reference to FIGURES 3 and 4, the main body member 52 of the pump 50 defines a plurality of passageways including a cylinder 80 adapted to slidably receive the piston member 120 therein. In addition, as best shown in FIGURE 3, the housing member defines
20 a chamber 82 adjacent to and in fluid communication with the cylinder 80. In

their preferred form, the chamber 82 and cylinder 80 are circular cylindrical in shape, and are mutually aligned along a working axis L extending through the central region 58 of the pump body 52. An additional vertical passageway 84 is defined along the vertical extent of the handle portion 56 of the main body member 52. The vertical passageway 84 is in fluid communication with the chamber 82 which is in turn in fluid communication with the cylinder 80.

[0046] A first one-way check valve assembly 90 is provided at the distal end of the piston member 120 as shown. In its preferred form, the first one-way check valve assembly 90 includes a biasing spring member 92 for urging a rubber check ball 94 into selective engagement with a seat portion 130 (FIGURE 5b) formed at the distal end 126 of the piston member 120. In its preferred form, the check ball 94 is formed of a softer durometer rubber having a softness characteristic to provide good sealing. A rubber ball having a durometer of between about 60 D to 70 D but preferably of about 65 D has been found to provide excellent sealing characteristics for petroleum based thread cutting working fluids typically encountered in the machining arts.

[0047] A second one-way check valve assembly 100 is disposed at the lower end of the handle portion 56 and in fluid communication with the vertical or handle passageway 84. Similar to the first check valve assembly, the second one-way check valve assembly 100 includes a spring member 102

provided for urging a rubber check ball 104 into engagement with a angled seat 74a of a threaded coupling element 76 provided for attachment of the subject pump 50 to an associated flexible hose (not shown) or other fluid conduit.

5 **[0048]** In accordance with the present application, each of the check balls 94, 104 are preferably formed of a rubber material having a compliant characteristic whereby the check balls 94, 104 are adapted to conform around metal particles or other debris passing through the subject pump thereby enabling each of the check balls 94, 104 to adequately operate through contact
10 with their respective seat portions 130, in the piston 120 and 74 in the threading coupling element 76. In that way, a proper seal can be established between the check balls and their respective circular sealing surfaces regardless of whether debris or the like becomes located between the ball and the sealing surface. Essentially, check balls conform to the metal particles,
15 chips, or other debris so that the debris or other pieces do not adversely affect the sealing capability of the valve assemblies.

20 **[0049]** In addition to the above, it has been found that the second one-way check valve assembly 100 works best with a check ball 104 having a shore hardness within a range of about 60 D to 70 D but preferably of about 65 D operative with an angled spherical seat 74a in the threaded coupling member

76. Further, as illustrated, a lead-in portion 74 is disposed adjacent the ball seat 74a in the coupling member 76 for purposes of selectively contacting the check ball 104 during operation of the subject pump gun 50 to encourage the ball to locate properly relative to the ball seat during use in order to form a good fluid seal between the check ball 104 and the ball seat 74a.

[0050] The lead-in portion 74 provides enhanced performance characteristics. More particularly, as shown in FIGURE 6a, a fitting 22 formed in accordance with the prior art has a valve seat portion 23a and a lead-in portion 23 forming an angle of incidence A relative to a longitudinal axis thereof of about 50 degrees. However, in accordance with the present application as shown in FIGURE 6b, a threaded coupling member 76 includes a spherical ball seat 74a and a lead-in portion 74 formed by a tapered surface 75 having an angle of incidence B relative to a longitudinal axis defined by the coupling member of about 30 degrees. It has been found that prior art devices of the type shown in FIGURES 1-2 often experience problems wherein the lower check ball sticks to the lead-in portion 23 of the coupling member owing to the softness of the check valve and the angle of incidence of the area adjacent the seat. However, in accordance with the present application, a lead-in portion 74 is provided in the threaded coupling member 76 adjacent the ball seat 74a, the lead-in portion being defined by a tapered surface 75 having an angle of incidence B of about 30 degrees, to enable a check valve ball 104

having a hardness of between about 60 D to 70 D but preferably of about 65 D to engage the seat 74a during use of the subject pump 50 without sticking to the lead-in portion 74. Although the preferred form of a lead-in portion 74 is a tapered surface 75, other forms of lead-in portion 74 can be used as well such as, for example, other formations or surface configurations or combination of configurations in the area adjacent the ball seat 74a to effect a precise positioning of the check ball 104 relative to the ball seat 74a during use of the oiler gun 50 without causing the check ball to stick to the lead-in portion during use of the tool.

10 **[0051]** With continued reference to FIGURES 3 and 4 but with additional reference to FIGURES 5a and 5b, the piston member 120 is preferably formed of a plastic material defining a body 122 with a fluid payout conduit 124 extending therethrough from a distal end 126 to a proximal end 128 thereof. As noted above, a seat portion 130 is defined at the distal end 126 of the body 122 for receiving the check ball 94 biased thereagainst by the
15 spring member 92 in the first check valve assembly 90.

[0052] Further, at the proximal end 128 of the piston member, an outer skirt member 140 is formed as shown in a spaced apart relation relative to an inner member 142. A gap 144 is thereby defined between the outer skirt
20 member 140 and the inner member 142. As best shown in FIGURES 3 and 4, a

biasing spring 110 is received in the gap 144 between the outer skirt member 140 and the inner member 142.

[0053] The preferred form of the subject piston member 120 enables smoother operation, enhanced resistance to wear, and simplified manufacturing. In the prior art, sticking or slow piston motion often occurred because of metal particles contained within the oil becoming lodged between the piston and the piston bore causing the piston to stick or to move with substantial friction. In typical prior art pistons in oiler guns of the type described above, clearances are held as tightly as the manufacturing process permits thus inviting the sticking or slow moving piston problem. However, in accordance with the present application, the amount of sticking piston motion and slow piston motion is reduced by increasing the clearance between the piston and the piston bore. As noted above, the piston 120 is provided with a plurality of guide rib members 136 defining annular surfaces that create an effective outer piston diameter that contact the inner surface of the bore 80. The annular guide rib members 136 also provide for overall enhanced moldability of the piston 120. The preferred piston member 120 shown in FIGURES 5a and 5b help improve the manufacturing process by enabling the piston to be manufactured using an injection molding process while maintaining a uniform wall thickness. Prior art pistons experienced some difficulties in size tolerances. In addition, moving the o-ring seal 132 closer to

the spring member 110 helps exclude dirty cutting fluid from the area between the outer circumference of the piston and the cylindrical bore 80 that it travels within.

[0054] In its preferred form, the outer skirt member 140 takes on the shape of an annular member substantially surrounding the biasing spring 110. Further, the inner member 142 is in the form of a cylindrical member disposed within the inner cylindrical hollow area 112 defined by the biasing spring 110. The spring size together with the gap size is particularly selected so that the biasing spring 110 freely floats within the gap 144 but with very little free play.

[0055] It is to be appreciated with reference once again to FIGURES 3 and 4 that the outer skirt member 140 and inner member 142 collectively form a fluid displacement member 150 movable with the piston member 120 between the relaxed position shown in FIGURE 3 and the actuated position shown in FIGURE 4. Preferably, the fluid displacement member 150 substantially completely fills the chamber 82 when the piston is compressed against the biasing force of the spring 110 (FIG. 4). In that way, the ratio in volume of the fluid passageways in the subject pump between the piston and the actuated condition of FIGURE 4 and the piston in the relaxed position of FIGURE 3 is substantially larger than the difference realized in the prior art.

[0056] As noted above with regard to prior art pump guns, gas such as bubbles or the like entrained in the working fluid adversely affects the efficiency of the gun. More particularly, gas is compressible and as understood by those skilled in the art, any gas which might accumulate in the gun will adversely affect pumping efficiency and, in particular, adversely affect the priming capability and priming height of the gun. In the pump 50 in accordance with the subject application, the volume of gas in the chamber is reduced to an optimized minimum by providing the fluid displacement member 150 movable together with the piston member 120 to nearly eliminate any volume within the piston itself that is not compressed. As shown above, preferably, the fluid displacement member 150 is formed integrally with the piston member 120. However, other forms of fluid displacement member can be used as well.

[0057] In addition to the above, as shown in the drawing figures, the sealing member 132 is carried in a groove 134 moved to the extreme proximal end 128 of the piston member 120 in order to reduce the volume within the piston itself that is not compressed.

[0058] Lastly, it is to be appreciated that preferably, the gap 144 formed between the outer skirt member 140 and the inner guide member 142 is minimized to bring the skirt and guide members 140, 142 as close as possible

to engagement with the spring member 92 to maximize the volume displaced by the fluid displacement member 150 formed by the skirt and guide members.

[0059] With continued reference to drawing FIGURES 3-5b, in its preferred form, the cylinder 80 has a smoothed surface adapted to receive a sealing member 132 carried on a groove 134 formed at the proximal end 128 of the piston member 120. A plurality of guide rib members 136 are provided on the main body member and spaced apart axially along the length thereof. In their preferred form, the guide members 136 have a uniform wall thickness so as to enable the piston member to be easily manufactured such as by an injection molding process.

[0060] Further in connection with the relationship between the piston member 120 and the cylinder 80, in its preferred form, the cylinder has a smoothed surface to enable the sealing member 132 to be easily manually actuated therein. A burnishing process can be used to smooth out roughness from machining which would normally cause the o-ring seal 132 to drag. This drag tends to inhibit the return of the piston when letting go of the trigger 60. In its preferred form, the sealing member 132 is a low durometer o-ring such as, for example, 55 durometer.

[0061] The exemplary embodiment has been described with reference to the preferred embodiments. Obviously, modifications and alterations will

occur to others upon reading and understanding the preceding detailed description. It is intended that the exemplary embodiment be construed as including all such modifications and alterations insofar as they come within the scope of the appended claims or the equivalents thereof.

WHAT IS CLAIMED IS:

1. A fluid pump comprising:
 - a housing defining a cylinder and a chamber in fluid communication
5 with the cylinder;
 - a manually displaceable piston received in the cylinder, the piston having a distal end, a proximal end, and a fluid payout conduit extending between the distal end and the proximal end, the piston being slidable within the cylinder between first and second positions relative to the housing;
 - 10 a spring received in the chamber between the housing and the proximal end of the piston, the spring biasing said piston toward said first position;
 - a first one-way check valve on the distal end of the piston in fluid communication with said fluid payout conduit;
 - a second one-way check valve on the housing and in fluid
15 communication with said chamber; and,
 - a fluid displacement member adapted to substantially completely fill said chamber when the piston is in said second position and to substantially completely open (empty/vacate) said chamber when the piston is in said first position.
- 20 2. The fluid pump according to claim 1 wherein said fluid displacement member includes an annular member surrounding said spring.
3. The fluid pump according to claim 2 wherein said annular member is
25 movable with said piston.
4. The fluid pump according to claim 3 wherein said annular member is formed integrally with said piston.

5. The fluid pump according to claim 1 wherein:
said spring is a coil spring defining an inner cylindrical hollow area;
and,
said fluid displacement member includes a cylindrical member disposed
5 within said inner cylindrical hollow area.
6. The fluid pump according to claim 5 wherein said cylindrical member is
movable with said piston.
- 10 7. The fluid pump according to claim 6 wherein said cylindrical member is
formed integrally with said piston.
8. The fluid pump according to claim 1 wherein:
said spring is a coil spring defining an inner cylindrical hollow area;
15 and,
said fluid displacement member includes an annular member
surrounding said spring and a cylindrical member disposed within said inner
cylindrical hollow area.
- 20 9. The fluid pump according to claim 8 wherein:
said annular member and said cylindrical member forming said fluid
displacement member are movable with said piston.
10. The fluid pump according to claim 9 wherein said annular member and
25 said cylindrical member forming said displacement member are formed
integrally with said piston.

11. The fluid pump according to claim 1 wherein:

said piston is formed of a plastic materials and carries an o-ring gasket sealing member adapted to engage an inner surface of said cylinder.

5

12. The fluid pump according to claim 1 wherein:

said first one-way check valve includes a compliant check valve ball having a durometer within a range of about 60 D to 70 D; and,

said second one-way check valve includes a compliant check valve ball having a durometer within a range of about 60 D to 70 D.

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13. The fluid pump according to claim 12 wherein said first and second compliant check valve balls are formed of the same rubber material having said durometer within a range of about 60 D to 70 D.

15

14. The pump according to claim 1 wherein said second one-way check valve includes:

a compliant check valve ball; and,

a fitting having a passageway extending therethrough defining a longitudinal axis and having a ball seat adapted to engage said compliant check valve ball and a lead-in portion adjacent the ball seat for selectively guiding the check ball relative to the ball seat during use of said pump.

20

15. The pump according to claim 14 wherein said lead-in portion includes a tapered surface defining an angle of incidence with said longitudinal axis of about 30 degrees.

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16. The pump according to claim 14 wherein said lead-in portion is integral with said fitting.

5 17. The pump according to claim 16 wherein said lead-in portion includes a tapered surface defining an angle of incidence with said longitudinal axis of about 30 degrees.

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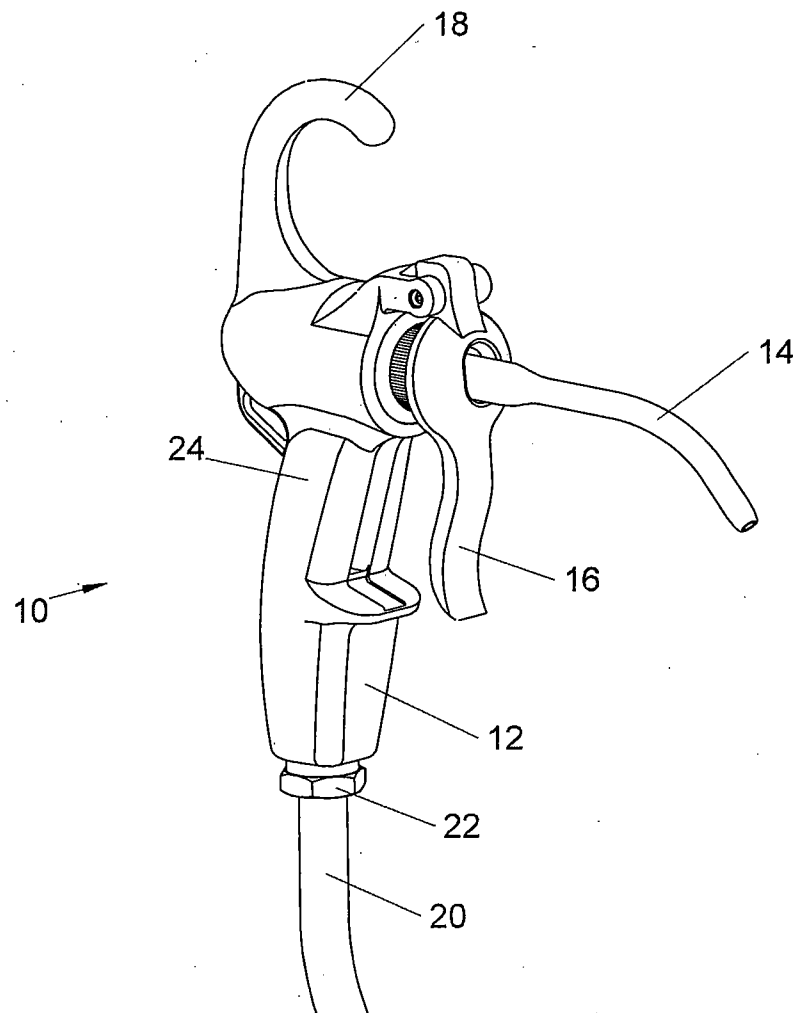


FIG. 1
PRIOR ART

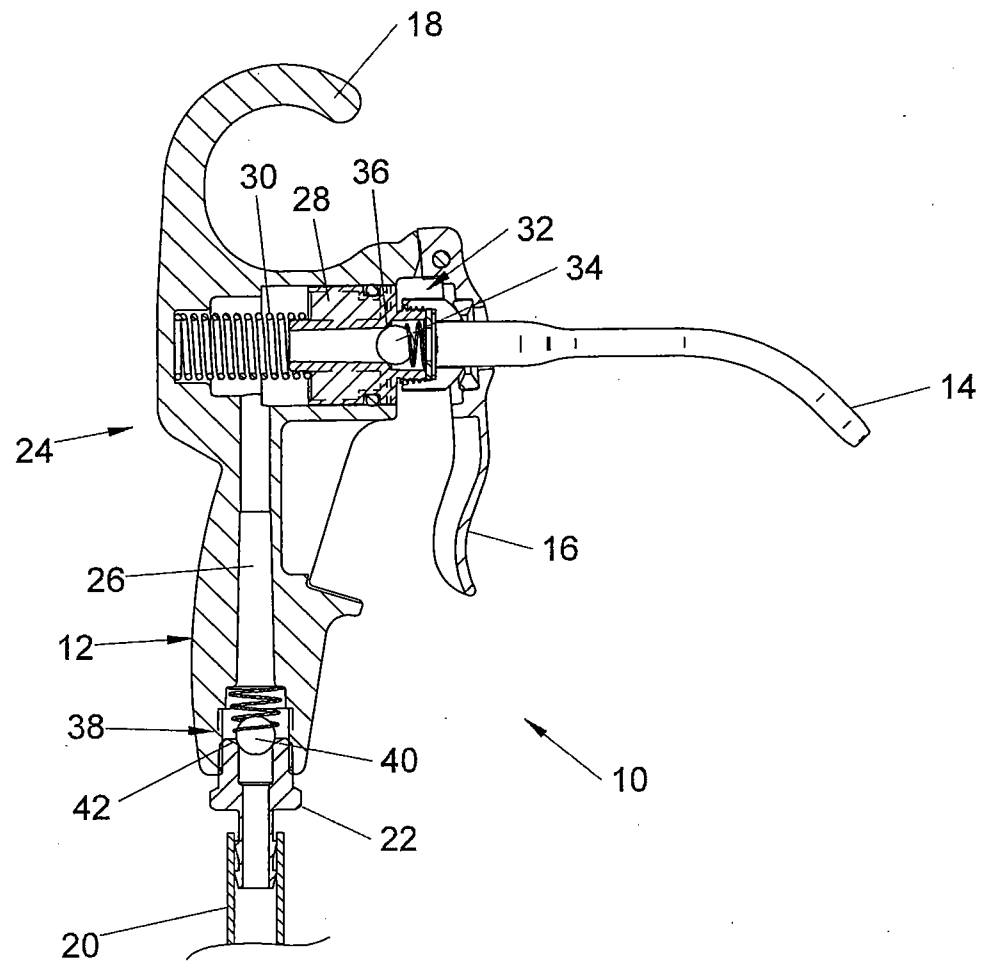


FIG. 2a
PRIOR ART

3/7

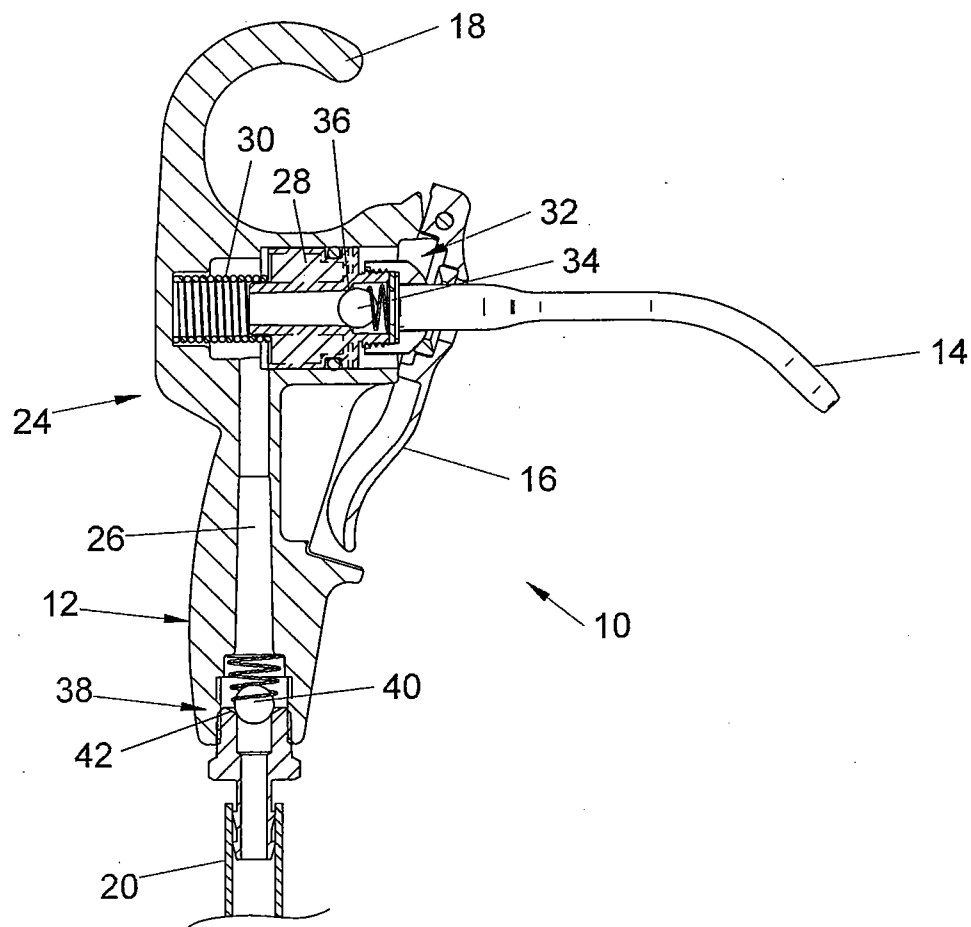
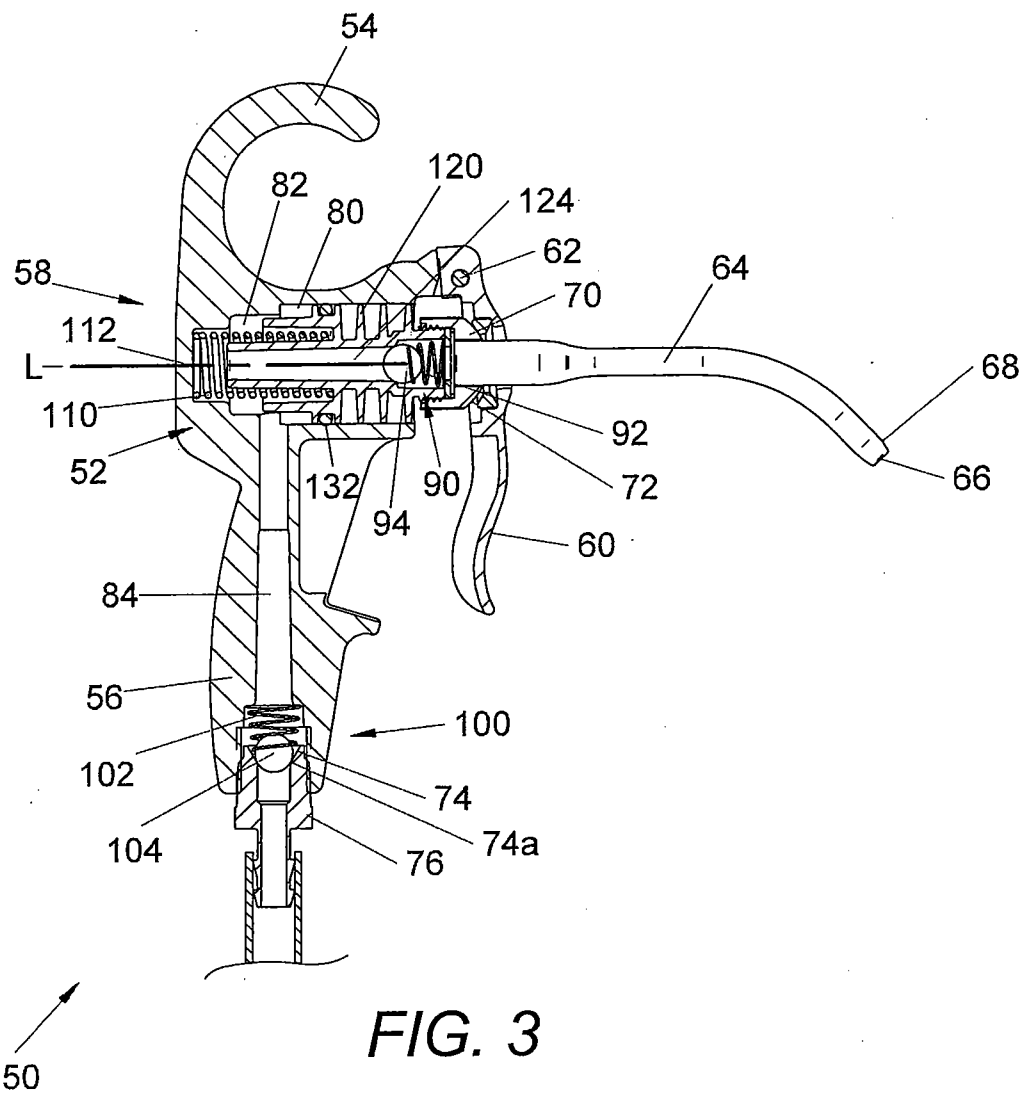
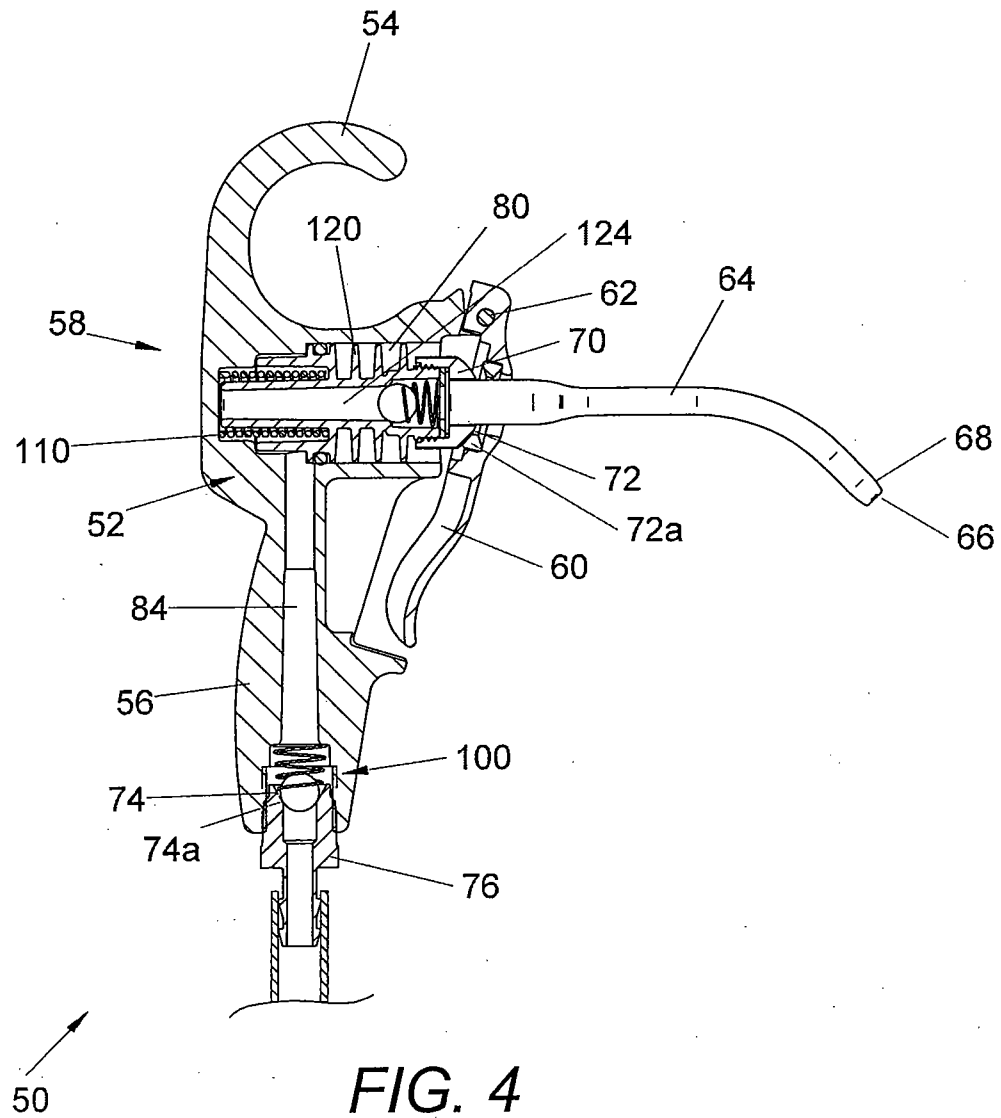


FIG. 2b
PRIOR ART





6/7

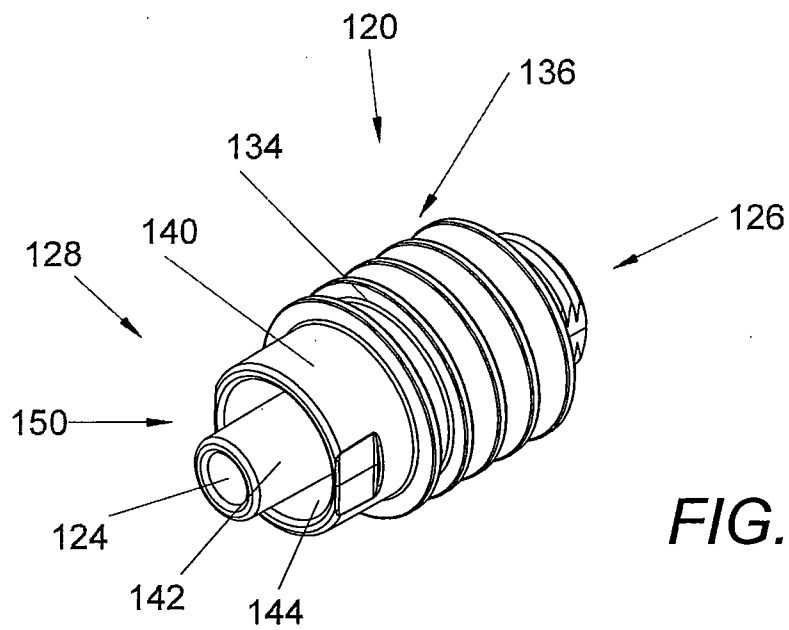


FIG. 5a

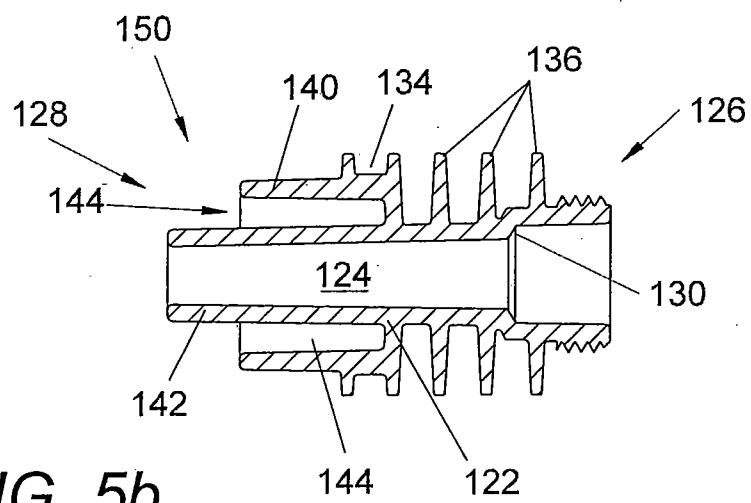


FIG. 5b

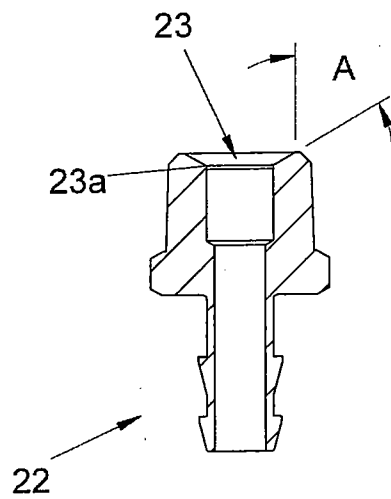


FIG. 6b

