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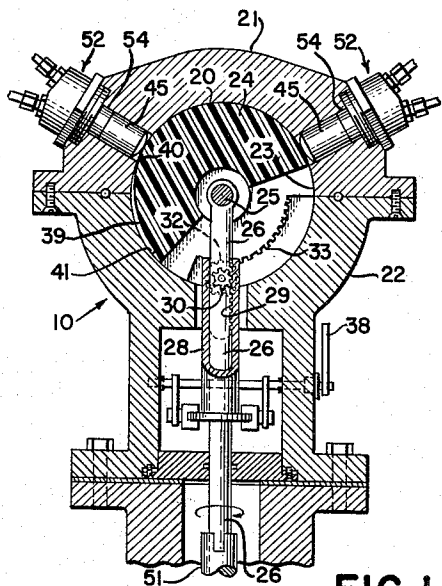


FIG. 1.

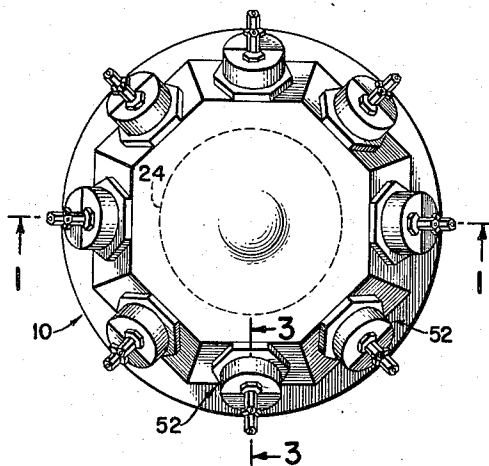


FIG. 2.

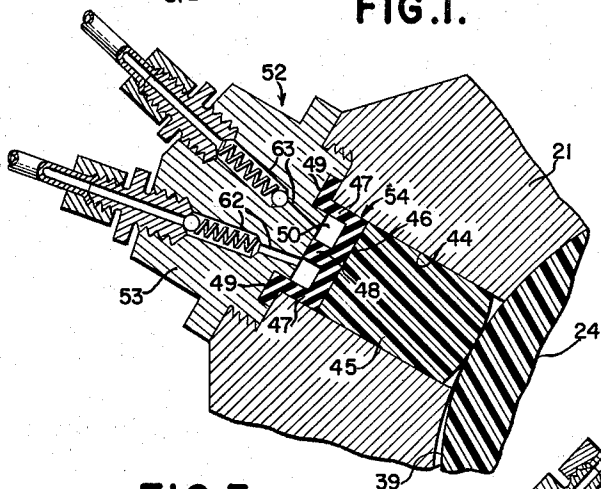


FIG. 3.

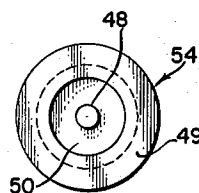


FIG. 4.

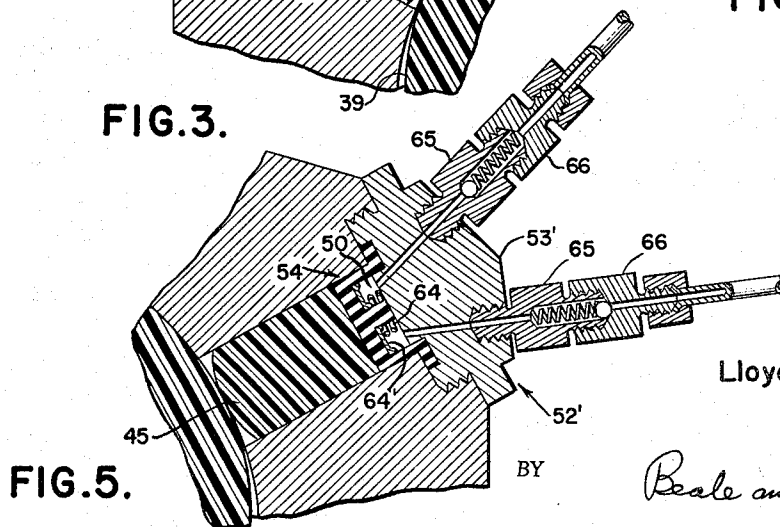


FIG. 5.

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1

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7 Claims. (Cl. 103-148)

This invention is directed to a sealed pump unit or subassembly comprising a cylinder head and a collapsible capsule bonded thereto and enclosing an expansible chamber of the pump unit.

In variable stroke positive displacement pumps of certain types, e.g., fuel injection pumps, the liquid-tight sealing of the pump chamber or chambers, and of the supply and discharge connections thereto is critical, and leaks are frequent. An object of the present invention is to provide an improved sealed pump unit which avoids such leakage. Another object is to provide a sealed unit complete with check valves which can be installed quickly as a replacement unit.

Other objects and advantages of the present invention will be apparent from the following description and the appended drawings, in which:

Fig. 1 is a section on line 1-1 of Fig. 2, showing a fuel injection pump provided with pump units in accordance with the present invention;

Fig. 2 is a plan view of the same;

Fig. 3 is a fragmentary section at enlarged scale, taken on line 3-3 of Fig. 1, showing the preferred embodiment of my invention installed outwardly of adjustable cam 24 and plunger 45;

Fig. 4 is a detached plan view of the resilient capsule 54 shown in section in Fig. 3; and

Fig. 5 is a section similar to Fig. 3, showing another embodiment of the present invention.

Referring now to the drawings, in which like characters indicate the same or similar parts, Figs. 1 and 2 show a fuel injection pump 10 provided with pump units or subassemblies 52 in accordance with the present invention. Pump 10 may use other kinds of pump units and is not a part of the present invention, being described more completely and claimed in my copending application Serial No. 829,412 filed concurrently herewith. Likewise, my pump units, such as 52, which are the subject of the present invention, may be used in other pump structures. To give a clear understanding of the present invention and an exemplary use thereof, a brief description will be given of pump 10. For a more complete description of pump 10, reference may be made to the aforesaid application.

Housing 21, 22 has a spherical cavity 23 which supports a cam 24 (preferably of nylon), cam 24 being of generally spherical contour with a spherical surface 20 which engages the surface of cavity 23 and is slidably supported thereby for rotation in any direction. A pivot pin 25 is mounted in cam 24 with its axis passing through the center of spherical surfaces 20 and 23. A shaft 26 having its axis also passing through the center of spherical surfaces 20 and 23 has its upper end pivotally mounted on pivot pin 25. Suitable drive means 51 connects shaft 26 with the engine (not shown) served by pump 10. Thus, cam 24 is rotated about the axis of shaft 26.

A slide 28 is slidably mounted on shaft 26 for rotation therewith. It carries a rack 29 which meshes with a pinion 30 which is rotatably mounted on shaft 26 for rotation about an axis perpendicular to the latter. A second pinion

2

32 rigid to pinion 30 meshes with a gear sector 33 integral with cam 24. A suitable control lever 38 and linkage engages a collar on the lower end of slide 28. By moving lever 38, slide 28 may be moved vertically, and this, through the gearing connections described, provides means for rotating cam 24 around pivot pin 25. Thus, independently of its rotation by shaft 26, cam 24 may be rotatably positioned about pin 25.

Cam 24 has a depressed cam surface 39 which varies in depth from a minimum at 40 for idling to a maximum at 41. The cam surface also varies in depth and extent around shaft 26. Each cylinder 44 (Fig. 3) of pump 10 has a piston or plunger 45 having a cam follower surface which is biased against cam 24 by suitable means, such as the resilient capsule 54 of the present invention.

In operation, cam 24 is rotated by the engine through shaft 26 and adjusted between idling and maximum power positions by control means 38, so as to vary the strokes of each of the plungers 45 according to power requirements.

The preferred embodiment of the present invention is shown in Fig. 3. Plunger 45 has an outer flat surface which is engaged by the flat outer surface of outer wall 46 of resilient capsule 54 (shown separately in Fig. 4).

Resilient capsule 54 has a forward wall 46 engaging plunger 45, a cylindrical side wall 47, slidably engaging cylinder wall 44, and a central column 48 extending from forward wall 46 to abut cylinder head 53, which is threadedly mounted in housing 21 over cylinder 44. Capsule 54 also has a flange 49 extending outwardly from its side wall 47 between cylinder head 53 and housing 21. Capsule 54 is made of a suitable synthetic rubber, and flange 49 is permanently bonded to metallic cylinder head 53 all around its perimeter, preferably with a suitable thermosetting cement, such as an epoxy resin cement, to provide a fluid-tight sealed chamber 50 between capsule 54 and cylinder head 53. Thus, resilient capsule 54 provides a partially collapsible annular chamber 50 surrounding central column 48. Resilient capsule 54 biases plunger 45 against control member 24, so that annular chamber 50 expands and contracts in accordance with the contour of the cam surface 39, along the portion thereof adjustably positioned to contact plunger 45. Inlet and outlet channels 62, 63 are provided through head 53 and are connected respectively with fuel supply and discharge pipes. A spring-biased ball check valve is provided in each of the enlarged portions of channels 62 and 63. Each of these enlarged portions is provided with a ball seat at its inner end. A ball seat for the outer end of each of these enlarged portions or check valve chambers is provided on the inner end of a connector coupling which is threadedly mounted in head 53. Plungers 45 are of such a length as to slightly compress resilient capsules 54 when their inner ends engage the spherical surface of control member 24. The construction of pump units 52 with resilient capsules 54 bonded thereto, and with check valves provided in the body of head 53, is such that complete cell units 52 may be removed and replaced by like units. By providing ball seats at both ends of the check valve chambers the spring and ball in each chamber may be reversed, making the parts interchangeable.

Fig. 5 shows an alternative construction for the pump units or subassemblies, designated 52', and comprising a cylinder head 53' with threadedly attached check valves, each of which has a body 65 containing the valve chamber and formed with an inner ball seat and a threadedly attached cap 66 in which is formed an outer ball seat. This construction also provides interchangeability of parts. A spring 64 is provided in annular chamber 50 to reinforce the resilient force of capsule 54 against plunger 45. A spring bearing plate 64' is provided between spring 64 and capsule 54. Otherwise, the con-

struction is the same as that of pump unit 52 (Fig. 3), the capsule being permanently bonded to cylinder head 53' to provide a fluid-tight collapsible annular chamber 50.

Pump units or subassemblies 52 and 52', each comprising a cylinder head with resilient capsule bonded thereto, and with check valves formed in or attached to the cylinder head itself, provide convenient replaceable units with sealed collapsible chambers. An improved fluid-sealed resilient capsule is provided, because the resilient capsule is permanently bonded to the cylinder head all around the flange 49.

As various other embodiments of my invention will be obvious to those skilled in the art, the foregoing examples are to be considered as illustrative and not as limiting the scope of the appended claims.

I claim:

1. A subassembly for a pump, said pump comprising a pump body having a cylinder formed therein, said cylinder having a side wall and an opening at its outer end, a plunger slidably mounted in said cylinder, and means to reciprocate said plunger in said cylinder, said pump having an inlet passage with an inlet check valve therein and an outlet passage with an outlet check valve therein; said subassembly comprising a head, means for attaching said head to said pump body over said opening, a resilient cylindrical capsule having an open inner end permanently bonded all around said inner end to said head in fluid-tight sealing engagement therewith, a closed cylindrical side wall having substantially the same outside diameter as the diameter of said cylinder, said side wall extending from said head for slidable engagement with the side wall of said cylinder, and a closed outer end comprising a front wall for resiliently engaging said plunger, said capsule having a contractable and expansible chamber inwardly of its side wall between said front wall and said head, said head having an inlet channel and an outlet channel both extending therethrough and opening into said chamber, said inlet and outlet channels comprising portions of said inlet and outlet passages respectively when said subassembly is assembled with said pump.

2. A pump subassembly as defined by claim 1, said capsule having a central column portion extending from said front wall to said head through said chamber.

3. A pump subassembly as defined by claim 1, said

capsule having an annular flange portion extending radially outwardly from said open inner end, said flange portion being permanently bonded to said head in fluid tight sealing engagement therewith.

4. A pump subassembly as defined by claim 1, said inlet and outlet check valves being disposed respectively in said inlet and outlet channels.

5. A detachable pump subassembly for use with a pump, said pump comprising a pump body having a cylinder formed therein, said cylinder having a side wall and an opening at its outer end, a plunger slidably mounted in said cylinder, and means to reciprocate said plunger, said pump having an inlet passage with an inlet check valve therein and an outlet passage with an outlet check valve therein; said pump subassembly comprising a head, means for attaching said head to said pump body over said opening, a resilient capsule attached to the inner side of said head for slidable reception in said cylinder, said capsule having a forward wall for engaging said plunger, a cylindrical side wall for slidably engaging the wall of said cylinder and a central column extending axially from the center of said front wall to said head, said capsule having an annular cavity surrounding said column between said front wall and said head, said head having an inlet channel and an outlet channel both extending therethrough and opening into said annular cavity, said inlet and outlet channels comprising portions of said inlet and outlet passages respectively when said subassembly is assembled with said pump.

6. A detachable pump subassembly as defined by claim 5, said resilient capsule having a flange portion extending radially outwardly from said cylindrical side wall, said inlet and outlet check valves being disposed respectively in said inlet and outlet channels, said flange portion being permanently bonded to said head all around said capsule to provide a fluid-tight seal.

7. A detachable pump subassembly as defined by claim 5, comprising a spring in said annular cavity urging said forward wall away from said head.

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