

- [54] PUMP WITH MEANS FOR
SUPERCHARGING THE PUMP INLET**

- [75] Inventors: **Hubert M. Clark; Gilbert H. Drutchas**, both of Birmingham, Mich.

- [73] Assignee: **TRW Inc.**, Cleveland, Ohio

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Related U.S. Application Data

- [62] Division of Ser. No. 186,865, Oct. 6, 1971, Pat. No. 3,728,046.

- [52] U.S. Cl..... 417/79, 417/310

- [51] Int. Cl. F04b 23/04, F04b 49/00

- [58] **Field of Search**..... 417/79, 83, 310

[56] **References Cited**

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Primary Examiner—Carlton R. Croyle

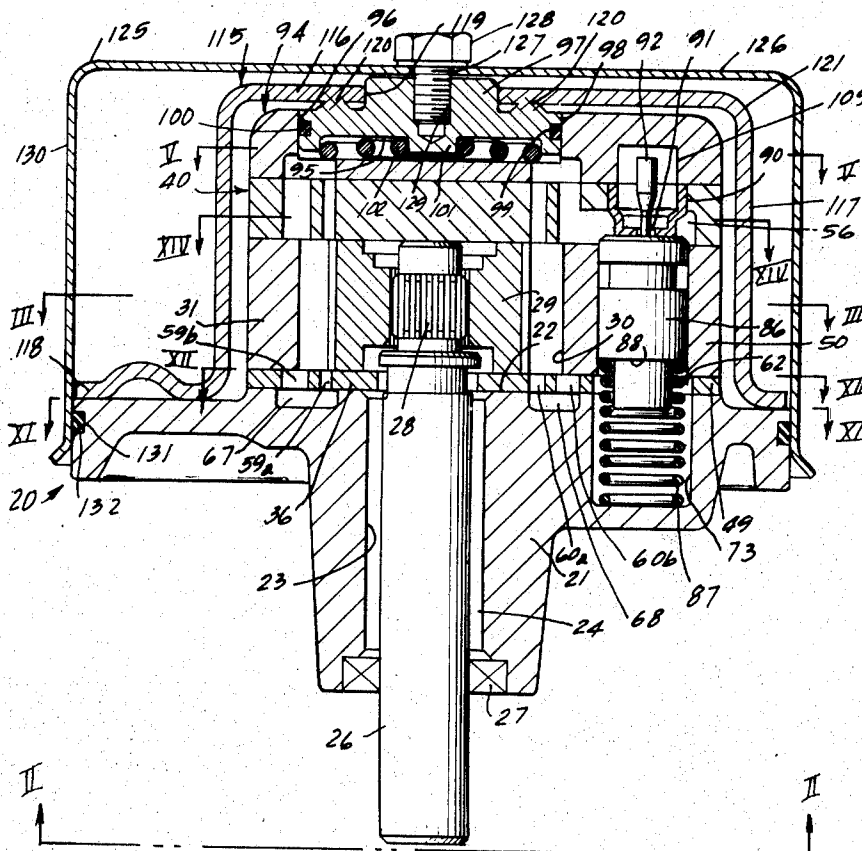
Assistant Examiner—Richard Gluck

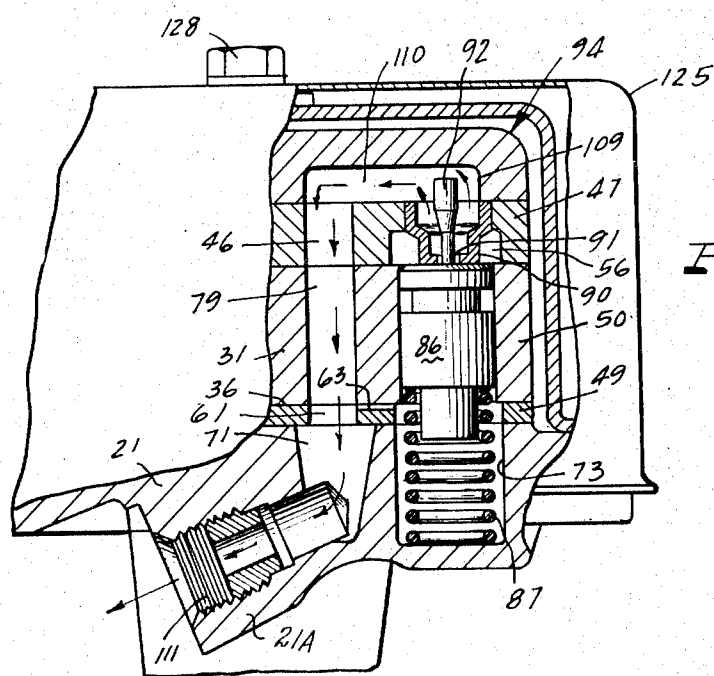
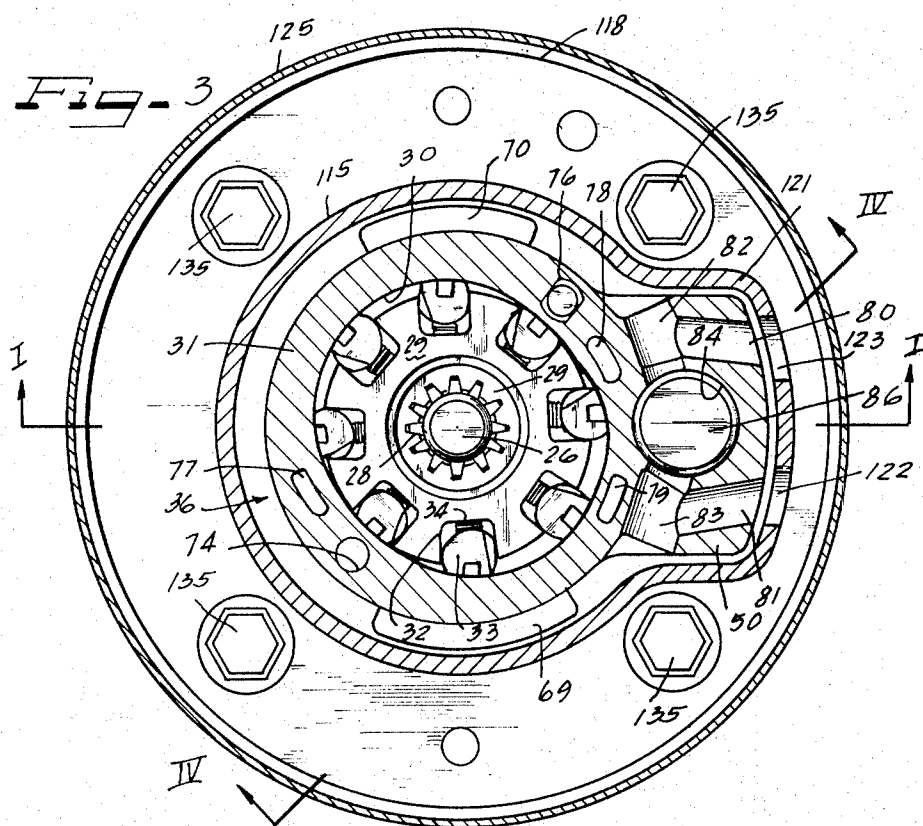
Attorney, Agent, or Firm—Hill, Sherman, Meroni,
Gross & Simpson

[57] ABSTRACT

A pump of the type having a stack-up of parts surrounded by a steel shell providing a space receiving fluid at inlet pressure for supercharging the pump inlet includes aperture means in the shell constituting a makeup opening from the reservoir by aspiration to the space and is particularly characterized by means between the stack-up of parts and the steel shell which isolates the supercharged fluid inwardly of the steel shell from the reservoir.

5 Claims, 15 Drawing Figures





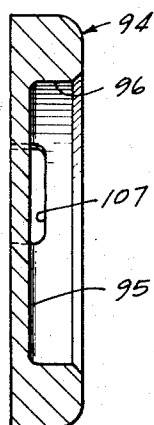


Fig-6

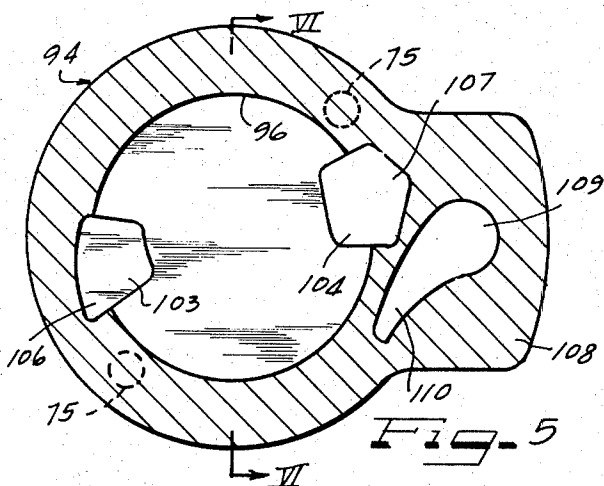


Fig-5

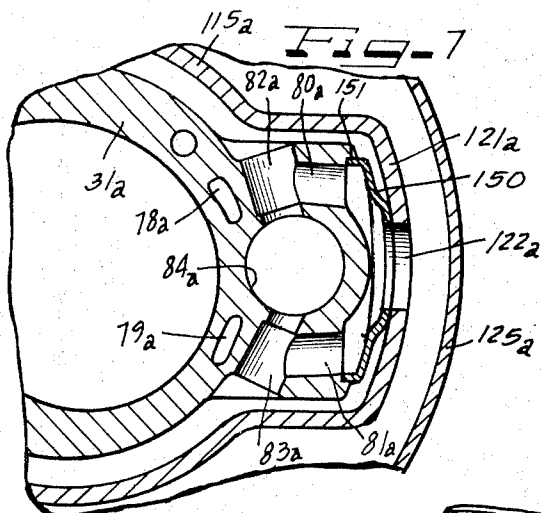


Fig-7

Fig-8

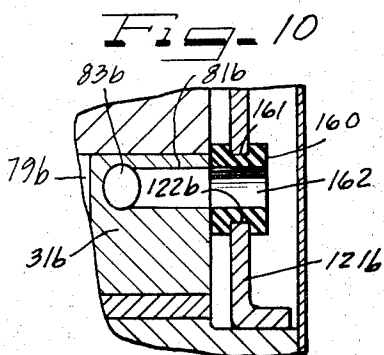
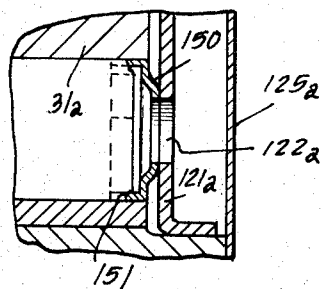


Fig-10

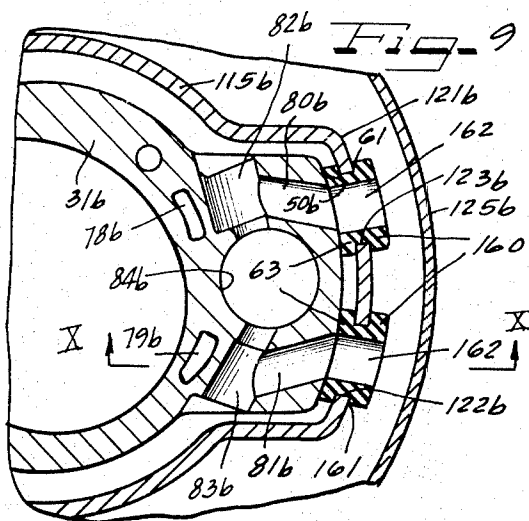


Fig-9

Fig. 11

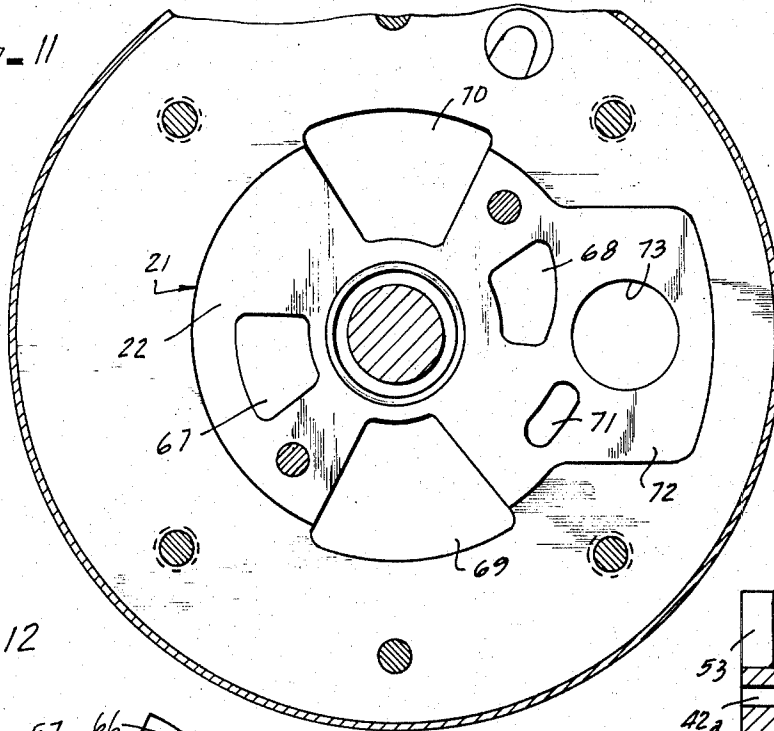


Fig. 12

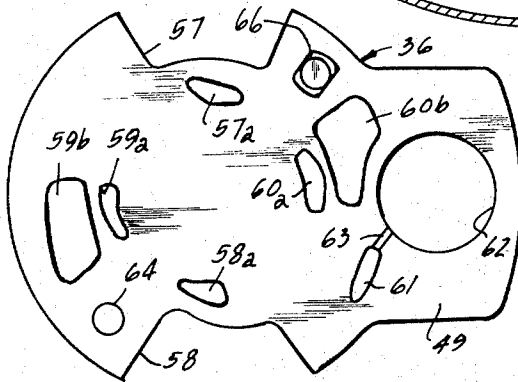


Fig. 15

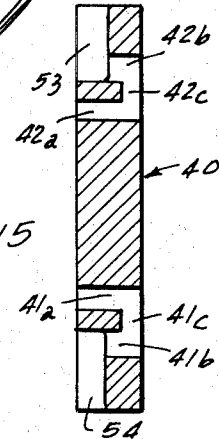


Fig. 13

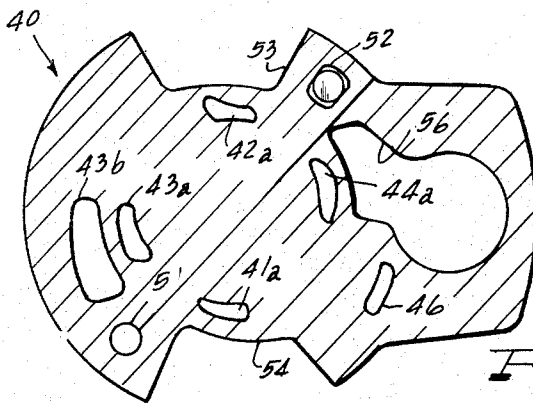
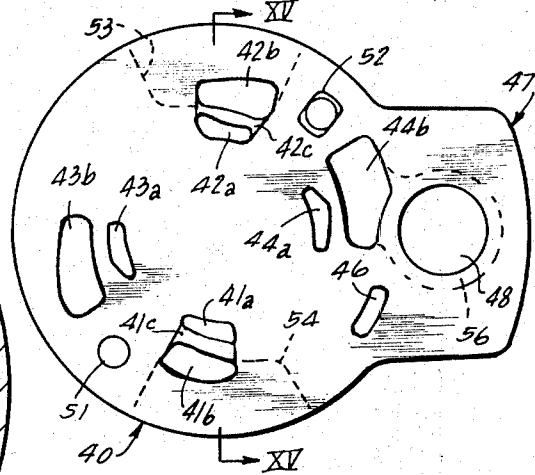


Fig. 14

PUMP WITH MEANS FOR SUPERCHARGING THE PUMP INLET

This is a division of application Ser. No. 186,865, filed Oct. 6, 1971, now U.S. Pat. No. 3,728,046.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to a pump of the type wherein a plurality of slippers in a rotor are free to rock angularly and to move radially while following the adjoining wall of a pumping chamber bore and more specifically relates to a pump of that general type used for power steering wherein a flow control valve is carried in the cam ring providing the pumping bore for the pump.

2. The Prior Art

The prior art is exemplified by our earlier U.S. Pat. Nos. 3,273,503 and No. 3,403,630. In U.S. Pat. No. 3,273,503, the concept is disclosed whereby a pressurized area acting on the upper pressure plate and thence on the stacked pump elements tends to hold the stack of pump elements in assembly with one another. If the pressure on such area is great, excessive deflection of both the upper plate and the cam may lead to variations in the end clearance of the rotor during operation and thereby reduce efficiencies at lower operating pressures and supply a potential for end seizure at higher pressures.

In U.S. Pat. No. 3,403,630 fastening bolts were extended through the stack-up of parts, however, the clamping of the assembly by means of bolts makes it difficult, if not impossible to supply equal torque on each bolt, thereby providing the possibility of misaligning the stack and making effective sealing difficult at the stacked joints. It is also possible that the stretching of the bolts under high pressure might lead to increased end clearances and inefficient pump operations.

SUMMARY OF THE INVENTION

The present invention contemplates the provision of a top plate having radially inwardly extending portions terminating in axial walls forming a reduced opening in which is received a guide member which may be integrated by attachment or assembly to the end wall of a drawn steel shell. There is thus provided between the top plate and the adjoining upper pressure plate a reduced area chamber which comprises an optimized area which can be pressure-loaded with a controllable pressure, thereby completely eliminating the necessity of using bolts and also eliminating the inherent difficulties which were part of the prior art constructions. Accordingly, the arrangement of the present invention eliminates the necessity of clamping the assembly by means of bolts and thereby eliminates the near impossibility of applying equal torque on each bolt and eliminates bolt stretching under high pressure.

By virtue of the reduced controllable pressurized area between the top plate and the upper pressure plate, sealing is easier and more efficient.

By the use of a rigid steel shell having a guide member cooperable with the top plate improved sealing of the shell is accomplished.

The structure of the pump disclosed herein also provides a solution of the problem of preventing supercharged fluid from around the cam ring and inside of

the shell housing from interfering with the intake of fluid from the reservoir.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a vertical cross-sectional view taken on line I—I of FIG. 3 and shows a power steering pump incorporating the principles of the present invention;

FIG. 2 is a bottom plan view taken on the plane of line II—II of FIG. 1;

FIG. 3 is a cross-sectional view taken on line III—III of FIG. 1;

FIG. 4 is a fragmentary view with parts shown in section taken on the plane of line IV—IV of FIG. 2;

FIG. 5 is a cross-sectional view taken on line V—V of FIG. 1 but with parts removed to show additional details of construction of the top plate;

FIG. 6 is a cross-sectional view taken on line VI—VI of FIG. 5;

FIG. 7 and FIG. 8 show one way of preventing the supercharged fluid around the cam ring and inside the steel shell from interfering with the intake of fluid from the reservoir through the holes in the housing shell and into the aspirator holes in the cam ring;

FIG. 9 and FIG. 10 taken on line X—X of FIG. 9 show a construction which is alternative to the arrangement of FIGS. 7 and 8 and wherein grommets may be snapped into the housing shell before assembly over the pump element stack;

FIG. 11 is a cross-sectional view taken generally on line XI—XI of FIG. 1;

FIG. 12 is a view showing a lower pressure plate taken on the plane of FIG. XII—XII of FIG. 1;

FIG. 13 is a top view of the upper pressure plate;

FIG. 14 is a cross-sectional view taken on line XIV—XIV of FIG. 1; and

FIG. 15 is a cross-sectional view taken on line XV—XV of FIG. 13.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The principles of the present invention find a particularly desirable application in a power steering pump and such a pump is shown in FIG. 1 generally at 20. A housing plate 21 has a flat wall 22 intersected by a bore 23 in which is received a bearing sleeve 24 and through which extends a shaft 26 which may be rotatably driven through an appropriate drive connection with a vehicular power source. A shaft seal 27 is shown diagrammatically.

The end of the shaft 26 projects beyond the surface 22 and includes a spline 28 effecting a driving connection with a rotor 29 which is rotatably driven within a pump bore 30 provided by a cam ring 31.

The rotor 29 has a plurality of peripheral notches 32, each receiving a slipper-type pumping element 33 which is free to rock angularly and to move radially in following the adjoining bore wall 30. A loading spring 34 preloads each respective pumping element 33 radially outwardly of a corresponding notch.

If desired, a lower pressure plate 36 may be interposed between the face 22 of the housing plate 21 and the cam ring 31 and rotor 29.

In accordance with the principles of this invention, an upper pressure plate is provided which is shown generally at 40. As will be noted upon referring to FIG. 13 in connection with FIG. 1, the upper pressure plate has two sets of inner and outer inlet ports 41a and 41b

being located on one side and 42a and 42b being located at the opposite side. The upper pressure plate is also provided with two sets of outlet ports shown respectively at 43a and 43b and 44a and 44b. A line outlet passage is shown at 46.

Although the main body portion of the upper pressure plate is generally circular in configuration, there is a boss portion 47 projecting to one side in which is formed an opening 48. The boss portion 47 corresponds to generally similar shaped boss portions provided on the lower pressure plate at 49 and on the cam ring at 50.

The upper pressure plate also includes a fixed dowel hole 51 and a slotted dowel hole 52. As shown on FIG. 15, the upper pressure plate 40 is notched as at 53 and at 54 to provide communication with corresponding inlet portions of the pumping bore 30, which in this particular pump, comprises a double-lobed pumping bore having two working chambers so that a double pumping impulse is generated on each rotation of the rotor. Note that the respective inlet ports 42a and 42b are intercommunicated as at 42c. In like manner, the ports 41a and 41b are intercommunicated as at 41c.

One side of the upper pressure plate 40 is also relieved at the discharge port 44b, thereby to provide a communicating passage 56.

The lower pressure plate 36, as shown in FIG. 12, is correspondingly ported. Thus, there is provided an inlet notch 57 and inlet port inwardly thereof at 57a. Opposite thereto is an inlet notch 58 and a corresponding inner port 58a.

A pair of outlet ports are shown at 59a and 59b and at 60a and 60b. A line outlet passage is shown at 61. The boss portion 49 has an opening 62 formed therein and line outlet passages communicated therethrough via a passage 63. A fixed dowel hole is shown at 64 and a slotted dowel hole at 66.

The face 22 of the housing plate is recessed as at 67 to intercommunicate the ports 59a and 59b of the lower pressure plate and is recessed as at 68 to intercommunicate the ports 60a and 60b. Inlet notches are shown at 69 and 70 and a recess 71 is disposed in register with the line outlet passage 61. The housing plate 21 also includes a boss 72 in which is formed a recess 73 in register with the opening 62.

Referring now to FIG. 3, it will be noted that the cam ring 31 has a fixed dowel opening 74, as well as a slotted dowel opening 76. There is also an axial opening 77 which is in register with the discharge passages of the adjacent plates and a corresponding axial opening 78 diametrically opposite thereto. Another axial passage 79 is in register with the line discharge passage 46 of the upper pressure plate and 61 of the lower pressure plate.

At the boss portion 50, the cam ring 31 is formed with a pair of aspirator holes 80 and 81, each of which intersects a corresponding by-pass hole 82 and 83. The by-pass holes 82 and 83 are arranged to lead from a valve passage 84 formed in the boss 50 to an inlet zone surrounding the cam ring 31.

Disposed within the passage 84 of the cam ring 31 is a flow control valve shown generally at 86. The flow control valve 86 has a coil spring 87 bottomed at one end against the housing plate 21 within the recess 73 and the other end is bottomed against a shoulder 88 formed on the valve 86.

The upper pressure plate 40 is particularly characterized by having pressed therein an orifice plug having a flow orifice 91 formed therein through which all of the fluid discharged by the pump is directed. A tapered stem 92 forming part of the flow control valve 86 extends through the orifice 91, thereby to give the pump a drooping flow characteristic.

The top plate of the present invention is shown generally at 94 and includes radially inwardly extending portions forming a wall 95 which terminates in axial walls of a restricted opening, as shown at 96.

A guide member shown generally at 97 has axial walls 98 which are received within the restricted opening 96. Sealing means may be disposed between the adjoining walls 96 and 98. In this embodiment, the guide member 97 has a peripheral recess 99 formed in the walls 98 and an O ring sealing member 100 is contained therein to provide an adequate seal between the walls 96 and 98.

The guide member 97 has an inwardly projecting pilot portion 101 extending into the coils of a coil spring 102 which is loaded against the wall 95 and the top plate 94, thereby to exert a continuous spring bias thereagainst.

The top plate is apertured as at 103 and 104 and is recessed as at 106 and 107 to intercommunicate the outlet ports of the upper pressure plate 43a, 43b and 44a, 44b and also so that fluid at pump-generated pressure can be communicated to the space radially inwardly of the walls 96. Clearance holes 75 are provided for the dowels. It will be noted that the top plate 94 also has a boss 108 which projects to one side of its generally cylindrical body and in which is formed a generally tear-shaped recess including a hole 109 and a passage 110. The boss 108 overlies the corresponding boss 47 of the upper pressure plate and thus the passage 110 communicates fluid at discharge pressure to the line discharge passage 46 from whence the fluid is directed through the line discharge passage 79 in the cam ring 31 and the line discharge passage 61 in the lower pressure plate 36 and the line pressure passage 71 in the housing plate 21. The housing plate 21 is formed with a fitting boss 21a which is tapped as at 111 for attachment thereto of an appropriate conduit leading to a point of utilization.

It is further contemplated by the present invention to provide a rigid steel shell which may be formed by drawing into a generally cup-shaped configuration so as to include a steel shell shown generally at 115 having an end wall 116 and side walls 117 terminating in an outwardly directed circumferentially extending flange 118. The end wall 116 is formed with an opening 119 in which is received an upstanding portion of the guide member 97. Thus, the edges of the opening 119 overlie the portions of the guide member which are disposed inwardly of the steel shell 115. It is contemplated by the present invention that the guide member 97 and the steel shell 115 be placed in sealed-together assembly by means of a weldment 120.

The end wall 116 of the steel shell 115 is spaced somewhat above the top plate 94 and is also spaced somewhat radially outwardly of the other pump components. With respect to the shape of the steel shell 115, it should be noted that the hollow shell is generally cylindrical in configuration but in conformance with the configurative disposition of the other parts, the steel shell 115 also has a boss portion 121 apertured as

at 122 and 123 in register with the aspiration holes 80 and 81 in the cam ring 31.

The side walls 117 of the steel shell 115 are spaced somewhat radially outwardly of the pump components, thereby to form an inlet zone which completely surrounds the pump, thereby surrounding the pump with a body of oil to promote good sound insulation and to insure adequate supply of inlet fluid to the inlet ports of the plate members.

To provide a reservoir of fluid for the pump, a thin reservoir can is provided as shown at 125. The reservoir can 125 is generally cup-shaped in configuration having an end wall 126 apertured as at 127 to pass a fastening 128 which is threadedly received in a corresponding threaded opening 129 formed in the guide member 97. The can 125 also has side walls 130 which are closely received around the radially outermost portions of the plate housing 21. The plate housing is peripherally recessed as at 131 and receives an O ring sealing member 132 to establish a good seal with the walls 130 of the reservoir can 125. Thus, the make-up holes 122 and 123 in the steel shell 115 communicate with the contents of the reservoir inside of the reservoir can 125.

In operation, fluid is drawn into the pump at the corresponding inlet areas of each working chamber and the fluid is discharged through the discharge ports 43a, 43b and 44a, 44b and thence into a discharge zone 56 in the upper pressure plate.

The flow of fluid from the discharge zone is regulated by the flow control valve in response to the pressure drop across the orifice 91. The discharged fluid then flows through the passages 110, 46, 79, 61, 71 to the point of utilization. Fluid is returned to the reservoir, or if it is by-passed by the flow control valve 86, it passes through the by-pass passages 82 and 83 directly into the inlet zone between the steel shell 115 and the pump components. Fluid flowing through the by-pass passages 82 and 83 has an aspirating effect on the aspirating passages 80 and 81, thereby drawing make-up fluid through the make-up holes 122 and 123.

As shown on FIG. 3, the steel shell 115 is connected in firm assembly to the plate housing 21 by four bolts 135, which pass through corresponding holes in the radially outwardly extending flange of the steel shell 118.

If any problem is presented in preventing supercharged fluid around the cam ring 31 and inside the drawn steel shell 115 from interfering with the intake of fluid from the reservoir 125 through the make-up holes 122 and 123 and into the aspirator holes 80 and 81 in the cam ring 31, two specific arrangements are shown herein.

In FIGS. 7 and 8, the boss portion of the steel shell is shown at 121a and is provided with only a single make-up opening 122a. A baffle 150 is formed to fit a notch 151 in a cam ring 31a and is disposed inside of the steel housing shell and the upper and lower pressure plates. The baffle 150 snaps into projections on the cam ring provided by the notch 151 prior to assembly of the housing shell 115a over the pump element stack. It will be apparent that the baffle 150 isolates the zone inside of the housing shell from the reservoir 125a.

In the arrangement of FIGS. 9 and 10, the housing shell is shown at 115b and includes a boss portion 121b. In this form of the invention, the make-up holes in the

steel shell 115b are shown at 122b and 123b. Rubber grommets are shown at 160 and each grommet is circumferentially grooved as at 161 to receive the edges of a corresponding opening 122b or 123b. The grommets 160 are each provided with a through aperture 162 which is disposed to register with a corresponding aspirator opening 80b or 81b. The end surface of each grommet 160 shown here at 163 seals up against the end surface of the adjoining wall of the cam ring shown at 50b. Again, it will be apparent that the grommets 160 isolate the zone inwardly of the steel shell 115b from the reservoir section 125b.

Although various minor modifications might be suggested by those versed in the art, it should be understood that we wish to embody within the scope of the patent warranted hereon all such modifications as reasonably and properly come within the scope of our contribution to the art.

We claim as our invention:

1. In a pump of the type having a stack-up of parts forming a pump unit and including a cam ring providing a pumping chamber and means including porting plate means on opposite sides of said cam ring forming inlet and outlet ports for said pumping chamber, casing means outwardly of said stack-up of parts and spaced sufficiently outwardly of said cam ring to form an inlet zone surrounding said cam ring, and communicating with said inlet ports, said cam ring having a boss portion formed with an axially disposed valve bore therein, a flow control valve in said bore receiving fluid at pump-generated pressure from said outlet ports, said cam ring having means forming by-pass holes therein controlled by said flow control valve, said by-pass holes being disposed to direct by-passed fluid into said inlet zone, said cam ring further having means forming aspirating passage means therein intersecting said by-pass passages, and reservoir means communicating said aspirating passage means with a supply of fluid so that the fluid flowing through said by-pass passages will aspirate fluid through said aspirating passage means and direct all of the by-passed fluid and the aspirated fluid into the inlet zone to supercharge the inlet ports of the pump.

2. In a pump as defined in claim 1, said reservoir means comprising a reservoir can surrounding said casing means,

and means forming make-up passages in the casing means and being operatively disposed between the reservoir and the aspirating passage means.

3. In a pump as defined in claim 2, and further characterized by means to prevent supercharged fluid around the cam ring and inside the inlet zone from interfering with the intake of fluid from the reservoir through the make-up passages.

4. In a pump as defined in claim 3 wherein said last mentioned means comprises a baffle formed to fit between the housing means and the stack-up of parts for isolating the supercharged fluid from the fluid in the reservoir.

5. In a pump as defined in claim 3 wherein said last mentioned means for blocking the supercharged fluid comprise a flexible grommet received in the make-up passage and engaging the stack-up of parts to isolate the supercharged fluid in the inlet zone.

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