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(54) **Pump having interchangeable heads**

(57) A pump comprising a housing (12) having a head carrying area (18), a motor (14) disposed within the housing (12), a rotor (17) rotated by the motor (14), and a pump head assembly (100) mounted to the head mount of the housing (12), the pump head assembly (100) being one of a piston head assembly (100) or a diaphragm head assembly. The head carrying area (18) is configured such that the piston head assembly (100) and the diaphragm head assembly may be interchangeably mountable thereon. The head carrying area (18) comprises a cylinder seat (36) surrounding an aperture (34) and a radially outward of the aperture (34). The sidewall (22) may also have a step (28). The cylinder seat (36) may be sized to receive a cylinder (118) of the piston head assembly (100) and the annular step (28) of the annular sidewall (22) may be configured to receive a diaphragm support ring of the diaphragm head assembly.

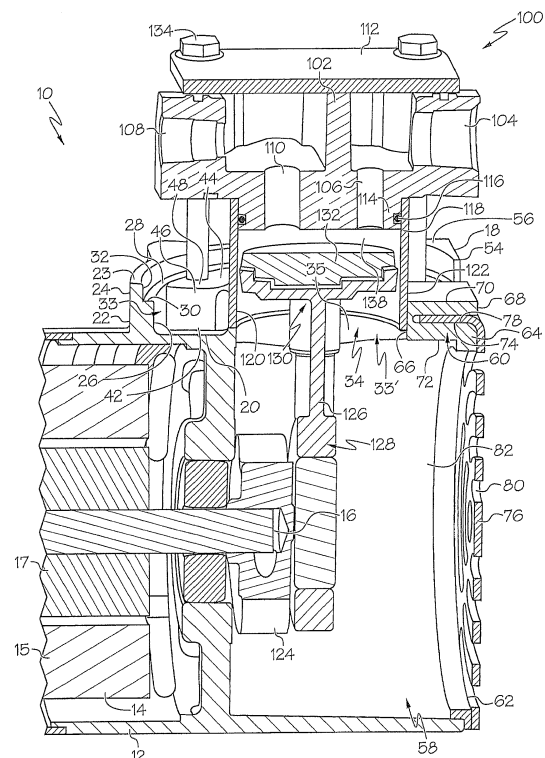


FIG. 1

Description

[0001] This application claims the benefit of U.S. Provisional Patent Application No. 61/909,894, filed November 27, 2013, and of U.S. Patent Application No. 14/252,530, filed April 14, 2014, the entire disclosures of which are hereby incorporated by reference.

[0002] This present invention relates to a pump which provides the interchangeability of a diaphragm pump head and a piston pump head mounted to the pump such that the pump can be selectively configured by an operator as one of a diaphragm pump or a piston pump.

[0003] Having flexibility in stocking pumping types may be desirable for pump distributors. For example, different applications may be better carried out by a diaphragm pump or a piston pump. Currently, if a pump distributor wishes to vary the type of pump utilized, i.e., change from a diaphragm pump to a piston pump for a particular application, the distributor must purchase an entirely new pump.

[0004] A pump provides for interchangeability of heads thereby allowing the distributor or operator to vary the type of pump between a diaphragm pump and piston pump by mounting different heads to the same housing, motor and shaft. The present pump includes a housing having a head carrying area; a motor; a shaft rotated by the motor; and a pump head coupled to the head carrying area. The pump head may be selected from a piston pump head and a diaphragm pump head. The piston pump head and the diaphragm pump head are interchangeably mountable on the head carrying area.

[0005] The head carrying area includes a sidewall and a plurality of piston pump head mounting bosses. The bosses may be disposed radially inward of a first side surface of the sidewall. The piston pump head mounting bosses may be integral with the first side surface and extend laterally in a direction radially inward of the first side surface. The carrying area also includes a plurality of diaphragm pump head mounting bosses. These bosses may be disposed radially outward of the sidewall. The diaphragm pump head mounting bosses may extend laterally in a direction outward away from said first side surface. The diaphragm pump head mounting bosses may also extend in a radial and lateral direction away from the center axis of an aperture delimited in the radial direction by said first side surface. The radial and axial direction of the piston head mounting bosses and diaphragm head mounting bosses is relative to a long axis passing through the aperture. Outward is away from said axis and inward is towards said axis. The head carrying area, which can also be called a mounting structure or mount, includes a diaphragm support ring structure adapted to carry a diaphragm support ring. The ring support structure may be adjacent and about said aperture. The ring support may be continuous with said first side surface. The support may be formed in said first sidewall having said first side surface.

[0006] The head carrying area also includes a cylinder

seat adjacent said aperture of said housing. It is about said aperture. It is about in a radial direction relative to the axis of said aperture. It surrounds the aperture and is annular. A second side surface delimits said aperture in the radial direction. The second side surface is an annular side surface and radially outward of a portion of said aperture.

[0007] The cylinder seat is sized and adapted to receive and carry a cylinder. The cylinder is adapted to be in sealing engagement with said piston pump head when said piston pump head is coupled to said carrying area and said cylinder is carried by said seat.

[0008] The pump, when configured as a diaphragm pump comprises a diaphragm eccentric, removably coupled to said shaft, a reciprocating diaphragm support operably coupled to said diaphragm eccentric and extending in the axial direction in said aperture, a diaphragm coupled to said reciprocating support. The diaphragm pump head is removably coupled to the carrying area. An outer edge of said diaphragm is clamped between said diaphragm support ring and said diaphragm pump head. The support ring and head provide opposing forces on said outer edge of said diaphragm.

[0009] The pump, when configured as a piston pump, comprises a piston eccentric removably coupled to said shaft, a piston operably connected to said piston eccentric and extending in the axial direction in said aperture, said cylinder bearing on and carried by said cylinder seat, a head of said piston is sealingly engaged with said cylinder and in said cylinder. The piston pump head is removably coupled to said carrying area. The cylinder is between said piston pump head and said cylinder seat. The piston pump head and seat exert opposing forces on said cylinder and at opposite ends of said cylinder.

[0010] The pump in at least in one embodiment of the invention comprises a housing having a head carrying area; a motor; a shaft rotated by said motor; and an assembly coupled to the head carrying area and the shaft. The assembly is selected from a first assembly and a second assembly wherein the first assembly comprises a piston pump head, a cylinder, a piston and piston eccentric. The cylinder is disposed between the head and a portion of the head carrying area. The piston pump head is coupled to the head carrying area. The piston is at least partially disposed in the cylinder and the piston eccentric is coupled to the piston. The second assembly comprises a diaphragm pump head, a diaphragm support, a diaphragm, and an eccentric. The diaphragm head is coupled to the head carrying area. The diaphragm is coupled to the diaphragm support; and the eccentric is coupled to the diaphragm support.

[0011] With respect to the above embodiment, the piston pump head and the diaphragm pump head can be interchangeably mounted on the head carrying area. Further, the head carrying area can comprise a cylinder seat and a sidewall. The cylinder seat would carry the cylinder when the first assembly is selected, and the sidewall would preferably carry a diaphragm support ring when

the second assembly is selected. In this case the diaphragm support ring and diaphragm pump head exert opposing forces on the diaphragm.

[0012] Further with respect to the above embodiment, the head carrying area can include a plurality of piston head mounting bosses disposed radially inward of the sidewall and a plurality of diaphragm head mounting bosses disposed radially outward of the sidewall. Therefore when the first assembly is selected, the piston pump head of the first assembly is coupled to the piston head mounting bosses, and when the second assembly is selected, the diaphragm pump head is coupled to the diaphragm head mounting bosses. Preferably a top surface of the piston head mounting bosses is at or below a top surface of said annular step of said annular sidewall.

[0013] A pump embodying the invention could also simply have at least a housing having a head carrying area; a motor coupled to a shaft; and one of a plurality of interchangeable assemblies coupled to said carrying area of the housing and the shaft. The plurality of interchangeable assemblies would be selected from a group of assemblies consisting of a first assembly and a second assembly. The first assembly comprises a piston pump head and the second assembly comprises a diaphragm pump head.

[0014] The invention is further embodied by a pump housing comprising a head carrying area; the head carrying area is adapted to couple to a head selectable from a group of heads consisting of a piston pump head and a diaphragm pump head.

[0015] Further the invention is embodied by a first assembly and a second assembly. A piston pump head, a piston and a cylinder form part of the first assembly. A diaphragm pump head and a diaphragm support form part of said second assembly. The first assembly and the second assembly are interchangeable with a pump housing having a head carrying area. The piston pump head couples to the head carrying area when the piston of the first assembly is coupled to an end of a shaft in the pump housing. The diaphragm pump head couples to the head carrying area when the diaphragm support of the second assembly is coupled to the end of the shaft.

[0016] Other aspects and advantages of the present invention will be apparent from the following detailed description of the preferred embodiments and the accompanying drawing figures.

[0017] The accompanying drawings form a part of the specification and are to be read in conjunction therewith, in which like reference numerals are employed to indicate like or similar parts in the various views.

Fig. 1 is a partial sectional view of one embodiment of a pump having interchangeable heads wherein a piston pump head is coupled to a head carrying area of the pump housing in accordance with the present invention; structure corresponding to the inlet and outlet valve assembly have been intentionally omitted for ease

of reference;

Fig. 2 is a top perspective view of the pump shown in Fig. 1 wherein the pump has been rotated to look into an end of the pump housing and a cover and a plug shown in Fig. 1 have been removed;

Fig. 3 is a sectional view of the pump having interchangeable heads of Fig. 1 with the diaphragm pump head and its associated components coupled thereto and the piston pump head and its associated components all removed in accordance with the teachings of the present invention;

Fig. 4 is a top perspective view of an embodiment of the pump having interchangeable heads of Fig. 1 wherein the pump is fitted with a diaphragm pump head like the one in Fig. 3; and

Fig. 5 is a top view of the pump of Fig. 1 wherein the piston pump head, associated fasteners, piston, eccentric, and shaft and other components have been removed.

[0018] The following detailed description of the present invention references the accompanying drawing figures that illustrate specific embodiments in which the invention can be practiced. The embodiments are intended to describe aspects of the present invention in sufficient detail to enable those skilled in the art to practice the invention. Other embodiments can be utilized and changes can be made without departing from the spirit and scope of the present invention. The present invention is defined by the appended claims and, therefore, the description is not to be taken in a limiting sense and shall not limit the scope of equivalents to which such claims are entitled.

[0019] As shown in Fig. 1, the present invention includes pump 10 comprising a housing 12, a motor 14, and a shaft 16. Motor 14 includes a stator 15 and a rotor 17 which rotates shaft 16. Shaft 16 and the motor rotor 17 may be seamless. Housing 12 of pump 10 further includes a head carrying area 18 to which the interchangeable pump heads may be coupled. The head carrying area 18 can be called a mount or mounting structure or head carrying section. As shown in Figs. 1 and 5, head carrying area 18 includes a floor 20 and a sidewall 22. The sidewall 22 extends in the axial direction away from the floor 22. Sidewall 22 may include a top surface 23, a surface 24 and a first side surface 26. Surface 24 is an outer surface. First side surface 26 is an inner surface. The sidewall 22 and first side surface 26 are annular. First side surface 26 delimits, in the radial direction, a first portion 33 of aperture 34. Floor 20 provides a radially extending surface which extends between first side surface 26 and a restricted diameter of the aperture 34. Sidewall 22 may also include a step 28 between first side

surface 26 and outer surface 24 wherein the step 28 is annular and defined by a top surface 30 and a vertical transition surface 32. The step 28 defined by top surface 30 and vertical transition surface 32 in combination with the top surface 23 provide a diaphragm ring support structure for a diaphragm support ring 214.

[0020] Floor 20 may be substantially parallel to the longitudinal axis of shaft 16. The floor 20 extends radially inward and is between said first side surface 26 and a second side surface 35. Second side surface 35 delimits in the radial direction a second portion 33' of aperture 34. A cylinder seat 36 surrounds and is adjacent and about the second portion of aperture 34. The cylinder seat 36 is also formed in wall portion having said second side surface 35. The second portion 33' of aperture 34 is radially inward of sidewall 22 and first side surface 26. Second portion of aperture 34 has a second radius extending from the axis of aperture 34 to second side surface 35. First portion 33 of aperture 34 has a first radius extending from the axis of aperture 34 to the first side surface 26. The second radius is shorter than the first radius. The radius can be shorter by at least 35%. Cylinder seat 36 may include a bearing surface 38. The floor 20 extends in the radial direction between first side surface 26 and cylinder seat 36.

[0021] Now turning back to Fig. 1, head carrying area 18 may also include a plurality of piston head mounting bosses 42 extending in the radial and lateral direction inward and away from first side surface 26 and sidewall 22. The bosses 42 extend in an axial direction away from floor 20. Fig. 5 further illustrates the embodiment of Fig. 1 including four piston head mounting bosses 42. As shown in Figs. 1 and 5, each piston mounting boss 42 has a top surface 44, a side surface 46 having a height, and a fastener receiving hole, such as a bolt-hole 48, defined in top surface 44 and extending into mounting boss 42 for a portion of its height. Bolt hole 48, or a portion thereof, may be threaded to receive a fastener such as a threaded rod or bolt. Top surface 44 of mounting boss 42 may be located at or below top surface 30 of annular step 28. Mounting bosses 42 may be integral with first side surface 26 of sidewall 22 as shown, or mounting bosses 42 may be separate elements extending from floor 20.

[0022] As shown in Figs. 1 and 5, head carrying area 18 may also include diaphragm head mounting bosses 50 that are located outward in the radial and lateral direction of sidewall 22 and first side surface 26. Similarly, each diaphragm mounting boss 50 has a top surface 52, a side surface 54 having a height, and a fastener receiving hole, such as a bolt-hole 56, defined in top surface 52 and extending into the boss 50 for a portion of its height. Bolt hole 56, or a portion thereof, may also be threaded to receive a fastener such as a threaded rod or bolt. Top surface 52 of mounting bosses 50 may be located at or above top surface 23 of annular sidewall 22. Mounting bosses 50 may be integral with sidewall 22 as shown, or mounting bosses 50 may be separate ele-

ments extending from housing 12.

[0023] As shown best in Figs. 1 and 3, housing 12 includes a shaft chamber 58 in which the pump eccentric and at least a portion of the reciprocating member, piston 126 or reciprocating diaphragm support 242, for the respective pumps are located. Shaft chamber 58 is continuous with aperture 34. As shown in Fig. 5, housing 12 may include a slot 60 which is cut-away and extends inward from an end surface 62 of housing 12 to aperture 34 delimited by first side surface 26 and second side surface 35. Now turning back to Fig. 1, a plug 64 may be inserted into slot 60 during operation of the pump wherein plug 64 has an inner face 66, outer face 68, a top surface 70, and a bottom surface 72. Inner face 66 may help define aperture 34 and a portion of second side surface 35. Outer face 68 may have an inward slot 74 defined therein and extending into plug 64. Top surface 70 may be located at or below top surface 30 of step 28. Bottom surface 72 may have a profile that matches the inner surface 82 of housing 12 in chamber 58. Chamber 58 may be closed with a cover 76 that is removably connected to housing 12. In one embodiment, cover 76 includes a leg 78 that is configured to be received into slot 74 wherein cover 76 helps secure plug 64 in slot 60 when it is secured to housing 12 by preventing outward and upward displacement of plug 64. Cover 76 may be a vented cover having a plurality of vent holes 80 to vent shaft chamber 58.

[0024] Head carrying area 18 is adapted to allow one of two pump heads to be mounted thereon so that an operator or distributor may interchange a diaphragm pump assembly 200 and a piston pump assembly 100. As further shown in Fig. 1, assembly 100, with piston pump head 102, can be mounted to a portion of pump 10. Piston pump head 102 includes an intake 104, an intake channel 106, an outlet 108, and an outflow channel 110. Piston head 102 also includes a top cap 112 that may be removably coupled thereto. Piston pump head 102 also includes a cylinder plug portion 114 having a sealing member such as an O-ring 116 disposed thereon.

[0025] Assembly 100 further includes a cylinder member 118 having an inner surface 120 and an outer surface 122. Cylinder plug portion 114 is configured to be received into cylinder member 118 such that O-ring 116 forms a seal with inner surface 120. Assembly 100 includes a piston eccentric 124 and a piston 126 operably connected to piston eccentric 124 as will be appreciated by a person of skill in the art. Piston 126 includes an arm with a first end 128 and a second end 130. First end 128 is operably connected to piston eccentric 124 and head 132 of piston 126 is disposed on second end 130.

[0026] To couple assembly 100 to portions of pump 10, piston eccentric 124 is removably coupled to shaft 16 in shaft chamber 58. Piston 126 is positioned so that its arm is in shaft chamber 58 and operably connected to piston eccentric 124. Piston 126 is positioned to extend in the axial direction in aperture 34 and may be inserted into shaft chamber 58 through slot 60 of housing 12. Cyl-

inner member 118 is then slid over the head 132 of piston 126 to bear on bearing surface 38 of cylinder seat 36 and outer surface 122 of cylinder member 118 and may engage vertical face 40 of cylinder seat 36. Cylinder plug portion 114 of head 102 is inserted into cylinder member 118 such that O-ring 116 forms a seal with inner surface 120. Top cap 112 may be placed on top of head 102 and bolts 134 may then be inserted through bolt holes (not shown) in top cap 112 and cylinder head 102. Bolts 134 are received into bolt holes 48 of piston head mounting bosses 42 and bolts 134 are tightened down to removably couple piston head assembly 100 to housing 12. As further shown in Fig. 2, top cap 112 is fastened to piston head 102.

[0027] Fig. 2 shows the assembly 100 having the piston pump head 102 mounted to housing 12 prior to inserting the plug 64 in slot 60. Next, as shown in Fig. 1, plug 64 may be inserted in slot 60 and removably coupled to a portion of housing 12 and carrying area 18. Cover 76 may then be coupled to housing 12 to close access to shaft chamber 58 and, in some embodiments, help clamp plug 64 in its place. Now intake 104, intake channel 106, outlet 108, and outflow channel 110 are in fluid communication with a compression chamber 138 defined by cylinder member 118 and its inner surface 120 and piston pump head 102 and its plug portion 114. Once motor 14 is turned on, the rotating piston eccentric 124 is configured to provide the desired vertical travel and reciprocation of piston 126. The head 132 of piston 126, within cylinder member 118, reciprocates and for each rotation of shaft 16 provides the fluid flow desired.

[0028] As shown in Fig. 3, an assembly 200 includes a diaphragm pump head 202 having an intake 204, an intake channel 206, an outlet 208, and an outflow channel 210. As shown in Fig. 4, diaphragm head assembly 200 also includes a top cap 212 that may be removably coupled to head 202. Turning back to Fig. 3, assembly 200 includes diaphragm support ring 214 that comprises an intermediate section 216, an outward upward rim 218 extending upward from an outer edge 219 of intermediate section 216 and an inner downward rim 220 extending downward from an inner edge 221 of intermediate section 216 as shown. Support ring 214 may generally resemble a "Z" shape. A portion of section 216 is a bearing surface 222 wherein support ring 214 is carried on and bears down on and engages sidewall 22 of housing 12. Further, inner downward rim 220 may also bear against vertical transition surface 32 of annular step 28.

[0029] As shown in Figs. 3 and 4, assembly 200 includes diaphragm pump head 202 having an outer surface 226, a horizontal annular outwardly extending ledge 228 defined in the outer surface 226 with an annular notched seat 230 defined in outwardly extending ledge 228. Ledge 228 may have a generally rectangular shape with notched seat 230 being circular or round. Notched seat 230 is configured to engage and rest on annular upward rim 218 of diaphragm support ring 214 such that a bearing surface 232 of notched seat 230 bears on top

surface 217 of annular upward rim 218. A portion of diaphragm pump head 202 is received into the space delimited by upward rim 218 of diaphragm support ring 214 as shown.

[0030] As further shown in Fig. 3, assembly 200 includes a diaphragm 234 having an outer edge 236 and an inner edge 238. Diaphragm 234 is a flexible member comprised of any material currently known or developed in the future for the diaphragm of a diaphragm pump. For example, diaphragm 234 may be rubber, neoprene, polyethylene, polypropylene, nylon, plastic, any other known elastomer or polymers, or any other known diaphragm material. Outer edge 236 of diaphragm 234 is sandwiched between diaphragm pump head 202 and diaphragm support ring 214 as shown in Fig. 3. The pump head 202 and ring 214 exert opposing forces on the outer edge 234 when diaphragm pump head 202 is removably coupled to housing 12. Similarly, inner edge 238 of diaphragm 234 is sandwiched between a top surface 240 of a head 242' of diaphragm support 242 and a bottom surface 244 of a removable top 246 of head 242'. Top 246 may be removably coupled to a portion of the head 242' of diaphragm support 242 to clamp diaphragm therebetween. The head 242' of diaphragm support 242 is operably connected to a second end 248 of a diaphragm support arm 250. The range of reciprocating motion of diaphragm support head 242' may be limited so its movement is not impeded by bosses 42. Diaphragm support head 242' may also be shaped to allow head 242' to avoid hitting the piston pump head mounting bosses 42 of head mount 18 during vertical displacement of head 242' and diaphragm shaft 250. Such shaping may include contouring, notching, cut-out portions, or tapering. A first end 252 of diaphragm support arm 250 is operably connected to a diaphragm eccentric 254 as shown in Fig. 3.

[0031] To assemble assembly 200 on pump 10, piston eccentric 254 is removably coupled to shaft 16 in shaft chamber 58. Diaphragm support arm 250 is positioned in shaft chamber 58 and is operably connected to diaphragm eccentric 254. Diaphragm support arm 250 is positioned to extend in the axial direction in aperture 34 and may be inserted into shaft chamber 58 through slot 60. Diaphragm support ring 214 is then placed in engagement with sidewall 22 to bear thereon as described herein and shown in Fig. 3. Diaphragm 234 is then positioned so outer edge 236 overlaps support ring 214. The inner edge 238 has already been sandwiched between a portion of support head 242' and top 246. Diaphragm top 246 is removably coupled to a portion of support head 242' to clamp diaphragm 234 therebetween. Diaphragm pump head 202 is placed so that outer edge 236 of diaphragm 234 is clamped between a portion of said ring and a portion of said head 202. The portion of the head is the portion extending into the space delimited by upward extending rim 218 and intermediate portion 216. Cover top 212 may be positioned on top of head 202. Then, as shown in Fig. 4, bolts 258 may be inserted through bolt holes 260 in cover top 212 (not shown) and

diaphragm head 202. As shown in Fig. 4 and 5, bolts 258 may be received into bolt holes 56 of diaphragm mounting bosses 50 and bolts 258 are tightened down to removably couple diaphragm pump head 202 to carrying area 18 of housing 12 with the necessary clamping force on outer edge 236 of diaphragm 234.

[0032] As shown in Fig. 4, top cap 212 is fastened to diaphragm head 202. In one embodiment, plug 64 may be inserted in slot 60 and removably coupled to carrying area similar to the embodiment shown on Fig. 1. Cover 76 may then be coupled to a portion of housing 12 to close access to shaft chamber 58 and, in some embodiments, help clamp plug 64 in its place. Intake 204, intake chamber 206, outlet 208, and outflow chamber 210 are all in fluid communication with a compression chamber 262 defined by diaphragm 234, head 242' of support 242 and diaphragm pump head 202. Once motor 14 is turned on, the rotating diaphragm eccentric 254 is configured to provide the desired vertical travel and reciprocation of arm 250 and head 242' and inner edge 238 of diaphragm 234 relative to outer edge 236 for each rotation of shaft 16 to provide the intake and compression force desired.

[0033] Another second interchangeable pump head like 102 and 202 may be disposed on pump housing 12 at a second end of housing 12 and simultaneously powered by motor 14. As will be appreciated by one of skill in the art, a two pump head design may be configured to act individually, in series for a two-stage pump, or in parallel. An operator may even mix and match the head types if desired.

[0034] As is evident from the foregoing description, certain aspects of the present invention are not limited to the particular details of the examples illustrated herein. It is therefore contemplated that other modifications and applications using other similar or related features or techniques will occur to those skilled in the art. It is accordingly intended that all such modifications, variations, and other uses and applications which do not depart from the spirit and scope of the present invention are deemed to be covered by the present invention.

[0035] Other aspects, objects, and advantages of the present invention can be obtained from a study of the drawings, the disclosures, and the appended claims.

Claims

1. Pump housing, comprising:

- a head carrying area (18), said head carrying area (18) being adapted to couple to a head (102, 202) selectable from a group of heads (102, 202) consisting of a piston pump head (102) and a diaphragm pump head (202).

2. Pump housing of claim 1, **characterized in that** said head carrying area (18) comprises a cylinder seat (36) adapted to carry a cylinder (118),

- wherein when said piston pump head (102) is coupled to said head carrying area (18) and said cylinder (118) is carried by said cylinder seat (36), said cylinder seat (36) and said piston pump head (102) exert opposing forces on said cylinder (118).

3. Pump housing of claim 2, **characterized in that** said head carrying area (18) further comprises:

- a plurality of piston head mounting bosses (42) extending in a direction radially inward and away from a first inner side surface (26) of a sidewall (22) of said head carrying area (18), said first inner side surface (26) at least partially delimiting an aperture (34); and
- a plurality of diaphragm head mounting bosses (50) extending in a direction radially outward of an outer surface (24) of said sidewall (22),

-- wherein when said piston pump head (102) is coupled to said head carrying area (18), it is coupled to said piston head mounting bosses (42), and

-- wherein when said diaphragm pump head (202) is coupled to said head carrying area (18), it is coupled to said diaphragm head mounting bosses (50).

4. Pump housing of claim 3, **characterized in that** said head carrying area (18) further comprises a second side surface (35), wherein said second side surface (35) also delimits said aperture (34) and said aperture (34) receives a reciprocating diaphragm support (242) when said diaphragm pump head (202) is coupled to said diaphragm head mounting bosses (50).

5. Pump housing of claim 4, **characterized in that** said head carrying area (18) has a floor (20), wherein said piston head mounting bosses (42) extend in an axial direction away from said floor (20), wherein said floor (20) extends radially between said cylinder seat (36) and said first inner side surface (26).

6. Pump housing of claim 5, **characterized in that** said cylinder seat (36) is about said aperture (34).

7. Pump housing of claim 2, **characterized in that** said cylinder seat (36) does not carry said cylinder (118) when said diaphragm pump head (202) is coupled to said pump housing (12).

8. Pump housing of any one of the above claims, **characterized in that** said head carrying area (18) is adapted to allow one of said two pump heads (102, 202) to be mounted thereon.

9. Pump, comprising:

- a piston pump head (102), a piston (126) and a cylinder (118) forming part of a first assembly;
- diaphragm pump head (202) and a diaphragm support (242) forming part of a second assembly; and
- a pump housing (12) of any one of the above claims;
- wherein said first assembly and said second assembly are interchangeable with the pump housing (12) having the head carrying area (18),
- wherein said piston pump head (102) couples to said head carrying area (18) when said piston (126) of said first assembly is coupled to an end of a shaft (16) in said pump housing (12),
- wherein said diaphragm pump head (202) couples to said head carrying area (18) when a diaphragm support arm (250) of said second assembly is coupled to said end of said shaft (16).

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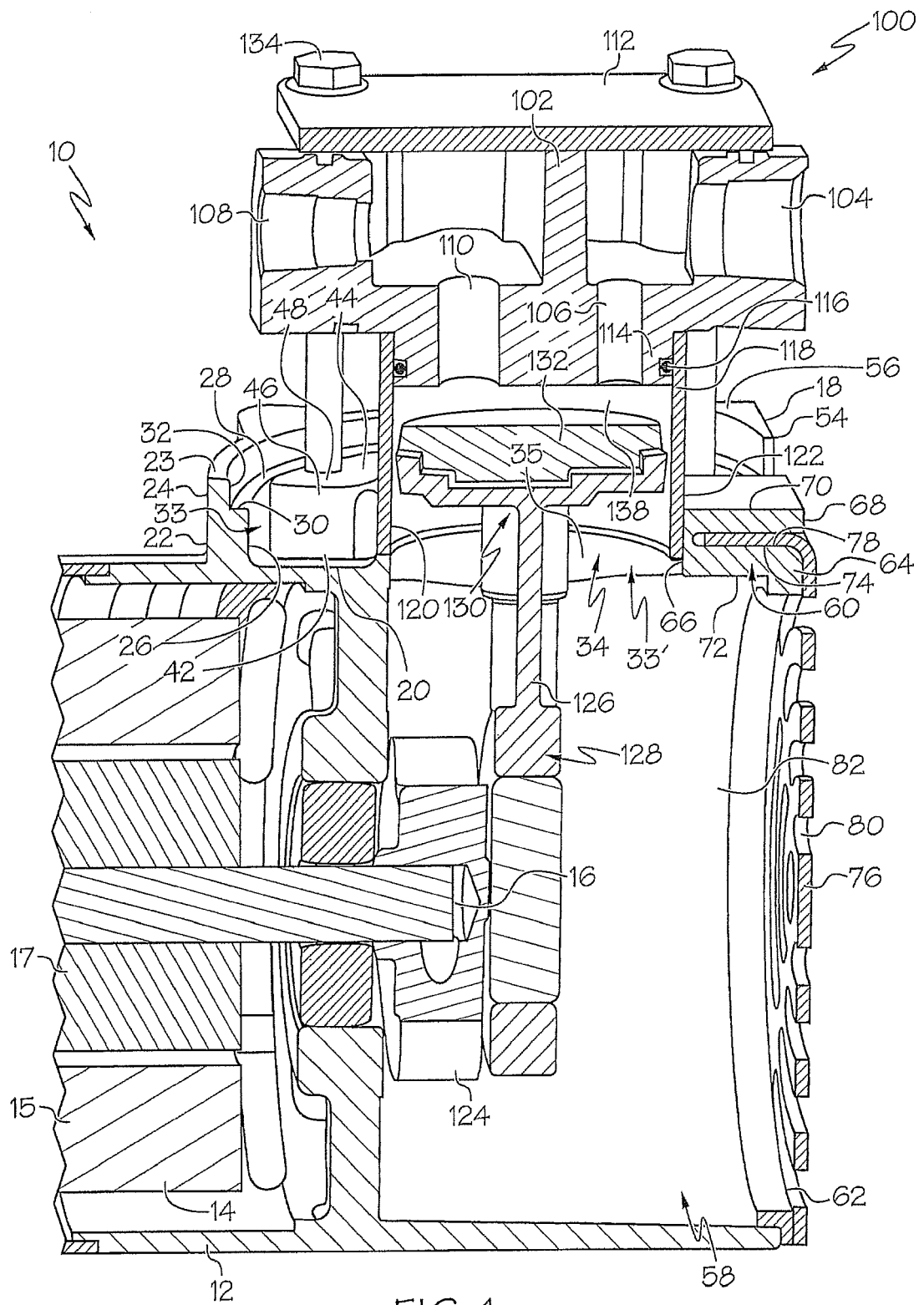


FIG. 1

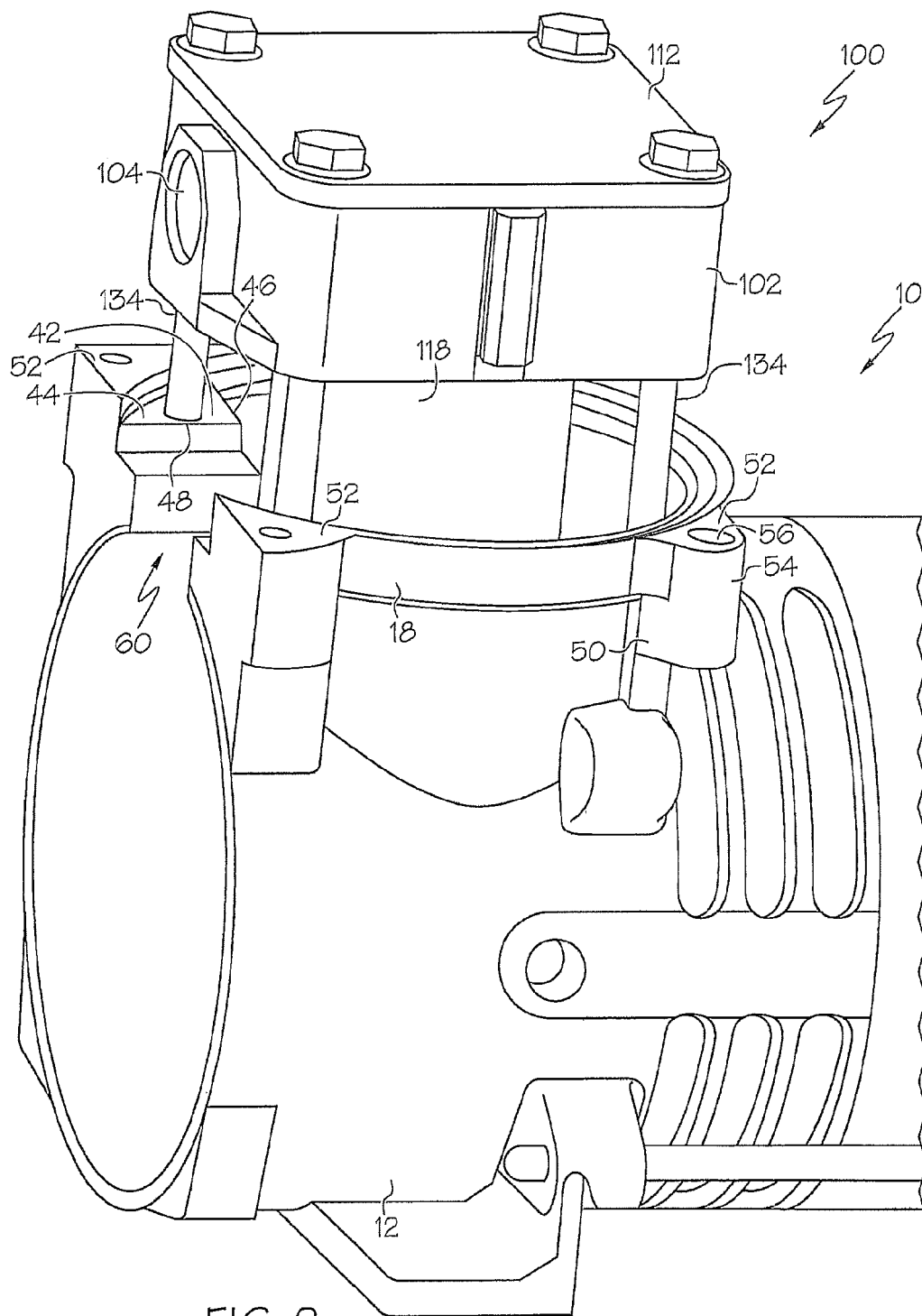
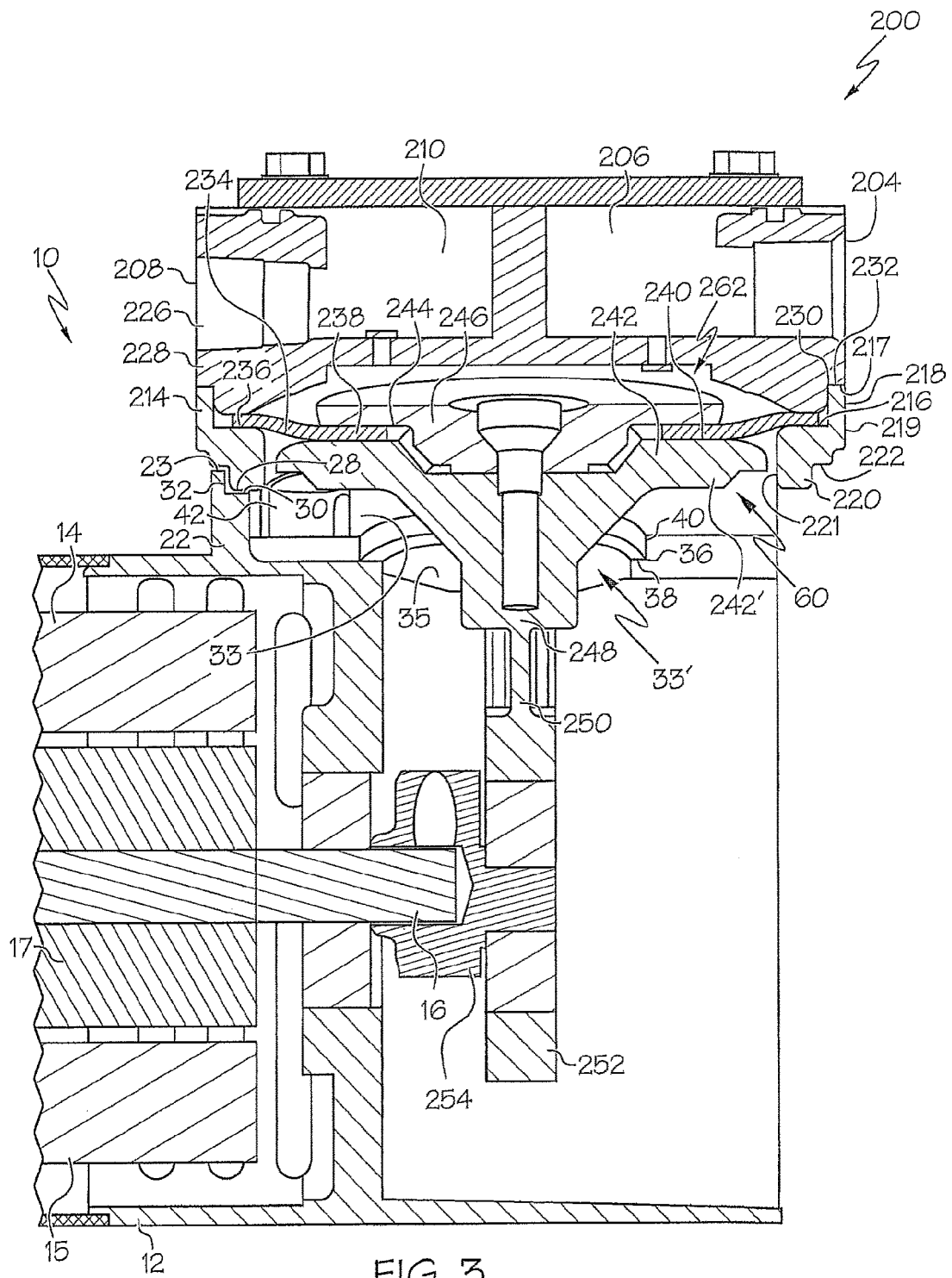


FIG. 2



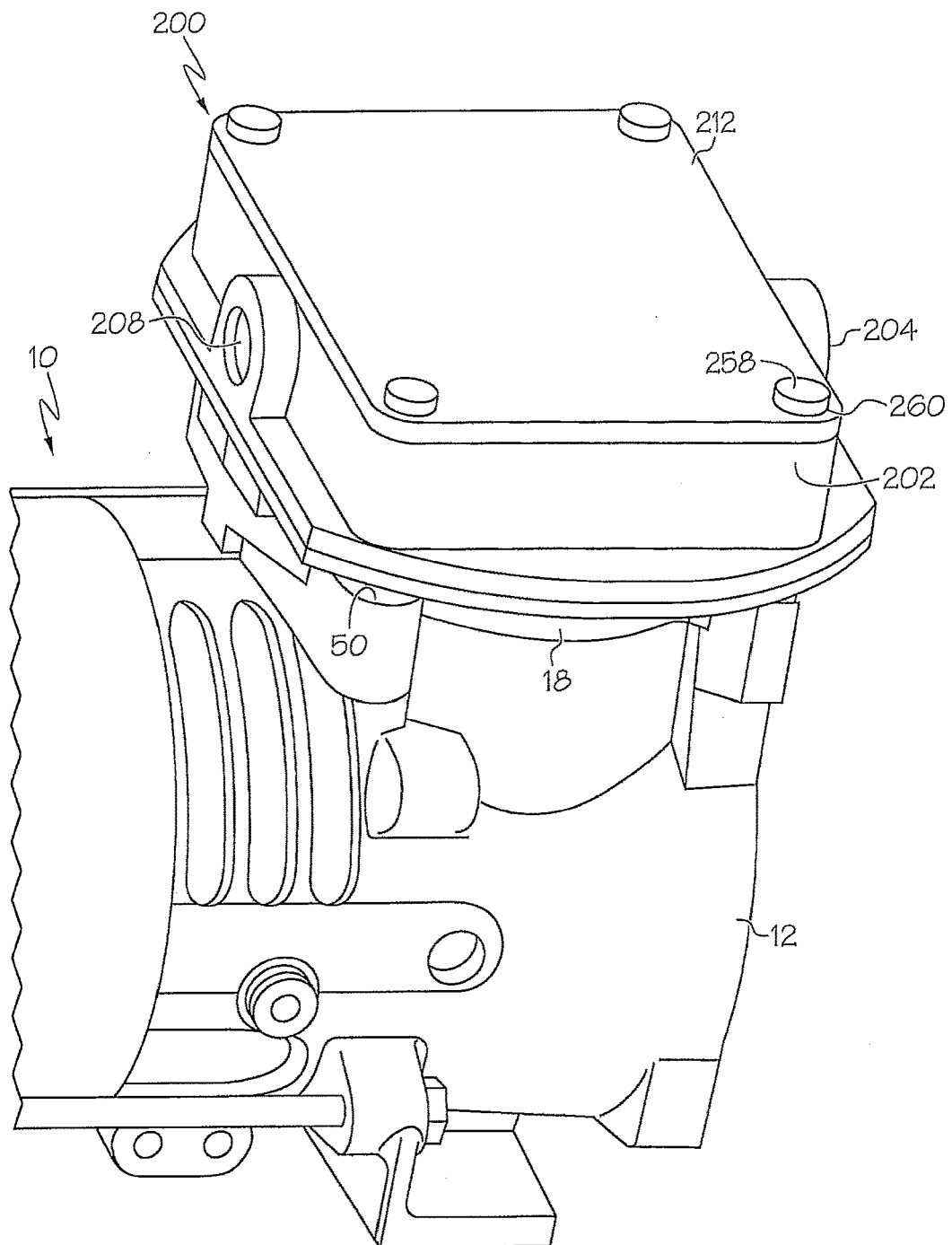


FIG. 4

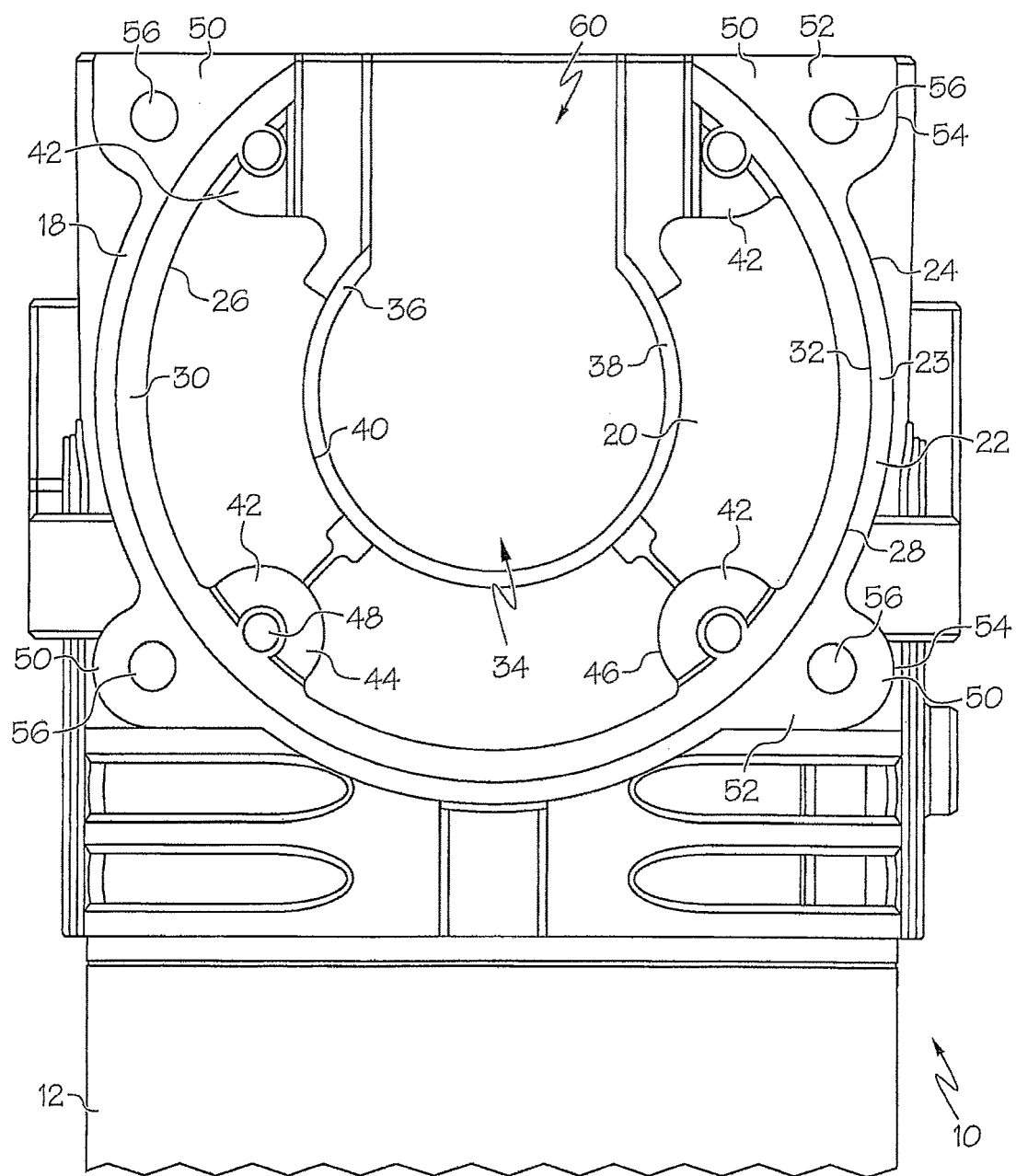


FIG. 5



EUROPEAN SEARCH REPORT

Application Number
EP 14 19 2774

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 1 114 933 A2 (TECHNO TAKATSUKI CO LTD [JP]) 11 July 2001 (2001-07-11) * paragraphs [0051] - [0055], [0041]; figures 21, 30 *	1-9	INV. F04B39/12 F04B39/14
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Place of search Munich		Date of completion of the search 19 May 2015	Examiner Jurado Orenes, A
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 14 19 2774

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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REFERENCES CITED IN THE DESCRIPTION

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