March 8, 1966 H. J. SADLER ET AL 3,238,890

PISTON TYPE PUMP

Filed Oct. 17, 1963 3 Sheets-Sheet 1

FIG. 1

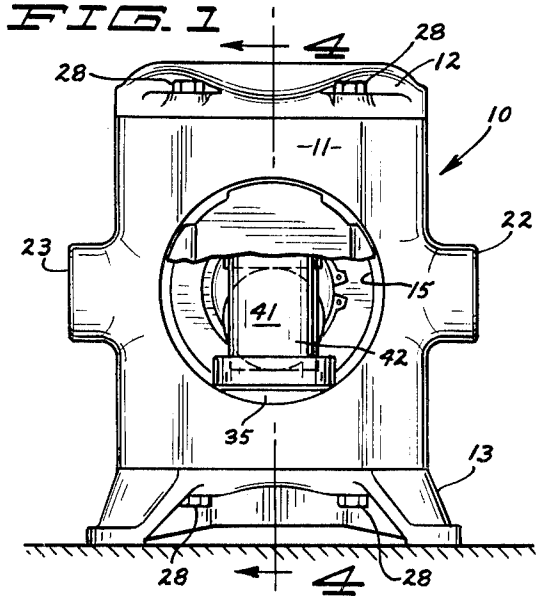


FIG. 2

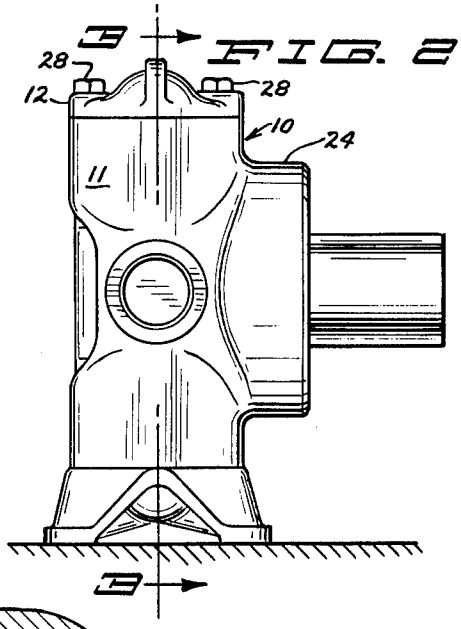
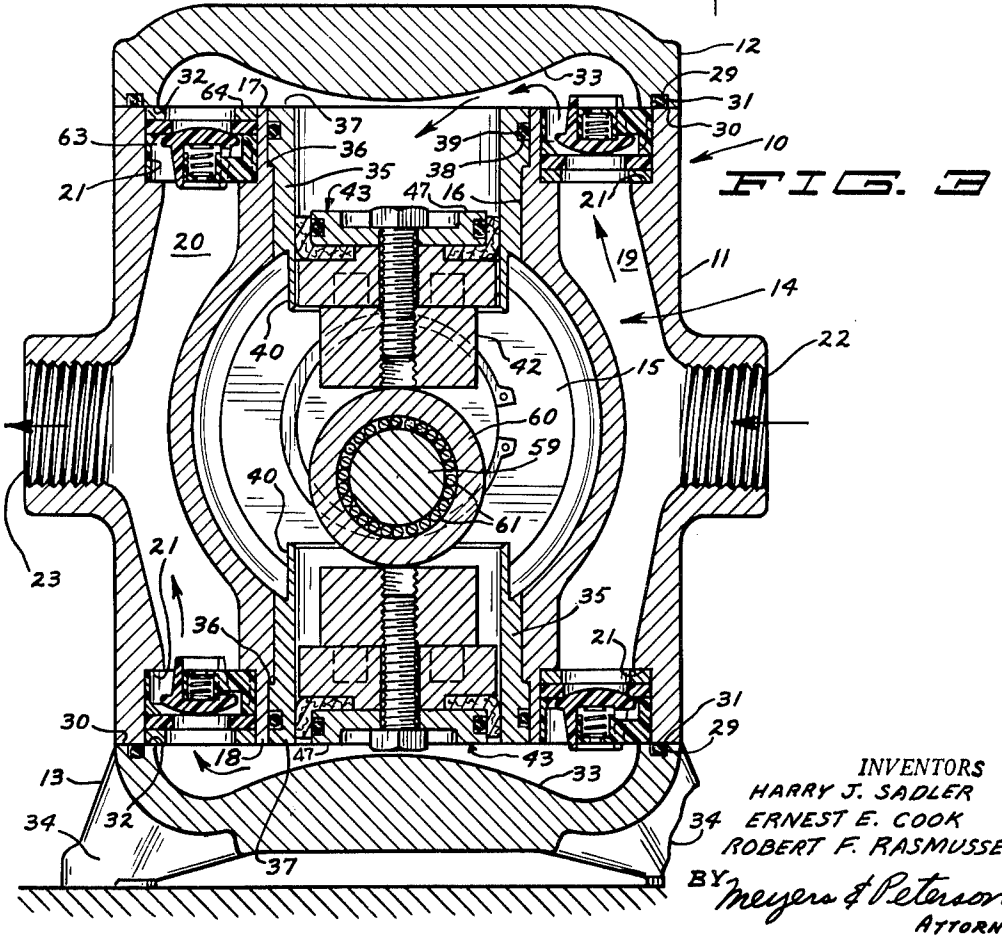


FIG. 3



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Filed Oct. 17, 1963 3 Sheets-Sheet 2

FIG. 4

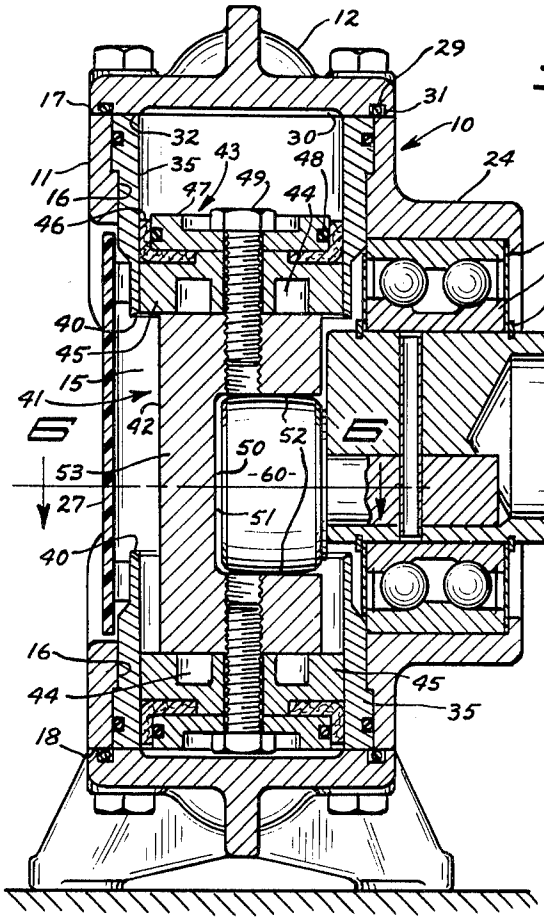
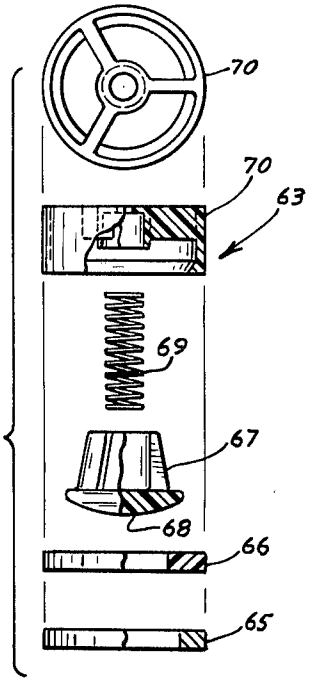


FIG. 5



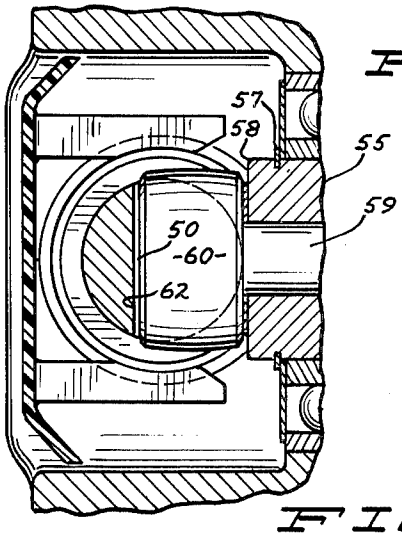


FIG. 6

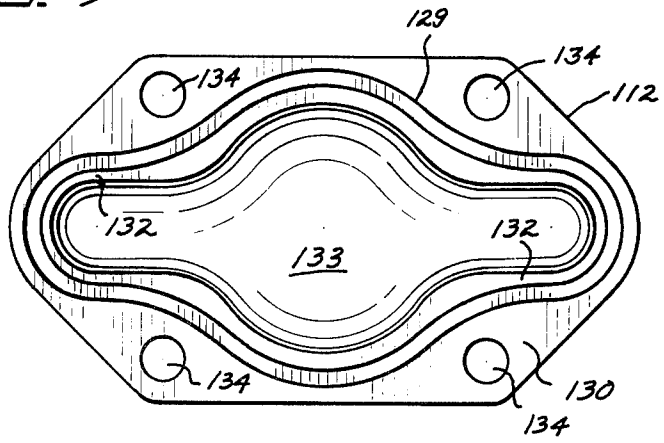
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Filed Oct. 17, 1963 3 Sheets-Sheet 3

FIG. 7



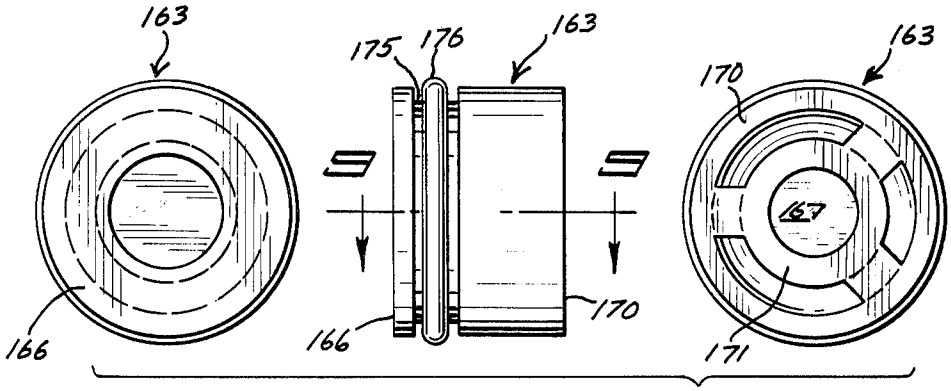


FIG. 8

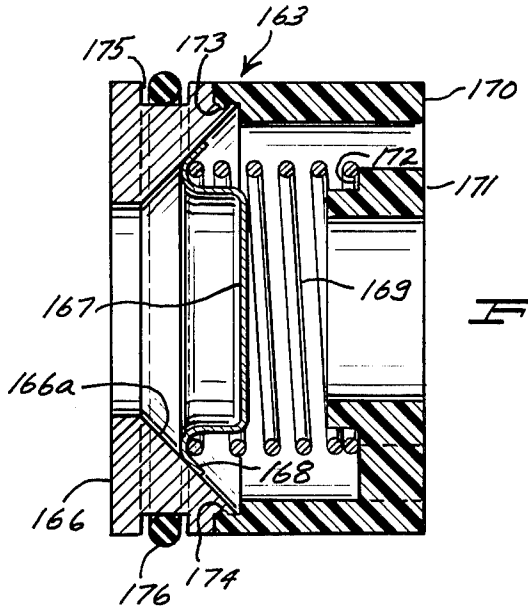


FIG. 9

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United States Patent Office 3,238,890 Patented Mar. 8, 1966

3,238,890

PISTON TYPE PUMP

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Filed Oct. 17, 1963, Ser. No. 316,978
10 Claims. (Cl. 103—171)

This invention relates to pumps and more particularly to a pump of the piston type with positive displacement. This application is a continuation-in-part of our application for Piston Type Pump, Serial No. 30,163, filed May 19, 1960, now abandoned.

It is the general object of the invention to provide a pump which not only is light in weight and economical in construction but also is high in capacity and efficient in operation.

More specifically, it is an object of the invention to provide a pump of the character described in which a dual piston is disposed diametrically across a hollow body having a closed loop with the piston drive exposed to atmosphere and not subjected to contact with the fluid being pumped

The invention also has for an aim the provision of novel valve assemblies for controlling the flow of fluid within the pump which assemblies are unitized and which can be readily installed without requiring accurate machining of the pump housing.

A further object of the invention is to provide a pump which has simple cast body and cylinder heads which, when secured together, retain in rigid and sealed relation without internal fastening, all of the valve, cylinder and piston parts. Such arrangement, in addition to favoring economy, also greatly assists in the assemblage and repair of the pump units.

Another object of the invention is to provide a simple drive connection between an eccentric drive and two pistons which utilize but a single connecting rod without pin or pivot joints.

A further object of the invention is to provide a double-acting piston pump in which cast passageways are smoothly and efficiently formed to produce a steady and full flow of fluid at a wide range of pressures.

A still further object is to provide a double-acting piston pump in which the body cylinders and working parts are symetrically disposed and contain identical and interchangeable parts to minimize cost of construction and replacement.

These and other objects and advantages of this invention more fully appear in the following description, made in connection with the accompanying drawings, wherein like reference characters refer to the same or similar parts throughout the several views and in which:

FIGURE 1 is a side elevation of the pump with the side cover partly broken away to show the piston drive assembly.

FIGURE 2 is an end view taken from the right in FIGURE 1.

FIGURE 3 is an enlarged vertical section taken on the line 3—3 of FIGURE 2.

FIGURE 4 is an enlarged vertical section taken on the line 4—4 of FIGURE 1, certain parts being shown in full line representation.

FIGURE 5 is an exploded view of the poppet valve parts.

FIGURE 6 is a sectional segment of the connecting rod and drive assembly taken on the line 6—6 of FIGURE 4.

FIGURE 7 is a bottom plan view of a somewhat different housing head that may be utilized.

FIGURE 8 is a composite view of one of the improved valve assemblies, the bracketted individual views being a left end view, a side elevational view and a right end view, respectively.

FIGURE 9 is a sectional view taken in the direction of line 9—9 of FIGURE 8.

With continued reference to the drawings, the pump is shown in its entirety in FIGURES 1 and 2. The pump housing is designated generally as **10** and in turn constitutes a housing body **11**, a housing head **12** and a housing foot **13**. The housing **10** is in the form of a hollow closed loop shown in FIGURES 1 and 3, a continuous passageway **14** being formed throughout. Inwardly from housing **10** is a medial open space **15** as shown in FIGURES 1 and 4 which space is open to the atmosphere.

The housing body **11** has a cylindrical bore **16** formed transversely of the closed loop housing and extending upwardly through the top **17** of housing body **11** and downwardly through bottom **18** thereof. In the form shown in the instant application, the cylinder bore has a single vertical axis which passes through the center of the medial open space **15** within the closed loop housing. Cylindrical bore **16** thus communicates between the endless passageway **14** and the atmospheric air in space **15**.

That portion of the endless passageway which lies within the housing body **11** constitutes a pair of passageways **19** and **20** to the right and the left respectively of the medial open space **15** shown in FIGURE 3. Each of the upstanding passageways **19** and **20** terminates at top **17** and bottom **18** in an enlarged shouldered opening **21** as shown in FIGURE 3. The housing body **11** is also provided with a threaded inlet **22** and a threaded outlet **23** communicating respectively with the passageway portions **19** and **20** of the endless passageway **14**.

Referring now to FIGURE 2, a large boss **24** is cast integrally with the body **11** and is provided with an opening **25** adapted to receive a roller bearing structure **26** as shown in FIGURE 4. A cap or cover **27** is removably secured to the housing body **11** to cover the atmospheric opening **15** when the pump is assembled.

Also constituting a part of the closed loop housing **10** is the housing head **12** which may be bolted thereon by means of cap screws **28** as shown in FIGURES 1 and 2. An endless groove **29** may be cast in face **30** and provided with a continuous sealing gasket **31** as shown in FIGURES 3 and 4. It will be observed that a portion **32** of the surface **30** extends marginally over the passageway openings **21** for a purpose to be subsequently disclosed. A contoured recess **33** is formed in the housing head **12** so as to complete the endless passageway **14** and provide communication between passageways **19, 20,** and cylinder bore **16**.

The housing foot **13** is similarly bolted to the housing body **11** by such means as cap screws **28** and the foot **13** is similar in construction to housing head **12** with the exception of the legs **34** which may be utilized to support the entire pump if desired. The housing foot **13** is provided with a marginally projecting surface **32**, a contoured recess **33**, groove **29**, sealing gasket **31** and surface **30** for sealing against the opposed surface **18** of housing body **11**, all as previously described in connection with the housing head **12**.

At the upper and lower ends **17** and **18** respectively of housing body **11** and within the traversing cylinder bore **16** are positioned a pair of cylinder sleeves **35** as shown in FIGURES 3 and 4. The sleeves **35** have shouldered abutment at **36** with the bore **16** so that the outer terminal edge **37** lies flush with the plane of housing body top **17** and bottom **18** as shown. A groove **38** is formed annularly around each of the sleeves **35** and a seal such as O-ring **39** is positioned therein for making a pressure-tight connection between the sleeve **35** and bore **16** of housing body **11**. Sleeve **35** may be provided with skirt extensions **40** which project slightly into the atmospheric space **15** as shown in FIGURE 3.

A piston assembly **41** has a connecting rod **42** and a piston **43** disposed at each end thereof as shown in FIGURES 3 and 4. Where the cylinder sleeves **35** are diametrically opposed as in the instant disclosure, a single connecting rod **42** may be employed as shown in FIGURE 4. Further, the rod **42** may be made of shaft material and formed with pins **44** at each end thereof. A piston backing plate **45** is positioned at each end of the connecting rod **42** upon the pins **44** and a piston cup **46** is in turn positioned upon the backing plate. A piston cup spreader **47** is then placed over the piston cup **46** and the spreader **47** is provided with a circumferential groove and O-ring cup spreader **48** as shown. A piston cap screw **49** extends axially through the piston assembly and is threadably received in the end of the connecting rod **42** so as to hold each of the piston assemblies in secured relation with respect to the rod.

A notched area **50** which is substantially in the form of a longitudinal cylindrical segment is cut out of the connecting rod **42** as shown in FIGURES 4 and 6 so as to create a flattened surface **51** formed at the side of the connecting rod and a pair of longitudinally spaced bearing surfaces **52** extending laterally outward from the flattened surface **51**. The notched out portion **50** of course leaves a substantial connecting portion **53** so that the connecting rod **42** will not be unduly weakened by the presence of the notch.

In order to drive the position assembly in reciprocation within the cylinder bore, a drive assembly **54** is provided. The drive constitutes a shaft **55** journaled in bearing **26** as shown in FIGURE 4 and the shaft may be provided with a coupling extension **56** as shown. Shaft **55** may be keyed with respect to bearing by such means as snap rings **57**.

Eccentrically located with respect to the inner end **58** of shaft **55** is a crank pin **59** as shown in FIGURES 4 and 6. The crank pin **59** has a roller **60** rotatably mounted thereon and needle bearings **61** may be suitably interposed between pin **59** and roller **60** as shown in FIGURE 3. Roller **60** is adapted to interfit in the notch **50** with its outer circumference engaging the lateral bearing surfaces **52** as shown in FIGURE 4. The circumference of roller **60** may be convexed slightly in axial cross-section so that it will be self-aligning with respect to the bearing surfaces **52** on the connecting portion **53**.

The flattened surface **51** lightly contacts or is closely positioned to the exposed end face **62** of roller **60** so that the flattened portion **51** will be keyed thereagainst and the connecting portion **53** prevented from rotating. The opposed bearing surfaces **52** will thus be kept in contact with the roller **60** at all times during operation of the pump.

Duplicate valve assemblies **63** are positioned in the open ends of each of the upstanding passageways **19** and **20** formed in the housing body **11**. The valve assemblies **63** are retained against shoulder **21** so that their outermost ends **64** will lie flush with the respective surfaces **17** and **18** at the top and bottom of housing body **11**. The valve assemblies **63** are thus retained in position by the overhanging margins **32** of the housing head and foot portions **12** and **13**. Similarly, the head and foot margins **32** bear against the outermost ends **37** of sleeves **35** and retain them in the ends of cylinder bore **16**.

The valve assemblies **63** are shown in exploded view in FIGURE 5 and each constitutes a backup ring **65**, a plastic seat **66**, a poppet **67** provided with a spherical surface segment **68**, a compression spring **69** and a spoked guide **70** as shown. The valves are reversible so that they can stop and permit flow of fluid in either direction through the passageways.

In the assembly of the pump, body housing **11** first is provided with the bearing **26** and drive assembly **54**, the eccentric crank pin and roller bearing being secured to the inner end of the shaft **55** as shown in FIGURES 4 and 5. The piston assembly **41** is then placed in position with the pistons **43** lying in the cylindrical bore **16** and the notched-out portion **50** of connecting portion **53** interfitting over the roller **60** as shown in FIGURES 3, 4 and 6. The cylinder sleeves **35** with their sealing rings **39** attached thereto are then inserted into the cylinder bore **16** at each end, the sleeves serving to abut and hold the bearing assembly **26** in place within the boss **24**. Poppet valve assemblies **63** are then inserted into the opened shouldered ends of passageways **19** and **20**, the poppet valves in passage **19** permitting flow outwardly thereof by checking the return flow therethrough. The valve assemblies **63** which are inserted into the ends of passageway **20** are inverted so as to permit flow of fluid into the ends thereof but to check the flow reversely outward. The housing head **12** and foot **13** are then provided with sealing rings **31** and fastened securely by means of cap screws **28** to the housing body **11** so as to abut and retain the valve assemblies and cylinder sleeves in firmly seated relation. It will be observed that cap screws **28**, once removed, will permit disassembly of the pump.

Although the valve assemblies **63** have functioned well in practice, they are somewhat difficult to install due to the rather large number of parts plus the fact that they cannot be pre-assembled. Another disadvantage stems from the fact that the housing body **11** must be fairly accurately machined in order to accommodate properly these assemblies **63**.

Accordingly, an improved valve assembly has been depicted in FIGURES 8 and 9, such assembly having been denoted generally by the reference numeral **163**. The unitized assembly comprises a metallic seat member **166** formed with a tapered seating surface **166*a*** as seen in FIGURE 9. A cup-shaped poppet **167** of sheet metal has a tapered or reversely flared flange **168** which seats against the surface **166*a*** when the valve is closed, the taper of the flange complementing that of the surface **166*a*** which taper is easily provided by a simple metal forming or stamping operation. A compression spring **169** has one end received in the annular groove that is formed between the cylindrical wall of the poppet **167** and its flange **168**. A spoked retaining sleeve or guide **170** has a centrally disposed bushing **171** provided with a shoulder at **172** for abutting the other end of the spring **169**. In this way the spring **169** acts against the poppet **167** in a direction to normally urge its flange **168** against the seating surface **166*a***. The guide **170** may be fabricated from a suitable plastic, such as nylon, and through the agency of an integral rib at **173** the guide **170** can be fixedly mated with the metallic seat member **166**, the member **166** having an annular groove **174** for the reception of said rib.

The seat member **166** is formed with a peripheral groove at **175** for the accommodation of a resilient O-ring **176**. As can be seen from FIGURE 3, the cylindrical portion of the various shouldered openings **21** must be rather precisely machined in order to provide a relatively tight fit with the circumstance of the various parts **65**, **66** and **70** comprising the valve assemblies **63**. No precision machining is needed when utilizing the modified valve assemblies **163**, for the O-ring will compress

only to the extent required to provide the needed sealing action around each valve assembly, assuming that the outer diameter of the unitized assembly **163** is somewhat less than the diameter of the shouldered opening **21**.

At this time attention is directed to FIGURE 7 where a modified housing head **112** is pictured. As with the head **12**, there is an endless groove **129** formed in its face **130** with which the sealing gasket **31** of FIGURES 3 and 4 is placed. A portion **132** at each end of the face **130** extends marginally over the passageway openings **21** when the head **112** is attached to the housing body **11**. As can be perceived from FIGURE 7, this marginal portion **132** subtends an angle greater than 180 degrees so as to overlie a substantial portion of the modified valve assembly **163** when installed, thereby assuring a firm retention of each assembly **163** during operation of the pump. A contoured recess **133** in the face **130** corresponds generally to the recess **33** in the face **30** of the head **12**. Four apertures **134** are provided in the head **112** for the bolts **28**.

In the operation of the pump, fluid enters the inlet **22** and when shaft **55** is rotated the piston assembly **41** will be reciprocated to cause alternate flow of fluid into the respective cylinder sleeves **35** and ejection thereof when the piston assembly reverses its direction, the fluid being discharged from outlet **23** for each half revolution of the shaft **55**.

Since the roller **60** has a slightly convex bearing surface, it is not essential that the cast housing body **11** be machined to a high degree of accuracy. Slight misalignment will be automatically compensated for by the character of the roller bearing surface. Since the crank pin and roller as well as the shaft **55** and bearing assembly **26** are not located within, or subjected to, direct contact with the endless passageway **14**, no material pumped into the unit will come in contact with these members nor is there any opportunity for fluid to leak from the pump into the drive parts.

It will, of course, be understood that various changes may be made in the form, details, arrangements and proportions of the parts without departing from the scope of the invention as set forth in the appended claims.

What is claimed is:

1. A piston type pump comprising, a housing body having horizontal flat top and bottom, an upstanding cylindrical bore extending through the flat top and bottom thereof and having an atmospheric opening medially of the body constituting a lateral drive-receiving enlargement at an intermediate portion of said cylindrical bore, a pair of passageways each extending through the flat top and bottom of said housing body at opposed sides of said cylindrical bore, an inlet communicating with one of said passageways, an outlet communicating with the other of said passageways, a valve assembly inserted in each end of each passageway, a cylindrical sleeve inserted in each end of said cylindrical bore, a piston in each of said cylindrical bores, a drive assembly reciprocably connected to the pistons, a housing head secured over the cylinder bore and the end of each passageway at the top of said housing body, a housing foot secured over the cylinder bore and the end of each passageway at the bottom of said body, each of said head and foot having a flat forward area along and adjacent portions of the periphery thereof and a rearwardly recessed area inscribed within said flat forward area and providing communication between said pair of passageways and said cylinder bore, each of said housing head and foot further having a portion of said flat area thereof abutting associated cylinder sleeves and valve assemblies at marginal portions thereof whereby to hold the sleeves and valve assemblies in their inserted position without additional fastening means.

2. The structure set forth in claim **1** wherein each of said valve assemblies includes a resilient ring extending about its periphery for effecting a seal with its particular passageway.

3. The structure set forth in claim **1** in which said valve assemblies are each constructed of two outer parts interfitted to provide a unit, one of said parts having a valve seat, and said unit further including a spring pressed poppet engageable with said seat.

4. The structure of claim **3** including a compressible ring extending peripherally about one of said parts to provide a seal with its respective passageways, said parts being of smaller cross-sections than the passageway in which they are placed.

5. A piston type pump comprising, a housing defining a closed loop and having an endless passageway formed therein, said closed loop surrounding an inner open space, an inlet communicating with said endless passageway, an outlet spaced from said inlet and also communicating with said endless passageway, a pair of open ended cylinders lying mutually in spaced relation between said inlet and said outlet, each communicating with the endless passageway and with said inner open space, a piston reciprocably positioned in each of said cylinders, valve means in said passageway interposed between said inlet and each of said cylinders, valve means in said passageway interposed between said outlet and each of said cylinders, each of said valve means including a member providing a tapered seat and a poppet having a correspondingly tapered flange engageable with said seat, and drive means operably connected to said pistons through said inner open space for reciprocating the same.

6. The structure set forth in claim **5** wherein said poppet is of sheet material, said flange flaring outward and rearward to provide an annular groove, and a coil spring having one end received in said groove for biasing said poppet in a direction to cause engagement of said flange with said seat.

7. The piston type pump as defined in claim **1** being particularly characterized in that said flat area abutting associated cylinder sleeves and valve assemblies lies along the lateral edges only of the area of communication between said pair of passageways and said cylinder bore.

8. A piston type pump comprising, a housing defining a closed loop and having an endless passageway formed therein, said closed loop surrounding an inner open space, an inlet communicating with said endless passageway, an outlet spaced from said inlet and also communicating with said endless passageway, a pair of open ended cylinders lying mutually in spaced relation between said inlet and said outlet, each communicating with the endless passageway and with said inner open space, a piston reciprocably positioned in each of said cylinders, valve means in said passageway interposed between said inlet and each of said cylinders, valve means in said passageway interposed between said outlet and each of said cylinders, each of said valve means being a self-contained unit having a resilient ring extending about its outer periphery for effecting a seal with the inner cylindrical wall of its particular passageway, each unit being comprised of two cylindrical parts of lesser diameter than that of the particular passageway in which it is placed, one of said pairs having an annular groove in which said resilient ring is disposed, said resilient ring projecting radially beyond said groove so as to bear tightly against said passageway wall, and drive means operably connected to said pistons through said inner open space for reciprocating the same.

9. A piston type pump comprising, a housing defining a closed loop and having an endless passageway formed therein, said closed loop surrounding an inner open space, an inlet communicating with said endless passageway, an outlet spaced from said inlet and also communicating with said endless passageway, a pair of open ended cylinders lying mutually in spaced relation between said inlet and said outlet, each communicating with the endless passageway and with said inner open space, said cylinders being diametrically opposed, a piston reciprocably positioned in each of said cylinders, a single connecting rod rigidly secured at its respective ends to said

pistons, said connecting rod having a notch cut in the side thereof intermediate its ends and lying within said inner open space, said notch forming a first flat surface parallel to the axis of said rod and a pair of second flat confronting abutment surfaces formed at right angles to said first flat surface, valve means in said passageway interposed between said inlet in each of said cylinders, valve means in said passageway interposed between said outlet in each of said cylinders, a drive shaft journaled normally to said connecting rod and having an eccentric crank pin projecting into said notch, and a roller journaled in said crank pin, said roller circumferentially bearing substantially against both of said confronting abutment surfaces and also bearing endwise against said first flat surface, said roller having an outer circumferential bearing surface which is slightly convexed in axial cross-section.

10. The structure set forth in claim **8** wherein said parts are retained together by overlapping portions, one of said overlapping portions having an annular rib thereon and other of said overlapping portions having a groove in which said rib is received.

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