June 27, 1967 H. M. PURCELL 3,327,636

FLUID PUMP OR MOTOR STRUCTURE

Filed April 30, 1965

Fig - 4

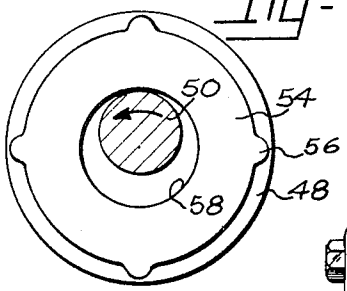


Fig - 5

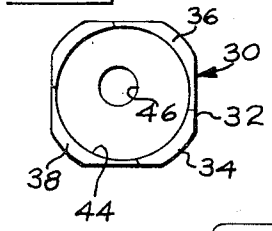


Fig - 1

Fig - 2

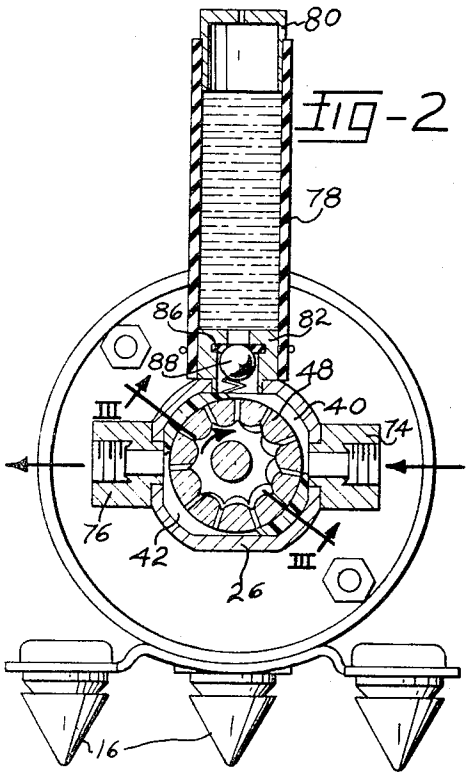
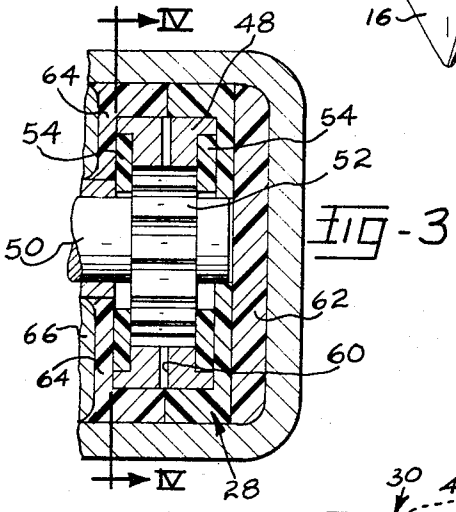


Fig - 3



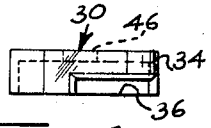


Fig - 6

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FLUID PUMP OR MOTOR STRUCTURE

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This invention relates to pumps and is particularly concerned with gear pumps of the type having an inner gear ring inside a larger outer gear.

Pumps of the nature referred to are known and are widely used because they are relatively effective for being compact and inexpensive to manufacture. Such pumps heretofore, however, have presented certain problems in connection with ultimate reduction of costs therein while at the same time maintaining efficient operation particularly with respect to properly sealing the gears at their end faces.

With the foregoing in mind the present invention has as a primary object the provision of a gear pump of the nature referred to which is quite inexpensive to manufacture but which is highly efficient in operation.

Another object of this invention is the provision of a gear pump of the nature referred to which has extremely long life and which is sufficiently inexpensive to form a throwaway item so that no service problems are encountered.

Another object of this invention is the provision of a small gear pump which can be operated directly from a motor shaft and which is particularly adapted for use in automobiles and the like such as for supplying hydraulic fluid for operating convertible tops and similar hydraulically actuated auxiliaries.

Another object of this invention is the provision of a gear pump of the nature referred to which will operate equally well in either direction of rotation.

It is also an object of this invention to provide a gear pump of the nature referred to in combination with a makeup reservoir so that the pump can be connected in closed circuit with fluid motor means actuated thereby and the fluid circuit will remain air free of all times.

These and other objects and advantages of this invention will become apparent by reference to the following detailed description and accompanying drawings wherein:

FIGURE 1 is a side view of a pump according to the present invention and a driving electric motor therefor partly broken away;

FIGURE 2 is a sectional view indicated by line 2—2 on FIGURE 1;

FIGURE 3 is a sectional view indicated by line 3—3 on FIGURE 2;

FIGURE 4 is a sectional view indicated by line 4—4 on FIGURE 3;

FIGURE 5 is a view looking in at one of the housing parts in which the gear pump rotates; and

FIGURE 6 is a plan view of the housing part looking down on top of FIGURE 5.

Referring to the drawings somewhat more in detail, **10** represents an electric motor having an output shaft **12**. The electric motor is supplied by the electric lead **14** and may be a reversible electric motor. Shock absorbing mounting means **16** are provided on the motor base.

A pump according to the present invention is generally indicated at **18** and is secured to one end of motor **10** as by nuts **20** threaded on to the through bolts **22** of the

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motor. The pump comprises an outer casing part **24** which is preferably pressed from a blank and which casing, as will be seen in FIGURE 2, is generally circular with flat regions **26** uniformly distributed about the periphery.

The casing **24** is adapted for receiving housing means **28** which consists of two identical cup-like plastic members. Teflon for example, which are formed to be closely received within the casing **24**.

One housing part is indicated at **30** in FIGURES 5 and 6 wherein it will be seen to comprise the plate **32** for engaging the plate **26** of the casing and while having the rounded corners **34** are being received within the rounded part of the casing. This shaping of the casing and the housing parts accurately locates the housing parts in the casing while preventing rotation of the housing parts.

Each housing part has two notches **36** and **38** formed therein which, when the housing parts are brought together in edge to edge engagement, form port means **40** and **42** through which fluid flows to and from the pump. As shown in FIGURE 2 port **40** could be the inlet port and port **42** the outlet port; but it will be understood that the pump is reversible and can pass fluid through the ports in either direction.

Each housing part **30** has a cylindrical cavity **44** therein and an off center hole **46** in the bottom wall. The cylindrical cavity **44**, when the two housing parts are placed in edge to edge engagement, define a cylindrical chamber in which the outer internal gear **48** is rotatably received. The bores **46** in the housing parts rotatably receive shaft **50** on which is mounted the inner external gear **52** that meshes with gear **48**, as will best be seen in FIGURE 2.

Both gears **48** and **52** are preferably formed of sintered powdered metal but could be produced in any suitable manner. Gear **52** is advantageously sintered directly on its shaft **50** or is formed integrally therewith, whereby vibration of the inner gear is avoided and cutting of the end plates of the pump is eliminated.

The pump can be constructed with both of gears **48** and **52** of the same axial length and the bottom walls of the housing members **30** will in that case seal the face between the gear teeth at the ends of the gear. I have found, however, that the operation of the pump can be improved by forming gear **48** longer in the axial direction than gear **52** and recessing the ends of gear **48** and setting plastic washers, Teflon for example, in the recesses.

The washers are indicated at **54** in FIGURES 3 and 4 and will be seen to comprise portions **56** by means of which the washers are keyed to the large gear **48** so as to rotate therewith. Each washer has a center hole **58** through which shaft **50** extends and each washer radially extends inwardly far enough to close the ends of the two spaces between the gears. The provision of the washers reduces the friction within the pump and reduces the relative speed between gear **52** and the end plate, reduces cutting of the end plates, and thereby promotes longer life and efficient operation of the pump.

According to the present invention a novel porting arrangement is provided which takes the form of bores **60** in the outer gear which may extend from the two spaces substantially radially outwardly to the outer periphery of the large gear box **48**. These bores, of which there may be one or two or more, if it is necessary to convey all of the fluid from the inlet port into the inside of the large gear and out of the large gear to the outlet port. This

porting arrangement has been found to be effective and inexpensive to incorporate in the pump and eliminates the difficulty of forming the usual kidney shaped inlet and outlet ports at the ends of the gears, which many times produce sealing problems.

The housing parts **30** of the housing **28** in which the gears are rotatable are, as mentioned, preferably of Teflon or a suitable slippery plastic material, and the housing parts fit closely on the periphery of the outer gear, closely embrace the end faces of the outer gear and the faces of the washers **54**.

Sealing between the inlet and outlet ports is thus extremely good and the pump operates with an extremely high efficiency due to this extremely effective sealing and furthermore, due to the low friction characteristics of the metal outer gear ring in the Teflon housing and the Teflon washers **54** running in the housing.

In actual tests it has been found that the efficiency of the pump actually increases over a period of time, probably due to the fact that the metal gears tend to run high with the plastic washers **54** and the parts **30** of housing **28** which appear, in effect, to establish a sort of labyrinth sealing arrangement that is effective for preventing fluid leakage and at the same time the friction within the pump is not increased in any way.

It will be noted that the housing **28** is placed in casing **24** with a resilient rubber-like member **62** on one side between the cup housing and the bottom wall of casing **24** and with a rubber-like washer **64** on the other side of the housing and with this assembly being fixed in the casing by the ring member **66** pressed into the open side of the casing preferably welded in place. This makes a sealed unit which, at the same time, is inexpensive enough to form a throw-away item should it become defective.

Ring-like member **66** supports a bushing **68** in which shaft **50** is journalled and includes a sealing ring **70** to seal against leakage from the pump into the motor. The connection of shaft **50** with motor shaft **12** is preferably by way of a coupling **72** which will prevent the transmission of vibration from the motor to the pump and thus enhance the efficiency and life of the pump.

As will be seen in FIGURE 2 communication with ports **40** and **42** is accomplished quite simply by mounting fittings **74** and **76** in casing **24** to which pipes or tubing or other conduit means can be connected to place the pump in circuit.

A feature of the present invention is to be found in the make-up reservoir mounted directly on casing **24**. The make-up reservoir may take the form of a length of plastic tubing **78** closed at the top by vented cap **80** and connected at the bottom to fitting **82** as by spring ring **84**. Fitting **82** has a bore therethrough communicating with port **40** and the bore has therein a seat member **86** normally closed from the pump side by spring pressed ball **88**. The ball **88** is lightly spring biased against spring **86** but will yield to permit fluid to flow from the inside of plastic tube **78** into port **40** at any time that port **40** is the inlet port for the pump and any cavitation occurs in the fluid system. Such cavitation would normally occur first at the inlet side of the pump and the aforementioned reservoir structure is thus ideally located to provide make-up fluid to the fluid system when necessary.

It will be understood that this invention is susceptible to modification in order to adapt it to different usages and conditions and accordingly, it is desired to comprehend such modifications within this invention as may fall within the scope of the appended claims.

What is claimed is:

1. A pump comprising; an outer internally toothed gear, an inner externally toothed gear inside said outer gear eccentric thereto and meshing therewith, non-rotatable housing means fitted over and enclosing said gears, circumferentially spaced ports in said housing means communicating with spaced regions about the periphery of said outer gear, passage means in said outer gear communicating the periphery thereof with the inside of the outer gear for exchanging fluid between said ports when said gears rotate within said housing means, said housing means comprising a pair of cup shaped members fitted over said gears from opposite sides and meeting in edge to edge relation about the outer gear, a cup-like metal casing in which said housing means is received, and a closure member in the open side of said casing.

2. A pump comprising; an outer internally toothed gear, an inner externally toothed gear inside said outer gear eccentric thereto and meshing therewith, non-rotatable housing means fitted over and enclosing said gears, circumferentially spaced ports in said housing means communicating with spaced regions about the periphery of said outer gear, passage means in said outer gear communicating the periphery thereof with the inside of the outer gear for exchanging fluid between said ports when said gears rotate with said housing means, said housing means comprising a pair of cup shaped members fitted over said gears from opposite sides and meeting in edge to edge relation about the outer gear, a cup-like metal casing in which said housing means is received, a closure member in the open side of said casing, and a rubber-like cushion in the casing on opposite sides of said housing means.

3. A pump comprising; an outer internally toothed gear, an inner externally toothed gear inside said outer gear eccentric thereto and meshing therewith, non-rotatable housing means fitted over and enclosing said gears, circumferentially spaced ports in said housing means communicating with spaced regions about the periphery of said outer gear, passage means in said outer gear communicating the periphery thereof with the inside of the outer gear for exchanging fluid between said ports when said gears rotate with said housing means, said housing means comprising a pair of cup shaped members fitted over said gears from opposite sides and meeting in edge to edge relation about the outer gear, a cup-like metal casing in which said housing means is received, a closure member in the open side of said casing, a rubber-like cushion in the casing on opposite sides of said housing means, a bearing in said closure member, and a shaft journaled in said bearing and drivingly connected to said inner gear.

4. A pump comprising; an outer internally toothed gear, an inner externally toothed gear inside said outer gear eccentric thereto and meshing therewith, non-rotatable housing means fitted over and enclosing said gears, circumferentially spaced ports in said housing means communicating with spaced regions about the periphery of said outer gear, passage means in said outer gear communicating the periphery thereof with the inside of the outer gear for exchanging fluid between said ports when said gears rotate with said housing means, said housing means comprising a pair of cup shaped members fitted over said gears from opposite sides and meeting in edge to edge relation about the outer gear, a cup-like metal casing in which said housing means is received, a closure member in the open side of said casing, a rubber-like cushion in the casing on opposite sides of said housing means, a bearing in said closure member, and a shaft journaled in said bearing and drivingly connected to said inner gear, said housing means having shaft receiving apertures therein on both sides of said inner gear and said shaft engaging both said apertures.

5. A pump comprising; an outer internally toothed gear, an inner externally toothed gear inside said outer gear eccentric thereto and meshing therewith, non-rotatable housing means fitted over and enclosing said gears, circumferentially spaced ports in said housing means communicating with spaced regions about the periphery of said outer gear, passage means in said outer gear communicating the periphery thereof with the inside of the outer gear for exchanging fluid between said ports when said gears rotate with said housing means, said outer gear having a greater width than said inner gear, counterbores

in the opposite faces of said outer gear, and washer elements mounted in said counterbores and engaging the end faces of said gears to close the ends of the tooth spaces thereof.

6. A pump comprising; an outer internally toothed gear, an inner externally toothed gear inside said outer gear eccentric thereto and meshing therewith, non-rotatable housing means fitted over and enclosing said gears, circumferentially spaced ports in said housing means communicating with spaced regions about the periphery of said outer gear, passage means in said outer gear communicating the periphery thereof with the inside of the outer gear for exchanging fluid between said ports when said gears rotate with said housing means, said outer gear having a greater width than said inner gear, counterbores in the opposite faces of said outer gear, washer elements non-rotatably mounted in said counterbores and closing the tooth spaces at the ends of said gears, said washers and said housing means being formed of a low friction plastic material.

7. A pump comprising; an outer internally toothed gear, an inner externally toothed gear inside said outer gear eccentric thereto and meshing therewith, non-rotatable housing means fitted over and enclosing said gears, circumferentially spaced ports in said housing means communicating with spaced regions about the periphery of said outer gear, passage means in said outer gear communicating the periphery thereof with the inside of the outer gear for exchanging fluid between said ports when said gears rotate with said housing means, said outer gear having a greater width than said inner gear, counterbores in the opposite faces of said outer gear, washer elements non-rotatably mounted in said counterbores and closing the tooth spaces at the ends of said gears, said washers and said housing means being formed of a low friction plastic material, said housing means being non-circular in cross sectional shape, a cup-like metal casing conforming in shape to said housing means and surrounding said housing means, a closure member fixed in the open side of said casing, resilient elements in the casing on opposite sides of said housing means, and fittings in said casing for connection to fluid conduits and providing communication of the conduits with said ports.

8. A pump comprising; an outer internally toothed gear, an inner externally toothed gear inside said outer gear eccentric thereto and meshing therewith, non-rotatable housing means fitted over and enclosing said gears, circumferentially spaced ports in said housing means communicating with spaced regions about the periphery of said outer gear, passage means in said outer gear communicating the periphery thereof with the inside of the outer gear for exchanging fluid between said ports when said gears rotate with said housing means, said outer gear having a greater width than said inner gear, counterbores in the opposite faces of said outer gear, washer elements non-rotatably mounted in said counterbores and closing the tooth spaces at the ends of said gears, said washers and said housing means being formed of a low friction plastic material, said housing means being non-circular in cross sectional shape, a cup-like metal casing conforming in shape to said housing means and surrounding said housing means, a closure member fixed in the open side of said casing, resilient elements in the casing on opposite sides of said housing means, fittings in said casing for connection to fluid conduits and providing communication of the conduits with said ports, a reservoir mounted on the casing and a connection through the casing leading from said reservoir to one of said ports, and a check valve in said connection opening toward said port.

9. A pump comprising; an outer internally toothed gear, an inner externally toothed gear inside said outer gear eccentric thereto and meshing therewith, non-rotatable housing means fitted over and enclosing said gears, circumferentially spaced ports in said housing means communicating with spaced regions about the periphery of said outer gear, passage means in said outer gear communicating the periphery thereof with the inside of the outer gear for exchanging fluid between said ports when said gears rotate with said housing means, said outer gear having a greater width than said inner gear, counterbores in the opposite faces of said outer gear, washer elements non-rotatably mounted in said counterbores and closing the tooth spaces at the ends of said gears, said washers and said housing means being formed of a low friction plastic material, said housing means being non-circular in cross sectional shape, a cup-like metal casing conforming in shape to said housing means and surrounding said housing means, a closure member fixed in the open side of said casing, resilient elements in the casing on opposite sides of said housing means, and fittings in said casing for connection to fluid conduits and providing communication of the conduits with said ports, an additional fitting mounted in said casing having a passage communicating with one of said ports, a check valve in the passage of the additional fitting opening toward said one port, a tube sealed at one end to the additional fitting and communicating with the passage therein for containing make-up fluid, and vented closure means in the other end of said tube.

10. A pump comprising; an outer internally toothed gear, an inner externally toothed gear inside said outer gear eccentric thereto and meshing therewith, non-rotatable housing means fitted over and enclosing said gears, circumferentially spaced ports in said housing means communicating with spaced regions about the periphery of said outer gear, passage means in said outer gear communicating the periphery thereof with the inside of the outer gear for exchanging fluid between said ports when said gears rotate with said housing means, said outer gear having a greater width than said inner gear, counterbores in the opposite faces of said outer gear, washer elements non-rotatably mounted in said counterbores and closing the tooth spaces at the ends of said gears, said washers and said housing means being formed of a low friction plastic material, said housing means being non-circular in cross sectional shape, a cup-like metal casing conforming in shape to said housing means and surrounding said housing means, a closure member fixed in the open side of said casing, resilient elements in the casing on opposite sides of said housing means, and fittings in said casing for connection to fluid conduits and providing communication of the conduits with said ports, said casing having a mounting flange at the open end.

11. A pump comprising; an outer internally toothed gear, an inner externally toothed gear inside said outer gear eccentric thereto and meshing therewith, non-rotatable housing means fitted over and enclosing said gears, circumferentially spaced ports in said housing means communicating with spaced regions about the periphery of said outer gear, passage means in said outer gear communicating the periphery thereof with the inside of the outer gear for exchanging fluid between said ports when said gears rotate with said housing means, said outer gear having a greater width than said inner gear, counterbores in the opposite faces of said outer gear, washer elements non-rotatably mounted in said counterbores and closing the tooth spaces at the ends of said gears, said washers and said housing means being formed of a low friction plastic material, said housing means being non-circular in cross sectional shape, a cup-like metal casing conforming in shape to said housing means and surrounding said housing means, a closure member fixed in the open side of said casing, resilient elements in the casing on opposite sides of said housing means, and fittings in said casing for connection to fluid conduits and providing communication of the conduits with said ports, said casing having a mounting flange at the open end, an electric

motor bolted to said flange, and coupling means connecting said shaft with the water output shaft.

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