Oct. 21, 1947. F. A. QUIROZ 2,429,368

ROTARY PUMP

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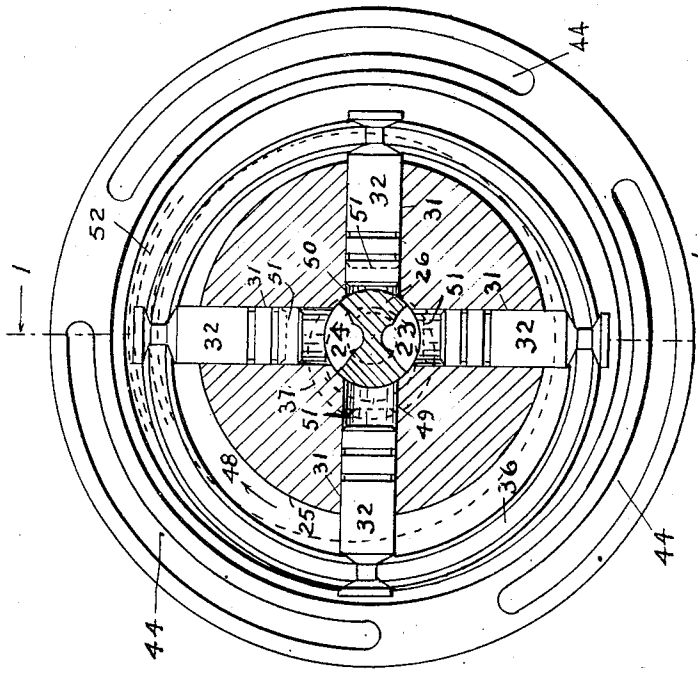


Fig. 2

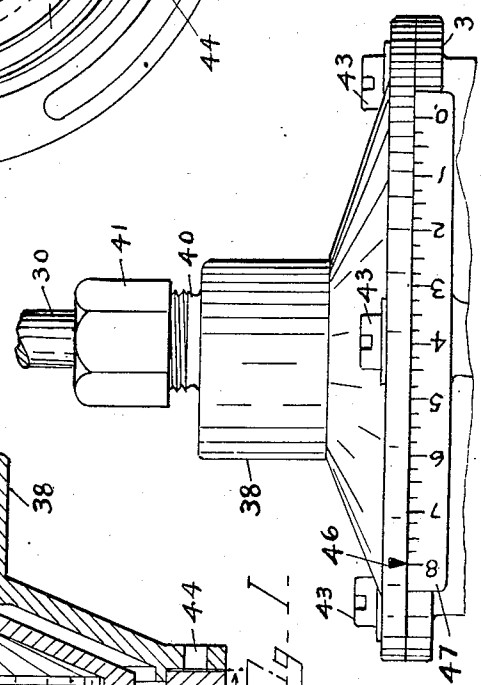


Fig. 3

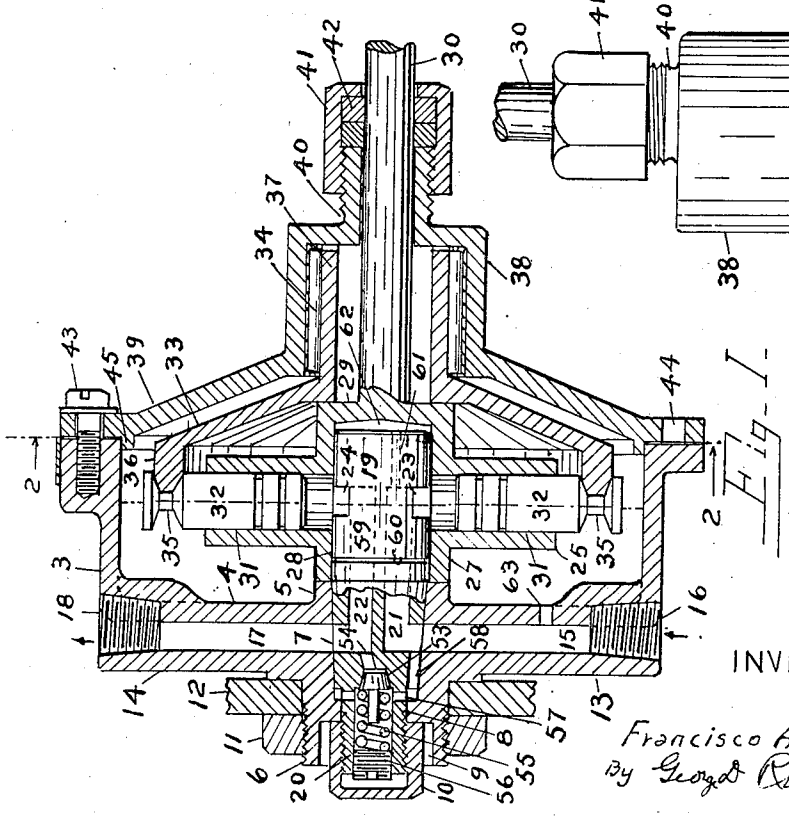


Fig. 1

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ROTARY PUMP

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9 Claims. (Cl. 103—161)

1

This invention relates to improvements in rotary pumps of the type in which a number of pistons in a rotary member are actuated to move radially in corresponding cylinder bores by means of a second member rotating eccentrically to the axis of rotation of said rotary member.

An object of this invention is to provide an improved pump of this type, which is simple in construction and inexpensive to manufacture and assemble.

Another object is to provide a pump of this type with simple means for changing the volumetric capacity of the pump, without the necessity of providing complicated extra mechanism or extra parts.

Another object is to provide simple and inexpensive means in said pump for controlling and changing the pressure of the liquid to be pumped.

Another object is to provide a pump of this character with an inexpensive indicator for reading the amount of liquid being pumped.

Another object is to provide an efficient and inexpensive pump which can be manufactured in production, particularly in small units to be used for pumping oil for oil burners or similar work, which are easy to adjust to meet the requirements of the service, especially in relation to capacity and pressure.

Other objects will be obvious or in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements and arrangement of parts, as will be exemplified in the illustrative embodiment to be hereinafter described, and the scope of which invention will be indicated in the following claims.

In the accompanying drawings in which I show an illustrative embodiment of my invention;

Fig. 1 is a central vertical sectional view through the pump casing and its internal parts, along the line 1—1 of Fig. 2, showing the pistons in elevation, and other internal parts, partly in section and partly in elevation or partly broken away.

Fig. 2 is a vertical view along the line 2—2 in Fig. 1 showing the cover of the casing and other parts in elevation and the rotor and axle member in section, and

Fig. 3 shows the cover of the casing and part of the casing upon which the capacity scale is mounted, all as seen from the top in Fig. 1.

Similar reference characters refer to similar parts throughout the several views of the drawings.

Referring first to Fig. 1, I provide a casing 3,

2

preferably a casting, generally cylindrical in form, closed at the left hand side by a wall 4 and open at the opposite side, said casing having an external flange to receive the cover 39 which completes the housing of the pump. The wall 4 is provided with a boss 5 which is concentric with the axis of the casing and extends to the outside of the casing at 6. In the center of the boss 5, and also concentric with the axis of the casing 3, is a tapered hole 7 which extends into the boss 6. At the bottom of the tapered hole 7 is provided a smaller hole 8 which goes through to the outside of the casing axially of the boss 6, and which is counterbored at 9 to provide the necessary room for the nut 10 which holds the axle member firmly anchored to the casing. The boss 6 is externally threaded to receive a locking nut 11 which provides the means for mounting the pump on a vertical plate 12. This method of mounting is commonly used for small pumps. It is obvious that other means for mounting the pump can be provided, such as a conventional base cast integral with the casing. Extending from the boss 6 and along the outside of the wall 4, are provided two radial bosses 13 and 14. The boss 13 has a passage 15 threaded at the outer end 16 to receive the suction pipe connections to draw the liquid into the pump. The boss 14 has a discharge passage 17 which is also threaded at the outer end 18 to receive the pipe connections for discharging the liquid to be pumped.

A cylindrical axle member 19, preferably made of a hardened metal, is firmly secured in the tapered hole 7, in a position coaxial with the axis of the casing, by means of the nut 10, which forces the tapered end of the axle member 19 against the wall of the tapered hole 7 by pulling the stud 20 which is an integral part of the axle member 19. The part of the axle member 19 extending into the casing from the tapered hole 7 is perfectly cylindrical and uniform in diameter throughout the entire length, and is provided with two ducts 21 and 22. The duct 21 is the suction duct through which the liquid passes into the pumping cylinder bores and communicates at one end with the suction passage 15 and at the other end with a suction port 23 which discharges the liquid into the cylinder bores of a rotor 25. The duct 22 is connected at one end to the discharge passage 17 and at the other end to a discharge port 24 through which the liquid is forced out of the pump. The ports 23 and 24 are located diametrically opposite each other on the axle member periphery, and in a plane at right angles to the axis of the axle member width preferably

one-half the diameter of the cylinder bores, and should be as long as possible in radial length and yet leave between the ports a solid portion 26, wider than the diameter of the pistons, in order to prevent the liquid flowing back from bore to bore as the cylinder bores pass in rotation from one port to the other.

The rotor member 25 is the heart of the pump and is made in the form of a disc wheel with a concentric hub 27, extending on both sides of the wheel. A concentric hole 28 is provided and should be made deep enough to have sufficient bearing area for the rotor 25 as it rotates on the axle member 19. This is the only positive bearing that supports the rotor 25 in this pump. Usually in this type of pump the rotor member is actually supported by outside bearings and the axle member 19 is closely fitted into the hole 28 so as to make a good seal and prevent the flow of liquid away from the regular course. This kind of construction is very expensive, since besides the extra parts that are required a perfect alignment must be assured between working parts to prevent jamming. One of the main purposes of this invention is to make the pump inexpensive. The central hole 28 is closed at one end by the wall 29 to prevent any liquid from leaking out, and to provide a support for the driving shaft 30 which goes out of the casing through the stuffing box 42. Sufficient clearance should be allowed between the gland 40 and the shaft 30 to take up all the tolerance factors of misalignment. The shaft 30 should be supported only by the packing 42 so as to allow the cover 39 to move freely whenever a change in position has to be made in order to change the capacity of the pump according to the scale 47 shown in Fig. 3.

The rotor 25 is provided with a number of cylinder bores 31, the axis of each of which is located at a right angle to the axis of rotation. Operating in said cylinder bores, there are a number of perfectly fitted pistons 32, each having at the outer end a deep circular tapered groove 35 to engage with the tapered rim of the cup member 33 as will be hereinafter explained.

The cup member 33 is preferably mounted on a needle bearing 34 which is inexpensive, flexible and long enough to provide, in a single bearing, sufficient bearing area to give a good support to the cup member 33. The bearing 34 is mounted in a housing 38 which extends out of the cover 39, and is located in a position to cause the cup member 33 to rotate on an axis parallel to the axis of rotation of the rotor 25. In other words the cup rotates eccentrically to the rotor 25. Usually in this type of pump, when a cup or drum is used to operate the pistons, the pistons engage the inside wall of the cup only, as centrifugal force is exclusively used to force the pistons in their outward movement. Centrifugal force throws them against the inside wall of the cup and the drum or cup wall pushes them in for the inward stroke. This arrangement will not work satisfactorily in small pumps, because the pistons are too light in weight, and since the centrifugal force decreases as the radius of gyration decreases when the revolutions per minute are constant, therefore, there is not enough centrifugal force to compel the pistons to move in their outward stroke so as to produce good suction. Therefore, I have provided a tapered groove at the outer end of each piston to engage with the tapered rim 36 of the eccentric cup 33, whereby to make the movement of the pistons positive in both directions, regardless of the speed of the rotor or the weight of the pistons. The groove 35 in the pistons should have the same taper angle as the taper angle of the rim of the cup 33. This angle should be not less than 20 degrees in order that, with a very small clearance between the groove and the rim, the pistons will be allowed to move sideways when the position of the pistons are at half stroke, and the angle formed by the axis of the piston and a radial line of the eccentric cup is greater. If the groove 35 and the rim 36 were not tapered, the pistons would jam at a half stroke position unless a great amount of clearance were allowed between the pistons and rim, but such clearance would permit too much play with the pistons in a full stroke position and perpendicular to the axis of the eccentric cup, so that resultant knocking would destroy the pump in a short time. The amount of taper in both groove and rim, which is required to give the best results, depends on the amount of eccentricity of the cup and the diameter of the rotor. Nevertheless it should not be less than 20 degrees. It will be observed that I have provided the cup with the wall that connects the rim 36 with the hub 37 conical in form, the object of which is to obtain enough rigidity, especially when the cup is made out of thin sheet metal by the stamping process. The cup has to be rigid in order to withstand the side radial thrust caused by the pressure exerted against the pistons on inward stroke. The hub 37 of the eccentric cup 33 is made hollow in order to provide the necessary room for the driving shaft 30 to pass to and through the stuffing box 42. Power may be applied to the exterior portion of said shaft.

The stuffing box 42 is provided by a nut 41 which compresses the packing 42 against the gland 40. The object of the packing in this pump is to prevent the air from getting into the pump chamber which would be drawn in by the vacuum condition which exists inside the pump housing because of the hole 63 which connects the housing with the suction duct 15, and allows any liquid leaking out of the rotor to go back to the liquid supply line of the pump.

The cover 39 is secured to the pump housing 3 by a number of bolts 43, preferably three in number for small units. Each bolt goes through a corresponding slot 44 located at the flange of the cover 39, and said bolts are screwed into corresponding tap holes in the housing. A lip 45 is provided in the cover 39 having an outside diameter slightly smaller than the diameter of the housing 3 in order to provide a sliding fit, and at the same time to keep the cover 39 in perfect alignment, as well as concentric with the axis of the housing 3. The object of the slots 44 is to allow the cover 39 to be rotated to any desired position within 90 degrees, when the bolts 43 are loosened, in order to change the eccentric position of the cup 33, and thus alter the pumping capacity of the pump. This will permit the indicator mark 46 to be moved to any desired position on the scale 47, and the cup to be set for the desired capacity effect (see Fig. 3). The position of the parts as they are illustrated in the drawings will give the pump its maximum capacity. As the mark 46 is moved by rotating the cover 39 counter-clockwise, the capacity will proportionately decrease to no capacity when the zero mark is reached; the length of the scale from the maximum mark to the zero mark is 90 degress.

In this type of pump, as heretofore known, the

capacity of the pump is usually altered by changing the amount of eccentricity of the piston driving means, which in turn changes the length of the stroke of the pistons until the cup rotates concentrically with the pump rotor and there is no radial movement of the pistons to effect pumping action. But this system requires an extra mechanism with extra parts and makes the pump too expensive to manufacture.

In my pump the length of the stroke of the pistons remains constant and the capacity is changed by increasing or decreasing the amount of liquid bypassed by the cylinder bores between the suction and discharge ports 23 and 24 respectively. It can be seen in the drawings that, in the position the pump as illustrated, the rotor revolves in the direction shown by the arrow 48, and the cylinder bore 49 carries the maximum amount of liquid from the suction port 23 for discharge at the discharge port 24, while the cylinder bore 50 carries the minimum amount of liquid from the port 24 to be bypassed to the suction port 23. The difference between the two volumes is the amount of liquid being pumped. By changing the eccentric position of the cup 33, the cylinder bore 49 will carry less liquid because the position of the piston will be further in when passing through the same sealing space of the axle member 19, while the position of the piston in the opposite cylinder bore 50 will be further out in said cylinder, and therefore will bypass more liquid, so that the differential in the amount of liquid carried by the two cylinder bores will decrease, and consequently, the capacity of the pump will decrease in proportion until the amount carried by the cylinder bore 49 becomes equal to the amount bypassed by the cylinder bore 50, in which case the capacity of the pump will be zero. The relative position of the pistons at zero capacity is shown in Fig. 2 by the dotted lines 51. This will happen when the position of the cover 39 is moved 90 degrees. The position at zero capacity of the eccentric cup 33 is shown by dotted lines 52 in Fig. 2.

It is also desirable in this type of pump to bypass the liquid being pumped whenever the pressure reaches a certain point, especially when the pump is used in connection with oil burners. Occasionally the nozzle of an oil burner clogs or chokes up, and, if oil is not bypassed, the increasing pressure of the oil may cause some damage to the pipe lines; it is therefore essential that the oil be bypassed when it reaches a certain pressure limit.

For this purpose I have provided a release valve 53 which can be adjusted from the outside of the pump by simply removing the nut 10 and turning the set screw 56 to obtain the proper pressure on the spring 55 which forces the valve 53 in its seat. This valve is located in the axle member 19, and no extra parts or extra machining is necessary in the housing. An orifice 54 allows the liquid to pass through the valve from the discharge duct 22 whenever the pressure is too great and overcomes the pressure of the spring 55. The liquid passes, after leaving the valve 53, through the orifices 57 and 58 into the suction duct 15, and is circulated around the pump without doing any damage.

The axle member 19 is also provided with a circular groove 59 to catch and trap any liquid which tends to get out between the axle and the rotor, and therefore forces it to return through an orifice 60 to the suction duct 21. Another small orifice shown by dotted lines 61 allows any

liquid which may leak out to the space 62 to be drawn back into the suction duct 21, and thereby prevents any pressure from being built up in space 62 which might create a thrust against the rotor 25.

An orifice 63 is also provided to allow any liquid which may leak out through the pistons to return to the suction duct 15, yet allowing only a small amount of liquid to remain in the housing of the pump to be splashed by the rotor and thus be used as a lubricant for the different moving parts of the pump.

The operation of the pump is as follows: the driving shaft 30 causes the rotor 25 to revolve around the axle member 19. As the pistons 32 are interlocked by means of the grooves 35 with the rim of the eccentric cup 33, they are forced to rotate concentrically with the axis of rotation of the cup 33, which is outside of the axis of rotation of the rotor 25, and therefore the pistons have a reciprocating movement in relation to the cylinder bores in the rotor 25. As the pistons pass over the port 23 they have an outward movement which causes a vacuum in the cylinder bores, and draws the liquid that enters the pump through the suction ducts 15 and 21. When the pistons pass over the port 24 they have an inward movement which pushes the liquid through the port 24 and out of the pump through the discharge ducts 22 and 17.

To change the volumetric capacity of the pump, the screws 43 are slightly loosened and the cover 39 is then turned around to move the indicator mark 46 to any position in the scale 47 according to the capacity desired to be attained.

To change the release pressure at which the valve 53 bypasses the liquid, the nut 10 is removed and the pressure of the spring 55 is adjusted by means of the screw 56, as may be required.

My pump is reversible and will reverse the flow of the liquid by turning the rotor in the opposite direction or by changing the position of the cover 39 more than 90 degrees.

My pump can also be used as a motor to obtain a hydraulic transmission of power. It will rotate if liquid is forced through the pump. The speed and the direction of rotation can be changed by using the same means which are used for changing the volumetric capacity of the pump.

As many possible embodiments of the above invention may be made and as various changes might be made in the embodiment above set forth, it is to be understood that all matter hereinbefore set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense

I claim:

1. A pump construction comprising a casing open at one end and closed at the other, an axle member having its forward portion mounted in the closed end of said casing and its rearward portion extending into the casing interior, suction and discharge ducts in said casing leading from the exterior thereof to the periphery of the forward portion of said axle member, suction and discharge ports in said axle member connecting with said ducts and having inner ends open from the periphery of the rearward portion of said axle member, a rotor member rotatably mounted and bearing on the periphery of said rearward portion of the axle member, radially extending cylinder bores formed in said rotor member, the inner ends of said cylinder bores passing in rotation over, and connecting with, said inner ends of

said suction and discharge ports, a cover member closing the open end of said casing, said cover member having a cylindrical housing portion eccentric with the axis of said rotor, means permitting said cover member to be adjustably rotated a selected number of degrees about the rotor axis, a cup member having a tapered rim eccentric to said rotor axis and a hollow cylindrical hub portion concentric with, and mounted in, said housing portion so that rotating the cover member changes the eccentricity of the cup rim with relation to the rotor axis, a piston in each cylinder bore in sealing contact with the walls thereof, said pistons having portions extending outwardly from the cylinder bore ends, tapered grooves near the ends of the extending piston portions and concentric with the axes of said pistons, said tapered grooves being engaged by said tapered cup rim so that the pistons reciprocate in said cylinder bores as the rotor rotates.

2. A pump construction comprising a casing open at one end and closed at the other, an axle member having its forward portion mounted in the closed end of said casing and its rearward portion extending into the casing interior, suction and discharge ducts in said casing leading from the exterior thereof to the periphery of the forward portion of said axle member, suction and discharge ports in said axle member connecting with said ducts and having inner ends opening from the periphery of the rearward portion of said axle member, a rotor member rotatably mounted and bearing on the periphery of said rearward portion of the axle member, radially extending cylinder bores formed in said rotor member, the inner ends of said cylinder bores passing in rotation over, and connecting with, said inner ends of said suction and discharge ports, a cover member closing the open end of said casing, said cover member having a cylindrical housing portion eccentric with the axis of said rotor, means permitting said cover member to be adjustably rotated a selected number of degrees about the rotor axis, a cup member having a tapered rim eccentric to said rotor axis and a hollow cylindrical hub portion concentric with, and mounted in, said housing portion so that rotating the cover member changes the eccentricity of the cup rim with relation to the rotor axis, a piston in each cylinder bore in sealing contact with the walls thereof, said pistons having portions extending outwardly from the cylinder bore ends, tapered grooves near the ends of the extending piston portions and concentric with the axes of said pistons, said tapered grooves being engaged by said tapered cup rim so that the pistons reciprocate in said cylinder bores as the rotor rotates, and said casing and cover member having cooperative means for indicating adjusted positions of the cover member effective to vary the eccentricity of the cup rim to the rotor axis.

3. A pump construction comprising a casing open at one end and closed at the other, an axle member having a tapered portion and a cylindrical portion, said tapered portion being mounted in the closed end of said casing, suction and discharge ducts in said casing leading from the exterior thereof to the periphery of the tapered portion of said axle member, suction and discharge ports in said axle member connecting with said ducts, the cylindrical portion of said axle member extending into the casing interior, a rotor member rotatably mounted and bearing on the periphery of said cylindrical portion, radially extending cylinder bores formed in said rotor member, the inner ends of said cylinder bores passing in rotation over, and connecting with, said suction and discharge ports, a cover member closing the open end of said casing and having a cylindrical housing portion eccentric with the axis of said rotor, means permitting said cover member to be rotated at least 90° about said rotor axis, securing means for holding said cover member in place at any position of rotation, a cup member having a tapered rim eccentric to said rotor axis and a hollow cylindrical hub portion concentric with, and mounted in, said housing portion so that rotating the cover member changes the eccentricity of the cup rim with relation to the rotor axis, a piston in each cylinder bore in sealing contact with the walls thereof, said pistons having portions extending outwardly from the cylinder bore ends, tapered grooves near the ends of the extending piston portions and concentric with the axes of said pistons, said tapered grooves being engaged by said tapered cup rim so that the pistons reciprocate in said cylinder bores as the rotor rotates.

4. A pump construction comprising a casing open at one end and closed at the other, an axle member having a tapered portion and a cylindrical portion, said tapered portion being mounted in the closed end of said casing, suction and discharge ducts in said casing leading from the exterior thereof to the periphery of the tapered portion of said axle member, suction and discharge ports in said axle member connecting with said ducts, the cylindrical portion of said axle member into the casing interior, a rotor member rotatably mounted and bearing on the periphery of said cylindrical portion, radially extending cylinder bores formed in said rotor member, the inner ends of said cylinder bores passing in rotation over, and connecting with, said suction and discharge ports, a cover member closing the open end of said casing and having a cylindrical housing portion eccentric with the axis of said rotor, means permitting said cover member to be rotated at least 90° about said rotor axis, securing means for holding said cover member in place at any position of rotation, a cup member having a tapered rim eccentric to said rotor axis and a hollow cylindrical hub portion concentric with, and mounted in, said housing portion so that rotating the cover member changes the eccentricity of the cup rim with relation to the rotor axis, a piston in each cylinder bore in sealing contact with the walls thereof, said pistons having portions extending outwardly from the cylinder bore ends, tapered grooves near the ends of the extending piston portions and concentric with the axes of said pistons, said tapered grooves being engaged by said tapered cup rim so that the pistons reciprocate in said cylinder bores as the rotor rotates, and said casing and cover member having cooperative means for indicating adjusted positions of the cover member effective to vary the eccentricity of the cup rim to the rotor axis.

5. In a pump construction as defined in claim 1, a by-pass means interconnecting the discharge and suction ducts, and an adjustable spring loaded valve means for controlling movement of fluid through said by-pass means from the discharge duct to said suction duct.

6. In a pump construction as defined in claim 4, a by-pass means interconnecting the discharge and suction ducts, and an adjustable spring loaded valve means for controlling movement of

fluid through said by-pass means from the discharge duct to said suction duct.

7. A pump construction comprising a casing open at one end and closed at the other, an axle member having a tapered portion and a cylindrical portion, the closed end of said casing having a tapered seat, said closed end of the casing having an opening of reduced diameter axially aligned with and outwardly extending from said tapered seat, said tapered portion of the axle member having an axially extending threaded stud to project through said opening, a nut on the exterior end of said stud and cooperative with the closed end of said casing whereby to affix said axle member to the casing with its tapered portion engaged in and bound to said tapered seat, suction and discharge ducts in said casing leading from the exterior thereof to the periphery of the tapered portion of said axle member, suction and discharge ports in said axle member connecting with said ducts, the cylindrical portion of said axle member extending into the casing interior, a rotor member rotatably mounted and bearing on the periphery of said cylindrical portion, radially extending cylinder bores formed in said rotor member, the inner ends of said cylinder bores passing in rotation over, and connecting with, said suction and discharge ports, a cover member closing the open end of said casing and having a cylindrical housing portion eccentric with the axis of said rotor, means permitting said cover member to be rotated at least 90° about said rotor axis, securing means for holding said cover member in place at any position of rotation, a cup member having a tapered rim eccentric to said rotor axis and a hollow cylindrical hub portion concentric with, and mounted in, said housing portion so that rotating the cover member changes

the eccentricity of the cup rim with relation to the rotor axis, a piston in each cylinder bore in sealing contact with the walls thereof, said pistons having portions extending outwardly from the cylinder bore ends, tapered grooves near the ends of the extending piston portions and concentric with the axes of said pistons, said tapered grooves being engaged by said tapered cup rim so that the pistons reciprocate in said cylinder bores as the rotor rotates.

8. A pump construction as defined in claim 7, wherein said casing and cover member have cooperative means for indicating adjusted positions of the cover member effective to vary the eccentricity of the cup rim to the rotor axis.

9. In a pump construction as defined in claim 7, a by-pass means interconnecting the discharge and suction ducts, and an adjustable spring loaded valve means for controlling movement of fluid through said by-pass means from the discharge duct to said suction duct.

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