Nov. 12, 1940. C. F. WAITE 2,221,501

ROTARY PUMP

Filed Nov. 7, 1936 2 Sheets-Sheet 1

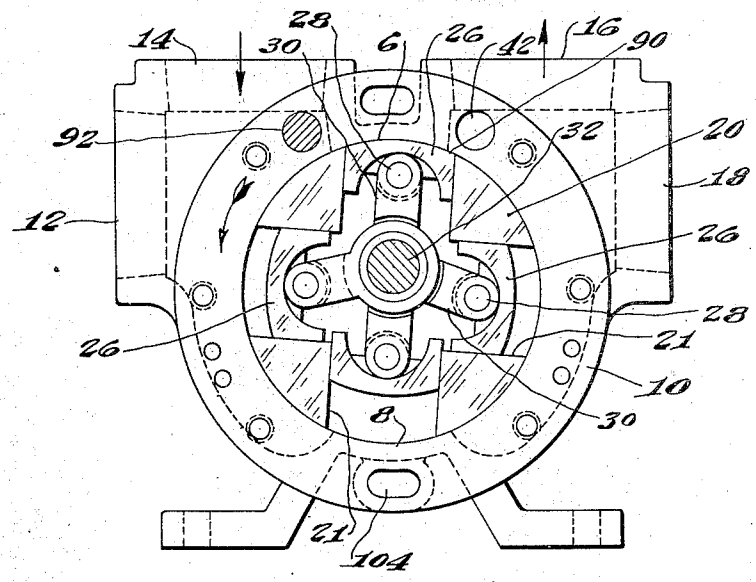



Fig. 1

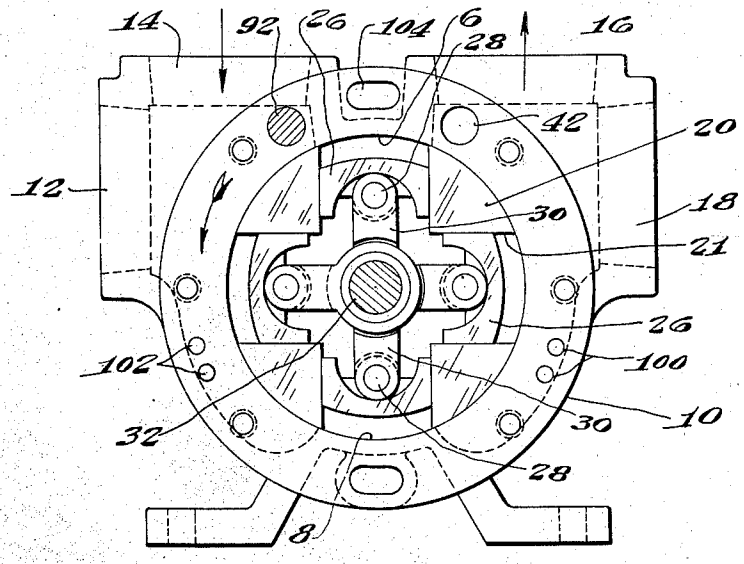



Fig. 2

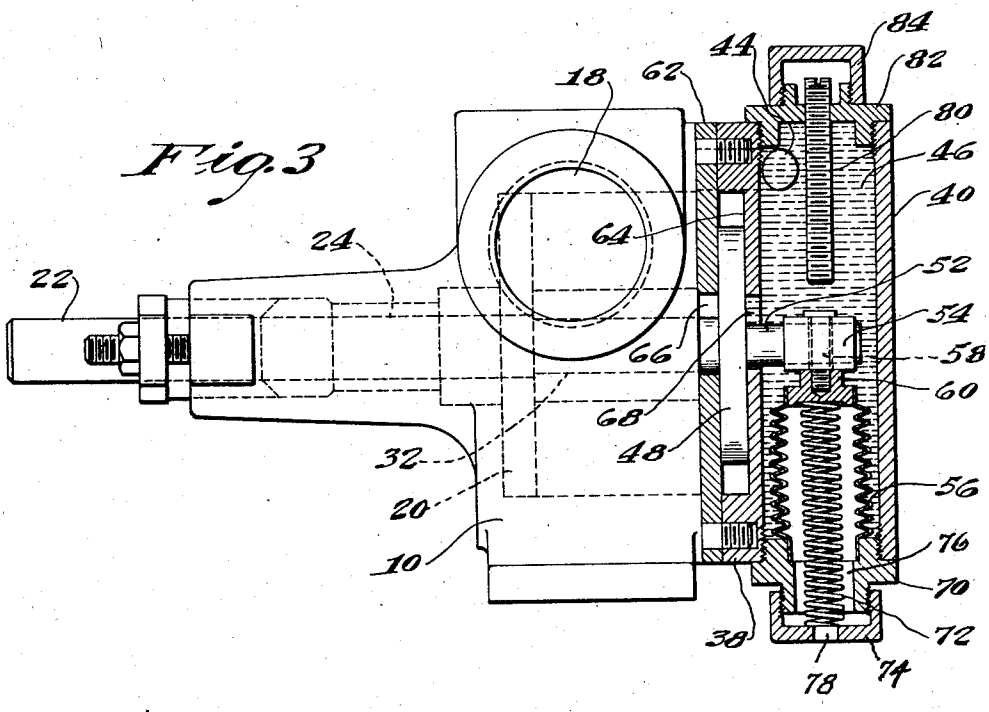
INVENTOR
Charles F. Waite
BY J. Stanley Churchill.
ATTORNEY

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Fig. 3



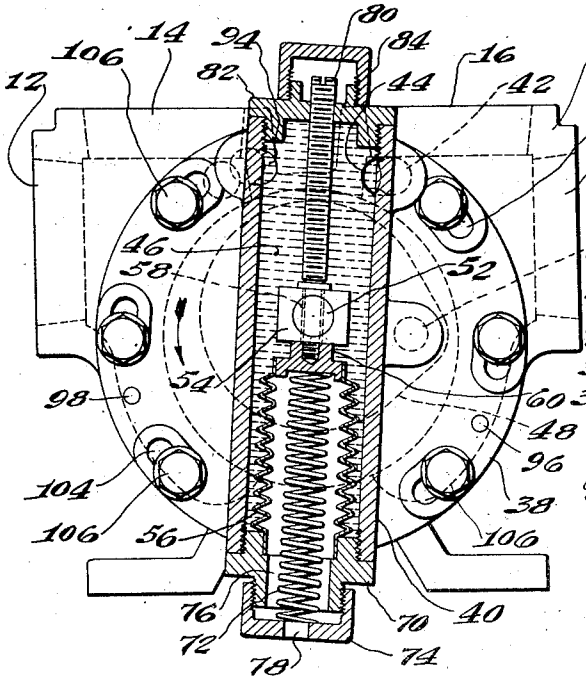




Fig. 4

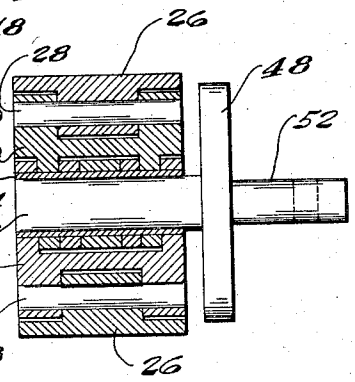



Fig. 5

INVENTOR
Charles F. Waite
BY J. Stanley Churchill
ATTORNEY

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## ROTARY PUMP

Charles F. Waite, Cambridge, Mass., assignor, by mesne assignments, to Norman R. Pearson and Evelyn Dennett

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11 Claims. (Cl. 103—161)

This invention relates to a pump and particularly to a rotary type pump for the displacement of liquid.

One object of the invention is to provide a novel and superior rotary pump of the type wherein a rotor is rotated within a pump housing, and in which one or more pistons are arranged to be moved in one or more piston chambers formed in the rotor, and in which provision is made by novel and improved mechanism for varying piston movement in accordance with and preferably by variations in the pressure in the fluid being discharged.

Another object of the invention is to provide a novel and improved pump of superior construction whereby excessive friction and consequent wear of the operating parts may be reduced to a minimum.

A further object of the invention is to provide a novel and improved construction of pump of the type specified which may be conveniently adapted to discharge in either direction.

With these objects in view and such others as may hereinafter appear, the invention consists in the rotary pump and in the various structures, arrangements and combinations of parts hereinafter described and particularly defined in the claims at the end of this specification.

In the drawings illustrating the preferred embodiment of the invention, Fig. 1 is a front elevation of a rotary pump, embodying the present invention, with the cover removed; Fig. 2 is a similar view showing the pistons in a different position of operation; Fig. 3 is a side elevation with the cover and by-pass portions shown in cross-section; Fig. 4 is a front view with the cover in place and partly in cross-section and Fig. 5 is a detail in cross-section illustrating the mounting of the pistons upon the rotor shaft.

In general, the present invention contemplates a rotary pump of the type provided with a housing having an inlet and an outlet and a rotor arranged to be rotated within the housing. The rotor is provided with one or more piston chambers and with one or more pistons disposed therein and provision is made for effecting movement of the piston or pistons upon rotation of the rotor including a pivot member, preferably a pin, mounted to be normally eccentric to the axis of the rotor and a rigid connecting member operatively connecting said pivoted member with each piston and arranged to be free to revolve about the axis of said pivot member. Provision is made for shifting the relative position of the axes of said pivot member and the rotor in accordance with and preferably by variations in the pressure in the fluid being discharged. The pump is preferably constructed to be capable of ready adaptation for operation in either direction, as will be described.

Referring now to the drawings, the illustrated pump comprises a housing 10 provided with the usual intake and discharge openings. In order to adapt the pump to varying conditions of installation, the housing 10 is constructed with two inlets and two outlets. As herein shown, the openings 12, 14 and the opposite openings 16, 18 may be used as either inlets or outlets, depending upon the direction of discharge desired. For the description of the operation of the present invention, it will be assumed that the openings 12, 18 are plugged up and that the opening 14 is the intake and the opening 16 is the discharge. For convenience of description it will be assumed that the direction of rotation of the pump is counterclockwise, as indicated by the arrows in Fig. 1.

A rotor 20 is arranged to rotate within the housing 10 and, as herein shown, the rotor is secured to a shaft 22 mounted in bearings 24. The shaft 22 may be driven in any usual or preferred manner, as by a pulley, not shown, attached to the driving end of the shaft. The housing 10 is provided with the usual land areas 6, 8 which separate the elongated intake and discharge sections 14, 16 of the pump.

The rotor 20 is provided with one or more, and as herein shown, four equally spaced openings 21 which form piston chambers, and into which pistons 26 are slidingly received. Each piston 26 is pivotally mounted on a pin 28 secured in a hinged lever 30 which is loosely mounted upon a normally eccentric pin 32. As shown in Fig. 5, the hinged levers 30 are arranged to fit over a bushing 34 on the pin 32 in nesting relation to each other.

The eccentric pin 32 is arranged to be varied in its eccentricity with relation to the rotor 20, as will be described. The housing 10 is provided with a cover 38 which is provided with a cylindrical by-pass portion 40 communicating with the discharge side of the pump housing through a port 42 in the housing and a port 44 in the by-pass portion to the pressure chamber 46. As herein shown, the eccentric pin 32 is carried by an arm 48 which is pivoted on a stud 50 mounted in the cover 38. An extension 52 from the other side of the arm 48 is swivelly connected by a block 54 to a bellows 56. A stud 58 which extends loosely through the block 54 and the extended

end of the eccentric pin 52 is secured in the top section 60 of the bellows 56. As herein shown, the pivotally mounted arm 48 is constructed with a wide flat surface and is arranged to swing between an intermediate cover 62 and an inner surface 64 of the pressure chamber cover to insure parallel alignment of the eccentric pin 32 with the rotor 20. A slot 66 is provided in the intermediate cover and a slot 68 is provided in the pressure chamber cover to permit clearance for the pins 32, 52 when the arm 48 is swung on its pivot 50. The bellows 56 is mounted within the chamber 46 between the adapter 60 and a plug 70 screwed into the lower section of the pressure chamber. A coiled spring 72 is mounted within the bellows 56, one end bearing against the adapter 60 and the other end is held within a nut 74 attached to the plug 70. It will be seen that the inside of the bellows 56 is open to the atmosphere through the holes 76, 78 in the plug 70 and nut 74 respectively. Normally the coiled spring 72 yieldingly urges the eccentric pin 32 upwardly against an adjustable stop screw 80 to the position shown in Fig. 4. The adjustable stop screw is held in a plug 82 at the top of the bypass portion 40 and is protected from readjustment by a cover 84 attached to the plug 82. The stop screw 80 is adjusted so that when the eccentric pin is in its maximum position, the pistons 22 will come in contact with the upper land area 6, as shown in Fig. 1.

In operation the liquid entering the intake side of the pump is drawn into the piston chamber by the suction created by the inward stroke of the piston and is forced into the discharge side of the pump by the outward stroke of the piston as indicated by the arrows in Fig. 1. When the pressure is increased on the discharge side of the pump, such as by shutting off the discharge outlet, the liquid entering the chamber 46 through the ports 42, 44 causes the bellows 56 to contract against the tension of the coiled spring 72. This movement of the bellows operates to swing the arm 48 downwardly on its pivot 50 thereby changing the position of eccentricity of the pin 32 to a position approaching concentricity with the rotor 20. Such a position is illustrated in Fig. 2, where the pistons 26 rotate concentrically with the rotor 20 without causing any displacement of the liquid whatever. Thus it will be seen that the pressure is automatically equalized during the operation and eliminating much wear and strain on the operating parts. It will be noted that the coiled spring 72 may be adjusted to the tension desired by turning the nut 74.

In order to prevent "water hammer" or vibration of the unit due to the locking of the liquid between the land area 6 and the pistons 26, a vent 90 is provided between the pistons 26 and the land area 6 at the end of the piston stroke. This is accomplished by tilting the pressure chamber cover 38 at a slight angle, see Fig. 4, and consequently the position of the eccentric pin 32 with relation to the land area. In other words, each piston 26 reaches its maximum outward position when it arrives at the position illustrated in Fig. 1 so that upon continued rotation of the rotor, the piston 26 will start on its downward stroke before the discharge vent 90 is closed, thereby relieving any pressure on the film of liquid which would normally be locked between the piston and the land area 6.

As hereinbefore stated, the pump is adapted to be reversed in its operation and as herein shown, the housing 10 and the pressure chamber 46 are provided with a second set of ports 92, 94 which are plugged up when the rotation of the rotor is counterclockwise, viewing Fig. 1. When it is desired to run the rotor in a clockwise direction, so that the direction of displacement of the liquid will be from the port 16 to the port 14, the cover 38 and the intermediate cover 62 are removed, the intermediate cover 62 is then reversed to align the port therein with the port 92 in the housing, and replaced at an angle opposite to the angular position shown in Fig. 4, so that the ports 92, 94 are in alignment and the ports 42, 44 are plugged. Dowel pins 96, 98 in the cover which fit into holes 100, 102 in the housing are provided to insure the alignment of the cover to the housing and to facilitate the interchangeability of the pumping unit. As herein shown, slots 104 are provided in the cover to accommodate the bolts 106 for securing the cover to the housing in either position.

It will be observed that the pressure of the fluid within the pressure chamber tends, at all times, to force the pivot pin 50 into a position concentric with the axis of the rotor and consequently to move the pistons into a neutral or non-pumping position. This result is secured by the use of the bellows 56 confining the action of the fluid pressure to a direction such as to move the pivot 50 into concentric position. This result is particularly important in practice for the reason that when the pump is utilized, for example in pumping gasoline, the temperature conditions often produce static pressure within the pressure chamber or upon the discharge side of the pump which may reach 100 to 150 pounds per square inch. If the spring 72 is set at a tension of 20 pounds, for example, then the pistons of the pump are retained by the static pressure within the pressure chamber in a neutral or non-pumping position until such time as the pressure has dropped to below 20 pounds. This reduces the wear and strain upon the parts and particularly upon the driving motor.

From the description thus far, it will be observed that the present construction of rotary pump lends itself to the production of a pump of maximum capacity without unduly increasing the size of the pump. The provision of a plurality of pistons enables much greater capacity per unit size to be obtained than has heretofore been possible.

While the preferred embodiment of the invention has been herein illustrated and described, it will be understood that the invention may be embodied in other forms within the scope of the following claims.

Having thus described the invention, what is claimed is:

1. A rotary pump having, in combination, a pump housing provided with an inlet and an outlet, a rotor within the housing, an opening in the rotor extending inwardly from the periphery thereof and forming a piston chamber, a piston disposed within said chamber to be movable longitudinally thereof and rotatable with the rotor, means for effecting movement of said piston upon rotation of the rotor, said means including a pivot member, normally eccentric to the axis of the rotor, a rigid connecting member operatively connected with the pivot member and with the piston end free to revolve about the axis of the pivot member, pressure means responsive to variations in the discharge side of the pump and operating independently of variations

in the pressure on the inlet side of the pump for shifting the relative position of the axes of the pivot member and the rotor, a cover member for said housing in which said pressure means is contained and means for adjusting said cover with relation to said housing whereby to permit rotation of the pump in an opposite direction and still maintain said pressure means responsive to the discharge pressure of the pump and effective for shifting the relative position of the aforesaid axes.

2. A rotary pump having, in combination, a pump housing provided with an inlet and an outlet, a rotor within the housing, an opening in the rotor extending inwardly from the periphery thereof and forming a piston chamber, a piston disposed within said chamber to be movable longitudinally thereof and rotatable with the rotor, means for effecting movement of said piston upon rotation of the rotor, said means including a pivot member normally eccentric to the axis of the rotor, a rigid connecting member operatively connected with the pivot member and with the piston and free to revolve about the axis of the pivot member, means for shifting the relative position of the axes of the pivot member and the rotor actuated solely by variations in the pressure in the fluid being discharged, a cover member for said housing in which said last named means is contained and means for adjusting said cover with relation to said housing whereby to permit rotation of the pump in an opposite direction and still maintain said pressure means responsive to the discharge pressure of the pump and effective for shifting the relative position of the aforesaid axes.

3. A rotary pump having, in combination, a pump housing provided with an inlet and an outlet, a rotor within the housing, an opening in the rotor extending inwardly from the periphery thereof and forming a piston chamber, a piston disposed within said chamber to be movable longitudinally thereof and rotatable with the rotor, means for effecting movement of said piston upon rotation of the rotor, said means including a pin normally eccentric to the axis of the rotor, a rigid connecting member operatively connected with the pin and with the piston and free to revolve about the axis of the pin, and means for shifting the relative position of the axes of the pin and the rotor including a pressure chamber operatively connected with the discharge side of the pump only and into which said pin projects, a spring cooperating with said pin to effect movement thereof in one direction, means for mounting the pin whereby the fluid pressure within the chamber opposes the spring to effect movement of the pin in the opposite direction, a cover member for said housing in which said shifting means is contained and means for adjusting said cover with relation to said housing whereby to permit rotation of the pump in an opposite direction and still maintain said pressure means responsive to the discharge pressure of the pump and effective for shifting the relation position of the aforesaid axes.

4. A rotary pump having, in combination, a pump housing provided with an inlet and an outlet, a rotor within the housing, an opening in the rotor extending inwardly from the periphery thereof and forming a piston chamber, a piston disposed within said chamber to be movable longitudinally thereof and rotatable with the rotor, means for effecting movement of said piston upon rotation of the rotor, said means including a pin normally eccentric to the axis of the rotor, a rigid connecting member operatively connected with the pin and with the piston and free to revolve about the axis of the pin, and means for shifting the relative position of the axes of the pin and the rotor including a pressure chamber into which said pin is extended, said pressure chamber being operatively connected with the discharge side of the pump, a spring cooperating with the pin to effect movement thereof in one direction, an air chamber having its end wall movable and within which said spring is disposed, said spring being opposed by fluid pressure within the pressure chamber, a cover member for said housing in which said shifting means is contained and means for adjusting said cover with relation to said housing whereby to permit rotation of the pump in an opposite direction and still maintain said pressure means responsive to the discharge pressure of the pump and effective for shifting the relative position of the aforesaid axes.

5. A rotary pump having, in combination, a pump housing provided with an inlet and an outlet, a rotor within the housing having a plurality of piston chambers formed therein, a plurality of pistons, one disposed in each piston chamber, and means for effecting movement of said pistons upon rotation of the rotor, said means including a pivot member movable into and from concentric relation to the rotor, a plurality of connecting members pivoted on the pivot member and one connected to each piston for effecting movement of the pistons upon rotation of the rotor when the pivot member is in an eccentric position with relation to the axis of the rotor, and means for shifting the relative position of the axes of the pivot member in the rotor in response only to variations in the pressure in the fluid being discharged, said connection member being mounted upon the pivoting member in a hinge-like and nesting relationship, a cover member for said housing in which said shifting means is contained and means for adjusting said cover with relation to said housing whereby to permit rotation of the pump in an opposite direction and still maintain said pressure means responsive to the discharge pressure of the pump and effective for shifting the relative position of the aforesaid axes.

6. A rotary pump having, in combination, a pump housing provided with an inlet and an outlet, a rotor within the housing, an opening in the rotor extending inwardly from the periphery thereof and forming a piston chamber, a piston disposed within said chamber to be movable longitudinally thereof and rotatable with the rotor, means for effecting movement of said piston upon rotation of the rotor, said means including a pivot member movable into and from concentric relation to the rotor, a connecting member pivoted on the pivot member and operatively connected with the piston, and means for shifting the relative position of the axes of the pivot member and of the rotor, said means including a pressure chamber operatively connected with the discharge side of the pump, a spring arranged to move the pivot member in one direction, and means for moving the pivot member in the opposite direction against the spring, said means being actuated solely by variations in the fluid pressure within the chamber, said spring being mounted within a chamber open to the atmosphere, a cover member for said housing in which said

shifting means is contained and means for adjusting said cover with relation to said housing whereby to permit rotation of the pump in an opposite direction and still maintain said pressure means responsive to the discharge pressure of the pump and effective for shifting the relative position of the aforesaid axes.

7. A rotary pump having, in combination, a pump housing provided with an inlet and an outlet, a rotor within the housing, an opening in the rotor extending inwardly from the periphery thereof and forming a piston chamber, a piston disposed within said chamber to be movable longitudinally thereof and rotatable with the rotor, means for effecting movement of said piston upon rotation of the rotor, said means including a pivot member movable into and from concentric relation to the rotor, a connecting member pivoted on the pivot member and operatively connected with the piston, and means for shifting the relative position of the axes of the pivot member and of the rotor, said means including a pressure chamber operatively connected with the discharge side of the pump, a spring arranged to move the pivot member in one direction, and means for moving the pivot member in the opposite direction and against the spring, said means being actuated solely by variations in the fluid pressure within the chamber, and means for adjustably limiting the movement of the pivot member in the first mentioned direction, a cover member for said housing in which said shifting means is contained and means for adjusting said cover with relation to said housing whereby to permit rotation of the pump in an opposite direction and still maintain said pressure means responsive to the discharge pressure of the pump and effective for shifting the relative position of the aforesaid axes.

8. A rotary pump having, in combination, a pump housing having an inlet and an outlet and having two ports spaced apart communicating with said inlet and outlet respectively, said housing being open at one side, a rotor within the housing having a piston chamber adapted to register with the inlet and outlet as the rotor is rotated, a piston in the piston chamber, means effecting movement of the piston upon rotation of the rotor, a cover member closing the side of the housing, means mounted upon the cover member and movable therewith as a unit for controlling the movement of the piston in response to variations in pressure of the fluid being discharged including a pressure chamber having two ports spaced apart, one of said ports normally registering with the aforesaid outlet port in the housing, and means for securing the cover member to the housing having provision for permitting the position of the cover member to be varied whereby to effect registration of the other of said pressure chamber ports with the aforesaid inlet port of the housing when it is desired to run the pump in the reverse direction, said means for controlling the movement of the piston being connected solely to the discharge side of the pump.

9. A rotary pump having, in combination, a pump housing having an inlet and an outlet and having two ports spaced apart communicating with said inlet and outlet respectively, said housing being open at one side, a rotor within the housing having a piston chamber adapted to register with the inlet and outlet as the rotor is rotated, a piston in the piston chamber, means effecting movement of the piston upon rotation of the rotor, a cover member closing the side of the housing, means mounted upon the cover member and movable therewith as a unit for controlling the movement of the piston in response to variations in pressure of the fluid being discharged including a pressure chamber having two ports spaced apart, one of said ports normally registering with the aforesaid outlet port in the housing, and means for securing the cover member to the housing having provision for permitting the position of the cover member to be varied whereby to effect registration of the other of said pressure chamber ports with the aforesaid inlet port of the housing when it is desired to run the pump in the reverse direction and means for definitely positioning the cover member with respect to the housing in said two positions to insure registration of said ports, said means for controlling the movement of the piston being connected solely to the discharge side of the pump.

10. A rotary pump having, in combination, a pump housing provided with an inlet and an outlet, an inlet chamber and a discharge chamber communicating with said inlet and outlet, a rotor within the housing, said housing being provided with land areas adapted to be engaged by said rotor and separating the inlet chamber from the discharge chamber, an opening in the rotor extending inwardly from the periphery thereof and forming a piston chamber, a piston disposed within said chamber to be movable longitudinally thereof and rotatable with the rotor, means for effecting movement of said piston upon rotation of the rotor, said means including a pivot member, a rigid connecting member operatively connected with the pivot member and with the piston and free to revolve about the axis of the pivot member, pressure means for shifting the relative position of the axes of the pivot member and the rotor, a cover member for said housing in which said pressure means is contained, and an arm rockingly mounted in said cover and upon which said pivot member is mounted adapted to guide said pivot member through an arc, said piston being adapted to engage with one of said land areas when in maximum outward position at a slightly angular position with relation to said land area, whereby to provide a relief opening communicating with the discharge side of the pump when the piston is at its maximum outward position, said cover member being adapted to be adjusted with relation to said housing when it is desired to run the pump in the reverse direction so as to change the position of said arm and to dispose said piston at a different angular position with relation to said land area when the piston reaches its maximum outward position.

11. A rotary pump having, in combination, a pump housing provided with an inlet and an outlet, a rotor within the housing, said housing being provided with land areas adapted to be engaged by said rotor, an opening in the rotor extending inwardly from the periphery thereof and forming a piston chamber, a piston disposed within said chamber to be movable longitudinally thereof and rotatable with the rotor, means for effecting movement of said piston upon rotation of the rotor, said means including a pivot member, normally eccentric to the axis of the rotor, a rigid connecting member operatively connected with the pivot member and with the piston and free to revolve about the axis of the pivot member, pressure means for shifting the relative po-

sition of the axes of the pivot member and the rotor, a cover member for said housing in which said pressure means is contained, and means mounted in said cover for guiding the pivot member through an arc in response to said pressure means whereby to change the relative position of said piston to one of said land areas when the piston is in its maximum outward position, said cover member being adapted to be adjusted with relation to said housing when it is desired to run the pump in the reverse direction, said adjustment being effective to dispose said piston in a different position with relation to said land area when the piston is in its maximum outward position.

CHARLES F. WAITE.