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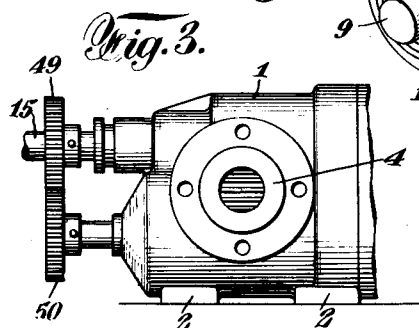
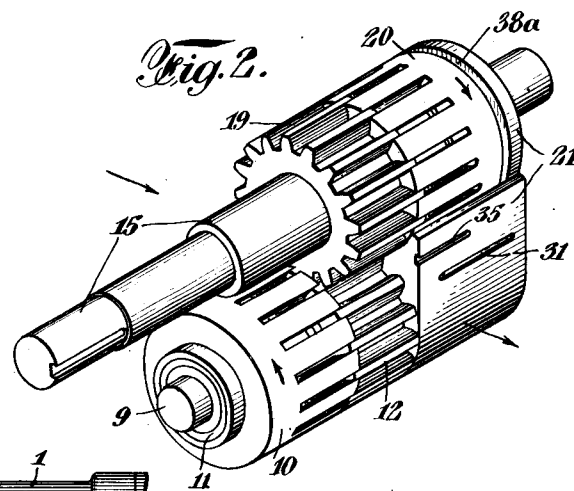
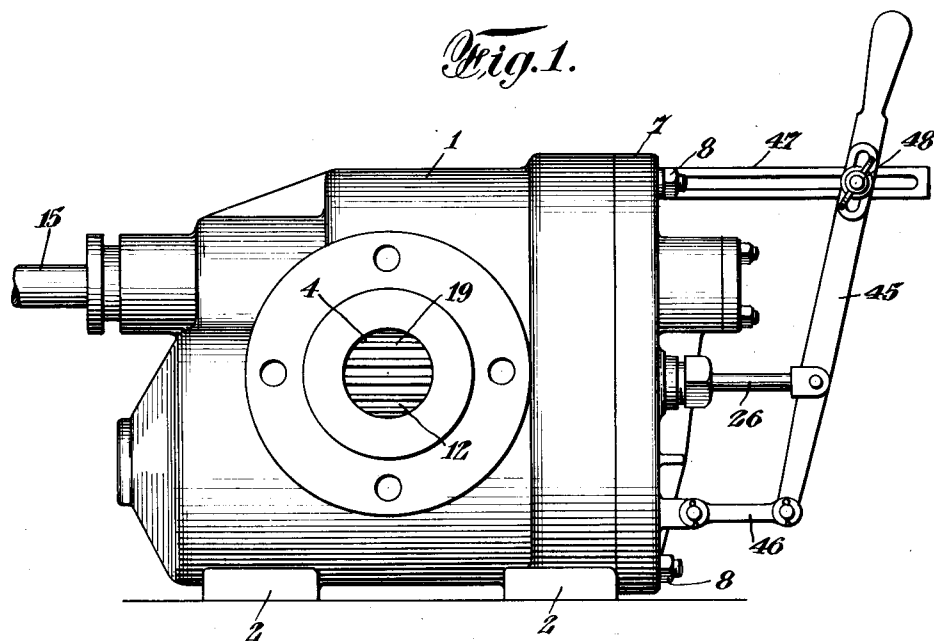
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1,742,215

ROTARY FLUID UNIT

Filed March 29, 1927

4 Sheets-Sheet 1



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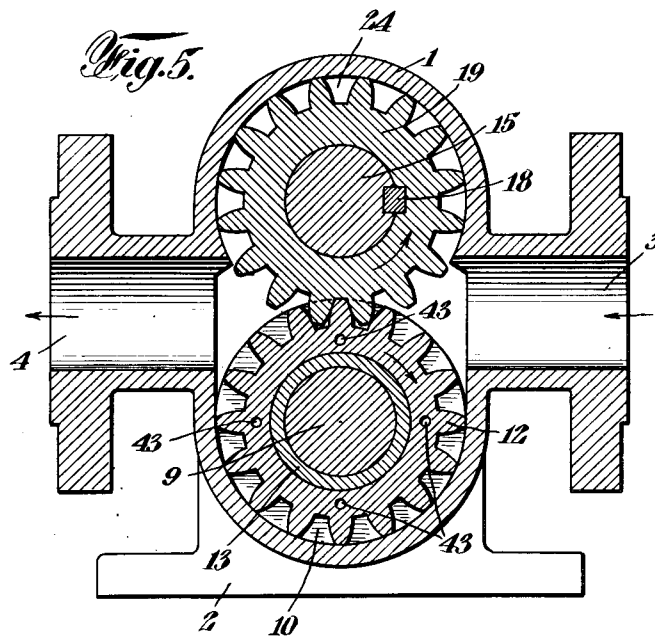
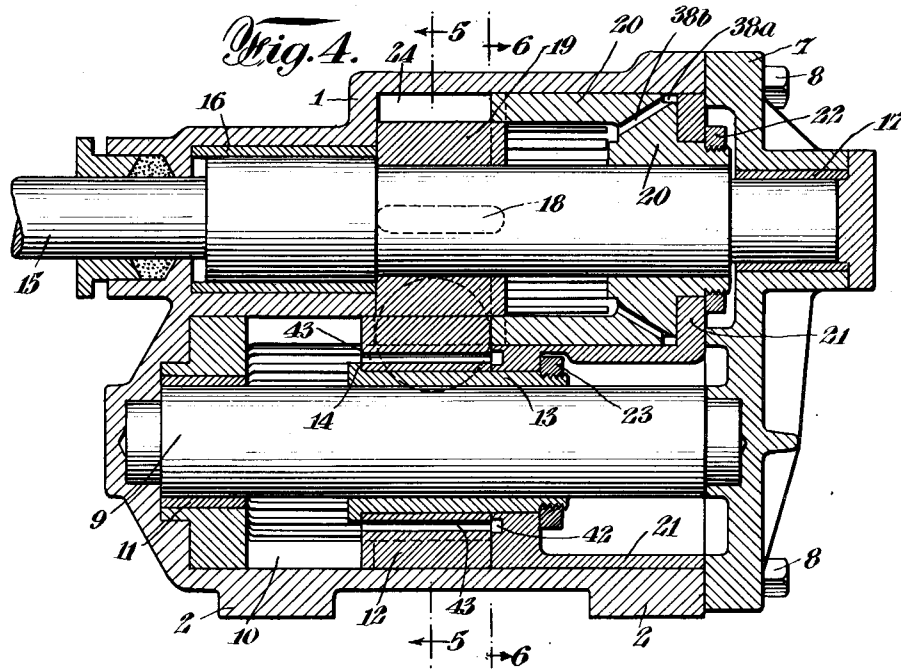
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Fig. 6.

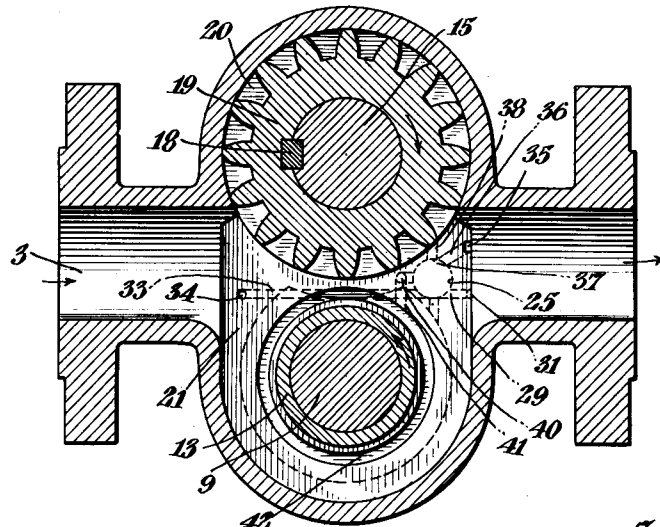
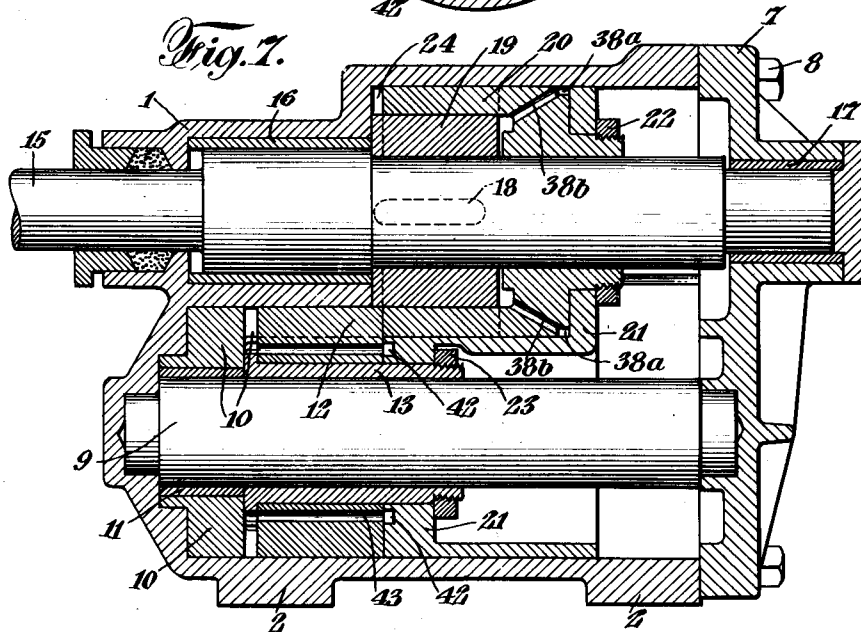


Fig. 7.



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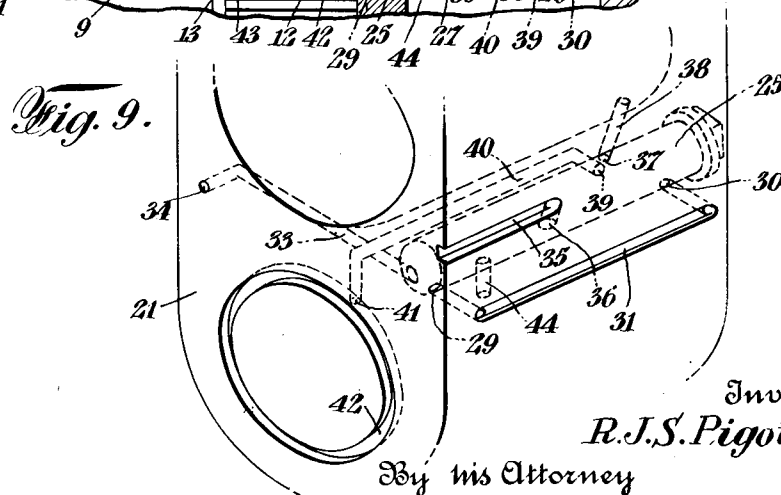
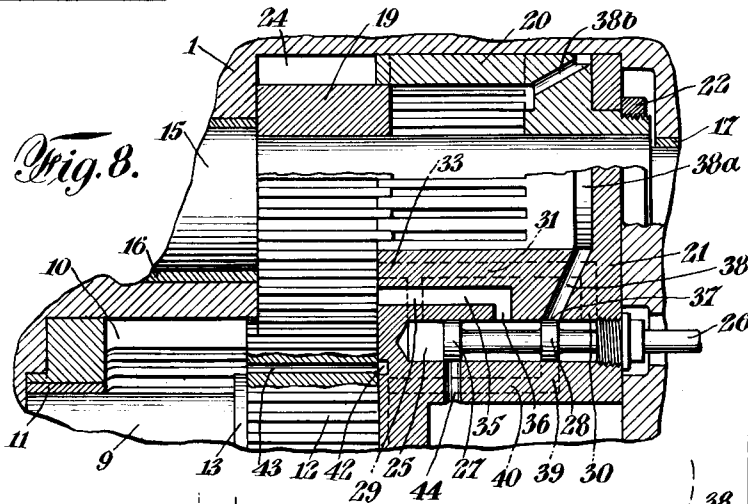
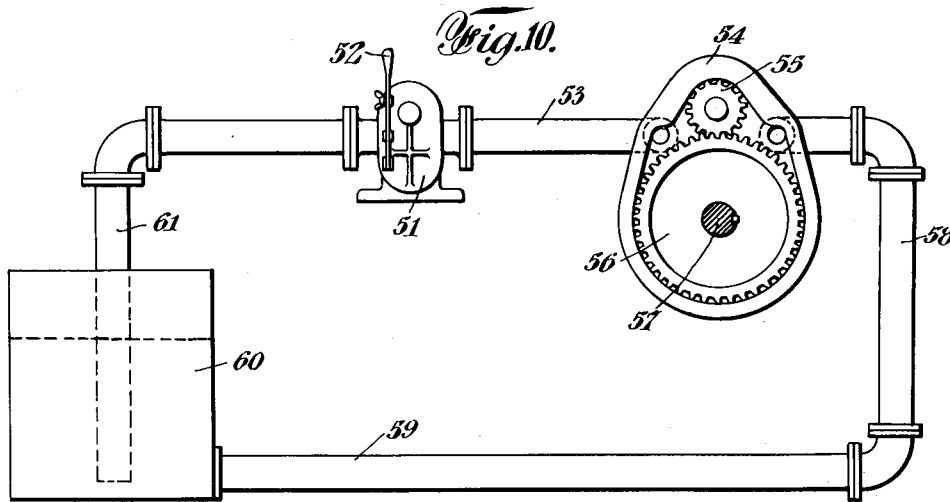
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4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

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ROTARY FLUID UNIT

Application filed March 29, 1927. Serial No. 179,236.

My invention relates to devices for delivering fluids and more particularly to rotary units of a type capable of delivering a variable volume of fluid per unit of time at constant speed or conversely, of maintaining a constant volume at variable speed.

In the present forms of rotary units—gear, impeller or otherwise—the volume of fluid delivered is a function of the speed and only by varying the speed can the volume be varied. This has been a limiting factor in such units and has prevented their use where otherwise it would be greatly extended, not only for transferring fluids from one point to another but as a means to supply and control a fluid motor.

In general, my invention embraces a plurality of revolving members enclosed in a casing—driven from a source of power—as is well known in the art. The amount of fluid delivered is then dependent upon the effective width of the faces of the revolving members. As long as the width of these faces remains constant, the volume of fluid delivered will also remain constant for any given speed. However, by changing these effective widths, the output of the unit may be varied to any extent desired from minimum to maximum at any given speed. It is in this manner that I secure a variable volume of delivery with constant speed and furthermore, may automatically maintain that volume at any given amount by a valve arrangement which utilizes the pressures within the unit to control the extent to which the faces of the revolving members are exposed for any given setting of the valve.

Such units, as illustrated by pumps or blowers, are widely adaptable to industrial uses where variable volume or rate of delivery is desired such as for hydraulic presses, control of volume in different stages of oil refining and in chemical processes, temperature control by fluids, supply to oil burners, draft and air pressures and innumerable other uses which are evident. Similarly, units embodying my invention are especially well adapted to feed fluid motors and many advantages accrue therefrom. This form of transmission—variable unit and fluid motor—provides an

extremely flexible drive and is widely suitable for the propulsion of motor vehicles and other motor vehicles and other transportation means as well as in industrial uses. Among other advantages of such transmissions, besides the constant-speed-variable-volume feature are that one unit may supply several motors in parallel—such as might be a stoker feed—where, should one motor be stalled by part of the mechanism which it drives, the remaining motors will speed up to take care of the output of the unit and keep the mechanism to its capacity although one part has failed. Likewise, motors may be placed in series to drive separate but dependent mechanisms in synchronism at any given speed. As the whole unit output must pass through each motor, the stoppage of one will cause all of the others to stop and so prevent damage or loss.

The form which I have chosen to illustrate my invention is that of a gear pump although it will be understood that other forms of rotary units having a plurality of rotors can equally well be adapted to the same principles for other uses and I am not confined solely to gear pumps.

The following specification, of which the drawings form a part, describes my invention in this preferred form.

In the drawings:

Fig. 1 is a side elevation of the discharge side of the pump.

Fig. 2 is an isometric of a stripped pump showing the gears, spiders and follower plate.

Fig. 3 is an elevation of the drive end of a pump arranged for non-lubricating fluids.

Fig. 4 is a longitudinal section of a pump at full volume setting.

Fig. 5 is a section through 5—5 of Fig. 4.

Fig. 6 is a section through 6—6 of Fig. 4.

Fig. 7 is a longitudinal section similar to Fig. 4, but at minimum volume setting.

Fig. 8 shows the valve and port arrangement.

Fig. 9 is an isometric phantom showing the connections and passages to the valve chamber.

Fig. 10 illustrates a transmission arrangement.

The pump casing is shown at 1, supported by the base 2 and having an inlet 3 and an outlet 4. The casing is closed by the head 7 with bolts or studs 8. In the lower part of the casing is a shaft 9 (Figs. 4 and 7) which fits in the casing and head as shown and is held against movement by a set screw (not shown) in the casing end. On the casing end of this shaft is a spider 10 having a bearing 11 and a gear 12 having a bearing 13 in which is an offset 14 against which the gear 12 abuts. This spider and gear are always in engagement (Fig. 2) and both fit closely within the circular portion of the casing where they revolve. The inner portion of the spider is hollow to a depth approximately equal to the width of the face of the gear 12 and is so arranged circumferentially as to be the complement of the gear; that is, the spider conforms in shape to the tooth spaces and is of the same diameter as the gear so that, in effect, the spider acts as a movable wall or sealing means as it closes over the gear in the manner to be described later.

Above the fixed shaft 9 is the power driven shaft 15 which turns in the bearings 16 of the casing and 17 of the head. Fixed to this shaft by the key 18 is another gear 19 adapted to mesh with the gear 12. Also on this same shaft and in engagement with the gear 19 is the spider 20 of similar construction to the spider 10 and having a like relation to gear 19. So far it will be seen that gear 19 will drive gear 12 and that spiders 20 and 10 will revolve with their respective gears and that the effective width of the gear teeth in engagement can be varied by the spiders coming over their respective gears. In order that these movements may be simultaneous, I provide a follower plate 21. This follower fits over a reduced end of the spider 20 and is retained by the nut 22 (Fig. 4); the spider being free to rotate while the follower is stationary. Extending downward, the follower is developed into a hollow portion around the shaft 9 with its outer edge abutting against the lower gear 12 and flush with the inner face of spider 20. Gear 12 is retained against the follower plate 21 by the nut 23 on the bearing 13 which rotates with gear 12 on shaft 9. It will thus be seen that any longitudinal movement of the follower 21 will move the spider 20 over the gear 19 and the gear 12 into the spider 10 to decrease the degree of engagement of the working gears so that—the two spiders fitting closely within the casing—the effective width of the gear faces 24 (Fig. 4) is reduced and may be still further reduced to its minimum shown in Fig. 7 at 24.

When in operation, the internal pressure developed in the pump will act longitudinally against the faces of the spiders and against the exposed area of the follower plate and tend to force the upper spider and the fol-

lower plate to their extreme position toward the head 7 and thus keep the gears in their maximum degree of mesh as in Fig. 4 and the pump at its greatest output. In order to overcome this and permit of any easily made and stable setting of the follower plate 21 with its attached spider 20 and gear 12 at any desired point for the particular volume or delivery wanted, I provide a balanced valve whereby the pressures are balanced and the follower-spider-gear assembly will automatically seek its position according to the setting of the valve.

Within the follower 21 (Figs. 8 and 9) is a valve chamber 25 in which fits a piston valve 26 having pistons 27 and 28. Toward the extremities of this valve chamber are two exhaust ports 29 and 30 connected by the cut 31 in the side of the follower 21. A second exhaust passage 33 leads from the valve chamber across the follower 21 to an outlet 34 on the inlet or suction side of the pump. Therefore the portions of the valve chamber outside of the pistons 27 and 28 will always be open to the suction of the pump. From the outlet or pressure side of the pump another cut 35 in the side of the follower 21 leads to the port 36 in the central portion of the valve chamber. Therefore the space between the pistons 27 and 28 of the valve will always be at the output pressure developed by the pump. Also leading from the valve chamber is a port 37 and passage 38 leading upward to the annular groove 38^a in the rear of spider 20 which in turn connects with the passage 38^b to the interior of this spider. Also a port 39 goes to the passage 40 and thence to the point 41 where it opens into the circular cut 42 in the face of the follower 21. This circular cut 42 registers with a concentric series of holes 43 passing through the gear 12 and opening into the inner portion of the spider 10 (Figs. 4, 8 and 9). Likewise, there is a passage 44 connecting the valve chamber with the lower recessed portion of the follower plate.

The valve 26 may be connected to any suitable actuating mechanism such as is shown in Fig. 1 where the valve is connected to the operating arm 45 pivoted by the link 46 and having a guide 47 upon which the arm 45 may be locked in any position by the wing nut and bolt 48.

The operation of the pump is as follows. The shaft 15 will drive the gear 19 and carry the spider 20 with it—these two always being in some degree of engagement. Gear 19 drives gear 12 which in turn carries spider 10 with it—these two also being always in some degree of engagement (Fig. 2). Then with the parts in the positions of Fig. 4, the pump will deliver maximum volume and the valve will be in the position of Fig. 8 with passages 38, 40 and 44 closed by the pistons 27 and 28. The internal pressure act-

ing against the faces of the spiders and follower plate will tend to force them apart and keep the gears at maximum effective width. The pressure entering through the cut 35 and port 36 will be confined between the pistons 27 and 28 and be without effect. The exhaust ports 29 and 30, connecting to the exhaust opening 34, remain open as always.

If it is desired to change the output of the pump—to reduce the volume or output—the valve 26 is advanced into the valve chamber the desired amount. In so doing, a portion of the port 44 is uncovered by the piston 27. This results in pressure flowing through cut 35, port 36, between the pistons of the valve and out port 44 to all of the space between the back of the follower plate 21 and the head 7. Also ports 37 and 39 are uncovered by piston 28 so that the space between the upper spider and gear is open to the exhaust port 30 through passage 38, groove 38^a and passage 38^b and a similar space in the lower gear and spider is open to the exhaust port 30 through holes 43 in gear 12, circular cut 42 in the follower and the passage 40. Therefore, the pressure exerted behind the follower plate as just described will force it forward; the fluid between the gears and their spiders will be exhausted as just described and the upper spider 20 will move over its gear 19 while the lower gear 12 will move a corresponding amount into its spider 10. Thus the effective width of engagement of the gears will be decreased and the volume, or output, of the pump is reduced accordingly. This forward motion of the follower-spider-gear assembly will continue until ports 38 and 44 are again closed by this following-up of the valve by the aforesaid assembly or a balance of pressures established at which time the follower-spider-gear assembly comes to rest and the pump will continue to deliver the reduced volume. If the forward movement of the valve is continued, the effective width of the gear teeth will continue to be reduced until the position of Fig. 7 is reached which is that of minimum or zero volume of the pump.

If it is desired to increase the volume delivered by the pump, the valve is drawn outwardly and functions as follows. The port 44 is uncovered so that the fluid formerly under pressure between the follower 21 and the head 7 is opened to the exhaust and will flow out through the valve chamber and the passage 33 to the exhaust opening 34 (Figs. 8 and 9). The ports 37 and 39 will be uncovered so that fluid under pressure will flow through cut 35, port 36, between the pistons 27 and 28 and out of port 37, passage 38, annular groove 38^a to the inside of the spider 20. Fluid will also pass out of port 39, passage 40, circular cut 42 and through the holes 43 in gear 12 to the inside of spider 10. Therefore, as pressure is removed from behind

the follower and there is pressure back of the gears in the spiders as well as against the faces of the spiders and follower, the follower will move toward the head 7, the gears will be drawn into a greater degree of engagement and the effective width of the gear teeth increased to raise the pump volume.

Consequently, it will be seen that by a movement made easily and without effort, the valve is shifted to change the volume of the pump at will without change of speed and that the elements of the pump will adjust themselves to their proper positions according to the position of the piston valve as so moved.

Theoretically, the follower will move to a position where the ports 44, 37 and 39 are closed by the pistons 27 and 28 but it may be that the position of equilibrium may be slightly to one side or the other but this in no way affects the operation of the valve or pump inasmuch as, when equilibrium is established, the follower will retain the position to which it moves until the valve setting is again changed. It is also obvious that, instead of having the valve 26 manually operated as shown, it may equally well be arranged to adjust automatically the position of the follower plate—and hence the output of the pump—in accordance with conditions of flow, pressure, temperature, etc.

The foregoing description contemplates the use of a fluid having lubricating qualities or where the faces of the rotors can be lubricated but where other fluids are used, the wear on the rotors would be undesirable and lead to excessive leakage. In such event, I extend the shafts 9 and 15 and mount upon them a pair of gears 49 and 50 (Fig. 3) preferably of finer pitch than the pumping gears or of any desirable pitch where rotors other than gears are used. The driving is then done by these gears and while the pumping rotors will mesh as before, there will be no driving as between them and consequently no wear.

In Fig. 10 I show in diagram form a transmission to which my invention is well adapted. This pump is shown at 51 and its valve control at 52. The fluid passes through pipe 53 to motor 54, is exhausted through pipes 58 and 59 to tank 60 where it is again taken up by the pump through pipe 61. The motor 54 is shown as being of the gear type for low speeds where the gear 55 is smaller than the gear 56 on the driving shaft 57. Such a transmission with a pump embodying the principle of my invention provides a range of all motor speeds between minimum and maximum without change in the speed of the pump. Also this form of transmission is invaluable for all forms of transportation, speed changers, industrial and marine uses, etc., and may be

combined in a very small space, is simple, efficient and rugged. No packing or other sealing means are necessary and by running the pump at relatively high peripheral speed, the fluid leakage past the rotors will be a very small percentage of the pump volume and practically constant.

It will be understood that the preferred form of my invention just set forth in the foregoing description of a pump and a transmission is illustrative and that many changes and adaptations in design and combination may be made without departing from the spirit thereof, or affecting the principle and I include all such within the scope of my claims.

I claim:

1. A rotary pump having a pair of rotors, one being fixed upon a rotatable shaft and the other being axially movable upon another shaft, axially movable means adapted to move over and closely fit around said fixed rotor, other similar but axially fixed means adapted to receive and closely fit around said movable rotor and a connection between the axially movable means and gear.

2. A rotary pump having a fixed rotor and a slidable spider, a fixed spider and a slidable rotor and a follower plate connecting the slidable gear and spider.

3. In a rotary pump having rotors in engagement, a shaft on which is fixed a rotor and a slidable spider, another shaft on which is a slidable rotor and a fixed spider and a follower plate connecting the slidable spider and the slidable rotor.

4. A rotary pump having rotors in engagement, spiders coacting with each of the rotors and a follower plate associated therewith, means to distribute the internal pump pressures to selected points with relation to said rotors, spiders and follower plate and a valve device arranged to control said distribution of pressures.

5. A rotary pump having rotors, means coacting with each rotor to vary the volume of the pump independently of its speed, an element connecting one of said means and one of said rotors and a valve device adapted to maintain said volume varying means in any selected position.

6. In a rotary pump, a fixed gear and a slidable spider on a shaft, a slidable gear in engagement with the fixed gear and a fixed spider on another shaft, a follower plate connecting the slidable spider and the slidable gear and a valve device in said follower plate in association with passages to selected points within the pump.

7. A rotary pump having a casing containing a fixed rotor and a slidable spider on one shaft, a slidable rotor and a fixed spider on a second shaft, a follower plate connecting the slidable rotor and spider and a pair of meshed

gears mounted on said shafts exterior to said casing.

8. A rotary pump having one shaft carrying a slidable spider and a fixed gear, a second shaft carrying a fixed spider and a slidable gear in engagement with the fixed gear, a follower plate connecting the slidable spider and slidable gear and a valve device within said follower plate adapted to maintain the connected slidable gear, slidable spider and follower plate in any selected position.

9. A rotary pump having a shaft carrying a slidable spider and a fixed gear, a second shaft carrying a fixed spider and a slidable gear in engagement with the fixed gear, a follower plate connecting the slidable spider and slidable gear, a valve device within said follower plate adapted to maintain the connected slidable gear, slidable spider and follower plate in any selected position and means exterior to the pump to actuate said valve device.

10. A rotary pump having a casing containing a fixed rotor and a slidable spider, a fixed spider and a slidable rotor, a follower plate connecting the slidable gear and slidable rotor and a valve within said follower plate adapted to distribute the pressure within the casing to selected points with respect to said rotors, spiders and follower plate.

11. A rotary pump having rotors in engagement and means coacting with each rotor to vary the volume of the pump independently of its speed; said means being actuated by the pressures generated within the pump.

12. A constant speed, variable volume pump having rotors in engagement and means acted upon by the pressures generated within the pump to vary the degree of engagement of said rotors; said means forming a movable wall to seal the tops and ends of the rotors and forming a closed chamber to the extent of the meshing width of the gears.

13. A rotary pump having rotors in engagement and means co-acting with each rotor to vary the effective portions of said rotors.

14. A rotary pump having rotors in engagement, means co-acting with each rotor to vary the effective portions of these rotors and a valve device controlling said means.

15. A constant speed, variable volume pump having rotors in engagement and means to vary the volume of the pump independently of its speed; said means coacting with each of the rotors to form the walls of a chamber extending the meshing width of the gears.

16. A constant speed, variable volume pump having rotors in engagement, means to vary the volume of the pump independently of its speed and a valve device contained in the means; said means coacting with each of the rotors to form the walls of a chamber extending the meshing width of the gears.

17. A variable volume, constant speed pump having rotors in engagement and means coacting with each rotor to vary the meshing width of the gears in response to pressure differentials created within the pump.

18. A variable volume, constant speed pump having meshed rotors in a chamber and means coacting with each rotor to form a movable wall of said chamber.

19. A variable volume, constant speed pump having meshed rotors in a chamber, means coacting with each rotor to form a movable wall of said chamber and a valve device contained in said means.

In testimony whereof I have signed my name to this specification this 26th day of March, 1927.

REGINALD J. S. PIGOTT.

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