Aug. 8, 1950 R. H. FREDERICK 2,517,862

VARIABLE CAPACITY PUMP

Filed June 5, 1947 5 Sheets-Sheet 1

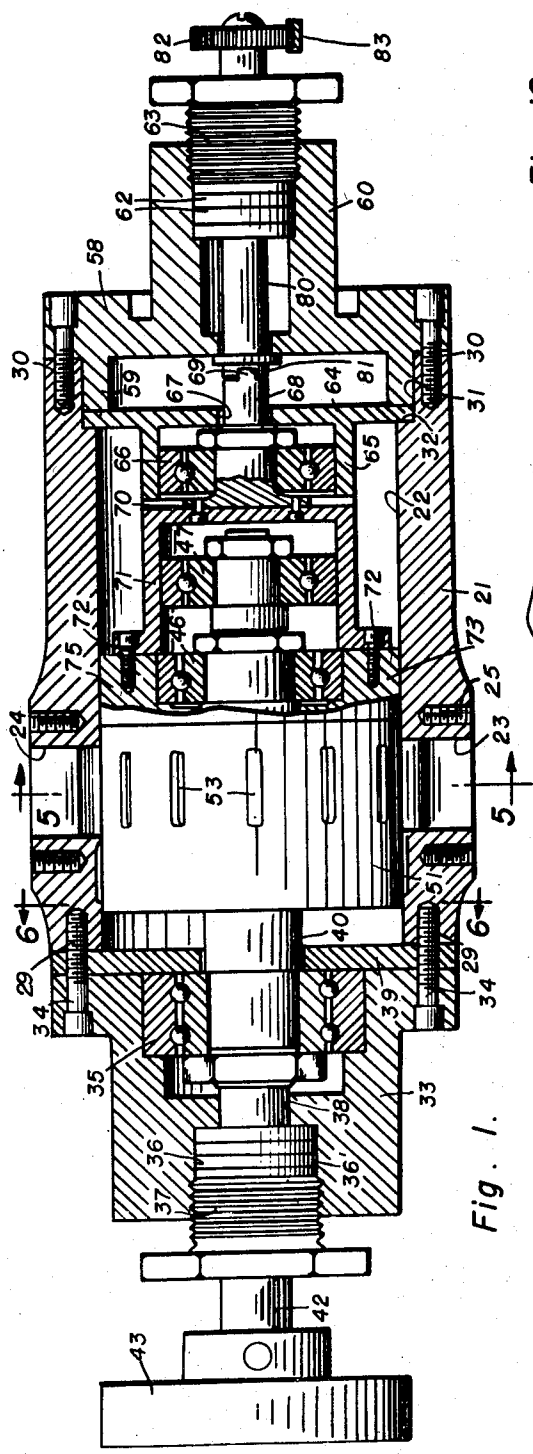


Fig. 1.

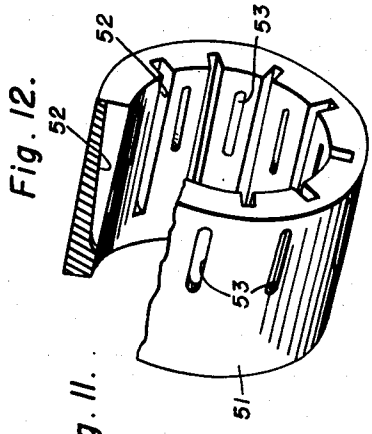


Fig. 12.

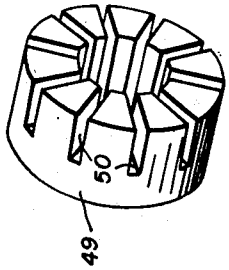


Fig. 11.

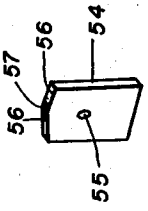


Fig. 13.

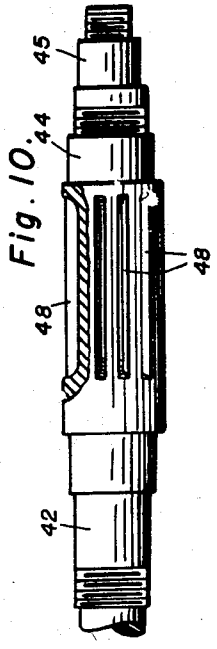


Fig. 10.

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VARIABLE CAPACITY PUMP

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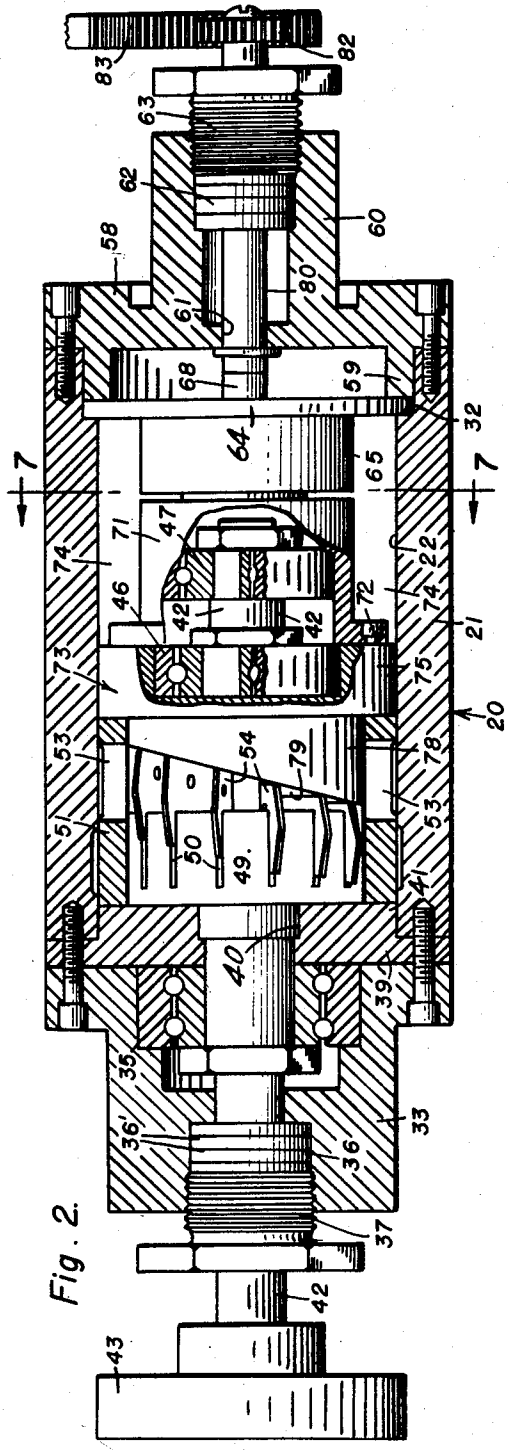


Fig. 2.

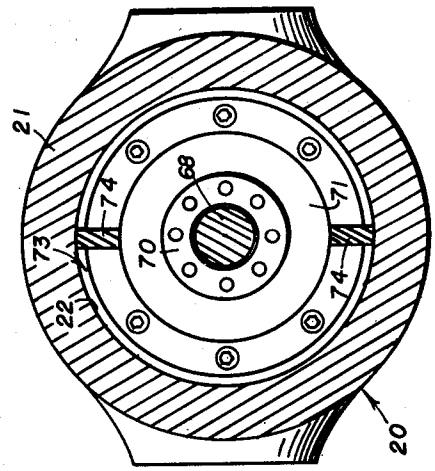


Fig. 7.

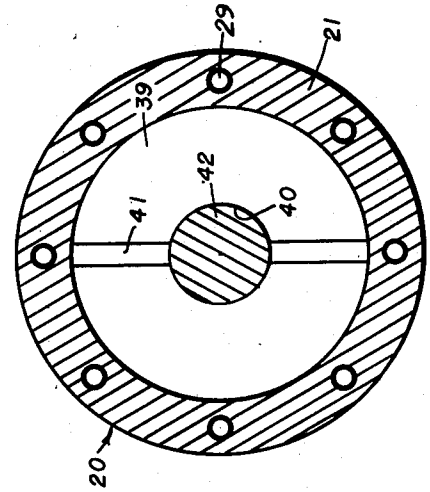


Fig. 6.

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VARIABLE CAPACITY PUMP

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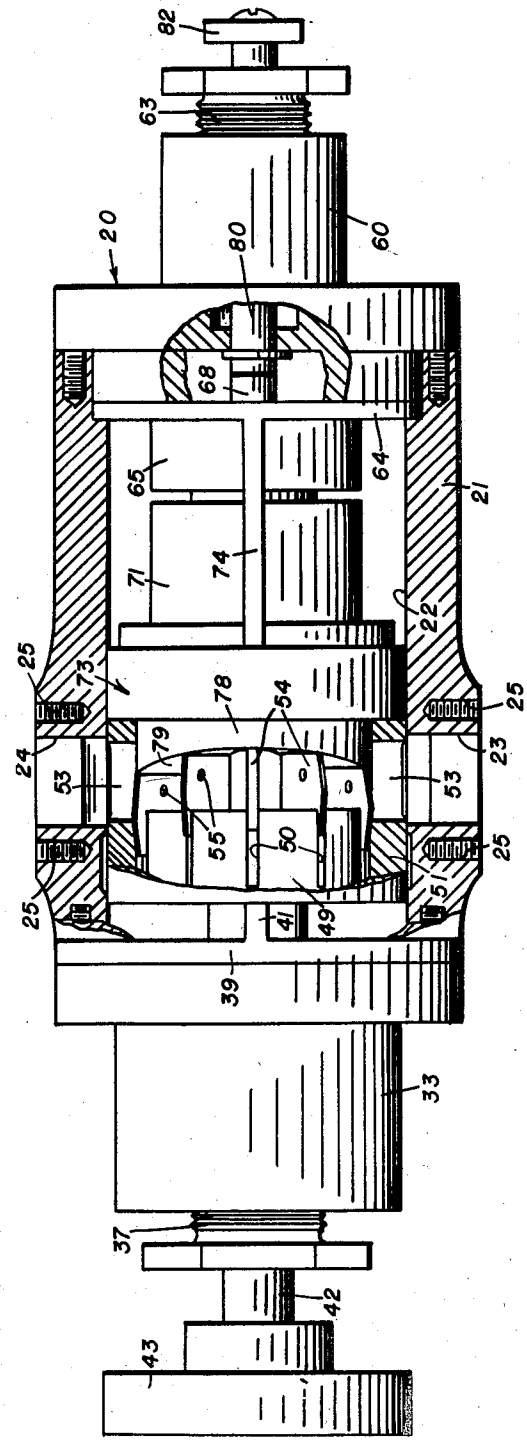


Fig. 3.

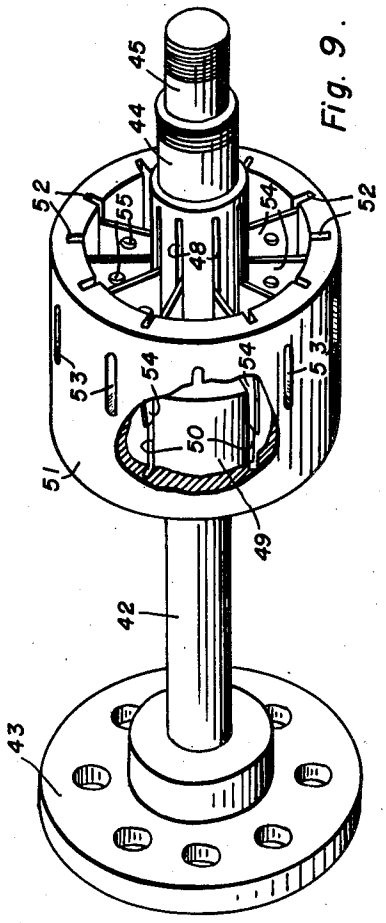


Fig. 9.

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VARIABLE CAPACITY PUMP

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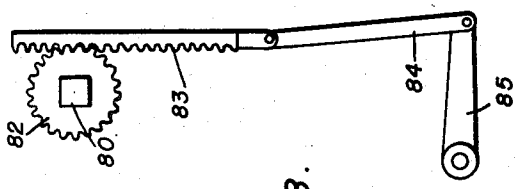


Fig. 18.

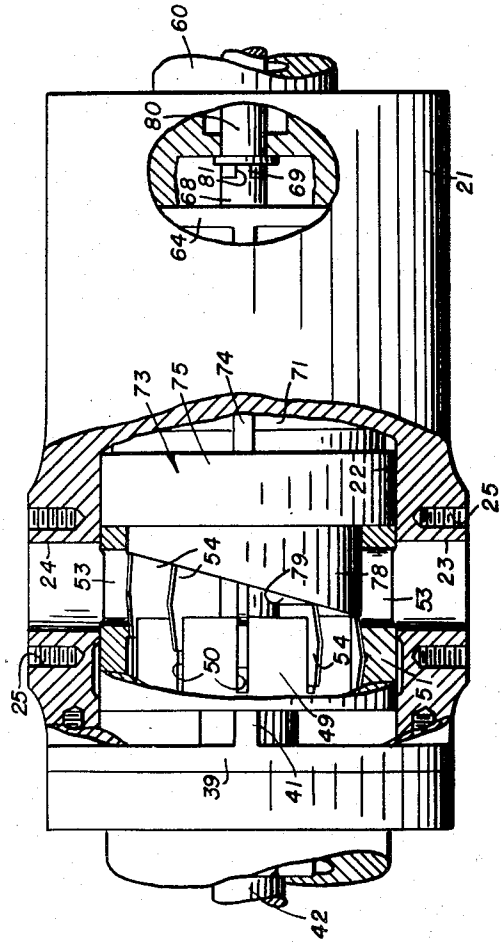


Fig. 4.

Fig. 17.

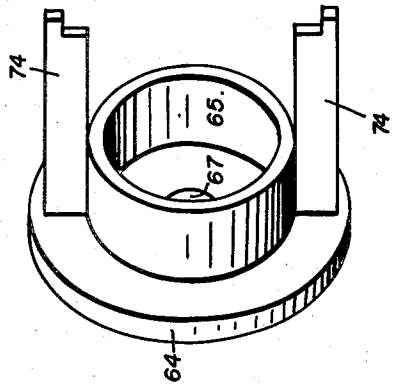
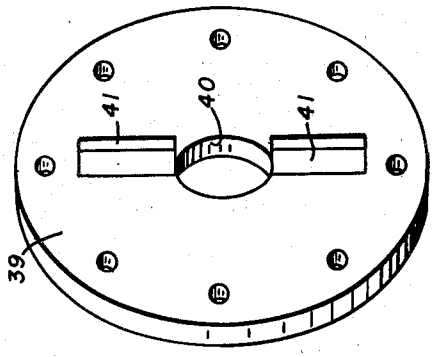


Fig. 8.



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VARIABLE CAPACITY PUMP

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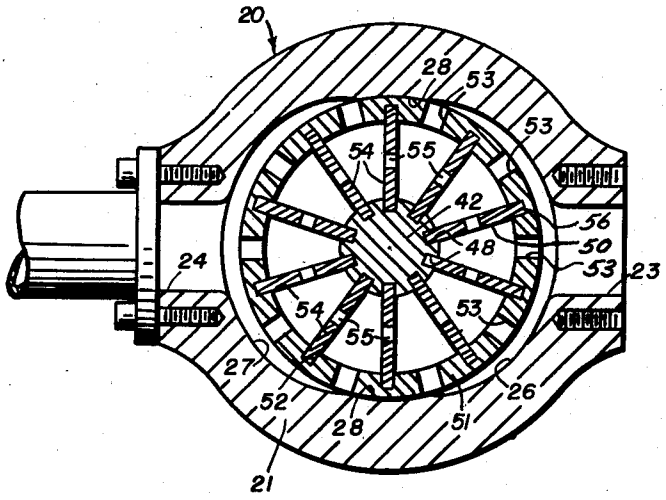


Fig. 5.

Fig. 16.

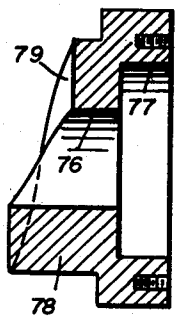
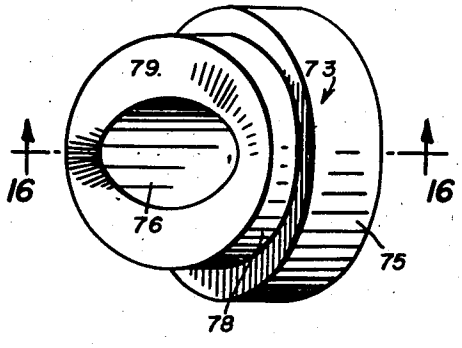


Fig. 15



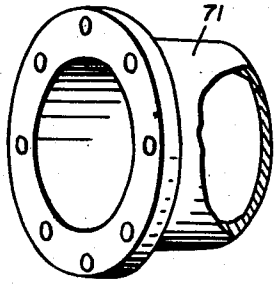


Fig. 14.

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Patented Aug. 8, 1950 2,517,862

UNITED STATES PATENT OFFICE

2,517,862

VARIABLE CAPACITY PUMP

Rheuel H. Frederick, High Bridge, N. J.

Application June 5, 1947, Serial No. 752,617

6 Claims. (Cl. 103—120)

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This invention relates to a variable capacity pump and has for its primary object to facilitate the varying of the capacity of the pump without interfering with its operation.

Another object is to enable the capacity of the pump to be varied from zero to full capacity by the simple rotation of a control shaft.

The above and other objects may be attained by employing this invention which embodies among its features a hollow circular casing having a pair of diametrically opposed ports opening thereinto, a rotor mounted in the casing for concentric rotation about the longitudinal axis thereof, vanes mounted in the rotor to move in radial planes longitudinally of the rotor and a cam mounted in the casing to move the vanes longitudinally of the rotor as the rotor rotates about the axis of the casing.

Other features include means to alter the position of the cam while the pump is in operation.

In the drawings:

Figure 1 is a longitudinal sectional view through a pump embodying the features of this invention taken through the diametrically opposed ports,

Figure 2 is a view similar to Figure 1 taken on a plane perpendicular to the plane of Figure 1,

Figure 3 is a view similar to Figure 1 illustrating portions of the rotor broken away to show the cam and vanes,

Figure 4 is a side view of the pump, certain portions of the casing being broken away to more clearly illustrate certain details of construction.

Figure 5 is a transverse sectional view taken substantially along the line 5—5 of Figure 1,

Figure 6 is a transverse sectional view, taken substantially along the line 6—6 of Figure 1,

Figure 7 is a transverse sectional view taken substantially along the line 7—7 of Figure 2,

Figure 8 is a perspective view of the fin carrying end plate for the pump casing,

Figure 9 is a perspective view of the pump shaft and rotor,

Figure 10 is a side view of the shaft showing the rotor removed and certain portions being illustrated in section more clearly to show certain details of construction,

Figure 11 is a perspective view of the circular block forming the core of the rotor,

Figure 12 is a perspective view of the sleeve forming the outer shell of the rotor, certain portions being broken away more clearly to illustrate certain details of construction,

Figure 13 is a perspective view of one of the rotor vanes,

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Figure 14 is a perspective view of the cam member controlling cup,

Figure 15 is a perspective view of the cam member,

Figure 16 is a longitudinal sectional view through the cam member illustrated in Figure 15,

Figure 17 is a perspective view of the end plate for the cylindrical body at the end opposite the rotor, and

Figure 18 is an end view of the control shaft, pinion and rack.

Referring to the drawings in detail, this improved pump designated generally 20 comprises a cylindrical body 21 formed with a longitudinal circular bore 22 and having intermediate its ends diametrically opposed ports 23 and 24 each of which is surrounded by a coupling flange having formed therein an annular row of internally screw-threaded sockets 25 by means of which pipes may be coupled to the pump. Formed internally of the cylindrical body 21 and extending therearound in alignment with the ports are arcuate recesses 26 and 27 respectively communicating with the ports 23 and 24. These recesses cooperate in forming diametrically opposed dams 28, the inner face of which are curved concentrically about the longitudinal axis of the body 21 for a purpose to be more fully hereinafter explained. The recesses 26 and 27 communicate with the bore 22 as will be readily understood upon reference to the drawings. As illustrated in the drawings, the ports 23 and 24, as well as the recesses 26 and 27 are formed in the body near one end. Opposite ends of the body are provided with annular rows of radially spaced internally screw-threaded sockets 29 and 30 and the bore 22 is enlarged as at 31 at the end opposite that near which the ports are formed to provide an annular internal shoulder 32 the purpose of which will be more fully hereinafter explained.

Closing the end of the body 21 adjacent the ports 23 and 24 is a cap 33 which as illustrated is coupled to the body by means of machine screws 34 which enter the sockets 29 securely to hold the cap in place. This cap is equipped near its inner end with a suitable anti-friction bearing 35 and at its outer end with an axially extending socket 36 for the reception of packing rings 36' and a tubular packing nut 37. Extending longitudinally through the cap between the anti-friction bearing 35 and the socket 36 is a longitudinal bore 38 which aligns axially with the longitudinal axis of the bore 22 in the body 21.

Clamped against the end of the body 21 by the cap 22 is a plate 39 which is formed with an

axial opening 40 which aligns with the longitudinal axis of the body 21, and formed on the face of the plate 39 which is disposed against the body 21 are diametrically opposed fins 41 which project toward but terminate short of the ports 23 and 24.

Mounted for rotation in the anti-friction bearings 35 and extending axially through the bore 38 and into the bore 22 of the housing 21 is a shaft 42. This shaft extends through the packing rings 36' and the packing nut 37 to the exterior of the pump and is equipped at its outer end with a coupling flange 43 which is adapted to be connected in any suitable manner to the source of power which will rotate the shaft. As illustrated, the inner end of the shaft projects through the bore 40 and is stepped as at 44 and 45 to receive anti-friction bearings 46 and 47 respectively, the mounting for which is to be more fully hereinafter described. Formed intermediate the ends of the shaft in uniformly spaced relation about the periphery are longitudinal grooves 48, and fixed to the shaft adjacent the inner ends of the fins 41 is a circular block 49 having formed therein a plurality of radial grooves 50 which open through its periphery, and one end of the block. These grooves 50 align with the grooves 48 in the shaft, and serve as guides for the sliding vanes to be more fully hereinafter described. Fitted over the cylindrical block 49 is a sleeve 51 which is provided on its inner surface with radially spaced longitudinal grooves 52 which open outwardly through one end, and align with the grooves 48 and 50 of the shaft 42 and sleeve 49 respectively. As illustrated in Figure 12, the bottom walls of the grooves 52 incline outwardly toward the periphery of the ring-shaped body 51 as they approach their open ends. Formed in the body intermediate the grooves 52 are radial slots 53 which open outwardly through the periphery of the body, and when the device is in position within the housing 21, these slots open into the passages 26 and 27 as will be readily understood upon reference to Figure 5.

Mounted for longitudinal sliding movement in the grooves 48, 50 and 52 are radial vanes 54 each of which is provided with a substantially centrally located aperture 55. The outer ends of the vanes 54 are also provided with oppositely inclined faces 56 which meet midway between opposite side edges of their respective vanes to form peaks 57. The slope of the faces 56 coincides with the slope of the bottom walls of the grooves 52.

Fixed to the end of the cylindrical body 21 opposite the cap 33 is a cover plate 58 which is provided with an inwardly extending annular flange 59 and an outwardly extending tubular boss 60. The cover plate is provided with an axial opening 61 the axis of which aligns with the longitudinal axis of the body 21 and seated in the outer end of the tubular boss 60 are suitable packing rings 62 which are held in place by a tubular packing nut 63.

Clamped between the inner ends of the annular flange 59 and the shoulder 32 is a plate 64 carrying an inwardly extending socket 65 in which an anti-friction bearing 66 is fitted. Mounted for rotation in the bearing 66 and extending through an axial opening 67 in the plate 64 is a stub shaft 68 carrying at its outer end a transversely extending rib 69 the purpose of which will be more fully hereinafter explained. A coupling flange 70 is carried on the inner end of the shaft, and coupled to the flange 70 is a cup-shaped member 71 in

which the anti-friction bearing 47 previously referred to is fitted. Coupled to the inner end of the cup 71 as by cap screws 72 is a cam designated generally 73. Formed on the plate 64 and extending inwardly therefrom at diametrically opposite points are fins 74 which extend the full length of the bore 22 between the plate 64 and the cam 73 to divide the space within the housing into two separate chambers.

The cam 73 above referred to comprises a cylindrical body 75 having formed therein an axial bore 76 the axis of which aligns with the longitudinal axis of the body 21, and communicating with the bore 76 at one end of the cam body 75 is an enlarged socket 77 in which the anti-friction bearing 46 previously referred to is fitted. Formed on the end of the cam body 75 opposite the socket 77 is a tubular extension 78 provided at its end with a cam face 79 which as illustrated in Figures 2, 3 and 4 is adapted to engage the ends of the vanes 54 opposite those entering the slots 50 in the cylindrical block 49. As shown in Figures 2, 3 and 4 the tubular extension 78 fits into the open end of the sleeve 51.

Mounted for rotation in the bore 61 and the packing nut 63 is a control shaft 80, the inner end of which is provided with a transversely extending groove 81 for the reception of the transversely extending rib 69 on the stub shaft 68. The outer end of the control shaft 80 has secured thereto a pinion 82 which has meshing engagement with a rack bar 83 to one end of which is coupled a suitable link 84 which in turn is coupled to a hand actuated lever 85 so that upon moving the lever, the shaft 80 will be rotated to move the cam 73 about the longitudinal axis of the pump.

In assembling the device the shaft 42 is mounted in an anti-friction bearing 35 to extend longitudinally through the cap 33 with the rotor comprised of the cylindrical block 49 and sleeve 51 mounted on the shaft adjacent the fins 41 of the disk 39. The shaft, rotor and disk are then assembled with the cylindrical body 21 and the screws 34 threaded into the sockets 29 with the fins 41 aligning longitudinally with the lands 28 previously described. The rotor will thus be positioned to bring the passages 53 into alignment with the recesses 26 and 27 and the ports 23 and 24. The cam member 73 is then entered through the opposite end of the bore 22 in the body 21 so that the cam face will bear against the rotor blades or vanes 54 and the portion 44 of the shafts 42 will be mounted in the bearing 46 so that the cam member 73 may be rotated independently of the shaft 42. The cup-shaped member 71 is then fastened to the cam member 73 by the screws 72 so that the portion 45 of the shaft 42 will enter the bearing 47 housed within the cup 71. The stub shaft 68 is fastened to the cup-shaped member 71 to extend in a direction opposite the cam member 73 in axial alignment with the shaft 42. The anti-friction bearing 66 is then fitted over the stub shaft 68 and the plate 64 is fitted over the bearing 66 and rests against the shoulder 32 with the fins 74 aligning with the fins 41 and lands 28 after which the end member 58 is attached to the body 21 with the slot 81 of the control shaft 80 receiving the tongue or rib 69 on the end of the stub shaft 68. It will be seen that the fins 41 and 74 when in alignment with the lands 28 will divide the body 21 longitudinally into a high pressure chamber and a low pressure chamber which are not the pumping or working chambers of the pump. With the pinion 82 fixed

to the control shaft 80 it will be obvious that upon moving the lever 85 as through the medium of a suitable hand control, the rack 83 will be moved to rotate the pinion 82 and thus impart rotary motion to the control shaft 80, the stub shaft 68, the cup-shaped member 71 and the cam member 73 so as to alter the position of the high point of the cam face 79 about the axis of the pump. In this way, the movements of the vanes 54 may be regulated from zero to full capacity.

In use, the port 23 is coupled to a suitable source of fluid supply and the discharge port 24 may be coupled to a discharge pipe. Upon setting the shaft 42 into motion through the medium of the drive flange 43 it will be obvious that the rotor on the shaft will move about the axis thereof so that the vanes 54 will move longitudinally toward the cam face 79 of the cam 73 under the influence of centrifugal force. In this way, fluid entering one side of the pump will be propelled by the vanes, to the other side of the pump and the capacity of the pump may be regulated while running by moving the rack bar 83. When this is done and the cam surface is in vertical position, the pump is operating at full capacity, as is seen in Figure 2. Rack bar 83, on actuation, rotates cam 73 until it is in horizontal position, or at right angles to the full capacity position. Now, the pump operates at zero capacity since one quarter of the capacity is taken in and one quarter is discharged back into the same chamber (see Figure 2). Obviously, any intermediate position of rotation causes the pump to operate at intermediate capacities between zero and full. The fluid flowing through the pump will enter either the port 23 or the port 24 and the passages 53 between the vanes to be propelled by the vanes from one side of the pump to the other across lands 28. Owing to the concentric curvature of the lands 28 the rotor will run closely thereto and will serve with the fins 41 and 74 and the other mechanism within the body 21 to separate it into a high pressure and a low pressure chamber which are not the pumping or working chambers of the pump.

The function of aperture 55 is to provide equalizing means for the pump while it is riding about the cam surface 79. As will be seen from an inspection of Figures 2 and 3, vanes 54 will slide longitudinally within radial grooves of the rotor and as a result, when vanes 54 are travelling up on the face of the cam, vanes 54 are slid into the receiving grooves and as a result, when the maximum compression is to occur, apertures 55 are within the wall of the retaining grooves and cease to function as equalizing means. However, when the vanes are at the low point of travel on cam 73, apertures 55 are exposed and serve to equalize pressure of fluid within the space defined by the vanes. This increases the efficiency and operation of the rotor and reduces vibration thereof.

While in the foregoing there has been shown and described the preferred embodiment of this invention it is to be understood that minor changes in the details of construction, combination and arrangement of parts may be resorted

to without departing from the spirit and scope of the invention as claimed.

Having described the invention what is claimed as new is:

1. A variable capacity vane-type pump comprising a pair of diametrically opposed ports opening thereinto, a rotor including radial slots mounted in said casing for concentric rotation about the longitudinal axis thereof, vanes movably retained in said slots, apertures in said vanes and a cam mounted in said casing to move the vanes longitudinally of the rotor as the rotor rotates about the axis of the casing, said apertures being pressure equalizing means, said cam including a cam face disposed between the ports to engage the ends of the vanes as the rotor rotates to move the vanes into their respective slots and thereby shut the pressure equalizing means.

2. The combination of claim 1 wherein said cam includes means to vary the capacity of the pump.

3. The combination of claim 2 wherein said means is a pinion and rack operatively secured to said cam.

4. A variable capacity vane-type pump comprising a hollow circular casing having a pair of diametrically opposed ports opening thereinto, a shaft extending longitudinally in said casing, a circular block rotatably mounted on said shaft, a sleeve fitted on said block, grooves in said block and sleeve in radial alignment, vanes slidably retained in said grooves, and a cam mounted in said pump and engaging said vanes for longitudinal movement of said vanes, said shaft including grooves radially aligned with the grooves in said block and sleeve and receiving said vanes therein.

5. The combination of claim 4 wherein said vanes include apertures for equalizing pressure in the rotor.

6. The combination of claim 4 wherein said vanes include apertures for equalizing pressure in the rotor and said cam includes a cam face disposed between the ports to engage the ends of the vanes as the rotor rotates to move the vanes into their respective slots and thereby shut the pressure equalizing means.

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