Dec. 22, 1964 C. H. VLACHOS 3,162,141

FLUID FLOW DEVICE

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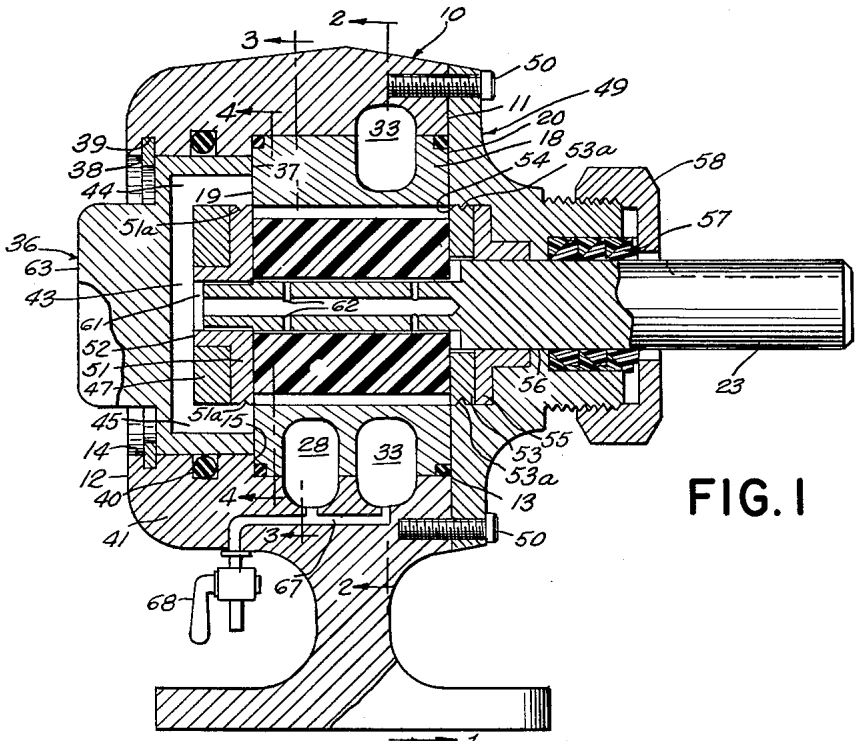

FIG. 1

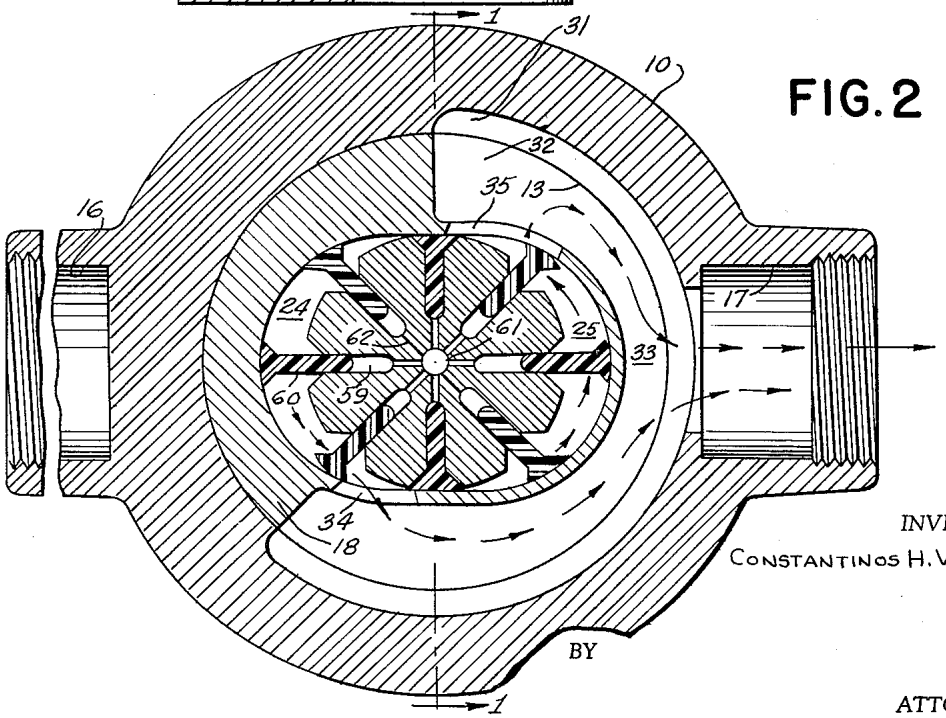

FIG. 2

INVENTOR
CONSTANTINOS H. VLACHOS

BY

ATTORNEY

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FLUID FLOW DEVICE

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FIG. 3

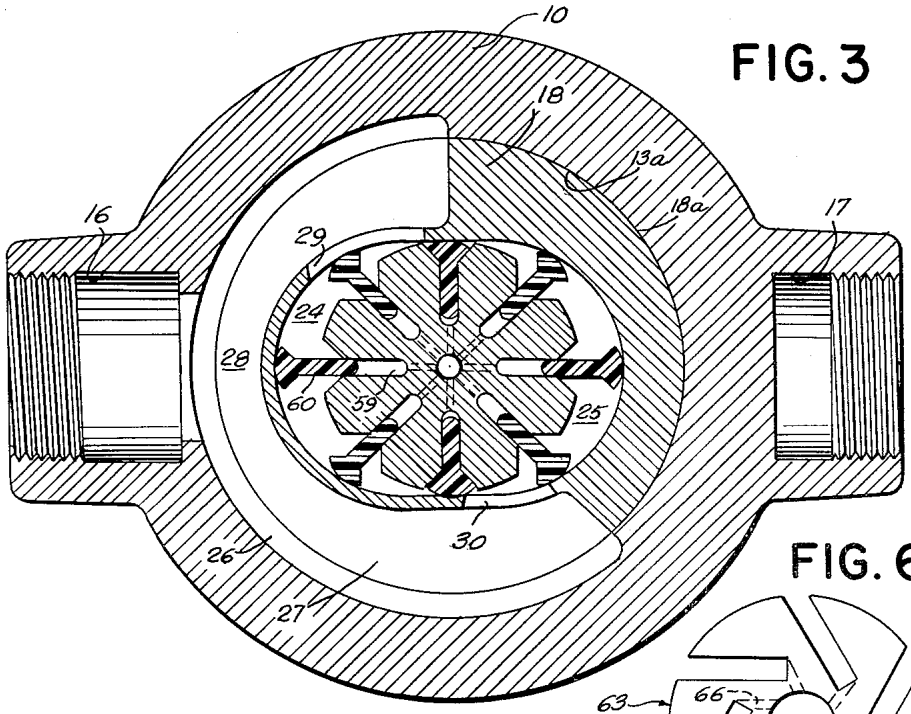


FIG. 6

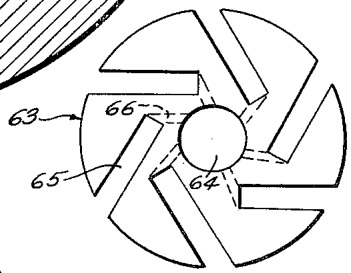
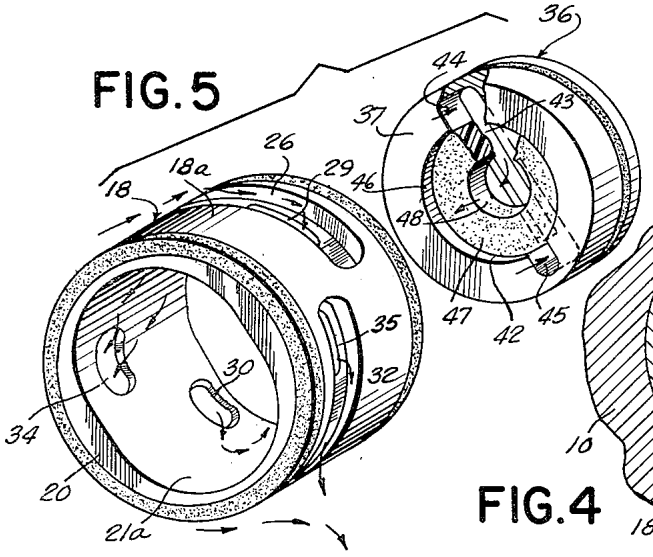


FIG. 5



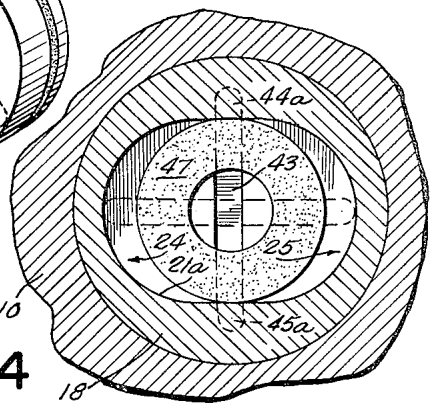


FIG. 4

INVENTOR.

CONSTANTINOS H. VLACHOS

BY

ATTORNEY

United States Patent Office

3,162,141

Patented Dec. 22, 1964

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FLUID FLOW DEVICE

Constantinos H. Vlachos, Box 448, Washington, D.C.

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8 Claims. (Cl. 103—136)

This invention relates to rotary vane type fluid devices and more particularly to a rotary vane type motor and pump having novel means for controlling the volume and pressure of the motivating or motivated fluid.

The principal object of this invention is to provide an improved rotary vane type motor and pump.

Another object of this invention is to provide an improved rotary vane type motor and pump having novel means for controlling the volume and pressure of the motivating or motivated fluid.

A further object of this invention is to provide an improved rotary vane type motor and pump having linear, non-pulsating fluid flow.

A still further object of this invention is to provide an improved rotary vane type motor and pump having self-balancing vanes which permit the rotor to seek its own center of gyration.

Another object of this invention is to provide an improved rotary vane type motor and pump wherein the sealing pressure of the vanes is provided by the motivating or motivated fluid.

A further object of this invention is to provide an improved rotary vane type motor and pump which is reversible.

A still further object of this invention is to provide an improved motor and pump which can be easily assembled and disassembled.

Other objects and advantages of the present invention will become apparent to those skilled in the art, from the following description wherein:

FIGURE 1 is a vertical cross-sectional view of one embodiment of the invention taken along line 1—1 in FIGURE 2;

FIGURE 2 is an enlarged cross-sectional view taken along line 2—2 in FIGURE 1 having portions thereof broken away;

FIGURE 3 is an enlarged cross-sectional view taken along line 3—3 in FIGURE 1;

FIGURE 4 is a partial cross-sectional view taken along line 4—4 in FIGURE 1 with the rotor and shaft removed;

FIGURE 5 is an exploded perspective view of the liner and the control cap of the embodiment shown in FIGURE 1 having a portion thereof broken away; and

FIGURE 6 is an end view of an alternate embodiment of the rotor used in the present invention.

According to the broad aspects of the present invention, there is provided a novel fluid flow device suitable for use either as a pump or motor comprising a casing having a chamber for receiving a rotor therein to provide at least one pump chamber. Each pump chamber is provided with suitable intake and discharge ports which communicate with the inlet and outlet ports of the casing. The rotor is provided with a plurality of slidable vanes which force fluid from the inlet port to the discharge port in the conventional manner. Means are provided for bypassing a preselected amount of fluid from the pump chamber to the back side of the vanes to urge them into positive sealing engagement with the wall of the chamber. Control means further are provided for regulating the amount of fluid bypassed to the back side of the reciprocating vanes to vary the amount of sealing pressure thereof and accordingly, the volume and pressure of the fluid output.

Referring to the drawings, there is shown the preferred embodiment of the invention comprising a suitable casing

10 having a front face 11, a rear face 12, a cylindrical socket 13 in the front face and an axially aligned cylindrical opening 14 having a smaller diameter than the socket 13 extending from the socket 13 to the rear face of the casing to provide an annular shoulder 15. The casing is also provided with a suitable inlet port 16 and an outlet port 17 which communicates with the cylindrical socket 13.

Received in the socket 13 of the casing is a cylindrical liner 18, the rear face 19 of which abuts the annular shoulder 15 and the front face 20 of which lies substantially flush with front face 11 of the casing. Formed in the liner 18 is an oblong chamber 21 which is adapted to receive a centrally disposed cylindrical rotor 22 mounted on a shaft 23 to provide a pair of opposed chambers 24 and 25. Formed in the cylindrical surface 18*a* of the liner is an arcuate recess 26 which registers with arcuate recess 27 formed in the cylindrical surface 13*a* of the socket 13 to provide an arcuate fluid intake passageway 28. As best shown in FIGURE 3, the intake passageway 28 communicates with the inlet port 16 in the casing and intake ports 29 and 30 in the liner which are diametrically opposed relative to the axis of the rotor shaft and which provide for entry of the fluid into pump chambers 24 and 25, respectively.

Also formed in the cylindrical surface 18*a* of the liner is arcuate recess 31 which registers with arcuate recess 32 formed in the cylindrical surface 13*a* of the socket 13 to provide arcuate fluid discharge passageway 33. As best shown in FIGURE 2, arcuate fluid discharge passageway 33 communicates with the outlet port 17 of the casing and discharge ports 34 and 35 which are diametrically opposed relative to the rotor shaft and which provides for discharge of the fluid from the pump chambers 24 and 25, respectively.

Provided in the casing 10 is a fluid drain passageway 67 which communicates with the bottom portions of fluid intake passageway 28 and fluid discharge passageway 33. A suitable drain valve 68 further is provided for draining the fluid from the device.

The axially aligned cylindrical opening 14 in the casing is adapted to receive a cylindrical closure cap member 36 which is rotatably mounted therein. Referring particularly to FIGURES 1, 4 and 5, the front face 37 of the closure cap abuts the rear face 20*a* of the liner to provide an end wall for pump chambers 24 and 25 and is retained therein by means of a retainer ring 38 which is disposed in an annular groove 39 in the opening 14 of the casing. An O-ring seal 40 is also provided in annular groove 41 in the opening 14.

The front face 37 of the closure cap is provided with an axially disposed cylindrical recess 42 having the same diameter as the rotor. Formed in the bottom face of the cylindrical recess 42 is a diametrical groove 43, the ends of which terminate in longitudinally extending grooves 44 and 45 in the cylindrical surface 46 of the recess 42. Seated in the recess 42 and having a thickness less than the depth of the recess is a bearing 47 made of Teflon or any other suitable material. The bearing 47 has an axial opening 48 which opens into the diametrical groove 43 to provide substantially an E-shaped fluid passageway as shown in FIGURE 1. The front face of the casing is closed by an end cap 49 which is secured to the casing by means of a plurality of circumferentially spaced suitable bolts 50.

The rotor 25 is mounted on the reduced portion 23*a* of the shaft 23 and is provided with an integral end plate member 51 also mounted on the reduced portion 23*a* of the shaft. The end plate 51 is received in the recess 42 in the closure cap 36 and abuts the front face of the bearing 47. The end plate 51 also has a hub portion 52 which

is journaled in the axial opening 48 of the bearing 47, and a V-shaped groove 51*a* extending about the cylindrical surface thereof in communication with the longitudinally extending grooves 44 and 45 in the closure cap for lubricating and cooling the end plate member. Mounted on the shaft 23 at the opposite end of the rotor is an end plate 53 which is received in a cylindrical recess 54 in the end cap 49 abutting a bearing 55 made of Teflon or any other suitable material. The cylindrical surface of the end plate 53 is provided with a groove 53*a* which communicates with the pump chambers for lubricating and cooling the end plate 53. The shaft 23 is journaled in the axial opening in the bearing 55 and extends to the exterior through an axial opening 56 in the end cap 49. As shown in FIGURE 1, the opening 56 in the end cap is enlarged at its end to accommodate the conventional packing rings 57. A locking nut 58 is provided for retaining the packing rings in sealing engagement with the shaft.

As best shown in FIGURES 2 and 3, the rotor 23 is provided with a plurality of radial slots 59 which receive slidable vanes 60, preferably made of Teflon. The vanes are adapted to slide radially in the slots and to engage and follow the contour of the surface of the oblong chamber in the liner. Also, the reduced portion 23*a* of the shaft has an axial bore 61 communicating with the diametrical groove 43 in the closure cap 36 and the bottom of each slot by means of a plurality of radial passageways 62 in the shaft.

It will be appreciated in reference to FIGURES 1 and 4, that a predetermined amount of fluid may be bypassed from the pump chambers 24 and 25 through the longitudinal grooves 44 and 45 and the groove 43 in the closure cap, the axial bore 61 in the reduced shaft portion 23*a* and through radial passageways 62 into the slots 59 to urge the vanes into sealing engagement with the pump chamber walls subject to a range of pressures depending upon the orientation of the closure cap 36. As noted particularly in FIGURES 1 and 4, the radial distance from the axis of the device to the bottoms of the openings 44*a* and 45*a* in the front face 37 of the cap member formed by the grooves 44 and 45 and end plate 51 is substantially equal to the radius of the rotor. Also the radial distance from the axis of the device to the top of the openings 44*a* and 45*a* is substantially equal to the maximum radial distance from the axis of the device to the longitudinally extending surface 21*a* of the oblong chamber 21. Accordingly, when the closure cap is in the position as shown in FIGURE 4, the rear face 20*a* of the liner will block openings 44*a* and 45*a* in the front face 37 thereof thus preventing any bypassing of the fluid. However, as the closure cap is rotated either in a clockwise or counterclockwise direction to a maximum orientation of 90° relative to the vertical as shown in broken lines in FIGURE 4, the amount of bypassing fluid is accordingly increased to a maximum. The range of volume and pressure of the fluid can thus be varied by rotating the closure cap within a 90° range.

In operating the present fluid flow device as a pump, drive is applied to the shaft in either direction and fluid is drawn through the inlet port of the casing, through intake passageway 28 and into pump chambers 24 and 25 by means of intake ports 29 and 30 in the liner. The extended vanes 60 then force the fluid toward discharge ports 34 and 35, through which it is exhausted into discharge passageway 33 and out through outlet port 17. Depending upon the orientation of the closure cap 36, a minute portion of the fluid will be bypassed through the openings 44*a* and 45*a*, diametrical groove 43, axial bore 61, radial passageways 62 and into the slots 59 to urge the vanes into positive sealing engagement with the pump chamber walls. With the closure cap orientated as shown in FIGURE 4, no fluid will be bypassed and accordingly the volume and pressure of the fluid will be at a minimum. As the closure cap is rotated by means of a suitable handle 63 to a maximum of 90° from the vertical, as illustrated by the dotted lines in FIGURE 4, a proportionately greater amount of fluid will be bypassed to the back side of the vanes providing an increased sealing pressure and accordingly an increased fluid volume and pressure. It will be obvious that the present fluid flow device can be employed as a motor by utilizing the fluid as the motivating means.

It will be appreciated that the present fluid flow device utilizes the motivated or motivating fluid as a means for urging the vanes into sealing engagement with the pump chamber thus permitting the vanes to balance themselves and, accordingly, the rotor to seek its own center of gyration. Furthermore, as preferably Teflon vanes and bearings are used, over a period of use, the parts of the device wear into rather than out of operative engagement. It will further be appreciated that in utilizing a fluid flow device having a dual pump chamber with positive sealing of the reciprocating vanes, a linear, non-pulsating fluid flow is provided.

Another advantageous feature of the present invention is the relatively few number of parts which can be easily assembled and disassembled. To assemble the preferred embodiment of the present invention as described, the liner is first inserted into the socket of the casing and adjusted into position so that the arcuate grooves 26 and 32 register with arcuate grooves 27 and 31, respectively, to provide intake passageway 28 and discharge passageway 33. The closure cap 36, with O-ring 40 in place, is inserted into the opening 14 and retained therein by means of the retainer ring 38. Next, the rotor mounted on the shaft with end plates 51 and 53 is inserted into the pump chamber so that the hub portion 52 is journaled in the Teflon bearing 47 and the end plate is received in the recess 42 in the closure cap and the rotor with the vanes retracted rests temporarily on the chamber wall. The end cap 49 is then mounted on the front face of the casing and secured thereto by the bolts 50 so that the shaft 23 will be journaled in Teflon bearing 55 and extend out through the axial opening 56 in the end cap. The end plate 53 also is received in recess 54. Finally, the packing rings are mounted on the shaft and the locking nut is applied to compress the rings into sealing engagement about the shaft.

In FIGURE 6 there is shown an end view of an alternate rotor 63 which can be used with the present invention to provide even higher pressures than available from the use of the rotor shown in FIGURES 1–3. The rotor 63 is provided with an axial fluid passageway 64, a plurality of spaced vane slots 65 being disposed at an angle to the radius of the rotor and a plurality of fluid passageways 66 communicating the axial passageway 64 with the bottoms of the vane slots 65. Suitable slidable vanes are provided in the slots which are urged against the wall of the pump chamber in the same manner as described in connection with the above mentioned embodiment.

From the foregoing detailed description, it will be evident that there are a number of changes, adaptations and modifications of the present invention which come within the province of those skilled in the art. However, it is to be understood that it is intended that all such variations not departing from the spirit of the invention, be considered as within the scope thereof as limited solely by the appended claims.

What I claim is:

1. A fluid flow device suitable for use either as a pump or motor comprising a casing having an inlet port and an outlet port, said device having a chamber, a rotor disposed in said chamber to provide at least one pump chamber, said pump chamber having an intake port and a discharge port, said device having a first fluid passage means communicating with said inlet port of said casing and said intake port of said pump chamber and a second fluid passage means communicating with said discharge port of said pump chamber and said outlet port of said

casing, said rotor shaft being journaled in said device, said rotor having a plurality of slots, each slot having a slidable vane disposed therein, said rotor having a fluid passage means communicating with the bottom of said vane slots and one end of said shaft, a rotatable means mounted in said device having a surface forming an end wall of a pump chamber, said rotatable means having an opening in said surface and a fluid passage means extending from said opening to and communicating with the fluid passage means in said rotor and shaft and means mounted on said device for rotating said rotatable means correspondingly to vary the amount of exposure of said opening to said pump chamber.

2. A fluid flow device suitable for use either as a pump or motor comprising a casing having an inlet port and an outlet port, said device having a chamber, a rotor mounted in said chamber to provide at least one pump chamber, said pump chamber having an intake port and an exhaust port, said device having a first fluid passage means communicating with said inlet port of said casing and said intake port of said pump chamber and a second fluid passage means communicating with said discharge port of said pump chamber and said outlet port of said casing, said rotor shaft being journaled in said device, said rotor having a plurality of slots, each of said slots having a slidable vane disposed therein, said rotor and shaft having fluid passage means communicating with the bottoms of said vane slots and an end of said shaft, a rotatable means axially mounted in said device having a surface forming an end wall for said pump chamber, said rotatable means having at least one radially disposed opening in said surface, at least a portion of said opening in said surface being disposed at a distance from the axis of said device greater than the radius of said rotor, said rotatable means having fluid passage means extending from said opening therein to and communicating with the fluid passage means in said rotor and shaft and means disposed in said device for rotating said rotatable means.

3. A fluid flow device suitable for use either as a pump or motor comprising a casing having an inlet port and an outlet port, said device having a chamber, a liner disposed in said chamber, said liner having a longitudinal opening therethrough, a rotor mounted in said opening in said liner to provide at least one pump chamber, said pump chamber having an intake port and an exhaust port, said liner having a first groove in the outside surface thereof communicating with the intake port of said pump chamber and said inlet port of said casing to provide a first fluid passage means and a second groove in the outside surface thereof communicating with the exhaust port of said pump chamber and the outlet port of said casing to provide a second fluid passage means, said rotor shaft being journaled in said device, said rotor having a plurality of slots, each of said slots having a slidable vane disposed therein, said rotor and shaft having fluid passage means communicating with the bottoms of said vane slots and an end of said shaft, a rotatable means axially mounted in said device having a surface forming an end wall for said pump chamber, said rotatable means having at least a radially disposed opening in said surface, at least a portion of said opening in said surface being disposed at a distance from the axis of said device greater than the radius of said rotor and less than the maximum radial distance of said pump chambers, said rotatable means having fluid passage means extending from said opening therein and communicating with the fluid passage means in said rotor and shaft and means disposed in said device for rotating said rotatable means.

4. A fluid flow device suitable for use either as a pump or motor comprising a casing having an inlet port and an outlet port, said device having a chamber, a liner disposed in said chamber, said liner having an oblong shaped, longitudinal opening therethrough, a rotor centrally mounted in said opening to provide a pair of

opposed pump chambers, each of said pump chambers having an intake port and an exhaust port, said liner having a first groove in the outside surface thereof communicating with the intake ports of said pump chambers and said inlet port of said casing to provide a first fluid passage means and a second grove in the outside surface thereof communicating with the exhaust ports of said pump chambers and the outlet port of said casing to provide a second fluid passage means, said rotor shaft being journaled in said device, said rotor having a plurality of slots, each of said slots having a slidable vane disposed therein, said rotor and shaft having fluid passage means communicating with the bottoms of said vane slots and an end of said shaft, a rotatable means axially mounted in said device having a surface forming an end wall for said pump chambers, said rotatable means having a pair of diametrically opposed openings in said surface thereof, at least a portion of each opening in said surface being disposed at a distance from the axis of said device greater than the radius of said rotor and less than the maximum radial distance of said pump chambers, said rotatable means having fluid passage means extending from said openings therein to and communicating with the fluid passage means in said rotor and shaft and means disposed in said device for rotating said rotatable means.

5. A fluid flow device suitable for use either as a pump or motor comprising a casing having an inlet port and an outlet port, said device having a chamber, a liner disposed in said chamber, said liner having a longitudinal opening therethrough, a rotor mounted in said opening in said liner to provide at least one pump chamber, said pump chamber having an intake port and an exhaust port, said longitudinally extending surface of said chamber having a first groove communicating with the intake port of said pump chamber and said inlet port of said casing to provide a first fluid passage means and a second groove therein communicating with the exhaust port of said pump chamber and the outlet port of said casing to provide a second fluid passage means, said rotor shaft being journaled in said device, said rotor having a plurality of slots, each of said slots having a slidable vane disposed therein, said rotor and shaft having fluid passage means communicating with the bottoms of said vane slots and an end of said shaft, a rotatable means axially mounted in said device having a surface forming an end wall for said pump chamber, said rotatable means having at least a radially disposed opening in said surface, at least a portion of said opening in said surface being disposed at a distance from the axis of said device greater than the radius of said rotor and less than the maximum radial distance of said pump chamber, said rotatable means having fluid passage means extending from said opening therein to and communicating with the fluid passage means in said rotor and shaft and means disposed in said device for rotating said rotatable means.

6. A fluid flow device suitable for use either as a pump or motor comprising a casing having an inlet port and an outlet port, said device having a chamber, a liner disposed in said chamber, said liner having an oblong shape, longitudinal opening therethrough, a rotor centrally mounted in said opening to provide a pair of opposed pump chambers, each of said pump chambers having an intake port and an exhaust port, said longitudinally extending surface of said chamber having a first groove communicating with the intake ports of said pump chambers and said inlet port of said casing to provide a first fluid passage means and a second groove therein communicating with the exhaust ports of said pump chambers and the outlet port of said casing to provide a second fluid passage means, said rotor shaft being journaled in said device, said rotor having a plurality of slots, each of said slots having a slidable vane disposed therein, said rotor and shaft having fluid passage means communicating with the bottoms of said vane slots and an end of said shaft, a rotatable means axially mounted in said device having

a surface forming an end wall for said pump chambers, said rotatable means having a pair of diametrically opposed openings in said surface thereof, at least a portion of each opening in said surface being disposed at a distance from the axis of said device greater than the radius of said rotor and less than the maximum radial distance of said pump chambers, said rotatable means having fluid passage means extending from said openings therein to and communicating with the fluid passage means in said rotor and shaft and means disposed in said device for rotating said rotatable means.

7. A fluid flow device suitable for use either as a pump or motor comprising a casing having an inlet port and an outlet port, said device having a chamber, a liner disposed in said chamber, said liner having a longitudinal opening therethrough, a rotor mounted in said opening in said liner to provide at least one pump chamber, said pump chamber having an intake port and an exhaust port, said liner having a first groove in the outside surface thereof communicating with the intake port of said pump chamber and a second groove therein communicating with the exhaust port of said pump chamber, said longitudinally extending surface of said chamber in said casing having a first groove communicating with said inlet port of said casing and the first groove in said liner to provide a first fluid passage means and a second groove communicating with said outlet port of said casing and the second groove in said liner to provide a second fluid passage means, said rotor shaft being journaled in said device, said rotor having a plurality of slots, each of said slots having a slidable vane disposed therein, said rotor and shaft having fluid passage means communicating with the bottoms of said vane slots and an end of said shaft, a rotatable means axially mounted in said device having a surface forming an end wall for said pump chamber, said rotatable means having at least a radially disposed opening in said surface, at least a portion of said opening in said surface being disposed at a distance from the axis of said device greater than the radius of said rotor and less than the maximum radial distance of said pump chamber, said rotatable means having fluid passage means extending from said opening therein to and communicating with the fluid passage means in said rotor and shaft and means disposed in said device for rotating said rotatable means.

8. A fluid flow device suitable for use either as a pump or motor comprising a casing having a cylindrical socket, said casing having inlet and outlet ports communicating with said cylindrical socket and a circular opening in the bottom wall of said cylindrical socket, axially aligned with and having a smaller diameter than said cylindrical socket to provide an annular shoulder, a liner received in said cylindrical socket, said liner having an oblong opening therethrough communicating with said circular opening in said casing, a rotor mounted on a reduced portion of a shaft disposed in said oblong opening in said liner to provide opposed pump chambers, each pump chamber having an intake port and a discharge port, the cylindrical surface of the liner having a first arcuate groove extending between the intake ports

of said opposed pump chambers and communicating therewith and the inlet port of said casing, the cylindrical wall of said socket having a first arcuate groove registering with said first arcuate groove in said liner to define a fluid intake passageway, the cylindrical surface of the liner having a second arcuate groove spaced longitudinally relative to the axis of said device from said first arcuate groove therein, extending between the discharge ports of said opposed pump chambers and communicating therewith and the outlet port of said casing, the cylindrical wall of said socket having a second arcuate groove registering with said second arcuate groove in said liner to define a fluid discharge passageway, a cylindrical closure member received in said circular opening in said casing having a front face abutting the rear face of said liner, means for retaining said closure member in said circular opening, said closure cap having an axially disposed cylindrical recess in the front face thereof having a diameter substantially equal to the minimum diameter of the oblong opening in said liner, the bottom wall of said cylindrical recess having a diametrically extending groove, the cylindrical walls of said cylindrical groove having a pair of diametrically opposed, longitudinally extending grooves communicating with said diametrically extending groove to define a substantially C-shaped groove in said cylindrical recess, the diametrical distance between the bottoms of said longitudinally extending recesses being substantially equal to the maximum diameter of said oblong opening in said liner, a bearing member disposed in said cylindrical recess in said closure member having a front face abutting the end face of said rotor, means disposed on the rear face of said closure member for rotating said closure member, an end cap member disposed on the front face of the casing having an axial opening, an end of said rotor shaft journaled in said bearing in said closure member and the other end thereof journaled in a suitable bearing in said end cap member and extending through the axial opening therethrough, said rotor having a plurality of radial slots, each slot having a slidable vane disposed therein, said rotor and shaft having fluid passage means communicating with the diametrical recess in the bottom wall of said cylindrical recess of said closure member and the bottoms of said vane slots.

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JOSEPH H. BRANSON, JR., *Primary Examiner.*

LAURENCE V. EFNER, *Examiner.*