Nov. 7, 1950 H. M. PURCELL 2,529,309

FLUID OPERABLE APPARATUS

Filed March 11, 1946 2 Sheets-Sheet 1

FIG. 1

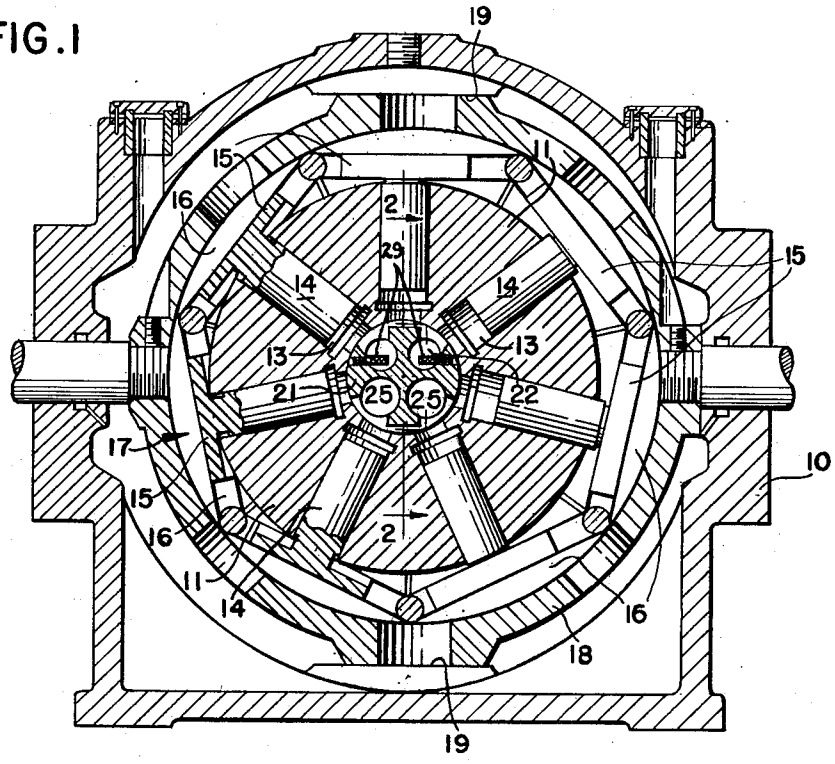


FIG. 4

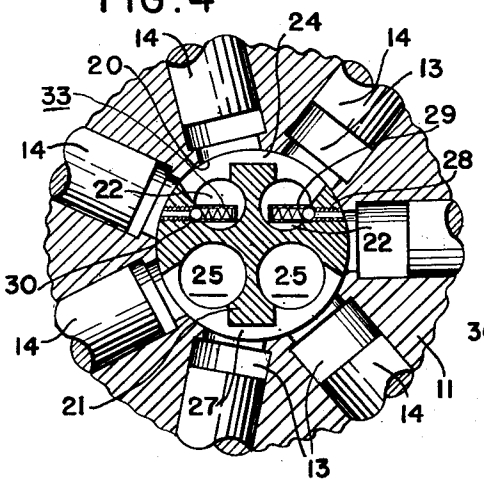
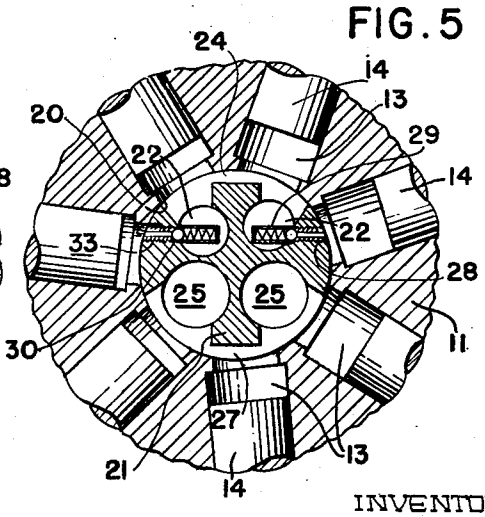


FIG. 5



INVENTOR
HOWARD M. PURCELL
BY
Toulmin & Toulmin
ATTORNEYS

Nov. 7, 1950 H. M. PURCELL 2,529,309

FLUID OPERABLE APPARATUS

Filed March 11, 1946 2 Sheets-Sheet 2

FIG. 6

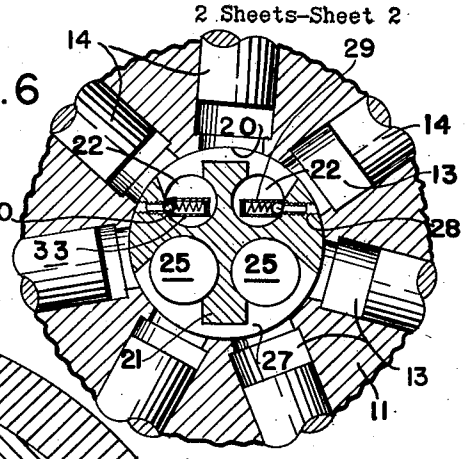


FIG. 7

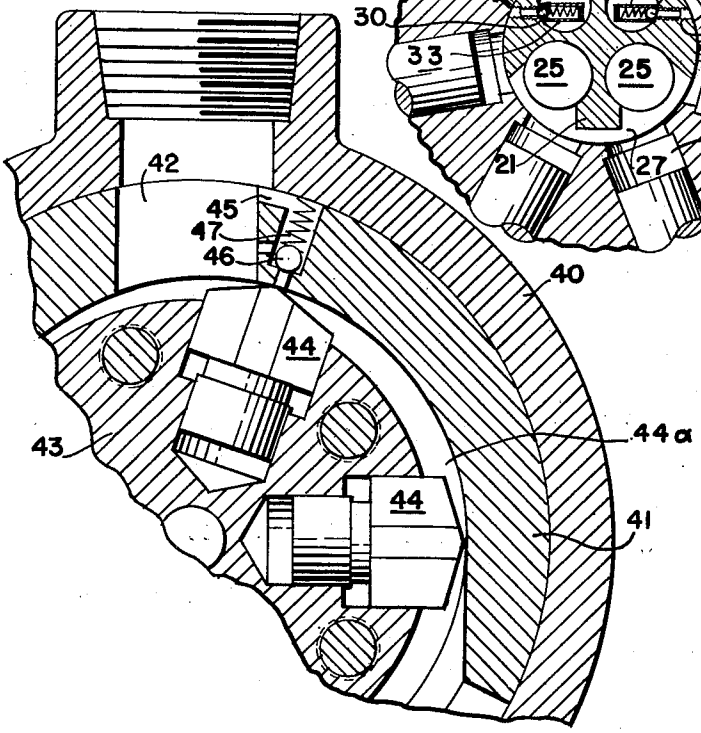


FIG. 2

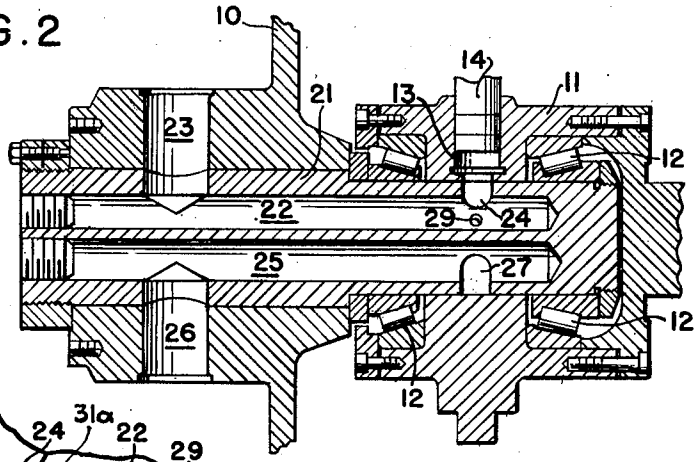
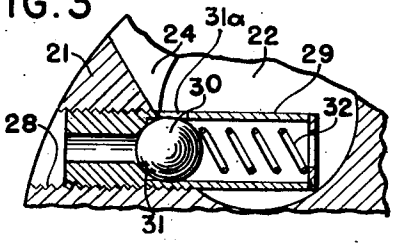


FIG. 3



INVENTOR
HOWARD M. PURCELL
BY Toulmin & Toulmin
ATTORNEYS

Patented Nov. 7, 1950

2,529,309

UNITED STATES PATENT OFFICE

2,529,309

FLUID OPERABLE APPARATUS

Howard M. Purcell, Mount Gilead, Ohio, assignor to H-P-M Development Corporation, Wilmington, Del., a corporation of Delaware

Application March 11, 1946, Serial No. 653,581

5 Claims. (Cl. 103—161)

1

This invention relates to fluid operable apparatus and, particularly, to fluid operable pumps and motors.

The particular object of this invention is to provide means in association with the fluid pump or motor which will reduce the noise of operation, and improve the efficiency and operating characteristics thereof.

Another object is to provide the porting arrangement for a pump which has a plurality of pumping chambers which substantially eliminates the noise generated when the pumping chambers successively establish communication with the discharge port of the pump.

It is still another object to provide a porting arrangement for a fluid pump or motor according to the foregoing objects, the operation of which is independent of the viscosity of the pumped fluid.

These and other objects and advantages will become more apparent upon reference to the accompanying drawings in which:

Figure 1 is a transverse section through a radial piston pump constructed according to this invention;

Figure 2 is a longitudinal section through a portion of the pump of Figure 1 and is indicated by the line 2—2 on Figure 1;

Figure 3 is an enlarged view showing the valve member which effects fluid communication between the pumping chambers and the pressure port of the pump valve means;

Figures 4 and 5 and 6 are fragmentary views illustrating the pistons of the pump of Figure 1 in different positions; and

Figure 7 is a partial section through a vane type pump constructed according to this invention.

General arrangement

A continuously operating fluid pump or motor generally comprises a plurality of pumping chambers which, in the case of a pump, expand during the period that they are in communication with a suction port and thereafter contract during the period that they are in communication with an outlet port. In most cases the inlet and outlet ports are symmetrically located and are separated by a lap which is equal to or greater in length than the size of the aperture of the pumping chamber which communicates with the said ports. In such an arrangement, during the time of passing across this lap, the pumping chambers do not compress the fluid above the pressure at the inlet port. Then, when the pumping chamber communicates with the discharge port, there is a sudden and vibration creating exchange of fluid therebetween which generates noise and promotes inefficient operation of the pump.

2

It is with the elimination of this source of noise and inefficiency that the present invention is concerned. This invention is further concerned with a means for eliminating the source of noise and inefficiency which is operable regardless of the viscosity of the fluid being pumped.

According to this invention the discharge port of the pump is reduced in size so that the pumping chambers exert pressure on the fluid therein before the fluid is expelled into the said discharge port. Then, to prevent an excessive build up of pressure in the pumping chambers a passage is provided between the discharge port of the pump and the pumping chambers which permits release of the said pressure to the discharge port before the pumping chambers are in direct communication therewith.

In order to insure that there will not be a surge of fluid between the discharge port and the pumping chambers there is provided in the aforementioned passage a check valve which permits flow to the discharge port but not therefrom. Then, the operation of the noise reducing passage is substantially independent of viscosity of the fluid and an interflow of fluid will take place only when the pressure in the pumping chamber is higher than that in the discharge port.

Structural arrangement

Referring to the drawings more in detail, there is shown in Figures 1 and 2 a radial piston pump having a casing 10 with a rotor 11 rotatably mounted therein on anti-friction bearings such as are indicated at 12.

The rotor comprises a plurality of radial cylinders 13 for reciprocably receiving the pistons 14 that have cross heads 15 at their outer ends to be received in the slots 16 in the segmented thrust ring 17.

The ring 17 is retained within a member 18 which is guided on the flats 19 so as to be reciprocable within the casing 10 in order to vary the rate and direction of delivery of the pump.

The rotor is bored centrally as at 20 for receiving a pintle or valve member 21 which is carried in the casing 10 in any suitable manner and on which the bearings 12 are mounted. The pintle 21 has a pair of longitudinal bores 22 which communicate with a port 23 in the casing and terminate at their inner ends in the port 24 which lies in the plane of the cylinders 13 in the rotor 11. The pintle 21 also comprises a pair of bores 25 which communicate between the port 26 in

the casing and the pintle port 27 arranged diametrically opposite the aforementioned pintle port 24.

Assuming that the rotor in Figure 1 is rotating counterclockwise the cylinders in communication with the port 27 are expanding and withdrawing fluid therefrom while the cylinders in communication with the port 24 are contracting and expelling fluid therein. Thus, there is a continuous exchange of fluid between the ports with a concomitant increase in pressure. The rate and direction of fluid flow through the pump may be varied by varying the eccentricity of the member 18 relative to the rotor 11 by suitable control means such as the rods which connect therewith and extend through the casing 10.

The portion of the pintle lying between the ports 24 and 27 must be of sufficient size substantially to prevent fluid flow therebetween and the ports preferably are separated by a distance at least equal to the diameters of the apertures which communicate the cylinder bores with the central bore 20 with the rotor.

In the usual type pump, as the pumping chambers pass from the point where they communicate with the suction port to where they communicate with the discharge port, the fluid therein is not compressed to the discharge pressure by inward movement of the pumping pistons. This compression may be zero with symmetrically arranged ports, or exceedingly high if the discharge port is small. In either case as each successive cylinder communicates with the discharge port, a sudden, pressure equalizing, interflow of fluid takes place which creates vibrations and noise.

In this invention the discharge port 24 is made smaller so the pistons will develop a pressure on the fluid being pumped at least equal to the pump discharge pressure. Since there is some variation in the manufacture of pumps, it is not possible to make the discharge port of the exact size necessary to permit the pistons to develop discharge pressure on the fluid as the pumping chambers communicate with the discharge port.

In order to overcome the aforementioned fault, the port 24 is made smaller than the theoretically correct size and there is provided a bore 28 in the pintle 21 which communicates with the port 24 and terminates in the surface of the pintle between the ports 24 and 27 somewhat in advance of the former. The location of the bore 28 is such that the cylinders communicate therewith prior to communicating with the port 24 and provides means for permitting the high pressures developed in the pumping chambers to be reduced by an exchange of fluid between the pumping chambers and the port 24.

In order to prevent the flow of fluid from the port 24 to the cylinders 13 the bore 28 has mounted therein a hollow sleeve 29 within which is a ball 30 urged into engagement with a seat 31 by a spring 32. The ball 30 prevents flow from the port 24 to the cylinders but, when the pressure in the cylinders rise to a value which exceeds that in the port, permits fluid flow from the cylinders to the port, as by means of the aperture 31*a* and thereby prevents the building up of exceedingly high pressure in the pumping chambers and the sudden noise created upon release thereof when the pumping chambers directly communicate with the port 24.

On the opposite side of the port 24 is a second check valve arrangement generally indicated at 33 which becomes operable during the time that the pumping chambers are passing from the

pressure port 24 to the suction port 27. It will be noted that the pumping chambers are contracting throughout the time that they lie above the horizontal center line and are continuously communicated with the discharge port either directly or through one of the checked passages. It will be apparent that although this invention has been described in connection with a unidirectional pump, it is also adapted for being employed with a reversible delivery pump in which case there would be check valve assemblies adjacent both ports.

In Figure 7 there is illustrated a vane pump having a casing 40 within which is a member 41 which comprises a discharge port 42. A rotor 43 having the vanes 44 is rotatable within the member 41 and defines therewith the pumping chamber 44*a*. In adapting this invention to the structure shown in Figure 7, there is provided a passage 45 which leads from the port 42 to a point on the inner surface of the member 41 to communicate with the pumping chamber before the leading vane passes the edge of the port 42. To prevent flow from the port 42 toward the pumping chamber there is provided a check valve comprising a ball 46 and spring 47 located in the passage 45. As in the case of the pump of Figure 1, the checked passage shown in Figure 7 communicates the pumping chamber with the discharge port to permit flow from the former to the latter to equalize the pressures therebetween prior to the establishing of direct communication therebetween. This eliminates a vibration creating and power absorbing interflow of fluid between the discharge port and the successive pumping chambers as the pump operates.

It will be noted that the discharge port proper can be made of a smaller size when the present invention is employed thereby to increase the lap between the suction and the discharge ports. Because of this the suction port can be made somewhat larger than formerly and the pumping chambers will communicate therewith for a somewhat longer time. This has the advantage of substantially preventing the creation of voids in the pumping chambers and eliminates another possible source of noise and inefficiency in the pump.

It will be understood that this invention is susceptible to modification in order to adopt it to different usages and conditions and, accordingly, it is desired to comprehend such modifications within this invention as may fall within the scope of the appended claims.

I claim:

1. In a radial piston pump; a rotor having a plurality of cylinders and a central axial bore into which cylinders open; a piston in each cylinder and means of reciprocating said pistons as said rotor is rotated; a valve member in said bore having a suction port positioned to communicate with said cylinders throughout substantially the whole of the time that said pistons are moving outwardly therein; said valve member also having a discharge port smaller than said suction port positioned to communicate with said cylinders during a portion of the time that said pistons are moving into said cylinders; and passageways formed in said valve member and opening at one end into said discharge port and at their opposite ends into said bore between said suction and discharge ports and including check valves providing for unidirectional communication between said cylinders and said discharge port during the

remainder of the time that said pistons are moving into said cylinders.

2. In a radiating piston pump; a valve member having suction and discharge ports; a rotor rotatable about said valve member and comprising a plurality of pumping chambers arranged for alternate communication with said ports; means for actuating said rotor and said pumping chambers for transferring fluid between said ports; and check valve means carried in said valve member between said suction and discharge ports and having outlet means connected with said discharge port and inlet means communicating with said pumping chambers on each side of said discharge port for permitting flow from said pumping chambers to said discharge port prior to and after communication of said chambers with said discharge port.

3. In a radiating piston pump; a rotor having a plurality of pumping chambers; a valve member having suction and discharge ports, the said pumping chambers being arranged for communication with said suction port through a predetermined arc during which they are expanding and with said discharge port through at least a portion of the arc during which they are contracting; and passages formed in said valve member on each side of said discharge port and having check valves therein opening into said discharge port for communicating said pumping chambers with said discharge port during the remaining portion of the arc through which said chambers are contracting.

4. In a radial piston pump; a rotor formed with an axial bore and a plurality of radially disposed cylinders opening at one end into the bore of said rotor; a plurality of pistons reciprocable in the cylinders of said rotor; a valve member extending into the bore of said rotor and having a suction port and a relatively smaller discharge port in alignment with the cylinders of said rotor,

said ports being spaced apart on said valve member by a distance substantially greater than the distance across the openings in said cylinders; and check valve means carried in said valve member and having outlets opening into said discharge port and inlets opening into the axial bore of said rotor on each side of said discharge port.

5. In a radial piston pump; a stationary central valve member; a rotor rotatable about said valve member and formed with a plurality of radially disposed pumping chambers having openings communicating with the surface of said valve member, said valve member having suction and discharge ports in alignment with the openings of said chambers and being spaced apart around the periphery of said valve member a distance substantially greater than the size of the openings of said chambers, and bores in said valve member extending from the discharge port to the surface of said valve member between the suction and discharge ports; and check valves in the bores of said valve member opening toward the discharge port of said valve member.

HOWARD M. PURCELL.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
924,787	Janney	June 15, 1909
1,081,810	Carey	Dec. 16, 1913
2,075,017	Benedek	Mar. 30, 1937
2,418,123	Joy	Apr. 1, 1947

FOREIGN PATENTS

Number	Country	Date
285,468	Germany	1915
506,684	Great Britain	1939
564,400	France	Oct. 18, 1923