R. MAW AND W. B. McLEAN.

COMBINED FLUID PRESSURE PUMP AND MOTOR.

APPLICATION FILED MAY 29, 1914. RENEWED NOV. 27, 1918.

1,308,436. Patented July 1, 1919.

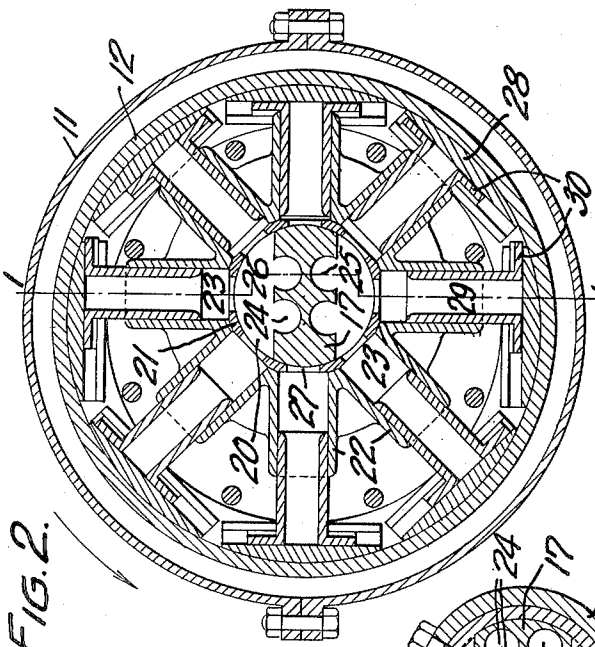


FIG. 2.

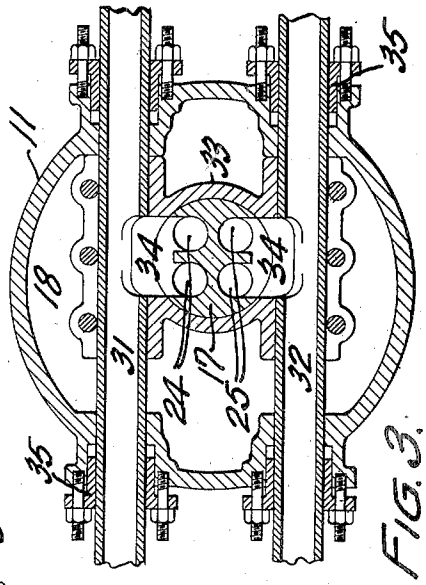


FIG. 3.

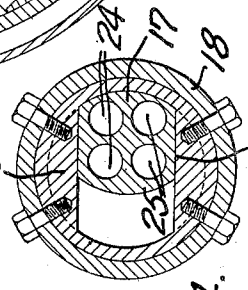


FIG. 4.

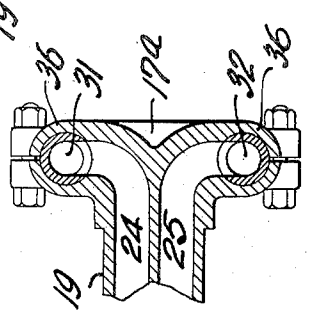


FIG. 6.

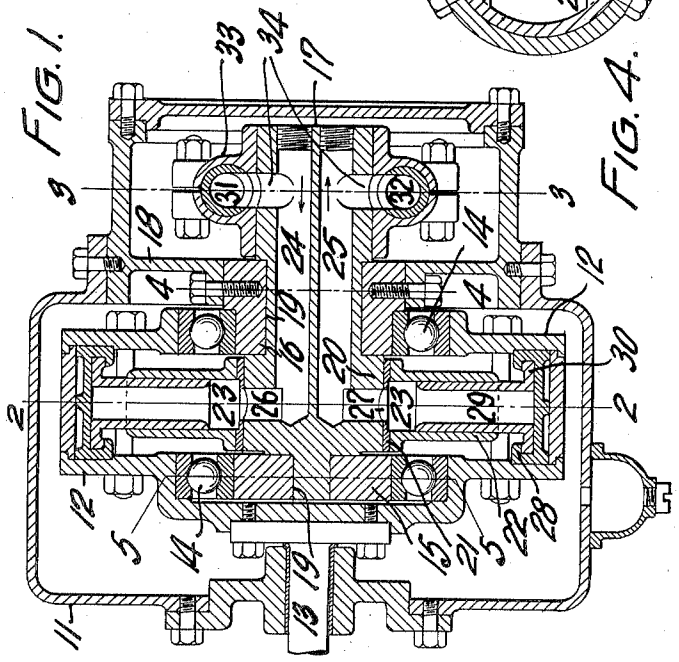


FIG. 1.

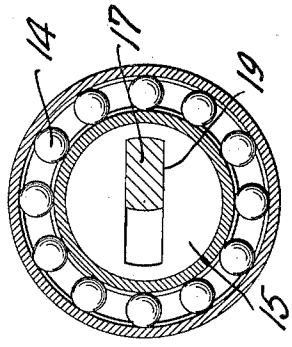


FIG. 5.

Witnesses

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UNITED STATES PATENT OFFICE.

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COMBINED FLUID-PRESSURE PUMP AND MOTOR.

1,308,436. Specification of Letters Patent. Patented July 1, 1919.

Application filed May 29, 1914, Serial No. 841,969. Renewed November 27, 1918. Serial No. 264,466.

To all whom it may concern:

Be it known that we, ROBERT MAW and WILLIAM B. McLEAN, citizens of the Dominion of Canada, and residents of the city of Montreal, in the Province of Quebec and Dominion of Canada, have invented certain new and useful Improvements in Combined Fluid-Pressure Pumps and Motors, of which the following is a full, clear, and exact description.

This invention relates to improvements in pumps, and the object is to provide a pump of adjustable stroke, whereby the amount of delivery may be regulated from nothing to full capacity, without changing the speed of the pump or of the driving means therefor.

A further object is to provide a pump so arranged that the suction and discharge may be alternated at will.

A still further object is to provide a pump for use in liquid transmission systems so arranged that the pressure of liquid is not directed entirely upon moving parts, whereby friction will be largely reduced.

To accomplish the above objects, a shaft is provided held against revolution, but permitted limited bodily movement in a lateral direction. A casing is revolubly mounted on the shaft containing a cylinder member, also revoluble on the shaft, and connected to the casing by pistons slidably mounted on the casing. These pistons are open at both ends, so that the pressure of liquid is directed largely against a relatively fixed part of the casing and not entirely against the piston which slides on the casing.

In the drawings which illustrate the invention:—

Figure 1 is a vertical longitudinal section of the pump.

Fig. 2 is a cross sectional view on the line 2—2, Fig. 1, showing the arrangement of cylinders, pistons, etc.

Fig. 3 is a cross sectional view on the line 3—3, Fig. 1, showing the connection of inlet and outlet pipes, and means for shifting the central shaft.

Figs. 4 and 5 are sectional views on the lines 4—4 and 5—5, Fig. 1, respectively, showing the different bearings of the pump shaft.

Fig. 6 is a fragmentary sectional view showing a slight modification of the structure shown in Fig. 1.

Referring more particularly to the drawings, 11 designates a fixed casing containing all parts of the pump and having mounted within it a revoluble casing 12, which may be operated by being directly connected with the shaft 13 of an engine or electric motor. The revolving casing 12 is rigidly connected to and concentric with the shaft 13, so that one end of the revolving casing is supported thereby. The revolving casing is also mounted by means of ball bearings 14 on collars 15 and 16 mounted on a central shaft 17, and slotted so as to hold the central shaft against revolution, but permit bodily movement in the radial direction of the casing. The collar 16 which is at the opposite end of the revolving casing from the shaft 13 is rigidly mounted in a web of the outer casing, and thus supports the central shaft and the revolving casing. It will thus be seen that the revolving casing 12 is supported at one end by the engine shaft and at the opposite end by the collar 16, while the movable shaft 17 is supported toward one end by the collar 16 carried in the casing web and at the opposite end by the collar 15 mounted in the revolving casing adjacent the engine shaft, so that it is held parallel with the engine shaft. The revolving casing and shaft 17 thus partly support one another, and are each partly supported in the outer fixed casing. The shaft 17 is flattened, as shown at 19, where it passes through the slots of the collars 15 and 16, and is thus held against revolution but is permitted a lateral sliding movement.

Within the revolving casing 12, the shaft 17 is provided with a circumferential flange or enlargement 20, upon which is revolubly mounted a polygonal hub or sleeve 21 carrying a cylinder member 22, having a plurality of bores 23 arranged radially of the shaft. The shaft is of hollow formation to provide inlet and outlet passages 24 and 25, which communicate through ports 26 formed in the flange 20 and ports 27 formed in the hub concentric with the cylinder bores. The ports 26 and 27 are on opposite sides of the shaft, and are so arranged that their common center line is at right angles to the direction in which the shaft is movable. The circumferential width of the ports is approximately one-third the circumference of the flange, and the ports are arranged equi-

distant, as shown in Fig. 2, and the circumferential space between them is greater than the width of the ports 27, so that it will be impossible for any cylinder to be in communication with more than one shaft port at a time.

The circumference of the revolving casing 12 is provided with a plurality of grooved guides 28 arranged perpendicularly to the radii of the casing, equally spaced and equal in number to the bores of the cylinder member. In each cylinder bore is a hollow piston 29 open at its outer end and provided with laterally projecting flanges or shoes 30 which engage in the grooves of the guides 28 and hold the piston against movement either toward or away from the casing center, but permit a bodily sliding movement, the pistons remaining perpendicular to the guides. These pistons are open at their outer end so that what may be termed the head of the piston is formed by the guide itself.

Supply and discharge pipes 31 and 32 lead respectively to the inlet and outlet passages of the shaft, and may be connected thereto in a variety of ways, of which the form shown in the drawings is one of the most simple. This arrangement consists of a clamp 33 closely surrounding the end of the shaft 17 and holding the pipes rigidly thereto, the clamp forming fluid tight joints with both shaft and pipes. Passages or ports 34 are formed connecting the pipes and the passages of the shaft. The pipes pass out of the casing 11, through stuffing boxes 35, which enables the entire casing to be filled with oil or grease under pressure, if desired, without any leakage around the pipes. An advantage of this particular construction is that the pipes themselves may be used as supporting and shifting members for the shaft, and thus obviate the necessity of forming a sliding joint between the pipes and shaft capable of remaining tight under high pressures.

It is obvious, however, that instead of the pipes being connected to the shaft by a separate clamping member, the shaft may have the clamp formed integral therewith, as shown at 36 in Fig. 6, which is a fragmentary view corresponding with Fig. 1. Numerous other modifications may be made in the structure. In the form shown, eight cylinders are provided radially arranged in a single plane. The number of cylinders may be varied as desired, or they may be arranged in any suitable number of planes, thus multiplying the number of cylinders and increasing the power with only a very small increase in the size of the machine.

When the device is used as a pump, power is applied to the shaft 13, which rotates the casing 12, the pistons 29 therein causing the cylinder member 22 to rotate simultaneously around the shaft 17, this shaft being slidable in a lateral direction may be moved into or out of concentric relation with the casing. When the shaft is concentric with the casing, it is obvious that there will be no relative movement between the pistons and cylinder, but when the shaft is moved to eccentric position, it carries the cylinder member with it, so that as the casing revolves, the pistons will reciprocate in the cylinder, owing to the varying distance between the cylinder center and the periphery of the casing. This causes fluid to be drawn in through the passage 26 as the pistons move out and to be expelled through the passage 27 as the pistons move in. According as the shaft is shifted a varying amount of eccentricity, the stroke of the pistons will be varied, so that the amount of fluid passed through the apparatus may be varied without varying the speed of rotation, even to such a point that no fluid circulates although the revolution continues at uniform speed. If the shaft is shifted, so that its center passes from one side to the other of the center of the revolving casing 12, it is obvious that those pistons which were formerly moving outward commence moving inward, so that fluid will be expelled through the passage 36 and drawn in through the passage 37, thus reversing the direction of the flow of fluid, without reversing the direction of revolution of the apparatus. It is also obvious that the device may be used as a motor if the fluid is supplied to one side or the other under pressure, the direction of revolution being determined according to which side receives the fluid under pressure. By varying the amount of eccentricity of the shaft within the casing, the speed of revolution and torque delivered by the apparatus may be varied without the necessity of changing the volume and pressure of fluid supplied. It will be noted that during either the intake or discharge, whether the apparatus is used as a pump or as a motor, the fluid passes through the open bottom of the cylinder and through the tubular piston, the pressure being exerted in every case against the guide 35 which is a relatively stationary part. The only pressure against the pistons is on the small annular area of their inner ends, and this pressure is merely sufficient to hold them closely against the guides and form fluid tight joints. By thus eliminating the piston heads, the very considerable friction between these heads and the guides is eliminated, without detracting in any way from the efficiency of the apparatus. The arrangement in fact adds to the efficiency, as the fluid coming constantly in contact with the guides maintains a very thin film between the guides and piston shoes, so that perfect lubrication is effected and the pistons in reality float on a thin film of fluid on the guides.

Having thus described our invention, what we claim is:—

1. A device of the character described comprising a stationary casing, a revoluble casing therein, a shaft mounted in said casing for bodily lateral movement from one side to the other of the rotative casing axis and held against revolution, coöperative pump members mounted between the shaft and rotative casing, fluid inlet and outlet passages in said shaft, and shaft shifting means forming supply and discharge pipes communicating with the shaft passages.

2. In a device of the character described, a fixed casing and a revoluble casing therein, a non-revoluble shaft extending to a point within the revoluble casing having flattened portions, slotted collars engaging the flattened portions of said shaft in the slots of which the shaft is laterally movable and mounted one within the revoluble casing and one within the fixed casing, coöperative pump members carried by the fixed casing and shaft, and inlet and outlet passages for said members formed through the shaft.

3. A device of the character described, comprising the combination with an outer fixed casing and an inner revoluble casing, of a shaft having flattened portions, a slotted collar mounted on each flattened shaft portion, in the slots of which the shaft is laterally movable, one of said collars being fixedly mounted in the fixed casing, and ball bearings supporting said revoluble casing on the shaft collars, and means holding the revoluble casing concentric with the fixed casing.

4. A device of the character described comprising a revoluble casing, a non-revoluble shaft having inlet and outlet passages therein, a revoluble cylinder member mounted on the shaft in communication with said passages, guides mounted in the revoluble casing, and open ended pistons mounted at one end in said guides and at the opposite end in said cylinders whereby the guides constitute piston heads.

5. In a device of the character described, a pair of relatively revoluble members, interengaging radially disposed pump portions carried by said members, the pump portions carried by one of the members having slidable connection therewith in a tangential direction.

6. In a device of the character described, a pair of relatively revoluble members, interengaging radially disposed pump portions carried by said members, the pump portions carried by one of the members having slidable connection therewith in a tangential direction and guides in which said members may slide, said guides forming the head of the adjacent pump members.

7. In a device of the class described, an inner and an outer revoluble member, radial cylinders located on the inner member, radial plungers coacting with said cylinders on said outer member, guides on said outer member permitting tangential movement of said plungers, and lateral flanges on said plungers engaging said guides to prevent radial movement of said plungers.

In witness whereof, we have hereunto set our hands in the presence of two witnesses.

ROBERT MAW.
WILLIAM B. McLEAN.

Witnesses:
S. R. W. ALLEN,
G. M. MORELAND.