Sept. 9, 1969 R. MOLL 3,465,684

PISTON PUMP

Filed June 28, 1968 3 Sheets-Sheet 1

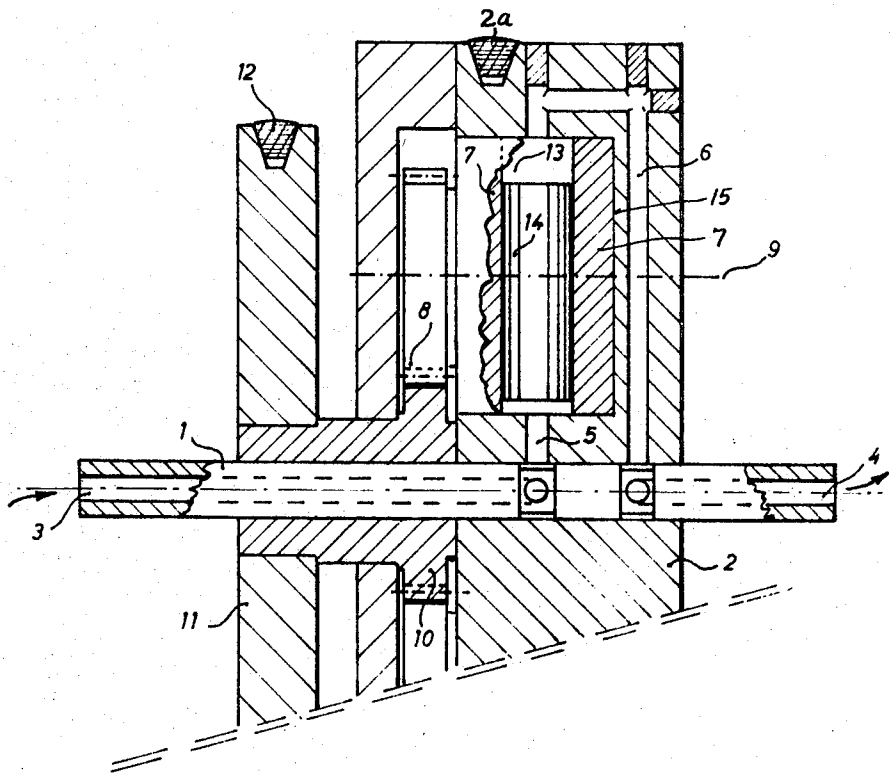



FIG. 1

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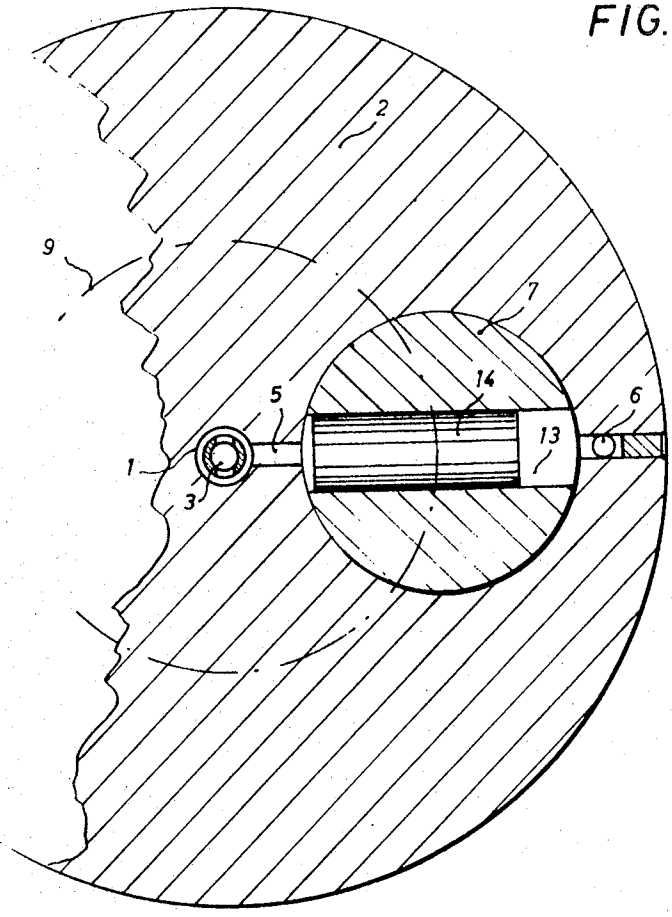
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PISTON PUMP

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FIG. 2




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FIG. 3

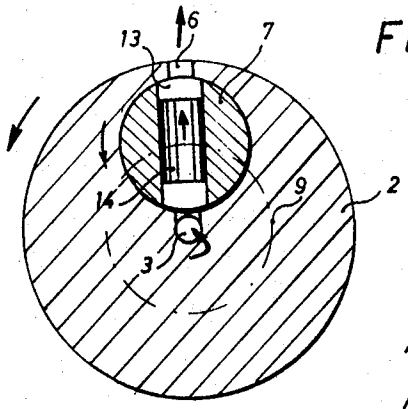
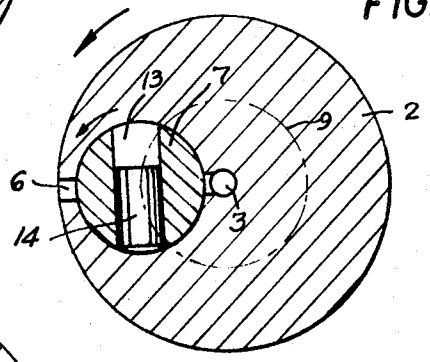



FIG. 4



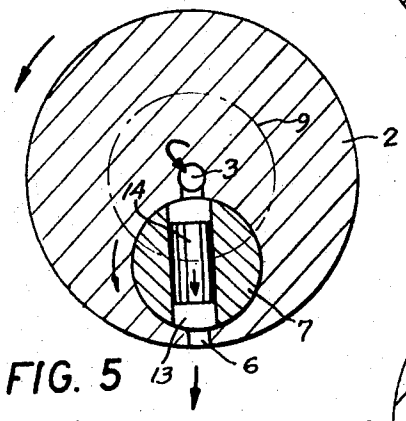
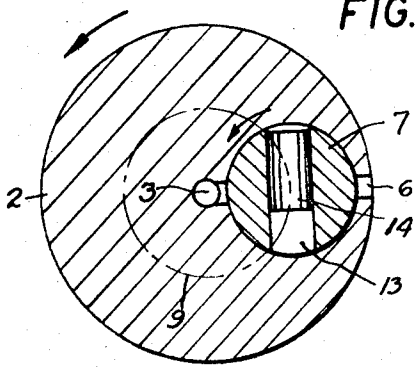




FIG. 5

FIG. 6




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United States Patent Office

3,465,684

Patented Sept. 9, 1969



3,465,684

# PISTON PUMP

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Filed June 28, 1968, Ser. No. 740,912
Claims priority, application Switzerland, July 1, 1967, 9,439/67
Int. Cl. F04b *19/02, 1/04, 1/20*
U.S. Cl. 103—160 6 Claims

## ABSTRACT OF THE DISCLOSURE

A piston pump includes a rotatable body provided with at least one rotatable satellite body disposed eccentrically relative to the axle on which the pump body is mounted. Within the satellite body is a chamber with a freely slidable piston confined therein. Fluid inlet and outlet conduits are provided within the pump axle and communicate with opposite ends of the chamber containing the free piston. Drive means are provided for rotating the pump body and means are also provided for independently rotating the satellite body. Upon rotation of both of said bodies, centrifugal force thrusts the piston outwardly and it is brought back toward the center of the body due to the twofold motion of the satellite body. This action results in suction of fluid through the inlet conduit and ejection of fluid under pressure through the outlet conduit.

This invention relates to a piston pump for transferring a fluid at a given rate of flow and at a given pressure, comprising at least one free piston situated eccentrically inside the pump body, the piston being moved by the centrifugal force resulting from the rotation of the pump body on its axle.

In known types of piston pumps the pistons are usually arranged radially or parallel to the axle of the pump, and their movement is controlled by some system of connecting rods or cams.

To enable the flow and pressure of the fluid being transferred to be varied, the aforementioned types of pumps require either the use of a regulator by-pass, which causes heavy losses of efficiency and heating of the fluid due to throttling in the narrow sections of the by-pass, or require a complex regulating mechanism.

The object of the present invention is to provide a piston pump having at least one free piston, wherein regulation of the flow and pressure of the fluid being pumped as well as automatic adjustment of said fluid relative to the usable output is accomplished without any appreciable loss of efficiency.

The pump of the present invention is characterized by the fact that it comprises at least one piston which can move freely in a recess in a satellite which is disposed eccentrically in relation to the axle of the pump body and is caused to rotate simultaneously about its axle and on a circular orbit round the axle of the pump body. Intake and outlet conduits in the pump body put each end of the recess containing the piston alternately in connection with external intake and outlet orifices in the pump body axle so that the combined effect of centrifugal force and the reversal of direction causes the piston to move alternately from one end of the recess to the other, alternately creating a suction behind and pressure in front of itself for the delivery of the fluid.

A pump of this type does not require a valve. The pressure of the impelled fluid is determined by the speed of rotation of the pump and by the radius of gyration of the orbit of the satellite. The frequency of the piston strokes and, therefore, the rate of flow are determined by the speed of rotation of the satellite about its axis and on its orbit.



Preferably, the pump described herein should have at least two satellite and piston assemblies arranged so as to balance the moving masses.

The satellite may be caused to rotate on its axis by a transmission means incorporated in the pump itself or by independent external transmission means.

The attached drawing shows, by way of example, one form of execution of the piston pump which is the object of this invention.

FIGURE 1 is a partial sectional view of the pump.

FIGURE 2 is a partial sectional view in a radial plane.

FIGURES 3–6 show successive positions of the piston while the pump is in operation.

The pump shown in FIGURES 1 and 2 has a fixed axle **1**, at the center of rotation of the pump body **2** which is rotatably driven on the axle by means of a transmission belt **2***a* connected to a suitable source of power (not shown). Coaxially of and at opposite ends of the axle **1** are separate conduits **3** and **4** providing passages for the intake and exhaust or outlet of fluid, respectively. The body **2** is provided with branch conduits **5** and **6** which are disposed radially relative to the conduits **3** and **4**, respectively, and are in permanent communication therewith. The body **2** has a recess **15** in which a satellite **7** is freely mounted and can be caused to rotate, for example, by means of a gear wheel **8** fixed to the satellite **7** on its axis **9**, the wheel **8** being driven by a gear wheel **10** fixed to the axle **1** of the pump body. Alternatively, the satellite **7** may be rotated by means of a pulley **11** and transmission belt **12**, the pulley being fixed to gear wheel **10** and the latter being freely rotatable on axle **1**. The transmission belt **12** would be connected to power source (not shown). The satellite **7** is provided with a chamber **13** communicating at one end with intake conduit **3** through branch conduit **5** and communicating at its opposite end with outlet conduit **4** through branch conduit **6**. A piston **14** is freely slidable within the chamber **13** between the orifices of the branch conduits.

When the flow and pressure are to be modified frequently, the gear wheels **8** and **10** are driven by means of the pulley **11** and belt **12** whose speed is determined by the output flow desired. The power source for driving the pulley in this case could be a variable speed motor, extensible pulley, etc. If the characteristics of the flow and pressure are to be constant, however, then the appropriate ratio between wheels **8** and **10** is selected, wheel **10** is made rigid with the axle **1** and belt **12** may be omitted since its use becomes unnecessary.

Referring to FIGURES 3–6 which show successive positions of the satellite **7** and of the piston **14** while they are in operation, the satellite **7** moves in a circular orbit around the axle **1** causing the piston **14** to be driven outwardly by the effect of centrifugal force. The movement of the piston **14** creates a suction of fluid behind itself and a compression of fluid in front of itself. The suction is used for drawing in the fluid through the conduits **3** and **5**, and at the same time forcing the fluid out through the effect of compression into the conduits **6** and **4**.

By rotating on its axis in the course of its orbital trajectory round the axle **1**, the satellite **7** gradually reverses the position of the piston **14** in relation to the axle **1**, and the process is repeated, each end of the piston being used in turn for the suction effect and then for the compression effect, and so on.

The user need only select appropriate speds for the rotation of the pump and for the relative rotation of the

satellite or satellities in order to obtain the desired flow and pressure, subject to the limits of capacity of the pump used.

When the consumption of the available delivery flow of fluid is nil or partial, the movement of the piston or pistons is so affected that its amplitude is automatically adapted to the flow without any heating of the fluid or notable losses of efficiency.

All the components of the pump described herein are simple in form and are inexpensive. The material used in manufacture of the components is preferably chosen according to the type of fluid to be pumped, which minimizes pump maintenance.

In the embodiment illustrated and described, only one satellite with one free piston therein is shown and referred to; however it is within the concept of this invention to provide for example two, four or more satellite and piston units depending upon the environment and work which the pump is to perform. Furthermore, instead of one piston per satellite, two pistons for example may be used and they may be disposed in a common plane or may be diametrically opposite each other. Also, instead of the pump axle being fixed and the pump body rotating therearound, the axle may be rotatable and the pump body fixed.

Various modifications in the illustrated embodiment may be made in keeping with the spirit of the invention. For example, the piston may have a weight added medially thereof for the purpose of increasing the mass of the piston and increasing the centrifugal force effect which results in a substantial increase in pressure of the fluid being pumped. In such a case, the center of the chamber within which the piston slides would be enlarged to accommodate the weighted area of the piston while the opposite ends of the chamber would retain their normal dimension to guide the piston in its reciprocatory movement.

The effect of the centrifugal force on the satellite can be nullified by accurately determining the dimension of the orifice so that the prevailing pressure in the outlet conduit exerts a force equivalent and opposite to the centrifugal force on the satellite, which eliminates excessive friction between the satellite and the body of the pump.

If desired, the throat area of the orifices of the inlet and outlet conduits may be enlarged so as to provide a greater evacuation time when the piston has travelled to its closest point adjacent the related orifice which results in increased efficiency of the pumping operation.

It is also possible to eliminate the gear drive means for rotating the satellite by providing a cam arrangement between the satellite and the adjacent side walls of the pump body. The satellite is provided with two eccentric studs or fingers spaced 90 degrees relative to one another with their axes parallel. The side walls of the pump body sections within which the satellite is confined are provided with eccentric grooves of the same value relative to the axis of the pump and are spaced 90 degrees relative to one another. The fingers ride in their related grooves similar to a roller on a cam and rotatably drive the satellite.



I claim:

1. A piston pump comprising a body, an axle on which said body is mounted, means for rotating said body on said axle, at least one satellite member within said body and disposed eccentrically relative to said axle, a chamber within said satellite member, fluid intake and fluid outlet conduits each having orifices communicating with opposite ends of said chamber, at least one piston freely movable within said chamber between said conduit orifices, means for rotating said satellite independently of said pump body, whereby when said pump body and satellite are both rotated said piston is reciprocated between said intake and outlet orifices alternately such that the combined effect of centrifugal force and reversal of direction of said piston creates suction at the intake orifice and compression at the outlet orifice for delivery of fluid under pressure through said outlet conduit.

2. A piston pump according to claim 1, wherein said fluid intake and outlet conduits are disposed within said pump axle.

3. A piston pump according to claim 1, wherein the means for rotating said satellite comprises a gear wheel fixed to said satellite and a second gear wheel fixed to said axle, said gear whels being in constant engagement with each other.

4. A piston pump according to claim 1, wherein the means for rotating said satellite comprises a gear wheel fixed to said satellite, a second gear wheel freely mounted on said axle, a pulley fixed to said second gear wheel and means for driving said pulley at a variable speed.

5. A piston pump according to claim 1, wherein said piston includes a weight disposed peripherally and substantially medially thereof and the central portion of said chamber is enlarged to accommodate the weighted area of the piston.

6. A piston pump according to claim 1, wherein the orifices of the inlet and outlet conduits which communicate with the opposite ends of said chamber are of greater diameter than the diameter of the adjacent portions of the inlet and outlet conduits.


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WILLIAM L. FREEH, Primary Examiner

U.S. Cl. X.R.

103—161; 230—24