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FREE PISTON AND CYLINDER ASSEMBLY FOR HYDRAULIC PUMPS AND MOTORS

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3,434,429

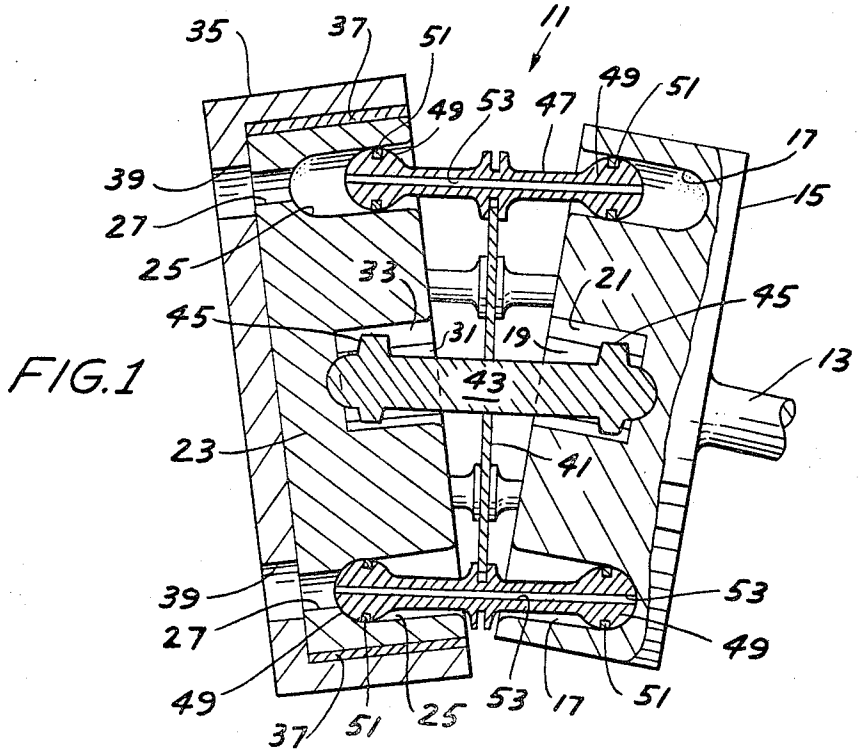


FIG. 1

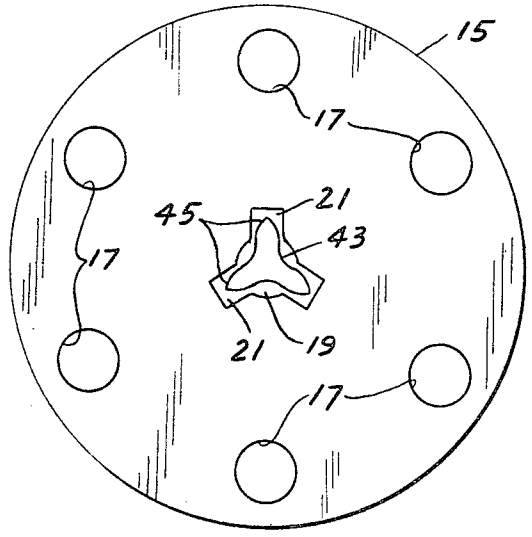


FIG. 2

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# FREE PISTON AND CYLINDER ASSEMBLY FOR HYDRAULIC PUMPS AND MOTORS

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U.S. Cl. 103—162 1 Claim

## ABSTRACT OF THE DISCLOSURE

A fluid pump or motor having rotatable cylinder blocks joined together by a constant velocity joint. The cylinders in said rotatable cylinder blocks are positioned opposite one another and are acted upon by spherical pistons fixed upon common, nonflexible piston rods, through which a passage is bored for passage of the working fluid during rotation of the heads.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of royalties thereon or therefor.

In current designs of positive displacement pumps of the axle piston type, it has been found necessary to provide ball sockets, slippers, wristpins, and other connecting devices to transfer forces. Such apparatus has proved expensive to manufacture and requires frequent repair.

It has been found in many of the prior art fluid pumps and motors, that excessive friction occurs at the points of connection and great difficulty has arisen due to inefficiency in providing lubrication and cooling at these points of connection.

It is also found in some designs that the distortion of the pistons occurs causing additional frction and resultant heat build up.

In many cases, scuffing of the piston and cylinder walls occurs due to the binding of the piston and its piston rod, or due to dirt, thermal shock, etc.

It is therefore an object of the present invention to obviate each and every one of the above described disadvantages currently occurring in the prior art.

It is also an object of the present invention to reduce or eliminate friction normally encountered at the point where the piston is connected to the piston rod and where it comes in contact with the revolving cylinder block or swash plate.

It is also an object of the present invention to provide an hydraulic pump or motor in which the cooling and lubrication of parts at their point of greatest friction is improved by increasing the fluid flow.

It is a further object of the present invention to provide an hydraulic pump or motor in which the bending moments encountered in conventional piston designs are entirely eliminated.

It is also an object of the present invention to provide an hydraulic pump or motor in which the scuffing of piston and cylinder is completely eliminated.

The above and further objects of the invention will become obvious to those skilled in the art upon reading the following description of the preferred embodiment of the invention which is furnished for illustration and not for limitation.

In the drawings:

FIGURE 1 shows a sectional view of opposing cylinder blocks of a preferred embodiment of the hydraulic pump or motor.

FIGURE 2 shows a view of one cylinder block of the preferred embodiment of the hydraulic pump or motor



with specific attention being given to the bores of said cylinder block.

It will be understood that although the description describes an hydraulic pump, those skilled in the art will obviously be aware of the usage of such structure as an hydraulic motor.

Now more specifically, in FIG. 1, the numeral **11** generally designates an hydraulic pump of the preferred embodiment of the invention. Power is provided to the pump by means of a shaft **13**, which is welded or otherwise suitably connected to a revolvable cylinder block **15**. As can be seen in FIGURE 2, cylinder block **15** has, suitably spaced therein, cylinders **17**. In the center of cylinder **15**, a suitable aperture **19** is bored, and slots **21** are machined at the periphery of said aperture for a purpose to be later described.

Referring once again to FIGURE 1, a second revolvable cylinder block **23** contains cylinders **25**, a central aperture **31**, and slots **33**. The cylinder block **23** is very similar to block **15** as shown in FIGURE 2. At the base of each cylinder **25**, apertures **27** allow the passage of fluid to the cylinders from a fluid source. A valve plate **35** is suitably mounted on cylinder block **23** and is spaced therefrom by a bushing **37**. Suitable ports in the shapes of curvilinear slots **39**, are machined in the valve plate **35**, so as to cooperate with fluid apertures **27**, in cylinder block **23**. The cooperation of the slots **39** with the fluid aperture **27** is well known by those skilled in the art.

Situated between cylinder blocks **15** and **23** is a piston centering disk **41**. The piston centering disk is mounted on universal timing shaft **43** having teeth **45** at the ends thereof. Shaft **43** enters apertures **19** and **31** in cylinder blocks **15** and **23**, respectively. The teeth **45**, thereon, cooperate with slots **21** and **33**, machined into the periphery of the apertures **19** and **31**. Thus, when power is supplied to shaft **13**, thereby causing the revolution of cylinder block **15**, cylinder block **23** is also revolved due to the cooperation of universal timing shaft **43** with apertures **19** and **31** and the slots therein. Suitably mounted on piston centering disk **41** are unitary, or nonflexible, piston rods **47** which are positioned so as to cooperate with opposed cylinders **17** and **25** in the two cylinder blocks. A spherical piston head **49** is machined onto each end of each piston rod **47**, and piston rings **51** are suitably installed in each piston head. An oil passage **53** extends from the top of one spherical piston **49**, through piston shaft **47**, to the top of the opposite piston **49**. This passage provides for the flow of working fluid from one cylinder **25** to the opposite cylinder **17**.

In the operation of the device, when power is applied to shaft **13** so as to cause it to rotate in either direction, the piston couple, at the bottom of FIGURE 1, is rotated to a position shown in the top of FIGURE 1 during the first 180° of revolution. In doing so, the piston heads **49** move away from the tops of cylinders **17** and **25**. Any fluid that is present at the ports **39** of valve plate **35**, then tends to move in and fill the cylinders. Fluid enters cylinder **17** by means of fluid passage **53** in piston shaft **47**. During the second 180° of revolution, that is, from top to bottom as shown in FIGURE 1, the pistons move into the cavities or approach the top of cylinders **17** and **25**, thereby forcing the fluid out so that it can be directed to the place where it is ultimately used by means of passage through the lower port **39** in valve plate **35**. As shaft **13** continues to rotate, the working fluid is continuously drawn into the cylinders and then removed therefrom in the above described manner. The shaft **43** keeps the two cylinder blocks in synchronization.

It will thus be noted that the applicant has herein provided a new and novel hydraulic motor or pump,

wherein the pistons are ground with a spherical configuration so that there will be no binding in the cylinder bores. The disk **41** is used to keep the pistons in a centered position. The same could be accomplished of course by designing, into each piston area, centering springs, snap rings, etc.

This invention has therefore shown a means to replace the common ball and socket, slippers, or wristpin type of connection between the piston and the piston rod and the rod and the swashplate with a ball piston Because of the flow of working fluid through the piston and rod assembly and in and around the piston itself on either end, cooling is enhanced and friction is reduced.

Wherein I claim:

**1.** A hydraulic positive displacement apparatus of the axial piston type comprising opposed first and second cylinder blocks positioned on an offset axis, a universal timing shaft connected between said cylinder blocks by means of a universal joint at each end of said shaft, each said universal joint disposed respectively at the center of each said first and second block to ensure said blocks rotate in unison, a plurality of cylinders in each said first and second block, each said cylinder having a substantially dome-shaped bottom wall, disk means mounted on said shaft and positioned normal thereto fixedly carrying a plurality of longitudinal unitary piston rods thereon, each of said piston rods retained by said disk means in substantially parallel relationship with said shaft whereby each said rod extends into one cylinder in each of said first and second blocks, a spherical piston integral with and positioned on each end of each of said piston rods for cooperation with said cylinders, each said spherical piston conforming to the dome-shaped bottom wall of its associated cylinder, port means in said first block communicating with each of the cylinders therein, valve plate means having slots therein mounted on said first block for movement relative thereto whereby the valve slots cooperate with the cylinder ports to allow hydraulic working fluid to be continuously drawn into and out of said first block cylinder port means, shaft means fixedly mounted on said second block to allow a turning force to be transmitted thereby, a passage extending axially through each of said piston rods and its associated spherical pistons such that each of said passages allows flow of the hydraulic working fluid to transfer to and from the cylinders in said second block to the cylinders in said first block in response to the revolving movement of said blocks.




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