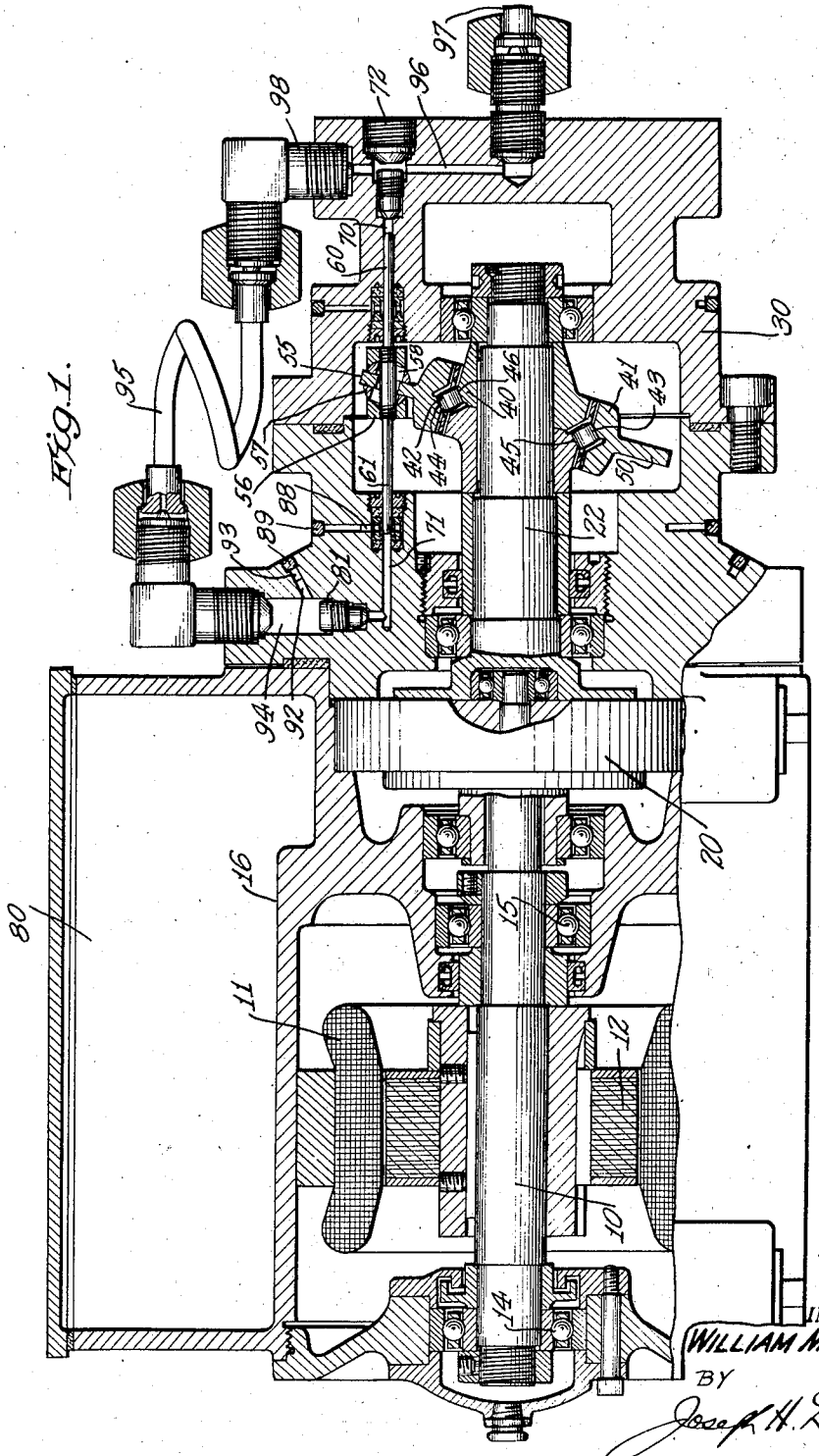
July 2, 1946. W. MESSINGER 2,403,292

HYDRAULIC PUMP

Filed May 9, 1945 2 Sheets-Sheet 1

Fig. 1.



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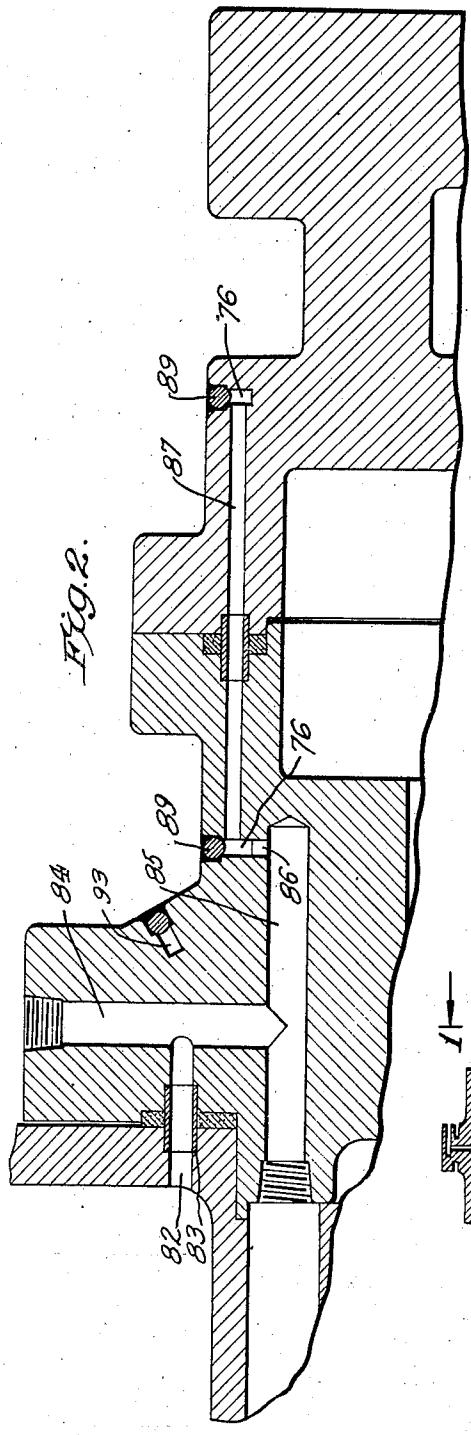


Fig. 2.

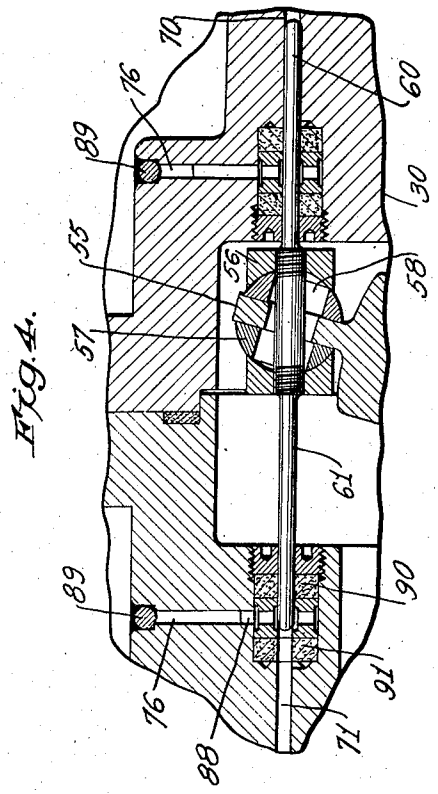


Fig. 4.

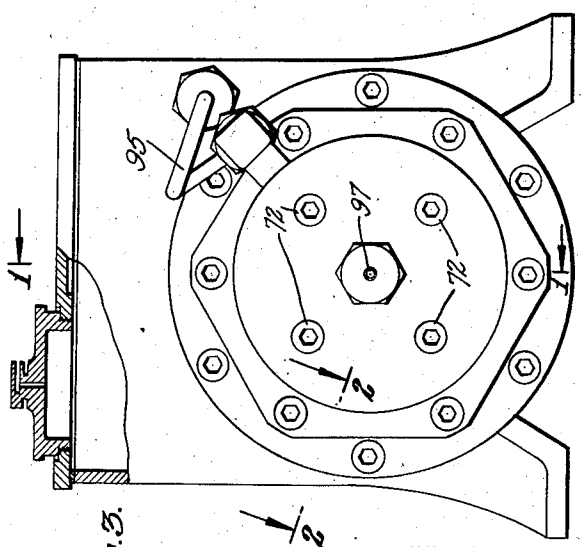


Fig. 3.

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UNITED STATES PATENT OFFICE

2,403,292

HYDRAULIC PUMP

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4 Claims. (Cl. 103—173)

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This invention relates to a power operated hydraulic pressure pump, and has for one of its principal objects the provision of a relatively small, light-weight structure capable of delivering a fluid stream at exceptionally high pressures on the order of 30,000 lbs./sq. in. and more. Such pumps may be utilized for the operation of a great variety of hydraulic devices such as lifting jacks, punches, presses and forcing implements.

More particularly, this invention relates to pumps wherein a swashplate is employed for the purpose of transforming circular motion into reciprocating motion for operating pump plungers. It is a further object of this invention to transmit the power to the plungers and to effect the conversion of circular motion into reciprocating motion by means of a 3-way bearing capable of taking up forces radially, as well as in opposite axial directions. By reason of this construction, a simplification has been achieved over other pumps of this type, resulting in greatly condensed structure and reduced weight so that the unit is readily portable while capable of delivering exceedingly high pressures.

It is a further object of this invention to provide a swashplate type pump which is double-acting, that is, plungers are disposed on both sides of the swashplate and certain of the plungers are operated on their power strokes while certain other plungers on the other side of the swashplate are operated on their suction strokes. This feature is made possible by the fact that power is transmitted to the swashplate through the bearing, whereas heretofore such power has been transmitted through a connection to one face of the swashplate.

It is a further object of this invention to provide a bearing as described above which takes the form of an X-bearing. More specifically, the X-bearing has its inner race fixed to the rotating drive shaft, its outer race fixed to or formed integral with the swashplate and held against rotation, and its raceway inclined with respect to the axis of rotation of the drive shaft. In this way gyration is imparted to the swashplate, such gyration having two-way axial components which are utilized to effect the power and suction strokes of double-acting plungers on opposite sides of the plate.

It is another object of this invention to provide a plurality of plungers operating within cylinders and adapted to be actuated in succession, the plungers and cylinders being so positioned as to provide overlapping and, hence, smooth discharge from the pump.

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In the pump described, circumferential passages are provided in the cylinder block, each such passage being adapted to communicate with a plurality of other passages. It is another object of this invention to provide a novel method and means for forming such passages.

Further objects and advantages of this invention will become apparent in the following detailed description thereof.

In the accompanying drawings,

Fig. 1 is a vertical section through the pump assembly taken substantially on the line 1—1 of Fig. 3.

Fig. 2 is a partial section taken substantially on the line 2—2 of Fig. 3 showing the arrangement of fluid supply and discharge passages.

Fig. 3 is an end view of the Fig. 1 assembly.

Fig. 4 is an enlargement of a portion of Fig. 1.

Referring to Fig. 1 of the drawings, there is shown the power driven hydraulic pump embodying this invention, and comprising three main parts as follows:

A. A power element for delivering rotary motion to a power shaft.

B. A transmitter and converter element for transmitting power from the power shaft to the driven members and for converting circular motion into reciprocating motion.

C. A pump element driven by the power element through the transmitter and converter element.

A. *The power element*

The power element for driving the power shaft 10 may be an electric motor comprising a stator 11 and a rotor 12 fixed to shaft 10 and supported on bearings 14 and 15. The motor is enclosed in a housing 16 through which shaft 10 extends, the shaft driving a reducing gear 20 for revolving a pump shaft 22 at relatively slow speed but with correspondingly high torque. The pump shaft 22 extends into the casing 30 of the pump element.

B. *The transmitter and converter element*

The power from the power element is delivered by way of power shaft 10, reduction gear 20 and pump shaft 22 to the pump element by way of the transmitter and converter element. This element in my invention takes the form of an X-bearing consisting of an inner race 40, an outer race 41 and rollers 42. The inner and outer races have cooperating race-ways in the form of circumferential grooves formed by walls at an angle of 90° with respect to each other. Certain rollers roll upon one wall 43 of one groove and upon the cooperating concentric wall 45 of the other groove,

while other rollers roll upon wall 44 of the first groove and upon the cooperating concentric wall 46 of the second groove. By this arrangement, the rollers will withstand loads radially as well as in both directions axially.

In order to utilize the X-bearing for the purposes specified, i. e., transmitting the drive from the power element to the pump element and converting circular motion into reciprocating motion, my construction provides the following: First, instead of mounting the X-bearing on the shaft 22 so that the plane of rotation of the races is normal to the shaft axis, I mount the X-bearing so that the plane of rotation thereof is inclined to the axis. Second, by holding the outer race against rotation, it will be given a gyrating, oscillating or wabbling swashplate motion as the inner race rotates. By providing an extension 50 on the outer race, either by fixing a flange thereto or forming the flange integral therewith, there is obtained a swashplate every point of which is reciprocated axially during each revolution of the inner race. The X-bearing thus not only transmits the power from power element A to the swashplate, but also converts the circular motion of shafts 10 and 22 into the reciprocating motion of any point on the swashplate. This reciprocating movement is utilized for actuating the pumping members of the pump element C.

C. *The pump element*

The swashplate 50 is connected through universal joints 55 with a plurality of plungers 60, 61 operating in cylinders 70, 71 bored within the casing 30. Sets of cylinders 70, 71 are symmetrically disposed around the axis of shaft 22. Each cylinder 70 is closed at its outer end by a screw plug 72. Any desired number of cylinders may be employed on each side of the swashplate, Fig. 3 illustrating one form in which four are employed. The plungers are thus constrained to axial movement and are held against rotation around the axis of shaft 22. In so doing, by reason of their connections 55 to the swashplate, they hold the swashplate and, hence, the outer race of the X-bearing, against rotation and make possible the gyrating, reciprocating movement of the swashplate. Such movement develops a radial component of motion with respect to the pump plungers. This radial movement is permitted by the ball and socket tappet arrangement fastened to the dual pump plungers and comprising screwed-on, concave socket members 56 and oscillating, ball-shaped levelling washers 57 providing a central aperture 58.

The axial components of the gyrating movement are caused to operate the plungers axially. A pair of plungers is connected to the same universal joint on opposite sides of the plate 50 so that the plate is double-acting in that it operates one plunger on a power stroke while operating the other plunger on a suction stroke. Two sets of plungers are arranged concentric with shaft 22 in opposed relation on opposite sides of the swashplate, and the number of plungers and cylinders is so chosen that the discharges overlap to even out the discharge pulses and yield substantially smooth flow.

Fig. 1 shows two opposed plungers 60, 61 connected to swashplate 50 by a universal connection 55. Plunger 60 has just completed its power stroke in cylinder 70, and plunger 61 has just completed its suction stroke in cylinder 71. The latter stroke has sucked fluid from reservoir 80 by creating a vacuum between a pressure check valve 81 at the inner end of the cylinder, through the cylinder to the inner end of plunger 61. This vacuum draws fluid from the reservoir, assisted by gravity, through reservoir duct 82 (see Fig. 2) which is protected by washer and tubular packings 83, through passages 84, 85 and 86, to a circumferential inlet slot 76. Two such inlet slots are provided, one on each side of the swashplate, to cooperate with the set of cylinders on the respective side, the two inlet slots being connected by a passage 87. Each slot 76 communicates with its respective cylinders by means of drilled holes 88.

These slots or gashes 76, after being machined into the pump block or casing 30, are sealed peripherally by a wire inlay 89 which is welded into position to prevent leakage.

As each plunger is drawn out of its cylinder, it draws fluid from the reservoir through the system of passages described, to fill the cylinder with fluid from the inner end of the piston up to the check valve 81 which closes the inner end of the cylinder. A suction packing 90 (see Fig. 4) is provided to maintain the seal surrounding the pump plunger, preserving the vacuum, and insuring complete filling of the cylinder and the intervening spaces ahead of the plunger.

On the power stroke of each plunger, it enters a pressure packing 91, compressing the fluid ahead of it and expelling the fluid under pressure through the respective check valve 81. The check valves at the left are connected by drill holes 92 to a circumferential delivery slot 93, constructed in the same manner as inlet slots 76. The collected discharge fluid is delivered to a chamber 94, and thence by a connection 95 is delivered to a fitting 98 where it joins the discharge from the cylinders on the right-hand side. The discharge from the latter cylinders passes by radial passageways 96 to the delivery pipe 97.

In accordance with the provisions of the patent statutes, I have herein described the principle and operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof, but I desire to have it understood that the apparatus shown is only illustrative and that the invention can be carried out by other equivalent means. Also, while it is designed to use the various features and elements in the combination and relations described, some of these may be altered and others omitted without interfering with the more general results outlined, and the invention extends to such use.

Having described my invention, what I claim and desire to secure by Letters Patent is:

1. A power driven hydraulic pump comprising a power element, a shaft rotated thereby, a pump element, means whereby the shaft operates the pump element, a source of fluid supply, the pump element comprising a pump body having a plurality of cylinders therein arranged symmetrically around the axis of the shaft, the body having a peripheral cut forming a circumferential passage, the body having an inlet passage for leading fluid from the source to the circumferential passage, the body having drill holes leading from the cut to the individual cylinders, the cut being sealed by a peripheral insert.

2. A power driven hydraulic pump as specified in claim 1, in which the cut is sealed by a strip of material welded therein.

3. A power driven hydraulic pump as specified in claim 1, in which the body has a plurality of discharge passages, a second circumferential cut

and drill holes connecting the discharge passages to the second circumferential cut, the second circumferential cut being sealed by a peripheral insert.

4. A power driven hydraulic pump comprising a power element, a shaft rotated thereby, a pump element, means whereby the shaft operates the pump element, a source of fluid supply, the pump element comprising a pump body having a plurality of cylinders therein arranged symmetrically around the axis of the shaft, the body having a peripheral cut forming a circumferential passage, the body having an inlet passage from the fluid supply to the circumferential passage and drill holes leading from the cut to the individual cylinders, the body having a plurality of discharge passages leading from the individual cylinders, the body having a second circumferential cut and drill holes connecting the discharge passages to the second circumferential cut, and a single high pressure outlet connected to the discharge passages.

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