Nov. 24, 1942. M. W. HUBER 2,302,864

PUMP

Filed Jan. 16, 1942

Fig. 1

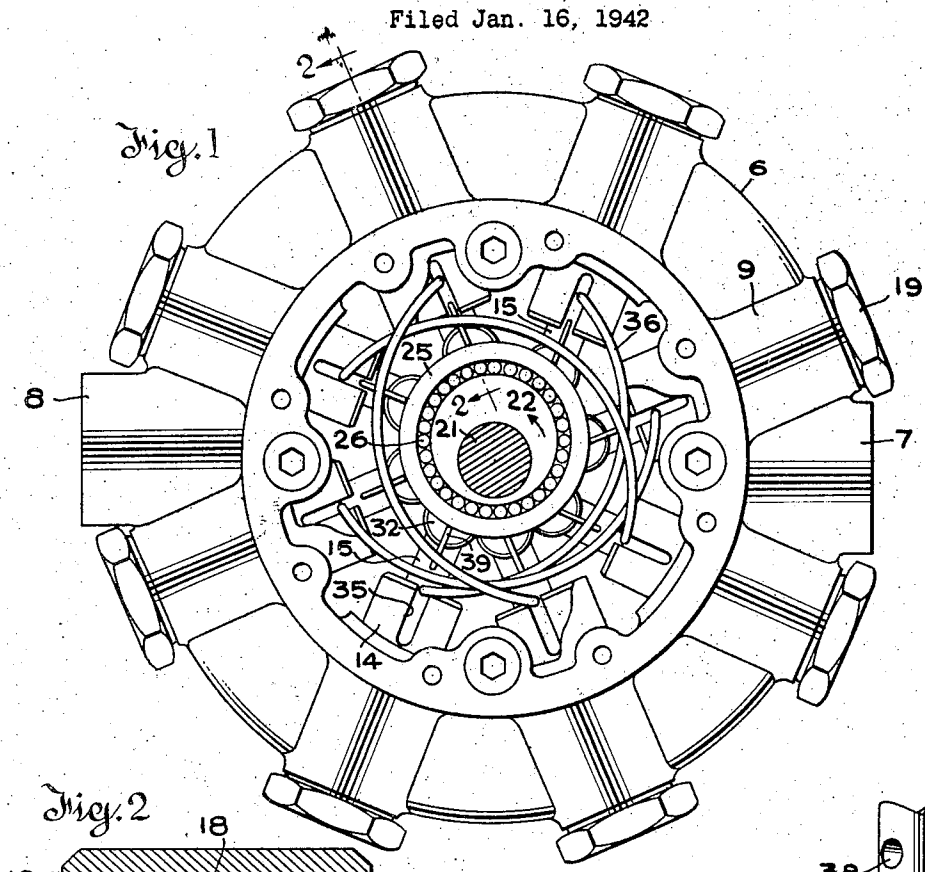


Fig. 2

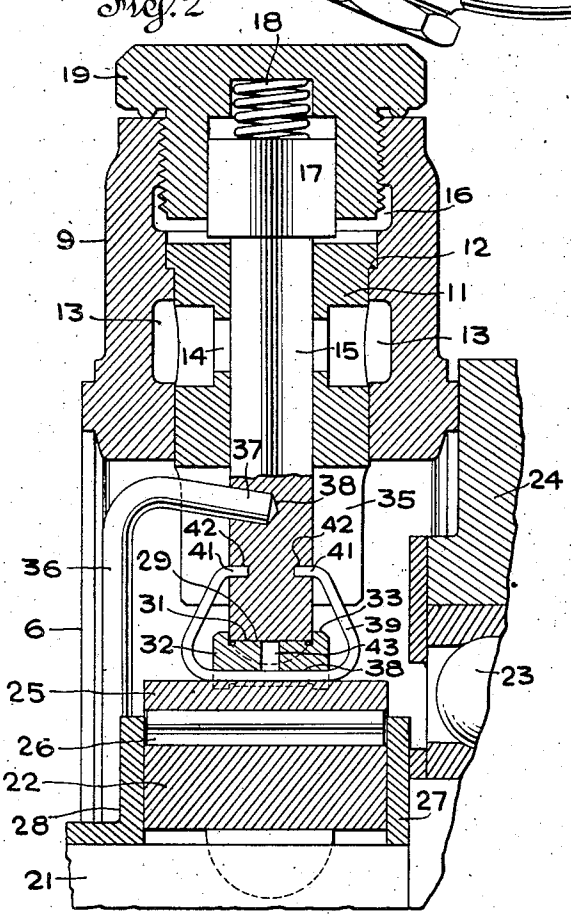
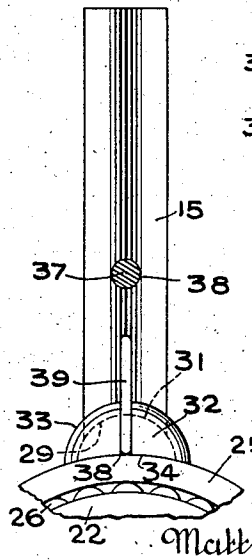


Fig. 3



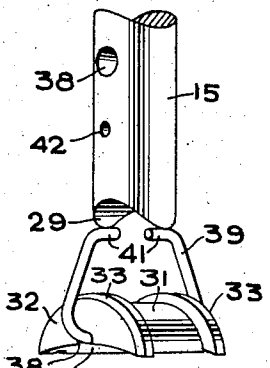


Fig. 4

Inventor

Matthew W. Huber

By

Dodge and Sons

Attorneys

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PUMP

Matthew W. Huber, Chicago, Ill., assignor to Hydraulic Controls, Inc., a corporation of Illinois

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4 Claims. (Cl. 103—174)

This invention relates to high pressure displacement pumps and particularly to pumps in which the cylinders are radially arranged.

The invention relates particularly to pumps of the type disclosed in the application of Harvey S. Pardee, which since the filing of the present application has issued as Patent No. 2,271,570, February 3, 1942, under which applicant's assignee is operating. In the Pardee pump, an even number of single acting cylinders (usually four or eight) are used, and these cylinders are offset from true radial lines in a direction opposite to the direction of rotation of the drive shaft. The drive shaft carries an eccentric on which a sleeve is rotatably mounted by means of a needle bearing. Between the sleeve and each pump plunger is a crescent shaped slipper which offers a concave cylindrical bearing contacting the sleeve and a convex cylindrical journal which is received in a concave cylindrical bearing machined across the inner end of the plunger. Flanges at the ends of the journal on the slipper limit motion of the slippers in the direction of the axis of the sleeve.

A plurality of bow or arcuate wire springs connect opposed plungers in pairs, and flex slightly as the pumps run, to accommodate slight differences in the instantaneous velocities of the two opposed plungers, such differences being entailed by the geometry of the crank and connecting rod couples comprising the eccentric and each slipper.

In the Pardee pump the slipper is not positively connected either to the sleeve or to the plunger. On the contrary, the assembled relation is maintained by the springs which are mounted under sufficient initial tension to ensure that the parts will be held in close engagement at all times. This implies sufficient tension to pull the plunger through its suction stroke and maintain under all conditions a thrust engagement with the slipper.

In commercial pumps having plunger strokes and cylinder cores each of the order of $\frac{5}{16}$ inch, this action is consistently secured, as evidenced by oscillograph studies, at speeds up to at least 3500 R. P. M. though the usual operating speed is 1750 R. P. M. At such speeds the pump has good operating characteristics delivering against discharge pressures from 2500 to 3000 pounds per square inch.

Obviously precise manufacture, the elimination of excess weight in the plungers, and the use of excellent heat treated material are essential to sustained performance because inertia effects are substantial and unit pressures are high. The bearing area between slipper and plunger cannot be increased, being coextensive with the end of the plunger. Use of a simple cylindrical plunger is dictated by the requirements of precise manufacture at reasonable cost. Indeed, many features of the design are critical to an extent not obvious at first glance.

Failure of a spring, which has proved to be a rare occurrence, releases two slippers. Contrary to what might be expected, this does not necessarily wreck the pump, but it does involve serious risk.

The purpose of the present invention is to attach the slippers to their plungers, without increasing the unit pressure between the slipper and plunger, and without weakening the plunger, and to do so within the very limited clearances imposed by controlling design factors. The attaching element carries no operating load under normal conditions, but serves to prevent the escape of a slipper in the event that a plunger should stick slightly on the suction stroke. It also prevents the escape of the slipper upon spring failure.

The construction here disclosed involves the use of a stirrup which is formed of wire, is seated in a groove in the concave bearing of the slipper and enters into hooked engagement in diametrically opposite sockets drilled in the plunger. This slightly reduces the bearing area between the slipper and sleeve, but the effect is not objectionable, as demonstrated by test runs of sufficient duration to disclose inherent weaknesses had they been present. Retention of the slipper on the plunger reduces the element of risk above set forth, and can be ensured by the use of a wire clip of remarkably small dimensions.

A preferred embodiment of the invention will now be described by reference to the accompanying drawing, in which:

Fig. 1 shows a commercial eight cylinder pump with the front cover plate removed to show the invention applied. In the Patent Office drawing, Figure 1 is approximately full size.

Fig. 2 is a fragmentary section on the line 2—2 of Fig. 1, drawn at twice the scale of Fig. 1.

Fig. 3 is a detail view of one plunger and slipper with the slipper engaging a portion of the eccentric sleeve, and the retainer stirrup in place.

Fig. 4 is a perspective view showing the stirrup engaged with the slipper, and the two about to be assembled with a plunger.

Referring first to Fig. 1, 6 represents the body

of the pump which is provided with an inlet connection 7 and a discharge connection 8 and a plurality of radial bosses 9 which house the cylinder bushings 11. Eight such bosses are shown in Fig. 1, the pump being of the eight cylinder type. The bosses 9 are bored to receive cylinder bushings 11 which are pressed to place and seat against shoulders 12. The housing 6 is provided with passages 13 which communicate with the inlet passage 7 and with inlet ports 14 which are drilled in the bushings 11 and which are exposed by the plunger 15 when the plunger 15 moves radially inward to its limit of motion.

The discharge chambers 16 all communicate with the discharge connection 8. Cup-shaped discharge valves 17 of generally cylindrical contour are urged inward, that is, in a closing direction by coil compression springs 18, whose inner ends are housed within the cup-shaped valves 17 and whose outer ends are received in sockets in the screw plugs 19, one of which is screwed into each of the bosses 9. Each valve 17 seats against the outer end of the corresponding bushing 11 and the parts are so dimensioned that at the extreme outer limit of motion of each plunger 15, the plunger engages the valve 17 and holds it off its seat. This position is shown in Fig. 2.

The pump shaft appears at 21 and carries keyed to it an eccentric 22. In the example illustrated, it is understood that the shaft 21 turns counterclockwise, and it will be observed that the axis of each of the cylinder bushings 11 is offset clockwise slightly from a line radial to the center of shaft 21.

The shaft 21 is mounted in bearings of the ball type, one of which appears at 23. These bearings are mounted in the main housing 24 of the pump, only a fragment of which appears in Fig. 2. Mounted on the eccentric 22 is the sleeve 25 and interposed between the sleeve and the eccentric are a series of bearing rollers 26 which because of their small diameter relatively to their length, form what is commonly known as a needle bearing. The needles are confined by the discs 27 and 28. Each of the plungers 15 is formed at its inner end with an arcuate seat 29 which is machined across the entire inner end of the plunger and seats on a convex cylindrical journal 31 which is formed on the slipper, generally indicated by the reference numeral 32.

As a convenient means for limiting the motion of the slipper in a direction transverse to the plunger 15, flanges 33 are provided at the two ends of the slipper. The lower face of the slipper is formed with a concave cylindrical bearing 34 which fits the cylindrical sleeve 25 already mentioned. The inner ends of the bushings 11 are slotted as indicated at 35 and opposed plungers 15 are connected together by cross connecting springs 36. These have hooked ends 37 which enter sockets 38 bored in the plungers 15 and work in the slots 35. These sockets are drilled at a slight angle, as best indicated in Fig. 2, so that the springs retain themselves. The construction causes the bushing to guide the plungers close to the eccentric and slippers and the slots guide the springs 36.

In an eight cylinder pump there are four such springs and the lengths of the hooked ends 37 are differentiated so that the springs may overlap without interference, as clearly indicated in Fig. 1. Because of the bowed configuration of the springs they are out of the orbit of the sleeve 25.

So far, the pump conforms to the Pardee design and no novelty for the pump is here claimed. To establish a retaining connection between each plunger 15 and its slipper 32 there is provided, according to the present invention, a transverse groove or slot 38 which is cut across the face of the bearing 34 on slipper 32. The depth of this slot slightly exceeds the diameter of the wire used for the stirrup about to be described.

Seated in this groove is a stirrup 39 which is of generally U-shaped configuration with its ends inturned as indicated at 41 so as to enter sockets 42 drilled in opposite sides of the plunger 15. Stirrup 39 is slightly resilient and is so adjusted as to hold the slipper snugly against the end of the bearing 29 in the plunger 15. The passage 43 indicated in Fig. 2 is for oil distribution purposes.

A characteristic of the stirrup construction is its resilience and the form of the slipper 32 is such that the groove 38 in the slipper is not strictly concentric with the journal 31 and cannot be made so. From this it follows that as the slipper turns in the bearing 29, the distance between the groove 38 and the sockets 42 changes slightly.

In describing the invention, an embodiment particularly adapted to a commercial pump of the Pardee design is described. To some extent, details are dependent on the exact design of the pump and modifications within the general scope of the invention are possible and are contemplated. Consequently, the embodiment described in considerable detail is intended to be illustrative and not limiting.

I claim:

1. The combination of a pump, comprising at least one pair of substantially opposed single acting pistons, an eccentric sleeve interposed between said pistons, slippers, one slipper interposed between each piston and the eccentric sleeve and having cylindrical bearing engagement with the end of such piston and with said sleeve, and means serving to cross-connect said pistons comprising a tension spring mounted under sufficient stress to hold the enumerated parts in thrust reaction throughout the cycle of the pump; and connecting means, one engaging each piston and its slipper on areas on opposite sides of the bearing engagement between the piston and the slipper whereby said bearing area is maintained undiminished.

2. The combination of a pump, comprising at least one pair of substantially opposed single acting pistons, an eccentric sleeve interposed between said pistons, slippers, one slipper interposed between each piston and the eccentric sleeve and having cylindrical bearing engagement with the end of such piston and with said sleeve, and means serving to cross-connect said pistons comprising a tension spring mounted under sufficient stress to hold the enumerated parts in thrust reaction throughout the cycle of the pump; and stirrups, one stirrup, embracing each slipper, housed in a groove formed in the sleeve-engaging face thereof and hingedly connected with the corresponding piston.

3. The combination of a pump, comprising at least one pair of substantially opposed single acting pistons, an eccentric sleeve interposed between said pistons, slippers, one slipper interposed between each piston and the eccentric sleeve and having cylindrical bearing engagement with the end of such piston and with said sleeve, and means serving to cross-connect said

pistons comprising a tension spring mounted under sufficient stress to hold the enumerated parts in thrust reaction throughout the cycle of the pump; and elastic stirrups, one engaging each slipper, each stirrup having opposed inturned ends in hook engagement with the corresponding piston at opposite sides thereof.

4. The combination of a pump, comprising at least one pair of substantially opposed single acting pistons, an eccentric sleeve interposed between said pistons, slippers, one slipper interposed between each piston and the eccentric sleeve and having cylindrical bearing engagement with the end of such piston and with said sleeve, and means serving to cross-connect said pistons comprising a tension spring mounted under sufficient stress to hold the enumerated parts in thrust reaction throughout the cycle of the pump; and elastic stirrups one embracing each slipper and confined in a groove therein, and having hooked ends engaging the corresponding piston, said stirrups being mounted under initial stress.

MATTHEW W. HUBER.