Nov. 24, 1942. H. S. WILCOX 2,302,865

PUMP

Filed Jan. 16, 1942

Fig. 1

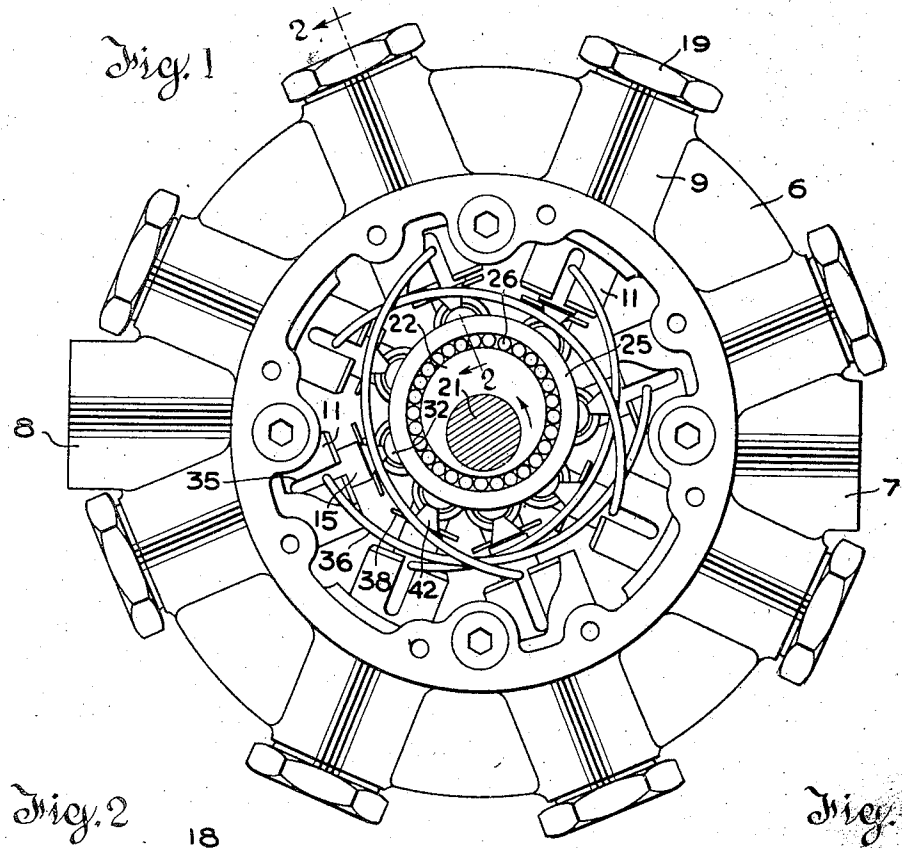


Fig. 2

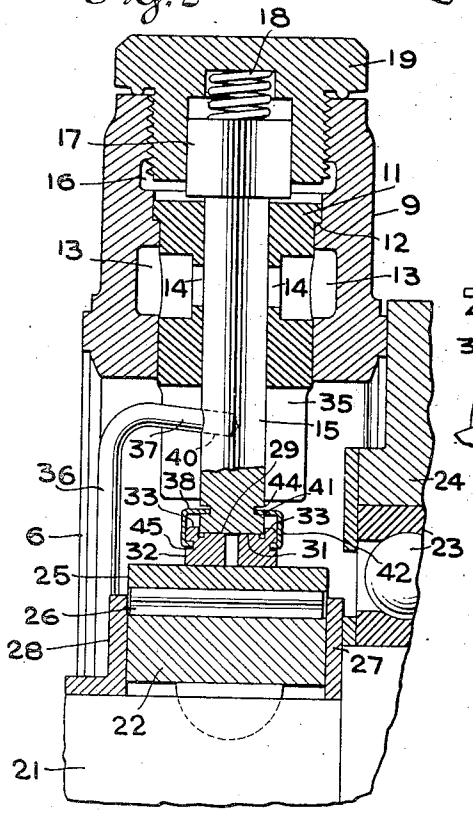


Fig. 3

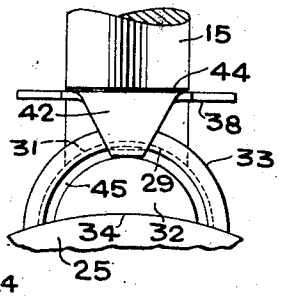


Fig. 4

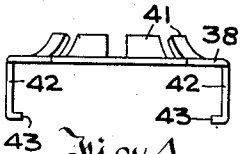


Fig. 6

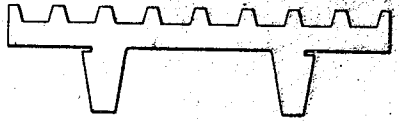


Fig. 7

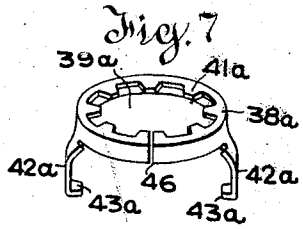
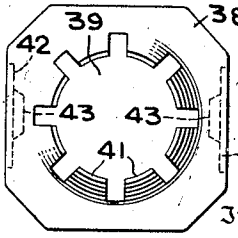


Fig. 5



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UNITED STATES PATENT OFFICE

2,302,865

PUMP

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Application January 16, 1942, Serial No. 427,053

5 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 issued as Patent No. 2,271,570 on 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 pump runs, 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 bores 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.

Connection of the slipper with the pump plunger has heretofore been proposed, and one workable scheme disclosed in the application of Matthew W. Huber, Serial No. 427,065, filed January 16, 1942, and assigned to applicant's assignee, involves the use of a slender wire stirrup which embraces the slipper and engages the plunger. Because such a stirrup cannot be located so as to operate accurately as a swinging link, it is made resilient and is mounted under stress so that it urges the slipper toward the plunger.

The object of the present invention which was conceived as an improvement on the Huber invention is to provide a more rugged sheet metal clip which engages an arcuate groove in the slipper, the arc being concentric with the plunger engaging journal in the slipper. Thus, the clip is simply a retainer and has no spring action. It has no active function in the normal operation of the pump, but prevents the escape of a slipper if its plunger tends to stick slightly during the suction stroke. Also it retains the slipper in the event of breakage of a cross-connecting spring and thus minimizes the danger of wrecking the pump.

Critical factors in the design of pumps of this type impose the use of very small clearances, a fact which greatly complicates the problem of developing a small and rugged attachment. Two somewhat similar embodiments which meet practical requirements 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. The pump is shown approximately full size in the Patent Office drawing as filed.

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

Fig. 3 is a further enlarged view of a part of the plunger and slipper as viewed in Fig. 1.

Figs. 4 and 5 are an elevation and plan of the clip before application to the plunger.

Fig. 6 shows a blank for forming a modified type of clip.

Fig. 7 is a perspective view of the clip formed from the blank shown in Fig. 6.

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 40 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.

The present invention provides means for retaining each slipper in operative relation with its plunger. The length of the bushings 11, necessary to ensure adequate guiding of its plunger 15, is such that the minimum clearance between the end of the bushing and the slipper is small. Furthermore, since these pumps operate at high speeds and against high discharge pressures, the unit pressure between the plunger 15 and the slipper 32 is high and it is desirable to maintain a thrust engagement between these two parts across the entire transverse area of the plunger.

According to the preferred form of the invention which is illustrated in Figs. 1 to 5 inclusive, use is made of a clip whose form is best shown in Figs. 2 to 5. The clip takes the form of an octagonal disc or plate 38, and this disc as initially formed, has a central aperture 39 having a serrated margin producing a series of inwardly extending fingers 41. Before the application of the disc to the plunger, these fingers 41 are curled upward, as best shown in Figs. 4 and 5. The disc carries two opposed pendant arms 42 with inturned lugs 43 (see Fig. 4). A short distance above the bearing 29 the plunger 15 is provided with a circumferential groove 44 of moderate depth and the clip is applied to the plunger by slipping it over the plunger until the fingers 41 can enter the groove 44 after which the fingers are bent back into the plane of the disc 38, as shown, for example, in Figs. 2 and 3. This fixes the disc on the plunger so that the two move as a unit in the direction of the axis of the plunger.

Slipper 32 is provided on its two end or plane faces with arcuate grooves 45 which receive the inturned lugs 43, already described. Obviously the slipper may be brought into engagement with the lugs 43 by a rotary motion after which the clip serves to retain the slipper in position against the bearing 29. The clip is not loaded during the normal operation of the device, but under the conditions above stated, the clip retains the slipper in engagement with the end of the plunger so that it will not drop away and become jammed in other moving parts of the pump.

The modification shown in Figs. 6 and 7 is believed to be inferior, but reasonably satisfactory.

The finished clip takes the form of a stamping having an annular section 38*a* with inwardly projecting fingers 41*a* surrounding the central aperture 39*a*. The blank from which the clip is formed is illustrated in Fig. 6. The clip carries pendant arms 42*a* with inturned fingers 43*a*. Being formed from a flat strip, as indicated, the clip is not a complete annulus but is separated at 46 so that it may be opened slightly and sprung over the end of the plunger 15 until the fingers 41*a* can enter the groove 44. While the type of clip shown in detail in Figs. 4 and 5 is preferred, the clip shown in Figs. 6 and 7 has sufficient strength for most purposes and when used performs the same function as the preferred form of clip.

The invention has the advantage that the clip is comparatively rugged; it can be used with clearances now standard in commercial pumps and does not reduce the bearing area between the slipper and the plunger or the bearing area between the slipper and the sleeve. Furthermore, because the clip is free to rotate on the plunger and because the arc of its engagement with the slipper groove is small, the clip leaves the slipper sufficiently free to assume proper alinement. The slipper is not subject to load in the normal operation of the pump and it is ample to retain the slippers in engagement with the pump plunger upon failure of a cross connecting spring, or in the event that a piston sticks slightly during the suction stroke.

While two embodiments of the invention have been described in considerable detail, their specific forms are prescribed by critical design factors in the particular pump chosen for illustration.

Modifications within the general scope of the invention are possible and are contemplated and may be dictated in the case of pumps of somewhat different design. Consequently the description above given is intended to be exemplary and not limiting.

What is claimed is:

1. In an eccentric-driven radial pump, the combination of a rotary eccentric, a substantially radial plunger having a cylindrical bearing formed across its inner end, and a slipper having a bearing engaging the eccentric and an opposed journal engaging the bearing on the plunger; connecting means for said slipper and plunger comprising a retainer swiveled on the plunger adjacent said bearing and having extensions engaging arcuate guiding means formed in the ends of the slipper concentrically with the axis of the journal on the slipper; and yielding means urging said plunger radially inward and serving to maintain thrust engagement between eccentric, slipper and plunger.

2. The combination defined in claim 1 in which the plunger is of simple cylindrical configuration and the swivel connection between plunger and retainer comprises a circumferential groove on the plunger which secures and confines portions of the retainer.

3. The combination defined in claim 1, in which the plunger is formed with a circumferential groove and the retainer comprises a continuous encircling annulus formed with lugs confined in said groove.

4. The combination defined in claim 1 in which the guiding means on the ends of the slipper are arcuate grooves, which are engaged by inturned portions of arms, formed on the retainer and straddling the slipper.

5. In an eccentric-driven radial pump, the combination of a rotary eccentric; at least two substantially radial plungers mounted in opposed relation and each having a cylindrical bearing formed across its inner end; slippers, one for each plunger, each slipper having a bearing engaging the eccentric and an opposed journal engaging the bearing on a corresponding plunger; means for connecting each slipper with its plunger, said means comprising a retainer swiveled on the plunger adjacent the inner end thereof and having extensions engaging arcuate guiding means formed on the ends of the slipper concentrically with the axis of the journal on the slipper; and yielding means mounted under stress and serving to connect said opposed plungers in pairs.

HARRY S. WILCOX.