April 24, 1951 J. D. E. VENNING 2,550,392

HYDRAULIC RECIPROCATING PUMP

Filed May 6, 1947

Fig. 1.

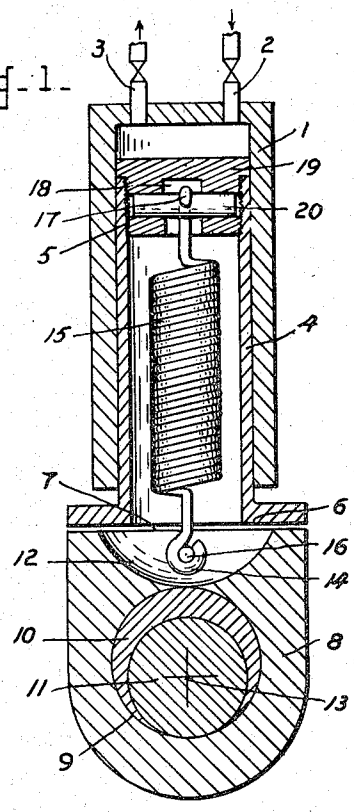


Fig. 6.

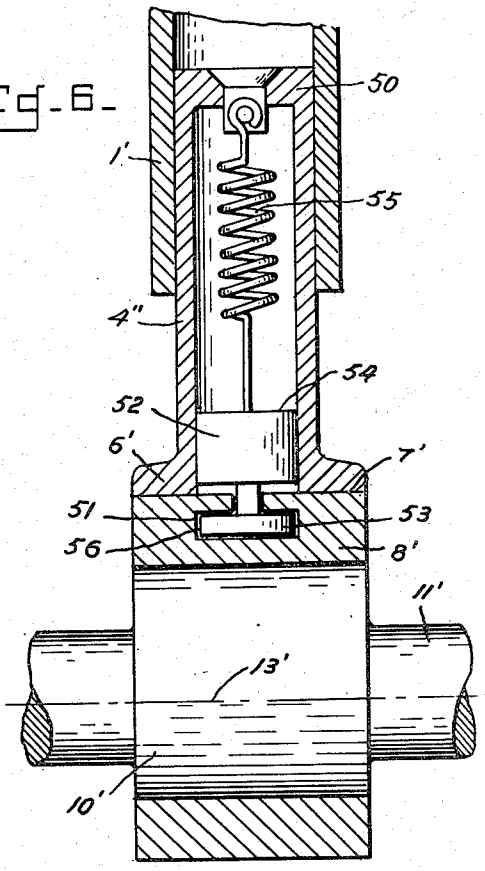
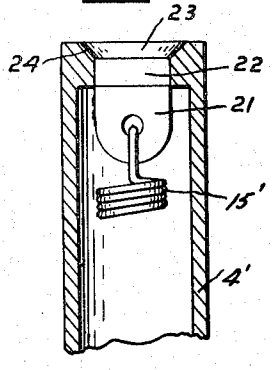


Fig. 2.



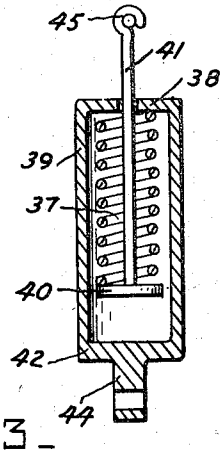


Fig. 3.

Fig. 4.

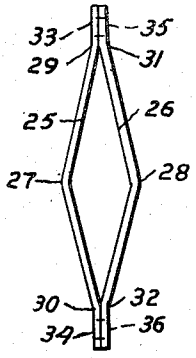
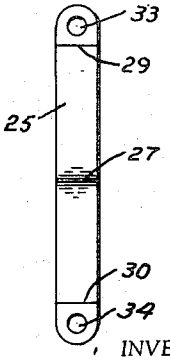


Fig. 5.



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HYDRAULIC RECIPROCATING PUMP

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8 Claims. (Cl. 103—211)

1

This invention relates to hydraulic liquid pumps of the type in which a crankshaft or a similar member drives a piston or ram, moving in a cylinder, through the medium of a bottom end or big end bearing which is in sliding engagement with the piston or ram.

In known pumps of this character the return stroke of the piston or ram is produced by a compression spring, which is located inside or outside the pump chamber.

It is the object of the present invention to provide a reciprocating pump of the type described wherein the piston or ram is connected resiliently to the bottom end or big end bearing so as to remain substantially in contact with the latter during the return stroke of the piston or ram.

The resilient connection is preferably formed by a spring device located inside the piston, which is made hollow for this purpose, one end of the spring device being anchored to the inside of the piston at the end thereof remote from the bearing, whilst the other end of the spring device is anchored to the bearing.

The invention will now be described by way of example with reference to the accompanying drawings, wherein:

Figure 1 shows a sectional elevation of a pump;

Figure 2 shows a partial sectional elevation of a ram with a modified form of spring anchoring;

Figure 3 shows a sectional view of a modified form of spring system;

Figures 4 and 5 show a front elevation and side view of a further form of spring system; and

Figure 6 shows a sectional elevation of a modified form of a pump ram and its driving shaft and eccentric.

Referring first to Figure 1, a reciprocating pump of the type described is provided with a cylinder 1 provided with a valve controlled inlet 2 and a valve controlled outlet 3. In the cylinder 1 is slidably mounted a piston or ram 4 which is of tubular or hollow construction and at one end is screw-threaded internally, as indicated at 5, or other means of attachment are provided. The other end of the piston 4 is provided with an enlarged flange or face 6 adapted to bear on a bearing face 7 of a bottom end or big end bearing 8. The latter is provided with a circular axial bore 9 for the reception of a disc 10 mounted eccentrically on a driving shaft 11.

In the bearing face 7 is provided a recess 12 which extends at right angles to the axis 13 of the driving shaft 11. The recess 12 is of sufficient depth and width to accommodate an eye 14 or a lug at one end of a stiff tension spring 15.

2

The lug 14 is secured in the recess 12 by a pin 16, which extends transversely across the recess 12 and is secured at its ends in the bearing 8.

The spring 15 extends into the hollow piston 4 and at its other end is provided an eye or lug 17, which is preferably arranged at right angles to the eye or lug 14 engaging with the recess 12.

The second eye or lug 17 engages with a recess 18 in an externally screwed plug 19 which is screwed into the screwed end 5 of the hollow piston or ram 4. Other means of attachment may, however, be provided.

The second eye or lug 17 is secured to the plug 19 by a pin 20 passing therethrough.

The recesses 12, 18 in the bearing face 7 and plug 19 are of such shape and size as to allow of free movement of the spring 15 during relative reciprocating movement between the bearing face 7 and the flanged or enlarged end 6 of the piston 4.

The operation of the arrangement above described, assuming the cycle is to commence at the bottom dead centre position, is as follows:

As the driving shaft 11 is rotated, the piston is forced away from the driving shaft 11 by the eccentric disc 10 through the medium of the bearing 8 of which the bearing face 7 engages with the flanged end 6 of the piston 4. During this movement relative sliding movement takes place between the bearing face 7 and the flanged end 6 of the piston 4, first in one direction and then in the opposite direction, until the upper dead centre position is reached. The return stroke then commences and during this stroke the spring 15 holds the flanged end 6 of the piston 4 in contact with the bearing face 7 and causes the piston 4 to follow the bearing 8 during the return stroke.

With an arrangement as above described a more positive crank type reciprocating motion may be obtained than with the usual return spring or springs which are arranged either inside or outside the pump chamber 1.

The spring 15 may be of such rating as to be almost unyielding, whilst its deflection is extremely small as compared with the deflection required of the known return spring, which is equal to the whole stroke of the pump.

When using a spring of high rating in connection with high speed pumps, the "period" is well above any speeds at which the pump is liable to be called upon to operate, which is not the case with pumps having a normal spring return.

Instead of anchoring one end of the spring 15 to a screwed plug 19, as shown in Figure 1, the spring 15' may be anchored to an apertured lug

21 (Figure 2) provided on a plug 22 having at its end a conical flange 23, which engages with a conical seat 24 in the end of the piston 4'. This arrangement enables the spring 15' to take up automatically any position relatively to the other end, thus preventing it from being constrained or deformed by the movement of the piston 4'. Further, the plug 22, by reason of its shape and form, is capable of withstanding considerable pressure in the position which it occupies.

The spring arrangements above described with reference to Figures 1 and 2 may be replaced by two links 25, 26 (Figures 4 and 5), of metal or other suitable material, of which the central portions are bulged outwardly from one another, as indicated at 27, 28, whilst their ends 29, 30, 31, 32 are straight and in contact with one another. In the ends of the links are provided registering holes 33, 34, 35, 36, the pitch or distance between these holes being slightly less than the distance between anchoring means, such as pins, similar to the pins 16, 20 (Figure 1) but arranged parallel to one another.

The links 25, 26 form a tension spring of high rating and may be so designed that only sufficient resilience is provided to accommodate the lateral movements of the bearing 8 (Figure 1).

With the arrangements as above described it will be seen that as the length of the piston or ram 4, 4' is increased, and consequently the longer the tension spring 15, 15' or the links 25, 26, the less deflection or resiliency is required, whereby a positive action is obtained which approaches an orthodox rigid connecting rod.

In an alternative arrangement, as shown in Figure 3, a compression spring 37 is arranged between one end 38 of a casing 39 and a shoulder 40 on a rod 41 passing slidably through the end 38 of the casing 39, the other end 42 of the casing 39 and the free end of the rod 41 being each provided with a lug 44, 45 secured respectively to the outer end of the piston 4 or 4' and to the bearing 8, in the manner above described with reference to Figures 1 and 2. When this arrangement is in use a compression is applied to the compression spring.

As will be appreciated from the foregoing description, the resulting reciprocating movement is more nearly positive at all points of the cycle of operations as compared with pumps of the known type in which a compression spring inside or outside the pump cylinder is employed for returning the piston for the next stroke.

As shown in Figure 6, a driving shaft 11' is provided with an eccentric or equivalent member 10' engaging with a bearing 8'.

The bearing 8' is provided with a flat face 7' which engages with one end of a ram or piston 4'' slidably engaging with a cylinder 1'.

At the end adjacent the bearing 8' the piston 4'' is provided with a flange 6' to give a large bearing surface between the end of the piston 4'' and the flat surface 7' of the bearing 8'. The piston 4'' is hollow and is preferably closed at its end 50 remote from the flange 6'.

In the flat face 7' of the bearing 8' is provided an inverted T-shaped slot 51, which extends the full length of the flat face 7' and which is at right angles to the axis 13' of rotation of the shaft 11'.

In the flanged open end 6' of the piston 4'' is slidably mounted a cylindrical member 52 provided at its outer end with a T-shaped member 53 which engages with the T-shaped slot 51 in the bearing 8'.

Between the inner end 54 of the cylindrical member 52 and the closed end 50 of the piston 4'' is provided a spring device 55, which is normally adapted to draw the cylindrical member 52 into the piston 4'', whereby the flanged end 6' of the latter is held in contact with the flat face 7' of the bearing 8'.

With an arrangement as above described it will be appreciated that when the shaft 11' is rotated, for example from an outer or top dead centre position, the eccentric 10' moves the bearing 8' downwardly and outwardly relatively to the axis of rotation 13' of the shaft 11', the flanged end 6' of the piston 4'' being held in engagement with the flat face 7', under the action of the spring device 55, and sliding thereon, the T-shaped member 53 engaging with the T-shaped slot 51 and sliding along the latter.

The piston 4'' is thus caused to follow the downward movement of the bearing 8' until the inner or lower dead centre position of the bearing 8' is reached.

During the continued movement of the shaft 11', the piston 4'' is moved positively into its cylinder 1'.

Suitable clearance 56 is provided between the T-shaped member 53 and the T-shaped slot 51 so as to ensure effective contact between the flanged end 6' of the piston 4'' and the flat face 7' of the bearing 8' during the outward working or pressure stroke.

With an arrangement as above described the piston 4'' of a reciprocating pump is constrained, by the action of the spring device 55, to follow the resultant movements of the bearing 8' as this is moved by an eccentric or crank journal 10' during the inoperative stroke without any regular or cyclic variation of the initial deflection or loading of the spring device 55.

The piston 4'' may also be operated at wide variations of stroke without varying the loading of the spring device 55.

The spring device 55 may be of such rating as to satisfy the requirements of inertia force, with ample reserve, but without causing additional loads on crank or eccentric journals 10'.

The spring device 55 further provides a means against failure of the piston to carry out its inoperative stroke at high speeds.

The spring device 55 may be in the form of any type of spring system, such as a tension spring or a compression spring as described above with reference to Figures 1 to 5.

What I claim is:

1. In a hydraulic pump, a cylinder, a hollow ram longitudinally movable in said cylinder, one end of the ram being formed with a flat surface transverse to the axis of the ram and cylinder, a driving shaft, an eccentric on said shaft, a big end bearing mounted on and encircling the eccentric and having a flat surface thereon, a resilient connection maintained in tension and completely enclosed within the hollow ram by the big end bearing, means connecting one end of the resilient connection to the interior of the ram at the end of the ram remote from the big end bearing and further means whereby a tensile force is exerted between the other end of the resilient connection and the big end bearing, the flat surface on the end of the ram being thereby held in slidable engagement with the flat surface on the big end bearing.

2. In a hydraulic pump as claimed in claim 1,

the resilient connection comprising a tension spring.

3. In a hydraulic pump as claimed in claim 1, the resilient connection comprising a system of bent links connected pivotally at their ends to the big end bearing and to the interior of the ram at the end of the ram remote from the big end bearing.

4. In a hydraulic pump, a cylinder, a hollow ram longitudinally movable in said cylinder, one end of the ram being formed with a flat surface transverse to the axis of the ram and cylinder, a driving shaft, an eccentric on said shaft, a big end bearing mounted on and encircling the eccentric and having a flat surface thereon, a resilient connection maintained in tension and completely enclosed within the hollow ram by the big end bearing, means connecting one end of the resilient connection to the interior of the ram at the end of the ram remote from the big end bearing, and a slidable connection between the other end of the resilient connection and the big end bearing whereby a tensile force is exerted between the other end of the resilient connection and the big end bearing, the flat surface on the end of the ram being thereby held in slidable engagement with the flat surface on the big end bearing.

5. In a hydraulic pump as claimed in claim 4, the slidable connection between the said other end of the said resilient connection and the said big end bearing comprising a part slidable longitudinally within the interior of the ram and a part slidable in said big end bearing in a direction at right angles to the axis of rotation of the driving shaft.

6. In a hydraulic pump as claimed in claim 4, the slidable connection between the said other end of the said resilient connection and the said big end bearing comprising a cylindrical part slidable longitudinally on the interior of the ram and a T-shaped part slidable in a corresponding T-shaped slot in said big end bearing in a direction at right angles to the axis of rotation of the driving shaft.

7. In a hydraulic pump, a cylinder, a hollow ram longitudinally movable in said cylinder, one end of the ram being formed with a flat surface transverse to the axis of the ram and cylinder, a driving shaft, an eccentric on said shaft, a big end bearing mounted on and encircling the eccentric and having a flat surface thereon, a resilient connection maintained in tension and completely enclosed within the hollow ram by the big end bearing, a pivot connecting one end of the resilient connection to the interior of the ram at the end of the ram remote from the big end bearing and a pivot connecting the other end of the resilient connection with the big end bearing, the flat surface on the end of the ram being thereby held in slidable engagement with the flat surface on the big end bearing.

8. In a hydraulic pump the combination of a cylinder, a hollow ram longitudinally movable in said cylinder, one end of the ram having a flat surface, a driving shaft, an eccentric on said shaft, a bearing mounted on and encircling the eccentric, the bearing having a flat surface which engages with the flat surface on said one end of the hollow ram, a resilient connection completely enclosed in the hollow ram, means connecting one end of the resilient connection and the bearing, means provided between the latter connection and the bearing to provide a sliding movement of the bearing in the operation of the pump and means connecting the other end of the resilient connection and the other end of the hollow ram.

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