Mar. 6, 1923. 1,447,931

J. DICKENS

FLUID PUMP

Filed Oct. 4, 1920

Fig. 1.

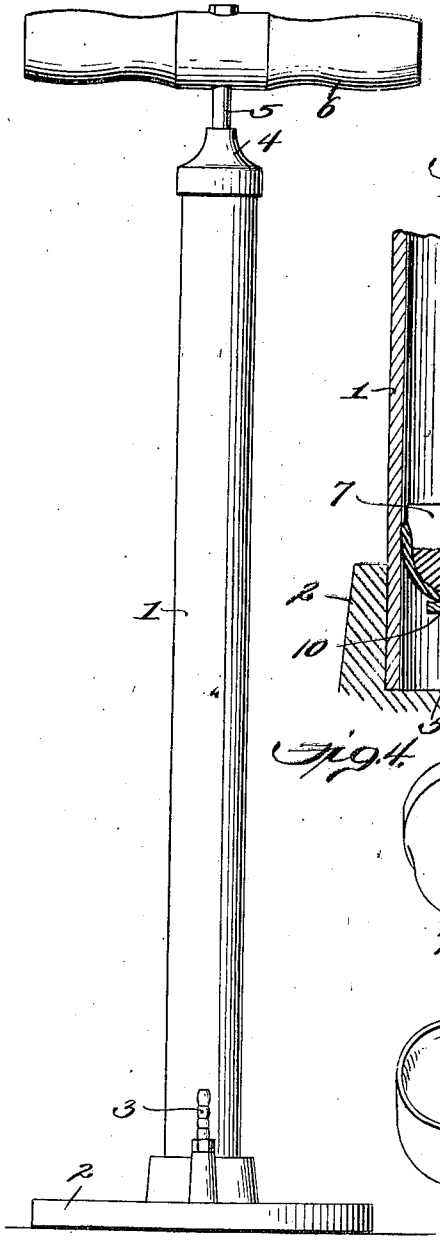


Fig. 2.

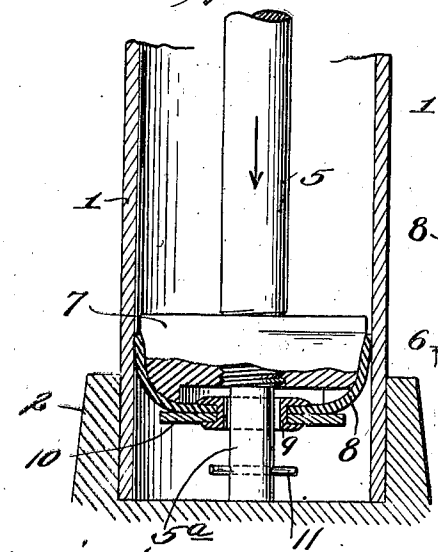


Fig. 3.

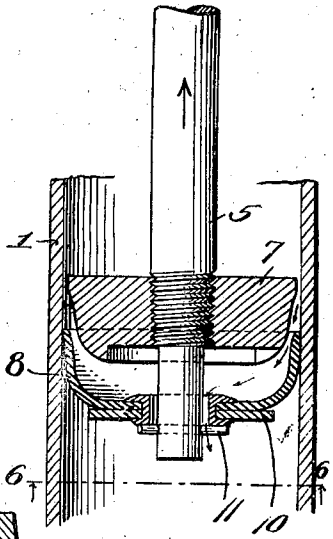


Fig. 4.

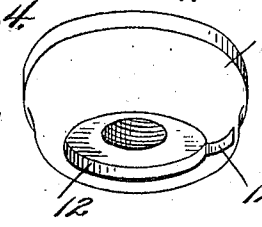


Fig. 6.

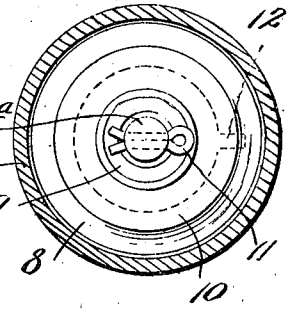
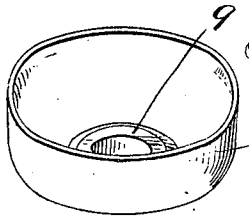


Fig. 5.



Inventor

John Dickens

By Charles L. Norris

Attorney

Patented Mar. 6, 1923. 1,447,931

UNITED STATES PATENT OFFICE.

JOHN DICKENS, OF PASSAIC, NEW JERSEY; ANNA J. DICKENS AND ANNA DE VRIES EXECUTRICES OF SAID JOHN DICKENS, DECEASED.

FLUID PUMP.

Application filed October 4, 1920. Serial No. 414,491.

To all whom it may concern:

Be it known that I, JOHN DICKENS, a citizen of the United States, residing at Passaic, in the county of Passaic and State of New Jersey, have invented new and useful Improvements in Fluid Pumps, of which the following is a specification.

The present invention relates to improvements in pumps for forcing fluid, and more especially to those employing a reciprocatory piston of the cupped packing type working in a cylinder. The primary objects of the invention are, to provide a novel and improved pump of this type which is capable of forcing fluids with great efficiency, there being practically no leakage past the piston during its working stroke and the fluid passing through the piston, during its return or idle stroke, with minimum obstruction, thus insuring the forcing of a full charge of fluid at each stroke of the piston and also reducing substantially the resistance to movement of the piston during said stroke; to provide a pump piston which will be very durable and not liable to distortion, such as would impair its efficiency; and to provide a pump in which the piston can be readily inserted and removed without damaging or distorting the piston, or otherwise impairing its efficiency.

The invention is applicable generally to all pumps of the reciprocatory piston type suitable for the forcing of fluid, but it is adapted to be applied with particular advantage to pumps such as those suitable for compressing air, and especially those of the kind used for the inflation of pneumatic tires and for similar purposes.

To these and other ends, the invention consists in certain improvements and combinations and arrangements of parts, all as will be hereinafter more fully described, the features of novelty being pointed out particularly in the claims at the end of the specification.

In the accompanying drawing—

Figure 1 shows in side elevation an air pump of the kind suitable for use in the inflation of pneumatic tires, the same being constructed in accordance with the present invention;

Figure 2 represents, on an enlarged scale, a vertical section through the lower end of the pump cylinder and the piston therein, the latter being shown at or in proximity to the end of its working stroke;

Figure 3 represents a section taken axially through the pump cylinder and the piston, showing the piston as it appears on its return or idle stroke;

Figure 4 is a detail perspective view of the expander head of the piston;

Figure 5 is a detail perspective view of the packing member of the piston; and

Figure 6 represents a section on the line 6—6 of Figure 5, looking in the direction of the arrows.

Similar parts are designated by the same reference characters in the several views.

In the present embodiment of the invention, wherein the same is shown applied, as an example, to an air pump of the type suitable for the inflation of pneumatic tires and for similar purposes, the pump comprises a pump cylinder 1, which may be composed of cylindrical tubing, and a base or foot piece 2, into which the lower end of the pump cylinder is fitted with an air-tight fit and is arranged to discharge air compressed in the lower end of the cylinder, through a nipple or outlet 3 which may be connected in the usual or any suitable way to the part to which the air under pressure is to be applied. The upper end of the pump cylinder is covered by a cap 4 having a central opening through which the piston rod or stem 5 is reciprocable, the upper end of the piston rod being provided with a handle 6, or equivalent means for actuating it. The construction just described is suitable where the invention is applied to air pumps of the tire-inflating type, but it is to be understood that equivalent parts may be employed where the invention is applied to pumps of other types.

The piston of the pump, according to the present invention, comprises a cupped packing member and a cooperative expander member, the expander member operating on the packing member to force the packing member against the interior wall of the cylinder mechanically, so as to form a fluid-tight fit therewith during the working stroke of the piston, the expander member, during the initial part of the return stroke of the piston, retracting relatively to the packing member to relieve the expanding force which was applied thereto during the working

stroke of the piston and to provide a passage through which the fluid may pass from one side of the piston to the other side thereof during the return or idle stroke of the piston. Preferably and as shown in the present instance, the expander member of the piston comprises a rigid head 7 which is threaded or otherwise fixed rigidly on the piston rod 5, and this expander head is tapered or is approximately in the form of a mushroom. The packing member of the piston comprises preferably a cupped washer 8, preferably of leather or other similar material, the cavity of the cupped washer being presented toward the smaller or tapered end of the expander head 7. The cupped washer is of a size and shape to receive the tapered portion of the expander head and the expander head is so shaped that when it is forced into the cupped washer it will expand the peripheral portion of this washer, thus forcing the peripheral portion of the washer positively and uniformly against the inner wall of the cylinder, so as to produce a fluid tight fit between the washer and the inner wall of the cylinder and also between the washer and the periphery of the expander head. When the expander head is withdrawn from the cupped washer, as occurs during the initial part of the return stroke of the piston, a passage is provided between the cupped washer and the periphery of the expander head through which air or fluid may pass from the upper side to the lower side of the piston. Simple means may be provided for the passage of this air past the cupped washer. Preferably and as shown, the cupped washer is provided with a central perforation into which is fitted and secured an eyelet 9, this eyelet also serving to secure a rigid disk or washer 10 to the under or convex side of the washer. The lower end 5^a of the piston rod may be reduced in diameter so as to fit loosely through the eyelet 9, thereby providing a passage between this part 5^a of the piston rod and the eyelet through which air or fluid from the upper side of the piston may pass during the return stroke of the piston. Suitable means is provided to prevent dislocation of the cupped washer from the expander head of the piston, although permitting relative movements between these parts, such as those which take place incident to the working and return strokes of the piston. Preferably and as shown, a cotter pin 11 is fitted into the lower end of the piston rod, a suitable distance below the position occupied by the eyelet 8 when the expander head is forced in the cupped washer, as will be clear from Figure 2, this cotter pin limiting the relative separation between the cupped washer and the expander head during the return or idle stroke of the piston, as will be clear from Figure 3. The end of the expander head 7 opposite to the cupped washer, may be provided with a counter bore or recess 12 to accommodate the adjacent end of the eyelet 9 and one or more vents 12^a may lead to this counter bore from the periphery of the expander head to admit air to the counter bore and thus prevent a vacuum effect which would tend to resist relative separation of the expander head and cupped washer at the moment the return stroke of the piston commences.

The operation of the pump constructed in accordance with the present invention is as follows: Upon the commencement of the downward or working stroke of the piston, the expander head 7 moves toward and enters the cavity in the cupped washer, this action taking place immediately upon the commencement of the working stroke of the piston, due to the fact that the peripheral edge or lip of the cupped washer is in frictional contact with the inner wall of the cylinder, and hence the cupped washer will be held stationary, while the expander head 7 is directly connected to the piston rod and moves therewith. The entrance of the expander head into the cupped washer acts to expand the peripheral portion or lip of the washer positively and evenly, forcing the same against the cylinder wall to produce a fluid-tight fit between the washer and the cylinder wall and also between the washer and the expander head. As the working stroke of the piston continues, the expander head and cupped washer advance in unison or substantially so, compressing or forcing the fluid below the piston, and as the pressure of this fluid increases, it opposes the advance of the cupped washer, but the cupped washer is advanced positively by the expander head and as the pressure of the fluid below the piston increases, the expander head is forced further or with an increase in pressure into the cupped washer, thus increasing the expanding force applied to the peripheral portion or lip of the cupped washer in accordance with the increased pressure of the fluid at the lower or pressure side of the piston. Consequently, a fluid tight fit of the piston is insured throughout the working stroke thereof and the expanding force applied to the cupped washer to produce this fluid tight fit is proportionate to the pressure of the fluid at the lower or pressure side of the piston, and hence the maximum quantity or volume of fluid is forced at each stroke of the piston and the frictional resistance of the piston is always at a minimum, taking into consideration the pressure developed in the fluid at the lower or pressure side of the piston. When the working stroke of the piston has been completed, the movement of the piston rod is reversed and the initial part of the reverse movement of the piston rod causes reverse

movement of the expander head 7. This causes the expander head to be retracted or withdrawn from the concavity of the cupped washer, because the peripheral portion or lip of the cupped washer will be held stationary during this preliminary part of the return stroke of the piston, by its frictional engagement with the wall of the cylinder. The retracting movement of the expander head 7 continues while the cupped washer remains stationary, until the limiting device, such as the cotter pin 11, comes up against the eyelet 9, whereupon the continued return movement of the piston rod causes the cupped washer and the expander head to move in unison. Withdrawal of the expander head from the cupped washer relieves the expanding force which was applied to the peripheral portion or lip of the washer during the working stroke of the piston, thus reducing the frictional resistance to the movement of the cupped washer to that incident to the mere contact of the lip of the cupped washer with the wall of the cylinder, and retraction of the expander head also produces an annular opening or passage way between the periphery of the expander head and the peripheral portion or lip of the cupped washer. As the return stroke of the piston continues, fluid above the piston may freely pass through this annular space between the periphery of the expander head and the lip or peripheral portion of the cupped washer and thence through the space between the eyelet 9 and the reduced portion 5^a of the piston rod, so that the transfer of fluid from the upper to the lower side of the piston takes place with minimum obstruction, and hence resistance offered to the return stroke of the piston is reduced to a minimum. Furthermore, by minimizing the obstruction to the flow of fluid to the lower side of the piston, the development of a vacuum below the piston during the return stroke thereof, is avoided, and hence a full charge of fluid is received by the cylinder preparatory to each forcing operation. This is particularly advantageous when an elastic fluid, such as air, is being forced by the pump. When the next working stroke is applied to the piston, after the return stroke thereof has been completed, the initial part of the working stroke of the piston immediately forces the expander head into the cupped washer, thereby expanding the latter and producing a fluid tight fit of the piston and the cylinder, and the fluid compression or forcing action of the pump commences immediately as the working stroke of the piston continues. In this way, the forcing of the fluid is insured at substantially the commencement of the working stroke of the piston, without depending upon the development of a pressure in the fluid at the pressure side of the piston to force the washer or packing against the cylinder to produce a fluid-tight fit therewith.

When the expander head moves into engagement with the cupped washer, it preferably engages the bottom of the cup as well as the peripheral sides thereof, thus preventing undue stretching of the leather or material comprising the cupped washer, and hence increasing the durability.

It will be understood that in the type of pump shown in the present instance, a suitable check valve will be provided in the nipple 3 or in the connection leading therefrom to prevent return flow of fluid into the cylinder during the return stroke of the piston. Also, check valves or non-return flow means may be provided when the invention is applied to a pump of other types.

Obviously, the piston may be removed from the upper end of the cylinder by removing the cap 4 and reinserted into the cylinder without distorting or otherwise injuring the packing member in a manner that would impair its operation.

A pump constructed in accordance with the present invention is capable of developing high pressure in the fluid being forced, it is of relatively large capacity as a full charge of fluid is forced at each working stroke of the piston and the forcing or compressing of the fluid commences immediately following the commencement of the working stroke of the piston, a minimum resistance is offered to the return stroke of the piston, the piston is durable and it is not liable to distortion such as would impair its function when the piston is removed from or inserted into the cylinder.

I claim as my invention:—

1. A pump comprising a cylinder having a compressing chamber at one end, and a reciprocatory piston rod to extend through the opposite end of the cylinder and carrying a piston, the piston embodying a cupped packing member, the convex side of which is presented toward the compressing chamber of the cylinder, and an expander head fixed to the piston rod and shaped to fit into the concave side of the cupped packing member to force the latter outwardly against the cylinder wall.

2. A pump comprising a cylinder having a compressing chamber at one end, and a reciprocatory piston rod adapted for insertion into the opposite end of the cylinder, said piston rod carrying a piston which embodies a cupped packing member, the convex side of which is presented toward the compressing chamber of the cylinder and an expander head shaped to fit into the concave side of the cupped packing member and operative when moved toward the compressing chamber of the cylinder to force the cupped edge of the packing member against the cylinder wall.

3. A pump comprising a cylinder closed at one end to form a compressing chamber and having an opening at its opposite end, and a piston rod adapted for insertion into the said opening in the cylinder and carrying a piston which embodies a cupped packing member, the convex side of which is presented toward the compressing chamber of the cylinder and an expander head of a diameter substantially equal to that of the cylinder and shaped to fit into the concave side of the cupped packing member, the expander head being operative to expand the cupped edge of the packing member into fluid-tight fit with the cylinder wall.

4. A pump comprising a cylinder having a compressing chamber toward one end, and a reciprocatory piston rod, extending through the opposite end of the cylinder and carrying a piston, the latter embodying a cupped packing member loosely fitted on said rod to provide an air passage through its center and to permit the packing member to move longitudinally on said rod, the convex side of the cupped packing member being presented toward the compressing chamber of the cylinder, and an expander head fixed to the piston rod and having a shape to fit into the concave side of the cupped packing member and having a diameter approximately equal to the bore of the cylinder, the expander head being movable into the concave side of the cupped packing member to shape it and to expand it into fluid-tight engagement with the cylinder wall when the piston rod is moved toward the compressing chamber of the cylinder.

5. A fluid-compressing pump comprising a cylinder to form a compressing chamber, and a reciprocatory piston rod extending through the opposite end of the cylinder and carrying a piston working in the cylinder, the piston having a cupped packing member, the convex side of which is presented toward the compressing chamber of the cylinder and adapted to fit within the cylinder, and an expander head fixed to the piston rod behind the packing member and movable by the working stroke of the piston rod toward the compressing chamber and into the concavity of the packing member to force the periphery thereof against the interior wall of the cylinder.

6. A pump of the type having a cylinder closed at one end to form a compressing chamber and a reciprocable piston rod extending through the opposite end of the cylinder and carrying a piston therein, the piston comprising an expander head fixed on the piston rod and a cupped packing member located between said head and the compressing chamber and loosely fitted to move longitudinally relatively toward and from said head, the latter being forced into the concavity of the packing member to expand it against the cylinder when the piston is initially moved toward the compressing chamber and withdrawing from the packing member to relieve such expansion when the piston is moved in a reverse direction.

7. A pump comprising a cylinder having a compressing chamber at one end thereof and a piston reciprocable therein, the piston having a rod, an expander head immovably fixed thereon, and a cupped packing member loosely fitted to move longitudinally on the rod and having its concavity presented to receive said head, and its convex side arranged toward said compressing chamber, the head being forced into the packing member to expand its periphery against the cylinder when the piston is initially moved toward said compressing chamber and withdrawing from the packing member to relieve such expansion when the piston is moved in a reverse direction.

8. A pump comprising a cylinder and a piston reciprocatory therein, the piston having a rod, a tapered expander head fixed thereon, a cupped packing member of relatively soft material loosely fitted to move longitudinally on the rod in a direction toward and from said head and having a fluid passage between it and the rod, the concavity of the packing member being presented toward the tapered end of said head to receive the same when the piston is moved in one direction, thereby expanding the periphery of the packing member against the cylinder, the expander head having a recess surrounding the rod and facing the concavity of the packing member and a vent leading to said recess from the periphery of the head, the expander head withdrawing from the packing member to relieve such expansion and to provide a fluid passage between it and the packing member through said recess and vent when the piston is moved in an opposite direction.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

JOHN DICKENS.

Witnesses:
NELLIE FARLEY,
EDWARD R. JOHNS.