Sept. 27, 1932. J. FRASER 1,879,870

PUMP FOR DELIVERING MEASURED QUANTITIES OF LIQUID

Filed April 25, 1929 2 Sheets-Sheet 1

Fig. 1.

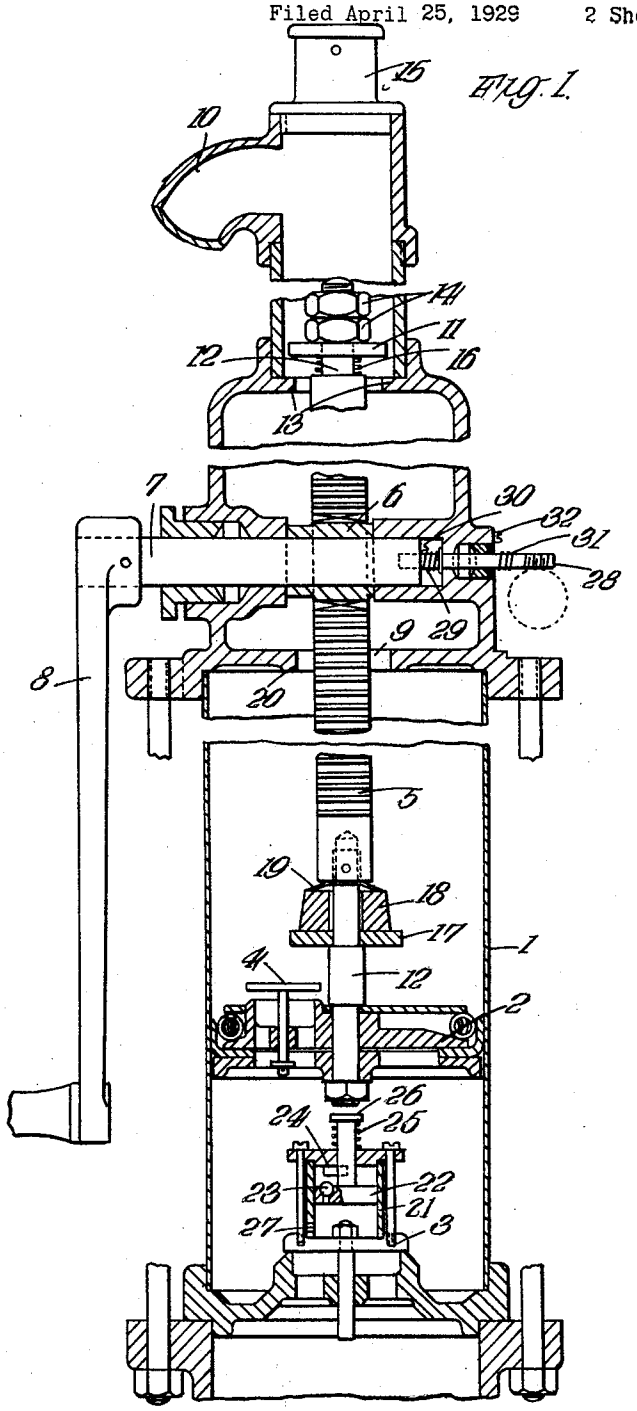


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Fig. 2.

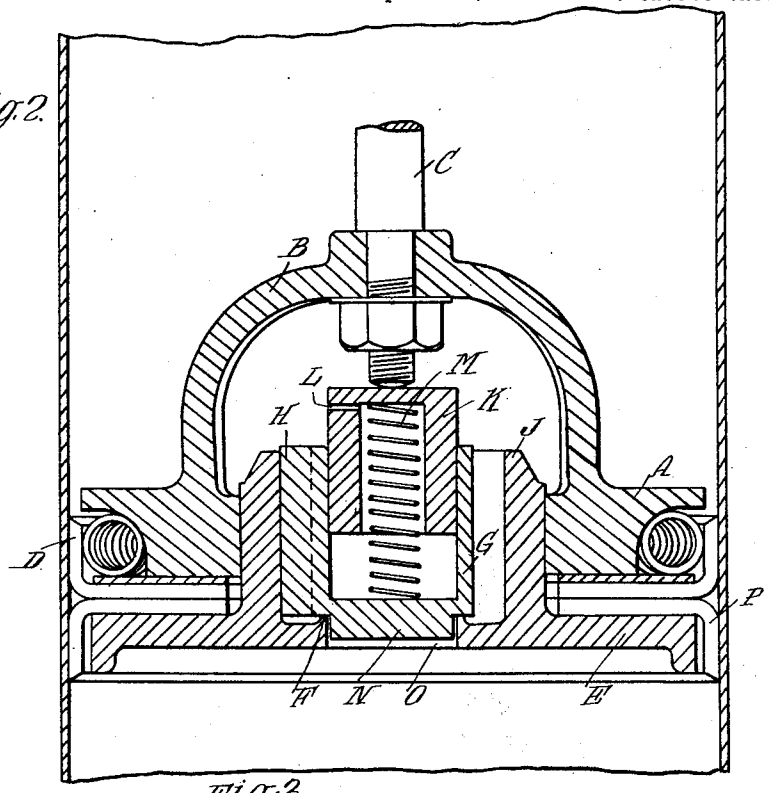
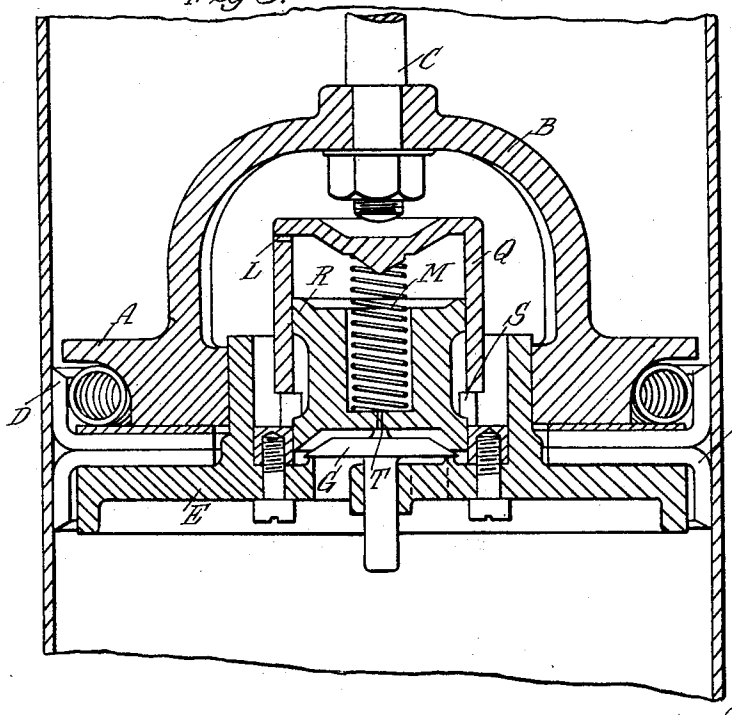



Fig 3.

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# UNITED STATES PATENT OFFICE

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## PUMP FOR DELIVERING MEASURED QUANTITIES OF LIQUID

Application filed April 25, 1929, Serial No. 357,978, and in Great Britain July 14, 1928.

The present invention relates to apparatus for delivering measured quantities of liquid of the type comprising a bucket pump the stroke of which is accurately determined. Such a pump in its simplest form comprises a bucket piston adapted to be reciprocated in a cylinder into which, on the delivery stroke of the piston, liquid is drawn from a source of supply through a suction valve and is, on the return stroke, passed from one side of the piston to the other through a non-return valve in the piston. In such a pump, on the delivery stroke of the piston, the suction valve and non-return valve are respectively open and closed, the reverse being the case on the return stroke. On stoppage of the piston at the end of its delivery stroke, however, there is a tendency for the non-return valve either to be opened or to remain open in such a manner that a quantity of liquid different from that which should be delivered at each stroke is passed, this being due to the fact that the kinetic energy in the moving liquid results in a momentary pressure on stoppage of the piston at the end of its stroke. Further, especially if the pump be rapidly operated and particularly if it be used for petrol or other volatile spirit in connection with which the present invention is especially applicable, vapour is sometimes generated in the pump cylinder or suction line resulting in delivery of short measure. It is the object of the present invention to overcome these drawbacks and thereby to render a pump of the type mentioned suitable for accurately delivering measured quantities of liquid.

According to one feature of the invention means is provided whereby, on stoppage of the piston when the desired volume of liquid has been delivered, opening of the non-return valve in the piston is prevented or delayed, thereby obviating passage of liquid due to the momentary pressure above referred to.

According to another feature of the invention the piston is adapted, on reaching the neighborhood of the limit of its return stroke, to make contact with the suction valve, intervening spring means being provided. Thus when the pump is out of use, pressure is exerted on the suction valve, so that emptying of the pump due to leakage of this valve is obviated or greatly minimized.

In order that the invention may be clearly understood and readily carried into effect it will now be described more fully with reference to the accompanying drawings in which

Figure 1 is a longitudinal section of an apparatus constructed in accordance with the present invention;

Figure 2 is a longitudinal sectional detail of a modification thereof, and

Figure 3 is a similar view of another modification.

The pump illustrated in Figure 1 comprises a cylinder 1 fitted with a bucket piston 2 of any suitable construction, a suction valve 3 being provided in the end of the cylinder 1 for admitting liquid under suction on the upward delivery stroke and the piston 2 being fitted with a non-return valve 4 for passing the liquid from one side of the piston to the other on its downward or return stroke. The piston 2 is reciprocated in the cylinder 1 by a rack 5 engaging a pinion 6 mounted on a spindle 7 adapted to be rotated by such means as a crank handle 8. On upward motion of the piston delivery of liquid takes place through an aperture 9 and delivery pipe 10. The length of the downward or return stroke of the piston is determined by a bridge piece 11 carried by the piston rod 12 and adapted to make contact with projections 13 on the pump casing. The stroke is adjustable by means of lock nuts 14, access to which may be had by removal of a cap 15, the bridge 11 being held in contact with the lower of the lock nuts 14 by a spring 16. In order to determine the limit of the upward stroke of the piston 2 and at the same time to close the delivery aperture 9, the piston rod 12 is fitted with a disc valve, preferably comprising a disc 17 resting, as indicated, on a shoulder of the piston rod and held in position by a ring 18 on the upper side of which a leaf spring 19 bears. The ring 18 is fitted comparatively loosely on the spindle 12 in order that it may accommodate itself to the aperture 9 and the disc 17 is adapted to make fluid-tight contact with a seating 20 around the lower edge of the aper-

ture 9. Thus, on completion of the delivery stroke of the piston 1, the delivery aperture 9 is closed and any possibility of the valve 4 being opened due to the sudden stoppage of the liquid in the cylinder 1 is obviated. On the other hand, the kinetic energy of the moving liquid will serve, on closure of the aperture 9, to generate a rise of pressure in the cylinder 1 and the suction line, whereby any vapour which may have been produced therein is condensed. In order to prevent such pressure becoming harmful, the ring 18 is, as indicated, externally of a conical contour; thus, as it enters the aperture 9, the effective area of the latter is gradually reduced and at the moment when the disc 17 makes contact with the seating 20 this effective area has been reduced almost to zero by means of the conical ring 18.

In order to prevent leakage of the suction valve when the pump is out of use that is to say the piston 2 is at the bottom of its downward return stroke, means is provided whereby the underside of the piston makes spring contact with the valve 3. To this end there is mounted on the valve a dash-pot 21 having a piston 22 fitted with a ball-valve 23 and normally held in its raised position, as determined by a stop 24, by means of a spring 25 adapted to bear on a flange 26 on the piston rod. The mechanism is so dimensioned that, as the piston 2 approaches the limit of its downward return stroke, the end of the piston rod 12 makes contact with the flange 26 thereby compressing the spring 25 and depressing the piston 22 in its dash-pot 21, liquid being free to escape through the ball valve 23 and also to the outside of the cylinder 21 through an aperture 27. Immediately the piston 2 begins to lift on its delivery stroke pressure on the valve 3 will be relieved, and it will, therefore, be free to open in order to permit a fresh supply of liquid to be drawn in. This is due to the fact that there is no definite outlet from the upper end of the dash-pot 21 so that return of the piston 22 toward its raised position under the action of the compressed spring 25 can only take place slowly due to leakage of liquid from the upper to the underside of the piston.

For the purpose of indicating or recording delivery, any suitable type of apparatus constructed and operated by complete delivery strokes in known manner, but not shown on the drawing, may be fitted. In order, however, to indicate if delivery by partial strokes of the piston, which would not affect the above mentioned indicating or recording apparatus, has been made, it is desirable to fit a totalizing indicator or recorder so arranged as to be operated only on any upward delivery movement of the piston 2, but not to be affected by any downward movement thereof. Such mechanism might, for example, be driven from the spindle 7 through any suitable form of free-wheel device. A simple arrangement for this purpose is indicated on the drawings, according to which there is arranged co-axially with the spindle 7, and having a bearing therein, a spindle 28 adapted to drive totalizer mechanism by such means as a worm and worm-wheel as shown. Surrounding this spindle, but normally bearing only lightly on it, is a helical spring 29 one end of which is attached by a screw or the like 30 to the spindle 7, the other end being free. Thus, assuming that the spring 29 is wound in the correct direction, on rotation of the spindle 7 in such a direction as to raise the piston 2 the spring 29 will tighten around the spindle 28 which will, therefore, be rotated with the spindle 7, and will serve to operate the totalizer. On reversal of the rotation of the spindle 7, however, the spring 29 will immediately become slack around the spindle 28 to which, therefore, no rotation will be imparted by reverse rotation of the spindle 7. In order to ensure that this is the case a second spring 31, attached at 32 to the casing, may surround the spindle 28, its direction of winding being such that it tightens around this spindle on any tendency of the latter to rotate in the backward direction.

It will be realized that the above described means for preventing the passage of liquid through the plunger due to pressure generated by kinetic energy of the moving liquid is only operative when the plunger has reached the end end of its delivery stroke. In many types of measuring apparatus, however, the measured quantity it is desired to deliver is not always represented by the full stroke of the plunger, but the latter is arrested by a suitable stop after a given proportion of its stroke has been covered. In such a type of pump the constructions of plunger illustrated in Figures 2 and 3 are to be preferred. Referring to Figure 2, the plunger, as regards its main constructional features, may be of normal type comprising a disc A formed with a bridge B to which the piston rod C is attached, a cup leather D being provided on the underside of the disc A. The disc E serving to secure the cup leather is formed with a seating F for non-return valve G provided with three or more projections H whereby it is maintained centrally within a cylindrical extension J of the disc E. As indicated, the valve G is in the form of a cylinder having within it a piston K provided with a small aperture L and normally kept in contact with the end of the piston rod C or other suitable stop by means of a spring M. Thus the piston K within the cylindrical portion of the valve G operates as a dash-pot and prevents sudden opening of the valve, the rate of lift depending on the size of the aperture L and the viscosity of the

liquid pumped. This aperture is made of such a size that before any appreciable opening of the valve G has taken place the pressure due to kinetic energy of the moving liquid in the suction line has been dissipated, and no appreciable amount of liquid due to such pressure is passed through the valve. As an additional precaution, however, the valve G may, as indicated, be provided with an extension N adapted to fit within a cylindrical aperture O, so constituting an auxiliary valve in series with the main valve. Thus, although the valve G may have left its seating F, no liquid can pass until the lower edge of the extension N has passed this seating and consequently the passage of liquid due to the above mentioned cause is prevented.

It has been found, however, that appreciable rise of the valve G from its seating does not in practice occur, its prevention being due to the above described action of the dash-pot rather than to the pressure of the spring M, which is comparatively weak and is merely intended for returning the piston K after it has been driven into its cylinder by opening of the valve G in normal operation; that is to say, on application of the steady pressure which occurs on the downward stroke.

In order that the accuracy of the apparatus shall not be vitiated by leakage of liquid passed around the cup leather D due to pressure resulting from kinetic energy, it is preferred that a second reversed cup leather P shall be provided, the disc E serving, as indicated, to secure both the cup leathers.

In the modification shown in Figure 3 the main and auxiliary valves are separate. For this purpose the disc E supports a cylinder Q provided with a piston R normally held in contact with the non-return valve G by means of the spring M. In this position a series of ports S is covered by the piston R, that is to say, the piston would prevent passage of liquid from one side of the plunger to the other even though the non-return valve G was slightly open. During the delivery stroke the various parts occupy the relative positions shown in the drawing, both valves being closed. Conversely, on the return stroke, due to pressure of liquid underneath the plunger, both valves are opened, the piston R being raised clear of the ports S to provide a free passage for liquid through the plunger. If during any portion of the delivery stroke the motion of the plunger be arrested and consequential pressure is generated underneath it due to the kinetic energy of the moving liquid, the non-return valve G may be lifted slightly thereby and a corresponding movement imparted to the piston R. It will be observed, however, that the latter serves to close the ports S by a finite lap which is greater than the maximum movement which might be produced due to pressure of liquid resulting from the kinetic energy therein. Thus, although such pressure may serve momentarily to open the valve G, the size of the aperture L is such as to ensure that the ports S are not uncovered and consequently no liquid which would otherwise produce inaccuracy is passed. It will be seen that a small aperture T in the piston R is necessary to permit the latter to descend over the length of the lap by which it covers the ports S. This aperture may be made so small as not to allow of the passage of any material amount of liquid and thus to avoid any sensible inaccuracy in the apparatus. Further, as indicated, the aperture T is preferably so placed as normally to be closed by the upper side of the non-return valve G.

It will be appreciated that, with constructions such as those above described, it is possible readily to modify the plungers of existing pumps, it being only necessary, in respect of the construction shown in Figure 2 or 3 for example, to remove the disc or the like securing the cup leather and supporting the usual non-return lift valve and to replace it by a disc E carrying the main valve and delaying device with or without an auxiliary valve and securing a second cup leather as above described.

What I claim and desire to secure by Letters Patent of the United States is:—

1. In apparatus for delivering measured quantities of liquid, a plunger comprising a disc, a valve-seating on said disc, a non-return valve co-operating with said seating, a spring tending to maintain said valve on said seating and a dash-pot operative to restrict the rate of opening of said valve.

2. In apparatus for delivering measured quantities of liquid, a plunger comprising a disc, a valve-seating on said disc, a non-return valve co-operating with said seating and a dash-pot associated with said valve, said dash-pot having an aperture for passage of liquid operative to restrict the rate of opening of said valve.

3. In apparatus for delivering measured quantities of liquid, a plunger comprising a disc, a valve-seating on said disc, a non-return valve co-operating with said seating, and a second valve in series with and adapted to open subsequently to said non-return valve.

4. In apparatus for delivering measured quantities of liquid, a plunger comprising a disc, a valve-seating on said disc, a non-return valve co-operating with said seating, a cylinder on said valve and a piston in said cylinder having a restricted aperture allowing passage of liquid through said piston.

5. In apparatus for delivering measured quantities of liquid, a plunger comprising a disc, a valve-seating on said disc, a non-return valve co-operating with said seating, a cylinder on said valve, a piston in said cylinder having a restricted aperture allowing pas-

sage of liquid through said piston and a spring tending to force said piston out of said cylinder.

6. In apparatus for delivering measured quantities of liquid, a plunger comprising a disc, a valve-seating on said disc, a non-return valve co-operating with said seating, a cylinder on said valve, a piston in said cylinder having a restricted aperture allowing passage of liquid through said piston, a spring tending to force said piston out of said cylinder and a stop for limiting said outward movement of said piston in said cylinder.

7. In apparatus for delivering measured quantities of liquid, a plunger comprising a disc, a valve-seating on said disc, a non-return valve co-operating with said seating, a cylinder on said valve, a piston in said cylinder having a restricted aperture allowing passage of liquid through said piston, a cylinder on said disc surrounding said first mentioned cylinder and projections on one cylinder making sliding contact with the other cylinder to permit relative axial movement of said cylinders.

8. In apparatus for delivering measured quantities of liquid, a plunger comprising a disc having a cylindrical aperture, a valve-seating surrounding said aperture, a non-return valve co-operating with said seating, an extension of said valve fitting within said aperture, a cylinder on said valve, a piston in said cylinder having a restricted aperture allowing passage of liquid through said piston, a cylinder on said disc surrounding said first mentioned cylinder and projections on one cylinder adapted to make sliding contact with the other cylinder to guide the relative axial movement of said cylinders.

JOHN FRASER.