Oct. 25, 1949. A. T. LASPE ET AL 2,485,752

SURGE-COMPENSATED LIQUID PUMP

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FIG. 1.

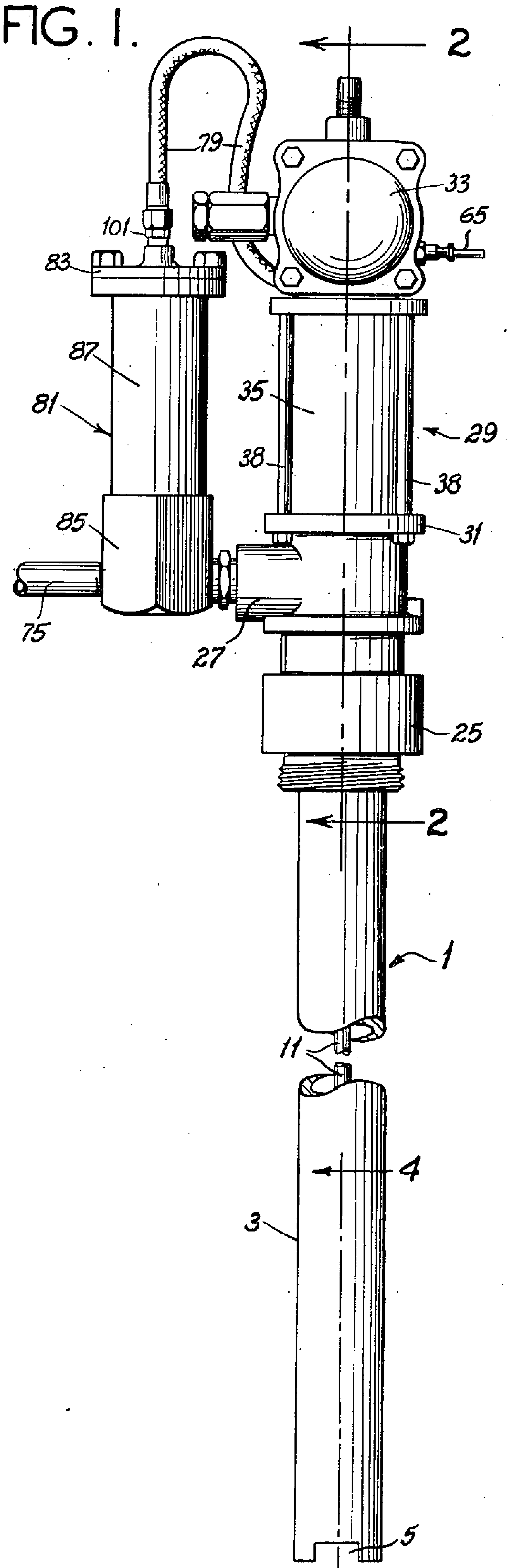

FIG. 5.

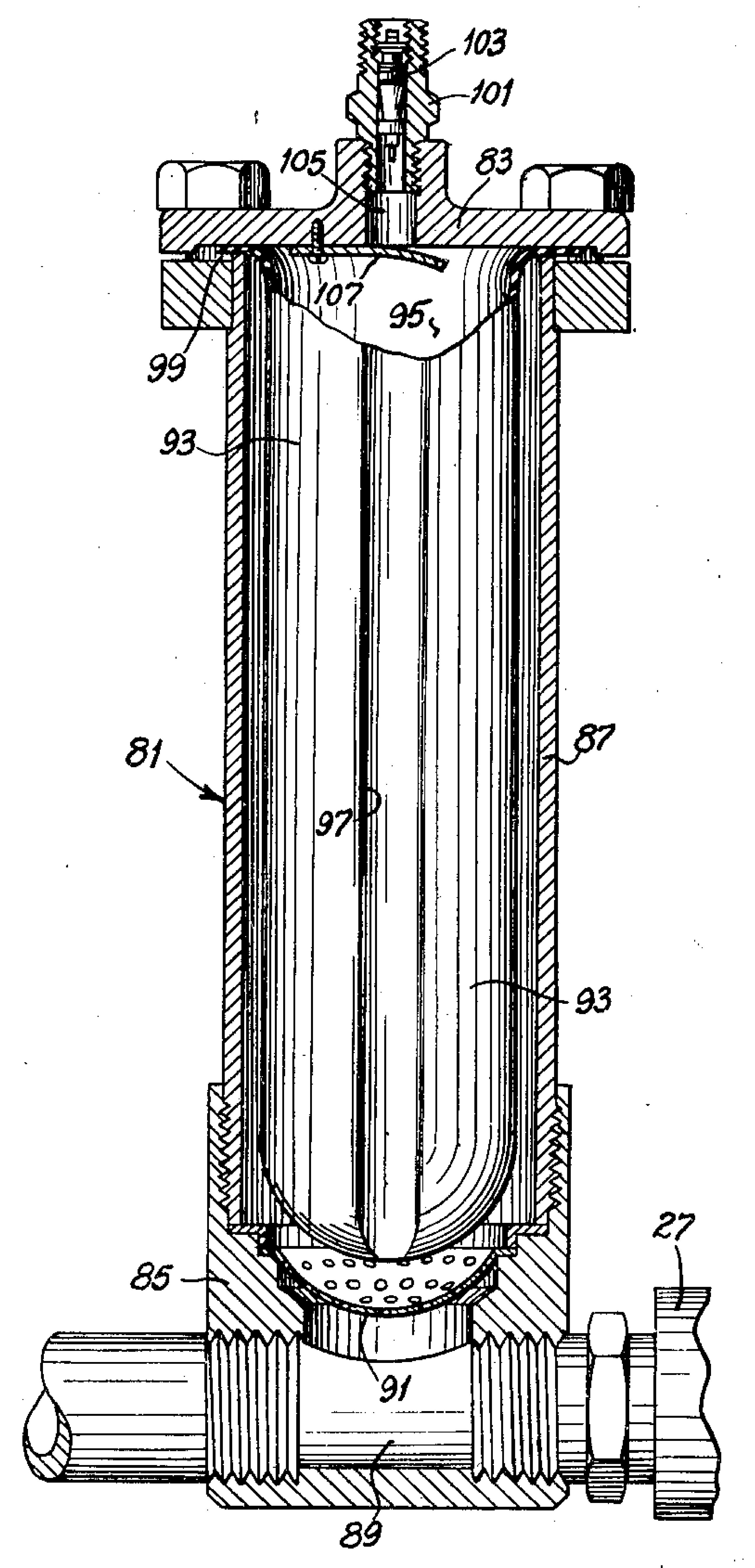

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FIG. 2.

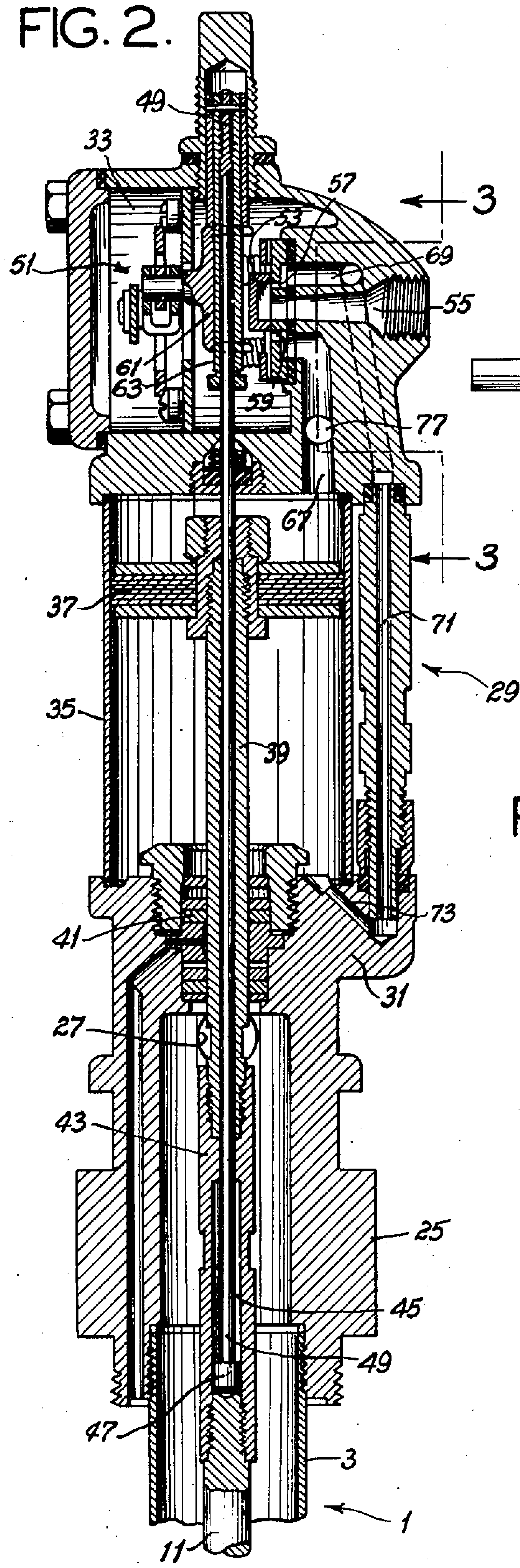


FIG. 3.

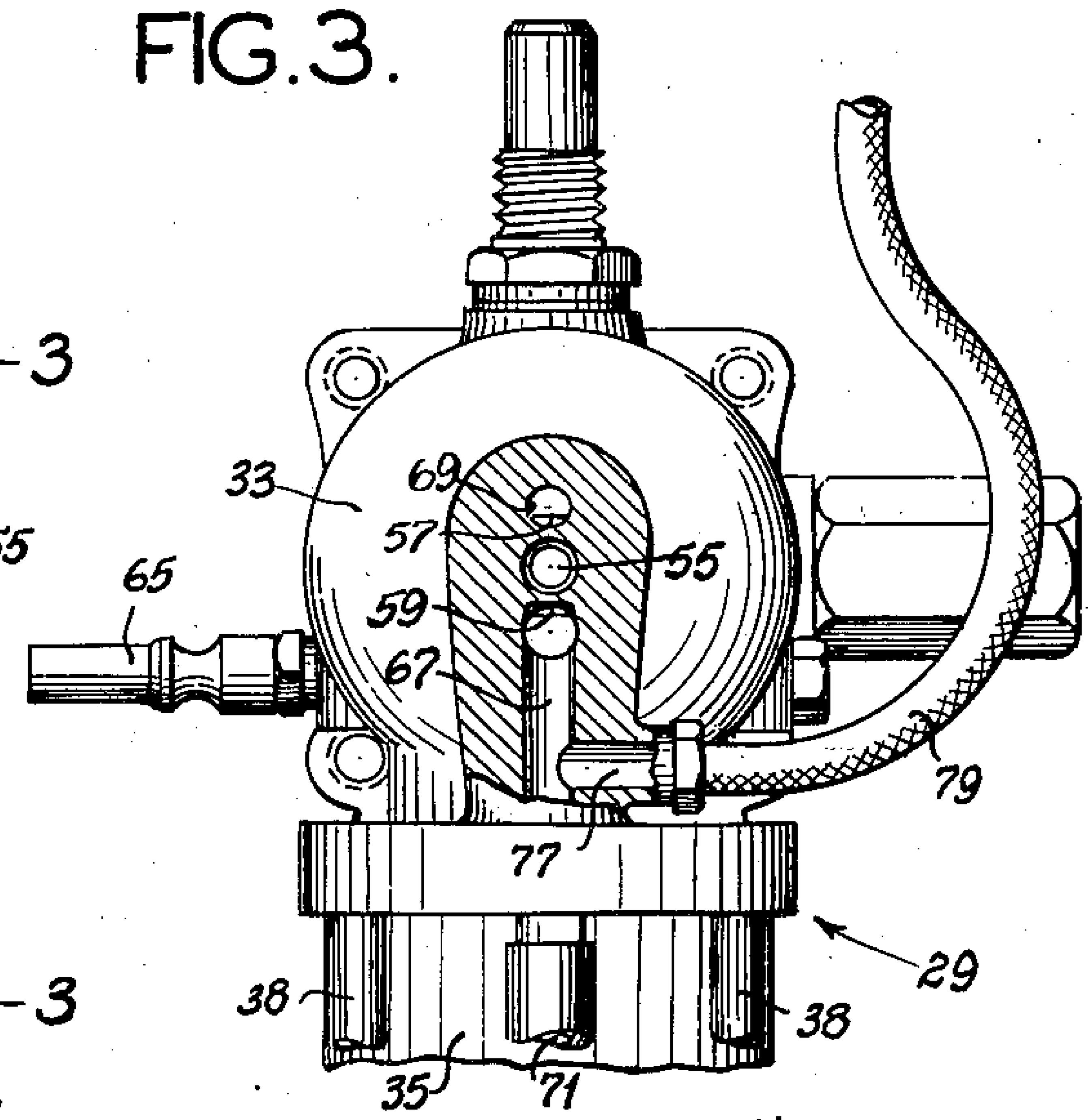
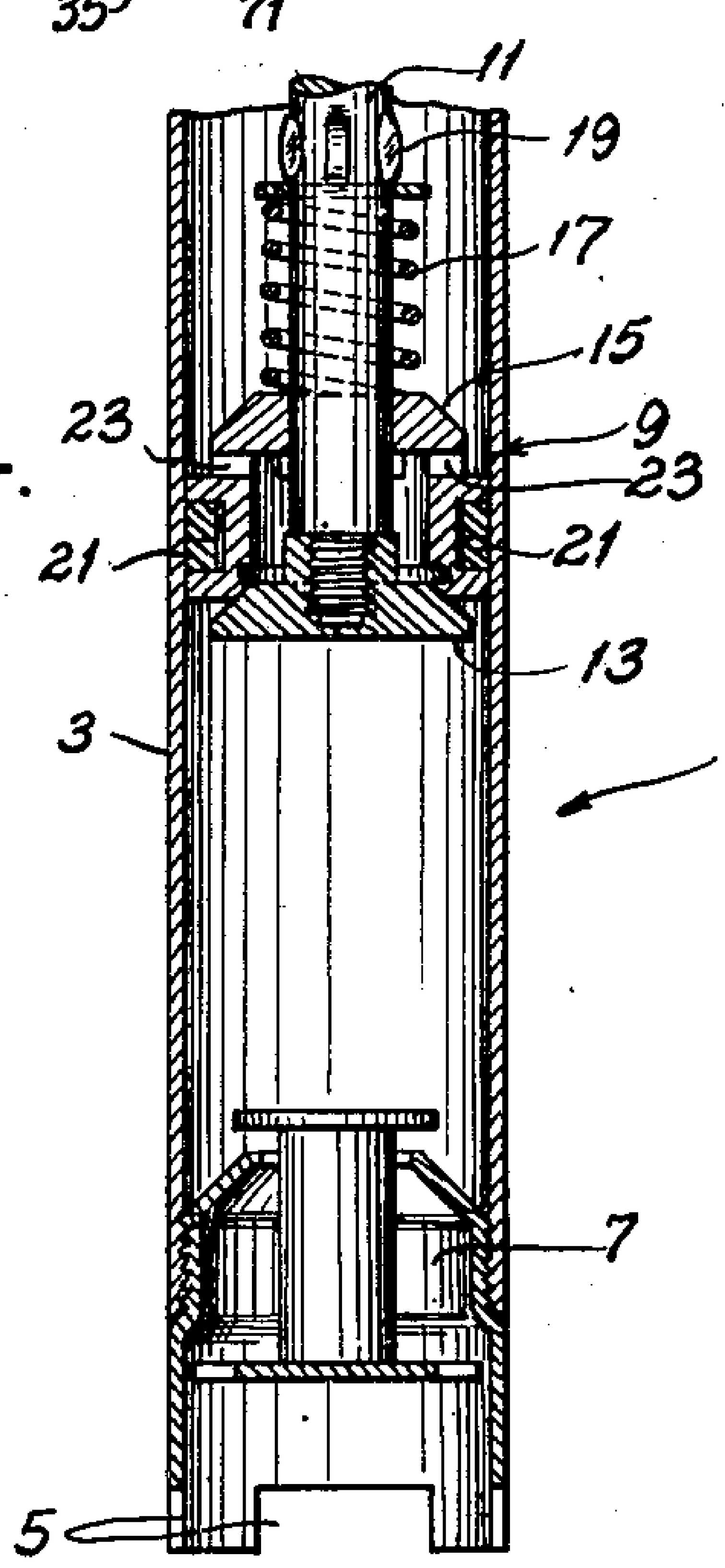


FIG. 4.



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SURGE-COMPENSATED LIQUID PUMP

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4 Claims. (Cl. 103—224)

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This invention relates to liquid pumps, and with regard to certain more specific features, to surge compensated lubricant-dispensing pumps.

Among the several objects of the invention may be noted the provision of a lubricant-dispensing pump which, although operated by a direct-connected reciprocating air engine tending to produce surging, and will in fact produce a substantially uniform discharge flow; the provision of a pump of the class described wherewith surging effects are minimized to the point that they do not deleteriously affect lubricant delivery; the provision of a pump of the class described in which surge compensation is by means of a convenient and compact structure automatically maintained at optimum efficiency; and the provision of a pump of this class which is simple in form and reliable in operation. Other objects will be in part apparent and in part pointed out hereinafter.

The invention accordingly comprises the elements and combinations of elements, features of construction, and arrangements of parts which will be exemplified in the structure hereinafter described, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawings, in which one of various possible embodiments of the invention is illustrated,

Fig. 1 is a side elevation of a lance type of lubricating pump embodying the invention;

Fig. 2 is an enlarged fragmentary vertical section taken on line 2—2 of Fig. 1;

Fig. 3 is a fragmentary left-hand elevation of Fig. 2 and including a broken-away section taken on line 3—3 of said Fig. 2;

Fig. 4 is a fragmentary detail section taken on line 4—4 of Fig. 1, and constituting a downward continuation of Fig. 2; and,

Fig. 5 is an enlarged vertical section taken through a pressure-compensating element.

Similar reference characters indicate corresponding parts throughout the several views of the drawings.

The general class of pumps to which the present invention applies is referred to in U. S. Patents 2,215,852 and 2,269,423. Generally speaking, such a pump consists of a so-called lance type of lubricant pump cylinder adapted to be inserted into a barrel or the like of lubricant for pumping lubricant therefrom. This pump is surmounted by an integral reciprocating air engine which operates the pump. The air engine and the lance form a unit, the lance of which may be inserted through an opening in the top of a drum

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while the air engine is supported at the upper end of the lance outside of the drum. The inlet of the pump constituting the lance is within the drum and the outlet is outside of and above it. This outlet ordinarily has connected with it a flexible lubricant line on the end of which is a valve-controlled delivery nozzle for delivering lubricant to the required points. In view of the fact that apparatus of this general nature is referred to in said patents, only such details thereof as are required for describing the present invention will be particularized herein.

One of the characteristics of apparatus of the class described above is that the lubricant pump is essentially of the single-stroke variety. That is to say, on one of its strokes (the up stroke), it has its largest volumetric displacement. Upon the down stroke the volumetric displacement is small or nil. Another way of stating this is that the lubricant pump is essentially a lift pump. This accounts for a definite surging action which is undesirable at the outlet nozzle. This surging is intensified by reason of the fact that the frictional resistance against a large volumetric flow is greater than that against a smaller or nil volumetric flow and hence the required air pressure on the up stroke of the air engine is greater than that used upon the down stroke. The present invention by very simple means overcomes the stated surging in apparatus of the class described or its equivalent.

Referring now more particularly to the drawings, there is shown at numeral 1 a lance-type of lubricant pump having a pump cylinder 3. Cylinder 3 has a lower inlet opening 5 adapted to receive lubricant when the bottom of the cylinder is inserted into the lubricant of the drum, which is usually at or near the bottom. Adjacent the opening 5 is a foot or check valve 7 which opens inward in response to flow into the cylinder 3 from the opening 5, but checks shut against any tendency of lubricant to flow from the cylinder 3 out through the inlet 5. Sliding in the cylinder 3 above the check valve 7 is a piston indicated generally by the numeral 9. This piston is carried on the lower end of a piston rod 11. The piston 9 is constituted by a head 13 upon which seats an open member 15, the latter being slidable on the lower end of the rod 11 and biased to a seat on 13 by means of a spring 17 reacting from an anchor 19 on shaft 11. The member 15 slides in the cylinder 3 and has packing rings 21 engaging the cylinder. It has openings 23 which, when the member 15 is unseated, permit flow from below the piston to points above it.

In view of the above it will be clear that when the piston 9 is reciprocated in the piston 1 a pumping action will occur. Upon a down stroke, lubricant in the cylinder 1 which is trapped above the check valve 7 will force the member 15 from its seat on 13 thus progressing to a position above the descending piston and becoming located in the parts of the cylinder 1 above said piston. Upon an up stroke, the lubricant above the then closed piston is forced out toward the upper end of the cylinder 1 while an additional charge is drawn in below the piston through the check valve 7. In order to eliminate description not germane to the invention, the usual air eliminator used in connection with pistons such as 9 has not been shown.

At the upper end of the cylinder 1 is a bung bushing 25 by means of which the apparatus is attached to the upper head of the lubricant drum. The drum is not shown, being a standard article of commerce. In the bung bushing 25 is the pump outlet 27.

The air engine 29 for operating the lubricant pump described surmounts said pump, the upper end 31 of the bung bushing 25 forming the lower head of this air engine. The upper hollow head of the engine is shown at numeral 33. Between the heads 31 and 33 is the air engine cylinder 35 held in place by means of draw studs 38 connecting said heads.

In the cylinder 35 is a piston 37 carried on a hollow piston rod 39 which extends through packings 41 in the lower head 31 and is connected through a hollow coupler 43 to the pump rod 11. The hollow coupler 43 includes a cylindric space 45 in which is carried a head 47 at the lower end of the valve stem 49. This hollow coupler 45 allows for lost motion between the reciprocating action of the piston 37 and the desired reciprocating action of the valve stem 49. When the piston 37 reciprocates in the cylinder 35 it directly reciprocates the rod 11 of the pump, but reciprocation of the valve stem 49 is only accomplished with lost motion so that the stem is reset to one of its positions or another at the ends of the strokes of the piston 37.

Within the hollow head 33 is a snap-acting, over-centering valve mechanism 51 which is operated by the valve stem 49 to re-set a sliding D-valve 53 for controlling flow of compressed air from the inside of the valve chamber 51 to ports 57 and 59 respectively. The D-valve 53 when uncovering one port 59 admits air to it and at the same time places the other port 57 in communication with an exhaust port 55. Conversely, when the port 59 is covered and the port 57 exposed, compressed air will flow into the latter and exhaust will occur from the former. The D-valve 53 is operated with lost motion from a shoe 61. The shoe 61 in turn is operated with lost motion from a sleeve 63 attached to the valve stem 49. Further description of the details of the operating mechanism between the valve stem 49 and the D-valve 53 will not be given since it is described in detail in said Patent 2,269,423. It suffices to say that the D-valve 53 is re-set each time that the piston 37 approaches the end of its stroke. In Fig. 2 it is shown in its upper position.

At numeral 65 is shown an inlet coupler for receiving an air hose (not shown) for supplying compressed air to the valve chamber 51 from a suitable compressed air supply tank.

The valve port 59 is in communication with the upper end of the cylinder 35 through a passage 67. The port 57 is in communication with the lower end of the cylinder 35 through passages 69, 71 and 73. Assuming that in Figs. 2 and 3 air is supplied under pressure to the fitting 65 of the valve chamber formed by the hollow head 33, flow occurs through the passage 67 to the upper side of the piston 37, thus driving it down. At this time air which was under the piston 37 from the previous stroke is exhausted through ports 73, 71, 69, 57, through the D-valve 53 and to the exhaust port 55. Under these conditions lubricant is transferred from the under side to the upper side of the pump piston 9 and very little is driven out through the pump outlet port 27. The small amount of lubricant that may be driven out due to the intrusion into the pump cylinder 3 of the pump rod 11 is negligible for the present purposes. When the piston 37 arrives at a point near the bottom of its stroke, the valve mechanism 51 trips the D-valve 53 to its alternate position connecting port 59 with the exhaust 55 and exposing port 57 to inlet pressure. This admits air under pressure to passages 57, 69, 71 and 73 to the bottom side of the piston 37, thus raising it while air above the piston exhausts through passages 67, 59 and 55, passing under the D-valve 53. The rising piston elevates the pump piston 9, thus compressing the lubricant charge above it and forcing the charge through the pump outlet 27 and into the line 75. If the valve at the end of line 75 is shut, then the air engine and pump will stall when he total pump piston pressure becomes enough to equal the total air pressure on the piston 37. However, whenever said valve is open, the air engine will continue to operate the pump to discharge lubricant, because then the resistance to pump discharge fluid is lower than the applied pressure from the air engine. The air pressure required for the purpose is, however, substantial because of line friction.

In view of the above it will be seen that the air pressure required underneath the piston 37 for a pumping or lift stroke is greater than the air pressure required above it for the downward return stroke of the pump piston 9. This fact is taken advantage of in carrying out the objects of the invention. To this end a ported connection is made at 77 with the air inlet passage 67 which leads to the top of the piston 37. This connection 77 communicates with a short line 79 leading to the upper end of a compensating device 81. This device 81 is quite close to the engine cylinder 35. Its construction is detailed in Fig. 5 wherein it will be seen to consist in an upper head 83 and a lower head 85 on a cylinder 87. In the lower head is a cross connection 89 between the pump outlet 27 and the line 75. Above the connection 89 is a rigid reticulated guard plate 91 which admits lubricant under lubricant line pressure into the cylinder 87. This pressure is applied to the outside of a resilient bladder 93 composed of synthetic rubber or the like and carrying air in its interior 95. This bladder is of more or less cylindric form as shown and includes side rib-like indentations, one of which is shown in Fig. 5 and numbered 97. Such ribs inhibit longitudinal collapse of the bladder while permitting lateral compressibility. The bladder is supported between the cylinder 87 and the head 83 by means of a clamped flange 99. The short line 79 communicates with the interior of the bladder through a connection 101 in which is a check valve 103 such as used on automobile tire inlets. This allows inward flow of air but checks outward flow.

Beneath the opening 105 which admits air from the head 83 into the bladder 93 is a rigid angled plate 107 attached to the head 83. This plate is not in the nature of a check valve but merely acts as a guard over the port 105 to prevent any adjacent portions of the bladder 93 from being jammed into the port 105 under possible extreme conditions of collapse.

The purpose of the screen 91 is to prevent the bladder 93 from expanding into the connection 89 under any possible extreme conditions of expansion.

Operation is as follows, assuming that an air line connection is made with the fitting 65 so as to deliver air to the chamber 33. The pressure is at ordinary line pressure such as will be found at most garages, say of the order of 150 to 200 p. s. i. It is also assumed that the valve at the end of line 75 is open. Starting with conditions such as shown in Fig. 2, the air will enter the port 69 and pass through the passage 67 to the top of piston 37. The piston will be driven down thus to drive down the pump piston 9 for transfer of lubricant from the bottom side to the top side of the piston. Since the pressure required to move the piston 37 under these conditions is not the full 150 to 200 p. s. i. and since the valve port 59 is relatively small, there will be a throttling action of the air through that port 59 so that the pressure in the passage 67 and above the piston 37 does not reach full line pressure. For example, it will become 90 p. s. i. This reduced pressure is communicated through port 77, line 79 and check valve 103 to the interior 95 of the bladder 93 thus tending to expand the bladder. After the piston 37 has descended, the D-valve 53 becomes tripped to cut communication of air from the valve chamber 33 to the top of the piston, and establish communication through port 57 and passages 69, 71 and 73 with the lower side of the piston 37, thus driving the piston upward. This discharges the lubricant on the upper side of the pump piston 59 out through the port 27, passage 89 and outlet pipe 75. As above stated the friction in the outlet line 75 requires a higher operating air pressure than the above stated 90 p. s. i. Thus, although the port 57 is also a restricted port, the piston does not move until time has allowed pressure to be built up sufficiently for the purpose. This pressure will be much closer to the line pressure of 150 to 200 p. s. i. At this time the previously applied 90 p. s. i. pressure in the bladder 93 is trapped therein by the check valve 103. Thus the larger pressure in the communicating passage 89 will constrict the bladder 93 against its lower interior pressure.

It will be seen that upon the next downstroke of the piston 37 there would ordinarily be no more sustaining pressure in the line 75. The resulting variations in pressure in the line 75 are the cause of the stated surging or spurting action for which it is designed to compensate. The compensation is provided by the fact that when the piston 37 is descending, the resilient air pressure in the bladder 93 will tend to re-expand it and thus supply pressure for continued flow in the line 75. While the lubricant flow supplied under the expansive action of the bladder 93 (during downward movement of the piston 37) is not under the higher pressure supplied by the upward movement of the piston 37, it is nevertheless under the substantial pressure of 90 p. s. i. or so. Thus is avoided the surging or spurting which normally would be caused by intermittent almost complete loss of pressure. Thus compensation is effected during the low pressure part of the cycle of the lubricant pump 1 and a relatively smooth non-spurting and non-surging flow is obtained in the pipe 75.

The purpose of the check valve 103 is to maintain the pressure in the bladder 93 during periods when the passages 67 and 77 are at exhaust pressure. It will be noted in this connection that upon every cycle of the apparatus a pressure impulse is applied to the valve 103. If perchance during idle periods leakage of pressure should have occurred from the bladder 93, it will upon starting be made up by the reception of air from passages 67 and 77. Thus an operator is assured that whenever his pump is coupled to the air supply line at the coupler 65 his compensator will become charged and will automatically remain charged.

A feature of the invention particularly to be noted is that the bladder connection is made to the low-pressure connecting port 67, as distinguished from the high-pressure connecting port 69. Consequently, the bladder is of a more resilient nature than it would otherwise be; or, stated otherwise, its coefficient of volumetric change is higher. Hence the compensator cylinder 87 will receive a larger volume of lubricant upon a pressure stroke of the pump 1 so as to have this larger volume available for a longer period of compensated flow between surges, thus more effectively smoothing out the flow. If the bladder 93 is pumped up too hard, as by direct application of air line pressure, then the effective compensation becomes too small.

It will be noted that the invention avoids the ineffectiveness of merely directly charging a compensating bladder from a point ahead of D-valve 53, that is, from the main air line or the equivalent.

It will be observed from the above description that the invention is operative in principle for a substantial range of line pressures found at most garages. However, the pressure reduction in passages 67 and 77, due to throttling action through the valve port 59, may be different for different line pressures and also for different designs of port 59 and passages 67 and 77. With the apparatus shown, for optimum or near optimum results, the reduced pressure in passages 67 and 77 is of the order of 90 p. s. i. or so, for a line pressure of 150 to 200 p. s. i., as above described. In the cases of other port designs, for optimum results, other line pressures may be desirable in order to obtain the most desirable relative pressure conditions in passage ports 67 and 77. To obtain such other line pressures, if the normal air-line pressure is too high, an ordinary pressure-reducing regulator (not shown) may be used to control the line pressure which enters the fitting 65.

It is to be understood herein that the invention is applicable to all liquid pumps with direct-connected reciprocating air engines which are essentially of the single-acting variety. The term single-acting as applied to the liquid pump is not to be construed as limited to pumps wherein all of the pumping action is on one stroke; but it is intended to apply to pumps wherein a preponderating part of the pumping action is on one stroke. It is this preponderance of pumping action that accounts for the different pressures carried in the air passages leading from the valve of the direct-connected engine, and advantage is taken of this by connecting the expansive compensator with the air passage in which the lower air pressure occurs.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As many changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

We claim:

1. A surge compensator for a reciprocating liquid pump having a direct-connected reciprocating-piston air engine, the pump having an outlet liquid passage and the air engine having an automatic valve control for its air supply and having air passages leading from the valve control to opposite sides of the piston; comprising means providing a space communicating with the pump outlet, a resilient member in said space exposed on one side to liquid pressure in the space and on the other side to air pressure, and means for communicating air pressure to the air-side of the resilient member from one of said air engine passages.

2. A surge compensator for a reciprocating liquid pump requiring more pressure on one stroke than the other and having a direct-connected reciprocating-piston air engine, the pump having an outlet liquid passage and the air engine having an automatic valve control for its air supply and having air passages respectively carrying different air pressures and respectively leading from the valve control to opposite sides of the piston; comprising means providing a substantial space communicating with the pump outlet, a resilient and substantially expansible member in said space exposed on one side to liquid pressure in the space and on the other side to air pressure, and means for communicating air pressure to the air-side of the resilient member from the one of said air engine passages which carries the lowest air pressure.

3. A surge compensator for an essentially single-acting reciprocating liquid pump having a direct-connected reciprocating-piston air engine, the pump having an outlet liquid passage and the air engine having an automatic valve control for its air supply and having air passages respectively carrying different air pressures and respectively leading from the valve control to opposite sides of the piston; comprising means providing a substantial space communicating with the pump outlet, a substantially resilient bladder member in said space exposed on one side to liquid pressure in the space and on the other side to air pressure, and means for communicating air pressure to the air-side of the resilient bladder member from the one of said air engine passages which carries the lowest air pressure.

4. A surge compensator for a reciprocating liquid pump requiring more pressure on one stroke than the other and having a direct-connected reciprocating-piston air engine, the pump having an outlet liquid passage and the air engine having an automatic valve control for its air supply and having air passages respectively carrying different air pressures and respectively leading from the valve control to opposite sides of the piston; comprising means providing a substantial space communicating with the pump outlet, a substantially resilient member in said space exposed on one side to liquid pressure in the space and on the other side to air pressure, means for communicating air pressure to the air-side of the resilient member from the one of said air engine passages which carries the lowest air pressure, and a check valve in said communicating means for freely admitting air under the last-named air pressure to said resilient member but preventing escape of said air in the absence of said last pressure.

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