Dec. 24, 1946. A. BURGER 2,413,136

POSITIVE OIL FEED PUMP BY MINUTE DROP-LIKE VOLUMES

Filed April 13, 1944

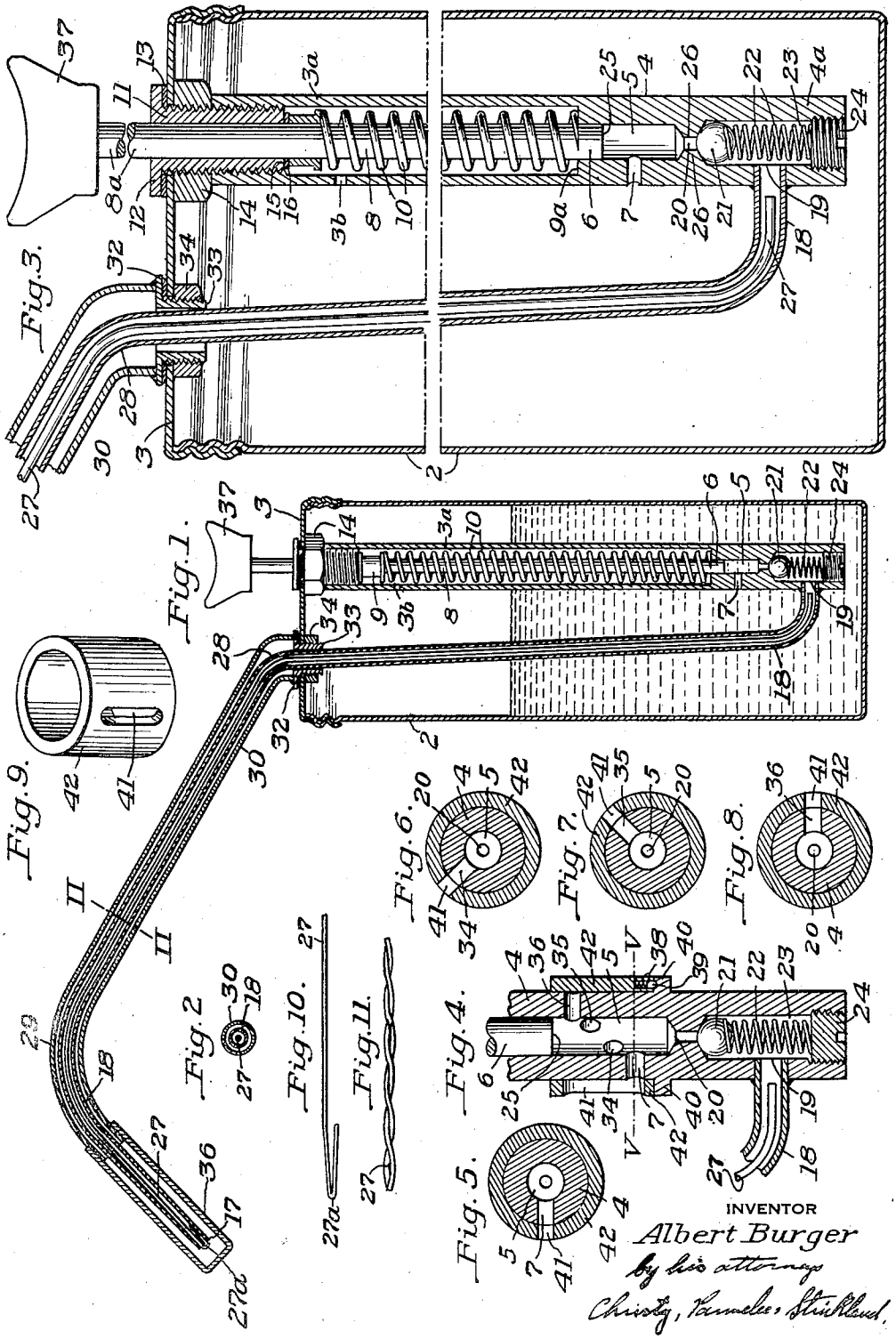


Fig. 3.

Fig. 1.

Fig. 9.

Fig. 6.

Fig. 7.

Fig. 8.

Fig. 2.

Fig. 10.

Fig. 11.

Fig. 4.

Fig. 5.

INVENTOR
Albert Burger
by his attorneys
Christy, Parmelee & Strickland

Patented Dec. 24, 1946 2,413,136

UNITED STATES PATENT OFFICE

2,413,136

POSITIVE OIL FEED PUMP BY MINUTE DROP-LIKE VOLUMES

Albert Burger, Millvale, Pa.

Application April 13, 1944, Serial No. 530,931

6 Claims. (Cl. 222—282)

1

This invention pertains to oil cans and like dispensing devices, and is for an oil can of the type using a plunger pump to procure positive discharge of lubricant therefrom. More especially, the present invention is for a dispenser of this type which will discharge only a small uniform quantity of liquid with each stroke of the piston.

In various industrial fields it is desirable to lubricate more or less frequently certain moving parts, but at the same time it is equally important to avoid excessive amounts of oil, a single drop or two, usually being sufficient. Usual diaphragm bottom oil cans of the familiar type are inadequate, first because they must be held in an inverted position and, secondly, because a uniform discharge of oil is not secured. Pump oilers have been devised and are in general satisfactory, in which the oil is positively discharged by the action of a small pump, making it unnecessary to invert the oiler and giving a pressure discharge, but such devices are difficult to control where only a drop or two of oil is desired due to the relatively large volume of oil which is discharged with each stroke of the pump.

My invention provides a pump-type oiler of simple and economical construction in which each stroke of the piston or plunger, no matter what its overall travel may be, will result in only one drop of oil being discharged, or in lieu of one drop, some predetermined uniform small amount. This in general is accomplished by the provision of a pump cylinder with a free opening therethrough near its discharge end so that until the plunger of the pump passes such opening any oil in the cylinder is expelled into the vessel in which the cylinder is contained instead of being forced into the discharge nozzle of the device, and only the measured charge of oil that remains after the bulk of it has escaped will be expelled into the dispersing tube or nozzle.

My invention further provides in an oiler of this kind a discharge tube so constructed as to retain by capillary action a quantity of oil so that excessive priming is unnecessary even though the dispenser be only infrequently used, and which incidentally will otherwise improve the operation of the device.

While my invention is primarily applicable to oil cans, it may be used for the dispensing of other fluids, and is not restricted to oil dispensing.

One of the objects of the present invention is to provide a pump for delivering by positive feed relatively minute volumes of liquid upon each stroke of the piston, irrespective of the particular length or travel of the piston, in order

2

to overcome some of the objections and difficulties incident to and inherent in the prior art structures.

A further object is to provide a liquid pump of the drop-feed type, having its parts, including the outlet delivery duct, of such a character and so disposed relative the structural and functional operating parts of the pump as to be readily primed in starting the operation thereof in a relatively short period of time and requiring a minimum number of strokes of the pump.

In the accompanying drawing one selected embodiment is shown for purposes of illustration only, and not necessarily for the purposes of limitation, as various changes in construction and arrangement may be made by those skilled in and familiar with the art, without departing from the spirit of the invention.

In the accompanying drawing

Figure 1 is a general assembly showing a section in a vertical plane, showing the pumping unit mounted on the detachable cover of the liquid container;

Figure 2 is a section of the delivery conduit or spout taken on the line II—II of Figure 1 and shows more clearly the relative position of the wire within the delivery duct of the conduit which carries the liquid, and also the outer protective tubular casing for the delivery conduit within;

Figure 3 is an enlarged broken section in a vertical plane showing more clearly the structure and relation of the parts of the pumping unit and also of the manner of assembly and mounting of the parts upon the cover of the receptacle containing oil or other liquid to be supplied in minute quantities;

Figure 4 is an enlarged fragment in vertical section showing a modified form of the pumping unit employing manual means for selectively varying the quantity of liquid dispensed with a constant overall length of piston stroke and more particularly shows a plurality of valveless or free intake passages disposed in the cylinder wall, and leading to the cylinder chamber at various distances from the outlet port at the delivery end of the cylinder chamber, which port is closed by an outwardly yielding check valve;

Figure 5 is a section taken on the line and looking in the direction of the arrows V—V of Figure 4 and shows the manually adjustable selective means for varying the volumetric delivery from the pumping unit, even though the piston stroke be uniform in extent of stroke and rate of speed, and shows the manually adjustable selective

means in a position about the cylinder wall in which each one of the plurality of free passages in the cylinder wall are closed, excepting the bottom unobstructed inlet passage, which is nearest the outlet aperture at the delivery end of the cylinder chamber, so that the smallest amount of liquid will be delivered upon each stroke of the piston;

Figures 6, 7 and 8 are sections similar to Figure 5, excepting that the manually adjustable sleeve-like member movable about the cylinder, has been moved to a position in which the aperture in the adjustable member is in alignment with each of the other three unobstructed inlet passages shown in Figure 4 and disposed at different distances from the outlet port of the cylinder chamber;

Figure 9 is an enlarged perspective view of the sleeve-like adjustable selective member which slides about the cylinder so that the slotted aperture therein may be aligned selectively with any one of the plurality of free inlet passages leading to the cylinder chamber and sealing the others, as desired to vary the volumetric delivery from the pump;

Figure 10 is an enlarged view of the end of a piece of wire that may be inserted within the duct of the conduit delivering the liquid from the pumping unit, and shows more clearly the hooked end at the end of the wire, which hooked end is within the outlet aperture at the end of the delivery duct, and serves to facilitate the maintaining of the liquid within the duct by a capillary-like effect; and

Figure 11 is an enlarged view showing a modified arrangement employing a pair of twisted wires that may be inserted in a delivery duct of a conduit of larger size, but yet obtaining a capillary-like action by the presence of the larger surface presented by the pair of twisted wires within the duct of the delivery conduit.

As shown in the drawing a container 2 is provided for holding the liquid to be delivered in the minute quantities in volumes of one or more drops upon a single stroke of the pump piston. Oil is one of the liquids that may be used, but it is understood that other liquids might be used and that the invention is not to be limited to oil.

As shown, a detachable cover 3 is provided for the container 2 and preferably, although not necessarily, an arrangement and construction is employed wherein the pumping unit and the delivery or feed conduit or spout are removable with the detachable cover 3 for purposes of convenience, as a single compact unit. It is understood, however, that the intrinsically novel features of the invention hereinafter to be more fully disclosed, may be employed without necessarily being limited to the removability of the cover, together with the pump and outlet spout associated therewith as a compact unit.

As shown, the pumping unit support includes an elongated tubular member 3*a*, which is provided at its lower end, adjacent the bottom portion of the container where the end portion will be submerged within the liquid with the effective functioning portions of the pumping unit including a cylinder 4 having a cylinder chamber 5 therein, piston 6, an inlet passage 7. The inlet passage 7 is free and valveless, and affords continuous and uninterrupted communication between the cylinder chamber 5 and the liquid within the container 2, for all periods and conditions, except those during which the inlet passage and port 7, is covered by the piston 6. The particular arrangement and relation between the intake passage 7, and the other parts will hereinafter be more fully considered. It is pointed out that while the member 3*a* is shown as a long cylindrical member, extending from the top of the container to a point near the bottom thereof, the parts performing the pumping function proper, to obtain a positive feed of relatively small volumes of liquid, are disposed at a lower portion of the extended tubular member 4.

The upper elongated portion of the tubular member 3*a*, above the pump functioning parts at the lower end thereof, serves as a convenient structure for supporting the pump unit on the cover 3, and for housing other elements such as the piston stem portion 8, which extends upward from the piston 6, through the cover 3 to a point outside the container where the piston stem 8 may be actuated by manual operation as by a knob or handle 37, or by a suitable power means not herein shown. A suitable vent aperture 3*b* may be provided in the tubular member 3*a*, for air and oil.

A suitable stop 9 is secured on the piston stem 8 in order to limit the upward movement of the piston stem 8. A coiled helical spring 10 is positioned within the tubular member 3*a* through which coiled spring 10 the piston stem 8 passes. One end of the spring 10 engages the stop 9 on said stem 8, and the other end of the spring engages a fixed point or shoulder 9*a* within and at the bottom of the elongated tubular body 3*a*. When the piston stem 8 is pressed downward during the work stroke of the piston 6 within the pumping unit, the spring 10 is compressed, said spring 10 serving to return the piston stem 8 to its original position.

Referring to the particular preferred structure as shown for mounting the pumping unit upon the cover 3, reference may be made to the enlarged section in Figure 3. As a convenient means for mounting the elongated tubular member 3*a*, there is provided an internally threaded portion at its upper end adapted to receive the threaded end portion of the bushing 11. The threaded portion of the bushing 11 extends through an aperture in the cover 3. The end of the bushing is provided with an annular flange 12, which forms a shoulder to engage the outer face of the cover, a suitable packing washer 13 being provided between the flange 12 and the outer face of the cover 3. As shown, a nut 14 is threaded on the portion of the bushing 11 extending through the aperture, said nut 14 engaging the under side of the cover preferably through another packing washer (not shown), which is interposed between the upper face of the nut 14 and the lower side of the cover 3. The upper end of the tubular member 4 is shown threaded on the downwardly projecting threaded end of the bushing 11 so as to engage the nut 14. It will be noted that as shown, the lower end or face 15 of the bushing 11 serves as a stop which engages the stop member 9 which may be suitably adjustably secured upon the stem member 8 in any well known conventional manner. Preferably, a packing or sealing washer 16 is interposed between the upper end of the stop 9 and the bottom face 15 of the bushing 11. It is understood that one means of determining or varying the limit of the movement of the stroke of the piston 6 within the cylinder chamber at the lower end of the cylindrical member 4, is to adjust the position of the stop 9 upon the upwardly projecting piston stem 8. If desired, more assessable means of conventional structure may be arranged

above the cover 3 adjacent the projecting end 8a of the piston stem 8. A finger rest or knob 37, of any suitable character, may be detachably mounted at the end of the stem 8a. As will hereinafter more fully appear, a change or modification in the length of the piston stroke, will not necessarily change the volume of the liquid which is delivered from the outlet end 17 of the outlet spout or conduit 18.

The lower end of said conduit 18 is connected in a suitable manner to the passage 19 through which the liquid passes as received from the cylinder chamber 5 after said liquid has been forced through the outlet port and valve aperture 20, at the end of the cylinder chamber 5. The valve aperture 20 is closed by the outwardly yielding ball check valve, comprising the ball 21, which is held against the lower side of the valve aperture 20 by the coil spring 22. The ball valve and spring are retained in proper position within the chamber 23 which chamber extends inwardly from the bottom of the tubular portion 4a by the screw plug 24 which is threaded in the end of the chamber 23. The removal of the plug 24 located near the passage at the end of the conduit 18, serves as a convenient means of cleaning any obstructions from the conduit 18 by forcing a flexible wire through the duct of the conduit 18.

It is to be noted that the structure as shown in Figure 3 adapts itself to expeditious and economical manufacture inasmuch as the pump cylinder chamber 5, and the chamber 23, on opposite sides of the valve aperture 20 may be readily formed by drilling operations from opposite ends of the tubular member 3a, 4a. The valve aperture 20 may be readily formed by drilling from the lower end of the tubular portion 4a.

The intake passage 7 through which the liquid is drawn into the cylinder chamber 5 of the pump, is disposed in the wall of the cylinder at a point intermediate the two limits of travel of the end 25 of the piston 6. As before indicated, the intake passage 7 or any duct leading thereto, is provided with no valve, but is free, open and unobstructed at all times, except during those periods in that portion of the stroke of the piston 6 in the downward power or work stroke of the piston 6, when the end 25 of the piston has been lowered to a point just below the intake passage 7. During such period, of course, the inner intake port of the intake passage 7 will be covered by the piston 6 and will remain so covered during the effective portion of the power or work stroke of the piston, in moving from the intake passage 7 downward to the end of the work stroke, to a point adjacent the valve aperture 20 within the inwardly extending webs 26 forming the valve seat for the ball 21.

During the movement of the power stroke of the piston end 25 from the intake passage 7 to the end of the power stroke, the volume of liquid previously confined or lodged within that portion of the cylinder chamber would be forced downward through the valve aperture 20. The outwardly yielding check valve 21 is unseated by the piston pressure of the confined liquid through the valve aperture 20. Assuming that the outlet delivery conduit 18 has been thoroughly primed, so that the volume or space within said outlet delivery conduit 18 has been completely filled with the liquid, the volume of liquid projected or forced from the outlet end 17 of the delivery conduit will be represented by the amount or volume of liquid that was displaced from the

cylinder by the piston in its movement from the lower side of the inlet passage 7 to the end of the power stroke. The proximate relation of the ball check valve 21 and the valve aperture 20 to the end of the working stroke of the piston, is one feature of importance in assuring a positive delivery of such relatively small volumes of liquid upon each stroke. If the check valve were positioned at a point a substantial distance from the end of the cylinder, a certain volume of the liquid in the duct between the end of the piston chamber and the check valve might be returned or withdrawn into the cylinder chamber by a re-expansion effect upon the initial portion of the return stroke of the piston, and interfere or prevent the normal feed of the correct volume of liquid to the cylinder chamber for positive delivery on the next working stroke of the piston.

One important and critical aspect of a pump unit of this character which positively feeds, by piston volume displacement, such minute volumes measured in drops, resides in the fact that if an outlet feed spout or conduit is provided with a diameter throughout its length which is relatively large, or if provided with an outlet aperture at the delivery end of the nozzle which is not sufficiently restricted, difficulties would be encountered in obtaining the proper and desired positive control of the drop by drop feed. Part of this difficulty might result from the surface tension property or characteristic of the liquid. For example, a single drop of the liquid if forced into a relatively large volume of liquid contained in the delivery tube, might be sufficient to cause an increase in the pressure within the duct of the delivery tube, but such pressure might not be sufficient to force a drop of the liquid from the delivery end of the spout due to the elastic or yielding effect of the surface tension characteristic of the liquid at the delivery outlet end 17. This might cause an effect comparable to what might be termed a dangling or hanging drop effect, rather than positive clean-cut feed of a drop of the liquid. Perhaps one example, which has been observed and which might serve to illustrate the effect and difficulty above referred to, is that observed in a leaky water faucet where an irregular and dangling effect of a volume of suspended water has been observed from the outlet end of the faucet. This rather crude or homely illustration is referred to as a means of indicating the nature and reality of the problem involved in obtaining a satisfactory type of feed pump, and associated delivery spout, in order to obtain a positively controlled clean-cut drop-by-drop feed.

From the practical standpoint, there are practicable factors tending to limit the smallness of the size of delivery conduit that may be employed. One of such factors is that, even though a tubular delivery conduit of very small size may be obtained, it is undesirable that the size of the duct within the delivery conduit be so small as to be readily clogged or obstructed so as to interfere with the flow of the liquid. Another practical factor is the cost of such a fine tube, together with the fact that such a small and delicate tube may be readily damaged or injured in use.

It has been determined that a satisfactory positive feed of the liquid may be obtained when a delivery outlet spout or conduit 18 is employed, which is provided with a duct therein of such a size as will require a priming operation of from 8 to 10 strokes of the piston 6, before the

liquid will be delivered from the outlet end 17 of the delivery spout or conduit 18. This means that the delivery conduit is provided with a duct therein throughout its length, such that the volume of said duct is represented substantially by a volume of from 8 to 10 drops of the liquid. A delivery duct having such characteristics is about 10 inches long, has an outside diameter of $\frac{3}{32}$ inch and an inside diameter of about $\frac{1}{32}$ inch. Other larger delivery tubes were employed and found unsatisfactory where the volume within the duct of the tube required a priming operation of as many as 125 strokes of the piston. The volumetric capacity of the duct within the delivery conduit 18 may vary but preferably should not exceed a capacity of approximately eight drops.

One further important feature of the invention, which is a factor which deals with the problems above referred to, and enables such problems to be dealt with and solved in a practical manner, so as to enable a relatively rugged and larger sized delivery conduit or spout to be used, is to provide one or more twisted flexible wires 27 that are inserted within the duct of the delivery conduit for either a portion or substantially the entire length thereof. The advantage of such an arrangement in the utilization of the flexible wire or wires 27, is that, dependent upon the size of the wire and the duct within the delivery conduit, a combination of elements is afforded which makes possible the use of a larger and more rugged and substantial sized delivery conduit or tube. The presence of the wire within and throughout a substantial portion of the length of the duct within the conduit occupies a portion of the volume which otherwise would have to be taken up by an excessive and objectionably larger volume of the liquid. Further, the increased surface contact between the wire and the liquid, serves as a medium to increase resistance to the flow and/or drainage of liquid from the delivery tube, and helps to maintain the duct of the delivery spout 18 in a filled condition at all times, so as to minimize the necessity for frequent priming. With a structure affording relatively large surfaces in contact with small volumes of liquid in a restricted duct, the forces comparable or incident to capillary action may be effective to contribute towards maintaining the delivery duct in a full condition to minimize, if not eliminate, the necessity for frequent priming operations.

In actual operation it may be desirable to provide a protective covering or protection for the portion of the delivery conduit or spout 18, as shown in Figures 1 and 3, wherein the conduit 18 extends through an aperture in the cover 3, and is provided with a bend as at 28 of less than 90° to the vertical, so as to extend to one side for a convenient length to a point such as that designated as 29, from which point preferably the conduit is bent downward somewhat, in order to permit of the ready delivery of the liquid a drop at a time, without having to tilt the main container holding the liquid and pumping unit.

In order to afford a protecting casing for the portion of the delivery conduit 18, extending through the cover 3, there may be provided, as more clearly shown in Figure 1, a protecting armor or tubing 30 which extends from the point at which the conduit 18 emerges from the top to the end 17 of the conduit 18. In the preferred form shown in Figure 1, the one end of the tube 30 may be suitably secured in any suitable manner, as for example, by soldering or welding to the top flange portion 32 of the bushing 33. The bushing 33 is provided with a threaded portion which extends through an aperture in the cover 3, a nut 34 being threaded on the bushing to retain the bushing in fixed relation to the cover 3 and to form a suitable support for the protecting tube 30 within and through which extends the delivery conduit 18. A removable cap 36 may be provided to protect the outlet end 17 of the conduit 18.

If desired, in order to impart to the pumping unit a characteristic wherein with a fixed length of the full working stroke of the piston 6, a variable volume delivery may be effected, an arrangement such as that more clearly shown in the modified form Figure 4 may be employed. As above indicated, delivery of a minute volume, such for example, as a drop at a time, was referred to. However, if it is desired to deliver a larger volume, such for example, as a number of drops of the liquid with each full working stroke of the piston 6, such increased volumetric delivery may be readily and conveniently effected by providing a plurality of additional inlet passages 34, 35, 36 spaced at increasing distances from the lower end of the cylinder chamber 5.

When the intake passage 7 is being employed to deliver the smaller volume of the liquid, the passages 34, 35, 36 may be closed by a suitable means, such for example, as by the sleeve-like member 42 having a slotted aperture 41 movable about the cylinder 4. It is pointed out that the intake passages 34, 35, 36 need not necessarily be closed in order to have the smaller quantity of liquid delivered or positively forced from the cylinder chamber 5.

However, when it is desired to feed a larger volume of the liquid from the cylinder chamber 5, with the same working stroke of the piston 6, it will be necessary to close the intake passage 7, or any other intake passages between the outlet port 26 and the free intake passage being used. Under such conditions, with one of the intake passages 34, 35, 36 open, a larger volume of liquid, measurable in a plurality of drops, will be positively forced within the delivery conduit 18, from the cylinder chamber 5 upon each working stroke of the piston 6. Such greater volume of liquid would be represented by the volume contained within the cylinder chamber 5 from the outlet port 20 up to a point just below the particular intake passage which would be open under the conditions assumed.

When any one of the intake passages, such for example, as intake passage 7, is being employed, only a fixed and definite volume is delivered, irrespective and independent of the length of the work stroke of the piston. Insofar as applicant is aware, this feature constitutes one of the unique and important features of the present invention which appears to be broadly new.

Figures 4 to 9 inclusive, shows one specific modified form as a selected embodiment illustrative of one of numerous other equivalent structures which may be employed in order to vary the volume of the liquid which is forced from the cylinder chamber to the delivery spout, upon each stroke of the piston, even though the stroke be of a fixed and uniform length, and moved at a uniform rate of speed, corresponding to a uniform number of strokes per unit of time such as a minute, for the variable volumetric delivery. As shown in Figure 4, an enlarged fragment of the pumping unit is shown having

its various main cylinder and piston parts disposed similar to those shown in Figure 3 as hereinbefore described. The difference in the modified form shown in Figure 4 is that a plurality of free and unobstructed intake passages 7, 34, 35, 36 are shown extending through the wall of the cylinder at different distances from the outlet port 20 at the end of the working stroke of the piston 6.

The volume of liquid may be selectively varied by providing adjustable means whereby, selectively, communication for any one of the unobstructed and free inlet apertures between the cylinder chamber, and the liquid outside of the pump, may be established, while each of the other outlet apertures are sealed. In this manner, the volume of liquid delivered may be varied because of the different volumes of liquid that will be trapped or contained within the cylinder chamber between the outlet port therein at the bottom, and the free intake passage, depending upon which one of the particular intake passages is free and unobstructed, so as to afford communication with the liquid outside of the cylinder.

Referring to Figure 4, and Figure 9, there is provided a sleeve-like member 42 which surrounds and fits snugly about the cylinder 4 and is adapted to move relative to the cylinder and to slide circumferentially thereabout to different positions which may be determined by a spring-pressed detent 38 which may fit within a series of recesses 39 in the upper side of the annular flange 40 surrounding the cylinder on which the sleeve-like member 42 rests. The sleeve-like member is provided with a slotted aperture 41 which is of a width corresponding substantially to the size of the various free inlet passages 7, 34, 35, 36 so that the slotted aperture 41 may be moved about the cylinder selectively to a line wth any one of the plurality of intake passages 7, 34, 35, 36 which are disposed at different distances from the end of the cylinder chamber, and are also angularly offset from each other and are disposed on different radii extending from the axis of the cylinder. This relative arrangement is more clearly shown in Figures 5 to 8.

While one preferred form of the invention has been shown and described herein for purposes of illustration, it is understood that various changes and modifications in detailed construction and arrangement may be made by those skilled in and familiar with the art, without departing from the spirit and scope of the invention as defined by the appended claims.

I claim as my invention:

1. A pump oiler of the class described for feeding small uniform quantities of liquid comprising a vessel, a pump cylinder in the vessel, a piston reciprocable in the cylinder, a fluid outlet port at the bottom of the cylinder, an outwardly yielding check valve for said port, a discharge tube leading from the valve to the exterior of the vessel, there being a plurality of free openings at different elevations in the cylinder between the outlet port and the upper limit of travel of the piston, and manually adjustable means for selectively closing all of said openings but one.

2. In a pump of the type for delivering minute volumes of liquid measurable in drops independent of the length of the full stroke of the piston in the cylinder, the combination including a pump, said pump including a cylinder having a cylinder chamber and a piston, an outlet port from said cylinder chamber, a delivery conduit connected with said outlet end of the cylinder, a plurality of inlet passages or ports to said cylinder chamber disposed at different distances from the end of the piston stroke at the outlet end of the cylinder for conducting the liquid material to said cylinder chamber, said inlet port being spaced from said outlet port and affording open and continuous communication between the cylinder chamber and the liquid material in the container, except at such times as when said inlet passage is covered by said piston means for closing all but one of said plurality of inlet ports, and an outwardly yielding check valve disposed at a point spaced from said inlet port a distance determined by the volume of liquid desired to be displaced, and the volume of liquid delivered through said outlet being independent of the length of the full stroke of the piston on its return stroke beyond the inlet passage, said check valve being disposed between said outlet port from said cylinder chamber and said delivery conduit, said outwardly yielding check valve being so disposed and arranged as to permit the flow of liquid to the outlet end of the delivery conduit during that portion of the work stroke of the piston, represented by the distance of the piston travel from the normal open inlet port to the end of the work stroke of the piston.

3. A pump as defined in claim 2 wherein the distance travelled by the piston from any one of the open inlet ports to the end of the work stroke of the piston represents a distance less than the total travel of the work stroke of the piston, the total distance travelled by the piston including a preliminary travel before reaching and closing any one of the inlet ports, said preliminary travel serving as a scavenging portion of the piston work stroke to force any volume of liquid within the cylinder between any one of the plurality of inlet ports when open and the end of the retracted or intake end of the piston stroke, said liquid being forced outward through any one of said inlet passages when open to maintain said inlet ports when open and passage in a clear and unobstructed condition, the remaining portion of the delivery or work stroke of the piston, between the intake port and the end of the work delivering stroke, serving to force the required minute volume of liquid past the outwardly yielding check valve and through the outlet end of said delivery conduit, the first portion of the return stroke of the piston up to the inlet port, serving to form a reduced pressure or vacuum zone, facilitating the intake of the liquid to the cylinder chamber after the piston on its return stroke has uncovered any one of said inlet ports when open, the remaining portion of the travel of the piston on its return stroke after said inlet port has been opened, serving as a suction stroke to draw in a scavenging volume of liquid through said intake port, which scavenging volume of liquid is again returned and forced through said inlet port in an opposite direction during the first portion of the work stroke of the piston up to the point where the intake port is again covered by the piston on its work stroke.

4. A pump as defined in claim 2 and including means comprising one or more supplementary free intake passages disposed and arranged in the wall of the cylinder chamber at a point between said first free intake passage and the end of the normal full return stroke of the piston.

5. A pump oiler of the class described for feeding small uniform quantities of liquid comprising a vessel, a pump cylinder in the vessel, a piston

reciprocable in the cylinder, a fluid outlet port at the bottom of the cylinder, an outwardly yielding check valve for said port, a discharge tube leading from the valve to the exterior of the vessel, there being a free passageway through the cylinder intermediate the upper and lower limits of travel of the piston, the volumetric capacity of the cylinder from the said outlet port at the bottom to said free passageway is substantially less than the volumetric capacity of the delivery tube whereby several operations of the pump are required to fill the tube, and including a wire in said delivery tube for reducing its overall capacity and providing extended contact area with the liquid and providing restricted liquid volume

to serve as a capillary means for partially retaining oil in the tube.

6. A pump as defined in claim 1 wherein said last named adjustable means for selectively closing all but one of said plurality of inlet openings disposed at different distances in the cylinder from the outlet port, includes a movable member having an aperture therein adapted to be selectively moved to different positions in alignment with any one of the plurality of inlet openings, whereby the volumetric capacity of liquid delivered by said pump per full working stroke may be varied independent of the length of the full piston stroke.

ALBERT BURGER.