LIQUID FILLING DEVICE

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9 Claims.

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This invention relates to an improved device for filling containers, and more particularly, to an improved device for sub-surface introduction of a liquid into a container rapidly and without foaming or similar difficulties.

The instant device may be used for filling barrels, drums, or similar shipping and storage devices. Hereforo, the usual practice was to fill barrels or drums with liquid by gravity flow, but such procedures are relatively slow and for this and other reasons leave something to be desired. Attempts have been made to pump liquid under pressure but this often leads to air occlusion in the liquid, with resulting foam production in the case of many liquids.

In U.S. Patent No. 2,702,684, issued to MacLeod et al. on February 22, 1955, there is described a sub-surface filling method and apparatus allegedly employed for rapid liquid filling of containers. The MacLeod device is actuated by electric circuits operating in response to signals from a weighing scale. This device depends upon a number of variables for its operation and involves a relatively complicated and expensive circuit and signal system. In addition, the operation of this device involves the withdrawal of a filling tube full of liquid from the substantially filled container at the end of the cycle, and this necessitates compensation for the volume of liquid corresponding to the volume of the withdrawn tube full of liquid.

In contrast, the instant invention resides in a greatly simplified device adapted for simplified operation. For example, the withdrawal of the MacLeod filling tube is dependent upon the filling of the container with a certain preselected weight of liquid, whereas the tube in the instant invention is initiated and compensation (by overfilling of the can or otherwise) must be made for this loss in volume within the container represented by the volume of the tube itself. In contrast, in the instant device the tube is left open during withdrawal and all of the liquid contained therein is retained in the container itself. The structural elements of the tube have a negligible volume, so that compensation therefore is not required or at least is greatly simplified.

The instant device is simply constructed, sturdy and easily operated without the necessity for complicated circuits and the like. It is, therefore, an important object of the instant invention to provide an improved apparatus for sub-surface introduction of liquid into a container.

It is another object of the instant invention to provide a filling device for introducing liquid into a container, comprising an elongated vertically positioned filling tube, a foot valve affixed to the lower end of the tube, means for vertically lowering and raising said filling tube, means for opening and closing the foot valve, whereby liquid flowing through the tube while in its lowered position may be introduced into a container at a point beneath the liquid level in the container, an overflow reservoir at the upper end of the tube for maintaining a liquid level in the reservoir and overflowing liquid into said tube, and a source of liquid communicating with said reservoir below the level therein.

Still another object of the instant invention is to provide a filling device for introducing liquid into a container, comprising an elongated vertically positioned filling tube, a foot valve affixed to the lower end of the tube, means for vertically lowering and raising said filling tube, means for opening and closing the foot valve, whereby liquid flowing through the tube while in its lowered position may be introduced into a container at a point beneath the liquid level in the container, an overflow reservoir at the upper end of the tube for maintaining a liquid level in the reservoir and overflowing liquid into said tube, and a valve means for selectively closing the top of the tube when it is in lowered position or the top of the tube when it is being raised to permit drainage of liquid therefrom.

Other and further objects, features and advantages of the present invention will become apparent to those skilled in the art from the following detailed disclosure thereof and the drawings attached hereto and made a part hereof.

In the drawings:

FIGURE 1 is an essentially diagrammatic view, showing a filling device embodying the instant invention in elevation with parts shown in section, this view showing the filling tube in lowered position;

FIGURE 2 is an essentially diagrammatic view corresponding to the view of FIGURE 1, except that the filling tube is shown as it is being raised;

FIGURE 3 is another view corresponding to FIGURES 1 and 2, except that the filling tube is shown in the raised or "idle" position;

FIGURE 4 is a fragmentary enlarged sectional view of the lower end of the filling tube.

As shown on the drawings:

In FIGURE 1, a filling device is indicated generally by the reference numeral 10 and a drum to be filled is indicated by the reference numeral 11. The filling device 10 comprises an elongated vertically positioned filling tube 12 and an air cylinder 13 adapted to vertically lower and raise the filling tube 12. The air cylinder 13 comprises a movable piston 14 carrying a rod 15 which in turn connected to an arm 16 suitably secured to the top portion of the filling tube 12 and adapted to move the filling tube 12 upwardly and downwardly in response to movement of the piston element 14. A source of air under pressure indicated diagrammatically as the pump 17 is connected to a three-way valve 18 mounted in a conduit 19 communicating with a lower chamber 20 within the air cylinder 13 in the conventional manner. As shown in the view of FIGURE 1, the pump 17 is closed off and the three-way valve 18 is vented to the ambient atmosphere so that the piston 14 is at its lowermost position and the filling tube 12 is in the lowered or "filling" position.

At the bottom of the filling tube 12, there is a foot valve 21 which is shown in FIGURES 1 and 4 in the "open" position. The foot valve 21 is adapted to close off the bottom of the tube 12 in its "closed position" and is actuated by a rod 22 connected thereto and concentrically positioned within the filling tube 12 extending the full length thereof. The rod 22 is connected directly to a piston 23 in a second air cylinder 24 and the rod 22 is movable axially relative to the tube 12 and the air cylinder 24.

The air cylinder 24 is a conventional device having a closed upper chamber 25 and a lower air chamber 26 connected by a valve controlled by the piston 23. The lower chamber 26 forms an air seal with the upper extremity 27 of the rod 22, so that actuating air pressure can be built up in either the upper chamber 25 or the lower chamber 26. Actuating air is supplied from a suitable source such as the pump shown diagrammatically at 27 which feeds to an upper air line 28 containing a three-way valve 29 and a lower air line 30 containing a three-way valve 31.

As
here shown, the pump is closed off from the lower air line 30 by the three-way valve 31 which vents the air line 30; and the upper air line 30 is connected to the pump 27 by the three-way valve 29 so that actuating air pressure is built up in the upper chamber 25 and the piston acting against a spring 32 within the lower air chamber 26 is urged downwardly and the foot valve plug 21 is urged downwardly and away from the bottom of the tube 22.

A tubular chamber 33 is mounted in axial alignment at the top of the filling tube 12. The chamber 33 is apertured at its top 33a to communicate with ambient atmosphere and is apertured at its bottom 33b to communicate with the top of the tube 12. In the position shown in FIGURE 1, the aperture 33b communicating with the tube 12 is sealed by a plug 34 carried by the rod 22 and movable axially therewith. The chamber 33 also communicates through a conduit 35 with vacuum applying means shown here in the form of a pump 36 controlled by a valve 37 which is closed in the position shown in FIGURE 1.

Liquid flows from a suitable source shown diagrammatically at S through an open valve 38 and into an overflow reservoir 39 at the top of the tube 12. The overflow reservoir 39 is in the form of an annular chamber surrounding the top portion of the filling tube 12 and extending from appreciably below the top 12c to appreciably above the top 12c of the tube 12. The liquid which is being fed into the drum 11 in the position shown in FIGURE 1 flows into the overflow reservoir 39 and then upwardly out the top 12a of the filling tube 12 and then down the tube 12 to the foot valve 21, and from there outwardly into the drum 11 and beneath the level 1-1 of liquid within the drum 11. The sealing plug 34 on the rod 22 closing off the top aperture 33b prevents liquid from escaping from the top of the tube 12.

Referring now to FIGURE 3, it will be seen that the same elements as those shown in FIGURE 1 are shown, but in different positions. Corresponding elements are given the same reference numeral in the 100 series in FIGURE 2. Thus the drum is 111 and it is shown substantially filled to the level L-2. Withdrawal of the tube 112 is shown in progress. In the raising or withdrawal position, the air cylinder 113 has been actuated by changing of the three-way valve 118 so that it affords communication between the lower chamber 120 and source of compressed air 117 and the piston 114 is moved upwardly out of the closed tube 112 which was to be removed, or it would be necessary to attempt to reproduce a predetermined amount of liquid to the drum 111, after the tube 112 had been removed. Either approach has undesirable features. In the instant invention, however, the tube 112 is emptied as it is removed from the drum 111.

The emptying of the tube 112 during the raising operation is accomplished by actuation of the rod 122 by the air cylinder 124. As shown in FIGURE 2, the three-way valves 129 and 131 are both shut off from the air pressure source 127 and vented to ambient atmosphere, so that both the upper chamber 125 and the lower chamber 126 of the air cylinder 124 have equal pressure and the spring 120 moves the piston 123 to an intermediate position. This results in the unsealing of the plug 134 and the opening of the top of the tube 112 to ambient atmosphere.

Finally the tube reaches the raised or idle position, which is shown in FIGURE 3. In FIGURE 3 elements corresponding to those shown in FIGURES 1 and 2 are given the same reference numeral in the 200 series. Thus the drum is indicated as 211 and the filling tube is 212. The new position of the elements 213 through 220 is apparent and does not require further explanation. Also the valve 238 connected to the bottommost portion of the liquid S remains closed and the level L-3 within the overflow reservoir 239 remains the same.

The rod 222 has, however, been moved axially upward to a third position wherein the foot valve 221 is closed. Movement of the rod 222 upward to its raised or top position is accomplished by actuation of the air cylinder 224 in conventional manner. The top chamber 225 thereof is vented to ambient atmosphere through the three-way valve 229, but the air pressure is built up in the lower chamber 226 by opening the three-way valve 231 to the atmosphere source 227, thus ensuring some liquid in the piston 223 to the top position. This also results in moving of the sealing plug 234 carried by the rod 222 to its uppermost position wherein the aperture 233a to ambient atmosphere in the chamber 233 is sealed. The closing of the aperture 233a, plus the closing of the foot valve 221 creates a substantially airtight chamber within the tube 212, and vacuum is applied to this chamber by opening the vacuum valve 237 connected to the pump 236. At least a portion of the rod 222 near the bottom is hollow so as to provide a conduit communicating with the interior of the filling tube 212 at 222a and communicating with the bottommost portion of the foot valve 221 at 222c. This structure is shown in detail in FIGURE 4 where the foot valve 21 is shown in the open position and the conduit is shown at 22a, the filling tube at 12, and the communicating port in the side of the tube at 22b. Vacuum is thus applied at the bottom of the foot valve 221 via the aperture 222c and liquid tending to be temporarily retained along the outside walls of the tube 212 will flow downwardly to the bottommost portion of the foot valve 221 and then will be sucked back up through the vacuum aperture 222c into the interior of the tube 212 (to collect just above the closed foot valve 221). Dripping of liquid from the tube 212 is thus avoided while it is retained in the raised or idle position.

To complete the cycle, the drum 211 will be removed and a new empty drum will be put in its place, the air cylinder 213 will be actuated to lower the tube 212 to its position shown in FIGURE 1. The processes may all be repeated as described in FIGURE 1, the vacuum valve 37 is closed, the air cylinder 24 is actuated to open the foot valve 21, and the valve 38 is opened to commence the flow of liquid into the drum. As soon as a small amount of liquid has collected in the drum, approximately to the level L-1, sub-surface feeding of liquid into the drum is in operation.

It will be understood that modifications and variations may be effected without departing from the spirit and scope of the novel concepts of the present invention.
I claim as my invention:

1. A filling device for introducing liquid into a container, comprising an elongated vertically positioned filling tube, a foot valve affixed to the lower end of the tube, means for vertically lowering and raising said filling tube, means for opening and closing the foot valve, whereby liquid flowing through the tube while in its lowered position may be introduced into a container at a point beneath the liquid level in the container, an overflow reservoir at the upper end of the tube with the tube opening into the reservoir spaced from the bottom thereof for maintaining a liquid level within the reservoir and overflowing liquid into said tube, a source of liquid communicating with said reservoir below the level therein, conduit means having an opening leading into the interior of the tube and having an opening at the bottom surface of the foot valve, and means communicating with said conduit means via said tube for applying vacuum to said conduit means while the tube is in raised position, whereby dripping of liquid from said foot valve is avoided.

2. A filling device for introducing liquid into a container, comprising an elongated vertically positioned filling tube, a foot valve affixed to the lower end of the tube, means for vertically lowering and raising said filling tube, means for opening and closing the foot valve, whereby liquid flowing through the tube while in its lowered position may be introduced into a container at a point beneath the liquid level in the container, an overflow reservoir at the upper end of the tube for maintaining a liquid level in the reservoir and overflowing liquid into said tube, and valve means for selectively closing the top of the reservoir when it is in lower position and opening the top of the reservoir to a vent when it is being raised to permit drainage of liquid therefrom.

3. A filling device for introducing liquid into a container, comprising an elongated vertically positioned filling tube, a foot valve affixed to the lower end of the tube, means for vertically lowering and raising said filling tube, means for opening and closing the foot valve, whereby liquid flowing through the tube while in its lowered position may be introduced into a container at a point beneath the liquid level in the container, an overflow reservoir at the upper end of the tube for maintaining a liquid level in the reservoir and overflowing liquid into said tube, a source of liquid communicating with said reservoir below the level therein, conduit means affording communication between the interior of the tube and the bottom surface of the foot valve, and valve means for selectively closing the top of the reservoir when the tube is in lower position and opening the top of the reservoir to a vent when it is being raised to permit drainage of liquid therefrom and applying vacuum to said conduit means while the tube is in its raised position, whereby dripping of liquid from the foot valve is avoided.

4. A filling device for introducing liquid into a container, comprising an elongated vertically positioned filling tube, a foot valve affixed to the lower end of the tube, means for vertically lowering and raising said filling tube, means for opening and closing the foot valve, whereby liquid flowing through the tube while in its lowered position may be introduced into a container at a point beneath the liquid level in the container, an overflow reservoir at the upper end of the tube for maintaining a liquid level in the reservoir and overflowing liquid into said tube, a source of liquid communicating with said reservoir below the level therein, conduit means affording communication between the interior of the tube and the bottom surface of the foot valve, a chamber above said reservoir communicating with the tube and with ambient atmosphere, means communicating with said chamber for applying vacuum thereto, and valve means for selectively closing the top of the reservoir when the tube is in lower position, venting the tube and reservoir to ambient atmosphere when the tube is being raised to permit drainage of liquid therefrom, and then applying said vacuum to said conduit means via said tube, whereby dripping of liquid from the foot valve is avoided.

5. A filling device for introducing liquid into a container, comprising an elongated vertically positioned filling tube, a foot valve affixed to the lower end of the tube, means for vertically lowering and raising said filling tube, means for opening and closing the foot valve, whereby liquid flowing through the tube while in its lowered position may be introduced into a container at a point beneath the liquid level in the container, a source of liquid communicating with said tube for flowing liquid therethrough to said foot valve, conduit means affording communication between the interior of the tube and the bottom surface of the foot valve, and a vent having valve means communicating with the tube top for selectively closing the vent when the tube is in lowered position and opening the vent when the tube is being raised to permit drainage of liquid therefrom.

6. A filling device for introducing liquid into a container, comprising an elongated vertically positioned filling tube, a foot valve affixed to the lower end of the tube, means for vertically lowering and raising said filling tube, means for opening and closing the foot valve, whereby liquid flowing through the tube while in its lowered position may be introduced into a container at a point beneath the liquid level in the container, a source of liquid communicating with said tube for flowing liquid therethrough to said foot valve, conduit means affording communication between the interior of the tube and the bottom surface of the foot valve, and a vent having valve means communicating with the tube top for selectively closing the vent when the tube is in lowered position and opening the vent when the tube is being raised to permit drainage of liquid therefrom and applying vacuum to said conduit means when the tube is in its raised position, whereby dripping of liquid from the foot valve is avoided.

7. A filling device for introducing liquid into a container, comprising an elongated vertically positioned filling tube, a foot valve affixed to the lower end of the tube, means for vertically lowering and raising said filling tube, means for opening and closing the foot valve, whereby liquid flowing through the tube while in its lowered position may be introduced into a container at a point beneath the liquid level in the container, a source of liquid communicating with said tube for flowing liquid therethrough to said foot valve, a chamber above said reservoir communicating with the tube and with ambient atmosphere, means communicating with said chamber for applying vacuum thereto, and a vent having valve means in said chamber for selectively closing the vent when the tube is in lowered position and applying vacuum to said conduit means when the tube is in raised position, whereby dripping of liquid from said foot valve is avoided.

8. A filling device for introducing liquid into a container, comprising an elongated vertically positioned filling tube, a foot valve affixed to the lower end of the tube, means for vertically lowering and raising said filling tube, a rod within the tube carrying said foot valve, means actuating said rod for opening and closing the foot valve, whereby liquid flowing through the tube while in its lowered position may be introduced into a container at a point beneath the liquid level in the container, an overflow reservoir at the upper end of the tube for maintaining a liquid level in the reservoir and overflowing liquid into said tube, a source of liquid communicating with said reservoir below the level therein, means defining a conduit in said rod having an opening into the interior of the tube and having an opening at the bottom surface of the foot valve, and means communicating with said conduit means via said tube for applying vacuum to said conduit means while the tube is in raised position, whereby dripping of liquid from said foot valve is avoided.

9. A filling device for introducing liquid into a container, comprising an elongated vertically positioned filling tube, a foot valve affixed to the lower end of the
tube, means for vertically lowering and raising said fill-
ing tube, a rod within the tube carrying said foot valve, 5
means actuating said rod for opening and closing the foot valve, whereby liquid flowing through the tube while in its lowered position may be introduced into a container at a point beneath the liquid level in the container, a source of liquid communicating with said tube for flowing liquid therethrough to said foot valve, means defining a conduit in said rod affording communication between the interior of the tube and the bottom surface of the foot valve, and a vent having valve means communicating with the tube top for selectively closing the vent when the tube is in lowered position and opening the vent when the tube is being raised to permit drain-
age of liquid therefrom and applying vacuum to said conduit means when the tube is in its raised position, whereby drippage of liquid from the foot valve is avoided.

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