

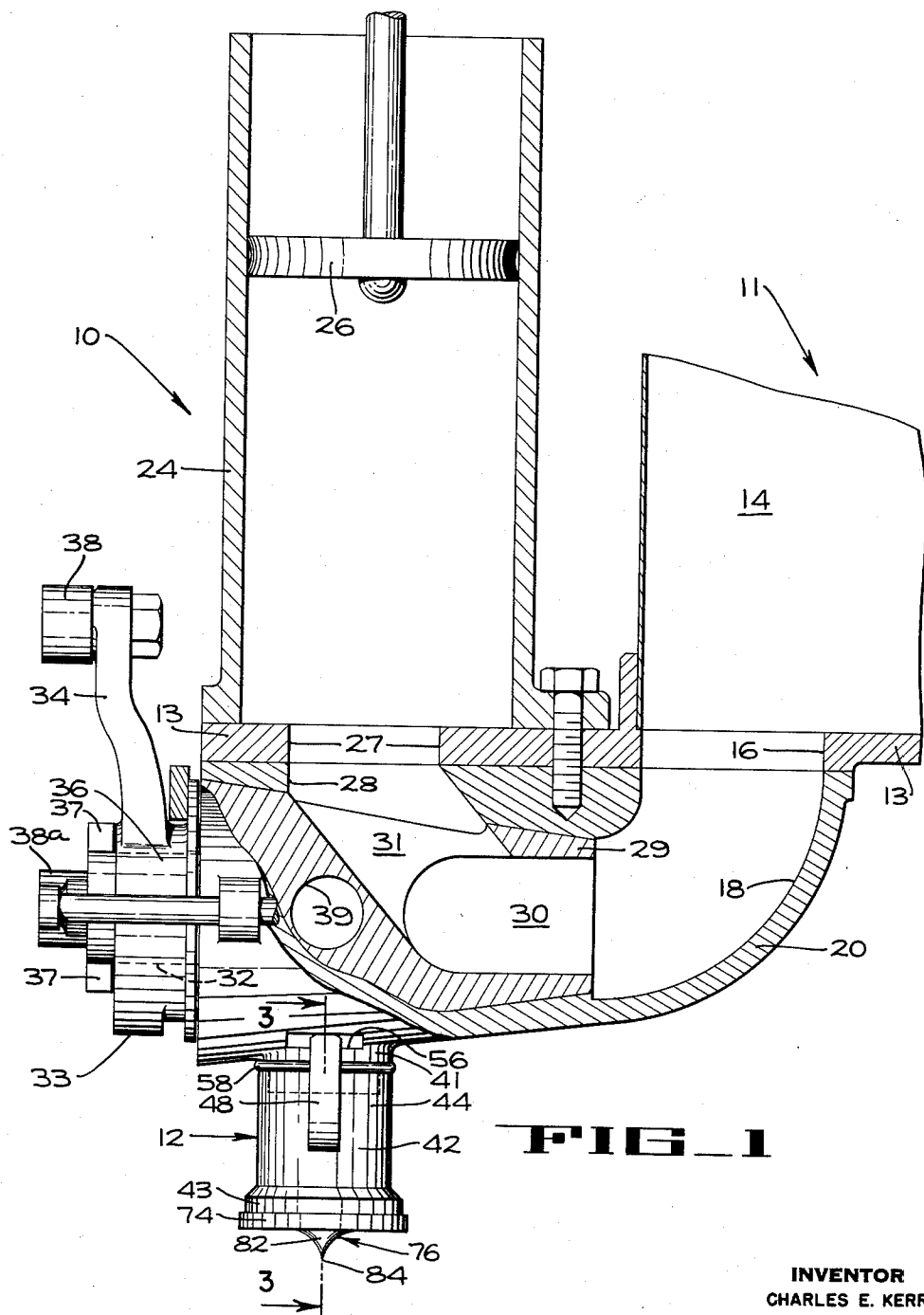
July 9, 1963

C. E. KERR
FILLING MECHANISM

3,096,914

Filed July 10, 1959

3 Sheets-Sheet 1



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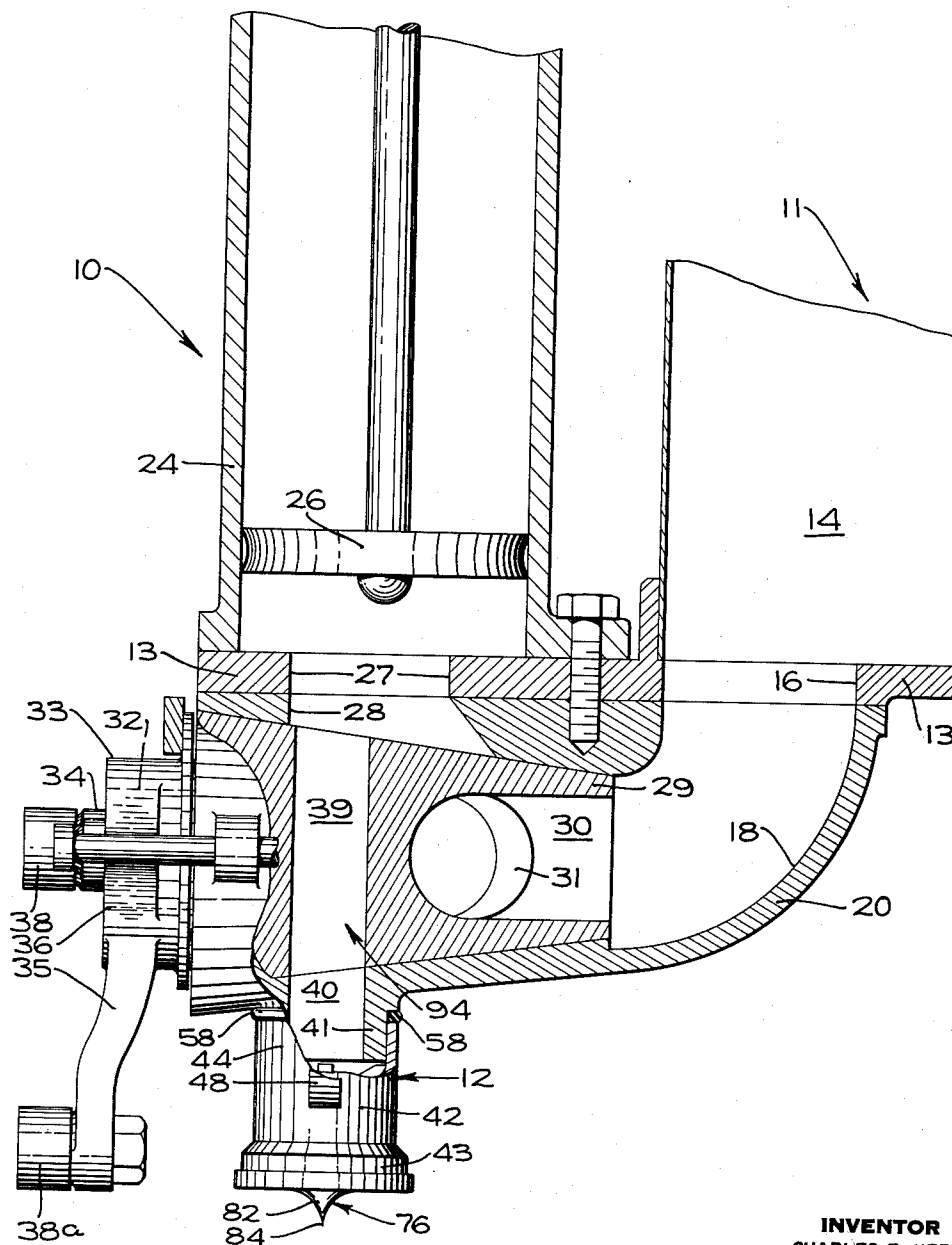
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FIG. 2



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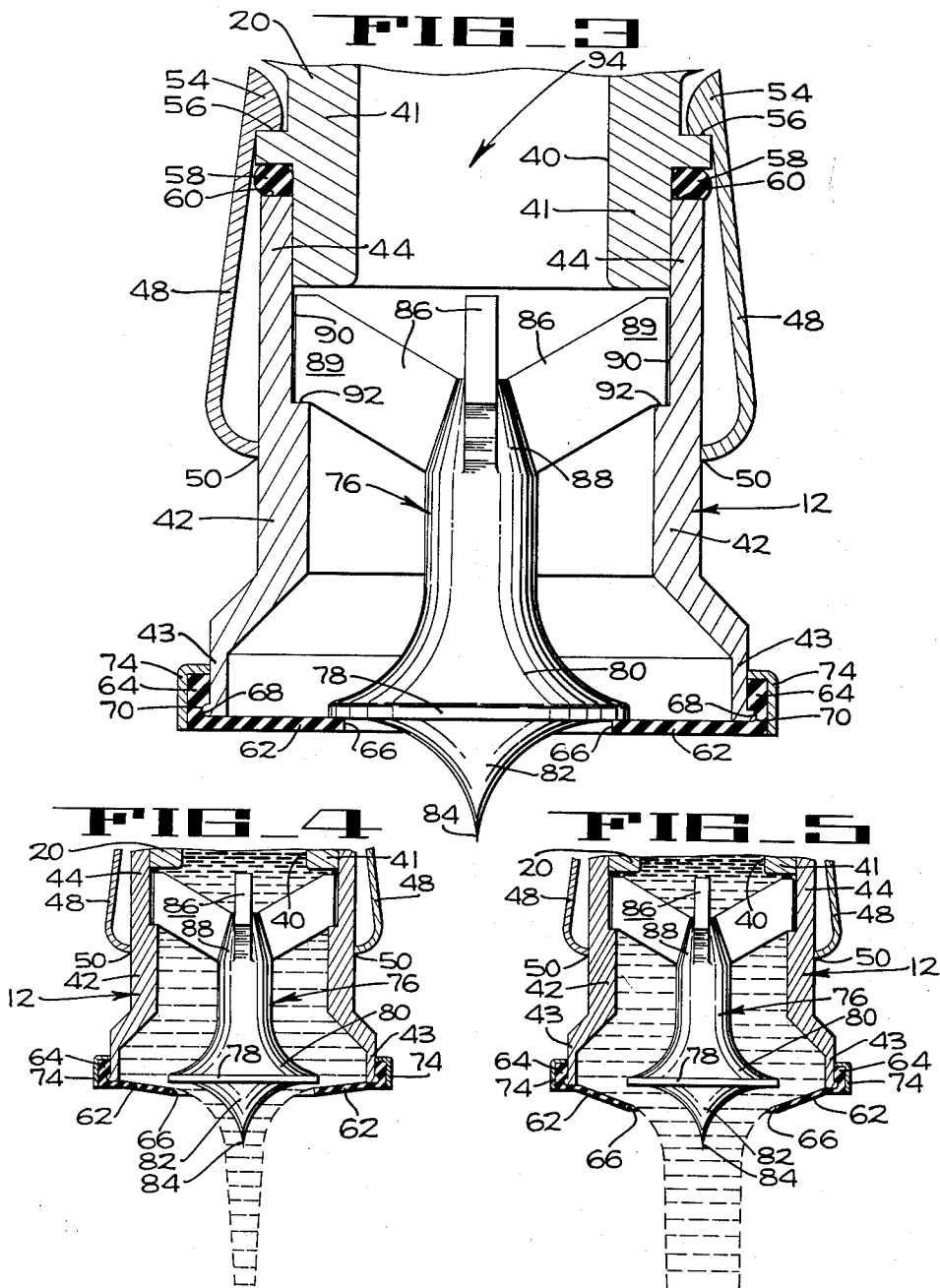
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FILLING MECHANISM

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7 Claims. (Cl. 222-333)

This invention relates to filling mechanisms used in plunger type filling machines, and more particularly to an apparatus for controlling the discharge of measured amounts of liquid from the valve of a filling machine.

In machines for filling containers with predetermined, measured amounts of a relatively free-flowing liquid, such as evaporated milk, particular problems arise in achieving consistent accuracy in measured amounts of liquid discharged into successive containers due to variations caused by foaming of the liquid, as it is discharged through the usual filler valve of the machine, and by the dripping of liquid from the valve after stoppage of the flow of liquid.

It is, therefore, an object of this invention to provide an apparatus for controlling the discharge of measured amounts of a liquid from a filling valve of a liquid filling machine, and assuring consistent accuracy in the measured amounts of a liquid discharged into successive containers.

Another object is to provide apparatus which will so control a liquid discharge from a filling valve as to virtually eliminate foaming of the discharged liquid.

A further object is to provide discharge control apparatus which will shut off the flow of a liquid after a measured amount has been discharged therefrom in such a manner as to prevent leaking of the fluid into a container being filled.

Another object is to provide an apparatus for controlling the discharge of measure amounts of a liquid through which is simple in construction, fool-proof in operation, low in maintenance requirements and readily adapted for use with filling valves now commonly used on liquid filling machines.

These and other objects and advantages will become apparent from the following detailed description and the accompanying drawings, in which:

FIG. 1 is a view partly in vertical section and partly in elevation of a portion of the filling mechanism of the present invention with a rotary valve member disposed in one operating position.

FIG. 2 is a view similar to FIG. 1, but with the valve member of the filling mechanism rotated 90° to a second position.

FIG. 3 is an enlarged cross sectional view taken along line 3-3 of FIG. 1 with a centrally disposed liquid dividing element shown in elevation and with a diaphragm used in the mechanism disposed in its closed position.

FIGS. 4 and 5 are cross sectional views similar to FIG. 3, but on a reduced scale, showing the diaphragm in different degrees of opening.

In the embodiment of the invention shown in the drawings the reference numeral 10 generally indicates a plunger type filling mechanism normally associated with a liquid filling machine 11, of the type disclosed in my co-pending application Serial No. 711,659, filed January 28, 1958, now Patent No. 2,958,346, issued on November 1, 1960. The liquid discharge controlling

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apparatus 12 of this invention is adapted for attachment to the filling mechanism 10 to control the discharge of liquid into a container positioned therebelow. The filling mechanism (FIG. 1) comprises a reservoir 14 which is mounted upon a horizontally disposed support plate 13 carried by the filling machine 11 and is adapted to be filled with a liquid to be dispensed into containers. The reservoir 14 is provided with a bottom outlet defined by an opening 16 through the support plate 13, and is in constant communication with an intake passage 18 in a valve housing 20 carried by the undersurface of the plate 13. A dispensing cylinder 24, provided with a plunger or piston 26 arranged for longitudinal reciprocation therein, is mounted on the support plate 13 above the valve housing 20. A bottom discharge port is provided for the cylinder 24 by an opening 27 through the support plate 13 (FIGS. 1 and 2), and this port 27 is in communication with a passage 28 in the valve housing 20.

A rotary valve 29 is rotatably mounted in the valve housing 20 and is provided with an axial passage 30, that communicates with the intake passage 18, and with a slanted passage 31 opening into passage 30. In FIG. 1, the valve 29 is disposed in a first position wherein the reservoir 14 is placed in communication with the dispensing cylinder 24 through the intake passage 18, passages 30 and 31 in the valve member, the passage 28, and the port 27.

The valve 29 is mounted in the housing for 90° oscillating movement about its longitudinal axis from its first position to a second position (FIG. 2) and back to its first position. This alternating 90° oscillating movement may be accomplished by any suitable means, such as, a cam operated valve actuator 33 (FIGS. 1 and 2). The valve actuator 33 includes a pair of arms 34 and 35 extending radially from a hub 36 and spaced 90° apart. The hub 36 is adapted to be connected in driving relation with a valve shaft 32 formed integrally with and projecting longitudinally from the valve 29 so that rotation of the hub 36 by the arms 34 and 35 will be transmitted to the valve 29 through a key 37. To cause the arms to be alternately rocked 90° in opposite directions, the arms 34 and 35 carry follower rollers 38 and 38a respectively, which are adapted to engage a suitable camming means (not shown) so as to impart 90° oscillation to the valve shaft 32 and the valve 29 at intervals determined by the camming means. The valve rotating mechanism is described in detail in the above cited Patent No. 2,958,346.

When the valve 29 is rotated 90° from the first position shown FIG. 1, in a counterclockwise direction as viewed from the left in FIG. 1, it will move to a second position shown in FIG. 2 wherein the slanted inlet passage 31 is rotated out of communication with the passage 28 to cut off communication between the reservoir 14 and the dispensing cylinder 24. At the same time, a discharge channel 39 in the valve 29 is rotated therewith from an inoperative position (FIG. 1) to an operative position (FIG. 2) to place the dispensing cylinder 24 in communication with a discharge passage 40 formed in a tubular projection 41 of the valve housing 20. The timing of the 90° oscillation of the valve by the actuator 33 is such that the upstrokes or intake movements of the dispensing cylinder piston 26 occur when the valve 29 is in its first position (FIG. 1) wherein the

cylinder 24 is in communication with the reservoir 14 and out of communication with the valve housing discharge passage 40, and the downstrokes or discharge movements of the piston occur when the valve is in its second position (FIG. 2) wherein communication is established between the dispensing cylinder and the discharge passage 40. The valve cycle is repetitive so that upon rotation of the valve 29 back to its first position (FIG. 1), communicating channel 39 will be rotated to its inoperative position, and the valve passage 31 will again be moved into registration with passage 28 whereby communication is established between the cylinder 24 and the reservoir 14. Thus, as the piston 24 rises it will draw liquid from the reservoir into the dispensing cylinder.

To control the discharge of liquid through the discharge passage 40, there is provided the discharge controlling apparatus 12 which comprises a hollow cylindrical body 42 (FIG. 3) flared at its open lower discharge end 43 and arranged to have its open upper end 44 telescopically receive the tubular projection 41 of the valve housing 20 in which the discharge passage 40 is formed. The apparatus 12 is secured in position surrounding the tubular projection 41 by a pair of diametrically opposed spring clips 48 welded at their lower ends to the outside of body 42, as at 50, and provided at their free ends with hook-like heads 54 arranged to snap over associated horizontally disposed ledges 56 on the tubular projection 41 (FIGS. 1 and 3) of the valve housing 20. A resilient ring 58 is positioned between the ledges 56 and the upper annular end face 60 of the upper end portion 44 of the body 42 to prevent leakage and to take up any looseness in the connection between apparatus 12 and tubular discharge member 41.

A closure means across the open bottom or outlet end 43 of the body 42 is provided by an annular diaphragm 62 (FIGS. 3-5) made from a flat sheet of flexible material and having an upstanding peripheral wall 64 terminating in an outer edge and closely embracing the outer surface of the body 42 at the outlet end 43. An opening 66, which is formed centrally in the diaphragm 62 and is circumscribed by an inner annular free edge, is arranged concentrically about the longitudinal axis of the body 42 to define a discharge control port, as will presently appear. The diaphragm 62 is secured in position across the body outlet 43 by the cooperation of an annular groove 68 (FIG. 3) provided in the diaphragm wall 64 and a bead 70 formed about the outlet end 43 of the body. A flanged retainer ring 74 is fitted to extend around and over the upstanding wall 64 to stiffen the diaphragm about its periphery and to insure its retention in proper position on the body 42.

To close the opening 66 there is provided within the body 42 a liquid dividing element or core 76 of generally cylindrical form disposed with its longitudinal axis along the longitudinal axis of the body 42 and having an enlarged annular abutment member, flange, or cut-off portion 78 formed concentrically about the axis of the element adjacent the lower end 80 thereof (FIGS. 3-5). The portion 78 is concentric with and of a larger diameter than opening 66 and is disposed above the diaphragm opening 66 to completely cover the latter in closing relation thereto to define, together with said diaphragm, a cut-off means for stopping a flow of liquid through the outlet 43 of the body, as will hereinafter appear. A generally conical liquid guiding portion 82, having a concavely curved outer face, is formed integrally with the element 76 below the cut-off portion 78 to project through the diaphragm opening 66 with its apex 84 disposed below the diaphragm and along the longitudinal axis of the body 42. The liquid dividing element 76 is supported to freely hang within the body 42 by a plurality of equally spaced, radially extending arms 86 secured at their inner ends to the upper end 88 of the dividing element and having their outer ends 89 received on an annular ledge 92 formed by

a recess 90 cut into the inner wall of the upper portion 44 of the body 42.

At the start of a cycle of operation of the filling mechanism, the valve 29 is in the first position shown in FIG. 1. During an upstroke of the piston 26, liquid is drawn from the reservoir 14 through the inlet passage 18, inlet passages 30 and 31, passage 28 and port 27 into the cylinder 24. At the completion of a predetermined amount of the piston upstroke (FIG. 1), the cylinder 24 is filled, below the piston, with a measured amount of liquid. The measured amounts of the liquid drawn into the cylinder can, of course, be selectively varied by changing the length of the piston stroke. When the piston 26 reaches the top of its stroke, the valve actuator 33 is actuated to cause the valve 29 to rotate 90° from its first position (FIG. 1) to its second position (FIG. 2) to place the cylinder in communication with the apparatus 12 through the communication passage 39 and the valve housing discharge passage 40.

It should be noted that all of the passages in the valve housing 20 and all of the passages in the valve 29, as well as all of the spaces within the body 42 of apparatus 12, are at all times completely filled with liquid except during the first or priming stroke of the piston 26.

Assume that the filler mechanism 10 and the apparatus 12 have been primed and are completely filled with liquid, that the piston 26 is at the top of its upstroke, and that the valve 29 has just been rotated to the position of FIG. 2. A closed liquid chamber 94 is then defined between the diaphragm 62 and the underside of the piston 26, and this chamber is filled with liquid. The outlet end 43 is closed by the diaphragm 62, and the annular area around the opening 66 bears against the underside of the cut-off portion 78 of the element 76. The diaphragm 62 is made of a material having properties of resilience and strength such that it would return, after being flexed, to its closed position if there were no liquid in the chamber 94. Since the chamber 94 is a closed, inverted chamber, a combination of forces tends to keep the diaphragm in its closed position when a charge of liquid is trapped between the diaphragm and the piston. These forces include a force caused by the resiliency of the diaphragm, atmospheric pressure acting on the under-surface of the diaphragm, there being a suction acting on the top of the column of liquid to resist the downward movement of the column in the closed chamber. Therefore, although the inherent resilience of the diaphragm would be sufficient to move it into its closed position (FIG. 3) were there no liquid in the chamber 94, under actual operating conditions the chamber is filled with a liquid and it is the combination of forces hereinbefore explained which is primarily responsible in moving the diaphragm from its open position (FIGS. 4 and 5) to its closed position (FIG. 3) and holding it in the closed position.

Again, assume the condition of operation wherein the valve 29 has been rotated into its second position (FIG. 2) so as to place the apparatus 12 into communication with the cylinder 24. As the piston 26 descends, toward its terminal position shown in FIG. 2 a force is exerted thereby against the top of the solid column of liquid extending from the piston to the diaphragm 62. This force causes the diaphragm to flex outwardly at its center permitting discharge of the liquid between the diaphragm 62 and the cut-off portion 78 whereby the opening 66 in the diaphragm will define a discharge control port. The liquid thus discharged through the discharge control port 66 will follow the contour of the concavely formed, cone shaped liquid-guiding portion 82 and flow from the point or apex 84 in a solid stream, avoiding the formation of air pockets therein and thereby obviating foaming of the liquid. Thus, the liquid is discharged from the apparatus 12 in an air-free, non-foaming stream.

At the conclusion of the downward stroke of the piston 26 (FIG. 2), the force exerted upon the solid column

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of liquid ceases and atmospheric pressure, the resiliency of the diaphragm, and the vacuum created within liquid filled chamber 94 above the column of liquid corresponding to the force of atmospheric pressure will return the diaphragm 62 to its closed position against the cut-off portion 78 of the element 76 to positively shut off any further flow of liquid from the apparatus 12. Thus, a complete seal between the diaphragm and the cut-off portion 78 of the element 76 is immediately effected upon completion of the piston downstroke so that no dripping of liquid will occur after the diaphragm has moved to its closed position at the conclusion of the piston downstroke. The valve 29 will now be rotated 90° to return to its first position (FIG. 1) and the piston 26 can commence its upstroke.

The timing of the valve actuating means 33 is such that the described operation of the filling head 10 and the apparatus 12 is periodically repeated. It should also be noted that the speed of descent of the plunger or piston 26 will control the volume of liquid flowing through the apparatus 12 in a given period of time. If the downstroke is slow, a narrow stream will be discharged from the apparatus through the control port 66 (FIG. 4) while an increased speed of the downward piston stroke will proportionally increase the width of the stream of liquid flowing past the port (FIG. 5). Whether the liquid stream discharged from the apparatus is narrow as in FIG. 5, the stream will be substantially air-free and non-foaming.

It will be evident that the dispensing cylinder 24, the plate 13, the valve housing 20, the body 42, and the core 76 and associated arms 86 constitute wall means circumscribing the elongated chamber 94 that includes the bore of the dispensing cylinder, the discharge port 27, the passage 28, the passage 40, and the passageway through the body; furthermore, the piston 26 and valve 29 constitute means in this chamber for drawing liquid into the chamber and for forcing such liquid downwardly through the outlet or opening between the diaphragm 62 and the flange 78.

From the foregoing description, it will be apparent that the present invention provides an apparatus for controlling the flow of measured amounts of a liquid that is periodically forced through the discharge of a valve in a filling head of a liquid filling machine, and which apparatus includes means for preventing dripping or flowing of the liquid between the periodic discharges and means for directing the discharging liquid into a stream that is free from air pockets and is in a non-foaming condition. It is to be particularly noted that the discharge of liquid is stopped as soon as downward movement of the piston is stopped, and thus the amount of discharge is measured by the downward stroke of the piston. Since there is no entrapped air in the liquid or any dripping or flowing after the piston has completed its stroke, there can be no inaccuracy in the measurement of the charge regardless of the speed of operation.

While I have described a preferred embodiment of the present invention, it will be understood that various changes and modifications may be made in the details thereof without departing from the spirit and scope of the appended claims.

Having thus described the invention, what I claim as new and desire to protect by Letters Patent is:

1. A liquid dispenser comprising a hollow generally cylindrical body having a lower edge circumscribing an outlet, a core having a cylindrical flange, means upwardly spaced from said lower edge and being connected to said core for supporting said flange in said outlet with said lower edge circumferentially spaced from said flange, said flange and edge defining an uninterrupted and continuous outlet opening extending entirely around said flange, an annular, resiliently flexible diaphragm having a circumferential outer edge secured to said lower edge of said

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body in fluid-tight relation therewith and an inner annular edge in resilient underlying fluid-tight engagement with said flange, a dispensing cylinder located above, and communicating with, said body, and means for filling the body above said diaphragm with liquid and for reducing the pressure above said diaphragm below the pressure under said diaphragm by sucking liquid into said dispensing cylinder whereby the diaphragm is held in fluid-tight engagement with said flange by imbalance of pressures above and below said diaphragm, said means being operative to force liquid in the body downwardly through the outlet opening between said diaphragm and said core, said liquid emerging through said opening in a compact annular stream which is continuous about said flange and substantially free of air, and said diaphragm resiliently returning to fluid-tight core engagement, incident to said imbalance of pressures, substantially simultaneously with interruption of downward movement of liquid in said body.

2. In a filling machine, an apparatus for dispensing liquid in a substantially non-foaming, dripless manner comprising a hollow substantially cylindrical body having a lower edge circumscribing an outlet; a core mounted in said outlet, the core including a flange in circumferentially spaced, substantially coplanar relation to said lower edge and including upper and lower generally conical end portions respectively upwardly and downwardly extended from said flange, said end portions having smoothly concave surfaces of revolution, and said lower end portion terminating in a lower apex; an annular resiliently flexible diaphragm having a circumferential outer edge secured to said lower edge of the body in fluid-tight relation therewith and an inner annular edge in resilient, underlying, fluid-tight engagement with said flange of the core; a dispensing cylinder located above, and communicating with, said body; and means for filling the body above said diaphragm with liquid and for reducing the pressure above said diaphragm below the pressure under said diaphragm by sucking liquid into said dispensing cylinder whereby the diaphragm is held in fluid-tight engagement with said core by imbalance of pressures above and below said diaphragm, said means being operative for forcing liquid in said body downwardly through said outlet between said diaphragm and said core, said diaphragm resiliently resisting said downward forcing of the liquid and confining the released liquid circumferentially of said lower end portion of the core, and said diaphragm resiliently returning to fluid-tight core engagement, incident to said imbalance of pressures, substantially simultaneously with interruption of downward movement of liquid in said body.

3. In a mechanism for dispensing liquid in precise quantities; wall means circumscribing an elongated chamber, said chamber having an upper end portion, a lower end portion providing a downwardly opening outlet, and an intake above the outlet, the lower end portion of said wall means having a peripheral edge circumscribing said outlet, said wall means including a core portion in said outlet with said edge being circumferentially spaced from said core portion, there being a continuous and uninterrupted annular outlet opening between said core portion and said edge; means in said chamber closing said upper end portion thereof for successively drawing a column of liquid into said chamber through said intake and for forcing such liquid column downwardly through said outlet; and a resiliently flexible diaphragm having a mounted edge connected to the peripheral edge of said wall means and a free edge yieldably, resiliently urged upwardly into fluid-tight engagement with said core portion wherein said outlet opening is closed by the diaphragm, whereby with a column of liquid filling said chamber between said diaphragm and said closing means incident to drawing of the liquid into said chamber by said closing means, said free edge of the diaphragm is held in said fluid-tight engagement with said core portion

by the resilience of the diaphragm and by atmospheric pressure applied externally against the diaphragm, whereby said column of liquid is forced downwardly between said core portion and said free edge of the diaphragm by said closing means, whereby liquid emerges from said chamber through said opening in a circumferentially continuous and uninterrupted annular stream, and whereby said free edge returns to said fluidtight engagement substantially simultaneously upon interruption of downward movement of the liquid column as a result of the resilience of said diaphragm and the effect of atmospheric pressure upwardly thereagainst.

4. A dripless, non-foaming liquid dispenser comprising a hollow substantially cylindrical body having a lower edge in a substantially horizontal plane and circumscribing a lower outlet, said body having an upper portion; a dispensing cylinder; housing means joining the upper portion of said body and said cylinder in communicating relation with each other and providing an intake above said outlet; a liquid impervious core providing an intermediate flange circumscribing an axis for the core, and end portions extended in opposite directions from and coaxially of the flange, said end portions being tapered endwardly from said flange; means engaging said body and attached to one of the end portions of said core in spaced relation to the flange thereof for mounting said core in said body with said lower edge of said body in circumferentially spaced coplanar relation to said flange and with the other end portion downwardly extended from said lower edge whereby an unobstructed annular opening is provided in said horizontal plane between said lower edge and said flange; an annular diaphragm of resiliently flexible sheet material having an outer edge secured in fluid-tight relation to said lower edge of said body and an inner annular edge yieldably upwardly urged into underlying, fluid-tight engagement against said flange by the resilience of the diaphragm; a piston vertically reciprocally mounted in fluid-sealing relation in said dispensing cylinder for drawing a column of the liquid into said dispensing cylinder through said intake so as to fill the body and cylinder between said piston and said diaphragm to reduce the pressure above the diaphragm to less than atmospheric pressure, and for forcing predetermined amounts of such column downwardly through the outlet between the core and the diaphragm; and means in said housing means for respectively opening and closing said intake during said drawing and forcing of the liquid by said piston.

5. In a liquid dispenser, wall means surrounding a chamber, said wall means having a lower edge circumscribing a substantially vertically disposed lower outlet for said chamber, said wall means providing an intake above said outlet, and means in said chamber for drawing a charge of liquid into the chamber through said intake and for forcing such charge downwardly through said outlet; apparatus for enabling liquid to be released through the outlet in discrete amounts while minimizing foaming and subsequent dripping comprising a liquid dividing and guiding core providing an intermediate circular flange concentrically circumscribing an axis for the core, and substantially conical end portions oppositely coaxially extended, and endwardly tapered, from said flange, said end portions providing concave surfaces of revolution concentric to said axis; means mounting said core in the chamber of said wall means with said flange radially inwardly spaced from, and in substantially the same plane as said lower edge, and with said end portions respectively upwardly and downwardly extended from said lower edge; and an annular diaphragm of resiliently flexible sheet material having an outer circular edge secured in fluidtight relation to said lower edge of the wall means and an inner circular edge upwardly urged into fluid-tight engagement against said flange, said chamber means being filled with liquid between said diaphragm and said liquid drawing means so as to displace air therebetween, whereby when a charge of liquid is drawn into said chamber, said dia-

phragm is urged upwardly into fluid-tight engagement against said flange by atmospheric pressure exerted externally against the diaphragm, whereby when the liquid is forced downwardly in said chamber said diaphragm flexes downwardly away from said flange to release liquid through said outlet, and whereby upon interruption of downward movement of said liquid said diaphragm returns into fluid-tight engagement with said flange as a result of the application of atmospheric pressure externally against said diaphragm and the resilience thereof.

6. In a filling mechanism including an axially upright dispensing cylinder having a downwardly opening discharge port, a valve connected to said discharge port having a downwardly opening discharge passage and open and closed positions respectively admitting liquid to said cylinder and allowing admitted liquid to be forced out of said port into said passage, and a piston reciprocally slidably fitted in fluid-tight relation in said cylinder for drawing liquid into the cylinder when said valve is open and for forcing liquid through said port when the valve is closed; an apparatus for controlling the release of liquid from said discharge passage in predetermined quantities while minimizing foaming and after-dripping comprising a tubular body having an upper end, a lower annular edge, and circumscribing a substantially cylindrical bore; means releasably mounting said body on said valve with said bore in coaxial alignment and in communication with said discharge passage of said valve; a liquid impervious and flow controlling core having a substantially circular intermediate flange concentric to an axis for the core, and generally conical, upper and lower end portions secured to and respectively upwardly and downwardly tapered from said flange, said upper and lower end portions of the core having outer concave surfaces of revolution concentric to said core axis; means connected to said upper end portion of said core, engaging said body, and mounting said core in said bore of the body with the core coaxial with the bore, with the body being in circumferentially spaced relation to the core, with the flange being in a substantially common plane with the lower edge of the body, and with the lower end portion of the core being downwardly extended from the body; and an annular diaphragm of resiliently flexible sheet material having an outer circular edge secured in fluid-tight relation to said lower edge of the body, said diaphragm being radially inwardly extended from said lower edge of the body, and said diaphragm having an inner annular edge in circumferentially underlying, fluid-tight engagement with the flange of said core but being resiliently downwardly yieldable away from said flange incident to downward movement of liquid in the column under pressure of said piston.

7. In a filling machine, an apparatus for dispensing liquid in a substantially non-foaming, dripless manner comprising a hollow, substantially cylindrical body having a lower edge circumscribing an outlet and an upper portion; a core mounted in said outlet, said core including a flange in circumferentially spaced relation to said lower edge and upper and lower end portions convergently projecting respectively upwardly and downwardly from said flange; an annular resiliently flexible diaphragm having a circumferential outer edge secured to said lower edge of the body in fluid-tight relation therewith and an inner annular edge in resilient, underlying, fluid-tight engagement with said flange; a dispensing cylinder communicating with the upper portion of the body; and means for filling the body above said diaphragm with liquid and for reducing the pressure above said diaphragm below the pressure under said diaphragm by drawing liquid into said cylinder whereby the diaphragm is held in fluid-tight engagement with said flange by imbalance of pressures above and below said diaphragm, said means being operative for forcing liquid in said body downwardly through said outlet between said diaphragm and said core, said diaphragm resiliently resisting said down-

ward forcing of the liquid and confining the released liquid circumferentially of said lower end portion of the core, and said diaphragm resiliently returning to fluid-tight engagement, as a result of said imbalance of pressures, substantially simultaneously with interruption of downward movement of liquid in said body.

References Cited in the file of this patent

UNITED STATES PATENTS

80,307 Reeve ----- July 28, 1868 10

1,855,922
2,043,578
2,098,886
2,557,880
2,640,481

644,706

Mosher ----- Apr. 26, 1932
De Markus ----- June 9, 1936
Safford ----- Nov. 9, 1937
Lynn ----- June 19, 1951
Conley ----- June 2, 1953

FOREIGN PATENTS

Great Britain ----- Oct. 18, 1950