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FILLING VALVE

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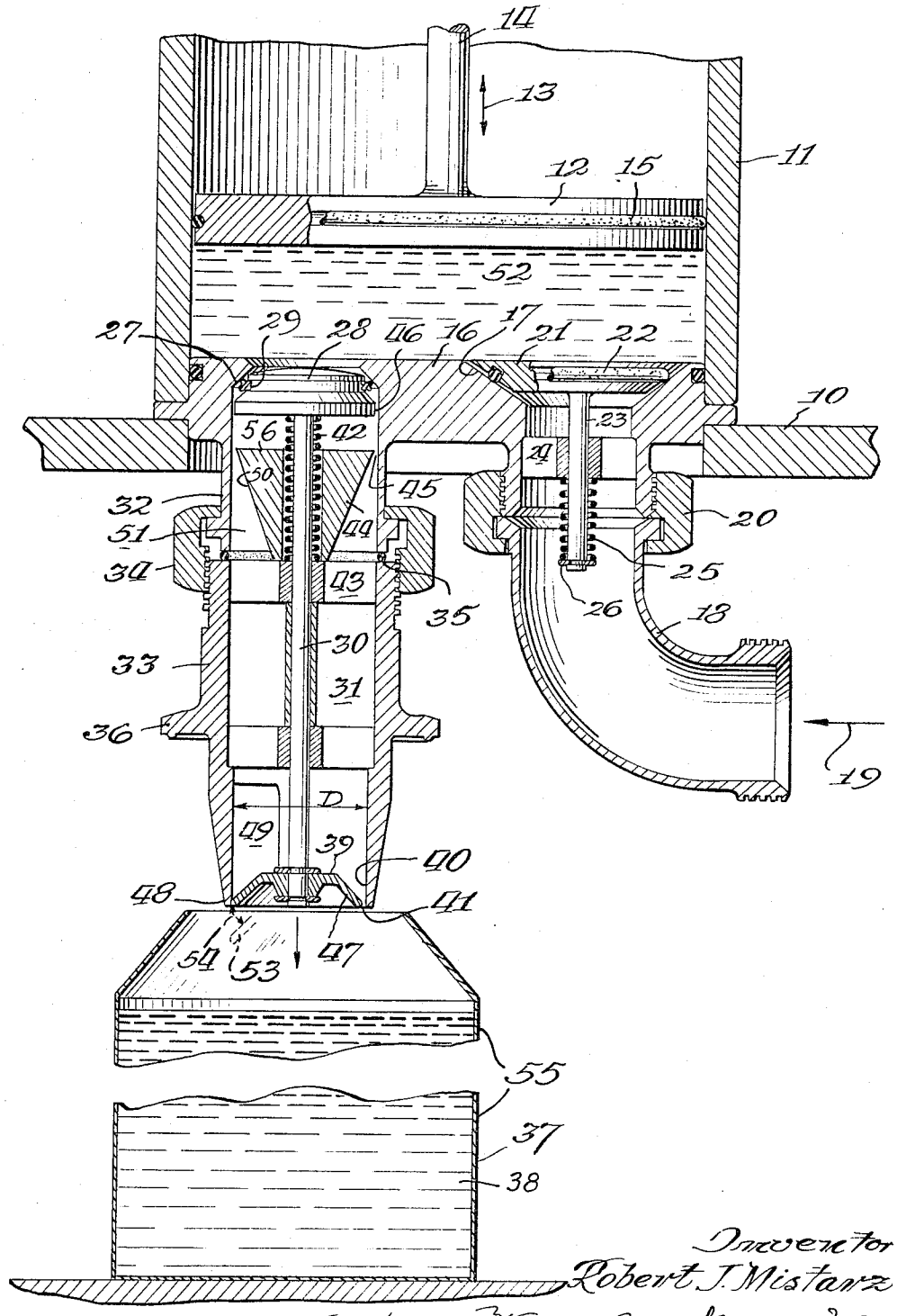

Inventor
Robert J. Mistarz
By Hofgren, Wegner, Allen, Stellman & McCord
Attorneys

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FILLING VALVE

Robert J. Mistarz, Northbrook, Ill., assignor to Chicago Stainless Equipment Corporation, a corporation of Illinois

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This invention relates to a nozzle apparatus for flowing a foamable liquid without excessive foaming thereof.

In flowing foamable liquids such as milk to a destination such as into a container, it is often difficult to prevent foaming with the result that the containers are improperly filled and portions of the liquid are wasted.

One of the features of this invention is to provide an improved nozzle apparatus for flowing a foamable liquid to a destination even at high speed without excessive foaming.

Other features and advantages of the invention will be apparent from the following description of one embodiment thereof taken in conjunction with the accompanying drawing.

The single figure of the accompanying drawing is a fragmentary sectional view of an improved nozzle apparatus embodying the invention and used for filling a container with milk. The apparatus of the embodiment includes a base plate **10** on which is mounted a cylinder **11** containing a piston **12** that is adapted to be moved up and down, as indicated by the arrows **13**, by means of a piston shaft **14**. The piston **12** is sealed to the inner surface of the cylinder **11** by means of a circular gasket **15** on the outer periphery of the piston **12**.

The bottom of the cylinder **11** is closed by a metal plate **16** containing an upwardly and outwardly flared inlet opening **17**. This opening **17** communicates with an inlet pipe **18** into which the liquid, here milk, is adapted to be drawn as indicated by the arrow **19**.

The pipe **18** is removably secured to the bottom of the metal plate **16** by means of a threaded collar **20** so that the apparatus may be disassembled for cleaning.

The inlet opening **17** is normally closed by means of a cone shaped inlet valve **21** that is provided with a circular gasket **22** to maintain a liquid seal when the valve is closed. The valve **21** is provided with a downwardly extending stem **23** extending into the pipe **18** and the stem is vertically movable within a supporting spider **24**. The valve stem **23** and thus the valve **21** is urged in a downward or closed direction by means of a helical spring **25** surrounding the lower end of the stem **23** and having one end bearing against the bottom of the spider **24** and the other end bearing against a collar **26** on the lower end of the stem **23**.

The plate **16** is also provided with an outlet opening **27** so that the opening **17** serves as an entrance to the cylinder **11** beneath the piston **12** and the outlet opening **27** serves as an exit for this same portion of the cylinder.

The outlet opening **27** is normally closed by a closure **28** that is sealed to the opening **27** by means of a gasket **29**. Extending downwardly from the closure **28** is a stem **30** which is located in a discharge chamber **31**. This discharge chamber **31** is located in a downward cylindrical extension **32** of the plate **16** which is aligned with a cylindrical fitting **33**. The extension **32** and fitting **33** are releasably held in alignment to form the complete chamber **31** by means of a threaded collar **34** similar to the collar **20**. A gasket **35** is provided to seal the extension and fitting together.

With the above construction the fitting **33** serves as a nozzle and is provided with an outwardly extending annular flange **36** which is spaced above the top of a milk carton **37** while it is being filled with milk **38**.

The nozzle **33** is provided on its lower end with a closure **39** that is adapted to close the bottom exit **40** of the nozzle when the valve **28** and closure **39** are in their raised or closed positions as shown in the drawing. However, a small bleed opening **41** is provided between one edge of the closure **39** and the adjacent edge of the exit **40** in order that the interior of the chamber **31** will be substantially at atmospheric pressure. Although the chamber **31** is normally full of liquid during operation of the nozzle structure, this liquid does not fall through the bleed opening **41** because the surface tension of the liquid produces a pipette effect.

The exit closure **39** is mounted on the bottom of the valve stem **30** so that both closures **28** and **39** are vertically movable as a unit between closed and open positions. In order to urge both in closed position there is provided a helical spring **42** around the upper end of the stem **30** with the upper end of the spring **42** bearing against the bottom of the exit closure **28** and the lower end bearing against a spider **43** that spans the nozzle fitting **33** adjacent the top thereof.

Resting on the top of the spider **43** and surrounding the spring **42** and adjacent portion of the stem **30** is a plug **44** having the shape of an inverted truncated cone. The bottom of the plug **44** rests on the spider **43** and the top **56** which is the base of the cone is generally circular and is spaced a short distance, such as about $\frac{1}{16}$ inch, from the inner surface of the extension **32** to provide the annular space **45**. The closure has its outer surface spaced a similar distance from the inner surface of the extension **32** to provide the small annular space **46** which in this same embodiment is also about $\frac{1}{16}$ inch.

The closure **39** has an outwardly and downwardly sloped skirt **47** whose lower edge is adjacent and within the lower edge **48** of the nozzle fitting **33**. Mounted on one side of this closure **39** is a radially extending plate **49**.

Because of the inwardly tapered shape of the plug **44** the outer side surface **50** of this plug cooperates with the adjacent inner surface of the extension **32** to provide an annular chamber **51** of increasing cross section when progressing from the top end or base **56** of the plug to its lower end that rests on the spider **43**.

During operation of the filling apparatus a milk carton **37** is positioned under the nozzle with the upper edge being spaced beneath the annular flange **36**. The inlet pipe **18** is connected to a supply pipe (not shown). Upward motion of the piston **12** acts as a pump to create a partial vacuum in the space **52** beneath the piston **12**. This draws the liquid (here milk) inwardly through the pipe **18** and the partial vacuum serves to lift the inlet valve **21** from its seat **17** against the urging of the spring **25**. After the piston shaft **14** has been given a full upward stroke the piston is then returned toward its initial position adjacent the metal plate **16** as indicated by the double arrow **13**. This serves to force down and close the inlet valve **21**. Also the resulting liquid pressure on the closure **28** moves it down against the base **56** of the plug **44** against the urging of the spring **42**. Because the annular space **46** and the annular space **45** are so small the liquid from the space **52** is forced through the space **45** at very high velocity as a high energy jet. Although the discharge chamber **31** is normally filled with the liquid being dispensed, this high energy jet does not cause excessive foaming because a major portion of the energy is absorbed by its passage through the annular chamber **51** of increasing cross section. Thus, by the time the liquid has reached the area of the spider **43** much of the energy is dissipated so that foaming is prevented.

Because of the tieing together of the closures **28** and **39** by the stem **30** the bottom closure **39** is moved to open position as indicated by the broken lines **53** by the down-

ward movement of the closure **28**. In the preferred embodiment, the distance of movement of the top closure **28** and thus of the bottom closure **39** as indicated by the arrow **54** is approximately one-fourth the diameter of the discharge chamber **31** in the region of the exit **40**. This diameter is indicated on the drawing by the line D.

With this arrangement foaming is very greatly retarded if not completely prevented even when the liquid being dispensed is a readily foamable liquid such as milk. This foaming is retarded because the high energy jet in the space **45** passes into the area **51** of increasing cross section so that much of the energy is absorbed. In addition, the annular area of the space **54** when the valves are fully open is approximately the same as the cross sectional area of the exit **40** and this is the reason why the distance **54** is approximately one-fourth the diameter D. This means that the liquid in the discharge chamber **31** flows from the nozzle into the container **37** in a stream of substantially constant cross sectional area until it is completely out of the nozzle.

In order to prevent foaming within the container **37** the downwardly and outwardly sloped skirt **47** on the closure **39** directs the liquid outwardly against the side walls **55** of the container so that it can flow in a sheet down these walls without turbulence and thus without entrapping air so as to cause foaming.

As the container **37** is filled with the liquid the rising level of course forces air from the container. In order to permit passage of the air through this annular sheet of liquid (not shown) the radial plate **49** provides a generally pie-shaped opening in the annular liquid sheet through which the air can escape.

As mentioned earlier, the nozzle **31** is normally filled with liquid. This is true because at the end of the down stroke of the piston **12**, when the closures **28** and **39** are open, the liquid has been flowing from the pump space **52** into the discharge chamber **31** and from there into the container **37**. As soon as upward movement of the piston **12** is begun, closures **28** and **39** move immediately to closed position as shown in the drawings under the urging of the spring **42**. This traps liquid within the discharge chamber **31** and between the two closures **28** and **39**. This trapped liquid cannot drop out of the bleed opening **41** because of the surface tension of the liquid. During this upstroke of the piston **12** the inlet valve **21** opens, as previously described, to draw more liquid into the pump space or chamber **52**. Then, as the piston **12** descends, this liquid is forced out the nozzle fitting **33** in the manner previously described.

The combination of the jet through the space **45** projecting into a space portion **51** of increasing cross section and the provision of the exit space **54** of approximately the same cross sectional area as the discharge exit **40** greatly reduces if not completely prevents foaming of the foamable liquid as previously described. However, the provision of the jet space **45** into the space **51** performs another very important and advantageous function in the following manner.

As stated, the discharge chamber **31** is normally filled with liquid from the preceding dispensing operation of the piston **12**. However, on certain occasions, such as when first starting operation, the chamber **31** will be full of air. By providing the high speed jet at the space **45** discharging into the annular area **51** of the discharge chamber, even this air is prevented from causing excessive foaming. The reason for this is that the first motion of the piston **12** in its downward movement causes the jet at the space **45** to provide an expanding mass of liquid that forces this air out the exit opening **40** without substantially entrapping this air in the liquid to cause foaming. Then, subsequent operating cycles of the piston **12** are in the manner previously described.

Having the cross sectional area of the exit opening **54** substantially the same as the cross sectional area of the exit **40** is very important in preventing foaming. This is true because the liquid exiting into the container **37** is at substantially the same velocity as when it passes through the discharge chamber **31**. Thus, entrapment of air is substantially prevented.

Having described my invention as related to the embodiment shown in the accompanying drawing, it is my intention that the invention be not limited by any of the details of description, unless otherwise specified, but rather be construed broadly within its spirit and scope as set out in the accompanying claims.

I claim:

1. Nozzle apparatus for flowing a foamable liquid without excessive foaming, comprising: means forming a cylindrical discharge chamber having an entrance end, an exit end and a cylindrical wall therebetween; a closure for said entrance; a closure for said exit; means connecting said entrance closure and said exit closure for simultaneous movement between open and closed positions; resilient means urging both said closures toward closed position; means for forcing said liquid under pressure into said chamber to provide a high energy jet of said liquid at said entrance along said wall, said forcing means operating through said liquid to open both said closures against the urging of said resilient means; means in said chamber at said entrance for providing an annular chamber portion with diverging walls of continuously increasing cross sectional area adjacent to and extending from said entrance to absorb a portion of said high energy to retard foaming; and means forming an atmospheric bleed opening into said chamber at said exit closure for maintaining said chamber at approximately atmospheric pressure when not in use.

2. The apparatus of claim **1** wherein means are provided for limiting the maximum extent of movement of said exit closure to fully open position with said extent being about one-fourth the diameter of said cylindrical discharge chamber in the region of said exit.

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LAVERNE D. GEIGER, *Primary Examiner.*

E. EARLS, *Assistant Examiner.*