United States Patent

[11] **3,626,996**

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[54] **CONTAINER-FILLING METHOD AND APPARATUS**
10 Claims, 8 Drawing Figs.

[52] **U.S. Cl.** **141/5,** 141/57, 141/59, 141/286
[51] **Int. Cl.** **B65b 1/04,** B65b 3/04
[50] **Field of Search** 141/4–7, 37, 39, 46–50, 57, 59, 286, 291–295, 302, 1

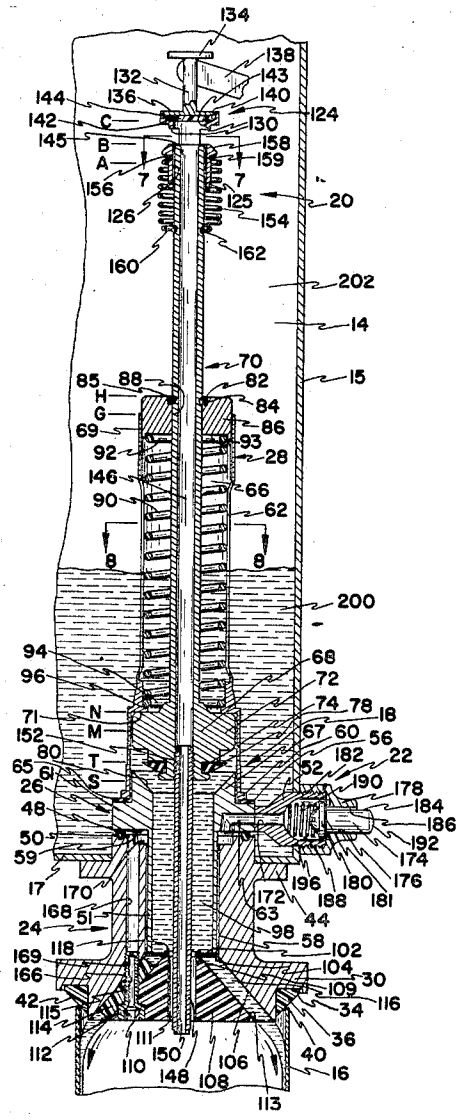
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Primary Examiner—Houston S. Bell, Jr.
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ABSTRACT: Method and apparatus for filling a container or can with a carbonated liquid or beverage wherein: the can is indexed into position beneath the filling apparatus; carbon dioxide gas is introduced into the can; carbonated liquid beverage flows into and fills the can; and the foam at the top of the liquid in the can, developed during filling, is evacuated through snift passageways which are isolated from the liquid-filling passageway. The lower portion of the liquid-filling passageway adjacent the spreader is small in volume and has a screen disposed immediately above the spreader to confine the foam for ease of removal whereby the sequential filling and capping of cans is significantly accelerated.



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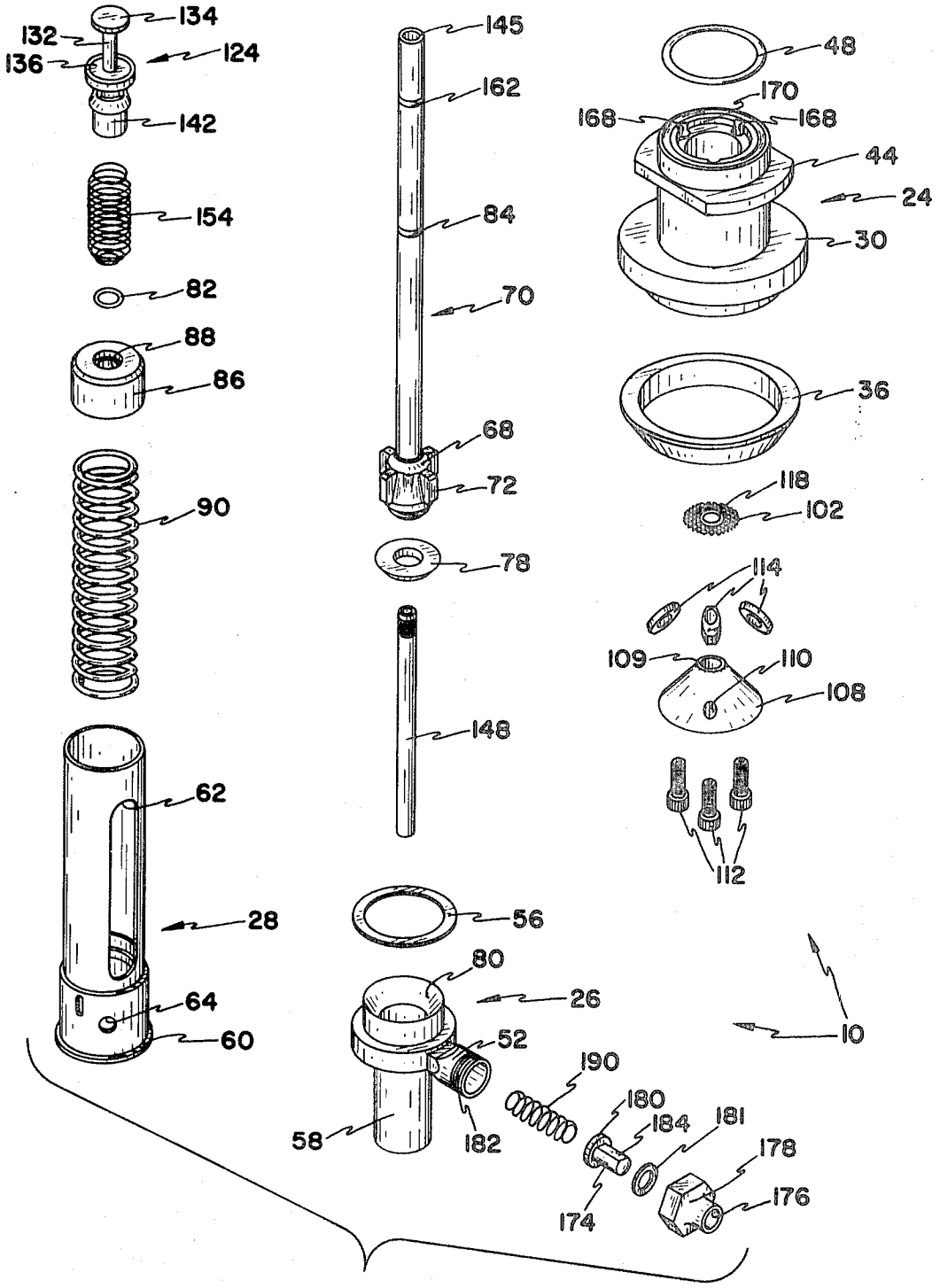


FIG. 1

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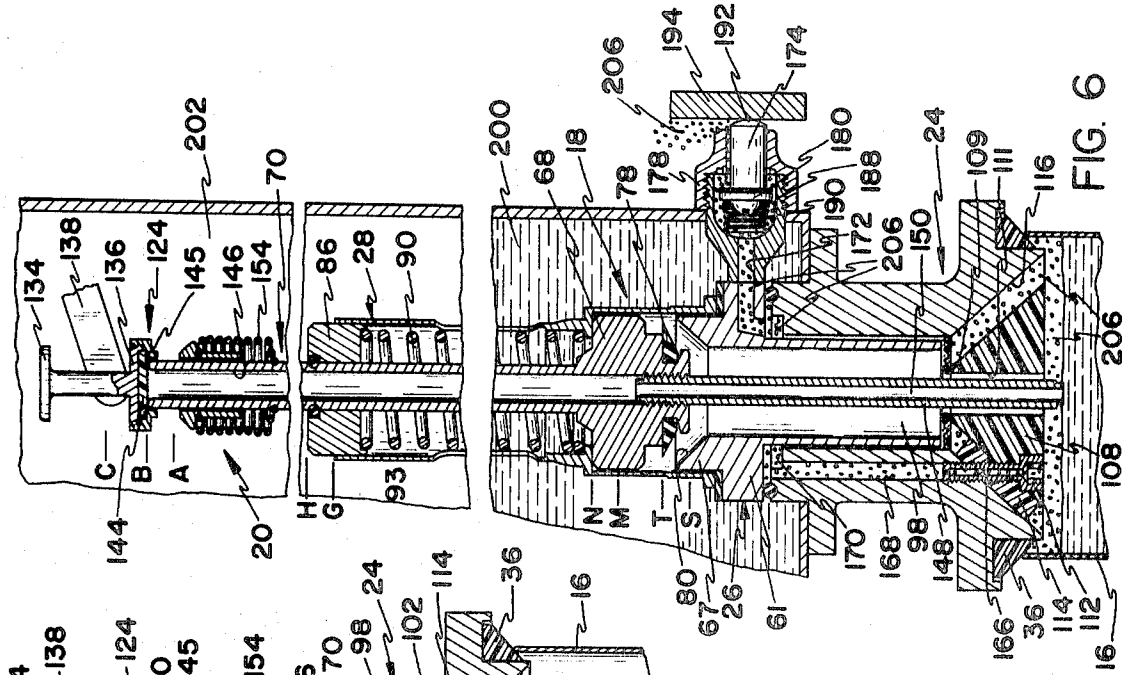


FIG. 6

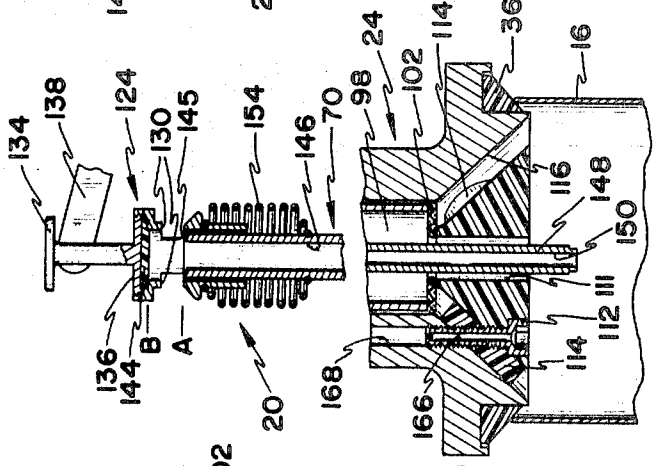


FIG. 3

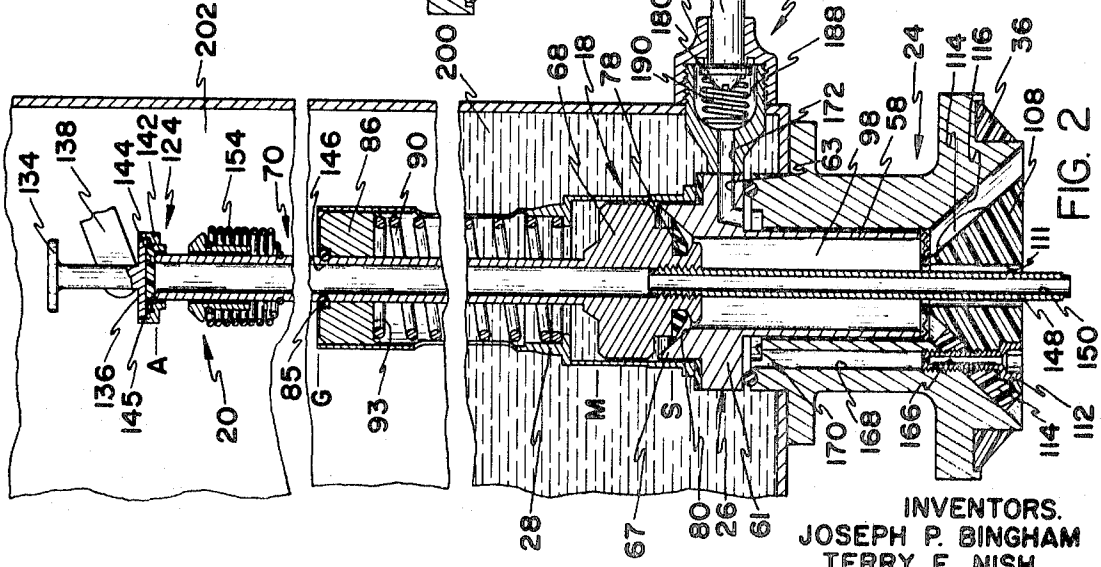


FIG. 2

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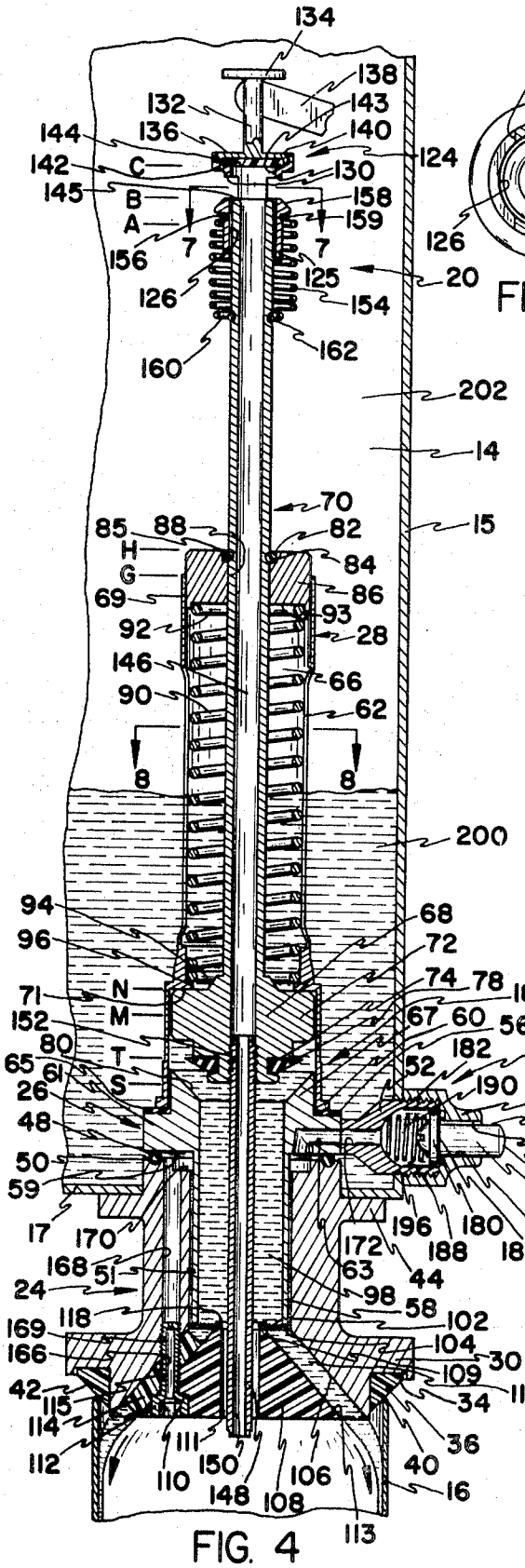


FIG. 4

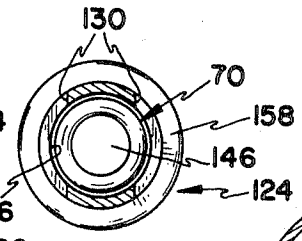


FIG. 7

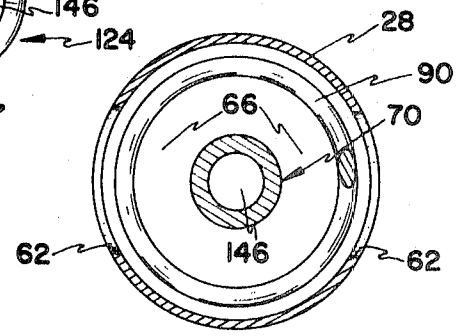


FIG. 8

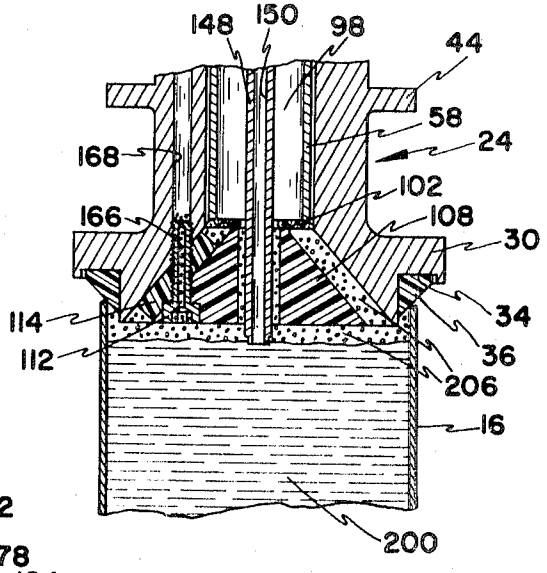


FIG. 5

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CONTAINER-FILLING METHOD AND APPARATUS

BACKGROUND

1. Field of Invention

This invention relates in general to a method and apparatus for filling containers with liquid, and more particularly to methods and valve apparatus for filling cans with carbonated beverage at speeds not heretofore attained.

2. Prior Art

In recent years there has been a significant increase in the demand by the public for carbonated beverages in cans. The result of this demand is that canners of such beverages have attempted to increase production. However, once a given canning facility is being operated on a 24-hour-a day basis, there has been no way to increase production short of adding additional canning equipment.

In addition to the inherent speed limitations of prior art canning equipment, cans are frequently not completely filled with beverage and are rejected, causing a further restriction on production.

In either case, the primary difficulty has been the creation of an excessive amount of foam during the filling operation. The development of foam has forced canners to operate their canning equipment at lower than maximum speeds, and, even so, the number of reject cans due to excessive foam has been high. Removal of foam from above the top of cans before capping has also posed a serious problem in the industry.

BRIEF SUMMARY AND OBJECTS OF THE INVENTION

The present invention has overcome or substantially alleviated the aforementioned disadvantages of the prior art by providing novel and useful can-filling valve apparatus and methods, the apparatus comprising a valve body, a beverage valve with an accompanying passageway for filling cans with beverage, a carbon dioxide gas valve with accompanying passageway, and a snift valve with a passageway separate from the gas and liquid passageways for removing foam from above the can-following filling. Novel structure is provided for confining the foam to a small volume of space above the can which reduces the amount of foam developed and aids appreciably in evacuation of the foam. By using can-filling apparatus and methods according to the present invention, it is possible to significantly increase production by increasing the speed at which the can filling is accomplished and by reducing the number of reject cans through improved foam control.

It is a primary object of this invention to provide novel apparatus and methods for filling containers with liquid.

Another important object of the present invention is the provision of novel can-filling valve apparatus and methods for carbonated beverages.

It is a further significant object of this invention to provide novel structure and methods for improved foam control.

These and other objects and features of the present invention will become more fully apparent from the following description and appended claims taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded perspective of one presently preferred valve apparatus according to the present invention;

FIG. 2 is a fragmentary cross-sectional view in elevation of the assembled apparatus of FIG. 1 in its initial position;

FIG. 3 is a fragmentary cross-sectional view in elevation of the assembled apparatus of FIG. 1 in its next or second position;

FIG. 4 is a cross-sectional view in elevation of the assembled apparatus of FIG. 1 in its third successive position;

FIG. 5 is a fragmentary cross-sectional view in elevation of the assembled apparatus of FIG. 1 in its fourth successive position;

FIG. 6 is a fragmentary cross-sectional view in elevation of the assembled apparatus of FIG. 1 in its fifth successive position;

FIG. 7 is a transverse cross-sectional view taken along line 7—7 of FIG. 4; and

FIG. 8 is a transverse cross-sectional view taken along line 8—8 of FIG. 4.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENT

General

The presently preferred can-filling valve apparatus **10** is best shown in FIGS. **1** and **4**, and is adapted to be secured to filling equipment comprising a bowl **14**. The bowl **14** comprises walls **15** and **17** and contains a beverage **200** and CO_2 gas **202**. The valve apparatus **10** is adapted to receive a beverage can **16** in sealed relation. The apparatus **10** broadly comprises a liquid or beverage valve **18**, a gas valve **20** and a snift valve **22**. A bonnet **24**, an intermediate housing **26** and an upper housing **28** also form part of the valve apparatus.

The Bonnet

The bonnet **24** is generally cylindrically shaped, having at its lower end a flange **30** which provides a groove **34** at its lower surface. The groove **34** receives a circular sealing rubber **36**, which is triangular in cross-sectional configuration. The sealing rubber **36** may be made of polyurethane or other suitable elastomeric material and is adapted to receive the open top of can **16** in sealed relation at **40**. A mounting flange **44** is formed in the upper part of the bonnet **24** and is adapted to be conventionally fastened to the bottom wall **17** of the bowl **14**.

An O-ring **48** is provided in a groove **50** at the upper surface of the bonnet **24** to seal the bonnet **24** to the intermediate housing **26**.

The bonnet **24** defines a central, axial bore **51** which runs the length of the bonnet and which terminates at its upper end in a horizontally disposed annulus **170**, the annulus having a diameter greater than the diameter of the bore **51**. Also, the bore **51** at its lower end merges with a frustoconical enlarged opening **106**.

The bonnet **24** is also equipped with three snift passageways **168** which are axially directed but offset in respect to the central bore **51**. Each snift passageway **168** communicates at its upper end with the annulus **170** and opens at its lower end along the frustoconical opening **106**. The lower part of each snift passageway **168** is threaded at **169**. The passageways **168** and the threaded sections **169** serve purposes to be hereinafter more fully described.

The Intermediate Housing

The intermediate housing **26** is generally cylindrical in configuration defining a stepped exterior, the lower thin-wall sleeve **58** thereof fitting concentrically within the bore **51** of the bonnet and extending essentially coextensive with the bore. The lower shoulder **59** of the flange **61** abuts the previously mentioned O-ring **48** to create a sealed relation between the bonnet and the intermediate housing. A dogleg passage **63** is disposed in the flange **61** and communicates at the lower end thereof with the annulus **170** of the bonnet. The dogleg passage **63** also communicates at its other end with a passage **172** in a housing **52** of a snift valve **22**, which will be hereinafter more fully described.

The upper shoulder **65** of the flange **61** receives an annular seal **56** upon which the lower flange **60** of the upper housing rests. Thus, the intermediate housing is disposed in sealed relation with the upper housing.

The flange **61** merges with an upward extension **67** which defines a tapered valve seat **80**.

The Upper Housing

The upper housing **28** comprises a sleeve terminating at its lower end in the flange **60** and at its upper end in a tubular guide **69**. The upper housing also defines an internal shoulder **71** spaced immediately above the valve seat **80**. The portion of the upper housing **28** disposed between the flange **60** and the

shoulder 71 defines a circular opening 64 while the portion of the upper housing 28 between the shoulder 71 and the tubular guide 69 defines a pair of opposed elongated slots 62, the opening 64 and the slots 62 accommodating selected flow of beverage from the bowl 14 into the container 16.

The Beverage Valve

The beverage valve mechanism 18 comprises a valve head 68 and a hollow vent stem, generally designated 70. The valve head 68 is generally in the shape of a cross when viewed in cross section (see especially FIG. 1), having radial arms 72 which guide the valve head during reciprocation in the upper housing 28. When the valve head 68 is open, as shown in FIG. 4, beverage is allowed to flow between the spaced radial arms 72.

The lower portion of the valve head 68 has an open groove 74, which carries a replaceable annular, wedge-shaped seal 78. The wedge-shaped seal 78 abuts the valve seat 80 when the valve head 68 is closed (see FIG. 2) to prevent the flow of beverage across the valve head 68.

The vent stem 70, which is of one-piece construction with the valve head 68 and centrally hollow at 146, extends from the head 68 upward a substantial distance beyond the upper end of the upper housing 28 and terminates at end 145. A plug 86 is carried at the exterior surface of the vent stem 70 approximately midway along the length of the stem. An O-ring 82 is interposed between the valve stem 70 and the plug 86 so as to fit within grooves 84 and 85 of the stem and plug, respectively. The plug 86 has a central bore 88 through which the vent stem 70 extends. Thus, the plug 86 moves back and forth within the tubular guide 69 of the upper housing 28 with the valve stem 70.

A main spring 90 normally biases the plug 86 together with the valve stem 70 into the elevated position illustrated in FIG. 4. Specifically, the mainspring 90 is located within the interior 66 of the upper housing 28. The upper end 92 of the mainspring 90 abuts the lower surface of the plug 86 within the open recess 93. The lower end 94 of the mainspring 90 abuts an interior flange 96 of the upper housing 28. Thus, the lower end 96 of the mainspring always remains stationary in space and the spring 90 always urges the valve seal 78 away from the valve seat 80 towards the open position, which accommodates beverage flow through the openings 62 and 64 of the upper housing 28, between the radial arms 72 and through the filling chamber 98 of the sleeve 58.

Structure for Spreading Beverage Flow and For Confining Foam

A fine-mesh screen 102 is horizontally disposed at the lower end of the filling chamber 98 immediately below the lower, annular edge 104 of the intermediate housing 26. The screen 102 rests upon the top surface 109 of a frustoconical flow spreader 108. The screen 102 has a central grommet 118 defining an opening through which a vent tube 148 passes. The vent tube has a central hollow interior 150, of substantial size although it is smaller in diameter than the diameter of the central hollow interior of the vent stem 70. The vent tube 148 is threadedly secured at 152 to the valve head 68. The flow spreader is situated within the lower frustoconical egress opening of the bonnet in spaced relation to the surface 106 to define the narrow passage 116. The spreader is maintained in the indicated relation by three equilateral spacers 114, which are interposed between the spreader 108 and the surface 106. Thus, in the open condition, beverage passing through the filling chamber 98 will be displaced along the tapered surface 113 of the spreader between the spacers 114 and into the can 16, as best illustrated in FIG. 4.

A series of three centrally hollow allen head screw fasteners 112 secure the spreader 108 and the spacers 114 in the illustrated position. Specifically, each fastener 112 extends through an opening 110 in the spreader 108 and an aperture 115 in one of the spacers 114, with the exterior threads of each fastener 114 engaging the lower threads 169 of one of the snift passageways 168 and the head of each fastener being essentially flush with the lower surface of the spreader. The hollow interior 166 of each fastener 112 provides communication between the top of the can 16 and one snift passageway 168. Obviously, even though the spacers 114 and the spreader 108 are illustrated as being separate pieces, they could be merged into a single part, formed, for example, by injection-molding techniques using a suitable synthetic resin, such as polypropylene. Thus, the spreader 108 and the spacers 114 are secured to the bonnet as illustrated in FIG. 4. The lower passage 116 formed between the bonnet surface 106 and the spreader surface 109 is so sized so as to be relatively small in volume, allowing sufficient beverage flow during the filling cycle, but minimizing and substantially confining the foam created during the filling cycle.

The construction and installation of the spreader and the spacers accommodate easy replacement following damage or breakage caused, for example, by a malformed can.

The Snift Valve

During a portion of the canning cycle, with the valve head 68 closed, foam (see FIG. 5), which has been confined above the beverage 200 at the top of the can 16 and below the screen 102, is evacuated along a path defined by the hollow 166 of the three fasteners 112, the snift passageways 168, the annular snift chamber 153, the dogleg passage 63, the snift valve passage 172 and released to the atmosphere through the snift valve 22. In this way, the heretofore serious problem of foam control is substantially alleviated.

In addition to the previously mentioned interior housing 52, the snift valve 22 comprises an exterior housing 178 which is threadedly secured at 182 to the interior housing 52. The snift valve also comprises a button 174 which extends outward beyond the housing 178 and loosely fits within an opening 176 for reciprocal movement. The button terminates at enlarged flange 180, held by a screw within the cavity 188 of the housing 52. The flange 180 is of a diameter larger than the diameter of the passage 186. Thus, when the compression spring 190, also within the cavity 188 of the housing 52, urges the button 174 with the flange 180 into the closed position illustrated in FIG. 4, the flange 180 will seal the snift cavity 188 from the atmosphere. A flat 184 is formed longitudinally along the button 174 to define a passage 186. Hence, when the button 174 is depressed mechanically during the canning cycle as by bar 194 (FIG. 6), foam is allowed to escape to the atmosphere at passage 186, the foam moving along the previously mentioned evacuation path.

The Gas Valve

The gas valve 20, which is situated adjacent the upper end 145 of the valve stem 70, comprises a vent stem cap, generally designated 124. The vent stem cap 124 comprises a lower body 125 which defines a central bore 126. The bore is exterior of but concentric with the upper end 145 of the valve stem 70 and the body 125 is adapted to be displaced to-and-fro along the exterior of the vent stem 70. The body 125 is secured to the valve stem 70 by a spring 154, i.e. the spring 154 has its upper end 156 retained in an anchor groove 159 of the body 125 immediately below a flange 150. The lower end 160 of the spring 154 is retained within a groove 162 in the valve stem 70. Thus, the vent stem cap 124 is normally urged by the spring 154 toward the elevated position of FIG. 4.

The body 125 is interrupted by a pair of opposed radial openings 130, which are disposed immediately above the flange 158. The body 125 terminates in a top flange 142, which is internally threaded at 140 and which defines a stepped shoulder 143 upon which a disc seal 144 rests.

The seal 144 is held in the illustrated position by the upper portion 132 of the vent stem cap 124. The upper portion 132 is spool shaped, having an upper flange 134 and a lower flange 136, which lower flange threadedly engages the flange 142 at threads 140. A mechanical arm 138 having bifurcated fingers fits between the flanges 134 and 136 in a conventional manner. The arm 138 is mechanically manipulated during the canning cycle to appropriately open and close the vent stem cap 124, as will hereinafter be more completely described.

Operation

The can-filling apparatus, heretofore described, is situated, for the most part, in the bowl 14, which contains a beverage 200 maintained at a level above the bottom of the slots 62 of the upper housing 28. A gaseous carbon dioxide atmosphere 202 is maintained under pressure above the beverage 200 in the bowl 14.

At the beginning of the canning cycle, the apparatus is in the closed position, as illustrated in FIG. 2. Specifically, the beverage valve 18 and the gas valve 20 are held in closed position partially by the mechanical arm 138, i.e. the disc seal 144 is held contiguous with the top end 145 of the valve stem 70 and the wedge-shaped seal 78 contiguously engages the valve seat 80. The force of the mechanical arm 138 is not necessary to close the beverage valve. The difference in the pressure of the carbon dioxide environment 202 and the atmospheric pressure in the vent stem 70 and the difference between the hydrostatic head of the beverage 200 in the bowl and the force of the mainspring 90 plus the atmospheric pressure within the fill chamber 98 provide enough force to close the beverage valve 18.

Also, the snift valve 22 is held closed by force of the spring 190.

In summary, the initial position of the apparatus 10 is such that the disc seal 144 is situated in space at elevation A, the top of the plug 86 is situated in space at elevation G, the top surface of the valve head 68 is situated in space at elevation M and the top surface of the wedge-shaped seal 78 is situated in space at elevation S.

Next, the mechanical arm 138 is displaced by conventional canning apparatus (not shown) to engage the upper flange 134 and lift the vent stem cap 124. At the same time, a can 16 is indexed into position below and elevated into contiguous relation with the sealing rubber 36. In this way, the relationship of parts illustrated in FIG. 3 is obtained, with the disc seal 144 being elevated to position B to open the gas valve 20 at ports 130. Otherwise, the components of apparatus 10 remain in the same respective elevations as illustrated in FIG. 2, i.e., the upper surface of the plug 86 remaining at elevation G, the upper surface of the valve head 68 remaining at elevation M and the upper surface of the wedge-shaped seal 78 remaining at elevation S.

The plug 86, the valve head 68 and the wedge-shaped seal 78 are so retained by the force consisting essentially of difference between the carbon dioxide pressure in the bowl and the atmospheric pressure in the vent stem plus the positive difference between the hydrostatic head of the beverage in the bowl and the force of the mainspring plus the atmospheric pressure in the filling chamber 98.

In the position of FIG. 3, carbon dioxide under pressure passes through the ports 130, along the interior 146 of the valve stem 70, through the bore 150 of the vent tube 148 into the interior of the can 16.

As soon as the CO_2 pressure reaches the interior of the can 16, the pressure within the filling chamber 98 is no longer atmospheric, but rather essentially equal to the carbon dioxide pressure of the bowl. By carefully selecting the value of the spring 90, the carbon dioxide pressure in the filling chamber 98 plus the spring force is now greater than the hydrostatic head of the beverage in the bowl. Therefore, the position of FIG. 4 is promptly obtained, being achieved by displacement of (a) the upper surface of the plug 86 to elevation H, (b) the valve head 68 to elevation M and the upper surface of the wedge-shaped seal 78 to elevation T. By reason of the mentioned displacement, the lower end of the vent tube 148 together with the gas valve 20 are elevated an identical distance, leaving the seal 144 at elevation C.

In the position of FIG. 4, beverage flows through the openings 62 and 64 in the housing 28, between the radial arms 72, through the filling chamber 98, across the tapered surface 113 of the spreader 108, which is very closely spaced to the bonnet surface 106 thereby defining a narrow diverging passageway 116 and into the can 16. By reason of the structural relationship between the spreader 108 and the bonnet 24, a very gentle cascading of the beverage onto the interior sidewall of the can is accomplished, as illustrated in FIG. 4, whereby foaming is appreciably required.

When the elevation of the liquid in the can touches the bottom end of the vent tube, as illustrated in FIG. 5, carbon dioxide gas with foam 206 is trapped within the bonnet and soon reaches a pressure equal to the hydrostatic head of the beverages in the bowl, causing beverage flow to cease, even though the beverage valve 18 remains open.

The screen 102 serves the remarkable purpose of confining the foam generated during filling to the volume between the liquid 200 in the can 16 and the bottom surface of the spreader 108, the space between the outside of the vent tube 148 and the central bore 111 of the spreader 108, the diverging passage 116 and the hollow interior 166 of each fastener 112. While the indicated utility of the screen has been demonstrated through experimentation, it is not known why the screen so confines the foam.

The mechanical arm 138 is next actuated to engage the flange 136 and lower the vent stem cap 124 to a closed position thereby displacing the disc seal 144 from elevation C to elevation D. At nearly the same time, the snift valve 22 is open when the plate 194 is caused to depress the button 174. In this way, the carbon dioxide pressure within the bonnet 24 is relieved and the foam 206 is evacuated from the previously mentioned confinement. See FIG. 6.

Immediately upon release of the carbon dioxide pressure from the bonnet, the top surface of the vent stem 70 and the disc seal 144 are lowered to elevation A, the top surface of the plug 86 is lowered to elevation G, the top surface of the valve head 68 is lowered to elevation M and the top surface of the wedge-shaped seal 78 is lowered to elevation S. Specifically, the initial condition of the apparatus as illustrated in FIG. 2 is resumed by the combination of previously mentioned forces.

The filled can 16 is lowered, removed and capped by conventional canning equipment (not shown) and the high-speed valve apparatus 10 is ready to commerce another canning cycle.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is, therefore, to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore to be embraced therein.

What is claimed and desired to be secured by United States Letters Patent is:

1. In a method for filling a can with carbonated beverage comprising the following steps: opening a gas valve, causing carbon dioxide to flow into a can, opening a liquid valve, causing a carbonated beverage to flow along a liquid flow path to fill the can, opening a snift valve and evacuating foam, developed during filling of the can, along a snift flow path which is entirely separate from the liquid flow path.

2. In a method of controlling foam during the filling of a container with carbonated beverage, comprising the following steps: activating beverage valve structure, discharging carbonate beverage through a small-mesh screen and across a juxtaposed beverage flow spreader immediately above the top of the container, creating foam above the container, confining the foam to essentially the available volume between the beverage in the container and the screen and evacuating the foam along a snift flow path.

3. In an elongated valve apparatus for filling a container with carbonated beverage comprising a gas valve disposed at one end of the valve apparatus for cyclically communicating gaseous carbon dioxide from a source to the container through vent means coextensive with a substantial axial length of the valve apparatus, a beverage valve disposed intermediate the length of the valve apparatus for cyclically communicating carbonated beverage from a reservoir to the container through bonnet means located at the other end of the valve

apparatus, the bonnet means defining carbon dioxide passageway means, beverage passageway means, and snift passageway means, each passageway means being insulated and separated from the other passageway means with each passageway means communicating with the container.

4. In a can-filling apparatus comprising a liquid valve, a gas valve and a screen, the apparatus receiving at one end thereof the open end of a container to be filled first with gas and then with liquid, the apparatus having liquid-communicating passageway means, the passageway means terminating adjacent liquid spreader means at the one end, the screen being essentially transverse the passageway means and closely juxtaposed the spreader means so that the volume of the liquid passageway means between the screen, the spreader means and the one end is very small when compared with the remainder of the passageway means.

5. In an apparatus as defined in claim 4 further comprising a snift valve and snift passageway means isolated from the liquid-communicating passageway means.

6. In an apparatus as defined in claim 5 wherein the gas is carbon dioxide, the liquid is a carbonated beverage, the screen is fine mesh, and the separate snift passageway means communicates between the very small volume of the liquid-communicating passageway means and the snift valve whereby foam created during the filling of the container is confined by the screen to the small volume of the liquid-communicating passageway means and is promptly evacuated through the separate snift passageway means and the snift valve after filling of the container.

7. In a vertically oriented valve apparatus, a carbon dioxide valve comprising hollow vent stem means, a carbonated beverage valve joined to the vent stem means, a snift valve, and a beverage flow spreader, vent tube means forming a continuation of the vent stem means and traversing axial of the apparatus from the beverage valve to below the spreader, the vent tube means having an unconstricted hollow interior of a size slightly less than the size of the hollow interior of the vent stem means for communicating carbon dioxide to a container.

8. In a high-speed valve apparatus comprising seriatum a snift valve; a snift block; and a bonnet; the snift block and the bonnet together defining beverage passageways forming a beverage flow path for filling a container; the bonnet, the snift block, and the snift valve defining snift passageways; the entire length of which is isolated from the beverage passageways and which forms a foam evacuation path.

9. In a valve apparatus comprising a valve for dispensing carbonated beverage into a container, a bonnet with a central bore terminating in a divergent egress port, and a beverage flow spreader, the spreader being frustoconical in configuration and being releasably secured by fasteners to the bonnet adjacent the divergent egress port but separated therefrom by spacers to define a narrow divergent chamber of fixed dimensions through which beverage passes and thereafter gently cascades in an annular ring upon the sidewalls of the container.

10. A bonnet comprising a body having a first flange adapted to be secured to a bulb containing gaseous carbon dioxide and carbonated beverage and a second flange carrying a sealing rubber for engaging an open end of a container to be filled with beverage through the bonnet, the body defining a central axial bore terminating in a divergent egress port and at least one axially directed snift passageway offset and separate from the central axial bore, the snift passageway opening at one end in the divergent egress port, the other end of the snift passageway communicating with an open groove in the bonnet remote from the divergent egress port, the open groove being adapted to communicate with a snift valve for evacuating foam from the container after it is filled with beverage.

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