United States Patent

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[54] **AUTOMATIC CONTAINER FILLING APPARATUS**
8 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **141/90,** 134/166; 137/240
[51] **Int. Cl.** **B65b 3/26,** B67c 3/04
[50] **Field of Search** 134/166; 137/240; 141/46, 85, 89-91, 198; 222/148; 134/95, 102

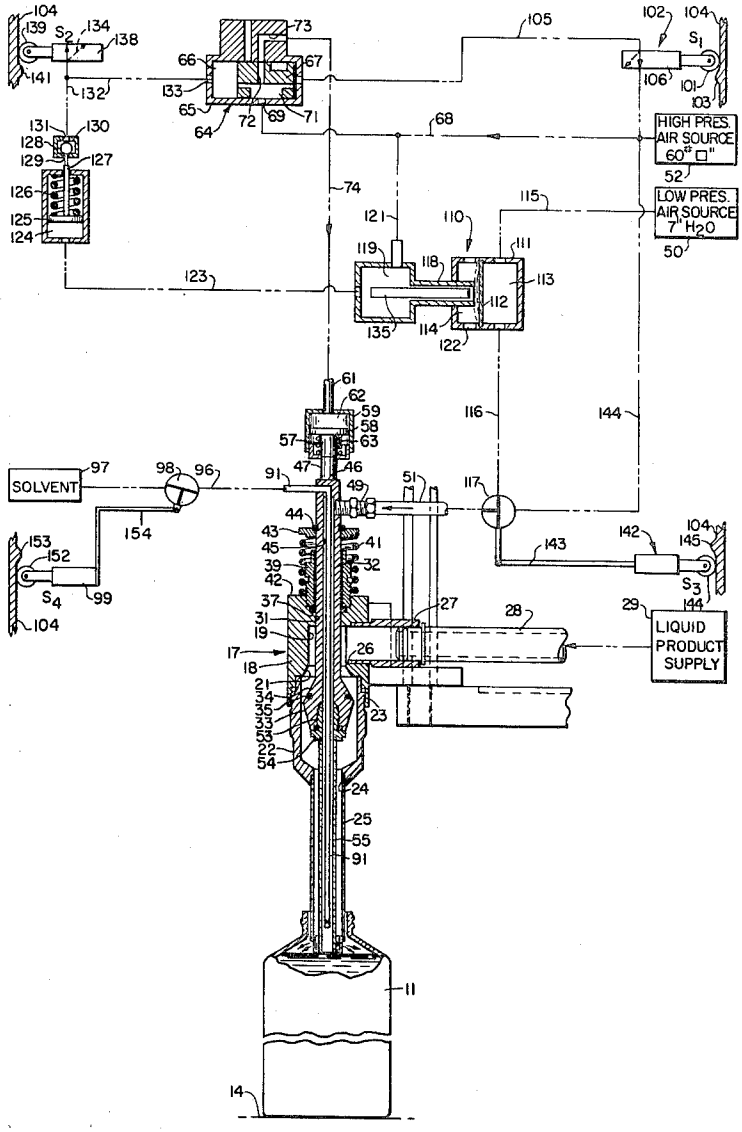
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ABSTRACT: An automatic machine for filling continuously a moving row of containers with a product liquid comprises a filling head for each container having a product fill nozzle adapted to extend into the container during filling and adapted to be withdrawn after filling. The type of filling head with which the invention is concerned incorporates a low pressure air sensing tube within the nozzle, and when the liquid in the container reaches and blocks the lower end of the sensing tube a control device is actuated to shut off the product fill valve leading to the nozzle. Each head includes a sensing tube cleaning arrangement whereby after each filling operation the sensing tube in the withdrawn nozzle is automatically subjected to a short time blast of high pressure air therethrough to try to clear out any product liquid coating its inner surfaces, to prevent the accumulation of deposits eventually restricting or even blocking the effective opening of the sensing tube. This avoids premature shut off of the product fill valve. A smaller diameter tube extends down through the interior of the sensing tube to terminate in openings opposite the internal surfaces at the lower end of the sensing tube and a control is provided to automatically discharge a quantity of solvent liquid such as water to dissolve or otherwise free the deposits of product liquid just prior to the high pressure air blast for more effective cleaning of the lower end of the sensing tube.



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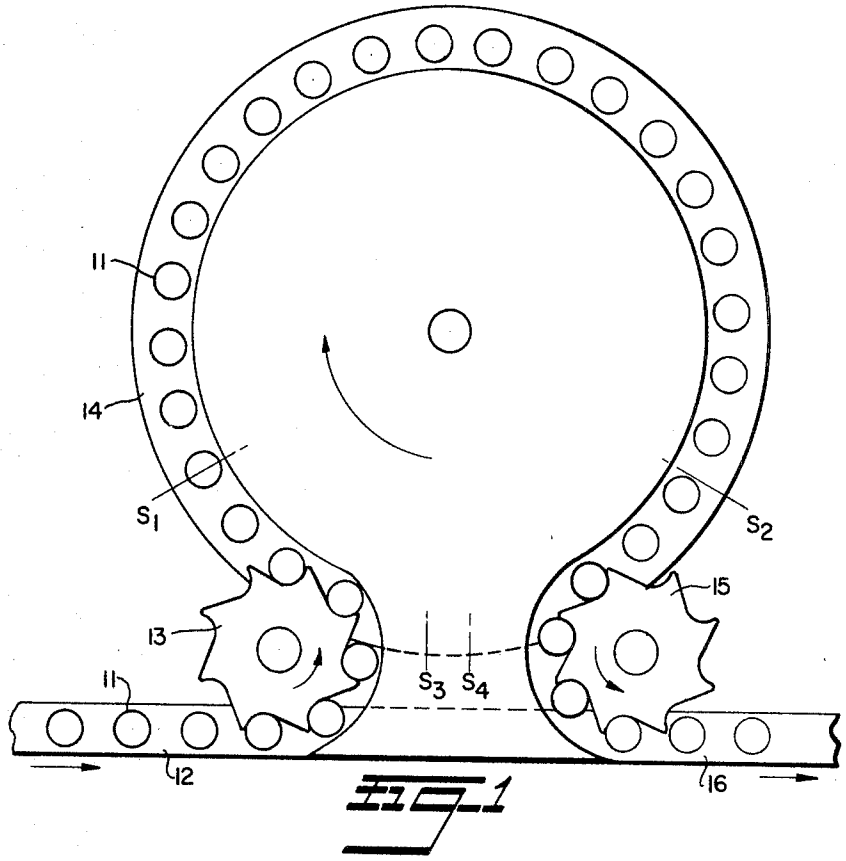


FIG. 1

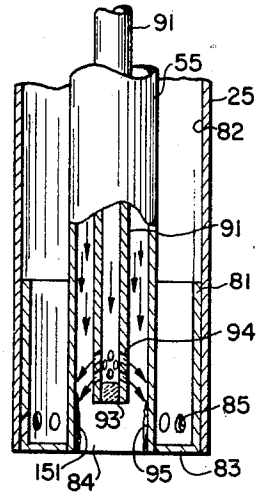


FIG. 4

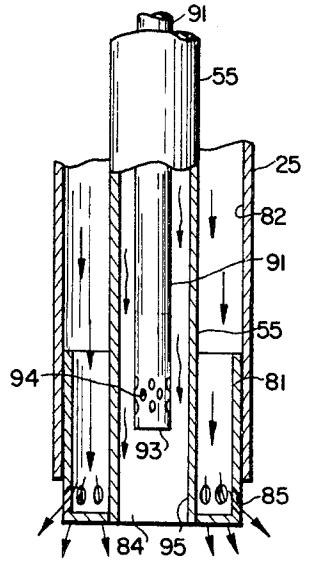


FIG. 5

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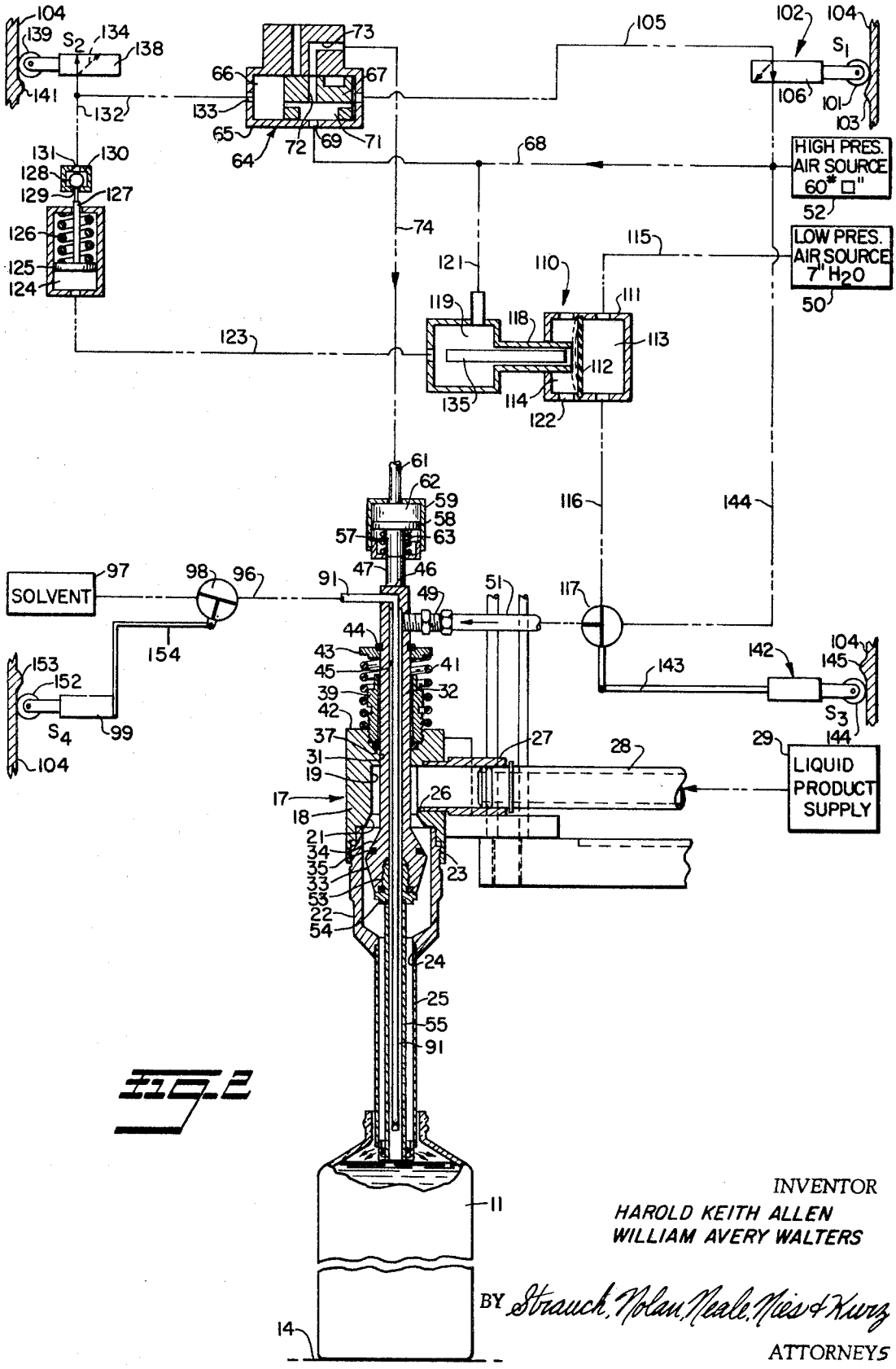


Fig. 2

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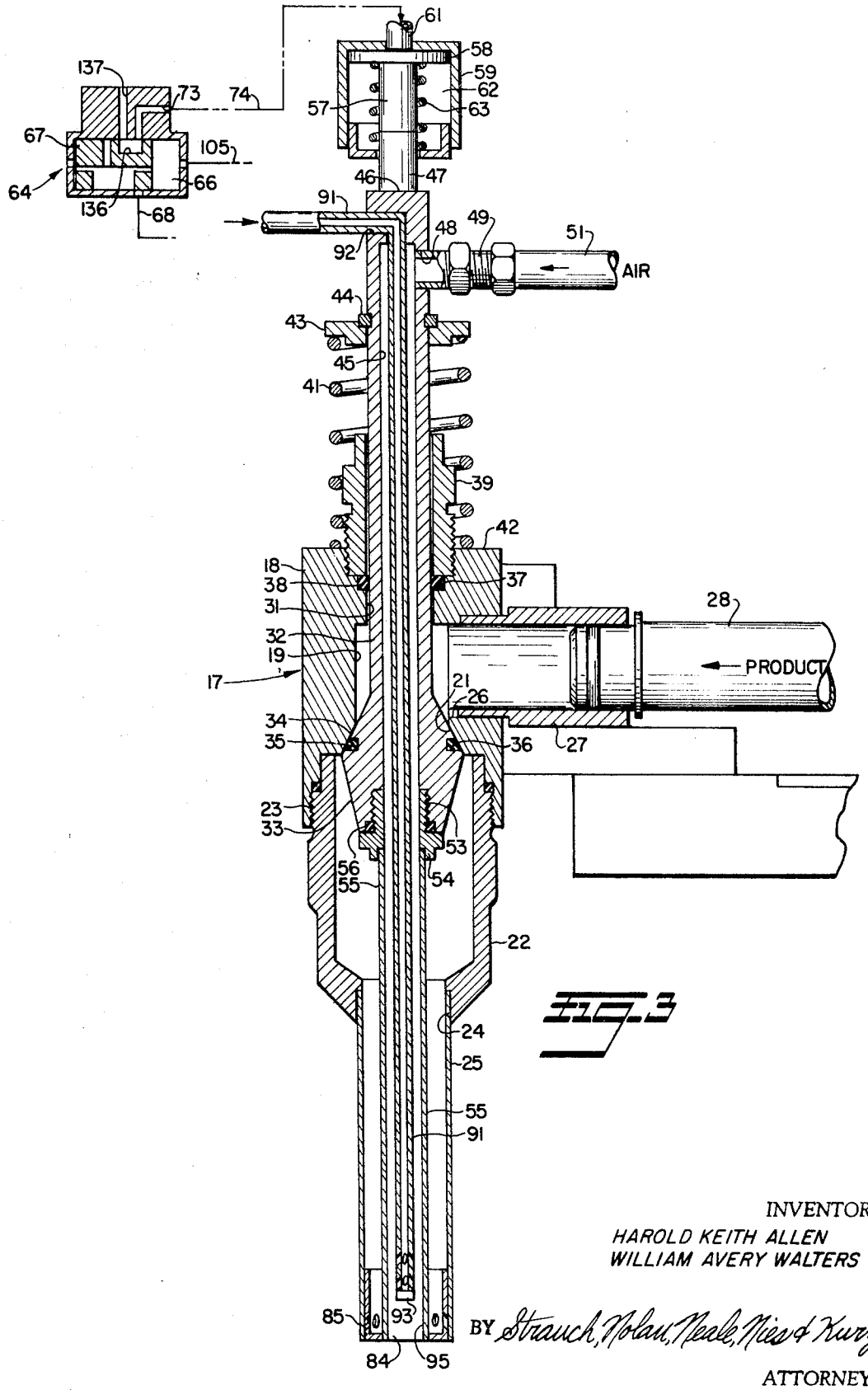


FIG. 3

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U.S. PATENT 3,522,824
AUTOMATIC CONTAINER FILLING APPARATUS

BACKGROUND AND SUMMARY OF THE INVENTION

Automatic container filling machines are known wherein a sensing tube containing low pressure air from a control device extends through the fill nozzle of a product liquid filling head and wherein blocking of the lower end of the sensing tube as the container reaches a desired fill level actuates the control device to close the product fill valve. In these heads, a short blast of high pressure air is passed down through the sensing tube during the period between withdrawal of the nozzle from a filled container and insertion of the nozzle into another container to start another fill cycle.

It has been found that many highly viscous or sticky liquids are not effectively removed from the lower end of the sensing tube by the air blast, and that they dry and otherwise accumulate on the sensing tube inner surfaces to eventually gradually reduce the effective inside diameter of the sensing tube. Any reduction in inner diameter of the sensing tube results in a pressure increase in the low pressure air upstream, and this results in premature actuation of the control device to shut off the product fill valve before the container is properly filled.

The invention solves this problem by automatically discharging a quantity of liquid such as water as a solvent against the lower interior surfaces of the sensing tube after withdrawal of the nozzle from a filled container and prior to introduction of the high pressure air blast. This either dissolves the deposits to form a more easily removable solution or otherwise weakens the adherence of the deposit to the sensing tube walls, and as a result the high pressure air blast much more efficiently and effectively cleans out the sensing tube. The foregoing is the major object of the invention.

As a result of the invention, the entire automatic filling operation is improved, and the machine operates over longer periods with little maintenance and no shutdown time for cleaning restricted or blocked sensing tubes. This is a great saving in rejects because restriction of the sensing tube is usually gradual and often many improperly filled containers pass out of the machine and must be rejected before the improper automatic operation is discovered. The invention avoids such waste.

It is a further object of the invention to provide a novel apparatus for maintaining the sensing tube of an automatic filling machine filling head against restriction internally wherein the tube inner surface is successively automatically subjected to applications of a solvent or like liquid and a high pressure air blast following withdrawal from a filled container.

Another object of the invention is a novel filling head structure wherein a sensing tube extending to the lower end of a product fill nozzle contains therein a solvent or like liquid conduit that discharges cleaning liquid against the lower internal surfaces of the sensing tube. Automatic sequential control of the cleaning liquid discharge in a filling machine is ancillary to this object.

BRIEF DESCRIPTION OF DRAWINGS

FIGURE 1 is a diagrammatic plan view showing a filling machine of the type for which the invention is peculiarly adapted, and illustrating the locations of the sequential control stations for carrying out the invention;

FIGURE 2 is a partially sectional, partly diagrammatic view illustrating the invention as incorporated into a container filling arrangement according to the preferred embodiment with the product fill valve shown open;

FIGURE 3 is an enlarged view mainly sectional showing a container filling head with the product fill valve closed;

FIGURE 4 is an enlarged elevation mainly in section showing the lower end of the fill nozzle as the parts are arranged when the solvent is being discharged against the sensing tube wall; and

FIGURE 5 is a similar enlarged section showing the arrangement of parts when product is being discharged into the container being filled.

PREFERRED EMBODIMENTS

Referring to **FIGURE** 1, containers 11 arriving on a belt conveyor 12 are transferred by starwheel 13 in accurately spaced relation onto the continuously rotating table 14 of a filling machine assembly. The containers 11, which may be plastic bottles as illustrated in **FIGURE** 2, are filled with a product liquid such as a liquid detergent as they are carried around on the conveyor. A second starwheel 15 removes the filled containers from table 14 and delivers them to take-away conveyor 16.

Rotating with table 14 are a series of container filling heads 17 one for each container being filled and one of which is shown in **FIGURE** 2. These heads are engaged in filling relation with the containers during travel between stations S_1 and S_2 shown in **FIGURE** 1.

Except for certain structural details and sequential operational steps the filling heads and their mounting, arrangement and actuation in the filling assembly are known and need not be described in detail, as will appear.

One filling head 17 is shown in **FIGURE** 2, and it comprises a body member 18 having an internal downwardly open bore 19 formed with a downwardly diverging smooth circular valve seat 21. A hollow lower body member 22 is detachably secured, as by screw threaded connection 23, to member 18 just below valve seat 21. Member 22 has a smaller diameter opening 24 in its lower end in which is fixed a fill nozzle tube 25.

On side of bore 19 is formed with an opening 26 in which is fixed a tube 27 receiving the end of a conduit 28 from a supply of liquid product indicated at 29.

Above bore 19, body member 18 is formed with a smaller bore 31 in which is vertically slidably mounted the hollow stem 32 of a product flow control valve 33. An annular conical face 34 is formed on the upper part of valve 33, adapted to engage seat 21 in the valve closed position of **FIGURE** 3 . An O-ring or like resilient seal 35 is preferably mounted in a groove 36 in valve face 34 to insure good sealing closure at the valve. Thus flow of the product liquid from the supply to the container is controlled by the position of valve 33.

A resilient O-ring seal 37 is mounted in a groove 38 at the upper end of bore 31, and seal 37 is compressed by a hollow thimble 39 threaded into the top of body member 18 so as to provide a liquid tight seal around stem 32 without interfering with the sliding displacement of the valve stem.

Thimble 39 also serves as a guide for a surrounding coil spring 41 that is compressed between the top surface 42 of body member 18 and a washer 43 on stem 32 which is anchored against upward vertical displacement along the stem by a snap ring and groove arrangement at 44. Spring 41 biases valve 33 toward its **FIGURE** 3 closed position.

Valve stem 32 has a central bore 45 closed at the upper end by end wall 46 on which is fixed a rigid post 47. Bore 45 is formed with side opening 48 mounting a nipple 49 connected to a conduit 51 adapted to deliver into bore 45 either low pressure (about seven inches of water) air from a source 50 or high pressure (about 60 pounds per square inch) from a source 52 as will appear. The lower end of bore 45 is threaded at 53 within valve 33 to mount a hollow sleeve 54 which has fixed thereto a depending sensing tube 55 of smaller diameter than and concentric with nozzle tube 25. When sleeve 54 is drawn tight an O-ring seal 56 is compressed to insure against fluid leaking through the threads 53. Tube 55 is open at both ends and provides an effective continuation of stem bore 45.

Post 47 on valve stem 32 abuts the end of a rod 57 fixed to a piston 58 slidable in a cylinder 59 open at its upper end to receive a conduit 61 for delivering air under pressure to chamber 62. A compression spring 63 biases piston 58 upwardly in chamber 62.

A shuttle type air valve assembly 64 comprises a housing 65 that contains an internal chamber 66 within which a shuttle element 67 may assume either of two operational positions, one as shown in **FIGURE** 2 and the other as shown in **FIGURE** 3. In the product fill valve open condition of the apparatus

shown in FIGURE 2, which is the condition prevailing when a container 11 on table 14 is moving clockwise and is being filled with liquid from supply conduit 28, shuttle element 67 is disposed to the right in chamber 66 to establish a path for high pressure air from conduit 68 leading from source 52 through shuttle valve inlet 69 and passages 71 and 72 in the shuttle element 67, outlet passage 73 and conduit 74 to cylinder chamber 62 wherein the pressure urges piston 58 down to compress spring 63 and to displace stem 32 downwardly and open valve 33.

Referring to FIGURE 5, which shows the lower end of the filling head nozzle 25 enlarged, tube 55 extends into a cup-shaped cylindrical shell 81 that has a sliding fit with the internal surface 82 of nozzle tube 25. The bottom 83 of shell 81 is closed except for opening 84 where the open lower end of tube 55 terminates. Shell 81 is fixed on tube 55. A series of openings 85 are provided in the side wall of shell 81, so that when valve 33 has been displaced to its open position of FIGURE 2 the product liquid descending nozzle tube 25 around the outer periphery of tube 55 will be diverted laterally outwardly toward the adjacent upper container walls to reduce foaming during filling.

A small diameter tube 91 extends through a side opening 92 in the upper end of valve stem 32 concentrically down through bore 45 and tube 55 to terminate in an axially closed end 93 within the lower end of sensing tube 55. There tube 91 is provided with a series of lateral openings 94 through which as will appear a solvent liquid such as water may be discharged to wash the internal wall 95 of sensing tube 55.

Tube 91 is connected by a conduit 96 to a source 97 for the solvent through a normally closed valve 98 controlled by a cam roller actuated unit 99 at the filling head.

As each empty container 11 maintained on table 14 by conventional means (not shown) and having an individual filling head 17 disposed in association with its nozzle tube 25 thrust into the container neck approaches the station S_1 indicated in FIGURE 1, valve 33 is in the closed position shown in FIGURE 3 and the shuttle valve element 67 is at the left side of the chamber 66 as also shown in FIGURE 3. The arrangement for inserting nozzle 25 into the container 11 to the distance shown in FIGURE 2 is conventional and need not be described.

At station S_1 (FIGURES 1 and 2) the roller 101 of a switching device 102 moving with the table 14, there being one at or on each filling head 17, engages a cam projection 103 on stationary track 104. A high pressure air line 105 from source 52 contains a valve 106 operated by switching device 102 and, just before cam roller 101 engages cam 103, valve 106 is open to pass high pressure air through line 105 to maintain shuttle 67 in its left (FIGURE 3) position in chamber 66.

When roller 101 passes over cam 103, switching device 102 is actuated momentarily to move valve 106 to the closed condition indicated in dotted lines in FIGURE 2 to connect line 105 to exhaust to atmosphere. Valve 106 reopens after roller 101 passes cam 103, but during the short period it was closed, the lowered pressure in the right side of chamber 66 permits the opposing high pressure applied through line 68 and inlet 69 to quickly shift shuttle 67 from its FIGURE 3 position to its FIGURE 2 position where it is maintained by the high pressure air in chamber 66 acting on both ends of the shuttle 67 when valve 106 reopens.

With shuttle 67 now in the FIGURE 2 position, high pressure air is applied through conduit 68, inlet 69, passages 71, 72 and 73 and conduit 74 to cylinder chamber 62 to displace piston 58, whereby stem 32 is depressed to open fill valve 33 and start flow of the product liquid into container 11.

At this time the shell 81 is displaced to the FIGURE 2 and 5 position below the end edge of nozzle tube 25 to uncover discharge openings 85 and direct the product liquid into the container. This condition continues until the container is properly filled and has reached the region of station S_2 of FIGURE 1, and at this time the container and fill head are separated by conventional means (not shown) so that the filled container can be taken off table 14.

As the filling container approaches station S_2, the rising level of liquid therein eventually approaches the open lower end of sensing tube 55.

With reference to FIGURE 2, fill control means in the form of a pneumatic amplifier device 110 comprises a housing 111 divided by an internal flexible diaphram 112 into a low pressure air chamber 113 and a regulator chamber 114. Low pressure air from a line 115 passes through chamber 113 to a line 116 connected by valve 117 to conduit 51 and sensing tube 55 from which it discharges into the container and may escape through the space between nozzle 25 and the container neck. This low pressure air is effective in chamber 113 to urge diaphragm 112 toward the open end of a conduit 118 leading from a chamber 119 connected by line 121 to receive high pressure air. The high pressure air discharged into chamber 114 exhausts through openings 122 but in passing it is effective on diaphragm 112 to urge the diaphragm oppositely to the force exerted by the low pressure air of chamber 113.

In practice, the parts and relative air pressure are all so arranged and correlated that diaphragm 112 normally exerts a balanced throttling action on the high pressure air flow through chamber 114. High pressure air from chamber 119 is also connected by a line 123 to a cylinder chamber 124 for acting on a piston 125 in a direction opposite a compression spring 126. The stem 127 of piston 125 is connected to a valve element 128 seating on an outlet aperture 129 in casing 130. Normally the force of spring 126 is high enough to overcome the pressure in chamber 124 and hold valve element 128 in closed position over aperture 129.

An inlet 131 in housing 130 is connected by conduit 132 to an opening 133 into shuttle valve chamber 66, and to the valve 134 of a switching device S_2 that is normally in the closed dotted line condition shown in FIGURE 2. During container filling it will be seen therefore that high pressure air from chamber 66 is connected into valve casing 130 where exhaust is prevented by the closed valve 128.

When the rising liquid in container 11 has reached and blocked the lower end of sensing tube 55, pressure will increase in tube 55 and chamber 113, this resulting in diaphragm 112 being displaced to the dotted line condition of FIGURE 2 where it further throttles tube 118. As a result, air pressure now increases proportionately in chamber 114 and within tube 118 and this increased air pressure is effective through a conduit 135, chamber 119 and line 123 to increase the air pressure in chamber 124 and raise piston 125 until valve element 128 is unseated from outlet 129, thereby connecting the left end of chamber 66 to exhaust. At this point, the higher air pressure from line 105 will quickly shift shuttle 67 to the left to its FIGURE 3 position wherein line 74 is connected to exhaust through passages 73, 136 and 137. Spring 63 now acts to quickly close valve 33, and this stops the filling of container 11. The pressure in chamber 124 reduces when the end of tube 55 raises out of the liquid.

At station S_2 a safety arrangement may be provided to shut off valve 33. This comprises the normally closed valve 138 which when roller 139 passes over cam 141 is momentarily opened to exhaust line 132 and permit the shuttle valve to assume its FIGURE 3 position.

After passing station S_2, filling head 17 on the moving table is disposed as in FIGURE 3 with shell 81 drawn up into nozzle 25. A further switching device 142 moving around with and usually on the filling head is mechanically connected by line 143 to valve 117, and when cam roller 144 passes over cam 145, valve 117 is turned to disconnect conduit 51 from the low pressure air line 116 and connect conduit 51 for a short period to the high pressure air line 144. This delivers a blast of high pressure air down sensing tube 55 for blowing out any residue or coating of the product liquid that may remain on the surface 95.

As the nozzle is withdrawn from the filled container the inner surface 95 of sensing tube 55 at the lower end is usually coated with the product liquid as indicated at 151 in FIGURE 5. In the invention this depositing coating, when the filling head reaches station S_4 in FIGURE 1, is subjected to discharge

of a quantity of solvent liquid, for example water when the liquid is water soluble, for conditioning the coating for more effective removal by the high pressure air blast. The solvent liquid usually impinges on the surface **95** at least just above the coating build-up at **151** as well as directly on the coating. As shown in **FIGURE** 2, the follower roller **152** of unit **99** passes over cam **153** and this actuates a mechanical connection **154** to momentarily open valve **98** to discharge a quantity of solvent liquid through tube **91** and opening **94** (**FIGURE** 4) directly into the deposited coating to dissolve or otherwise free it for ready removal by the air blast directly following at station S_3. As shown best in **FIGURE** 4, the openings **94** preferably are inclined downwardly and outwardly with respect to the tube axis for more effective impact on the surface **95**.

The invention has been found effective to effectively purge from the sensing tube any deposited product liquid, whereby variations in filling level of containers due to restriction of the sensing tube is eliminated. The liquid level in each container during quick filling of the container surges during approach to the level of the lower end of sensing tube **55**, and as a result the liquid may enter a considerable distance up into the sensing tube, but this is taken care of in the invention and the tube is always internally clean when it enters an empty container.

We claim:

1. Automatic container filling apparatus of the type wherein a product liquid filling head nozzle is cyclically introduced into a container to be filled, withdrawn after filling and then introduced into a further container to be filled and a fluid pressure control sensing passage extends to the lower end of the nozzle for operative contact with the rising liquid level in the container being filled, said apparatus comprising means for introducing product liquid into said nozzle and a movable valve element in said nozzle for controlling flow of product liquid therethrough; characterized by means in said apparatus for automatically discharging a quantity of solvent liquid against the lower inner wall surfaces of said sensing passage after said nozzle has been withdrawn from said filled container and then discharging a blast of air through said sensing passage to prevent product build-up in said sensing passage between container filling operations, said means for discharging said solvent liquid against said lower inner wall surfaces of the sensing passage comprising conduit means extending through the sensing passage to terminate within said passage in an opening opposite said inner wall surfaces of the sensing passage.

2. Apparatus as defined in Claim 1, wherein said filling head comprises a body having a product liquid passage therethrough terminating in a nozzle tube adapted to extend into the container, said valve element being slidably mounted within said body passage, and said sensing passage extends through the valve element and comprises at its lower end a sensing tube open at the bottom of said nozzle tube, and said solvent liquid is discharged through a lateral opening in said sensing tube against the adjacent inner wall surfaces of said sensing tube.

3. The apparatus defined in Claim 1, wherein the means for discharging solvent liquid through the sensing passage comprises a valve disposed in a conduit between said sensing passage and a source of said solvent liquid, and an operator for said valve is disposed on the filling head and has a cam follower actuator adapted to engage a stationary cam for a short period during each cycle.

4. Automatic container filling apparatus of the type wherein a product liquid filling head nozzle is cyclically introduced into a container to be filled, withdrawn after filling and then introduced into a further container to be filled and a fluid pressure control sensing passage extends to the lower end of the nozzle for operative contact with the rising liquid level in the container being filled, said apparatus comprising means for introducing product liquid into said nozzle and movable valve element in said nozzle for controlling flow of product liquid therethrough, said valve element being hollow and having said sensing passage formed therein; characterized by means in said apparatus for automatically discharging a quantity of solvent liquid against the lower inner wall surfaces of said sensing passage after withdrawal of said nozzle from a filled container and then discharging a blast of air through said sensing passage to prevent product build-up in said sensing passage between container filling operations, said means for discharging said solvent liquid against said lower inner wall surfaces of the sensing passage comprising a conduit extending through the sensing passage to terminate in an opening opposite said inner wall surfaces of the sensing passage.

5. Automatic container filling apparatus of the type wherein a product liquid filling head nozzle is cyclically introduced into a container to be filled, withdrawn after filling and then introduced into a further container to be filled and a fluid pressure control sensing passage extends to the lower end of the nozzle for operative contact with the rising liquid level in the container being filled, said filling head comprising a body having a product liquid passage therethrough terminating in a nozzle tube adapted to extend into the container, a valve element slidably mounted within said body passage for controlling flow of said product liquid, said sensing passage extending through the valve element and comprising at its lower end a sensing tube open at the bottom of said nozzle tube; characterized by means in said apparatus for automatically discharging a quantity of solvent liquid against the lower inner wall surfaces of said sensing passage after said nozzle has been withdrawn from a filled container and then discharging a blast of air through said sensing passage to prevent product build-up in said sensing passage between container filling operations, said means for discharging solvent liquid comprising a tube extending within said sensing passage and terminating in a laterally apertured end adjacent the lower inner wall surfaces of the sensing tube.

6. The apparatus defined in Claim 5, wherein said nozzle tube, sensing tube and solvent liquid carrying tube are concentric at their lower ends.

7. The apparatus defined in Claim 5, wherein the laterally apertured end of said solvent liquid carrying tube comprises a series of downwardly and outwardly inclined apertures.

8. The apparatus defined in Claim 5, wherein solvent liquid is supplied to said solvent liquid carrying tube through a passage containing a normally closed valve, and said apparatus comprises periodically operated means for automatically opening said valve for a predetermined time to effect said discharge of solvent liquid.