Sept. 8, 1970 A. MOORE 3,527,267

AUTOMATIC CONTAINER FILLING APPARATUS

Filed Oct. 17, 1967 3 Sheets-Sheet 1

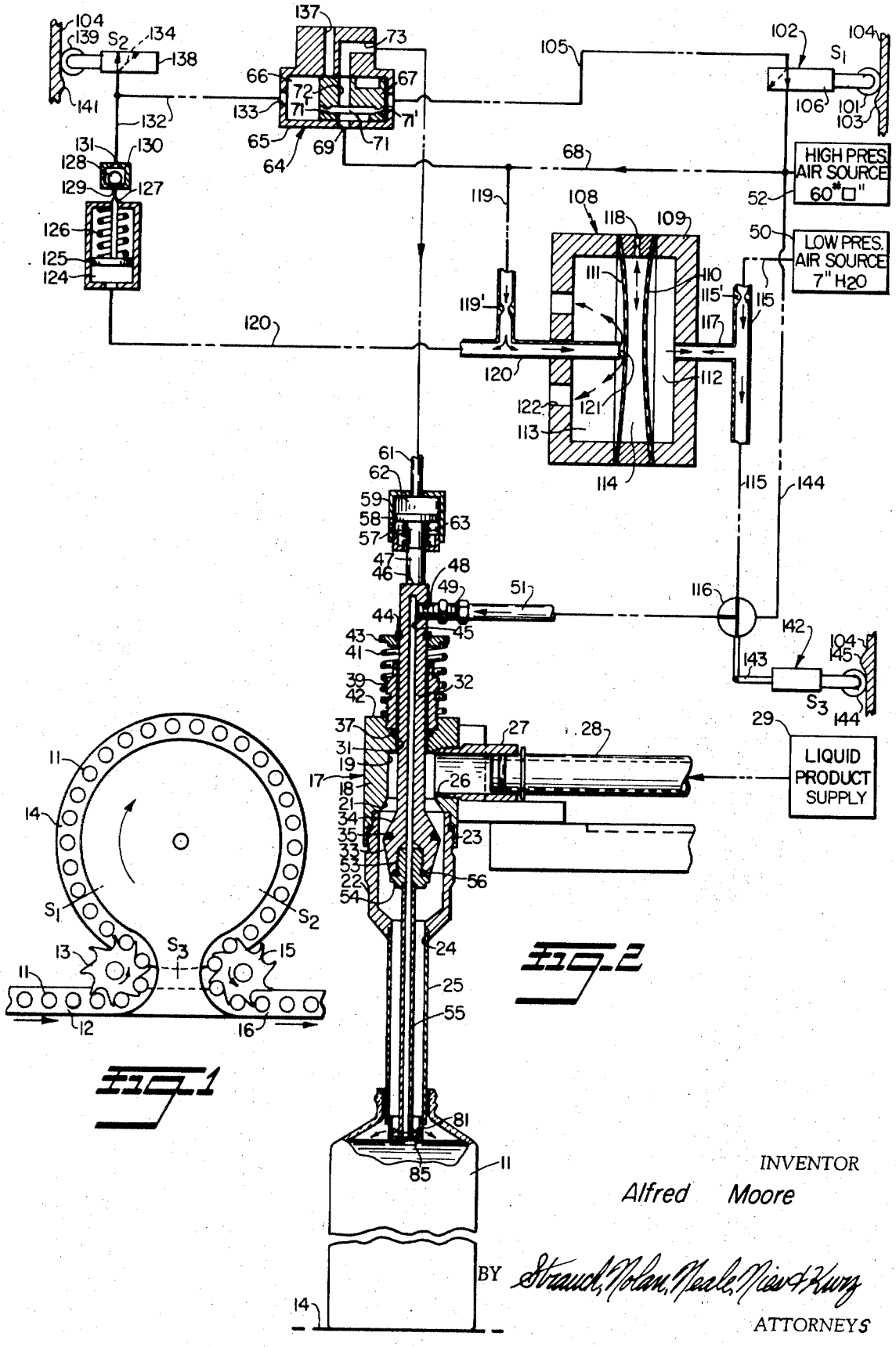


Fig. 2

Fig. 1

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AUTOMATIC CONTAINER FILLING APPARATUS

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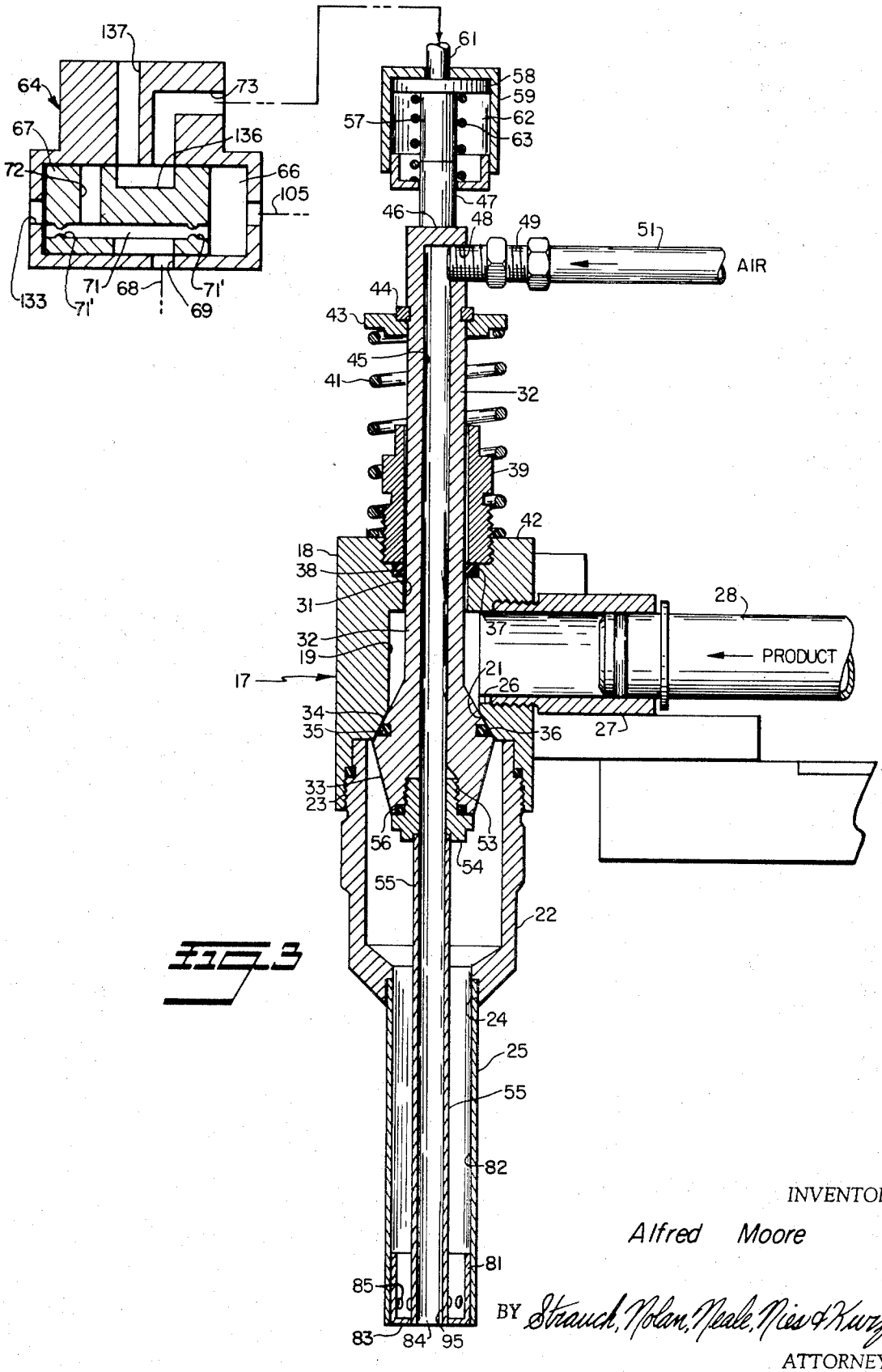


FIG. 3

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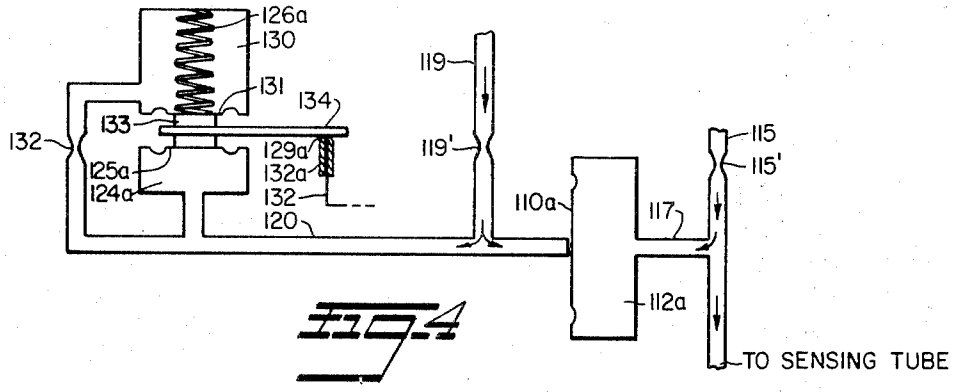


FIG 4

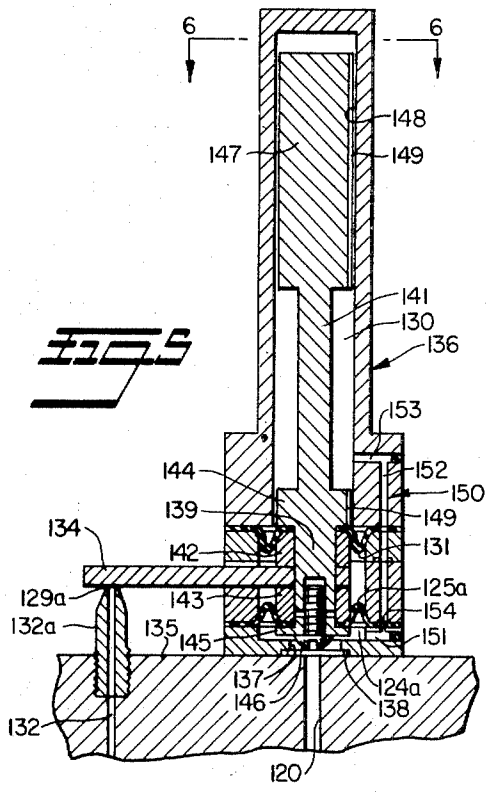


FIG 5

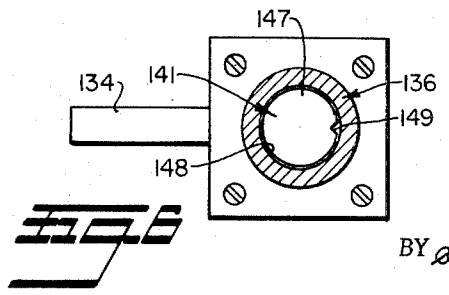


FIG 6

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AUTOMATIC CONTAINER FILLING APPARATUS

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U.S. Cl. 141—40 16 Claims

ABSTRACT OF THE DISCLOSURE

An automatic machine for filling continuously a moving row of containers with a fluent product 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for each container having a product fill nozzle adapted to extend into the container during filling and adapted to be withdrawn after filling.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 product in the container reaches and blocks the lower end of the sensing tube to raise the pressure in the sensing tube a control device is actuated to shut off the product fill valve leading to the nozzle. The term low pressure air includes vacuum. The rise in pressure in the sensing tube when the lower end is blocked is relatively rapid and this rapid pressure or pulse is applied directly to one side of a primary flexible diaphragm in the control device which at the other side is adapted to produce a corresponding amplified pressure rise or pulse in a high pressure air control circuit, preferably by selective throttling of an open end of a conduit in the high pressure air control circuit. This pulse is in turn applied to control a pressure responsive device in a high pressure air operating circuit for the product fill valve.

The invention discloses two specific modes of isolating the effect of a gradual rise or other change in a set low pressure air level in the sensing tube, such as may be caused by product gradually restricting the tube opening over a period of time, to prevent premature shut off of the product fill control valve. In one embodiment, an intermediate pressure compensation chamber is provided between the primary diaphragm and a second flexible diaphragm that throttles the high pressure air conduit, and this intermediate chamber is restrictively vented to atmosphere so that a gradual rise in pressure at the one side of the primary diaphragm will not move or affect the throttling action of the second diaphragm, while a rapid rise or pulse will be transmitted to quickly operate the second diaphragm and effect fill valve shut off.

In the other embodiment the compensation for a gradual rise in air pressure in the sensing tube is accomplished in the high pressure air control circuit. Here the primary diaphragm directly throttles the conduit in the high pressure air control circuit and the high pressure air at the other side of the diaphragm is applied to opposite sides of a diaphragm assembly connected to control the high pressure air fill valve control circuit. A restriction is provided in the passage connecting the opposite sides of this diaphragm assembly. Thus a gradual rise in air pressure in the sensing tube will proportionately appear in the high pressure air control circuit, but it will not move or otherwise affect the diaphragm assembly, while a rapid rise or pulse will, due to the aforesaid restriction in the high pressure air passage, unequally apply the pulse to opposite sides of the diaphragm assembly and actuate the product fill valve.

BACKGROUND AND SUMMARY OF INVENTION

Automatic container filling machines are known wherein a sensing tube containing low pressure air or vacuum and connected to a control device extends through the fill nozzle of a product liquid filling head and wherein blocking if 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.

It has been found that many highly viscous or sticky liquids tend to coat and harden in layers within the lower end of the sensing tube and are not removed even by an air blast synchronized with removal of the tube from the container. These coatings 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, and the invention is directed to solve this problem of premature shut off due to this or any other cause.

The invention solves this problem by providing a compensating arrangement associated with the control device whereby gradual pressure rise in the low pressure air of the sensing tube is ineffective on the control action, while a sharp rise or pulse in the pressure in the sensing tube effects the desired product fill valve cut off, and this is the major object of the present invention.

It is another object of the invention to provide a novel arrangement for amplifying a low pressure pulse caused by product blocking the lower end of a sensing tube in a wherein automatic compensation is provided for insuring filled container and applying the amplified pulse to effect a substantially uniform time shut off of a product fill valve after said pulse starts, regardless of gradual small changes in pressure in the sensing tube.

A further object of the invention is to provide in a system wherein a rapid rise in low pressure air in a product fill sensing tube is effective through a pressure responsive control device to provide a related rapid rise in a high pressure air control circuit containing a pressure responsive device for triggering actuation of a valve in a product fill valve circuit, means for automatically compensating for an undesired gradual increase in pressure within the sensing tube in such manner that the pressure pulse in the high pressure air control circuit always has a substantially uniform time constant shut off with respect to a controlled threshold value. In one embodiment the compensating means is interposed between the low pressure region at the sensing tube and the high pressure of the control circuit, and in another embodiment the compensation is applied to the pressure responsive device in the high pressure control circuit.

Further objects will appear with respect to details and mode of operation as explained in the specification and recited in the claims.

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 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.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 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;

FIG. 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;

FIG. 3 is an enlarged view mainly in section similar to FIG. 2 but showing the product fill valve closed;

FIG. 4 is a diagrammatic view showing another compensation arrangement for the system of FIGS. 1–3;

FIG. 5 is a sectional view showing a physical embodiment of the modification of FIG. 4 for incorporation into the apparatus shown in FIGS. 1–3; and

FIG. 6 is a section on line **6—6** of FIG. 5 showing the weight guide detail.

PREFERED EMBODIMENTS

Referring to FIG. 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 FIG. 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 FIG. 2. These heads are engaged in filling relation with the containers during travel between stations S_1 and S_2 shown in FIG. 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 FIG. 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**.

One 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**, a 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 FIG. 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 interferring with the sliding displacement of the valve stem.

Thimble **39** also serve 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 FIG. 3 closed position.

Valve stem **32** has a control 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. Source **50** may even in some cases be subatmospheric, so that the term low pressure air includes a vacuum. 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 leading 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 FIG. 2 and the other as shown in FIG. 3. In the product fill valve open condition of the apparatus shown in FIG. 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 a high pressure air fill valve circuit conduit **68** leading from source **52** through shuttle valve inlet **69**, passage **71** having orifices **71'** at its opposite ends, and passage **72** in the shuttle element **67**, outlet passage **73** and conduit **61** 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**. Orifices **71'** insure displacement of the shuttle element during the operation hereinafter described.

Referring to FIG. 3, 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 FIG. 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.

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 FIG. 1, valve **33** is in the closed position shown in FIG. 3 and the shuttle valve element **67** is at the left side of the chamber **66** as also shown in FIG. 3. The arrangement for inserting nozzle **25** into the container **11** to the distance shown in FIG. 2 is conventional and need not be described.

At station S_1 (FIGS. 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 (FIG. 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 FIG. 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 FIG. 3 position to its FIG. 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 FIG. 2 position, high pressure air is applied through conduit **68**, inlet **69**, passages **71**, **72** and **73** and conduit **61** 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 FIG. 2 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 FIG. 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 FIG. 2, fill control means in the form of a pneumatic amplifier device **108** comprises a housing **109** divided by two spaced parallel internal flexible diaphragms **110** and **111** into a low pressure air chamber **112**, an intermediate chamber **114** and a regulator chamber **113**. Low pressure air from source **50** passes through conduit **115** to a valve **116** for connecting it 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 also supplied by branch conduit **117** into low pressure chamber **112** where it tends to bias primary diaphragm **110** to the left. Intermediate chamber **114** is vented to atmosphere through a suitably restricted housing orifice **118**. Conduit **115** has a fixed restriction **115'** located upstream of branch conduit **117**.

High pressure air from source **52** passes through a high air pressure control circuit conduit **119** into a conduit **120** that has an open end **121** disposed within chamber **113** adjacent diaphragm **111**. High pressure air discharged into chamber **113** urges diaphragm **111** to the right in FIG. 2 to tend to reduce its throttling action on the end of conduit **120**, and its exhausts from chamber **113** through openings **122**. Conduit **119** has a fixed restriction **119'** upstream of the juncture with conduit **120**.

The force exerted by the high pressure air acting on one side of diaphragm **111** urging that diaphragm away from the open end of conduit **120** is opposite to the force exerted by the low pressure air of chamber **112** transmitted through diaphragm **110** and chamber **114** to act on the other side of diaphragm **111** to urge it toward the open end of conduit **120**. In practice relative air pressures and physical features are so arranged and correlated that a balanced throttling action is exerted by diaphragm **111** on the high pressure air flow through chamber **113** to produce a desired amplifier threshold pressure in conduit **120**. The pressure in conduit **120** may be identified as the amplified sensing pressure. This action and the novel function of chamber **114** in the association will be further described in more detail.

High pressure air is also connected by line **120** to a cylinder chamber **124** for acting on a piston **125** in a direction opposite to a compression spring **126**. The stem **127** of piston **125** is connected to a valve element **128** seating on an outlet or discharge aperture **129** in casing **130**. Normally the force of spring **126** is high enough to overcome the amplified sensing 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 FIG. 2. During container filling it will be seen therefore that high pressure air from shuttle valve 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 rapidly increase in tube **55** and chamber **112**, this resulting in diaphragm **110** being displaced to the left in FIG. 2 and this force is transmitted through chamber **114** to displace diaphragm **111** to the left to further throttle conduit opening **121**. As a result, air pressure now increases rapidly in chamber **113** and within conduit **120** and this increased air pressure pulse is effective to increase the amplified sensing pressure in cylinder chamber **124** and raise piston **125** until valve element **128** is unseated from outlet **129**, thereby quickly connecting the left end of chamber **66** to exhaust at aperture **129**. At this point, the higher air pressure from line **105** will quickly shift shuttle **67** to the left to its FIG. 3 position wherein line **61** 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 provded 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 FIG. 3 position.

After passing station S_2, filling head **17** on the moving table is disposed as in FIG. 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 **116**, and when cam roller **144** passes over cam **145**, valve **116** is turned to disconnect conduit **51** from the low pressure air line **115** 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**.

The foregoing construction and arrangements are merely conventional except for the structure and operation of the compensation arrangements associated with control device **108** and their cooperative association with the rest of the apparatus to improve the efficiency of container filling control.

Prior to the invention a control device was provided at this area at **108** wherein the low pressure sensing air was applied directly to the opposite side of a throttling diaphragm for the high pressure air. This type of operation may be adequate while the supplied low pressure in the line **115** remains constant and/or while the sensing tube **55** is clean and free of restrictions. However, during operation and particularly with certain type of products being filled into the container, the lower internal diameter of tube **55** may become restricted due to the accumulation of product which hardens in layers around surface **95**. This restriction of tube **55** results in an increase of the present threshold level of low air pressure within tube **55** which is directly effective on the throttling diaphragm to raise the threshold high pressure level in the conduit leading to cylinder chamber **124** of FIG. 2, with the disadvantage that when the rising liquid in the container starts quickly blocking the lower end of sensing tube **55** the shut off actuating pressure within chamber **124** rises more quickly to the effective high pressure value which actuates the shuttle valve to cut off the flow of product. This results in only partial filling of the containers, and since it is usually some time before this fact is discovered in a high speed automatic machine considerable waste results.

The foregoing disadvantages are eliminated in the present invention wherein the intermediate chamber **114** serves essentially as a dashpot or damping arrangement whereby gradual or slow pressure increases in the low pressure

chamber **112** do not noticeably affect the high pressure level in chamber **113**. As the low pressure air in chamber **112** increases, as when the lower end of sensing tube **55** become restricted, the increased pressure in chamber **112** will result in leftward displacement of diaphragm **110** but since chamber **114** is vented to atmosphere air will be correspondingly displaced out of restricted orifice **118** and there will be no effective increase in the force acting to displace diaphragm **111** to the left in FIG. 2. When the rising liquid blocks the lower end of sensing tube **55**, the resultant rapid increase in pressure the chamber **112** is transmitted as a pulse through chamber **114** since orifice **118** restricts outflow of air, and so this pulse exerts a force on diaphragm **111** displacing it toward the open end of conduit **120** and producing the rapid rise in high air pressure in conduit **120** that results in triggering of the shuttle valve to cut off product flow.

It has been found that the foregoing action is effective even when the lower end of the sensing tube is almost closed by accumulated solid product to provide uniform desired filling of the containers.

The actuating pressure existing in conduit **120** during filling is not affected by gradual change or drift in the sensing pressure and therefore the cylinder **124** may be so arranged that the critical air pressure for displacing piston **125** to trigger shuttle valve operation may be set closer to the threshold high air pressure in conduit **120** for more rapid cut-off. This helps to speed up the entire automatic machine.

FIGS. 4–6 illustrate another embodiment of the invention wherein compensation control is exercised according to the rate of change in the amplified sensing pressure in high pressure air conduit **120**. Certain parts corresponding to like parts in FIG. 1 bear the same number with the subscript *a* in FIG. 4.

Referring to FIG. 4 which shows this part of the overall FIG. 1 system diagrammatically, an abrupt change in pressure in the low pressure air conduit **115** which is connected to sensing tube **55** as in FIG. 1 displaces primary diaphragm **110***a* to increase its throttling action on high pressure air conduit **120** which is connected to chamber **124***a* below flexible diaphragm **125***a* and to chamber **130** above flexible diaphragm **131**. A restriction **132** is provided in conduit **120** between its connection to chamber **124***a* and its connection to chamber **130**.

Diaphragms **125***a* and **131** are rigidly interconnected by a block **133** from which projects an arm **134** extending over the exhaust aperture **129***a* in nozzle **132***a* of conduit **132** which latter is connected into shuttle valve chamber **66** as in FIG. 1. Arm **134** is normally biased to close aperture **129***a* by spring **126***a*, the pressure in conduit **120** being equally oppositely effective on equal area diaphragms **125***a* and **131**.

Should there be a gradual rise in the low air pressure in chamber **112***a*, as due to product accumulation partially blocking the lower end of sensing tube **55**, such results in a proportionate displacement of primary diaphragm **110**A to increase its throttling action on the open end of conduit **120** and there is a proportionate rise in the amplified sensing air pressure in conduit **120**. Since this rise is gradual it has equal effect in opposed diaphragm chambers **124***a* and **130** and so it does not affect the spring biased closure of aperture **129***a*.

However, when there is a sudden increase in the pressure in chamber **112***a*, as when the rising material in the container blocks the lower end of sensing tube **55**, there is a resultant proportionate amplified rise in pressure in conduit **120**. Due to restriction **132** this increased high air pressure is momentarily differentially applied to chambers **124***a* and **130**, with the higher pressure applied to diaphragm **125***a* acting against spring **126***a* to quickly lift arm **134** from aperture **129***a* and this exhausts the shuttle valve chamber **66** to permit operation of the shuttle valve to assume the FIG. 3 position where it closes product fill valve **33**.

The pressure in chamber **124***a* and **130** eventually equalizes and spring **126***a* returns arm **134** to close aperture **129***a* but by that time the sensing tube **55** is usually lifted out of the filled receptacle.

FIGS. 5 and 6 illustrate a useful and practical physical embodiment of the system portion shown in FIG. 4, certain corresponding parts bearing numbers corresponding to FIG. 4. In this embodiment the amplified sensing air pressure conduit **120** and the conduit connection **132** between shuttle valve chamber **66** and the nozzle **132***a* appearas passages in a common support base **135**.

The diaphragms **125***a* and **130** are externally peripherally clamped in a housing structure **136** fixed to base **135** by fasteners (not shown). The lower end of housing **136** is open at **137** where it extends over the open end of conduit **120** and a suitable resilient seal **138** surrounds the opening. The interior of the housing is separated into a lower diaphragm chamber **124***a* connected to conduit **120**, and an upper diaphragm chamber **130**.

The diaphragms are internally peripherally clamped upon the vertical stem **139** of a diaphragm biasing weight **141** disposed mainly in chamber **130**. The inner end of arm **134** is apertured to pass stem **139** and spacer collars **142** and **143** extend between the arm and the respective diaphragms. The inner periphery of diaphragm **131** is clamped between collar **142** and an enlarged guide section **144** of stem **139**. A cap **145** secured on the lower end of stem **139** as by a screw **146** clamps the inner periphery of diaphragm **125***a* against collar **143** and axially secures the stem, arm, collars and diaphragm inner portions in tight assembly.

The upper guide end section of stem **139** is further enlarged at **147**. As shown in FIG. 6 these guide sections of the stem are cylindrical for sliding up and down in the cylindrical bore **148** of chamber **130**. A continuous longitudinal grooving indicated at **149** on both guide sections insures and positively provides a passage for unrestricted air communication throughout diaphragm chamber **130**.

Chamber **124***a* is constantly connected to chamber **130** by a housing passage **150** formed by lateral bore **151**, longitudinal bore **152** and lateral bore **153**. This passage contains a fixed restriction **154**, which corresponds to restriction **132** in conduit **120** in FIG. 4, and is here physically formed as an opening in that portion of diaphragm **125***a* that extends across passage **150**. If desired this restriction can be formed anywhere along passage **150**.

In this embodiment the weight on stem **139** acts like spring **126***a*, the amplified sensing air pressure acting equally on equal area diaphragms **125***a* and **131**. A sudden rise in pressure in conduit **120** quickly displace the diaphragms and weight upward to uncover aperture **129***a* and trigger the shuttle valve to stop product fill as it does in the other embodiments. The enlarged guide sections of the stem **139** insure rectilinear motion of arm **134**.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects are 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 intended to be embraced therein.

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

1. Automatic container filling apparatus comprising a product filling head nozzle adapted to be cyclically introduced into a container to be filled, withdrawn after filling and then introduced into a further container to be filled, means providing a fluid pressure control sensing passage that extends tothe lower end of said nozzle for operative association with the rising product level in the container being filled, means providing sensing air at a predetermined relatively low pressure level to said passage, a product supply conduit connected to said nozzle, a valve in said conduit, a pressure responsive operator

connected to said valve, a fluid pressure actuating circuit connected to said operator, a reversible valve provided in said actuating circuit, pressure responsive means for controlling said actuating circuit to operate said reversible valve, control means for said pressure responsive means comprising a fluid pressure control circuit having pressure sensitive means responsive to a sudden change in pressure in said passage, and compensating means in said control means for maintaining a threshold operating pressure in said control circuit regardless of gradual uncontrolled increases in said pressure level in said sensing passage during successive fill cycles, for providing substantially uniform shut off of the product supply valve and thereby providing substantially uniform filling of successive containers.

2. The apparatus defined in claim 1, wherein said control means comprises a primary flexible diaphragm subject to the presssure of said passage and a secondary diaphragm connected to control the pressure in said control circuit, and said compensating means comprises means defining a variable volume chamber having a restricted outlet interposed between said diaphragms.

3. The apparatus defined in claim 1, wherein said pressure responsive means includes a movable pressure responsive element and said control circuit pressure is applied to opposite sides of said element through a passage section that interconnects chambers associated with said respective sides and has a restriction between said sides, and means connecting said element to control operation of said control circuit.

4. The apparatus defined in claim 3, wherein said element comprises flexible diaphragm means with one of said chambers being connected to said control circuit and the other containing means biasing the diaphragm means in one direction.

5. The apparatus defined in claim 4, wherein said pressure responsive means comprises a casing wherein said chambers are vertically spaced by said diaphragm means, and said biasing means comprises a weight means disposed in the upper chamber.

6. The apparatus defined in claim 4, wherein said control circuit includes a discharge nozzle and said nozzle is normally closed by a member on the biased diaphragm means.

7. The apparatus defined in claim 3, wherein said control means comprises a primary flexible diaphragm subject at one side to the pressure of said sensing passage and at its other side to pressure in said control circuit.

8. Automatic container filling apparatus comprising a product filling head having a discharge nozzle, means whereby said nozzle is cyclically introduced into a container to be filled, withdrawn after filling and then introduced into a further container to be filled, means defining a fluid pressure sensing passage extending to the lower end of the nozzle for operative association with the rising product level in the container being filled, means providing air at a predetermined relatively low sensing pressure level to said passage, means defining a product fill circuit connected to said nozzle, valve means in said fill circuit, a pressure responsive operator connected to said valve means, a relatively high fluid pressure actuating circuit connected to said operator, means for automatically activating said actuating circuit to actuate said operator to close said valve means when a container has been filled to a predetermined degree comprising pressure sensitive means responsive to a sudden appreciable increase in pressure in said passage such as may be caused by the rising product in a container blocking the lower end of said passage, and compensating means for automatically preventing small uncontrolled increases in said low pressure level in said sensing passage, such as may be caused by accumulation of product within the passage to gradually restrict the passage during successive fill cycles, from causing premature shut off of said valve means by said actuating circuit for providing substantially uniform shut off of said product fill valve means during the successive fill cycles and thereby providing substantially uniform filling of successive containers.

9. The apparatus defined in claim 8, wherein said compensating means maintains a substantially constant threshold value for the pressure in said actuating circuit regardless of said pressure increase in said passage.

10. The apparatus defined in claim 8, wherein said pressure sensitive means comprises a control device wherein said actuating circuit pressure is applied directly to one side of a first flexible diaphragm, and the pressure of said passage is operatively applied to the other side of said diaphragm, and said compensating means is applied to control the pressure level in said actuating circuit.

11. The apparatus defined in claim 10, wherein said compensating means comprising a second diaphragm in said control device defining a variable volume chamber between said diaphragms, said chamber having a restricted vent whereby said gradual increases in low sensing pressure level in said passage result in corresponding volume changes in said chamber without affecting said activating circuit pressure, and an abrupt change in said passage pressure will produce a sudden force transmitted through said changer to displace said first diaphrgam to activate said actuating circuit.

12. The apparatus defined in claim 10, wherein the operator for said valve means has a movable pressure responsive element and said actuating circuit pressure is applied to opposite sides of said element by a conduit having a restriction in the portion between said opposite sides.

13. The apparatus defined in claim 8, wherein said compensating means provides shut off of said product fill valve means within a uniform predetermined time after a sudden change in pressure starts in said passage regardless of the then effective value of said actuating circuit pressure.

14. In a container filling machine, in combination, a filling head having a liquid supply inlet and an outlet nozzle to be extended into the open mouth of a container to be filled, a liquid control valve in said filling head, air conducting means comprising a tube terminating in an outlet at a predetermined level within the container and extending a substantial distance below the end of said outlet nozzle during the filling operation, said air conducting means being arranged to discharge air continuously at a relatively low pressure into the container, means for supplying sensing air at a predetermined low pressure level to said air conducting means during container filling, said low pressure outlet being blocked by the liquid when it reaches said predetermined level to create a back pressure in the air conducting means, and pneumatically operated control means responsive to said back pressure for operating said valve to discontinue the flow of liquid into the container, said pneumatically operated control means including a high pressure air circuit having an outlet through which air may escape to the atmosphere during the filling operation, and a diaphragm valve associated with said low pressure air conducting means and arranged to be operated by said back pressure to close said high pressure outlet whereby to render the control means operative to effect closing of the valve when the liquid reaches said predetermined level, and compensating means operatively associated with said control means for automatically preventing an uncontrolled increase in said low pressure level, such as may be caused by product accumulation restricting the lower end of said tube, from causing premature closing of said high pressure outlet during filling of a container.

15. In the apparatus defined in claim 14, said compensating means comprising means maintaining a predetermined pressure in said high pressure air circuit regardless of the pressure level in said air conducting means.

16. In the apparatus defined in claim 14, said com-

pensating means being incorporated in said high pressure air circuit and being effective to proportionately increase the threshold level of operating pressure in said high pressure air circuit in proportion to an increase in said predetermined low pressure level in said air conducting means.

References Cited

UNITED STATES PATENTS

3,182,691	5/1965	Vergobbi et al.	141—41 X
3,207,189	9/1965	Vergobbi	141—41 X

HOUSTON S. BELL, JR., Primary Examiner

U. S. Cl. X.R.

141—90, 198

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,527,267 Dated September 8, 1970

Inventor(s) ALFRED MOORE

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 25, after "pressure" insert --rise--.

Column 2, line 34, cancel "wherein automatic compensation is provided for insuring".

Column 2, line 35, after "effect" insert --automatic compensation for insuring--.

Column 5, line 47, change "its" to --it--.

Column 5, line 60, change "amplifier" to --amplified--.

Column 6, line 26, change "provded" to --provided--.

Column 6, line 42, change "merely" to --mainly--.

Column 7, line 11, change "the" to --in--.

Column 8, line 11, change "appearas" to --appear as--.

Column 8, line 33, insert a comma after "6".

Column 8, line 58, change "are illustrative" to --as illustrative--.

Column 8, line 70, (line 6 of Claim 1) change "tothe" to --to the--.

Signed and sealed this 6th day of April 1971.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents

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