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Nicholls

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[54] **APPARATUS FOR FILLING CONTAINERS WITH LIQUID**

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[73] Assignee: **Farrow and Jackson Limited,** London, England

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[30] **Foreign Application Priority Data**

Dec. 21, 1970 Great Britain 60,565/70

[52] **U.S. Cl.** **141/386,** 141/294, 141/354, 141/371

[51] **Int. Cl.** **B65b 37/02,** B67c 3/26, B67d 3/02

[58] **Field of Search** 141/386, 371, 354, 141/294, 65

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Primary Examiner—Wayne A. Morse, Jr.

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[57] **ABSTRACT**

Valve mechanism for filling a miniature bottle in which a bottle rising to a filling position lifts a vertical sleeve from engagement at its end with a seal at the lower end of a tubular center part formed with a slot just above the seal. This enables liquid to run down a double passageway formed between the inner surface of the sleeve and the center part, while air in the bottle escapes through the slot and up the tubular center part. The passages in the double passageway converges to a narrow edge at their lower end and are so disposed in relation to the slot that the liquid is discharged on one side of the seal while the air enters the tubular part on the other side. The tubular part is divided into comparatively rigid upper and lower portions resiliently joined together so that the lower portion can adapt itself precisely to the path of the reciprocable sleeve, which is a neat sliding fit on arcuate surfaces extending along the tubular part.

3 Claims, 8 Drawing Figures

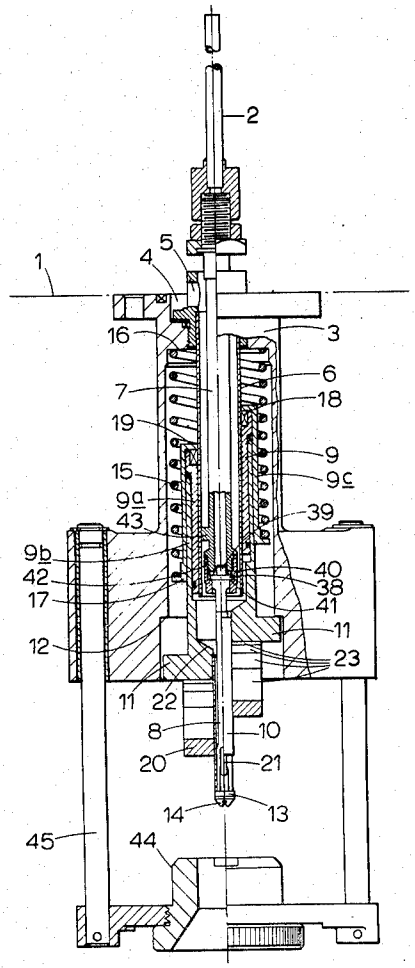

Fig. 1.

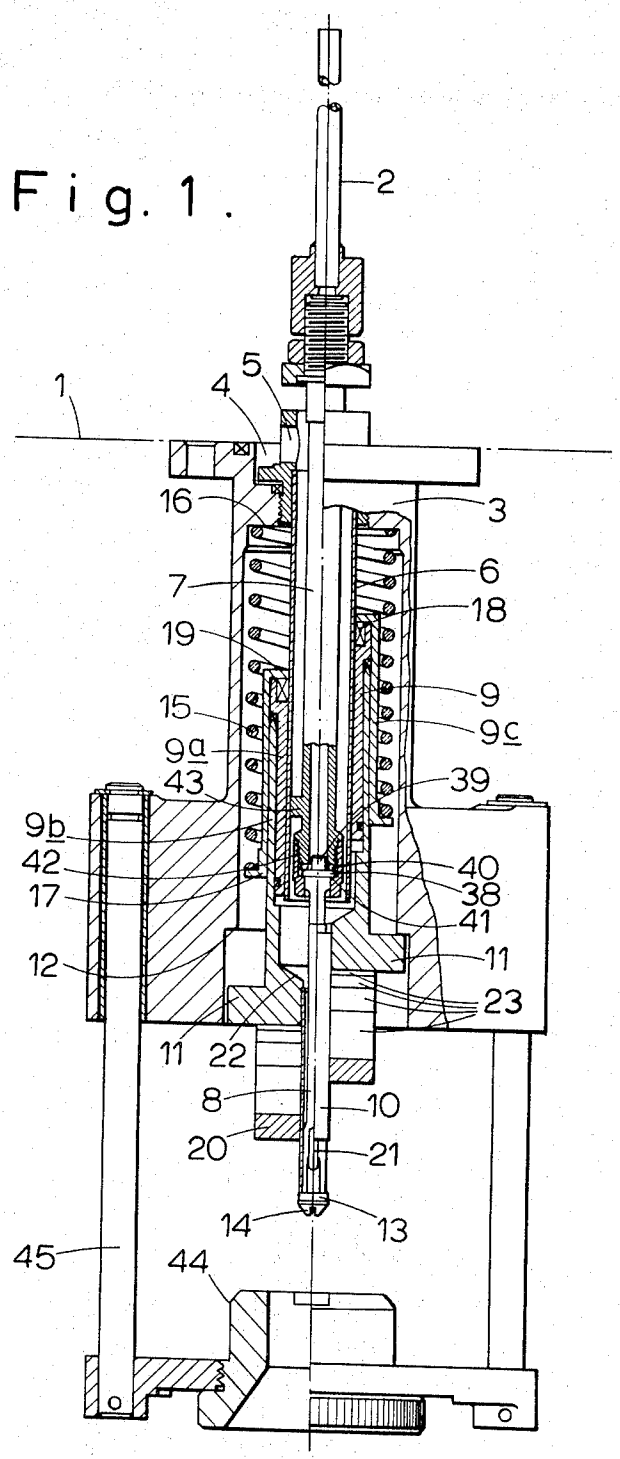
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Fig. 2.

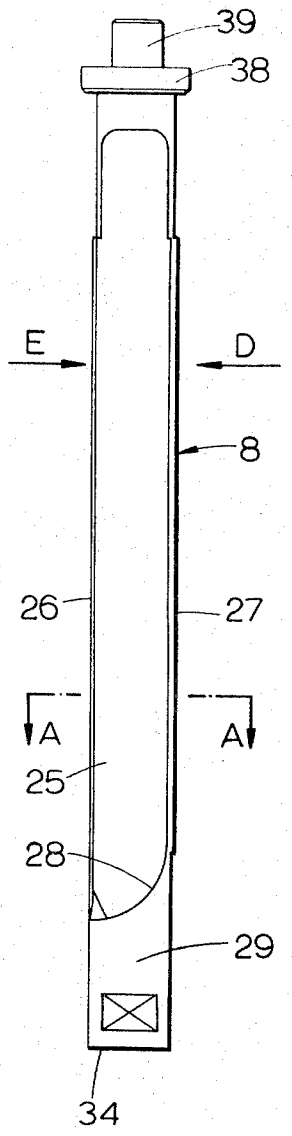


Fig. 3.

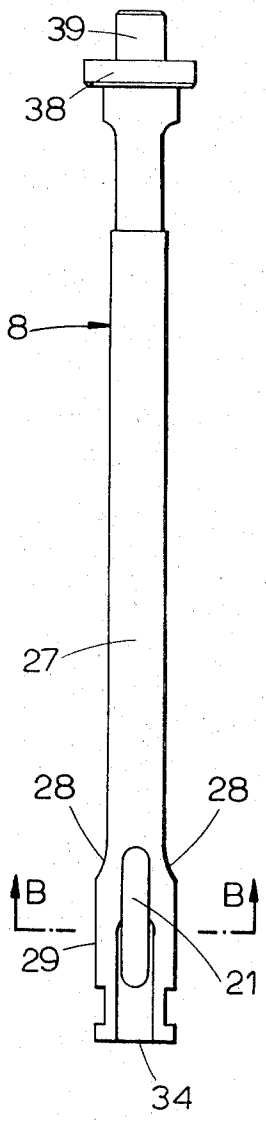
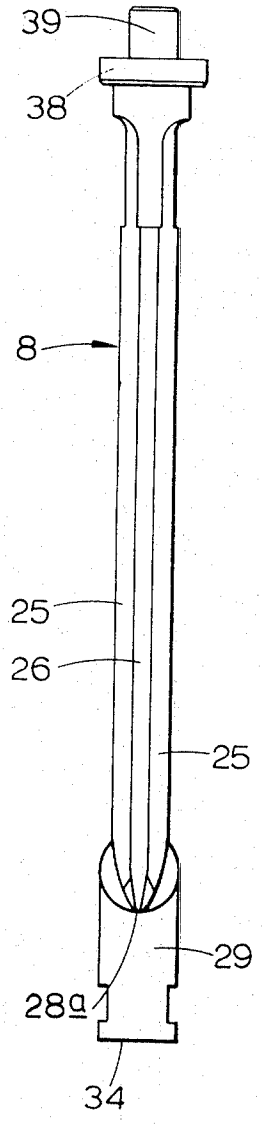


Fig. 4.



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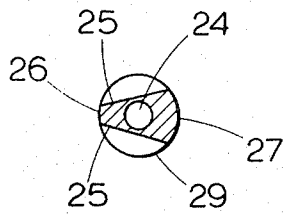

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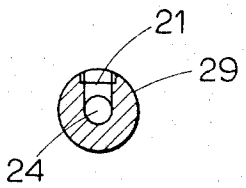


Fig. 7.

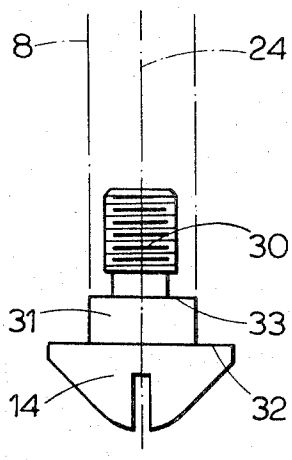
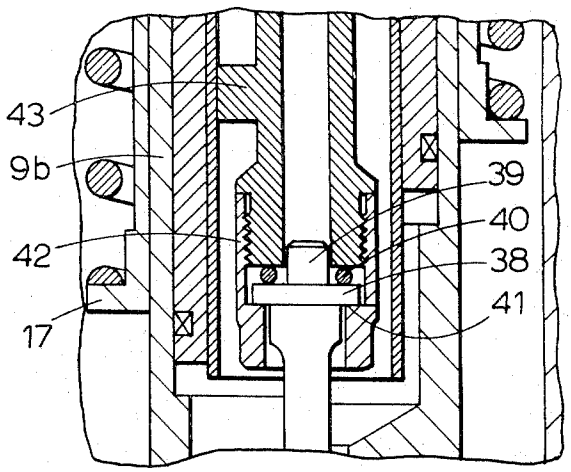


Fig. 8.



APPARATUS FOR FILLING CONTAINERS WITH LIQUID

This invention relates to apparatus for filling containers, particularly bottles, with liquid, and the type of apparatus with which the invention is concerned is that in which the manual or automatic presentation of the container to the apparatus is accompanied by the actuation of valve mechanism that permits the liquid to flow into the container while air escapes therefrom. The invention is applicable to various forms of filling apparatus and is very conveniently applied to gravity-vacuum fillers, that is to say fillers in which air is positively evacuated from the container prior to the entry of the liquid. However, the invention is equally applicable to simple gravity fillers.

A primary object of the invention is to provide valve mechanism, for use in bottle filling apparatus, that is particularly suitable for filling miniature bottles (e.g., bottles having a content of the order of 2 fluid ounces. However, the invention is not limited to apparatus for filling miniature bottles. The invention may be applied to the filling of larger bottles and various other forms of containers. The invention is applicable to the filling of bottles and other containers whether made of rigid material, e.g. glass, or resilient plastics material.

According to the invention, valve mechanism for filling a container includes a valve arranged to project downwards into the top of a container to be filled, and comprising a tubular center part, carrying a seal at its lower end, and formed with a lateral port close to the seal and a sleeve mounted to reciprocate on a lower portion of the tubular part between a position in which it engages the seal to close the valve and a position in which the valve is fully open, the center part and sleeve being formed to provide a passageway extending downwards between them and so arranged in relation to the port that when the valve is open liquid is discharged into the container, on one side of the seal, through one of the two ducts constituted by the said tubular part and the said passageway, while air is discharged from the container, on the opposite side of the seal, through the other of the two ducts, the lower portion of the tubular part being a substantially rigid member mounted to yield laterally so as to adapt itself precisely to the path of the reciprocating sleeve.

Preferably the central tubular part provides the air vent and the passageway between the vent tube and sleeve delivers the liquid to the container. For this purpose it is convenient for the passageway to be divided into two parts so as to provide good bearing surfaces for the sleeve in combination with adequate passages for the liquid. Thus, if the cross-section of the vent tube is basically circular to fit a circular bore in the sleeve, the passages may be defined by two chordal surfaces that converge, as viewed in cross-section, towards one side. Then the cross-section presents two arcuate surfaces, one substantially wider than the other, joined by the chordal surfaces, which are preferably flat. The lateral port is formed centrally at the lower end of the wider arcuate surface.

It will be appreciated that the vent tube has to be of comparatively substantial length, in that it has to extend upwards to a point above the liquid surface in a supply tank. Therefore, if the vent tube was a single rigid unit, there would be a danger that its lower end would not register precisely with the path of the reciprocating sleeve, with a consequent danger of undue

friction and wear. It is for this reason that the lower portion of the vent tube, on which the sleeve reciprocates, is yieldingly attached to the portion of the vent tube that lies above it. Thus, the lower portion may be formed at its upper end with a flange between which and the adjacent portion of the vent tube is located an annular cushion such as an o-ring. These portions may be clamped together, with a certain amount of lateral clearance, by a threaded sleeve. Therefore, the lower portion of the vent tube can accomodate itself to the path of the reciprocating sleeve.

In order that the invention may be clearly understood and readily carried into effect a valve mechanism for use in a bottle filling apparatus will now be described, by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is a sectional elevation of the mechanism;

FIG. 2 is an elevation of a part of the mechanism of FIG. 1,

FIG. 3 is an elevation in the direction of the arrow D in FIG. 2,

FIG. 4 is an elevation in the direction of the arrow E in FIG. 2,

FIG. 5 is a section on the line A—A in FIG. 2,

FIG. 6 is a section on the line B—B in FIG. 2,

FIG. 7 is an elevation of another part of the mechanism of FIG. 1, and

FIG. 8 shows a detail of FIG. 1 on an enlarged scale.

The valve assembly shown in the drawings is used in bottle filling apparatus having many of the features particularly described in U.S. Pat. No. 3,474,835 and the valve assembly itself has some of those features. Thus, the liquid to be received by the bottles is contained in a tank in which the liquid level is maintained by a float controlled valve and in which a vacuum of about three inches of mercury is maintained above the liquid in the tank. A number of the valve assemblies are fixed in a circle round the bottom 1 of the tank and each of these is furnished with an air vent tube 2 that rises above the liquid level in the tank. An equivalent number of jacks for automatically raising and lowering the bottles to be filled, are mounted together with the filling apparatus, on a continuously revolving support, so that each bottle may be picked up at one point from, for example, a straight line conveyor, and then carried round while being raised, filled and lowered, to be discharged in time for the jack to receive another bottle at the point.

Each valve assembly includes a body 3 secured to the bottom 1 of the tank in register with an opening through which the liquid passes to a space 4 in the body 3 and thence through ports 5 to filling tube 6 down which the liquid flows outside a center vent tube 7 mounted axially in the filling tube 6 and providing a connection between the upper vent tube 2 and a lower vent tube 8.

The parts of the valve assembly so far described all remain stationary with respect to the tank, but slidably mounted on the outside surface of the center vent tube 7 is a slide 9 to the lower end of which is fixed a sleeve 10 through which the lower vent tube 8 projects. The slide 9 and sleeve 10 are shown on the left-hand side of FIG. 1 in their lowermost position, in which the valve is closed. On the right-hand side, these parts are shown in their uppermost position determined by the engagement of a flange 11 on the slide 9 with a surface 12 in the body 3. In this position the valve is fully open. When the valve is closed, the lower end of the sleeve

10 bears on a seal 13 on a tip 14 fixed to the end of the lower vent tube 8, contact being maintained by a compression spring 15 interposed between a surface 16 in the body 3 and a flange 17 on the slide 9. The slide 9 is a composite structure including an internal sleeve 9*a* of polytetrafluoroethylene (having a toughening filler), that slides on the filling tube 6, with an internal seal 18, a sleeve 9*b* on which the flange 11 is formed and to which the sleeve 10 is fixed, and an outer cylinder 9*c* formed at its upper end with an internal flange 19 bearing on top of the sleeve 9*a* and at its lower end formed with the flange 17.

Very briefly, the action (described in greater below) of the valve is that, to open the valve, the top of a bottle neck, as it is raised for filling, is pressed against a rubber seal 20 on the base of the slide 9 and raises the slide 9 and sleeve 10 against the action of the spring 15 to uncover a slot 21 in the lower vent tube 8. Thus, by way of the lower, center and upper vent tubes 8, 7, 2, the pressure in the bottle becomes equal to that above the liquid in the tank, allowing the liquid to run down, outside the composite vent tube 8, 7, in the path defined by the filling tube 6 and the sleeve 10, to be discharged into the bottle. It will be noted that the filling tube 6 discharges into a convergent part 22 of the passage through the sleeve 9*b* leading to the comparatively fine bore sleeve 10. Plastics spacers 23 of different thicknesses may be interposed between the seal 20 and the flange 11 to provide the required filling level in the bottle.

The form of the lower vent tube 8 will now be described with particular reference to FIGS. 2 to 6. This tube has a bore 24 extending axially through its entire length. Over the major portion of its length it is formed on opposite sides with two flat faces 25 which, in cross-section, are at 30° to one another (FIG. 5). Between these two flat faces, therefore, are two arcuate surfaces 26, 27 on which the sleeve 10 is a sliding fit. The flat faces 25 flare out at 28 (FIGS. 2, 3) to a cylindrical portion 29 at the lower end of the vent tube. The slot 21 provides communication between the bore 24 and the curved surface of the portion 29 on the side of the arcuate surface 27.

The lower end of the bore 24 is closed by the tip 14, which has a spigot 30 (FIG. 7) screwed into the bore 24. A cylindrical part 31 of the tip is interposed between the spigot 30 and an annular platform 32 on which the seal 13 rests. The part 31 presents a surface 33 which bears directly against the bottom surface 34 of the lower vent tube 8. The seal 13 may be made of an acetal resin such as that known under the Registered Trade Mark "Delrin."

It will be appreciated that, to avoid contamination of the liquid, it is impossible to use any form of lubricant between the surfaces 26, 27, 29 of the lower vent tube 8 and the inner surface of the reciprocating sleeve 10. Like all the other parts mentioned above (except where otherwise specified), the tube 8 and sleeve 10 are made of stainless steel. Moreover, the lower vent tube 8 is provided with a hard chrome finish. However, in addition it has been found very advantageous to mount the comparatively rigid lower vent tube 8 so that it can be resiliently displaced slightly relatively to the comparatively rigid centre vent tube 7, to enable it to accommodate itself as precisely as possible to the bore of the sleeve 10. For this purpose the upper end of the lower vent tube 8 is provided with a flange 38 (FIG. 8) above which extends a short spigot 39 that enters the center vent tube 7. A rubber O-ring 40 is interposed between the flange 38 and the lower end of the centre vent tube 7 and these parts are clamped together by an internal shoulder 41 on a sleeve 42, screwed onto the center vent tube 7. The resilience of the O-ring 40 and the clearances are such as to enable the lower vent tube to take up a slightly inclined position or to be translated slightly in a horizontal direction with respect to the center vent tube 7. This tube 7 is rigidly located in the filling tube 6 by radial fins 43, and is rigidly secured at its upper end.

In operation, a bottle rising to be filled engages a nylon member 44 that has an internal conical passage, fixed to vertical pins 45 guided in bearings in the body 3, and is centred by the member 44 throughout the filling process. When the sleeve 10 has opened the slot 21, the vacuum in the tank can draw back into the tank liquid that has collected in the vent tubes at the end of the filling of the previous bottle and the reduction of pressure in the bottle enables the liquid to run down inside the filling tube 6 and sleeve 10. This liquid travels down the flat faces 25 of the lower vent tube and is discharged into the bottle above the tip on one side thereof. The divided liquid stream flowing down the faces 25 unites as it leaves the flared parts 28 of these faces, because the lower end of the arcuate surface 26 tapers to a narrow edge 28*a* (FIG. 4). Residual air escapes from the bottle on the other side of the tip 14, passing through the slot 21 and up the vent tubes 8, 7, 2 to the tank. The filling stops when the liquid reaches the lower edge of the sleeve 10, when in its uppermost position. However, the liquid, which continues to flow down the sleeve 10, now findsits way through the slot 21 and up the vent tubes. This liquid can rise as high as the liquid level in the tank. When the bottle recedes, any flow down the sleeve 10 is stopped when its lower end passes the flared ends 28 of the flat faces 25 and is finally sealed when the seal 13 is reached.

When the apparatus is used for simple gravity filling, without the application of reduced pressure above the surface of the liquid in the tank, the filling of each bottle is slower because there is no differential pressure to remove the residual liquid from the vent tube. Instead, when the slot 21 is opened by the raising of the sleeve 10, the liquid remaining in the vent tube runs down under gravity into the bottle, building up a slight increase in pressure in the bottle. When the vent tube has been cleared, normal filling takes place with the liquid running down the outside of the lower vent tube 8 and driving the air out of the bottle up the inside of the vent tube.

The apparatus shown in the drawings is designed for filling miniature bottles, for example, one and two-thirds or 2 fluid ounces. The diameter of the tip 14 is, in this example, 0.340 inches.

I claim:

1. A valve mechanism for filling a generally vertical container, such as a bottle, with liquid, said valve mechanism comprising:

a generally vertical, upper tube;

a generally vertical, lower tube adapted to extend downwardly into the container;

connecting means connecting said lower tube to said upper tube in axial alignment therewith to create a continuous first passage through said tubes, said connecting means enabling limited resilient deflec-

tion of said lower tube out of alignment with said upper tube;

a sleeve mounted on said lower tube for sliding motion thereon;

guide means guiding said sleeve for reciprocating motion in a path in general axial alignment with said upper tube;

and said lower tube further including,

two axially extending bearing surfaces on opposite sides of said lower tube in continuous sealing contact with said sleeve,

two axially extending, spaced surfaces, said spaced and bearing surfaces extending in continuous peripheral relation to define the outer surface of said lower tube, said spaced surfaces disposed in spaced relation from the interior of said sleeve to define two second passages extending axially between said lower tube and said sleeve,

a seal extending about at least a portion of the periphery of the lower end of said lower tube,

a lateral slot in one of said bearing surfaces, said slot communicating with said first passage, said slot spaced closely above said seal, said second passages being positioned on opposite sides of the other of said bearing surfaces;

said sleeve in a lower position thereof having its lower end in engagement with said seal to close said slot and said second passages from communication with the interior of the container, movement of said sleeve to a raised position out of engagement with said seal exposing said slot and said second passages to the interior of the container to cause liquid to discharge from said second passages on the side of said lower tube adjacent said other bearing surface into the container while air escapes from the container through the said first passage, said connecting means enabling said lower tube to align itself coaxially with said sleeve whereby wear of said sleeve is minimized during reciprocating motion thereof along said lower tube.

2. A valve mechanism as defined in claim **1,** wherein said sleeve and said lower tube are of substantially circular cross-section,

said bearing surfaces constituting unequal, major and minor arcuate surfaces, and wherein,

said spaced surfaces constitute chordal surfaces extending between said arcuate surfaces and converging toward said minor arcuate surface, said slot being positioned in said major arcuate surface and the liquid discharging on the side of said tube adjacent said minor arcuate surface.

3. A valve mechanism as defined in claim **2,** in which said minor arcuate surface at the lower end thereof tapers to a narrow edge so that the two streams of liquid passing down said second passages unite as they emerge from the valve.

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