FILLING HEAD FOR BOTTLE FILLING MACHINE HAVING VALVE FOR CONTROLLING AIR DISPLACEMENT

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Application August 8, 1946, Serial No. 689,255
In France March 2, 1944

Section 1, Public Law 690, August 3, 1946
Patent expires March 2, 1964

4 Claims. (Cl. 220—111)

My invention relates to filling heads intended for filling bottles or other vessels at equal pressures (i.e., without difference of pressure) with a liquid containing gas under pressure, such as lemonade, soda, beer, sparkling wine, etc.

It is known that filling at equal pressures is effected by introducing into the vessel to be filled such a quantity of gas (generally air) that the internal pressure of the vessel is equalized with that of the reservoir containing the liquid, in such a manner that liquid can then flow from the reservoir into the vessel by gravity in an atmosphere of practically uniform pressure.

Known filling heads of the aforesaid type generally comprise a liquid inlet tube, extending for a certain depth into the neck of the bottle to be filled, and an air return tube which opens into the bottle neck and discharges into the top of the liquid reservoir under pressure. Owing to these two tubes the bottle is filled exactly to the level of the opening of the air return tube. The tubes are then closed and a degassing passage is opened which permits communication of the neck with the atmosphere at the expense of a certain loss of liquid and gas. The bottle is then removed and rapidly closed by hand or automatically. Means are also generally provided for emptying liquid which may have entered the air return tube and which may affect filling of the next bottle.

Good operation of such filling heads in dependent of the stability of the liquid in the bottle when the gaseous pressure has been suppressed. If there is produced a moderate release of gas, the loss of liquid is slight and the bottle remains substantially at the filling level provided and may be worked without difficulty. If on the other hand the release of gas is intense, the loss becomes considerable and the final level may be abnormally low, even if corksing is effected very rapidly.

In order that the liquid may be stable, it is important that the bottle walls should be smooth and clean, and it is moreover necessary that the liquid should be quite free from air bubbles which form centers for the evolution of gas.

Known filling heads present the drawback that the liquid flows out in the form of one or more jets which entrep air bubbles with them. This air, which is generally only eliminated slowly and incompletely, causes instability and, which is moreover serious, does not cause it in a regular and uniform manner, so that the extent of final filling of the bottles varies within wide limits. The loss of liquid in degassing remains material, which is a drawback with valuable liquids such as sparkling wines. Finally, the liquid inlet tube and the air return tube require the provision of a vertically sliding centering device on the filling machine to guide the neck in relation to the head, which complicates the construction.

A first object of my invention is to provide a filling head wherein the liquid flowing into the bottle comes into contact with the walls of the neck thereof and then runs smoothly along the said walls without dividing and without entrapping air bubbles.

Another object of my invention is to provide a filling head wherein the liquid flowing from the air return tube, when emptying the latter, also runs along the walls of the bottle.

A further object of my invention is a filling head comprising means to impart to the liquid flowing into the bottle a whirling motion due to which it is discharged in the form of a substantially continuous conical film which directly reaches the neck walls before being able to divide and to entrap air bubbles.

Still a further object of my invention is a filling head wherein the liquid outlet tube and the air return tube are disposed in coaxial relation, the air return tube being the inner one.

My invention also refers to a filling head of the above type comprising a third tube, co-axial and external to the two first, and intended to ensure air admission into the bottle, to effect equalization of pressures, and also to permit emptying of the air return tube at the beginning of the filling operation.

My improved filling head comprises no tube dipping into the bottle, which dispenses with any sliding centering device. The bottle is thus filled to the edge of the neck, but during degassing there occurs a regular withdrawal of liquid, causing a limited and regular lowering of the liquid level to permit corking.

My invention has also for its object a filling head of the character described, wherein all the control valves are actuated by pushers disposed in parallel relation on the same face of the head to receive the action of a single rotating cam plate which operates them in the desired order.

In the annexed drawings:

Fig. 1 is a general vertical section of a filling head according to my invention.

Figs. 2 and 3 are sections thereof through lines II—II and III—III of Fig. 1.

Fig. 4 is a section through line IV—IV of Fig. 2.

Fig. 5 shows to an enlarged scale the lower part of Fig. 2.
Fig. 6 is a fragmental section through line VI—VI of Fig. 5. Fig. 7 is an enlarged section of the actuating cam.

Fig. 8 is an end view of the operative face thereof.

Figs. 9 to 11 are developments of the three radial zones of the said face.

Fig. 12 is a front view of the cam driving member.

Figs. 13 to 18 are diagrams illustrating the successive steps of a filling operation.

The head illustrated in Figs. 1 to 6 comprises a main body 1 fixed on the front of a connecting body 2 itself secured under the bottom of a reservoir 3 enclosing the liquid under pressure to be introduced into the bottles. Body 1 is covered by a bell-shaped cover 4.

The base of body 1 has a rigid collar 5 intended to fit over the neck 6 (Fig. 5) of the bottle to be filled and between collar 5 and body 1 there is interposed a packing 7 of rubber or like material to form a tight joint against the upper end of neck 6.

Ring 7 is tubular (Fig. 5) and through its bore there is passed with play a relatively short tube 8 the upper part of which is tightly fixed in a central bore 9 of body 1. Tube 8 itself receives a second tube 10 which extends higher into bore 9 to fit within a part thereof of smaller diameter.

The main part of tube 10 has an external diameter smaller than the inner diameter of tube 8 to provide an intermediate annular space 11 between the two tubes and an intermediate annular play 9a between the said tube 10 and the central bore of body 1. The lower end of tube 10 fits without play within tube 8, but it is provided with helicoidal peripheral grooves forming a passage between space 11 and the neck 6 of the bottle on which the filling head is fitted. The lower end of tube 10 receives a core 12 provided with a deep helicoidal groove by means of which tube 10 communicates with neck 6.

Fig. 6 shows the respective arrangement of tubes 10 and 8 and of packing 7. The various helicoidal grooves have been indicated by references 10a and 12a respectively as they are provided in tube 10 or in core 12. All the grooves are disposed in the same direction. Fig. 5 shows that tubes 8 and 10 come flush with the lower surface of packing 7 without extending into the inside of the bottle neck 5. The material forming packing 7 has a sufficient hardness so that the swelling of the latter, when the filling head is pressed against the bottle, cannot close a passage 13 provided between the periphery of the outer tube 8 and the said packing 7 which thus plays the role of a third tube surrounding tubes 8 and 10. A rigid ring could, if desired, be provided to reinforce to some extent the inner bore of packing 7 and to prevent abnormal expansion thereof.

The above-mentioned connecting body 2 (Figs. 1 and 3) is formed with a passage 14 at right angles communicating with the base of reservoir 3 by means of an opening 15 provided in the bottom of the body, and in the path of this passage there is interposed a chamber 16 enclosing a ball 17 which is normally impervious, but which may be pressed against a suitable seat 17a by an abnormally strong current of liquid. Ball 17 forms a safety valve in the case of liquid under pressure escaping freely to the atmosphere, for instance in the case of bottle breakage.

Passage 14 opens in a groove 18 cut obliquely on the rear face of body 1, the said groove in turn opening into a valve chamber 19 (Fig. 4) enclosing a valve 20 pressed by a spring 21 against the inlet of a passage 23 leading to another chamber 24 communicating with the annular space 9a above mentioned, that is to say in the path of the axial bore 9 of body 1 external to tube 10 (Fig. 5). It will be understood that chamber 24 thus communicates with the annular space 11 and with the bottle neck 6 through grooves 10a of Fig. 6.

Valve 20 may be pushed back by a pusher 25 (Fig. 4) driven through body 1 though a stuffing box 26, the said pusher being automatically operated by a cam, as hereinafter explained. It will be understood that by pushing pusher 25 communication is established between the base of reservoir 3 and the bottle, which permits liquid to fill the bottle if escape of air is ensured. The liquid which thus flows into the bottle by gravity assumes a whirling movement owing to grooves 10a and it is discharged into the neck in the form of a conical film which immediately reaches the walls of the latter without having time to be divided and to enrap air bubbles. This film runs downwardly along the said walls and progressively fills the bottle.

The escape of air is ensured by the central tube 10. It has been stated that the latter communicates with the upper part of the central bore 9 of body 1 (Figs. 5 and 2). This bore, which is blind, communicates by a horizontal passage 27 (Figs. 2 and 3) with a passage 28 opening into a valve chamber 29 (Fig. 3) which encloses a valve 30 pressed by a spring 31 against the outlet of the said passage 28. A pusher 32, passed through a stuffing box 33, is in the case of valve 28 above-described, of operating valve 33 against the action of spring 31. Connecting body 2 is moreover provided with a channel 34 (Figs. 3 and 1) which opens into the valve chamber 29 and, extending at right angles, discharges into the bottom of reservoir 3. But the outlet of channel 34 in reservoir 3 receives a vertical tube 35 extending to the upper part of the said reservoir to communicate with the atmosphere above the liquid.

It will be understood that the passages just described permit the air in the bottle to escape into the atmosphere of reservoir 3, thus allowing the liquid to flow into the bottle as above explained.

Connecting body 2 also comprises a second passage 36 similar to passage 35 above described and like it extending into reservoir 3 by a vertical tube 37 (Fig. 2). Tube 37 carries at its upper end a small chamber 38 enclosing a safety ball 39 actuated in such a manner as to operate as ball 17 above-described in order to prevent escape of gas in the case of damaged necks or of broken bottles. Passage 36 terminates in a valve chamber 40 (Fig. 3) similar to valve chamber 28 and enclosing also a valve 41 with spring 42 and actuating pusher 43 passing through a stuffing box 44. The passage 45 controlled by valve 41 communicates with a vertical canal 46 (Figs. 3, 2 and 5) extending into the interior of body 1 and terminating in a horizontal passage 47 (Fig. 5) opened by a projecting 48 (Fig. 5) provided between packing 7 and tube 8. This permits of putting the bottle under pressure at the beginning of the filling operation without having to use the air return passage which may enclose liquid which would be blown and atomised into the bottle. And the liquid thus enclosed in said air return passage may afterwards be freely discharged by gravity with the liquid recovered.
from the degassing operating, as will be hereinafter explained.

From the above described chamber 24 (Fig. 4) opens a vertical passage 48 which, rising in body 1, communicates with a passage 49 (Figs. 1 and 2) provided along one of the lateral walls of the bell-shaped cover 4. Passage 49 discharges at the upper end of the latter, as shown in Fig. 1, in a kind of transverse groove open downwards, provided on the internal face of the bottom of cover 4. On the opposite wall of the said cover 4 there is disposed a second passage 50 symmetrical with passage 49 and which communicates with a vertical passage 51 provided in body 1. Passage 51 terminates in a valve chamber 52 (Fig. 4) passing a valve 53 pressed by a spring 54 against a passage 55 which communicates with the outer atmosphere through another passage 56. Valve 53 is operated by a pusher 57 passing through a stuffing box 58. The operation of pusher 57 thus permits effective starting the degassing operation through an intermediate chamber (bell-shaped cover 4) adapted to recover the liquid drops blown with the gas.

From the bottom of the chamber formed by cover 4 there extends a passage 53 (Figs. 1 and 2) terminating in a horizontal passage 50 opening into a valve chamber 61 (Fig. 1) enclosing a valve 62 pressed by a spring 63 against the passage 50 above described and actuated by a pusher 64 passing through a stuffing box 55. Valve chamber 61 communicates by an oblique passage 66 with the upper part of the central bore 9 of body 1. This passage is intended to return to the bottle any liquid recovered within cover 4 during the degassing operation of the preceding bottle.

The five pushers 25, 32, 43, 57 and 64 extend in front of body 1 parallel to each other, as indicated by the section of Fig. 2, to be actuated by one and the same circular cam plate 67 (Fig. 1) loose on a pivot 68 fixed to the said body 1 and held in place by a nut 69. Cam 67 is integral with a four-armed star-shaped member 70 (Fig. 12) Member 70 is intended to be actuated by fingers 71 which move with respect to the filling head (the filling head is generally mounted on a revolving base while fingers 71 are fixed, but the reverse arrangement is obviously possible). As shown in Fig. 6, the four pushers are not located at the same radial distance from the cam center. Pusher 64 is furthest from this center. Pushers 32 and 43 are located on the same circle of less diameter. And pushers 25 and 57 are located on another circle of still smaller radius. To these three radial distances correspond three cam profiles of which Figs. 9 to 11 illustrate the development from point A of Fig. 8.

Pushers 25 and 57 cooperate with a short boss 67a which actuates the same successively and never simultaneously, one being always freed when the other begins being actuated.

Pushers 25 and 43 cooperate with an elongated boss 67b which may actuate them simultaneously.

Pusher 64 is actuated by a short boss 67c.

To explain operation of the apparatus described, reference is made to the diagrams of Figs. 12 to 18 wherein the valves have been represented by cocks with the references of the cam profiles. In order to facilitate understanding. Reservoir 3 is shown with the float 72 controlling escape of air or gas to permit admission of liquid under pressure from a suitable container. Tubes 8 and 10 and the annular space 13 are figured by simple separate tubes with the same references. For the sake of clearness, tubes 8 and 10 are shown as dipping slightly into the bottle although in fact, as indicated in Fig. 5, they do not dip at all.

The operation is as follows:

The neck of the bottle being pressed against packing 7, cam 67 effects its first quarter of a revolution under the action of a finger 71 (Fig. 12). Pusher 43 (Fig. 13) is actuated, which causes the interior of the bottle to be connected with the atmosphere of the reservoir. The bottle is thus put under pressure.

In the second quarter of a revolution of cam 67, pushers 32 and 54 are opened (position of Fig. 14) while pusher 43 remains open. The liquid enclosed in chamber 4 and in the air return tube 35 is then discharged into the bottle. It is to be noted that this discharge is effected through the helicoidal groove 12a (Figs. 5 and 6) of core 12, whereby the liquid is caused to flow in a conical film as above explained, and to run along the walls of the bottle without entrapping air bubbles.

During the third quarter of a revolution of cam 67, pushers 43 and 64 close (pusher 32 remaining open), while 25 is opened (Fig. 15). The bottle is then filled, the liquid flowing down through tube 8 while air escapes upward through tubes 10 and 35. The conditions in which this discharge of liquid is effected have already been explained and need not be further described.

Filling stops when the liquid level within the bottle reaches the lower end of tube 10, as indicated by B, being noted that in reality this level reaches the top of the bottle neck, as clearly understood when considering Fig. 5.

During the last quarter of a revolution of cam 67, pushers 25 and 32 are first closed (Fig. 16) and then pusher 57 is open (Fig. 17). The bottle is put in communication with the outer atmosphere. There is thus produced a de-compression through tube 8 and chamber 4, and the resulting sudden escape of gas blows a certain quantity of liquid. The level within the bottle falls to B' while the liquid blown with the gas collects in chamber 4.

It must be noted that owing to the conditions under which filling is effected the liquid within the bottle is very stable and the de-compression only affects the superficial layer thereof at the top of the neck, and the quantity of liquid blown into chamber 4 is very regular.

The bottle is then removed and replaced by a new one. It will be noted that at the end of the filling operation pusher 57 remains open and will only be closed during the first quarter of a turn of cam 67 (Fig. 13). But it is evident that closing of 57 could also be provided in the position of rest, as indicated in Fig. 18.

The head described ensures such a stability of the liquid in the bottle that, even at the highest gaseous saturation pressures used in practice, the filled bottle exposed to the atmosphere gives only rise to a very moderate evolution of gas bubbles without any froth formation and consequently without any loss of liquid between the removal from the filling machine and the use thereof.

The final filling level B' (Fig. 17) is extremely regular while with the known filling heads it varies from bottle to bottle, reaching sometimes abnormally low values. As the head according to my invention comprises no tube extending downwardly into the neck of the bottle, it is not easy to dispose the bottle to be filled without having to provide exaggerated vertical displacements either of the head or of the bottle.
It will be noted that, while the helicoidal grooves appear as the best means to obtain formation of a conical liquid film between the filling head and the walls of the bottle, there could be used any other equivalent disposition. For instance the head could be arranged with conical deflectors of slightly less diameter than the bottle neck. These conical or frusto-conical deflectors could also be arranged in co-axial formation to ensure the successive operations as described, and their upper surface could be provided with spiral grooves to impart a whirling movement to the flowing liquid.

I claim:
1. A filling head for filling bottles or the like with liquid containing gas under pressure from a closed reservoir, comprising a base adapted to be tightly jointed against the upper edge of the neck of the bottle to be filled; an air return tube co-axially disposed through said base to return air from said bottle to the upper part of said reservoir, said air return tube opening substantially at the level of said base without extending downwardly into said bottle; a liquid tube disposed co-axially to said air return tube and exterior to the same to permit liquid from said reservoir to flow into said bottle by gravity, said liquid tube also opening substantially at the level of said base without extending downwardly into said bottle; a core inserted in the opening of said air return tube, said core being provided with helicoidal grooves forming a passage for a fluid; and an annular core in the opening of said liquid tube, said annular core being also provided with helicoidal grooves for liquid passage.
2. In a filling head as claimed in claim 1, said base comprising a vertical outer tubular body with a flaring lower end; an annular member of plastic material in said outer body and in contacting relation therewith, said annular member forming the pressure equalizer tube; said liquid tube being disposed co-axial to said annular member and spaced therefrom said annular core comprising a hollow head closing the lower end of said liquid tube, said head being provided with helicoidal grooves on its periphery to afford passage for the liquid and said head forming the air return tube; and said helicoidally grooved core fitting in said hollow head.
3. A filling head for filling bottles or the like with liquid containing a gas under pressure from a closed reservoir comprising a pressure equalizer tube to connect the bottle to be filled with the upper part of said reservoir before the filling operation proper; valve means to control said tube; a liquid tube to permit liquid from said reservoir to flow into said bottle by gravity; valve means to control said liquid tube; an air return tube connecting the upper part of said bottle with the upper part of said reservoir to permit air from said bottle to discharge into said reservoir during filling operation; valve means to control said air return tube; a degassing chamber to collect liquid blown from said bottle during degassing of said bottle; a canal to connect said degassing chamber with said liquid tube, said canal being branched between the opening of said liquid tube in said bottle and said liquid tube valve means; a canal to connect the lower part of said degassing chamber with said air return tube, said canal being branched between the opening of said air return tube in said bottle and said air return tube valve means; valve means connecting the upper part of said degassing chamber with the outer atmosphere; and automatic means to operate all said valve means in proper succession.
4. In a filling head as claimed in claim 3, said valve means embodying actuating rods projecting from said head in substantially parallel formation; and said automatic operating means comprising a flat disc rotatable about an axis substantially parallel to said rods and provided with bosses adapted for cooperation with the ends of said rods.

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