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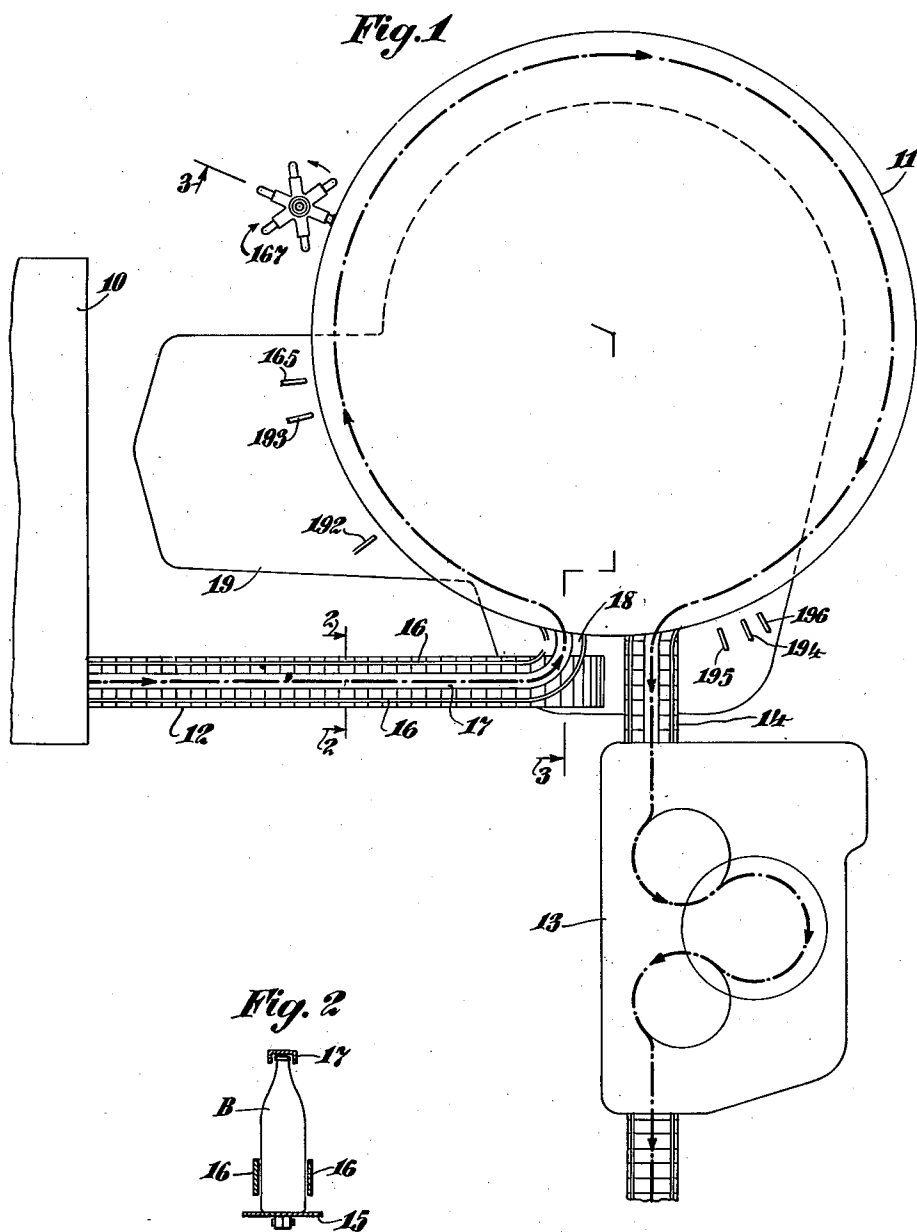
A. F. HOFFMAN ET AL

2,174,745

METHOD AND MACHINE FOR FILLING CONTAINERS

Filed Oct. 15, 1935

6 Sheets-Sheet 1.



INVENTORS
Albert F. Hoffman, Charles Schmutzer
BY *and Kurt Manrodt,*
Boznet, Henry & Campbell,
THEIR ATTORNEYS

Oct. 3, 1939.

A. F. HOFFMAN ET AL

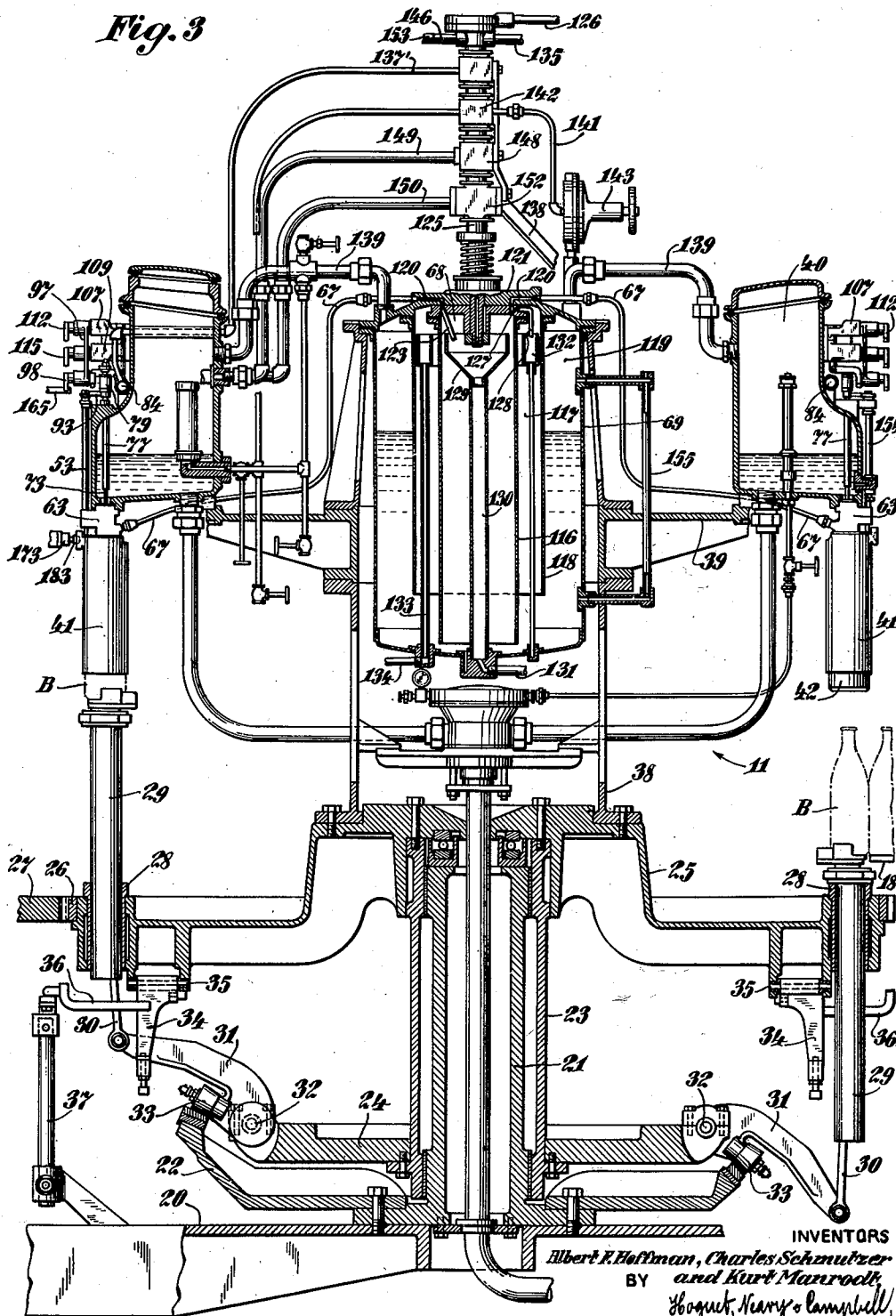
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METHOD AND MACHINE FOR FILLING CONTAINERS

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6 Sheets-Sheet 2

Fig. 3



INVENTORS
Albert F. Hoffman, Charles Schmutzer
and Kurt Manrock
BY
Hoaguet, Hays & Campbell,
Their ATTORNEYS

Oct. 3, 1939.

A. F. HOFFMAN ET AL

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METHOD AND MACHINE FOR FILLING CONTAINERS

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6 Sheets-Sheet 3

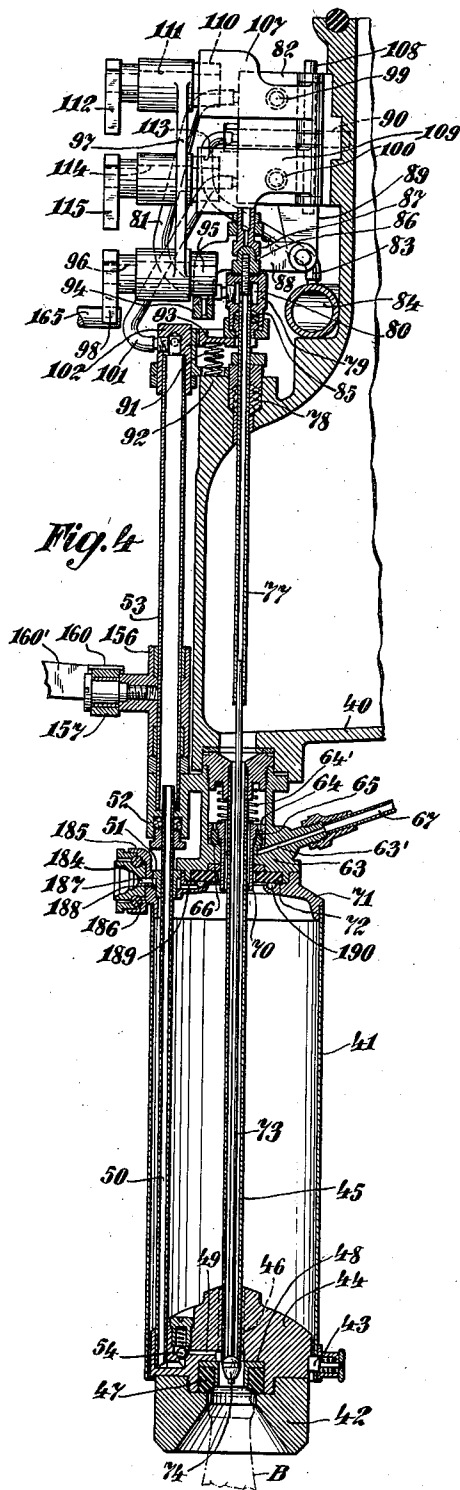


Fig. 4

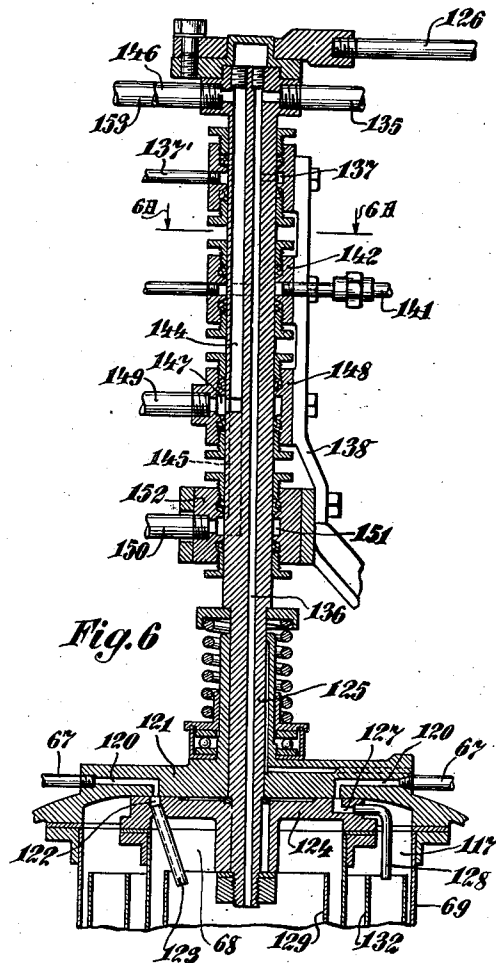


Fig. 6

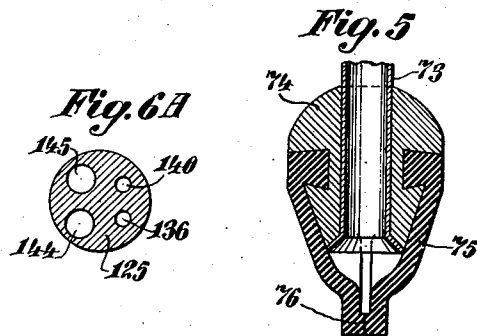


Fig. 5

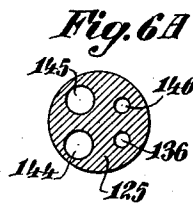


Fig. 6A

INVENTORS
 Albert F. Hoffman, Charles Schmutzer
 and Kurt Maurecht,
 BY
 Hoquet, Harvey & Campbell,
 Their ATTORNEYS

Oct. 3, 1939.

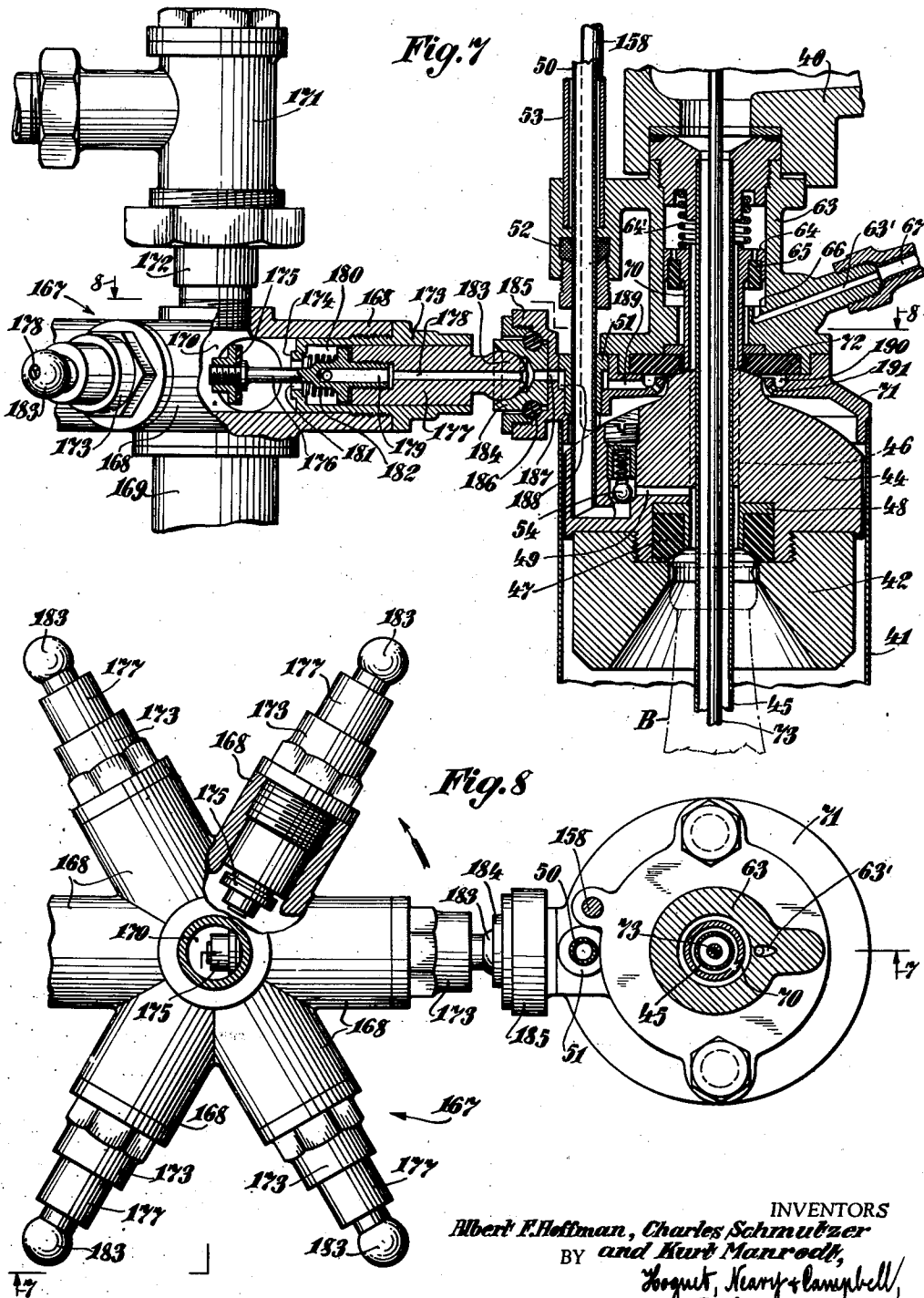
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METHOD AND MACHINE FOR FILLING CONTAINERS

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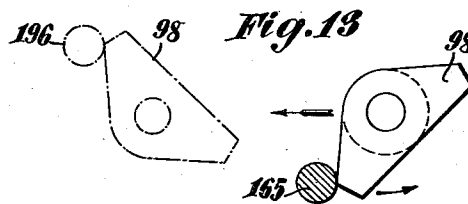
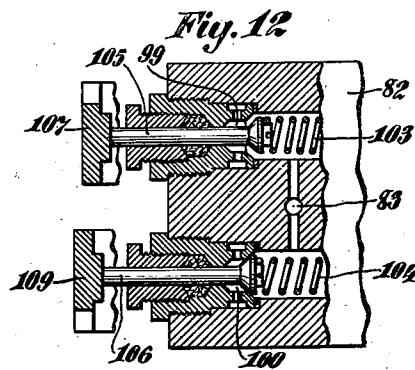
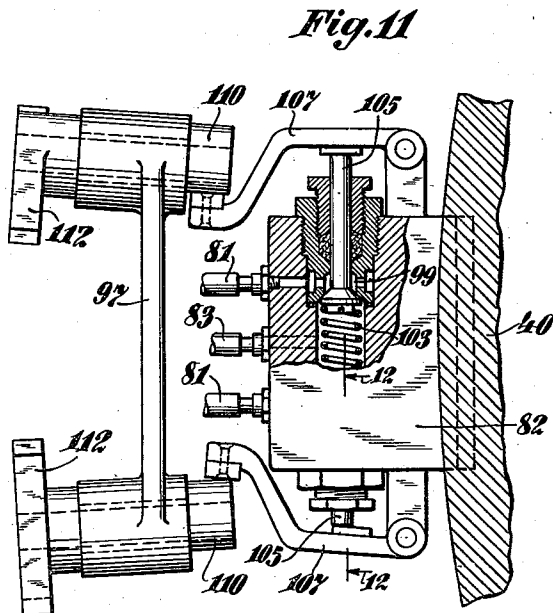
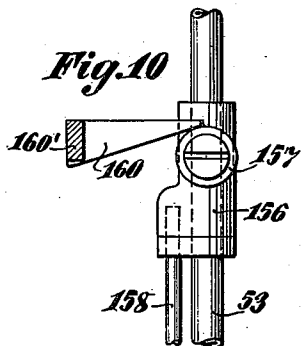
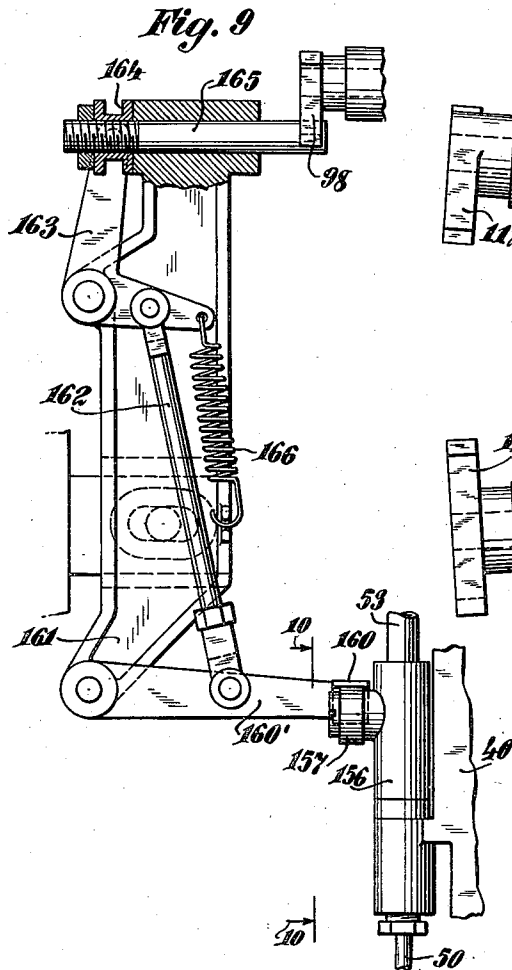
A. F. HOFFMAN ET AL

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METHOD AND MACHINE FOR FILLING CONTAINERS

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6 Sheets-Sheet 5



INVENTORS
Albert F. Hoffman, Charles Schmutzer,
BY and Kurt Manrodt,
Hoguet, Hany & Campbell
Their ATTORNEYS

Oct. 3, 1939.

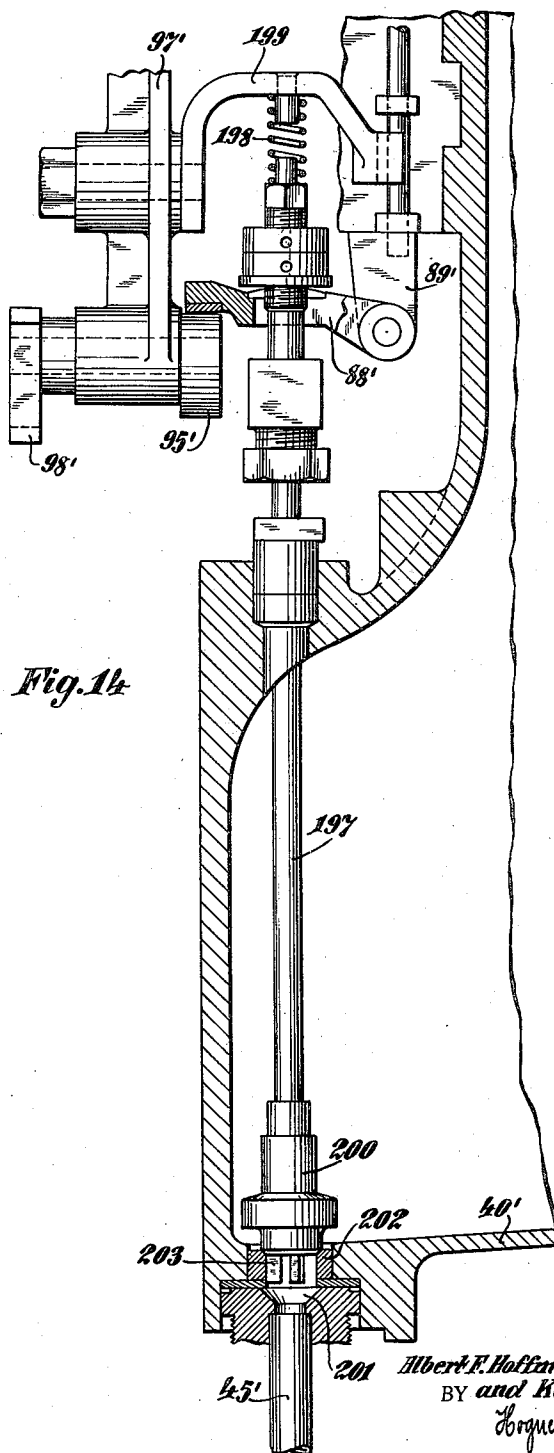
A. F. HOFFMAN ET AL

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METHOD AND MACHINE FOR FILLING CONTAINERS

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6 Sheets-Sheet 6



INVENTORS
Albert F. Hoffman, Charles Schmutzer
BY and Kurt Manrodt,
Loquet, Henry & Campbell,
Their ATTORNEYS

UNITED STATES PATENT OFFICE

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METHOD AND MACHINE FOR FILLING
CONTAINERS

Albert F. Hoffman, South Orange, Charles
Schmutzer, Irvington, and Kurt Manrodt, New-
ark, N. J., assignors, by mesne assignments, to
The Liquid Carbonic Corporation, Chicago, Ill.,
a corporation of Illinois

Application October 15, 1935, Serial No. 45,056

14 Claims. (Cl. 226—68)

This invention relates to a method and apparatus for filling containers with liquids and has particular reference to filling bottles with beverages, including beer, liquors, wines, soft drinks, and the like, under the most sterile conditions.

The sterile filling of containers is not only desirable for sanitary reasons, but in cases where the product is susceptible to deterioration because of infection from outside sources, it is absolutely essential that sterile conditions be maintained from the sterilization of the container to the sealing thereof. For example, beer and other malt beverages are now made and bottled in sterile condition without requiring the pasteurization step, so that in effect the bottled beer is so-called "draught" beer, retaining its original bouquet and flavor. The introduction of infectious matter after the beer has been sterilized, such as during the bottling process, would cause immediate infection and consequent spoilage of the beer.

In the current forms of filling machinery, especially those designed for filling bottles with beer, a bottle is placed on a platform and elevated to introduce within it an elongated filling tube connected to the beer reservoir. The interior of the bottle is connected by a self-sealing connection to a source of pressure having an equalizing connection to the beer reservoir. The pressure is usually provided by sterile air in a counterbalancing chamber or tank, and is effective to force the beer from the reservoir into the bottle and also maintains a counterbalancing pressure on the rising beer within the bottle to prevent foaming during the filling operation. As the beer rises within the bottle the air displaced by it flows through the self-sealing connection from the bottle to the counterbalancing tank or chamber and frequently carries with it particles or flecks of foam, which lodge in the crevices of the apparatus and quickly spoil and eventually contaminate the entire apparatus and the charge of beer within the reservoir. Also, when the filling tube is withdrawn from the bottle after the filling operation has been completed, outside air flows into the bottle to replace the sterile air which has been displaced by the filling tube, and this outside air, being unsterilized, introduces a further source of infection.

In accordance with the present invention, a method and apparatus for filling containers with liquids such as beer, liquors, wines, and other beverages, are provided in which the filling is conducted from sterilization of the bottles to the sealing thereof under absolutely sterile condi-

tions, and particularly in the case of sterile beer, in such a way as to maintain the advantages derived from sterilization of the beer, namely, avoidance of the pasteurization step to the end that the bottled beer is, in effect, draught beer, which retains the full bouquet and flavor which is ordinarily destroyed by the common subsequent pasteurization step. The invention will be described in connection with filling beer in bottles but the invention is not limited to that use, or even to beverages, but may be readily adapted to filling milk and other liquid foods in containers.

In the apparatus of the invention a suitable container, such as a bottle, is kept covered against contamination while being conveyed from the sterilizer to the filling position, where it is elevated into self-sealing contact with a centering bell and the latter is raised by the bottle so that a filling tube is projected into the bottle with its outlet adjacent the bottom thereof. A stationary shield in which the centering bell slides, completely envelops the bottle so as to protect it from contamination. Before a seal is made between the head of the rising centering bell and the filling mechanism, the bottle is automatically filled with a sterile, inert gas, preferably carbon dioxide gas, through a small tube concentric with the filling tube, so that this heavy gas displaces the air in the bottle, which flows out through the incomplete seal at the head of the centering bell. The gas accordingly affords a sterile protecting layer over the beer as it is subsequently supplied to the bottle. Then the seal is completed by the centering bell head and the latter opens a valve placing the interior of the bottle in communication with a pressure chamber in a counterbalancing tank containing sterile water under pressure of carbon dioxide gas.

The counterbalancing tank is of more or less conventional form and is connected at its upper end to the beer reservoir, so that the pressure on the beer in the reservoir and on the water within the counterbalancing tank is equalized at all times. Within the counterbalancing tank are one or more open-bottom pressure chambers in which the gas is trapped by the water to act as a pneumatic cushion whereby the flow of the beer is controlled by the counterbalancing pressure on the rising beer in the bottle and on the beer in the reservoir, irrespective of the amount of beer which is withdrawn from the reservoir as the result of the filling operation, so that the filling action is uniform and foaming is minimized.

Upon completion of the counterpressure connection between the bottle and the counterbal-

ancing tank, the filling tube is automatically opened to fill the bottle with a measured quantity of beer, and is then automatically closed irrespective of the pressure in the bottle. The carbon dioxide displaced by the rising beer within the bottle flows into the counterbalancing tank, carrying with it such flecks of foam and small charges of beer as are forced upwardly as a result of any surging and foaming of the beer. Within the tank at the discharge end of the tube connecting the bottle and tank, is a trough or funnel into which the entrained foam and beer is discharged for removal from the tank without becoming mixed with the water therein, whereby possible infection of the contents of the tank due to spoilage of this beer is prevented. The gas displaced from the bottle is added to the supply of gas within the upper portion of the tank.

After the bottle-filling operation, the filling tube is withdrawn from the bottle by lowering of the bottle from the enveloping shield. The withdrawal of the tube from the bottle leaves a space above the layer of gas remaining in the bottle and this space would ordinarily be filled with outside air with the consequent liability of infection of the contents of the bottle. In the present arrangement, however, a small charge of sterile carbon dioxide gas, substantially equal to the cubical volume of the filling tube, is introduced by an automatically-operated valve into the bottle, so that the space above the level of the beer in the bottle is completely filled with a protecting layer of sterile carbon dioxide. In this condition the filled bottle is transferred to the capping machine where a sterile cap, such as a crown cap, is applied to the bottle in the conventional way.

After the filling operation, but before the filled bottle is withdrawn therefrom, a jet of sterilizing liquid is supplied automatically to the centering bell and flushes it and the interior surface of the protecting shield to remove any beer or foam which may have accumulated thereon. A safety mechanism is provided which responds to the absence of a bottle to be filled in the filling position to prevent operation of the automatic beer valve, so that beer intended for a bottle is not spilled over the filling machinery. Other features of importance are also provided, all contributing to the maintenance of sterile conditions during the entire bottling operation.

It will be seen that with the new method and apparatus for filling containers, beer and other liquids may be bottled under absolutely sterile conditions from the sterilization of the empty bottles to the sealing of the filled bottles, the sterilized bottle being covered in its passage from the sterilizer to the filling apparatus to prevent contamination, filled with sterile gas, so that outside air cannot contact and contaminate the beer filled into the bottle, and refilled with sterile gas to replace the contents displaced by the filling tube, so that the beer is protected by a sterile gas layer during the transfer of the filled bottle to the sealing mechanism, which completes the filling operation by closure of the bottle with a sterile seal. Initially sterile beer thus remains sterile throughout the operation of sealing it in a container or bottle, so that the usual pasteurization step, made initially unnecessary by the sterilization of the beer, remains unnecessary when the method and apparatus of this invention are employed, whereas with the usual filling means, sterilization of the beer is useless because contamination inevitably results and pasteurization after bottling becomes essential.

For a more complete understanding of the invention, reference may be had to the accompanying drawings, in which

Figure 1 is a plan of the bottle sterilizing, filling and sealing apparatus in their preferred association, whereby the sterile filling method of this invention is obtained;

Figure 2 is an enlarged cross-section through the sterile conveyor between the sterilizing and the filling apparatus, as seen along the line 2-2 of Fig. 1;

Figure 3 is a vertical section through the filling apparatus of the invention, as seen along the line 3-3 of Fig. 1;

Figure 4 is an enlarged axial section through a filling head and illustrates the appurtenant parts thereof;

Figure 5 is an enlarged section of the pear valve closing the filling tube;

Figure 6 is an enlarged section through the gas and brine supply stem at the top of the filling apparatus;

Figure 6A is an enlarged cross-section through the supply stem, as seen along the line 6A-6A of Fig. 6;

Figure 7 illustrates the cooperation between the rinsing apparatus and filling head and is an axial section as seen along the line 7-7 of Fig. 8 showing the centering bell in elevated position;

Figure 8 is a plan view and partial section as seen along the line 8-8 of Fig. 7;

Figure 9 illustrates the beer valve safety control mechanism;

Figure 10 is a partial view of the safety mechanism as seen along the line 10-10 of Fig. 9;

Figure 11 is a plan view and partial section of the gas supply valve arrangement;

Figure 12 is a partial section through the two gas valves, as seen along the line 12-12 of Fig. 11;

Figure 13 illustrates the cooperation between the beer valve pawl and the trip detents therefor; and

Figure 14 illustrates a modified form of the beer filling tube valve.

Referring to Fig. 1 of the drawings, illustrating a preferred plan of the bottle sterilizing, filling and sealing apparatus arrangement, 10 designates a conventional sterilizer, where the bottles are washed and sterilized, 11 designates the novel filling apparatus, supplied with sterilized bottles from 10 by conveyor 12, and 13 designates a conventional sealing mechanism, such as a crown capping machine, supplied by conveyor 14 with filled bottles from the filling apparatus 11.

As is illustrated in Fig. 2, the conveyor 12 comprises the usual driving belt 15, advancing the bottles B, which are guided by stationary guide rails 16. The open mouths of the bottles B are kept closed by a channel-shaped stationary hood 17, which is kept sterile and which prevents contamination of the interior of the bottles from the outside during their short travel to the filling apparatus 11, in which they are pushed by the following bottles from the conveyor 12 over the guideway 18. As indicated in Fig. 1, the hood 17 is curved to follow the guideway 18, so that the bottles are kept covered up to the filling position in the filling apparatus 11.

A suitable source of power, located at 19 and conventional in form, drives the filling apparatus 11, the conveyors and other appurtenant parts of the organization in a manner readily understood.

Referring to Fig. 3, the filling apparatus 11

includes a base plate 20 to which is bolted a pedestal 21 carrying a stationary crown cam 22. Journalled on the pedestal 21 is a sleeve 23 provided at its lower end with a disc 24 and at its upper end with a rotary spider 25. The spider 25 is fitted with a ring gear 26 engaged by a pinion 27 driven by the source of power 19 (Fig. 1). Located at equally spaced intervals around the periphery of the spider 25 is a series of vertical bushings 28 in each of which is slidably mounted a vertical bottle lift 29, which is supported and actuated by a connecting rod 30 pivoted on the outer end of a rocker arm 31 journalled on the disc at 32 and carrying the cam-following roller 33 which engages the crown cam 22.

Each rocker arm 31 is provided with a corresponding latch 34 adapted to engage and hold the corresponding rocker arm 31 in the filling position to which it is elevated by cam 22. Each latch 34 is pivoted at its upper end on a pin 35 connected to the spider 25 and is fitted with a detent 36 arranged, after the bottle is filled, to engage the stationary knock-out pawl 37 mounted on base plate 20 so that the rocker arm 31 again rides on cam 22. With this arrangement the crown cam 22 sustains the weight of the bottle lifts 29 and the bottles only during the time that the latter are being raised or lowered; during the filling operation the latches 34 hold the bottle lifts 29 in elevated position, disengaged from cam 22.

Secured to the upper surface of the rotary spider 25 is a turret 38, also provided with a spider 39 supporting the ring-shaped reservoir 40 for containing the beer or other liquid which is to be filled into the bottles or other containers. Supported by the reservoir 40 and located in alignment with corresponding bottle lifts 29, is a series of cylindrical shields 41. As is illustrated in the enlarged sections of Figs. 4 and 7, slidable axially within each shield 41 is a centering bell 42 normally retained in lowermost position by spring-pressed pin 43 which engages in a notch in centering bell head 44. The centering bell is adapted to be lifted by a bottle B and is provided with a head 44 having a central opening through which passes the stationary filling tube 45. Grooves 46 in the wall of the opening for the filling tube 45 in head 44 provide passages for the flow of air and gas in a manner to be described.

The centering bell is fitted with a soft rubber gasket 47 adapted to engage and seal the mouth of the bottle or other container which is raised by cam 22 into engagement with it. This gasket 47 is held by bushing 48 in a recess formed in centering bell head 44. Centering bell head 44 is drilled at 49 to connect grooves 46 with an eccentric tube 50 seated at its lower end in centering bell head 44 and, when the latter is raised, tube 50 slides upwardly through guide bushing 51 and stuffing box 52 so as to telescope within a stationary tube 53 carried by the reservoir 40. Communication between the drilled passage 49 and the tube 50 is controlled by a ball valve 54 in the centering bell head 44.

The filling tube 45 passes through a valve body 63 interposed between the shield 41 and the reservoir 40 and communicates with the interior of the latter. Surrounding the filling tube 45 and located within the valve body 63 is a slidable valve 64 having seal buttons 65 which are normally urged against the valve seat 66 by means of a coil spring 64' within the valve body

63. Valve 64 controls communication between the interior of the valve body 63 and a passage 63' connected to counterpressure tube 67 which leads to the interior of either the high pressure chamber 68 or the medium pressure chamber 117 of the counterbalancing tank 69, the details of which will be described later. The lower end of the stem 70 of valve 64 extends downwardly within the shield 41 for engagement by the upper end of the centering bell head 44 when the latter is raised within shield 41, as is illustrated in Fig. 7. Located at the head 71 of shield 41 is a rubber seat 72 shaped to conform to the upper end of centering bell head 44 so that when the latter is raised by the bottle B into engagement with the seat 72, the joint between the centering bell head 44 and the seat 72 is automatically sealed.

Extending axially through the filling tube 45 is an elongated small tube 73 carrying at its lower end a pear-shaped valve 74 which normally seals the lower end of filling tube 45. As illustrated in Fig. 5, pear valve 74 is made of metal but is provided with a soft rubber tip 75 having a self-closing slit-shaped opening 76 which opens to pass gas under pressure issuing from the lower end of the gas tube 73, and which closes after the gas pressure is released to prevent beer from entering the gas tube 73. The upper end of the gas tube 73 is secured within the lower end of tube 77, passing through reservoir 40 and slidable through a stuffing box 78 in the upper wall of reservoir 40. The upper end of tube 77 carries a gland 79 having an opening 80 which communicates with the interior of the tube 77 and is supplied with sterile carbon dioxide gas under pressure by flexible tube 81 connected to valve body 82 supplied by pipe 83 from carbon dioxide gas header 84. The tube 77 is sealed to the gland 79 by means of a packing 85 and the gland 79 is fitted with a ball 86 cooperating with an axially adjustable socket 87 carried by a lever 88 pivoted on a bracket 89 integral with a valve body 82 suitably secured by cap screws 90 to the outer surface of the reservoir 40. A spring 91 interposed between a boss 92 on the outer surface of reservoir 40 and a fork 93 surrounding the tube 77 and normally engaging the gland 79, urges tube 73, 77 in an upward direction so as to hold pear valve 74 seated against the lower end of filling tube 45. The free end 94 of the lever 88 engages a cam 95 mounted on the end of a short shaft 96 journalled in a bracket 97 secured to valve body 82 and carrying a triangular-shaped pawl 98 at its outer end (Fig. 13).

The valve body 82 is fitted with two gas valves 99 and 100, the former for supplying carbon dioxide under pressure to tube 81, which conducts it to gland 79 of gas tube 73, 77, and the latter for supplying gas to tubes 50 and 53 through tube 101 connecting valve body 82 with the cap 102 of tube 53. Gas valves 99 and 100 are urged to closed position by springs 103 and 104, respectively, and the valves are provided with push pins 105 and 106, respectively. Push pin 105 of valve 99 is engaged by a lever 107 pivoted on pin 108 on valve body 82, and push pin 106 of valve 100 is engaged by lever 109 also pivoted on pin 108. A cam 110 on the inner end of shaft 111 journalled in bracket 97, engages the free end of lever 107. The outer end of shaft 111 is fitted with a triangular pawl 112. A cam 113, on the inner end of shaft 114 journalled in bracket 97, engages the free end of lever 109. The outer end of shaft 114 carries a triangular pawl 115. Cams 95, 110 and 113 are similarly operated for

controlling the flow of beer, first gas and second gas to the bottle B in a manner to be described.

The counterpressure tank 69 contains a high pressure chamber 68 formed by the long, open-bottom, inner cylinder 116, a medium pressure chamber 117 formed by the short open-bottom cylinder 118, and the low pressure chamber 119 between cylinder 118 and the wall of the tank 69. Counterpressure tube 67 leading to the filling head (Fig. 6) is connected to passage 120 in the head 121 of tank 69 and rotating therewith. Initially, tube 67 is connected by passage 122 and spout 123 to the high pressure chamber 68 through stationary plate 124 keyed on the lower end of supply stem 125, which is held stationary by the rod 126 at its upper end. As the filling progresses and the machine rotates, the connection of tube 67 shifts to medium pressure chamber 117 through passage 127 and spout 128, as is illustrated on the right-hand side of Fig. 6. Spout 123 discharges into funnel 129 leading out of tank 69 by way of pipes 130 and 131, and spout 128 discharges into annular trough 132 leading out of tank 69 by way of pipes 133 and 134 (Fig. 3). Pipes 131 and 134 are normally closed by valves, not shown.

High pressure chamber 68 is supplied with sterile carbon dioxide gas by feed pipe 135 and passage 136. Passage 136 also supplies annular passage 137 in the rotary slip-ring carried by suitably-supported brackets 138, so as to rotate therewith. Passage 137 is connected by pipe 137' to annular gas header 84, carried by the beer reservoir 40. The low pressure chamber 119 is connected to beer reservoir 40 by pressure equalizing pipe 139, which in turn is connected to a carbon-dioxide and air return passage 140 (Fig. 6A) through pipe 141 and the slip-ring 142. Surplus air and gas displaced by the beer from the bottles is purged through blow-off valve 143. Stem 125 is also provided with passages 144 and 145 for circulating brine to a conventional cooling coil (not shown) in beer reservoir 40. Passage 144 is supplied with brine by pipe 146 and is connected by annular passage 147 in slip-ring 148 to pipe 149 leading to the coil, the other end of which is connected to return pipe 150 communicating through annular passage 151 in slip-ring 152 with return passage 145 leading to return pipe 153. Gage glasses 154 and 155 on reservoir 40 and counterpressure tank 69, respectively, indicate the respective beer and water levels therein.

Slidable on the tube 53 is a slide 156 having the laterally projecting safety roller 157 and fitted with a depending rod 158 passing through head 71 of shield 41 and resting on the centering bell head 44, so as to be lifted thereby, as is illustrated in Figs. 7, 9 and 10. Safety roller 157 in its lower position lies in the path of cam-shaped dog 160, on the end of a lever 160', pivoted on a bracket 161 and connected by link 162 to a bell crank 163, pivoted on bracket 161. The free end of bell crank 163 engages the collar 164 adjustably mounted on the outer end of beer valve detent 165 slidably mounted in bracket 161 and normally held in the path of beer valve pawl 98 by spring 166 connected at one end to bell crank 163 and at its other end to the bracket. Thus, if there is no bottle, centering bell 42 is not raised to lift rod 158 and slide 156 to remove safety roller 157 from the path of dog 160, so that, as the machine rotates, roller 157 engages and lifts dog 160, which, through lever 160' and link 162, rotates bell crank 163 to withdraw detent 165 from

the path of pawl 98, whereby the beer is not turned on and spilled.

Located adjacent the filling machine 11 and rotating in synchronism therewith, is a rinsing star 167 (Figs. 1, 7 and 8). The star consists of a plurality of radial arms 168 journaled on a standard 169 and supplied at its center chamber 170 with a sterilizing solution or liquid by piping 171 through a slip joint 172. Each arm 168 is fitted with a sleeve 173 having a valve seat 174 at its inner end normally closed by a valve 175 carried on the end of a valve stem 176 mounted on the end of a plunger 177. An axial passage 178 in plunger 177 communicates through valve stem passages 179 with the interior 180 of sleeve 173, which in turn communicates with chamber 170 through passage 181 in valve seat 174. A spring 182 normally urges plunger 177 radially outwardly and valve 175 against its seat 174.

The free end of plunger 177 is provided with a ball 183, shaped to cooperate water-tightly with a spherical socket 184 seated in a recess in an abutment 185 on the head 71 of shield 41. A rubber gasket 186 seals the joint between socket 184 and abutment 185. The socket 184 and abutment 185 are provided with a passage 187 aligned with passage 178 in plunger 177 which communicates with an annular groove 188 around bushing 51 leading through passage 189 in head 71 to annular groove 190 surrounding the centering bell head 44 when the latter is in the raised position shown in Fig. 7. Groove 190 is provided with jet holes 191 directed on centering bell head 44, through which the sterilizing solution or liquid sprays on the head 44. When star 167 rotates away from socket 184 in a counterclockwise direction, as seen in Figs. 1 and 8, spring 182 moves plunger 177 to the right (Fig. 7), thereby closing valve 175 to shut off the flow of sterilizing solution or liquid.

Each of the three pawls 98, 112 and 115 is provided with two detents, similar to detent 165 (Figs. 1, 3, 4, 9 and 13), one for opening the corresponding valve and the other for closing it. These detents are located in the paths of the corresponding pawls, and the reset detent is spaced ahead of the valve opening detent by a distance determined by the amount of time the corresponding valve is to remain open. Thus the detents 192 and 193 (Fig. 1) controlling first gas valve pawl 112 are spaced further apart than are second gas valve detents 194 and 195 for pawl 115, while beer valve pawl 98 detents 165 and 196 are spaced sufficiently far apart to insure regular and relatively slow filling of the beer. As is indicated in Fig. 13, the first detent trips the pawl and the second detent restores it. The spacing of the detents is variable.

In operation, the mouths of the sterilized bottles conveyed from sterilizer 10 by conveyor 12 are closed against outside contamination by hood 17, which keeps them covered until the bottles are delivered over guide 18 to the bottle lifts 29. Each bottle lift 29 is elevated by its rocker arm 31 as actuated by cam 22 so that the mouth of the bottle lifts centering bell 42 within shield 41 and seals itself against gasket 47 while being centered by bell 42. As the bell 42 is raised by the bottle B, it raises rod 158 which in turn lifts safety roller 157 out of the path of dog 160 so that detent 165 remains in position to trip beer pawl 98 at the proper time. If there is no bottle on lift 29, safety roller 157 remains depressed, and, as the machine rotates, engages dog 160 so that detent 165 is withdrawn and the beer is

not turned on. In this way, spilling of the beer, due to the absence of a bottle, is prevented.

Cam 22 is so shaped that centering bell head 44 is not quite brought into sealing engagement with seat 72 at the time that pawl 112 is tripped by its detent 192 to cause cam 110 to actuate lever 107 and depress valve 99, so that carbon dioxide gas flows under pressure through tubes 81, 77 and 73 and into pear valve 74, forcing open the slit 76, so that the heavy gas flows into the bottle B at a point adjacent the bottom thereof, the bottle B being well within the shield 41 and the filling tube 45 projecting into the bottle. The slit 76 is self-closing so that after the gassing has ceased, the interior of the pear valve 74 and gas tube 73 are sealed against the ingress of beer.

The heavy sterile gas displaces the lighter air which flows out into shield 41 through passages 46 and past the incomplete seal between head 44 and seat 72.

When the bottle is purged of air and completely filled with the sterile gas, the reset detent 193 trips pawl 112 and closes valve 99. Then cam 22 raises the bottle B further to seal the head 44 of centering bell 42 against the seat 72, so that the bottle is sealed from outside air. In this movement, the centering bell head 44 engages valve stem 70 to open valve 64, so that the interior of the bottle B is connected through valve seat 66, passage 63', counter-pressure tube 67 and passage 120 with the high pressure chamber 68 of counterbalancing tank 69, whereby carbon dioxide gas pressure in the bottle B and in chamber 68 is equalized.

Instead of initiating beer flow by the building up of pressure in the bottle as in conventional filling machines, the beer valve in the present arrangement is mechanically and positively actuated by the tripping of pawl 98 with detent 165. This causes cam 55 to rotate and actuate lever 88 to depress tube 73—77 and unseat pear valve 74, so that beer flows into the bottle from the reservoir 40 through the filling tube 45. However, because the pressure in the bottle B is greater than in the reservoir 40, only so much beer will flow as is equal in height to the difference between the head of the water column in tank 69, which is sustained by the gas in the high pressure chamber 68, and the distance between the beer level in reservoir 40 and the lower end of filling tube 45. This difference in height between the water and beer columns is such that the beer will flow into the bottle to a point slightly above the lower end of the filling tube. Then the pressure in the bottle is decreased because, during the rotation of the machine, passage 120 was disconnected from high pressure chamber 68 and became connected to medium pressure chamber 117 through passage 127 (Fig. 6). The flow of the beer is therefore resumed under the reduced pressure of medium pressure chamber 117 until the bottle is filled to the predetermined level, when beer pawl 98 is again actuated by reset detent 196 to close pear valve 74 to stop the beer flow through filling tube 45.

As the beer level rises, the gas in the bottle is displaced and returns to the tank 69 through tube 67, carrying with it flecks of foam and entrained beer droplets, for, even though foaming is minimized because of the gas pressure on the rising beer, there always is a certain degree of surging and consequent foaming. If this entrained foam and beer were deposited in the water of tank 69, spillage and contamination

of the entire apparatus would soon result. In the present arrangement, the gas is discharged into funnel 129 and trough 132 depending upon whether the tube 67 is connected to spout 123 or 128. The displaced gas mixes with the gas in the chambers 68 and 117 while the collected beer flows out of the tank 69 through pipes 131 and 134 so that it cannot contaminate the tank.

During the beer filling operation, the appropriate plunger 177 of rinsing star 167 seats in socket 184 and, in doing so, plunger 177 is retracted so as to unseat valve 175, whereby a jet of sterilizing solution or liquid is injected into annular space 190 to be sprayed through jet holes 191 over the upper surface of centering bell head 44 and runs down the interior of shield 41, thereby rinsing these and adjacent surfaces of any foam which may have accumulated thereon. In this way, the parts are automatically cleansed before the extraneous matter can dry and spoil. As the filling machine rotates, it turns the rinsing star step-by-step, due to the engagement between the ball 183 on a star plunger 177 and a socket 184 on the filling machine. Before the socket 184 has moved far enough to disengage the ball 183, the next socket 184 engages the next ball 183, thus rotating the rinsing star another step. As the rinsing star and carriage turn away from each other, the plunger 177 is released from socket 184 and is projected outwardly by spring 182 and valve 175 is closed.

After the filling operation has been completed in the manner described, knockout pawl 37 engages detent 36 of latch 34 and releases it from rocker arm 31 which again rides on cam 22. This cam lowers bottle B so that the seal between centering bell head 44 and seat 72 is broken, and valve stem 70 is released to permit spring 64' to close the counter-pressure valve 64. The filling tube 45 being stationary, is withdrawn from the bottle B as the latter is lowered, carrying centering bell 42 with it. As the filling tube 45 is withdrawn the beer level lowers because the beer had been displaced by the tube, thereby leaving a space above the level of the beer, which although partially filled with a protecting layer of carbon dioxide immediately over the beer, would be principally filled by the outside air, which might contaminate the contents. Accordingly, before the outside air can enter and as the filling tube 45 is withdrawn from the bottle, second gas pawl 115 is tripped by its detent 194 to open valve 100 and inject a charge of sterile carbon dioxide through tubes 101, 50, 53, passage 49 to unseat ball valve 54 so that the gas flows into the bottle and fills it by an amount substantially equal to the cubical volume of the filling tube; i. e. an amount substantially equal to the contents displaced by the filling tube 45. Then pawl 115 is reset by detent 195 and the gas ceases flowing.

The contents of the bottle B, now being protected by the sterile layer of gas, the bottle B is then lowered by cam 22 out of engagement with centering bell 42 which rests on pin 43 at the lower end of shield 41. The bottle in this condition is discharged by conveyor 14 to the sealing apparatus 13 where it is sealed with a sterile closure, such as a crown cap, under sterile conditions, and the filling and sealing operation is completed.

Instead of filling the bottle B with sterile carbon dioxide in the filling machine as described, this operation may be performed in the sterilizer 10, so that as the bottles issue therefrom on the 75

conveyor 12, their interiors are protected from any contamination by the gas filling. With this arrangement, the first gas valve 99 (Fig. 12) and its appurtenant parts, including pawl 112 and tube 73, will be unnecessary, and the simpler form of beer valve shown in Fig. 14 may be employed. In this arrangement, the pear valve is dispensed with, beer pawl 98' is actuated as before and its cam 95' actuates lever 88' pivoted on bracket 89'. Lever 88' actuates rod 197 normally urged downwardly by spring 198 interposed between its upper end and a bracket 199 on the cam frame 97'. The lower end of rod 197 carries the valve 200, normally closing the passage 201 to filling tube 45' through an annular valve seat 202, in which the valve 200 is guided and properly centered by prongs 203.

Accordingly, as the detent 165 engages pawl 98', cam 95' lifts lever 88' and rod 197 against the pressure of spring 198 and unseats valve 200 to allow beer to flow from the reservoir 40' through filling tube 45' into the bottle. When the beer has been filled into the bottle to the proper level, reset detent 196 restores pawl 98', cam 95' and lever 88' to their normal positions allowing spring 198 to close the valve 200 and stop the beer flow. The counter-pressure is established in the bottle in the manner described, and the bottle is also filled with the gas layer after the liquid filling is completed, so that the filled bottle with its contents protected by the gas, is transferred to the sealing apparatus 13.

It will be seen that the sterile method of filling and sealing containers according to this invention inhibits infection during the filling operation which would nullify the previous effort of rendering the beer sterile. Also, whether or not beer or other products which are subject to spoilage are packaged, the present method and apparatus provides for sanitary packaging which avoids contamination, so that the ultimate consumer is assured a sterile product. The new apparatus also embodies many novel features of importance whereby sterile, efficient, rapid and fool-proof filling of containers may be effected. While a preferred embodiment of the invention and its modifications are illustrated and described herein, it is not limited thereby, but is susceptible of changes in form and detail within its scope.

We claim:

1. The method of filling a container under sterile conditions in the absence of heat, which comprises filling the container with a gas which is inert with respect to the intended contents of the container, supplying the container with a predetermined quantity of the intended contents while displacing a corresponding volume of the gas therefrom, maintaining the said contents under pressure of the gas, maintaining the container closed against ingress of air and feeding additional gas to the container while so closed to replace that displaced by the filling apparatus, and sealing the container.

2. In a container filling apparatus, the combination of a member inserted in the container for supplying the same with a liquid to a predetermined level, the remainder of the container being filled with a gas, means for withdrawing the member, means for supplying the container with additional gas substantially equal in volume to the cubical volume of the member within the container, for replacing the contents thereof displaced by the member prior to withdrawal thereof, and means for maintaining the container

closed against ingress of air during said gas and liquid filling operations.

3. In a container filling apparatus, the combination of a member inserted in the container for supplying the same with a liquid, means for withdrawing the member, means for supplying the container with a volume of a gas substantially equal to the cubical volume of the member within the container, for replacing the contents thereof displaced by the member prior to withdrawal thereof, and means for maintaining the container closed against ingress of air during said gas and liquid filling operations.

4. In a container filling apparatus, the combination of means for filling the container with a gas, a member inserted in the container for supplying a liquid thereto up to a predetermined level, whereby a portion of the gas is displaced, means for withdrawing the member from the container, separate means for supplying the container with additional gas substantially equal in volume to the cubical volume of the member within the container, and means for maintaining the container closed against the ingress of air during the entire filling operation for replacing the contents thereof displaced by the member prior to withdrawal thereof.

5. In a container filling apparatus, the combination of means for filling the container with a sterile inert gas, means for filling the container with its intended contents to a predetermined level, while displacing a corresponding quantity of the gas therefrom, means for refilling the container with an inert gas above the level of the contents therein, means for maintaining the container closed against the ingress of air during the entire filling operation, and means for sealing the container while filled with the gas.

6. In a container filling and sealing apparatus, the combination with means for sterilizing the container, means for conveying the sterilized container to the filling position, means associated with the conveying means for maintaining the mouth of the container closed while conveyed to the filling position, means for transferring the container to the filling position, means at the filling position for reclosing the mouth of the container and filling it with the intended contents to a predetermined level, means for filling the container above the level of the contents therein with a heavy sterile gas while the container is closed against the ingress of air and for replacing the gas ejected during the filling operation while the container is so closed, means for transferring the container so filled to the sealing position, and means for sealing the container.

7. In a container filling apparatus, the combination of a gas pressure chamber, a normally open pressure equalizing connection between the interior of the container and the chamber, means for supplying a liquid to said container, said liquid displacing the gas therein through said connection into said chamber, and means associated with the discharge end of said connection in the chamber for collecting the liquid particles carried from said container by the displaced gas.

8. In a container filling apparatus, the combination of a cylindrical shield, means for introducing an empty container within the shield, means within the shield for filling the container with its intended contents, and means for rinsing the interior of said shield after each filling operation.

9. In a container filling apparatus, the combi-

nation of a filling tube adapted to be inserted in the container for supplying a liquid filling thereto, a valve normally closing the discharge of said tube and having an opening for introducing other material in said container, said opening being self-closing to prevent ingress of the liquid.

10. In a container filling apparatus, the combination of a filling tube adapted to be inserted in the container for supplying a liquid filling thereto, a valve normally closing the discharge of said tube, said valve being hollow and including a flexible material having an exit distensible by pressure within its interior and self-closing upon drop in said pressure to prevent ingress of the liquid.

11. In a bottle filling machine, the combination with a filler valve, including a filler tube adapted to be projected into the bottle, of a counter-pressure tube adapted to deliver an inert gas to the bottle prior to the delivery of the liquid through the filler tube, a bottle bell having a throat engaging the neck of the bottle to be filled and reciprocable relatively to the filler tube, a gas conduit connected with said bell and adapted to supply gas thereto, and means for preventing the flow of gas through said conduit and into said bell so long as the gas is flowing through said counter-pressure tube.

12. In a bottle filling machine, the combination with a filler valve, including a filler tube adapted to be projected into the bottle, of a counter-pressure tube adapted to deliver an inert gas under pressure to the bottle, a valve for controlling the admission of counter-pressure to said tube, means operated by the movement of the bottle for controlling said valve, and means for delivering an additional supply of gas to said

bottle operated upon the closure of said valve.

13. In a bottle filling machine, the combination with a liquid delivering valve, including a liquid delivering tube, adapted for insertion in the bottle, of a counter-pressure tube surrounding said liquid delivering tube, a valve controlling the passage of counter-pressure through said counter-pressure tube, a bottle engaging throat reciprocably mounted on said liquid delivering tube and adapted to engage and seal the top of the bottle when the liquid tube is projected into the top of the bottle, said throat having a gas passage therethrough and adapted to be connected with the counter-pressure tube when the throat is moved into engagement with said tube to open said counter-pressure valve, and means for supplying said passage with gas when said counter-pressure valve is closed and the throat is disengaged from the counter-pressure tube.

14. In a bottle filling machine, the combination with a filler valve, including a filler tube adapted to be projected into the bottle to be filled, of a counter-pressure tube adapted to deliver an inert gas under pressure to the bottle when the filler tube is projected into the bottle, means for shutting off the gas and liquid supply prior to the removal of the tube from the bottle, and means for delivering an inert gas to the bottle after the counter-pressure supply of gas has been discontinued and during the movement of the filler tube through the liquid in the bottle as the filler tube is withdrawn from the bottle.

ALBERT F. HOFFMAN.
CHARLES SCHMUTZER.
KURT MANRODT.