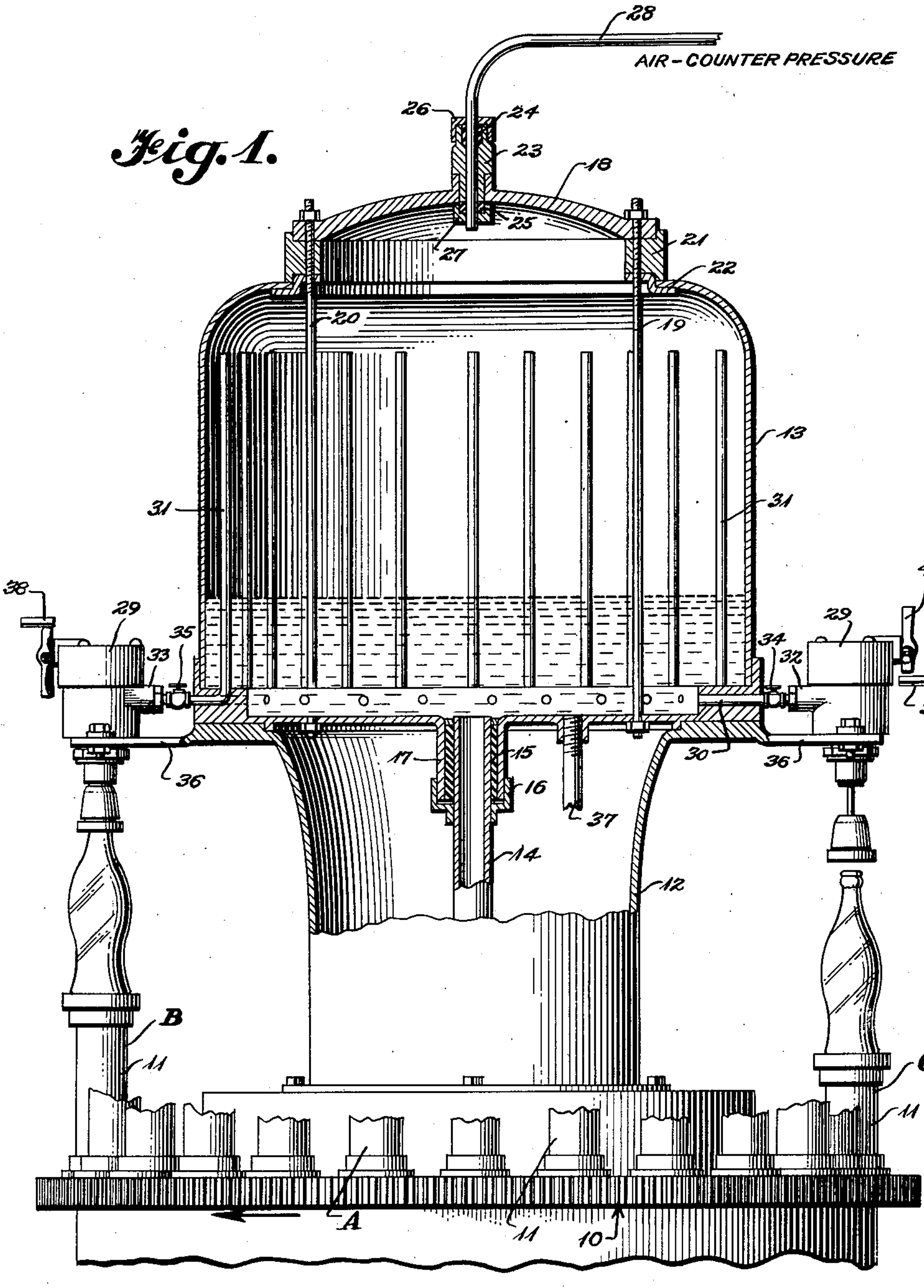
Jan. 2, 1951 L. R. HOLLIFIELD 2,536,746

FILLING VALVE

Filed June 1, 1949 4 Sheets-Sheet 1

Fig. 1.



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FILLING VALVE

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Fig. 2.

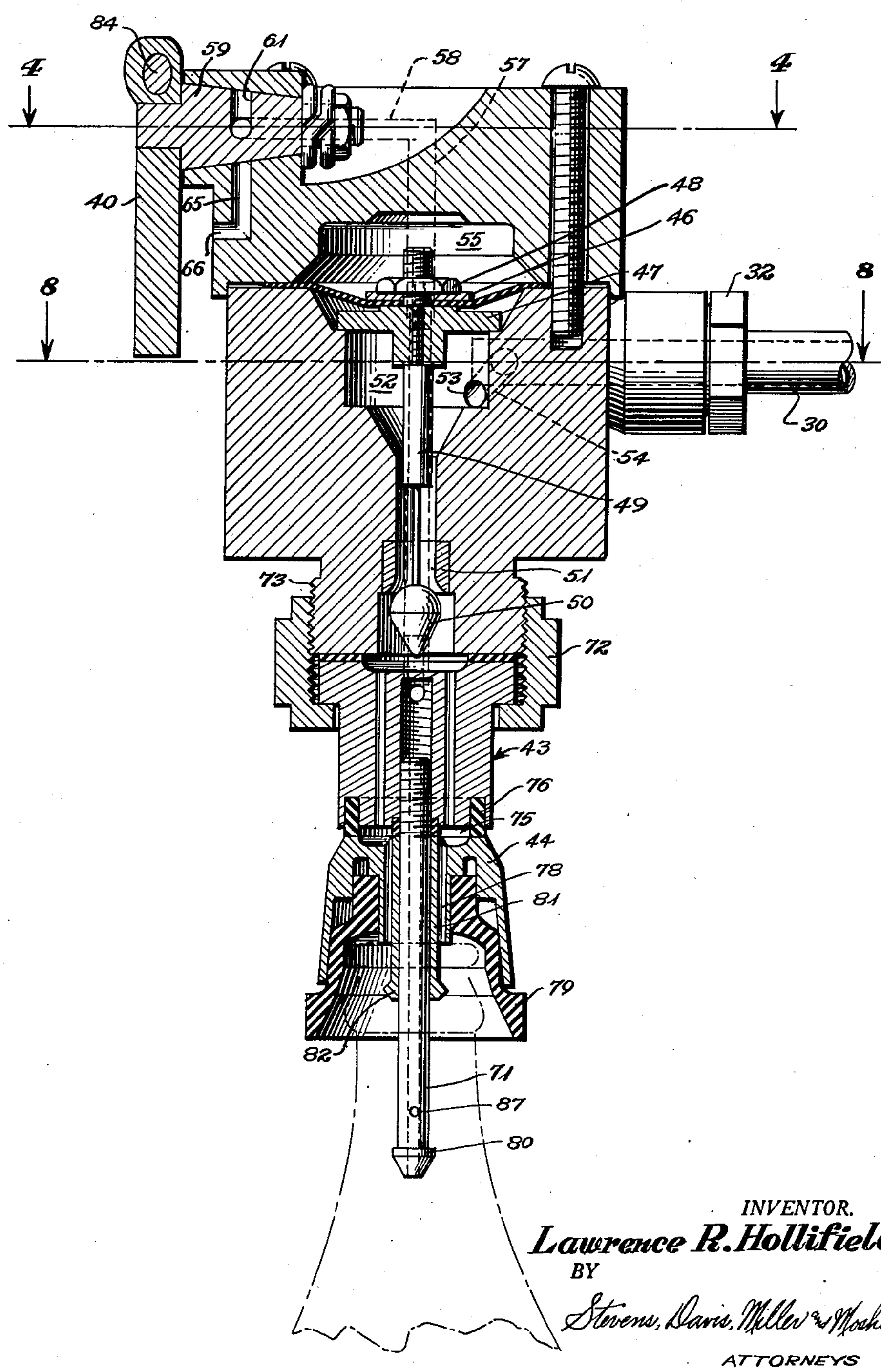

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Fig. 3.

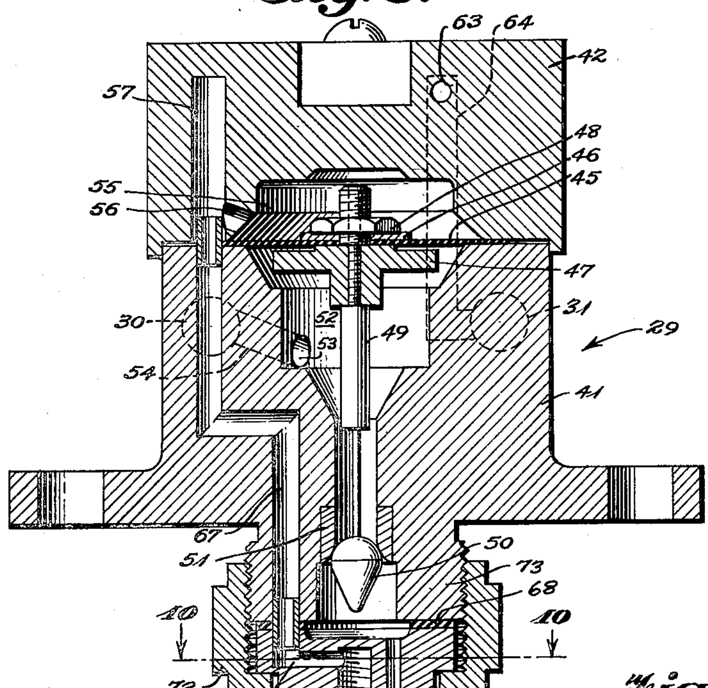
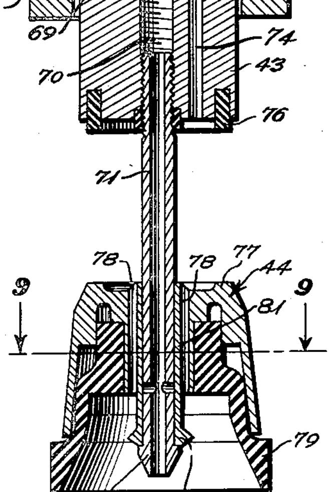



Fig. 9.

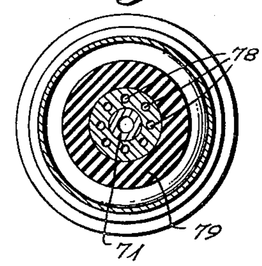
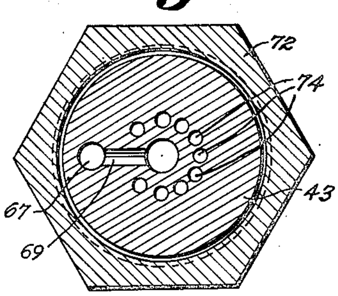


Fig. 10.



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FILLING VALVE

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Fig. 4.

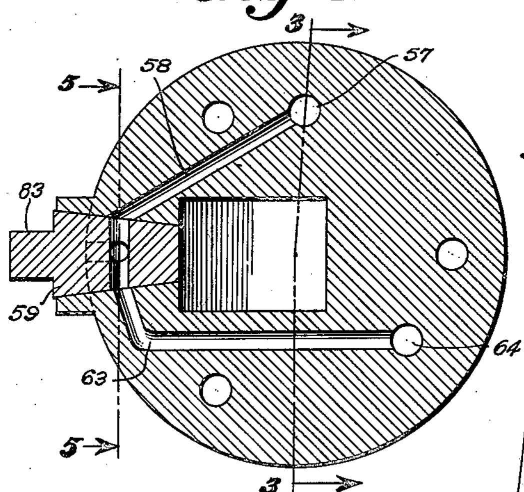


Fig. 5.

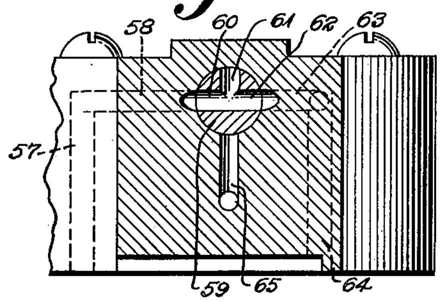


Fig. 8.

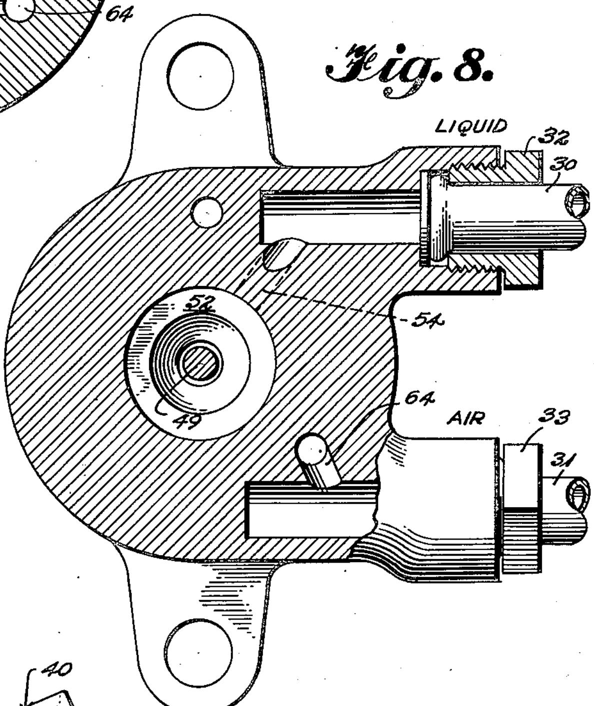


Fig. 6.

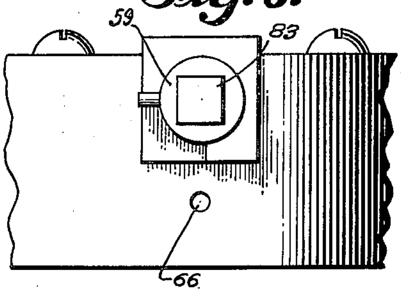
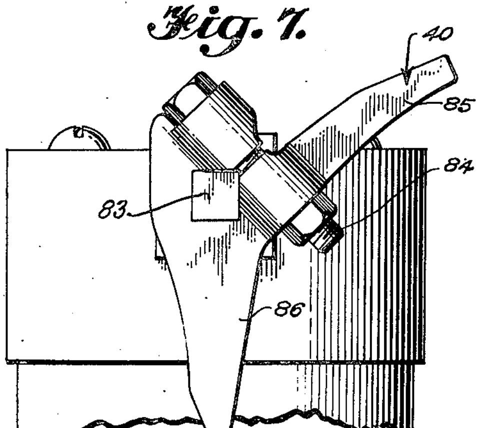


Fig. 7.



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Patented Jan. 2, 1951 **2,536,746**

UNITED STATES PATENT OFFICE

2,536,746

FILLING VALVE

Lawrence R. Hollifield, Grover, N. C.

Application June 1, 1949, Serial No. 96,574

3 Claims. (Cl. 226—115)

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This invention relates to filling apparatus and more particularly to apparatus for filling receptacles with gas-impregnated beverages.

In the bottling arts which relate to filling receptacles with carbonated beverages it is customary first to introduce the syrup or flavoring portion of the beverage and then to introduce carbonated water. While the operation of partially filling a bottle with syrup presents few difficulties, the introduction of carbonated water or other gas-impregnated liquid involves the inherent difficulty that the bottle must be pressurized to prevent foaming during the filling operation and this must be accomplished in a manner consistent with accurate liquid cut off. As a matter of fact, foaming difficulties are the principal reasons why it has been customary to fill bottles with carbonated beverages by a two-stage operation involving first introducing the syrup and then the gas-impregnated liquid.

One of the more acute phases of the problem presented in introducing air under pressure and carbonated water into the bottle is that of getting adequate cross-sectional area in the liquid conduits which are required to be introduced into the mouth of the bottle. If the cross section of the filling stem is increased, adequate filling speed is achieved but the problem of centering the stem in the mouth of the bottle becomes acute and bottle breakage and stem damage increases. If the stem is reduced in size to reduce the centering problem then the reduced cross-sectional areas of the filling conduits result in serious reduction in filling speed. Furthermore, the length as well as the diameter of the liquid conduits which lead to the mouth of the bottle has an important bearing on filling speed.

Another problem arises because the filling valve assemblies have heretofore been located within the storage tank for the carbonated water so that any repair or maintenance of the valve assembly requires removal of and loss of all of the carbonated water in the tank.

It is an object of this invention to overcome the foregoing difficulties and to provide a filling apparatus susceptible of use with all types of gas-impregnated beverages which is characterized by very high filling rates and very low stem damage and bottle breakage. In operations according to the present invention the production of foam is so inhibited and agitation is so prevented that it is quite possible to fill with premixed carbonated beverages rather than resorting to the two-stage filling operations of the prior art.

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It is a further object of this invention to provide a filling valve which may be mounted externally of a carbonated water supply tank and which may be isolated from the tank for removal and repair without loss of the tank contents. Additionally, the centered bell, nozzle and tube assembly of the present invention are arranged for easy and convenient removal for cleaning purposes.

Other objects and advantages of this invention will be apparent from the following detailed description of a preferred embodiment thereof in conjunction with the annexed drawings wherein:

Figure 1 is a view partially in elevation and partially in vertical section of a filling machine constructed in accordance with the teachings of the present invention;

Figure 2 is a view in vertical section of a filling valve according to the present invention shown in its open or filling position;

Figure 3 is a view in vertical section similar to Figure 2 but taken at a viewpoint 90° away from that of Figure 2 and showing the valve in its closed position;

Figure 4 is a view in section taken along the line **4—4** of Figure 2;

Figure 5 is a view in section taken along the line **5—5** of Figure 4;

Figure 6 is a fragmentary view in elevation of a portion of the valve operating mechanism;

Figure 7 is a fragmentary view in elevation of the valve operating mechanism showing the cam following lever which actuates the valve;

Figure 8 is a view in section taken along the line **8—8** of Figure 2;

Figure 9 is a view in section taken along the line **9—9** of Figure 3; and,

Figure 10 is a view in section taken along the line **10—10** of Figure 3.

If now more detailed reference is made to Figure 1, the broad operating principles of the machine can be understood. In filling bottles with soft drinks such as carbonated beverages, each bottle is first partially filled with syrup appropriate to the final beverage to be produced, is then filled with carbonated water to the desired level and is finally capped. The present machine is concerned with the second of these steps and it should therefore be understood that the bottles as they are fed onto the machine of Figure 1 are already partially filled with syrup and that after leaving the last station on the machine they will be capped.

The machine as illustrated in Figure 1 includes a rotary table **10** driven from any suitable power source, not shown, and provided with a plurality of circumferentially spaced bottle raising cylinders 11. The bottles are received successively on the machine at the station of the bottle raising cylinder indicated at A and each bottle begins to be raised as soon as it is in position on the respective cylinder 11. By the time each bottle reaches station B it has been raised enough to be in sealing engagement with the filling valve. As it is filled it continues to turn and as soon as the filling operation is complete the cylinder 11 is lowered and the bottle is ready for discharge as indicated at station C.

The details of the supplying of bottles to and the removal of the bottles from the raising cylinders 11 and the operation of the raising cylinders themselves have not been described in detail since they are conventional and per se constitute no part of the present invention.

Centrally mounted on the table 10 is a tank supporting casting 12 upon which a carbonated water supply tank 13 is mounted. This tank is supplied from below with carbonated water from a central pipe 14 leading through a seal 15 maintained in position by a collar 16. The pipe 14 is stationary and, of course, the tank 13 rotates with the table 10 so that the seal at 15 must be of the type which is leakproof under conditions of relative rotation. A depending boss 17 at the bottom of the tank 13 cooperates with the seal 15.

At the top of the tank 13 a dome cover 18 is provided. The dome cover is held in position by rods 19 and 20 which are threaded at the upper end and provided with nuts which bear on the margins of the dome. A spacer ring 21 is located between the bottom of the dome and the top of the tank 13. This ring coacts with a flanged ring 22 so as to seal the top of the tank gas tight. In the middle of the dome 18 there is located a fitting 23 provided with packing at 24 and 25 and with compression collars 26 and 27 for compressing the packing. The fitting 23 receives a pipe 28 through which air under pressure is supplied to the top of the tank 13. As was the case in connection with pipe 14, the pipe 28 is stationary, whereas, of course, the dome, being attached to the tank 13, rotates.

The tank 13 is provided with a plurality of valves 29, two of which are shown in Figure 1. Each of these valves is supplied through a channel 30 at the bottom of the tank 13 with carbonated water and through a stand pipe 31, with air under pressure. The stand pipes 31 extend to a plane above the full level of the carbonated water in the tank 13. During operation, a predetermined air pressure is maintained in the air space above the liquid in the tank 13. This pressure serves to maintain the CO_2 dissolved in carbonated water and to effect certain control functions to be hereinafter more fully described.

As was explained in the preliminary portions of this specification, one of the principal advantages of this invention is that the filling valves are located exteriorly of the tank so that, in the event any of them require maintenance or repair, they can be removed without the necessity of draining the tank 13 or of dismantling the apparatus as a whole. To this end, each of the valves 29 is connected to the respective pipes 30 and 31 by removable threaded collars 32 and 33 respectively. Between the threaded collar and the point of egress of the pipe 30 from the bottom of the tank 13, there is located a shut-off valve 34. A similar shut-off valve 35 is associated with each stand pipe 31. It is now apparent that to remove a valve 29 from the asembly only requires that the valves 34 and 35 be shut off and that the collars 32 and 33 be removed. From a structural point of view, the valves 29 are held from brackets 36 extending from the base of the tank 13 and bolts connect the ears on the respective valves to the respective brackets.

A separate drain pipe for draining the tank 13 incident to cleaning operations is indicated at 37. This pipe of course turns with the tank and is provided with a plug or valve, not shown, to keep it in normally closed condition.

It will be understood that during the course of travel of each bottle from Station A through Station B to Station C, it will be raised and lowered and moved in a circular path for almost 360°. Since there is a valve 29 for each raising cylinder 11, it will be appreciated that the operation of the valves can be made responsive either to the vertical movement of the bottle or to engagement with cams disposed in the circular path in which the valves move. Actually, in the present instance, resort is had to both of these expedients and cams 38 and 39 are mounted from any fixed support adjacent the path of movement of the valves 29 so as to intercept the path of movement of the lever 40 with which each valve 29 is equipped. The shifting of the position of the lever 40 controls the escape of carbonated water from the valve into the bottle and the upward movement of the bottle controls the positioning of the filling stem.

If now reference is made to Figures 2, 3 and 8, an understanding of the filling valves 29 can be gained. Each valve is comprised of a main body portion 41, a body portion cap 42, a separable lower body portion 43 and a bottle-engaging bell assembly 44. Disposed between the cap 42 and the main body portion 41 there is a flexible diaphragm 45. This diaphragm is connected through washers 46 and 47 and threaded nut 48 to a threaded valve stem 49. At the lower extremity of the valve stem 49, there is disposed a pear valve 50 co-acting with a seat 51 to control flow from a chamber 52 centrally located within the main housing 41 below the diaphragm. The chamber 52 is connected by a port 53 with a channel 54 leading to the carbonated liquid supply line 30 so that the chamber 52 is normally supplied with carbonated water at whatever pressure prevails within the tank 13. Since the pressure within the tank 13 is always above atmospheric pressure, the pressure within the chamber 52 will raise the diaphragm and cause the pear valve 50 to be closed under any conditions when atmospheric pressure prevails above the diaphragm.

Within the cap 42 and above the diaphragm, there is provided a cavity 55 which communicates through a channel 56 to a vertical channel 57 which, through a channel 58, leads to a valve 59. The valve 59 is provided with a T-shaped cavity comprised of channels 60, 61 and 62, see Figure 5. If the valve 59 is in the Figure 5 position, channel 58 communicates through channels 60 and 62 with a channel 63 leading to a vertical channel 64. Vertical channel 64 leads to air inlet pipe 33, see Figure 8. Leading from the plug valve 59 there is a channel 65 which vents to atmosphere at 66 below the axis of the valve 59 (see Figure 6). Thus it is possible, when the valve 59 is in the Figure 5 position, to admit air under pressure through the channel 64 which, through channel 63, valve 59 and channel 58, can reach the channel 57. Upon reaching the channel 57, it can pass through channel 56 into the cavity 55 and exert a pressure on the top of the diaphragm equal to the pressure of the carbonated liquid below the diaphragm in the cavity 52. Under these conditions the weight of the pear valve will cause it to unset so that liquid occupying the cavity 52 may discharge into the space below the pear valve. When, however, the valve 61 is turned 90° in an anti-clockwise direction from the Figure 5 position, the cavity 55 is placed in communication with atmosphere since it can vent through the channels 56, 57, 58, 61, 60 and 65. The air pressure in the tank 13 is not lost, however, due to the fact that the channel 62 of the valve 59 which previously registered with the channel 63, is now blocked and the body of the valve 59 blocks the channel 63 so that the air pressure in channels 64 and 63 is maintained.

From the foregoing it can be seen that when air under pressure is admitted to the chamber 55, the pear valve 50 can be moved to the open position shown in Figure 2, whereas, when channel 55 is vented to atmosphere, the pressure in the chamber 52 is sufficient to bias the diaphragm to the Figure 3 position and close the pear valve 50.

In view of the fact that the pear valve 50 controls egress of carbonated water from the chamber 52, it is apparent that during the filling of a bottle, the pear valve should be open. It is likewise apparent that while the pear valve is open, a substantial positive air pressure should exist within the bottle to be filled so that evolution of the CO_2 and resultant foaming can be prevented. To this latter end, the main housing 41 of each valve 29 is provided with a channel 67 which leads through a gasket 68 into a registering channel 69 located in the lower body portion 43 of the valve assembly 29. The channel 69 extends radially to a central channel 70 and the central channel 70 is internally threaded at one end to receive a hollow externally threaded stem 31 which functions as the air supply stem to the bottle. To maintain a seal between the lower body portion 43 and the main valve body 41, a flanged sleeve 72 is provided, the threads of which engage a threaded boss 73 at the base of the main valve portion 41. When the threaded sleeve 72 is drawn up to a sufficient extent the gasket 68 is sufficiently compressed to effect a liquid and pressure tight seal between the elements 43 and 41.

If now reference is made to Figure 10, it will be seen that the liquid issuing from the chamber 52 upon entering the lower body portion 43 is distributed into a plurality of apertures or channels 74. These channels lead to an annular space or header chamber indicated at 75 in Figure 2, which space or chamber is defined between a resilient annular gasket 76 projecting from the base of the part 43 and co-acting with a land 77 disposed on the top of the bell assembly element 44. It is considered desirable that the gasket 76 be made of rubber, either natural or synthetic, and that it be of sufficient thickness so that it can be compressed tightly against the land 77 when the bottle is in the Figure 2 position so that the space 75 is positively sealed.

If now reference is made to Figure 9, it will be seen that the header chamber 75 discharges into a plurality of channels 78 arranged in circumferentially spaced relationship in an annulus surrounding the stem 71. The portion of the bell assembly element 44 which is provided with the

channels 78 and which receives the stem 71 is metal and the underside thereof defines a cavity in which there is seated a rubber or rubber-like bottle-engaging bell 79. The bottle-engaging bell is provided with a flared mouth and is intended to seat tightly against the mouth of the bottle as indicated in Figure 2.

The stem 71 terminates in a generally frusto conical end portion which provides a flange at 80 (see Figure 2). The metal portion of the bell assembly 44 defines a sleeve bearing 81 so that the bell is free to slide up and down on the stem 71 and this bearing terminates in a flared portion 82 which can be seen and understood in both of Figures 2 and 3.

It will be noted that the resilient portion 79 of the bell assembly 44 terminates in a skirt which depends below the lower extremity of the stem 71. Thus as the raising cylinder raises the bottle toward filling position, the bottle mouth engages the inner resilient surface of the bell 79 which has a centering effect on the bottle before the mouth of the bottle is required to receive the end of the stem 71. This centering effect has been found to be important in preventing bent stems and bottle breakage. The limited universal movement afforded the bell assembly 44 by the clearance between the bearing 81 and the stem 71 has no effect on the seal between the land 77 and the gasket 76 and in view of the provision of header chamber 75, it is not necessary that the channel 74 register with the channels 78.

In conjunction with the description of Figures 2, 3, 4 and 5, reference was made to the valve 59 and the two positions which it occupies during the operation of the device. The means by which the valve 59 is moved from one position to the other will now be explained. The valve 59 includes a stem portion 83 of square cross section (see Figure 6) which is received in its operating lever which is the cam follower 40 (see Figure 7). The cam follower 40 is provided with a locking bolt 84 by which it is drawn into tight engagement with the square stem 83 of the valve 59. During the movement of the valve assembly 29 in the circular path which it follows as a result of the rotation of the table 10, the upper arm 85 of the cam follower 40 strikes the stationary cam 38 which moves it to the Figure 7 position at Station A and moves the valve 59 to the Figure 5 position. This results in the filling of a bottle. By the time the bottle has been filled, the whole valve assembly has moved to the position of cam 39 and that cam strikes the lower arm 36 of the cam follower 40 and moves the valve 59 90° in a counter-clockwise direction as it is viewed in Figure 5. This is a venting position consistent with and precedent to the discharge of the bottle from the conveyor and precedent to the reception of another bottle by that valve for filling.

The structure of the apparatus disclosed in the drawings has now been sufficiently described so that its operation may be fully understood. When a bottle is received at Station A, bearing in mind that it is already partly filled with syrup, it is moved by the table 10 to Station B and during that movement the raising cylinder 11 raises it from a position below the bell mouth of the sealing member 79 to the position shown in Figure 2. Thus the assembly 44 is raised from the Figure 3 to the Figure 2 position during the course of movement of the bottle from the station at which it is received on the conveyor to the station at which the filling operation begins. One highly important feature of the present invention is the guiding of the bell assembly 44 on the stem 71 which affords a limited measure of universal adjustment and assures the centering of the stem 71 within the bottle whereby bottle breakage is greatly reduced and efficient operation is enhanced. When the bottle has fully pressed the bell assembly 44 to its uppermost position, the land 77 tightly engages the lower surface of the gasket 76 and seals the header chamber 75 so that liquid may flow from the chamber 52, through the channels 74, into the chamber 75, through the channels 78 and along the edges of the bottle in distributed fashion into its interior.

Thus when the assembly 44 is in the Figure 2 position, the arm 85 of the cam 40 is biased to the Figure 7 position, air is admitted to the chamber 55 and the filling operation begins. Foaming within the bottle is prevented because the air pressure existing in the chamber 55 likewise exists in the bottle due to the channels 67, 69 and 70 and the hollow interior of the stem 71. As the bottle fills, the liquid will eventually rise to the level of the port 87 provided in the stem 71 adjacent its lower end and this alone will stop the filling operation, although at the same time the arm 86 will strike the cam 39 and vent chamber 55 to atmosphere causing closure of the pear valve 50. As this occurs the raising cylinder 11 will lower the bottle to the position shown at the right-hand of Figure 1 at Station C, whereupon the bottle is removed from the machine for capping.

In view of the fact that the air under pressure within the bottle is vented through the stem 71 during filling and in view of the fact that there is a continuous air passage from the bottle packing to the tank 13, it is apparent that perfect equilibrium exists, since the pressure loss in the tank 13 is exactly compensated by the air returning to the tank through the pipe 31. When, however, the liquid gets above the level of the port 87, further venting is not possible and the introduction of additional liquid would cause such an extreme pressure rise as to immediately snap the diaphragm 45 to its upper position whereby to close the pear valve.

Upon reference to Figures 2 and 3 it can be seen that the main body portion 41 of each valve is connected by bolts to the body portion cap 42 whereby the latter may be easily and conveniently removed for cleaning and repairing when necessary. The entire roller body portion and bell assembly are likewise easily removed for cleaning or repairing by simply unscrewing the threaded sleeve 72.

It should be emphasized that one of the important features of this invention is the fact that the filling valves are disposed wholly without the tank and that the valves are arranged for individual removal from the tank assembly without requiring the discharge of the tank contents.

What is claimed is:

1. Apparatus for filling receptacles with gas impregnated liquids that comprises a valve body, a hollow stem depending from said body, a bell assembly mounted for free sliding movement along said stem from a low position in which the skirt of the bell depends below the end of the stem to a high position in which the bell is in marginal sealing engagement with a portion of the valve body and defines therewith a header chamber, said bell assembly having a plurality of circumferentially spaced channels extending therethrough from said header chamber to the space within said bell assembly adjacent the stem, a supply tank for gas impregnated liquid having a liquid space and a compressed air space, a first valve in said valve body, first means establishing a passageway between said first valve and the compressed air space of said tank, second means establishing a passageway between said first valve and atmosphere, third means establishing a passageway between said first valve and the hollow interior of said stem, a second valve, fourth means establishing a passageway between the liquid space in said tank and said second valve, fifth means establishing a passageway between said second valve and said header chamber, a diaphragm for controlling the operation of said second valve, one side of said diaphragm being exposed to the pressure in the passageway established by said fourth means, and the other side of the diaphragm being exposed to the pressure in the passageway established by said third means, and means for selectively adjusting said first valve from a position closing the passageway established by said first means and connecting the passageway established by said third means to that established by said second means to a position closing the passageway established by said second means and connecting the passageways of the first and third means.

2. Apparatus for filling receptacles with gas impregnated liquids that comprises a rotatable supply tank for gas impregnated liquid having a liquid space and a compressed air space, a plurality of valve bodies each located exteriorly of said tank for rotation therewith, a hollow stem depending from each valve body, a bell assembly mounted for sliding movement along each stem from a low position in which the skirt of the bell depends below the end of the stem to a high position in which the bell is in marginal sealing engagement with a portion of the valve body and defines therewith a header chamber, each bell assembly having a plurality of circumferentially spaced channels extending therethrough from said header chamber to the space within said bell assembly adjacent the stem, a first valve in each valve body, first means establishing a passageway between each first valve and the compressed air space of said tank, second means establishing a passageway between each first valve and atmosphere, third means establishing a passageway between each first valve and the hollow interior of said stem, a second valve in each valve body, fourth means establishing a passageway between the liquid space in said tank and each second valve, fifth means establishing a passageway between each second valve and said header chamber, a diaphragm for controlling the operation of each second valve, one side of each diaphragm being exposed to the pressure in the passageway established by the respective fourth means, and the other side of the diaphragm being exposed to the pressure in the passageway established by the respective third means, and means responsive to rotation of said tank for cyclically adjusting successive first valves from a position closing the respective passageway established by said first means and connecting the passageway established by said third means to that established by said second means to a position closing the passageway established by said second means and connecting the passageways of the first and third means.

3. Apparatus for filling receptacles with gas impregnated liquids that comprises a central tank mounted for rotation, said tank having a liquid space and a space for gas under pressure, a plurality of circumferentially-spaced valve assemblies arranged exteriorly of the tank adjacent

its margin, means detachably connecting each valve assembly for rotation with the tank, a compressed gas conduit leading from the gas space of said tank to each of the valve assemblies, another conduit leading from the liquid space of said tank to each of the valve assemblies, a removable connection between each of said conduits and the respective valve assembly and a shut-off valve in each conduit between the tank and the respective removable connection whereby the valve assembly may be separated from the tank for repair or maintenance without the necessity of draining the tank.

LAWRENCE R. HOLLIFIELD.

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