April 30, 1968 W. HERBST 3,380,488

VALVED FILLING DEVICE FOR FILLING CARBON DIOXIDE-CONTAINING BEVERAGES INTO A VESSEL AND METHOD FOR DOING SO

Filed Oct. 19, 1965 4 Sheets-Sheet 1

Fig. 1

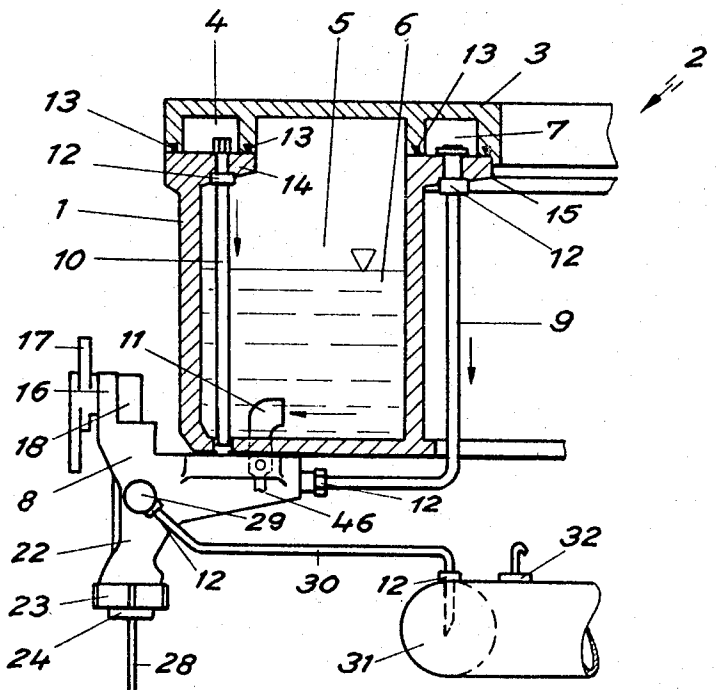
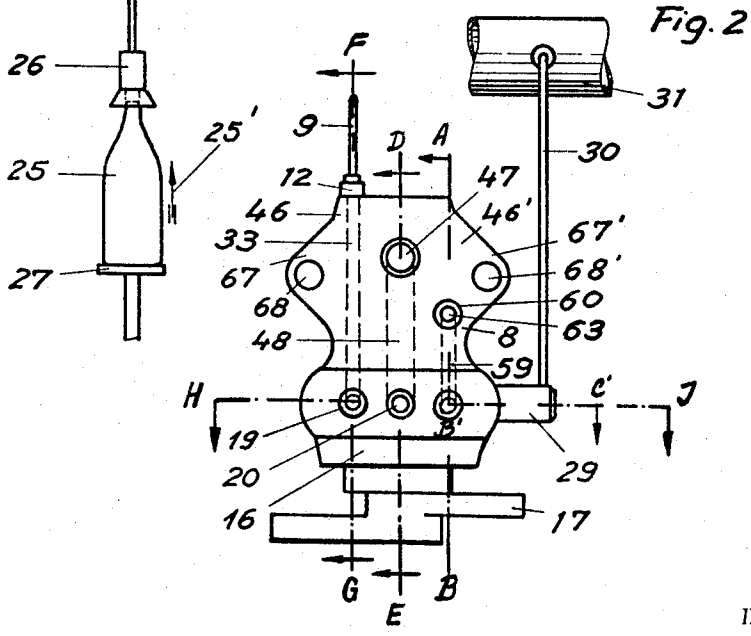


Fig. 2



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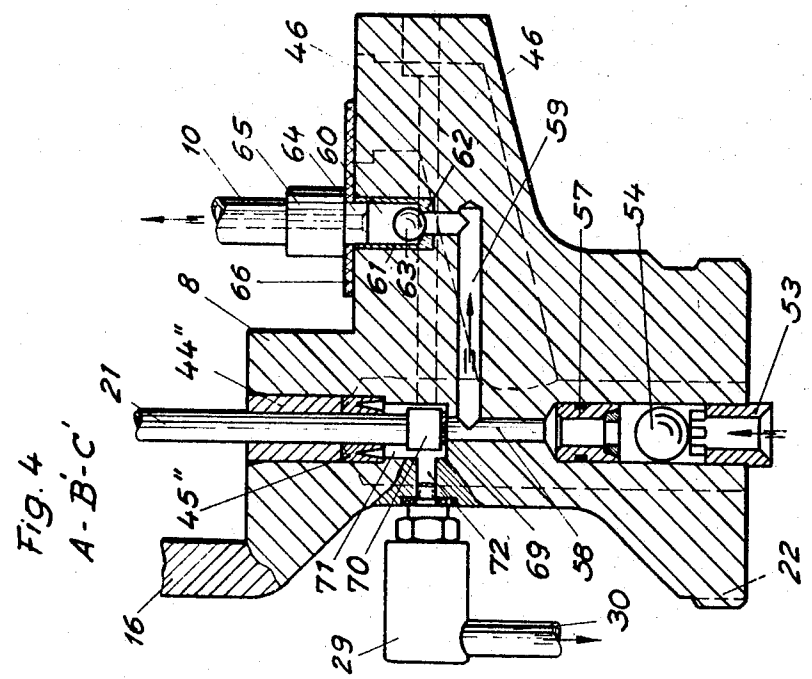


Fig. 4
A-B-C'

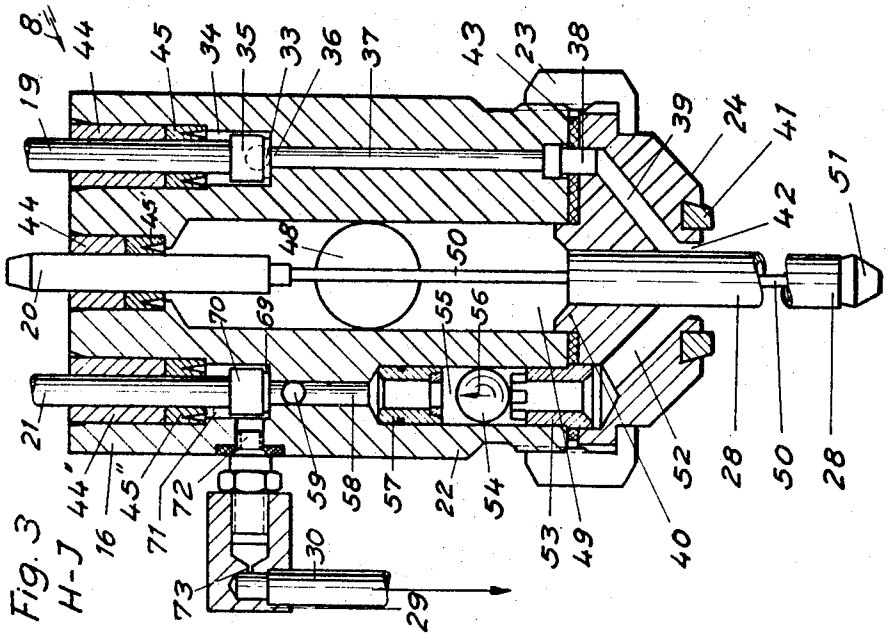


Fig. 3
H-J

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Fig. 5
D-E

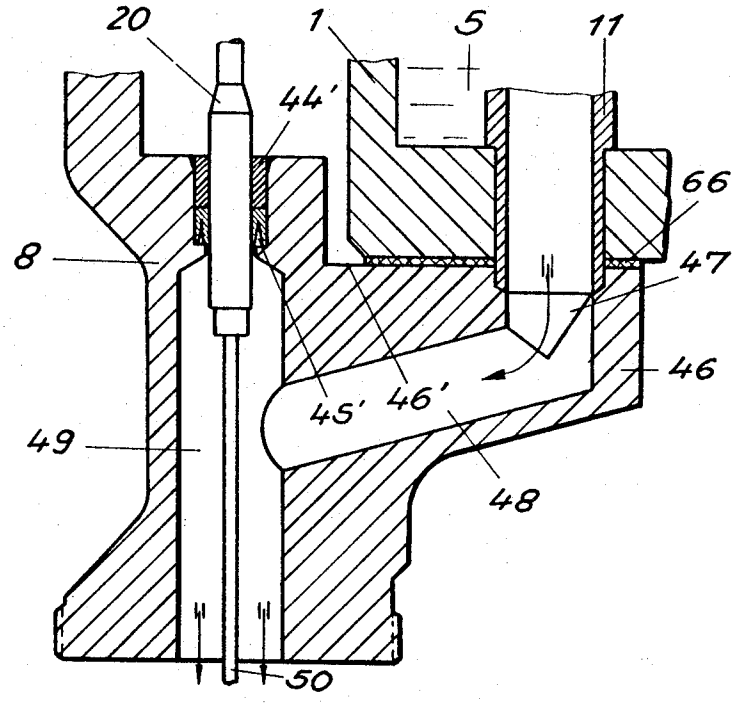
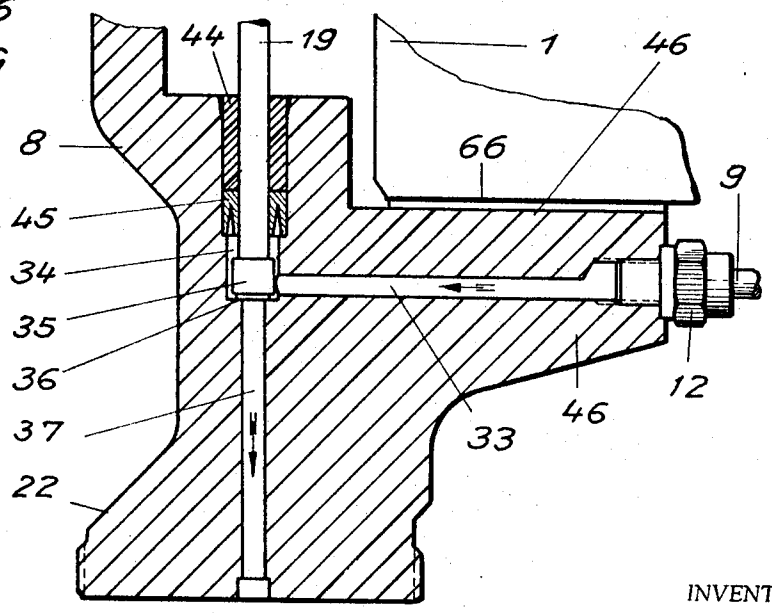


Fig. 6
F-G



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Fig. 7

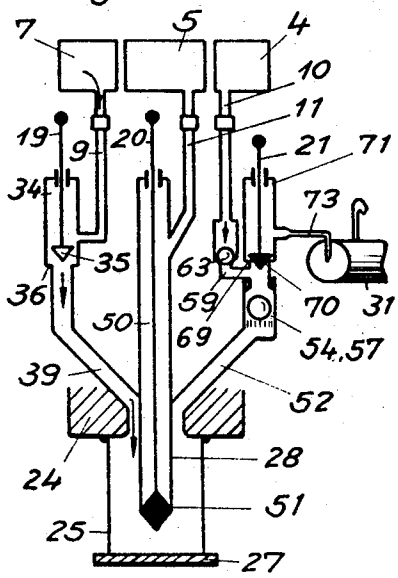


Fig. 8

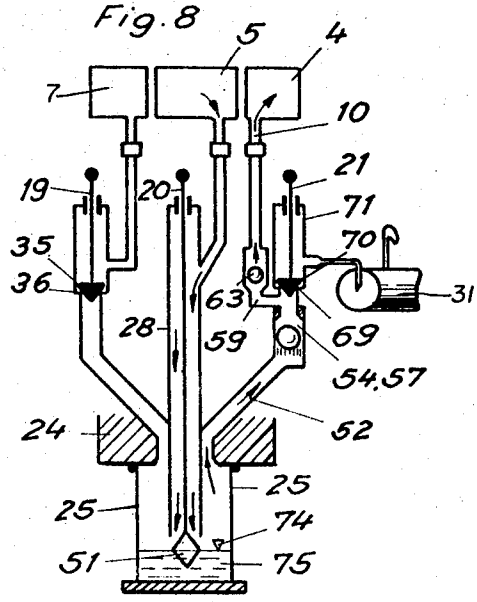


Fig. 9

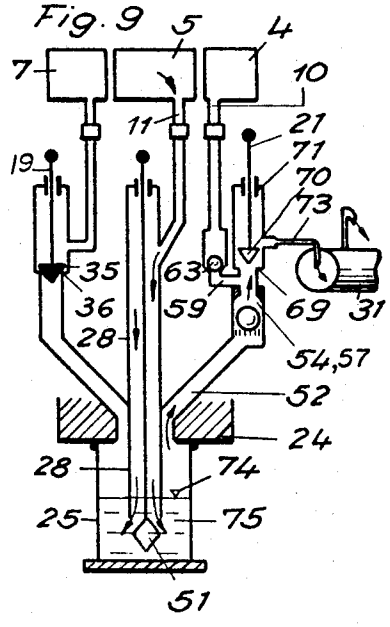
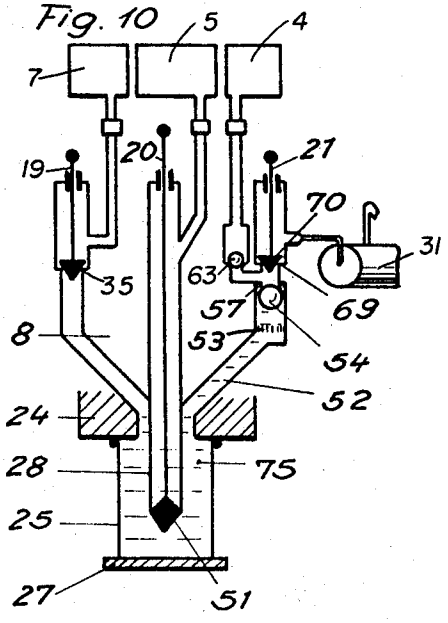


Fig. 10



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VALVED FILLING DEVICE FOR FILLING CARBON DIOXIDE-CONTAINING BEVERAGES INTO A VESSEL AND METHOD FOR DOING SO

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Filed Oct. 19, 1965, Ser. No. 497,854
Claims priority, application Germany, Mar. 31, 1965, E 29,009
15 Claims. (Cl. 141—6)

ABSTRACT OF THE DISCLOSURE

That method of filling with liquid a container having a filling opening, comprising, sealing the opening from atmosphere, filling the container with gas to a predetermined pressure, introducing liquid under pressure into the container while conducting gas therefrom through a conduit to a confined back gas chamber, opening said conduit to restricted flow of gas to atmosphere when the container is partially filled with liquid, to reduce pressure in the container, increase the rate of flow of liquid thereinto, and establish a pressure differential between said back gas chamber and container, closing the conduit between said container and back gas chamber by and in response to said pressure differential while permitting continued escape of gas to atmosphere, and cutting off flow of liquid into the container after the liquid has risen to said filling opening.

BACKGROUND OF THE INVENTION

Field of the invention

The invention relates to a valved filling device wherein carbon dioxide-containing beverages are filled into vessels, such as bottles, cans, and barrels. In order to permit charging such beverages into containers without foaming over and loss of carbon dioxide, the filling process must be conducted under back pressure, and thus there must also be a back pressure in the containers. Only then is the liquid charged into the container and the gas displaced thereby discharged from the container.

Summary of the invention

According to the primary object of the invention, namely to avoid various disadvantages of prior art in valved filling devices for machines for filling carbon dioxide-containing beverages into containers, such as bottles, cans, and barrels, the invention incorporates individual conduits separately controlled to be opened and closed within the filling device, for conducting the pressurized gas, the back gas, and the liquid to be filled, respectively, into the containers. By means of a filling pipe which is preferably closable by a foot valve, and valve devices for lowering the gas back pressure as soon as the end of the filling pipe is submerged, an accelerated filling of the containers is effected. A float valve for the back gas provided in the back gas conduit upstream of the back gas valve is provided to constitute a block against the escape of liquid. It is also proposed in accordance with the invention to branch off, in the back gas conduit of the filling device, behind the back gas float valve and before the valve seat of the controlled back gas valve, a discharge gas conduit leading to a relief valve opened by returning gas and continuing this discharge gas conduit to the back gas connection of the filling device, and to connect the back gas valve chamber provided behind the valve seat of the controlled back gas valve to the atmosphere.

Because of the provision of a discharge conduit branched off in front of the back gas valve and the connection of the same with an automatic relief valve which can be opened only by returning back gas, a two-fold forced control of the back gas is avoided, for the relief valve closes the back gas conduit, which is under counter-pressure and leads to the back gas chamber of the filling machine, automatically as soon as there is a lowering of the pressure in that portion of the conduit adjacent the container to be filled. Such lowering of pressure occurs when the controlled back gas valve connects the back gas chamber with the outside atmosphere.

It is further proposed by the invention to connect the back gas valve chamber with the atmosphere via a throttle element.

By means of the throttle element, the outflow of the back gases into the atmosphere can, in a conventional manner, be delayed and the back gas pressure decreased in a desired manner and at a desired rate.

It is furthermore proposed in accordance with the invention to provide the throttle element as a nozzzle, the capillary tube being adjustable or exchangeable, in the shape of a sleeve-like element attachable to the outside of the filling device.

Thereby, the rate of discharge of the back gas into the outside air can be controlled. In order to collect the droplets which might have been entrained by the back gas to the outside, the invention provides the filling device with a pipe leading from the throttle element to a collector pipe or a collecting vessel.

It is furthermore proposed by the invention to fashion the relief valve as a boring in the housing, being provided at its lower end with a float ball valve, a valve ball being inserted therein. As a consequence, no separate valve need be provided; it is sufficient to provide a ball within a corresponding bore, the ball being inserted therein in a sealing manner. It is quite feasible to make this ball of metal, for example rust-proof steel.

According to the invention, it is further proposed to construct the float valve as a bore in the housing having a permeable lining at the lower end, a metallic ball being inserted therein, wherein the upper end of the bore serves as a valve seat for the valve ball lifted by the rising liquid. As is known, the float-type valve serves to prevent any rising liquid from entering the upper back gas chambers, whereby the amount of liquid lost by spraying and being entrained by the back gas is kept small.

Furthermore, it is contemplated by the invention that the back gas conduit in the filling device commences as a bore in the filling pipe disk contacting the containers to be filled and is continued directly to the float valve of the filling device. The detachable filling pipe disk per se is conventional; in its center, the liquid filling pipe is provided. The two openings or bores in the filling pipe disk for the exit of the pressurized air and the entrance of the back gas, respectively, are provided and terminate in a common annular channel extending about the filling pipe.

According to the invention, it is furthermore proposed to provide the filling pipe at its lower end with a foot valve which can be opened and closed by means of a

valve tappet extending out of the filling pipe in a sealing manner, and to continue the filling pipe by means of a connection conduit to the connection point of the filling device with the liquid.

It is likewise proposed by the invention to extend the conduit for the pressurized gas in the filling device from the pressurized gas connection of the filling device to the valve chamber of the pressurized gas, and to control the passage of the pressurized gas through a bore of the filling pipe disk into the container to be filled by means of the valve element actuatable by a valve tappet. The valves of the filling device projecting upwardly with valve stems, namely the pressurized gas valve, the valve for the liquid, and the back gas valve, are controlled in a conventional manner.

According to the invention, it is furthermore proposed to arrange the filling pipe disk together with the filling pipe at the lower end of the filling device in a detachable manner and to mount the filling device by means of flanges to the lower side of the filling vessel with the sealing surface comprising the connection for the gas and the liquid. Thus, the filling pipe together with the foot valve and, if desired, also together with the valve spring for the foot valve can be removed in conjunction with the filling pipe disk from the filling device by moving it downwardly, and can be attached again in a corresponding manner. This facilitates the cleaning and the sterilization of the filling device, and also the assembly and dismantling of the same. The filling device is connected in a sealing manner by flanges with the bottom side of the filling vessel, with its extension containing the connections for the gas charging and discharging pipes and the connection for the liquid. The control lever of the filling device, which lever is cross-shaped, as well as the necessary drive means and supports for the cam shaft and the crankshaft project, are arranged in a conventional manner, at the front above the filling vessel or device.

Description of the drawings

In the drawings where like references denote the same or equivalent parts:

FIGURE 1 shows a sectional view of a container embodying the inventive improvements;

FIGURE 2 is a top plan view of the device shown in FIGURE 1;

FIGURE 3 is a sectional view along the lines H–I of FIGURE 2;

FIGURE 4 is a sectional view along lines A–B'–C' of FIGURE 2;

FIGURE 5 is a sectional view along lines D–E of FIGURE 2;

FIGURE 6 is a sectional view along line F–G of FIGURE 2; and

FIGURES 7 to 10 inclusive are schematic views of sequential positions of the various parts of the device involved in a filling operation cycle.

Description of the preferred embodiments

The invention is illustrated by way of example in schematic view. FIGURE 1 shows a radial section through the filling vessel having a filling device according to the invention mounted thereto. FIGURE 2 is a view of a filling device from the top, looking upon the sealing and flanged surface and with the liquid container omitted for clarity of illustration. FIGURE 3 shows a section along line H–I of FIGURE 2 through the filling device. FIGURE 4 shows to an enlarged scale, a section along line A–B'–C' of FIGURE 2 through the filling device, FIGURE 5 shows to a still further enlarged scale, a section along line D–E of FIGURE 2, looking in the direction of the arrows. FIGURE 6 shows a section along line F–G of FIGURE 2, looking in the direction of the arrows; and FIGURES 7 to 10 show schematically the sequential positions of the individual parts of the filling device during a filling operation cycle. In FIGURE 7, it is shown how the container is put under pressure; in FIGURE 8 the preliminary filling is shown; in FIGURE 9 the completion of the filling operation is illustrated; and in FIGURE 10 the end of the filling process is shown.

The container or turret for the liquid, designated **1**, of the filling machine **2** which is not illustrated in detail, is provided with a lid **3** having recesses for a back gas conduit **4**, a large annular chamber **5** containing the liquid to be filled, designated **6**, and a conduit **7** for the pressurized gas. A pressurized gas line **9** extends from the filling device or head **8** to the annular conduit **7**, and a back gas line **10** extends from the filling device **8** to the annular conduit **4** for the back gas. A connection pipe **11** for the entrance of the liquid is also inserted, coming from the filling device **8**, in the large annular chamber **5** of the container **1** for the liquid; this connection pipe **11** is provided with a quick acting gate valve for the liquid, which is not shown. The gate valve blocks, in a conventional manner, the passage of liquid from the annular chamber **5** into the filling device **8** when a bottle bursts, or when any other leakages occur, so that the liquid cannot discharge from the filling device to the outside under full pressure. The gas lines **9, 10** are sealingly inserted in the gas conduits **4** and **7** from each filling device **8** via bolted joints **12** and seals, the gas conduits **4, 7** resting in a sealing manner by means of sealing rings **13** on the annular flanges **14, 15** of the upper rim of the container **1** for the liquid and thus forming self-contained annular chambers. The filling device **8** is provided at its upper portion **16** with a star wheel **17** actuating, via a crankshaft-type gearing **18** (as in German Patent 1,048,497), the individual valve tappets **19, 20, 21**, FIGURE 3. The return springs and other drive elements are not illustrated in detail since their function and construction is known. The filling pipe disk **24** is connected to the lower end **22** of filling device **8** by means of a threaded retaining nut **23**; when the container or bottle **25** to be filled is lifted by automatic elevation of its lifting device **27**, the centering bell **26** contacts the filling pipe disk in a sealing manner and establishes the pressure-tight connection of the filling device with the bottle. The container **25** is raised by means of a vertically movable lifting disk **27**. The centering bell **26** slides along the filling pipe **28** when a container **25** is raised, as indicated by arrow **25**, FIGURE 1. It is also possible to provide the centering bell to be freely movable above the filling pipe **28** by means of guide rods or supporting arms, which are not shown. A throttle sleeve **29** (FIGS. 2, 3 and 4) is arranged laterally at and connected with the filling device **8** and is connected with a collecting vessel **31** via a pipeline **30**. In the collecting vessel **31** there is the same pressure as in the outside atmosphere. For this purpose, the container is provided with a vent opening **32** through which the gases blown into the vessel **31** through the pipe **30** may escape to the outside. The pipeline **30** is connected with the vessel **31** and the throttle sleeve **29** by means of fittings, as clearly shown upon FIGURES 3 and 4.

In FIGURE 2, the upper portion **16** of the filling device **8**, star wheel **17**, and throttle sleeve **29** are shown in plan, as well as valve tappets **19, 20, 21**. As a continuation of the pressurized gas line **9**, the pressurized gas conduit **33** is provided in the interior of the filling device **8**, this conduit being shown in dashed lines in FIGURE 2. Conduit **33** leads to the valve chamber **34**, FIGURE 3, of the pressurized gas valve **35**; the latter can be pressed against its seat **36** and lifted again therefrom by means of valve tappet **19**. This valve seat **36** represents the beginning of the pressurized gas bore **37** which passes, via the connection pipe **38** into the connecting channel **39** of the filling pipe disk **24**; channel **39** opens within the sealing ring **41**, into the annular space **42** of the filling pipe disk **24** in such a manner that, when the centering bell **26** is in engagement, a direct connection with the interior of bottle **25** is established via the bell. The filling pipe disk **24** is

threadedly connected via the reaaining nut **23** with the lower portion **22** of the filling device **8**, a sealing gasket **43** being provided.

As can be seen from FIGURE 3, the valve tappet **19** is guided, within the upper portion **16** of the filling device, in a sleeve **44** provided at its lower end with an annular seal **45**. Thereby, the valve chamber **34** is sealed against the escape of pressure fluid upwardly about the tappet. The pressurized gas is fed via the pressurized gas conduit **33**. The feed line **9** for the pressurized gas is connected with the extension **46**, FIGURES 1 and 4, of the filling device **8** with the aid of gland **12**.

As a continuation of the connecting pipe **11** for the entrance of the liquid, FIGURE 1, the liquid connection **47** is provided in the form of a bore in the extension **46** of the filling device **8**. In FIGURES 2 and 5, this bore is shown continued, as a conduit **48** for the liquid, to the liquid valve chamber **49** of the filling device **8**, this valve chamber having a valve compression spring, not shown, resting against the tappet **20** and urging the same upwardly, as viewed upon FIGURE 3. This chamber **49** is furthermore traversed, as can be seen from FIGURE 3, by the valve stem **50** which has fixed to its lower end, a foot valve **51** of filling pipe **28**. The valve tappet **20** is fixed to the upper end of stem **50**. The valve tappet **20** is urged upwardly by the aforesaid valve spring, not shown, and extends to the outside, in a sealing and axially displaceable manner, with the aid of a guide sleeve **44'** and an annular seal **45'** at the upper portion **16** of the filling device. The filling pipe **28** is sealed in a central bore of the filling pipe disk **24**, the latter having a collar **40** fitting into the lower end of valve chamber **49**. In addition to the pressurized gas conduit **39** terminating in the annular space **42** of the filling pipe disk **24**, the back air conduit **52** also leads into this annular space through the filling pipe disk **24** from the attachment **53**, FIGURE 3, the latter being constructed simultaneously as a connecting nipple and as a ball valve support. The float ball valve **54** remains at rest on attachment **53** during backflow of gas. However, when the liquid rises, the ball **54** is lifted within valve chamber **55** in the direction of the arrow **56** against the sleeve **57** forming a tight seat for the ball, whereby any further backflow is prevented. It will be noted that the upper end of attachment **53** is castellated so that ball valve **54** when in its lowermost position, cannot prevent the flow of gas. In the back gas conduit **58** above the valve seat sleeve **57**, a branch-off for the back gas is provided by the conduit or bore **59**, illustrated as a circle in FIGURE 3, as a longitudinal conduit, in section, in FIGURE 4, in dashed lines in FIGURE 2. This conduit **59** ends in the housing bore **60** of the extension portion **46** of the filling device **8**. In this housing bore **60**, a sleeve **61** having a lower bore and a seat **62** for a relief valve ball **63** is provided. This relief valve ball **63** is pressed upon its seat **62** by pressure in the housing bore **60**, whenever pressure in the bore **59** is less than that in bore **60**. The back gas line or conduit **10** is connected with the interior of the housing bore **60** via a nipple **64** and connecting piece **65**. A sealing gasket **66** is provided on the horizontally planar sealing surface **46'** of the extension **46**, so that the entire filling device can be sealingly secured to the bottom portion of the container **1** with the aid of the flange elements **57, 57'**, FIGURE 2, having mounting holes **68, 68'** to receive machine screws threaded into the base of container **1**.

Above the bore **59**, the back gas conduit **58** has a valve seat **69** for the controlled back gas valve **770** which is constructed in such a manner that it can be lifted from and forced upon seat **69** by means of tappet **21**. The valve tappet **21** is surrounded by a guide sleeve **44''** provided at its lower end with an annular seal **45''**, so that the valve **70** or the valve tappet **21** can be axially displaced without loss of pressure fluid therepast. Thus the back gas pressure which may be ambient in the valve chamber **71** can pass only through the side bore **72**, via the throttle sleeve **29** containing a throttling aperture **73** in its interior into the pipeline **30** and from there into the collecting vessel **31**, and subsequently to the outside. As previously noted, this sleeve is replaceable by others having apertures of different effective sizes, or alternatively, the aperture **73** may be made of adjustable size by any suitable means.

FIGURE 4 illustrates a section along broken lines A–B'–C' and shows particularly well the arrangement of the bore **59** with the relief ball valve **63** in the extension **46** of the filling device **8**. The back gas flowing through the attachment **53** in the upward direction to the float ball valve **54** passes via the sleeve **57** and the back gas conduit **58**, the valve **70** being closed, via the back gas bore **59** to the relief valve **63**, the current lifting the ball **63** so that the gas flows through the housing bore **60**, nipple **64** and the connecting piece **65** to line **10** and from there into the annular back gas conduit **4**, FIGURE 1. However, as soon as the back gas valve **70** is lifted from its seat **69** by tappet **21**, valve chamber **71** is connected, via the side bore **72**, the throttle sleeve **29**, the pipeline **30**, and the collecting vessel **31**, with the outside atmosphere. The back gas pressure decreases as fluid passes the throttling aperture **73**, to such an extent that there is ambient in the interior of the bottle **25**, as well as in the back gas conduit portions **52, 53, 55, 57, 58, 59**, a substantially lower pressure than in the back gas line **10**, as well as in the housing bore **60**. Consequently, the relief ball **63** is tightly and sealingly pressed against its seat **62**, so that back gas from conduit **4** cannot flow back via the line **10** to the bore **59** and discharge to the outside through the open back air valves **69, 70**, and side bore **72**. A lowering of the pressure in the annular channel **4** is thus prevented so that all filling devices **8** of the machine can be operated simultaneously in all phases of the filling process, without interfering with one another, and without more than one back gas valve controlled from the outside being required.

In FIGURE 5, a section to a greatly enlarged scale, through the filling device **8** along the line D–E of FIGURE 2 is illustrated. From this figure, the path of the liquid can be seen. The liquid feed pipe **11** extends into container **1**, so that liquid passes from the large annular chamber **5** via the liquid connection **47** in the extension **46** of the filling device **8** to the liquid conduit **48** and from there into the liquid valve chamber **49**; from there, as illustrated in FIGURE 3, the entrance of the liquid into the filling pipe **28** is effected. The liquid valve chamber **49** is traversed by the valve rod **50** of the foot valve **51** and likewise receives the valve spring thereof (not illustrated). This valve rod **50** carries the valve tappet **20** at its upper end which extends in a sealing manner from the valve chamber **49** via the guide sleeve **44'** and the annular seal **45'**. Between the bottom surface of the liquid vessel **1** and the sealing surface **46'** of the extension **46**, the sealing gasket **66** is inserted so that the conductance of the liquid from the large annular channel **5** to the liquid conduit **48** can be effected without loss of liquid. Through the same sealing plate **66**, or through a perforation provided therein corresponding to the housing bore **60**, back gas enters, in a sealed-off manner, from the extension portion **46** of the valve **8** into the back gas line **10**. This line **10** extends through the interior of chamber **5**, as shown in FIGURE 1.

FIGURE 6 shows to a greatly enlarged scale, a section along line F–G of FIGURE 2 and illustrates the conduits for the pressurized gas. The pressurized gas bore **37** in the lower portion **22** of the filling device **8** has been previously identified. The pressurized gas line **33** ends in the valve chamber **34**, this gas line carrying at the rear portion of the extension **46** a connecting nipple having a threaded connection **12** for the pressurized gas line **9**, When the valve **35** is lifted from seat **36**, the pressurized gas can pass through line **9** via the pressurized gas conduits **33** and **37**, as well as through the terminal channel **39** (FIGURE 3) into the interior of the bottle **25** which is pressed against the device.

In FIGURES 7 to 10, a cycle of the filling process is

schematically illustrated, the schematically shown elements having the same reference numerals as the elements of the filling device shown in FIGURES 1 to 6.

In FIGURE 7, the bottle plate or lifting device **27** with the container **25** is pressed against the filling pipe disk **24** in a sealing manner. The pressurized gas valve **35** is lifted from the valve seat **36** with the aid of the valve tappet **19** so that pressurized gas can flow from the pressurized gas conduit **7** into the valve chamber **34** via the pressurized gas line **9** into the interior of the container **25**, until there is a pressure equilibrium between the interior of the container **25** and the annular channel **7**. The foot valve **51** at the lower end of the filling pipe **28** is closed with the aid of the valve stem **50** and the valve tappet **20** which was lifted upwardly, so that it is not yet possible for the liquid to enter the container **25** from the liquid storage vessel **5** via the liquid feed pipe **11**. Likewise, no back gas flows via the back gas conduit **52** and the float valve **54**, **57** in the back gas chamber **71**, since the back gas valve **70** is pressed against the valve seat **69**, in its lower position, with the aid of the valve tappet **21**. Also, no gas is flowing through the back gas bore **59** to the relief valve **62**, **63** because, even when there is full ambient pressure in the container **25**, there is effective at both sides of the relief ball **63** (upstream and downstream of the relief ball **63**) approximately the same pressure. Above ball **63** is the pressure coming through line **10** from the back gas conduit **4**, and below the ball, there is effective pressure built up in the container **25** which does not exceed the pressure in the annular vessel **4** by an appreciable amount. The throttle aperture **73** branched off from the valve chamber **71** is extended by pipe **30** to the collecting vessel **31** which is ventilated; no flow takes place herein, either, because this aperture is presently sealed off by closed back gas valve **70**.

In FIGURE 8, the pressurized gas valve **35** is closed, and the foot valve **51** is opened, so that liquid now flows into the container **25**. Back gas flows through line **52** via the float valve **54** and sleeve **57** into the line **59** and lifts the relief ball **63** off its seat **62** in such a manner that the back gas displaced from container **25** now enters the back gas conduit **4**. All valve tappets **19**, **20**, **21** have been pressed downwardly, but the valve **35**, as well as the valve **70**, is closed, while the valve **51** is open.

In FIGURE 9, the level **74** of the liquid **75** has risen within the container **25** above the lower end of the filling pipe **28** so that the entire foot valve **51**, along with the opening for the exit of the liquid are submerged. Now, with the pressurized gas valve **35** closed and the foot valve **51** open, the back gas valve **70** is opened by lifting the valve tappet **21** so that the back gas valve chamber **71** is brought into contact with the outside atmosphere via the throttling aperture **73** and the collecting vessel **31**. Thereby, the gas pressure in the interior of the container **25**, as well as in the back gas conduits **52**, **54**, **59** decreases correspondingly, whereby the relief ball **63** is pressed against its seat by the higher pressure ambient in the annular channel **4**, and thus the feeding of gas from channel **4** via line **10** is prevented. Because of the counterpressure now being lowered in the interior of the container, the liquid now flows from the large annular channel **5** via the line **11** to the filling pipe **28** at a strongly increased velocity into the container **25**, so that the remainder of the filling operation is accomplished rapidly. Thus, as soon as the foot valve **51** in the interior of the container is covered by the liquid **75**, the pressure is lowered by the opening of valve **70** so that an accelerated filling of the container is effected. The liquid **75** finally fills the entire container **25** completely and then rises into the back gas channel **52** up to the float valve **54**, **57**, the ball **54** being thus lifted against the seat **57** (FIGURE 10), and thus the further passage of flowing medium, gas, foam, liquid, is prevented. With this step, the filling operation is terminated.

As can further be seen from FIGURE 10, the foot valve **51** of the filling pipe **28** is then closed by lifting the tappet **20**. By lowering the tappet **21**, the back gas valve **70** is closed. Now, the container **25** can again be withdrawn downwardly from the filling device or from the filling pipe disk **24** with the aid of the bottle lifting device **27**, the liquid present in channel **52** still discharging into the container to replace any residual free gas therein, and ball **54** again resting on castellated insert **53**. A new container **25** can then again be pressed against the filling pipe disk **24**, and subsequently the cycle set forth in connection with FIGURES 7 to 10 of the filling operation can be repeated indefinitely.

While I have disclosed here only the form of mechanism presently preferred by me for carrying the invention into practice, numerous modifications, variations and substitutions of equivalents will become apparent to those skilled in the art, after a study of the foregoing specification. Hence the disclosure should be taken in an illustrative rather than a limiting sense; and it is intended to cover all modifications and substitutions of equivalents as claimed.

What is claimed is:

1. That method of filling with liquid a container having a filling opening, comprising, sealing the opening from atmosphere, filling the container with gas to a predetermined pressure, introducing liquid under pressure into the container while conducting gas therefrom through a conduit to a confined back gas chamber, opening said conduit to restricted flow of gas to atmosphere when the container is partially filled with liquid, to reduce pressure in the container, increase the rate of flow of liquid thereinto, and establish a pressure differential between said back gas chamber and container, closing the conduit between said container and back gas chamber by and in response to said pressure differential while permitting continued escape of gas to atmosphere, and cutting off flow of liquid into the container after the liquid has risen to said filling opening.

2. The method of claim **1**, automatically closing said conduit between said container and atmosphere by and in response to an excess of liquid above the sealed opening in the container, breaking said sealed opening, and conducting said excess of liquid into the container to replace residual gas escaping to atmosphere therefrom.

3. The method of filling with liquid a container having a filling opening, comprising, sealing the opening from atmosphere, introducing a gas under pressure into the container from a source, to establish equilibrium, cutting off the source from the container, initiating flow of liquid under pressure into the container while simultaneously allowing gas to escape therefrom over a line to a back gas chamber, closing said line to said chamber and opening the same to restricted flow of gas to atmosphere when the liquid has risen to a predetermined height in the container, to thereby reduce pressure in the container and permit liquid to flow thereinto at increased rate, and cutting off further flow of liquid when the container has been filled.

4. The method of filling with liquid a container having a filling opening, comprising, sealing the opening from atmosphere, introducing gas under pressure from a confined source into the container, cutting off flow of gas from the source to said container when equilibrium has been established, initiating flow of liquid under pressure into the container while simultaneously allowing gas to escape over a line to a back gas chamber, closing said line to said chamber and opening the line to restricted flow to atmosphere when the liquid has partially filled the container to thereby reduce pressure in the container and increase the rate of flow of liquid thereinto, automatically closing said line to atmosphere and cutting off further flow of liquid when the liquid has risen above the filling opening therein, and breaking the seal of said filling opening to allow liquid above the filling opening to drain into the

container to replace residual free gas released therefrom on opening the container to atmosphere.

5. The method of filling with liquid a container having a filling opening in its top, comprising, sealing the opening from atmosphere, introducing into the container a filling pipe having a valved discharge opening, until the valved opening is at a predetermined depth below the filling opening, introducing gas into the container through a conduit from a confined source under pressure, cutting off flow of gas from the source when pressure equilibrium has been substantially established, opening the valve in said discharge opening to initiate flow of liquid under pressure into the container while simultaneously releasing gas in the container to a confined back gas chamber, opening said conduit to effect restricted flow of gas to atmosphere when liquid has risen in the container about the valved discharge opening therein to effect increased rate of flow of liquid into the container, automatically cutting off flow of gas to said back gas chamber in response to increased pressure differential between the container and back gas chamber, and closing the valve of said liquid discharge opening when liquid has risen above the opening in the container, breaking the seal of the filling opening to expose the container to atmosphere, and conducting excess liquid above the opening in the container, to replace residual gas escaping therefrom.

6. An apparatus for filling a container with liquid, comprising, a first source of gas under pressure, a second source of liquid under pressure, a back gas chamber, a filling head, first, second and third conduits connected respectively with said first and second source and said chamber, each said conduit having an outlet opening into said head, a first valve in said first conduit, a second valve in said second conduit, a pipe line having a restricted orifice and opening to atmosphere from said third conduit, a third valve in said pipe line, a relief valve in said third conduit and automatically operable to close the same by and in response to pressure in said back gas chamber greater than that at the outlet of said third conduit when said third valve is closed, means operable to seal the filling opening of a container to said head, about the outlets of all said conduits, and means operable to open and close said first, second and third valves in predetermined sequence.

7. The apparatus of claim 6, said second conduit including an outlet filling pipe for projection downwardly to a predetermined distance into a container sealed to said head, said second valve being positioned to open and close said filling pipe discharge opening.

8. The apparatus of claim 6, and a float valve in said third conduit between said head and said relief valve, said float valve operating to cut off flow of fluid to said back gas chamber and said pipe line, by and in response to rise of liquid to a predetermined height above said head.

9. The apparatus of claim 6, said pipe line including a removable and replaceable insert therein between the outlet of said pipe and said third valve, said insert having a restricted orifice for flow of gas therethrough.

10. The apparatus of claim 9, a closed connecting vessel, the outlet from said pipe opening into said vessel, and a vent to atmosphere opening into said vessel.

11. In an apparatus for automatically and simultaneously filling with liquid a plurality of containers, a turret rotatable about a central vertical axis and forming first, second and third annular discrete chambers circumferentially disposed about said axis for, respectively (a) liquid under pressure, (b) gas under pressure, (c) back gas, a plurality of filling devices fixed with said turret in circumferentially and radially spaced relation about said axis, each said device including a head, first, second and third conduits connected respectively with said first, second and third chambers, each said conduit having termini opening into said head, a pipe line extending to atmosphere from said third conduit and including a restricted orifice, first, second and third valves in said first and second conduits and said pipe line, respectively, a relief valve in said third conduit between said back gas chamber and the opening of said pipe line thereinto and operable to close said third conduit by and in response to a pressure differential between said back gas chamber and the terminus of said third conduit, means operable to open and close the first, second and third valves of each said device, in predetermined sequence, and means operable to releasably seal a plurality of containers each to a respective one of said heads to encompass the termini of the conduits opening thereinto.

12. The apparatus of claim 11, each said head being fixed to the under side of said turret beneath the chambers therein and having first, second and third bores forming portions of said conduits respectively and opening through the lower face of said head, a disk secured over said face, a filling pipe fixed in said disk centrally thereof in communication with said second bore and depending below said disk, a pair of channels in said disk each in communication with said first and third bores, respectively, and opening through said disk exteriorly of said filling pipe, said second valve being positioned to close the lower end of said filling pipe, said means to open and close said first, second and third valves including first, second and third vertical, axially movable tappets extending upwardly in alignment each with a respective one of said bores and connected with its respective valve.

13. In an apparatus for filling a container with liquid, means forming first, second and third closed pressure containers for, respectively, gas, liquid, and back gas, a filling head, first, second and third conduit means each extending from a respective one of said containers to said opening through said head, a pipe line connecting said third conduit means with atmosphere, first, second and third valves in said first, and second conduit means, said pipe line, respectively, a relief valve in said third conduit means between said third container and pipe line and closed by and in response to pressure difference between said third container and head, and means operable to seal the filling opening of a container to be filled, to said head about the termini of all said conduit means, and a one-way float valve in said third conduit means, between said head and pipe line, said float valve operating to cut off reverse flow of fluid to said third pressure container and said pipe line, by and in response to rise of fluid in said third conduit above the level of said head.

14. In an apparatus for filling containers with liquid, a head having first, second and third vertical, laterally spaced bores opening through its upper and lower ends, a disk removably and sealingly affixed to the lower end of said head, a vertical filling pipe fixed in a central bore in said disk and depending therebelow, and forming a continuation of said second bore, there being a pair of channels in said disk each communicating at one end with a respective one of said first and third bores and opening through said disk adjacent said filling pipe, a pair of upwardly facing valve seats in said first and third bores respectively, first, second and third rods each vertically slidable in a respective one of, and projecting upwardly through said bores, a valve secured to the lower end of each said first and third rods in operative relation with the seats therein, a valve secured to the lower end of said second rod and effective to open and close the lower end of said filling pipe, packing gland means carried by said head about each said rod at the upper ends thereof, and first, second and third conduit means for pressurized gas, pressurized liquid, and back gas respectively, each opening through said head into a respective one of said bores, said pipe and disk being removable as a unit from each head, to expose all said bores.

15. The apparatus of claim 14, the lower end of said third bore being counterbored, a valve seat in the upper end of said counterbore, a sleeve fitting the lower end of said counterbore, and a float valve in said counterbore

between said sleeve and seat, said seat and sleeve being removable from said third bore on removal of said disk.

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