Nov. 22, 1966 G. DOLL 3,286,742

APPARATUS FOR DISPENSING LIQUIDS

Filed Oct. 9, 1963 3 Sheets-Sheet 1

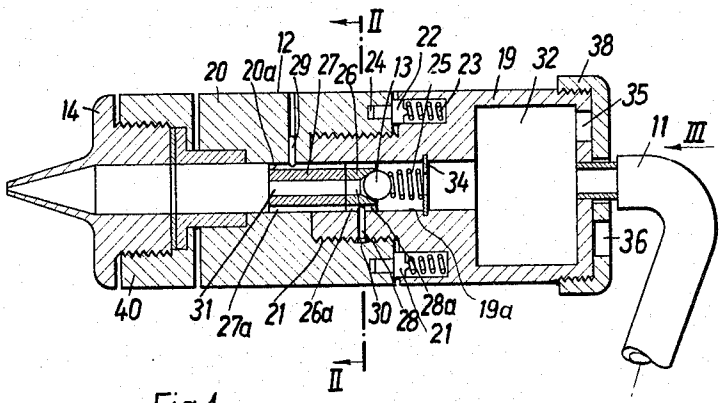

Fig.1

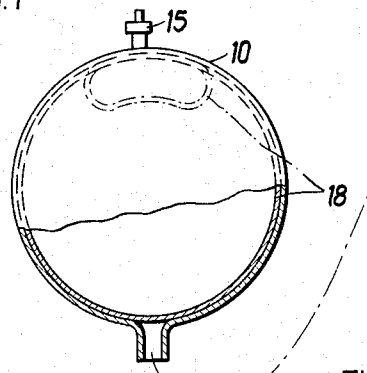

Fig.2

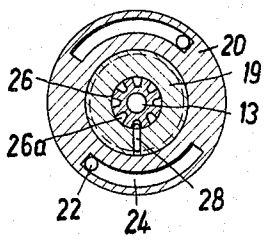

Fig.3

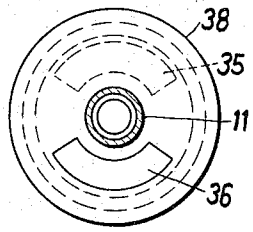

Fig.4

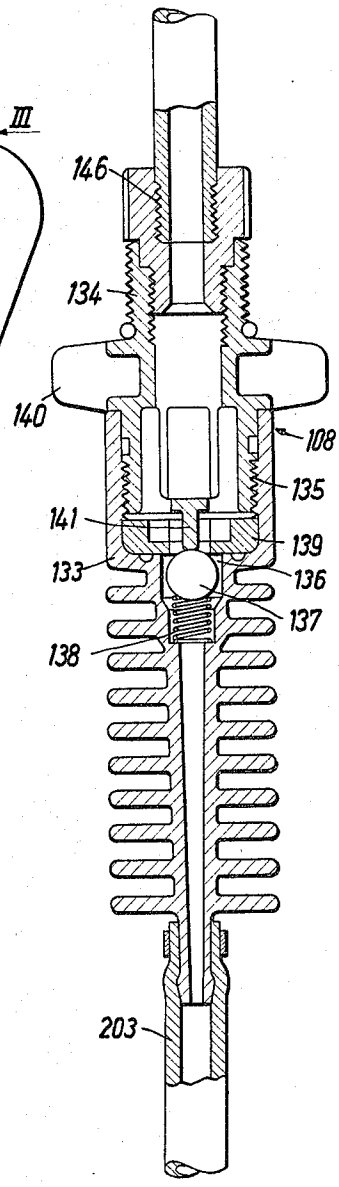

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Fig.7

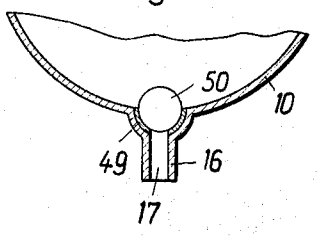


Fig.9

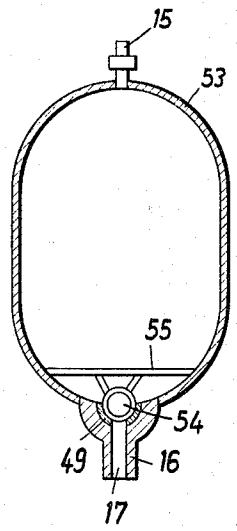


Fig.8

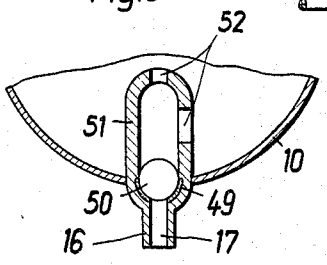
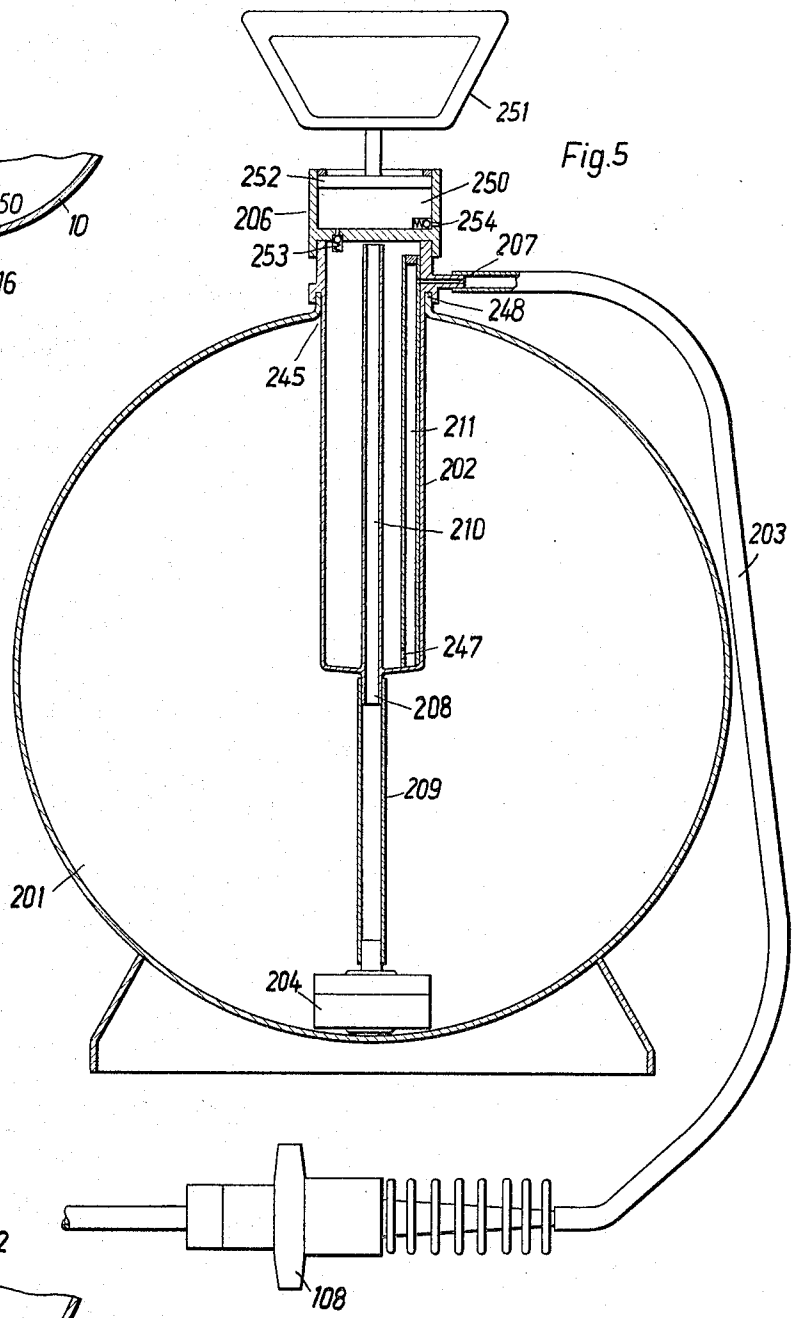


Fig.5



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APPARATUS FOR DISPENSING LIQUIDS

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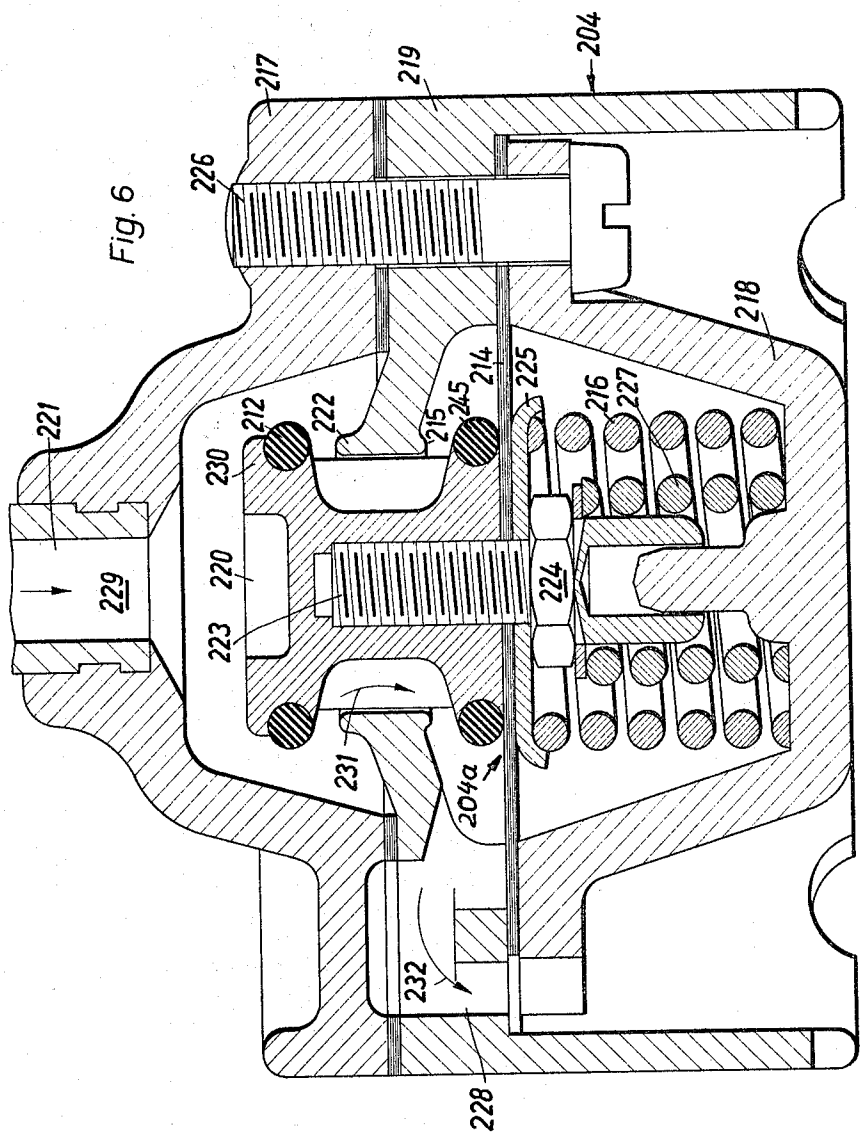
Fig. 6



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United States Patent Office 3,286,742 Patented Nov. 22, 1966

3,286,742

APPARATUS FOR DISPENSING LIQUIDS

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Filed Oct. 9, 1963, Ser. No. 319,630
Claims priority, application Germany, Oct. 15, 1962, A 41,390
13 Claims. (Cl. 141—27)

The present invention relates to an apparatus for dispensing or spraying liquids from a container which is adapted under pressure to receive the liquid and to dispense the liquid through an outer conduit, preferably a hose, while in the container there is provided a pressure accumulator or storage means, preferably in the form of an air cushion, whereas the outer conduit has interposed therein a quantity control valve.

It is an object of this invention to provide an apparatus of the above-mentioned type which will have an increased field of application over heretofore known apparatuses of the type involved.

It is another object of this invention to provide an apparatus as set forth in the preceding paragraph which will be simple in construction and can easily be handled.

These and other objects and advantages of the invention will appear more clearly from the following specification in connection with the accompanying drawings, in which:

FIGURE 1 diagrammatically illustrates in section a spraying apparatus according to the present invention with container and connecting hose connecting the latter to said spraying apparatus;

FIGURE 2 is a section along the line II—II of FIGURE 1;

FIGURE 3 is an end view of the spraying apparatus according to FIGURE 1 as seen in the direction of the arrow III of FIGURE 1;

FIGURE 4 is a longitudinal section through a modified quantity control check valve for use in a spraying apparatus according to the invention;

FIGURE 5 illustrates a modified container with mixing chamber and check valve-relief valve for use in connection with an apparatus according to the invention;

FIGURE 6 illustrates on a larger scale than FIGURE 5 a section through the check-relief valve of FIGURE 5;

FIGURE 7 is a magnetic rubber valve for retaining an air-over pressure in the container of an apparatus according to the invention;

FIGURE 8 represents a magnetic valve somewhat modified over that of FIGURE 7;

FIGURE 9 is a further modification of a magnetic valve in a container for use in connection with the present invention.

The apparatus according to the present invention is characterized primarily in that the outer conduit through which the fluid is dispensed from the container is also adapted to serve for filling the container and can be connected to fluid supply means, while a combined quantity control-check valve is provided with a check valve body occupying its closing position when the apparatus is dispensing, and being vented automatically when the container is being filled through the outer conduit. According to a further development of the invention, the check valve body is furthermore for purposes of dispensing fluid provided either with a manually operable venting means for lifting said check valve body off its seat, or with manually controllable bypass means.

The apparatus according to the present invention, therefore, requires a single outer conduit only and a corresponding combined quantity control and check valve, both for filling the container as well as for dispensing fluid

therefrom. For both operations, an actuation of the valve need be effected at one single area only, viz. at the sole outer conduit. In view of this simple structure, the apparatus according to the present invention can be produced at relatively low cost.

If it is desired for the apparatus according to the present invention to employ a quantity control-check valve with bypass passage means, it is advantageous to compose the valve housing of two coaxially arranged housing sections which are rotatable relative to each other between abutments. The thus designed valve housing has a central bore extending through both housing sections in which bore there are arranged two cylindrical valve seat bodies abutting each other at adjacent end faces and provided with central passages arranged in axial alignment with each other and also provided with radial bypass means adapted selectively to be moved from a position in which they are offset relative to each other and do not communicate with each other to a position in which they communicate with each other to a desirable degree, depending upon the relative rotation of the two housing sections and thereby valve seat bodies with regard to each other. Each of said valve seat bodies is connected to the respective housing section. The central bore of one of the two valve seat bodies forms a sealing seat for a movable valve body which is spring-biased and in rest position when it occupies its closing position.

If desired, that housing section which through a conduit communicates with the container may be provided with a mixing chamber adapted to be filled with desired ingredients through a cover and also to be closed by said cover.

When the apparatus according to the present invention has a pressure accumulator or storage means in the form of an air chamber which is not closed with regard to the fluid in the container, advantageously an arrangement may be employed according to which the container when emptied of fluid has an air-over pressure maintained by a valve designed as combined check valve and relief valve and communicating with that end of the outer conduit which is adjacent to the container. In this way, a loss in compressed air after completion of a fluid dispensing operation, will be avoided.

According to another embodiment of the invention, the outer conduit is connected to a passage within the range of the lowermost portion of the container, while for purposes of maintaining an air-over pressure in the liquid-empty container there is provided a floatable valve body of magnetic rubber which in its opening position floats on the surface of the liquid in the container, and in its closing position adheres to the sealing seat composed of magnetizable material.

Referring now to the drawing in detail, the apparatus shown in FIG. 1 comprises a container **10** with a hose **11** connected to the bottom side of said container and forming an outer conduit the other end of which is connected to a quantity control-check valve generally designated **12**. Container **10** has arranged therein an inflatable bag **18** of rubber elastic material which is filled with air under pressure and is adapted to be inflated from the outside through the use of an air valve **15**.

Quantity control-check valve **12** as shown in FIGS. 1 to 3 comprises two axially arranged sections **19** and **20** each being provided with a central passage **19***a*, **20***a*, respectively. That end face of valve section **20** which is remote from valve section **19** has rotatably inserted therein a connecting member **40** provided with an inner thread for selectively receiving a correspondingly threaded end of fluid supply conduit or the threaded portion of a nozzle **14**. Valve section **19** has that end thereof which is remote from valve section **20** provided with a mixing chamber **32** which communicates with hose or conduit

11. As will be seen from the drawing, valve section 19 is provided with an opening 35 normally covered by a screw cap 38 which in its turn is provided with an opening 36. Normally, i.e. when opening 35 is closed by cap 38, opening 36 is offset with regard to opening 35. However, cap 38 is rotatable so as to bring opening 36 into alignment with opening 35, thereby permitting the introduction of a washing ingredient, a plant insecticide or the like, from the outside into the mixing chamber 32.

The two sections 19 and 20 of the quantity control-check valve of FIG. 1 interengage each other over a threaded section 21 so as to be rotatable relative to each other. In this way, the said two sections 19 and 20 can be moved away from each other and toward each other. The movement toward each other is limited by pins 22 which latter are under the influence of pressure springs 23 and engage segmental slots 24 provided in valve section 20 (FIG. 2). Bore 19*a* of valve section 19 has longitudinally displaceably journalled therein a valve seat body 26 with a central passage 30. Valve seat body 26 is prevented from rotating relative to valve section 19 by means of a pin 28 which engages a longitudinal slot 28*a* in said body 26. Passage 30 in valve seat body 26 is adapted to be closed by means of a valve ball 13 which is spring-biased by a pressure spring 25 to thereby prevent flow of fluid from conduit 11 to nozzle 14 through passage 30. Pressure spring 25 rests against valve housing section 19 through the intervention of an abutment disc 34. The circumferential surface of valve seat body 26 is provided with bypass passages 26*a* which extend in the longitudinal direction of body 26 and are located outside the seat for valve ball 13.

Valve section 20 has inserted therein a valve seat body 27 which by means of a pin 29 is prevented from rotation and axial displacement. The right-hand end portion (with regard to FIG. 1) of valve seat body 27 enters bore 19*a* of housing section 19 and is engaged by the adjacent end face of valve seat body 26 in view of the thrust exerted by spring 25 or by fluid pressure acting thereupon. The cross-section of valve seat body 26 corresponds to the cross-section of valve seat body 27. Thus, valve seat body 27 has a central passage 31 and peripheral bypass passages 27*a*.

As will be evident from the above, the valve seat bodies 26 and 27 will at any rate have their inner end faces engage each other under pressure. If the two valve sections 19 and 20 occupy such a position with regard to each other that the bypass passages 26*a* and 27*a* do not communicate with each other, solely the spring-biased ball valve 13 is effective so that the entire assembly acts as a check valve in a direction counter to the direction in which fluid passes out of the container. The dispensing of fluid is prevented in this instance while the admission of fluid into the container can be effected without actuating the valve by merely removing nozzle 14 and instead threadedly inserting the corresponding end of a fluid supply conduit into member 40. In order to interrupt or finish the filling operation for the container, it is merely necessary to unscrew the said respective end of the fluid supply conduit and again to screw nozzle 14 into member 40. Also in this instance, no actuation of the valve is necessary.

More specifically, the apparatus according to FIGS. 1–3 operates as follows: When it is desired, for example, to spray pest control materials, in particular for plant protection, it is necessary first to turn the closure cap 38 until the slots 35 and 36 are brought into mutual alignment, and thereafter to fill the material into the mixing chamber 32. Thereupon the closure cap 38 is returned into its closed position and subsequently container 10 is filled with air by pumping air into the bag 18 until the pressure rises to approximately 1–2 atmospheres. For this purpose an air pump is connected to the air inlet valve 15. Then quantity control-check valve 12 without the spraying nozzle 14 is fitted via its connecting member 40 to a water supply. The water normally supplied at a

pressure of 2.5–6 atmospheres is forced through passages 31 and 30 thereby displacing ball 13 against the force of pressure spring 25, and finally is forced through passage 19*a* into mixing chamber 32. Thus the pest control material will be diluted. The solution containing the pest control material then flows out of mixing chamber 32 through hose 11 into container 10, where the air filled bag 18 is compressed. As soon as pressure balance between water and air is attained, the water is prevented from further flowing into the container. The container may in a well-known manner be provided with a water gauge for indicating the amount of water in the container. The desired mixing proportion between water and pest control material can be adjusted, if required, by allowing air to escape from the bag 18. For this purpose the valve 15 must be opened. Then the water is turned off, valve 12 is unscrewed from the water tap and the spraying nozzle 14 is screwed onto valve 12. Due to the pressure of the water, ball 13 is pressed onto valve seat body 26. In closed position of valve 12, by-pass passages 26*a*, 27*a* of valve bodies 26, 27 do not communicate with each other so that the water is prevented from escaping. For purposes of dispensing fluid, parts 19 and 20 are turned relative to each other to such an extent that the bypass passages 26*a* and 27*a* will communicate with each other. The quantity of fluid being dispensed can be controlled by the relative position of said bypass passages with regard to each other, in other words, will depend on the extent to which said bypass passages communicate with each other, which means whether they are in full alignment with each other or only partly overlap. If no resilient air bag 18 is provided in container 10, the water inlet of container 10 must be controlled by a valve. Such valves are shown in FIGS. 7 thru 9.

In FIG. 7, the casing of container 10 is provided at its water inlet opening 17 with a spherically formed seat 49 of magnetizable material to receive a ball 50 of magnetized rubber which, in its open position, floats on the water surface, whereas in its closed position, as illustrated in the drawings, it adheres to seat 49, from which it is lifted by the stream of water when the container is being filled.

FIG. 8 shows ball 50 arranged in a tubular cage 51 disposed within the casing of container 10. A portion of the cage extends into the container and is provided with openings 52 for the passage of water, whereas the portion projecting out of the container comprises the water inlet opening 17.

As can be seen in FIG. 9, container 10 may also be provided with a tubular casing 53 of elongated cross section. As a valve means for the water inlet opening 17 there is arranged a flexible disc 55 which carries a ball 54 of magnetized rubber. In its open position, the disc 55 is floating on the water surface, while, in its closed position, it sealingly engages the inner wall of the container and the magnetized ball 54 adheres to the spherical seat 49.

Another embodiment of a quantity control-check valve is shown in FIG. 4. This control valve 108 is located at the end of the hose 203 (see also FIG. 5). The valves 108 consists substantially of a check valve part 133 and a quantity control valve part 134 for controlling the admission of hydraulic medium to be discharged. The check valve part 133 is directly fitted to the hose 203 and is provided with a ball 137 subjected to the thrust of a helical spring 138 in the direction of discharge. Adjacent the valve ball 137, a valve seat ring 139 is arranged. Control valve part 137 comprises a finger 141 passing through the valve seat ring 139. This finger is adapted to be turned by means of a knob 140. Both valve parts 133 and 134 are assembled by means of a screw connection 135 so that by turning the knob or handle 140, the finger 141 is moved to and fro in axial direction relative to the ball 137 depending on the pitch of the thread of the screw connection 135. Thus, by axially displacing

finger **141** towards the ball **137**, the latter forces is lifted off the valve seat ring **139** against the thrust of the spring **138**, so that fluid is allowed to flow out of the container **201** through conduit **103**. For filling the container **201** the hose **203** may be connected to a water tap, either through the valve assembly or directly thorugh the check valve part **133**. During the filling operation, the ball **137** is lifted from the valve seat ring **139** under the pressure of the hydraulic medium, thus allowing the passage of water.

Another embodiment of the invention is illustrated in FIGS. 5 and 6. With the apparatus shown in these figures, container **201** is initially at the factory filled with compressed air which acts as an air accumulator. Due to the fact that this air pressure is maintained at about 1 to 2 atmospheres above atmospheric pressure, even if the container holds no liquid, the container **201** can always be completely emptied.

The apparatus shown in FIG. 5 comprises a ball-shaped container **201**, preferably a plastic container and a mixing chamber **202** arranged within the container and adapted to be connected to a check valve-relief valve **204** as well as to a hose **203**.

In the upper part of the ball-shaped container **201** an aperture is provided which is formed by an exteriorly threaded neck **248**. The mixing chamber **202** is screwed onto this neck by means of an interiorly threaded collar **205**. At its upper end, the mixing chamber **202** is closed by a threaded lid **206**. The lid **206** is so formed as to provide a handle. Furthermore the mixing chamber **202** extends radially into the container almost to the center thereof. In the vicinity of the ball center, the lower end of the mixing chamber is provided with a hollow extension **208** which is connected to a flexible tubing **209** in order to establish communication between the mixing chamber **202** and the valve **204**. The hollow extension **208** terminates in a rigid ascending pipe **210** arranged coaxially to the mixing chamber **202**. The upper end of the pipe **210** terminates near the upper end of the mixing chamber and slightly below the lid **206**. Adjacent the wall of the mixing chamber **202** and parallel to the rigid pipe **210** a pipe **211** is arranged which has an opening **247** at its lower end, said opening being formed in the wall facing the pipe **210**. The pipe **211** is connected to the hose **203** by means of a tubular connection **207** arranged between the lid **206** and the neck **248** of the container. The other end of the hose **203** carries a combined quantity control-check valve for the control of the volume of liquid to be discharged from the container.

As illustrated in FIG. 6, the pressure relief and check valve **204** located at the lower end of the flexible tubing **209** consists substantially of a housing comprising the parts **217**, **218** and **219**, and control valve means generally designed **204***a* and including a closing head **220**, spring means **216**, **221**, and a diaphragm **214** within the valve housing. An O-ring **245** is located between the diaphragm **214** and a valve seat **215**. The diaphragm **214** is urged toward valve seat **215** by the thrust of a helical spring **216** arranged between housing part **218** and diaphragm **214**. Closing head **220** cooperates with the diaphragm **214**. The valve housing part **217** is connected to the flexible tubing **209** by means of a tubular connection **221**. The tubular connection **221** terminates in the valve housing at the enlarged upper portion of the closing head **220**. This closing head has a second peripheral O-ring **212** adapted to be brought into sealing engagement with an annular seat **222**. The seat **222** forms a portion of the valve housing part **219**. The closing head is screwed to a bolt **223** and rests with the lower face of its cylindrical part on the diaphragm which is tightened against the closing head **220** by means of a supporting plate **225** and a nut **224**. In addition, the diaphragm **214** is retained in its position between the parts **218** and **219** of the valve housing by means of screws **226** extending vertically through the housing parts **219** and **217**. A second spring **227** is arranged between the nut **224** and the part **218** of the valve housing. This spring is mounted in such a way that, in the closed position of the valve, it is spaced apart from the bottom face of the nut **224**. The upper face of the diaphragm communicates with the bottom space of the valve **204** through channels **228** which lead through the parts **218** and **219** of the valve housing.

In FIG. 6 the valve is illustrated in its open position. During the filling of the container, air or water enters through the tubular connection **221** in the direction of the arrow **229** and exerts a pressure on the enlarged portion **230** of the closing head **220** as well as on the upper face of the diaphragm **214** in the direction of the arrow **231**. Thereby the thrust or preload of the helical spring **216** is overcome. The O-ring **245** and the diaphragm **214** are lifted from seat **215** and free the channels **228** so that the hydraulic medium is admitted in the direction of the arrow **232** into the container. As soon as the head **230** with its O-ring **212** has descended over a small distance against the force of the spring **216** thereby leaving a small open space between the O-ring **245** and the valve seat **215**, the total pressure of the fluid is applied upon the surface of the diaphragm **214**. As a result thereof the diaphragm is depressed rapidly thus increasing considerably the flow area. A further increase in the inlet pressure causes the closing head **220** to descend until its O-ring **212** bears against the valve seat **222** and the flow of the hydraulic medium in the direction of the arrow **229** into the container **201** is blocked. The magnitude of the pressure which causes the closing head **220** to close the valve is adjustable and depends on the thrust of the second spring **227**. The spring **227** becomes effective when the nut **224** in its downward movement has reached a point at which it bears against the spring. Thus, a further depression of closing head **220** is retarded in view of the increasing pressure of spring **227**. It will be recognized that the arrangement of two different springs **216** and **227** will allow rapid opening of the control valve and a slow closing of the control valve in view of the action of the second spring **227**.

The filling operation of the container is terminated when the enlarged portion **230** of the closing head **220** and its O-ring **212** come to rest on the valve seat **222**. Filling of the container is effected by fitting the quantity control-check valve **108** to a water tap. The container **201** which is closed by the valve **204** is at the manufacturing plant loaded with air having an over-pressure of 1–2 atmospheres which due to the closing action of the diaphragm **214** under the force of the spring **216** is constantly maintained. Admission of water from the tap effects the displacement of the air contained in the valve **108**, in the hose **203** and in the mixing chamber **202** through the valve **204** into the interior of the container **201**. As a result, the hose **203** as well as the mixing chamber **202** are filled completely with water. The water now flows through the hose connection **207** and the overflow opening **247** of pipe **211** into the mixing chamber **202**. As soon as the mixing chamber **202** is filled up to the upper end of the pipe **210**, the fluid escapes under pressure through pipe **210**, flexible tubing **209** and valve **204**, which thereby opens, into the interior of the container **201**.

When the pressure in the interior of the container or the pressure of the hydraulic medium respectively is equal to the thrust of spring **227**, the closing head and its O-ring **212** bear against the valve seat **222**, thus preventing further flow of liquid into and terminating the filling operation of the container. After turning off the water tap and subsequent pressure relief when opening the outlet at the end of the hose, the pressure in the outer chamber of the valve, i.e. in the space adjacent the O-ring **212** is relieved so that the pressure in front of the valve is less than in the interior of the container **201**. As a result, the closing head **220** opens under the

force of the helical springs 227 and 216. Simultaneously the diaphragm 214 and its associated O-ring 245 which are subjected to the action of the same spring are slowly urged against the valve seat 215 and the internal pressure is becoming effective through the channel 228 on the upper face of the diaphragm 214. Thus the internal pressure acts against the upwardly directed force of the spring 216 and prevents the O-ring 245 from being moved too rapidly onto the valve seat 215. As a result of this movement the fluid passage in the outlet direction will be closed.

The O-ring 245 engages the valve seat 215 only when the pressure in the interior of the container 201 which is applied partly to the diaphragm is equal to the pressure exerted by the spring 216. However, this is only achieved when the total amount of liquid has been discharged and when the internal pressure is reduced to the original pressure of 1–2 atmospheres above atmospheric pressure.

For closing the valve, i.e. for engagement of the O-ring 245 with the valve seat 215, it is necessary that the internal pressure is less than the pressure exerted by the spring 216, whereas for filling the container 201, the pressure applied to the inlet chamber ahead of the valve must be greater than the pressure prevailing in the containers 201. The development of over-pressure in the interior of the container is prevented by engagement of the O-ring 212 with valve seat 222. The valve 204 is suitable for large scale production and can be made of plastic material so that the cost of manufacture can be kept extremely low.

As will be evident from FIG. 5 the container 201 is provided with a stand 249 in the form of a ring which ensures the upright position of the container 201. The stand is arranged below the valve 204. FIG. 5 also shows that the lid 206 is designed as a handle to which a hand pump may be fitted. This pump consists of a cylinder 250 receiving an axially slidable hydraulic ram 252 which carries a handle 251. The cylinder 250 is screwed onto the collar 205 of the mixing chamber. In the wall of the cylinder 205 facing the mixing chamber 202 a check valve 253 is arranged which is adapted to be opened under pressure by the liquid being pumped in and to be closed in opposite direction by means of a spring. In addition, the cylinder 250 is provided with a check valve generally designated 254 which has an outwardly disposed opening. This check valve opens when the ram is moved upwardly and closes during the downward stroke of the ram. The outlet opening of the valve 254 may be connected to a hose or the like so as to allow the container to be filled by means of the hand pump and a water reservoir.

It is, of course, to be understood that the present invention is, by no means, limited to the particular constructions shown in the drawings, but also comprises any modifications within the scope of the appended claims.

What I claim is:

1. An apparatus for dispensing liquids, which comprises: a container for receiving and releasing fluid, pressure storage means arranged within said container for exerting pressure on fluid in said container, conduit means having one end connected to said container and having its other end adapted selectively to be connected to a nozzle and to the mouth of a fluid supply conduit, and a combined quantity control-check valve interposed in said conduit means and provided with passage means for conveying fluid in either direction from said one end to said other end of said conduit means and vice versa to thereby permit charging said container with and discharging fluid from said container through one and the same conduit means, said valve having two sections respectively confining parts of said passage means and being movable relative to each other, control means arranged in a portion of said passage means and normally being effective to permit flow of fluid only in the direction from said other end of said conduit means to said one end thereof, and means associated with at least one of said sections and operable in response to a relative movement of said sections with regard to each other to establish fluid connection between portions in said passage means ahead of and behind said control means to thereby permit fluid flow from said one end to said other end of said conduit means.

2. An apparatus according to claim 1, in which said two sections of said valve are rotatable relative to each other, and in which said passage means comprise first channel means, spring biased check valve means arranged in said first channel means so as to permit flow of fluid only in the direction from said other end to said one end of said conduit means for filing said container, said passage means also comprising second channel means operable in response to a rotative movement of said sections relative to each other selectively from an effective position in which said second channel means bypasses said first channel means to an ineffective position in which said second channel means does not bypass said first channel means through intermediate positions in which the effective cross-section of said second channel means is varied whereby the flow of fluid being dispensed from said container per time unit through said conduit means may selectively be varied from zero to a maximum.

3. An apparatus according to claim 1, in which one of said movable sections comprises means for mechanically moving said control means into an ineffective position to permit flow of fluid also in the direction from said one end of said conduit means to said other end thereof.

4. An apparatus according to claim 1, in which said sections of said valve are substantially axially arranged with regard to each other, and in which that one of said sections which is remote from said other end of said conduit means is provided with a mixing chamber having closable opening means for introducing therethrough and into said mixing chamber ingredients to be intermixed with the fluid being discharged from said conduit means prior to the fluid reaching said other end of said conduit means.

5. An apparatus according to claim 1, in which said container has arranged therein valve means forming a combined check valve and relief valve operable to maintain an air-over pressure in said container when the latter is empty of fluid, said valve communicating with said one of said conduit means.

6. An apparatus according to claim 5, in which said container has a ball-shaped outer contour, and flexible hose means supported by said container and communicating with said one end of said conduit means, said hose having said check valve-relief valve suspended thereon within the range of the inner central portion of said container.

7. An apparatus according to claim 1, in which said container has a ball-shaped outer contour, and which includes a tubular mixing chamber closed at the bottom and open at the top and being connected to the upper portion of said container while extending into approximately the inner central portion of said container, the interior of said mixing chamber communicating with said conduit means, cover means mounted on and closing the top end of said mixing chamber, ascending pipe means connected to the bottom of said mixing chamber and extending upwardly in said mixing chamber while ending short of said cover means so as to leave a gap therebetween and communicating with the interior of said mixing chamber, combined check valve-relief valve means arranged near the bottom surface of said container, and tubular means establishing communication between said combined check valve-relief valve means and said ascending pipe means.

8. An apparatus according to claim 7, which includes a pipe arranged within and extending in the longitudinal

direction of said mixing chamber, said pipe having an upper opening communicating with said conduit means and having a lower opening communicating with the interior of said mixing chamber.

9. An apparatus according to claim **7**, in which said cover means is detachably mounted on said mixing chamber and comprises air pump means operable to charge said pressure storage means.

10. An apparatus according to claim **7**, in which said combined check valve-relief valve means includes: a housing having inlet means communicating with said tubular means and having outlet means communicating with the interior of said container, and control valve means interposed between said inlet and outlet means and controlling communication therebetween, said control valve means including spring means operable in response to the pressure in said container dropping below the thrust of said spring means to move said control valve means to its closing position to interrupt fluid communication between said inlet and outlet means.

11. An apparatus according to claim **10**, in which said control valve means includes: a first valve seat and an axially oppositely located second valve seat, a diaphragm having its marginal area connected to said housing and having its central area movable toward and away from said valve seats, a valve member connected to said central area of said diaphragm and reciprocable therewith, one side of said central diaphragm area facing said second valve seat, said valve member having a first sealing area for sealing engagement with said first valve seat and also having a second sealing area adapted to engage and being continuously urged into engagement with said second valve seat by said spring means, said spring means being under a preload corresponding to the desired minimum pressure in said container, and means continuously establishing communication between the interior of said container and that side of said central diaphragm area which faces said second valve seat.

12. A apparatus according to claim **1**, in which said container adjacent its connection with said conduit means is provided with check valve means for maintaining a desired minimum air pressure in said container, said check valve means including a seat of magnetizable material and also including a valve body of magnetic rubber adapted to float on liquid in said container and to adhere to said seat when said container contains substantially no liquid.

13. An apparatus according to claim **12**, in which said valve body is supported by a disc adapted to float on the surface of liquid in said container, said disc having a marginal sealing area adapted to sealingly engage a wall portion of said container in response to the liquid level in said container dropping to a desired minimum level.

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