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DOUBLE FILLING MANIFOLD ARRANGEMENT

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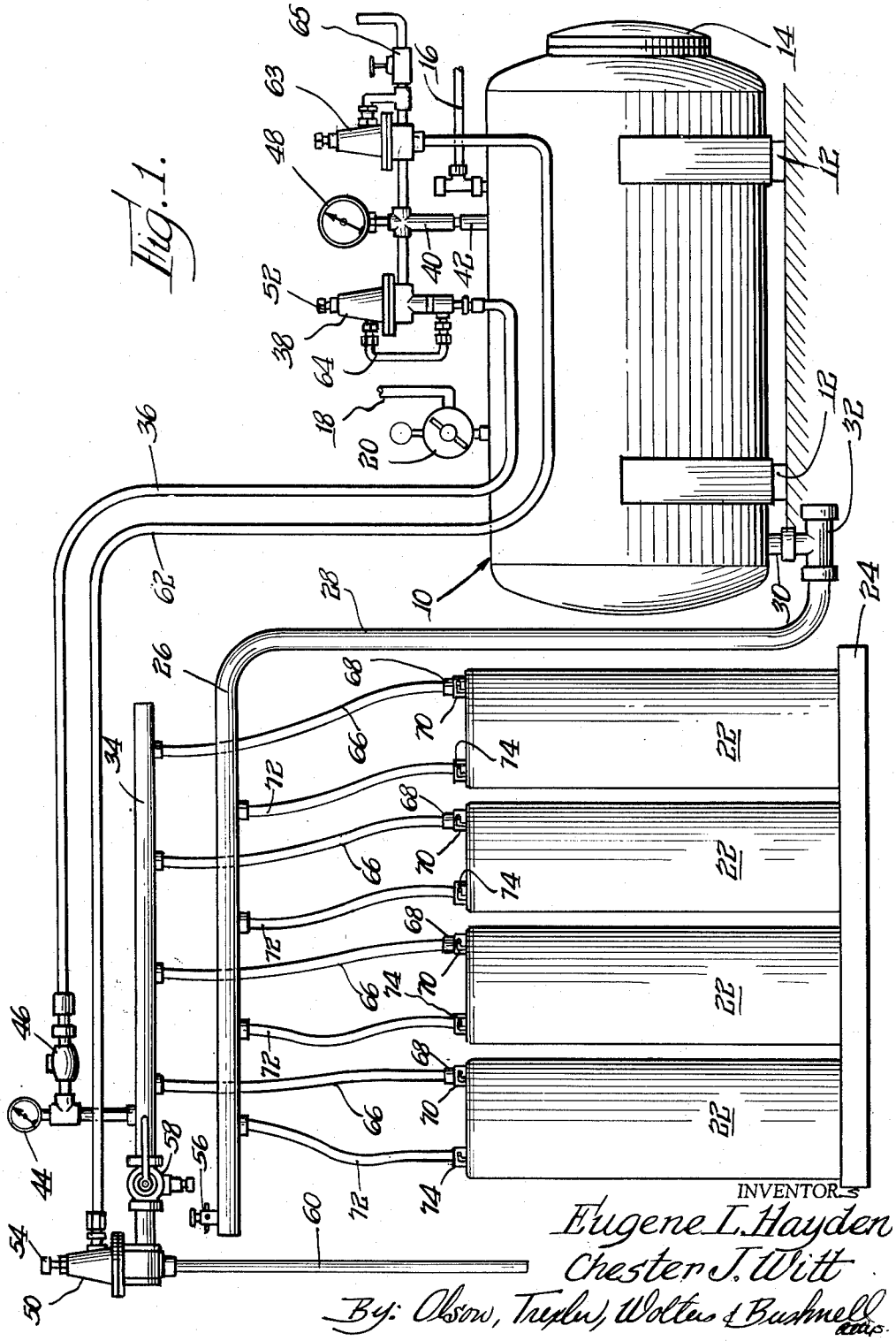
Fig. 1.



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DOUBLE FILLING MANIFOLD ARRANGEMENT

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This invention relates generally to fluid handling apparatus.

In one specific aspect, the present invention relates to apparatus for filling carbonated beverage into vending machine tanks.

In accordance with conventional vending machine practice, carbonated beverages are dispensed from refillable product tanks. Prior to actual filling, these containers are counterpressured or charged with a given amount of carbon dioxide gas in order to prevent foaming of the subsequently introduced, carbonated liquid. As the liquid-gas mixture enters the tank through one valve, the excess carbon dioxide gas from counterpressuring is allowed to escape to the atmosphere through another valve. Certain wasting of the carbon dioxide gas necessarily results. Moreover, counterpressuring is customarily performed as a distinct function separate and apart from the filling operation. This latter procedure has proved inefficient of operator time.

Therefore, a general object of the present invention is to provide new and improved apparatus for counterpressuring and filling containers with a liquid-gas mixture.

Another object of the invention is to provide such apparatus which is economical to operate.

Still another object of the invention is to provide apparatus of the type referred to that conserves the counterpressuring gas.

Yet another object of the invention is to provide apparatus for filling a liquid-gas mixture, which apparatus is characterized by rapid, efficient operation.

And yet another object of the invention is to provide apparatus for counterpressuring and filling containers with a liquid-gas mixture in which there is automatic compensation for changes in the vapor pressure of the mixture being filled.

Additional objects and features of the invention pertain to the particular structure and arrangements whereby the above objects are attained.

Apparatus in accord with the invention includes a reservoir containing a gas phase and a liquid phase; a first manifold arrangement supplying a liquid-gas mixture from the reservoir to a container at a first pressure; a second manifold arrangement for supplying gas from the reservoir to the container at a second, lower pressure prior to filling with the liquid-gas mixture and for receiving gas from the container during filling of the mixture; and a valve arrangement for maintaining the second pressure between a fixed maximum and a fixed minimum value relative to the first pressure.

In order that the principle of the invention may be readily understood, a single embodiment thereof applied to counterpressuring and filling a carbonated beverage, but to which the application is not to be restricted, is shown in the accompanying drawing wherein FIG. 1 is a schematic view in side elevation of apparatus constructed in accordance with the invention.

Referring now in detail to the drawing, a reservoir or tank indicated generally by the numeral **10** will be seen mounted on supports **12** and provided with an access hatch **14** which is advantageously hermetically sealed in place. For purposes of the present embodiment, tank **10** specifically takes the form of an injection-type carbonator, the previously mixed beverage liquid entering the tank **10** through a product inlet line **16** and carbon dioxide gas

entering the tank **10** under pressure through a gas inlet line **18**.

An adjustable regulator valve **20** is advantageously interposed in the gas inlet line **18** in order to control the rate of flow of gas into the tank **10** whereby to cooperate with the temperature of the incoming beverage liquid in establishing the gas pressure within the tank. During actual operation of the apparatus, inlet beverage liquid is mixed with the incoming carbon dioxide gas so as to absorb quantities of the gas and form a liquid-gas mixture. This liquid-gas mixture describes a liquid phase within the tank **10** whereas the unabsorbed carbon dioxide gas describes a gas phase in the tank **10** overlying the liquid phase. The regulator valve **20** is ordinarily set at a desired value which is allowed to remain undisturbed throughout the run of a given product.

The carbonated beverage from the tank **10** is intended to be filled into a number of individual product tanks or cans, such as the 5-gallon vending machine tanks **22** which are shown aligned on a platform **24**. In accordance with a feature of the invention, the product tanks are counterpressured and filled at a single station in a multiple-container operation. Accordingly, a product manifold **26** is connected to the tank **10** in communication with the liquid-containing portion thereof, as by means of a product line **28** coupled to the bottom of tank **10** by means of a stub **30** and a T-fitting **32**. In addition, a gas manifold **34** is connected to the tank **10** by means of a gas line **36**, line **36** communicating with the gas-containing portion of tank **10** through an adjustable regulator valve **38** and fittings **40** and **42**. A gauge **44** and a check valve **46** are advantageously connected in series with gas line **36** adjacent the manifold **34**. Moreover, a pressure gauge **48** is usefully connected to the fitting **40** for indicating the pressure in tank **10**.

An adjustable, pressure relief valve **50** is coupled to the gas manifold **34**; and conveniently, the regulator valve **38** and the relief valve **50** take the form of conventional, diaphragm valves, valve **38** being adjustable by means of an adjustment screw arrangement **52** and valve **50** being adjustable by means of an adjustment screw arrangement **54**. If desired, a carbonation test connection **56** can be fitted to the product manifold **26** and a 3-way manual valve **58** may be connected in the gas manifold **34** between valve **50** and the juncture between line **36** and the gas manifold.

Since gas is intended to be directed from the gas manifold **34** into the product tanks **22** for counterpressuring the tanks prior to their actual filling with the carbonated beverage, it is necessary to provide a pressure differential between the product manifold **26** and the gas manifold **34**, the product manifold **26** being maintained at the higher pressure. A suitable filling differential is achieved by adjusting the regulator valve **38**, as by rotation of the adjustment screw arrangement **52**, to achieve a gas manifold pressure, as sensed by gauge **44**, which is less than the pressure in tank **10**, as sensed by gauge **48**. Suitable filling differentials commonly exist in the range of ten to fifteen p.s.i.g. Whenever the pressure in line **36** drops so as to reduce the differential pressure between that line and the pressure in tank **10** to some value less than the selected value, the diaphragm in valve **38** responds to open the valve and admit gas from the tank **10** to the line **36**. Valve **38** remains closed whenever this differential pressure equals or exceeds the selected value. Thus, valve **38** serves to maintain a minimum or lower limit on the counterpressure in line **36** and thereby in the connecting manifold **34**.

Similarly, it is desirable to prevent gas pressure within the manifold **34** from building up above a certain level; and the causes of such potential build-up will become apparent hereinafter. The pressure relief valve **50** is

therefore adjusted as by means of the adjustment screw arrangement 54 to relieve at a pressure intermediate the pressure of the gas manifold and the pressure of the tank 10. Advantageously, valve 50 is arranged to relieve through a vent tube 60 at pressures approximately two or three p.s.i.g. in excess of the pressure at which the valve 38 is arranged to close. Hence, valve 50 maintains a maximum or upper limit on the counterpressure in manifold 34. Control of the counterpressure between the upper and lower limits established by valves 38 and 50 promotes efficient filling of the product tanks by preventing foaming of the carbonated liquid entering these tanks.

In accordance with an important feature of the invention, the valves 38 and 50 are arranged automatically to compensate for changes in the pressure within tank 10 which changes might result from variations in the temperature of the product entering through inlet line 16 or by virtue of a deliberate adjustment of the regulator valve 20 so as to provide a different degree of carbonation in the finished beverage. When the apparatus of the invention is thus arranged, little operator attention is required during a filling run.

Specifically, the pressure relief valve 50 is biased by the summation of a function of the pressure existing in tank 10 and the spring pressure achieved with the adjustment screw arrangement 54; and for this purpose, a conduit 62 is connected between the closed side of the diaphragm of valve 50 and the fitting 40. A regulating valve 63 is coupled between conduit 62 and fitting 40 to act as a pressure reducer. In somewhat similar manner, the valve 38 is biased by the summation of the pressure at the outlet side thereof plus the spring pressure provided through the adjustment screw arrangement 52, a conduit 64 being connected between the outlet side of valve 38 and the closed side of the diaphragm of valve 38 for this purpose. As will be recognized, both valves 50 and 38 are therefore biased in accordance with a function of the instantaneous pressure existing in the tank 10. Thus, the actual pressure at which either of these valves operates is subject to variation in accordance with the pressure within the tank whereby automatically to compensate for any such changes and whereby to establish operation of the valves at differential pressures which are constant relative to the tank pressure. Valve 63 is conveniently vented to the atmosphere through a needle valve 65.

Each of the product tanks 22 defines a substantially closed vessel, i.e. closed except for suitable fittings for filling and for dispensing the contents, the tanks 22 advantageously taking the customary, five-gallon capacity commonly used in vending machines. The fittings used in filling include separate fittings for inlet product and counterpressuring gas. So that a number of the tanks 22 can be filled at the same time, the gas manifold 34 is provided with a suitable number of individual gas filling lines 66, each of which is provided at its free end with a double-acting, flow check valve 68. A bayonet coupling 70 is provided in conjunction with each of the flow check valves 68 for facility in coupling and uncoupling the individual gas lines 66 to the respective product tanks 22.

In like manner, the product manifold 26 is provided with a suitable number of product filling lines 72, each of the lines 72 terminating in a bayonet coupling 74 for cooperation with similarly arranged coupling elements provided integrally with the product tanks.

For purposes of affording a more complete understanding of the invention, it is advantageous now to provide a functional description of the mode in which component parts cooperate. The apparatus of the invention is prepared for operation by adjusting the regulator valve 20 to provide the desired degree of flow of carbon dioxide gas into the tank 10 for purposes of carbonating the product entering through inlet line 16. Thereafter, the regulator valve 38 and the relief valve 50 are adjusted by means of the adjustment screws 52 and 54, respectively, to provide the desired pressure differentials. For example, valve 38 may be adjusted so that it will be closed at pressures above a value equal to the pressure within the tank 10 less approximately fifteen p.s.i.g. Similarly, valve 50 may be adjusted to open at a pressure equal to the value of the pressure within the tank 10 less approximately twelve p.s.i.g. The 3-way manual valve 53 is operated to open gas manifold 34 to the relief valve 50.

With the previously mixed beverage liquid flowing into tank 10 and with carbon dioxide gas flowing into the tank 10 through regulator valve 20, a product tank 22 will be connected to gas manifold 34 by means of one of the gas filling lines 66 for purposes of counterpressuring the product tank. Carbon dioxide gas will flow into the product tank until it is at the same pressure as the gas manifold 34. Advantageously, the flow check valves 68 are of the floating ball type whereby this equalization of the pressure in gas manifold 34 and product tank 22 will be indicated by the float ball settling to the bottom of the check valve. At this point, the flow of gas to the product tank ceases.

After the product tank has been counterpressured, a product filling line 72 will be attached to the tank by means of the coupling 74. Thereupon, the carbonated beverage liquid will be caused to flow from the product manifold 26 into the product tank by the greater pressure established and maintained in the product manifold. The counterpressuring gas that was previously filled into the product tank will be displaced by the entering liquid, this displaced gas returning to the manifold 34 through the check valve 68. If another product tank has been connected to the gas manifold, this counterpressuring gas will be directed by the product manifold to this other tank. However, should no such tank be attached to the gas manifold, the relief valve 50 will operate to vent the excess gas upon its building up sufficient pressure to operate that valve.

When the initial product tank is full, the float ball in the flow check valve 68 will move to the top of the valve and seat, stopping the flow of liquid into the tank and avoiding passage of liquid into the gas manifold. Both the gas filling line and the product filling line will then be disconnected from the filled tank, and the filled tank will be removed from the platform 24 to be replaced by an empty tank which it is desired to fill. It has been found that a 5-gallon product tank can be counterpressured in approximately twenty seconds and filled with product in approximately three minutes.

Because the product tanks 22 are counterpressured and filled at the same station in a multiple-container operation, filling of the product tanks is particularly fast and efficient. Moreover, the carbon dioxide gas which is conserved by re-use in the counterpressuring of other tanks results in an economical procedure.

If during the operation of the apparatus of the invention, the temperature of the mixed but uncarbonated beverage entering through inlet line 16 rises for some reason, the product will take up less of the carbon dioxide gas being introduced into the tank 10 and the pressure within the tank 10 will increase. This increase within the tank 10 will not effect the proper operation of valves 38 and 50 because these valves are biased in compliance with a function of the pressure within the tank 10, as has been described hereinabove. Accordingly, such changes in the pressure within tank 10 are automatically compensated for thereby giving rise to fixed pressure differentials for filling and counterpressuring the product tanks. But little operator attention is concomitantly required in the filling operation.

The specific example herein shown and described should be considered as illustrative only. Various changes in structure and arrangement may occur to those skilled in the art; and these changes are to be understood as forming a part of this invention insofar as they fall within the spirit and scope of the appended claims.

The invention is claimed as follows:

1. In apparatus for counterpressuring and filling containers with a liquid-gas mixture which apparatus includes a reservoir containing a gas phase and a liquid phase at a first pressure, the combination comprising: a first manifold connected to said reservoir in communication with said liquid phase; a second manifold connected to said reservoir in communication with said gas phase; first valve means, including a flow controlling gas valve selectively biased to maintain a predetermined minimum pressure on said second manifold, connected in fluid circuit between said reservoir and said second manifold for passing said gas to said second manifold at a second, lower pressure corresponding with said predetermined minimum pressure; second valve means connected in fluid circuit between said second manifold and the atmosphere for selectively venting said manifold at a third pressure intermediate said first and second pressures; a plurality of gas lines individually connected between a said container and said second manifold; and a plurality of liquid lines individually connected between a said container and said first manifold, a said container being initially connected to a said gas line and being subsequently connected into a said liquid line in continuation of the connection to the gas line whereby the gas initially charged into said container returns to said second manifold to be redirected into another container or to be vented upon filling of liquid.

2. In apparatus for counterpressuring and filling containers with a liquid-gas mixture which apparatus includes a reservoir containing a gas phase and a liquid phase at a first pressure, the combination comprising: a first manifold connected to said reservoir in communication with said liquid phase; a second manifold connected to said reservoir in communication with said gas phase; first adjustable valve means, including a flow controlling gas valve selectively biased to maintain a predetermined minimum pressure on said second manifold, connected in fluid circuit between said reservoir and said second manifold for passing said gas to said second manifold at a second, lower pressure corresponding with said predetermined minimum pressure; second adjustable valve means connected in fluid circuit between said second manifold and the atmosphere for selectively venting said second manifold at a third pressure intermediate said first and second pressures; means biasing said valve means in accordance with a function of said first pressure whereby automatically to vary the operating point of said valve means in compliance with said first pressure; a plurality of gas lines individually connected between a said container and said second manifold; and a plurality of liquid lines individually connected between a said container and said first manifold, a said container being initially connected to a said gas line and being subsequently connected to a said liquid line in continuation of the connection to the gas line whereby the gas initially charged into said container returns to said manifold to be redirected to another container or to be vented upon filling of liquid.

3. In apparatus for counterpressuring and filling containers with a liquid-gas mixture which apparatus includes a reservoir containing a gas phase and a liquid phase at a first pressure, the combination comprising: first means connected to said reservoir in communication with said liquid phase; second means connected to said reservoir in communication with said gas phase; first valve means, including a flow controlling gas valve selectively biased to maintain a predetermined minimum pressure on said second mentioned means, connected in fluid circuit between said reservoir and said second means for passing said gas to said second means at a second, lower pressure corresponding with said predetermined minimum pressure; second valve means connected in fluid circuit between said second mentioned means and the atmosphere for selectively venting said second mentioned means at a third pressure intermediate said first and second pressures; and a plurality of gas and liquid lines individually connected between a said container and said first and second mentioned means.

4. The combination according to claim 3 which includes a plurality of gas lines and which further comprises a double-acting flow check valve connected in each of said gas lines to prevent the entrance of liquid into said second mentioned means from the containers connected to said gas lines.

5. In apparatus for counterpressuring and filling containers with a liquid-gas mixture which apparatus includes a reservoir containing a gas phase and a liquid phase at a first pressure, the combination comprising: first means connected to said reservoir in communication with said liquid phase; second means connected to said reservoir in communication with said gas phase; first valve means, including a flow controlling gas valve selectively biased to maintain a predetermined minimum pressure on said second mentioned means, connected in fluid circuit between said reservoir and said second means for passing said gas to said second mentioned means at a second, lower pressure corresponding with said predetermined minimum pressure; second valve means connected in fluid circuit between said second mentioned means and the atmosphere for selectively venting said second mentioned means at a third pressure intermediate said first and second pressures; means biasing said valve means in accordance with a function of said first pressure whereby automatically to vary the operating point of said valve means in compliance with said first pressure, said biasing means including an adjustable valve means connected in fluid circuit between said gas phase and said second valve means for varying the bias thereon; and a plurality of gas and liquid lines individually connected between a said container and said first and second mentioned means.

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