March 30, 1943. J. L. HUDSON 2,314,984

CARBONATING APPARATUS

Original Filed Aug. 22, 1940 2 Sheets-Sheet 1

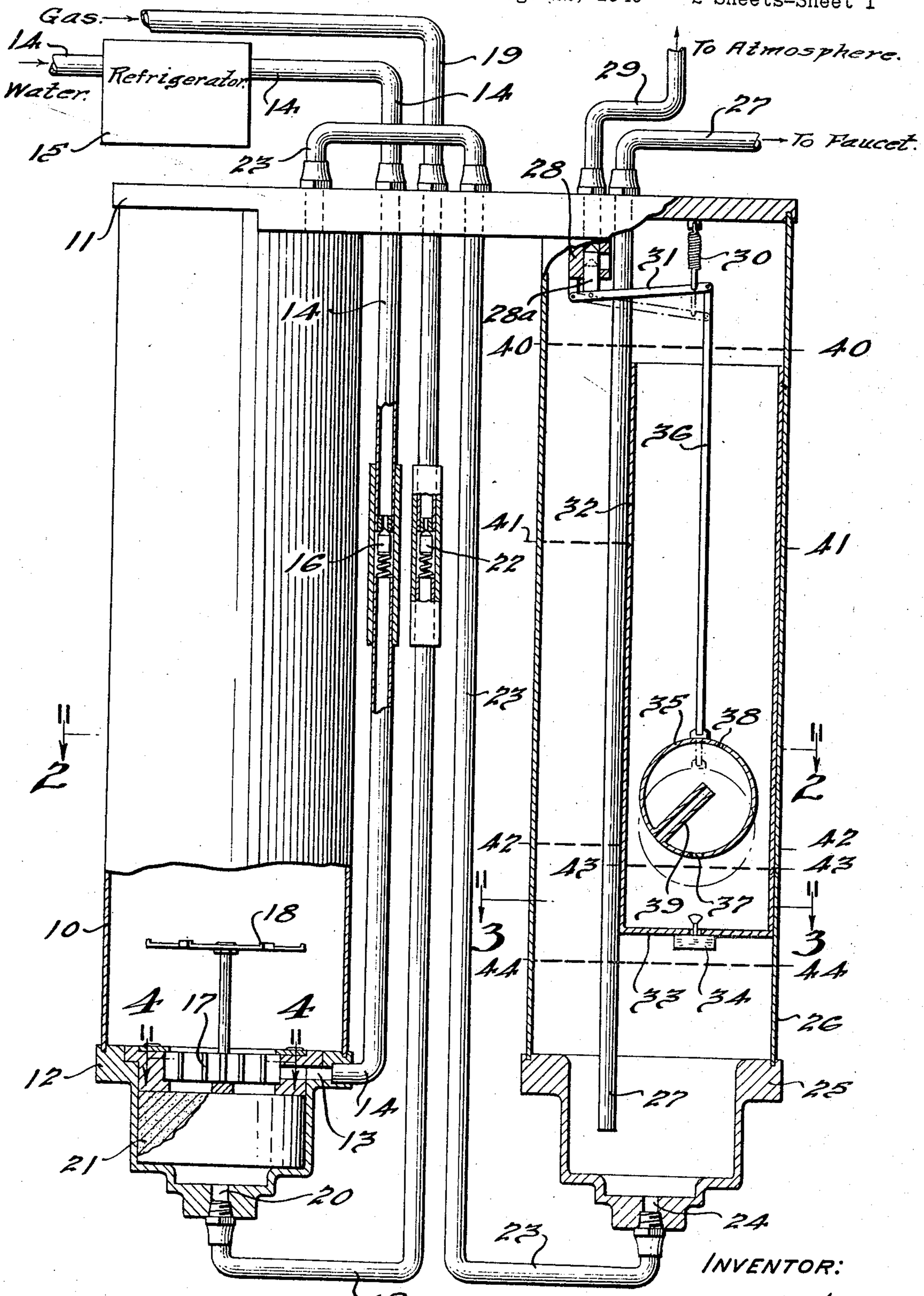

Fig. 1.

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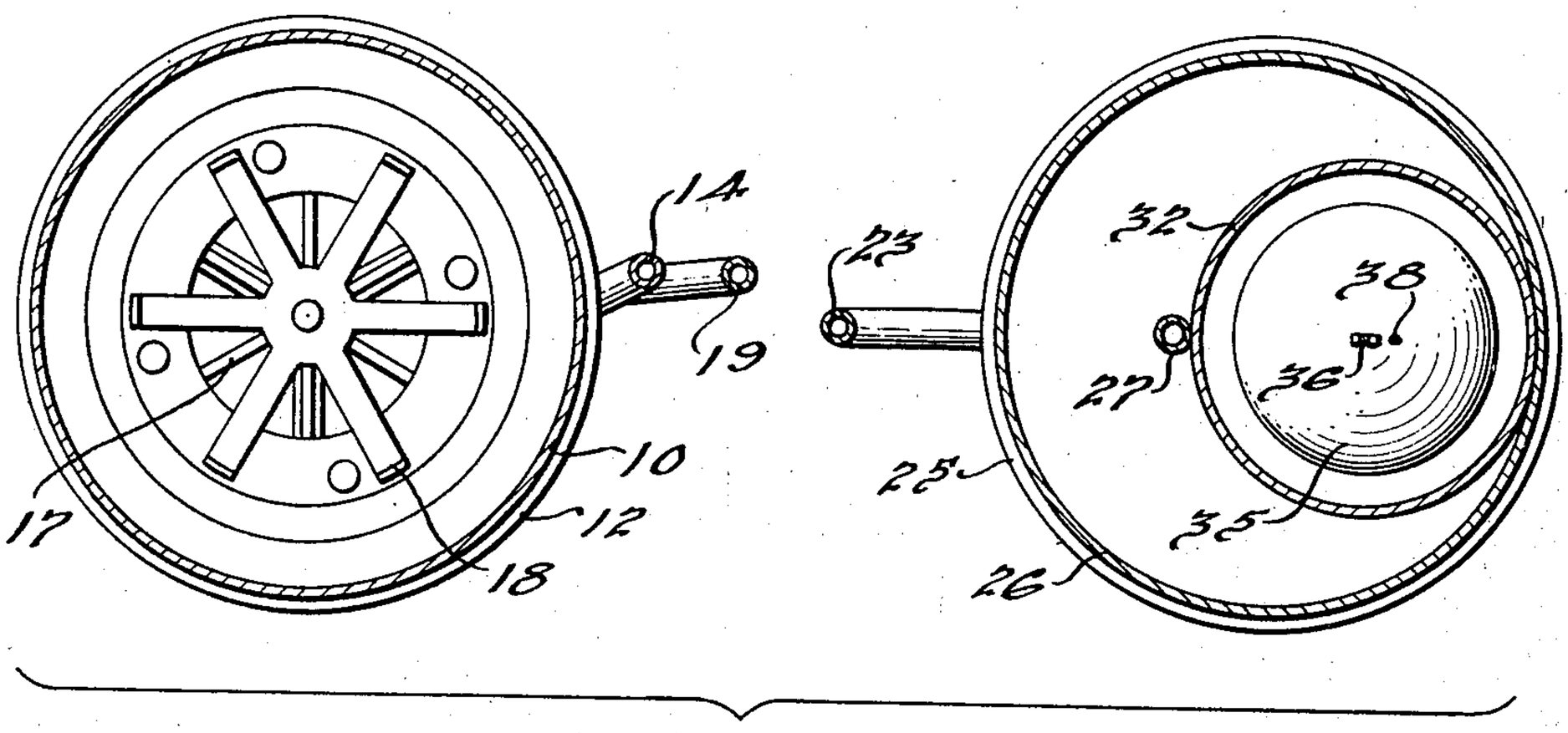

Fig. 2.

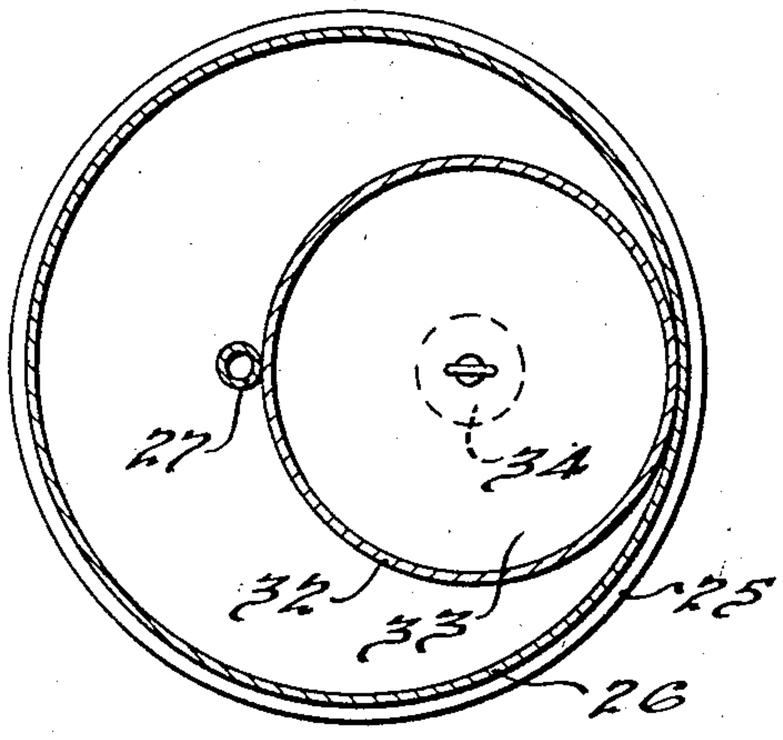

Fig. 3.

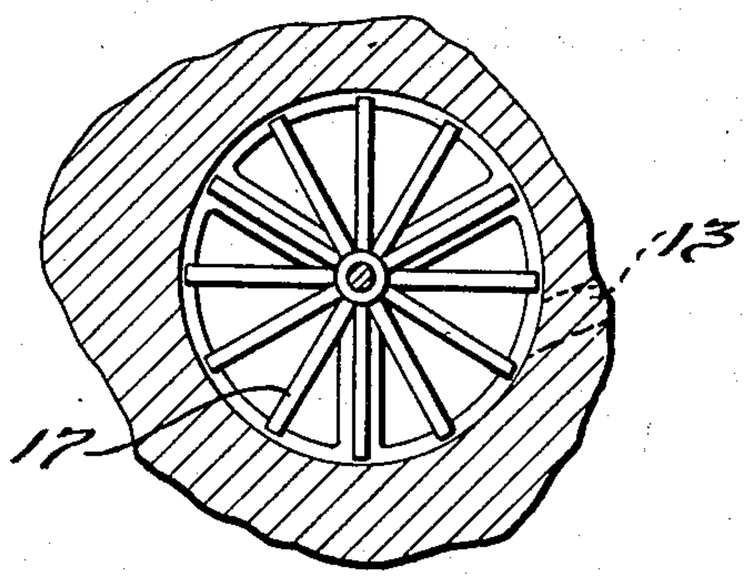

Fig. 4.

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2,314,984

UNITED STATES PATENT OFFICE

2,314,984

CARBONATING APPARATUS

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Original application August 22, 1940, Serial No. 353,636. Divided and this application July 20, 1942, Serial No. 451,580

6 Claims. (Cl. 261—19)

This invention relates to apparatus for dissolving gas in liquids and more particularly to carbonators for charging water or other potable liquid with CO_2 gas. The present application is a division of my copending application Serial No. 353,636, filed August 22, 1940.

The solubility of CO_2 gas in water varies inversely with the temperature of the fluids and directly with the pressure to which they are subjected during mutual contact; and under any given conditions of temperature and pressure the rate at which solution can be effected is dependent upon the areas of mutual contact between the liquid and gas, the rate of solution rising with the area of contact. CO_2 gas is usually supplied in charged cylinders under pressure that is ample to effect carbonization at satisfactory rates, especially if cool water is available. As city water supply pressures are not ordinarily high enough for efficient carbonating it has been customary to provide motor driven pumping apparatus to force the water into the carbonating chamber against the pressure of the CO_2 gas, the pump motor commonly being controlled by switch means actuated by a float that rises and falls with the water level in the carbonator chamber. Obviously such automatic pumping apparatus is bulky and heavy and in operation consumes energy so that its relatively high first cost and operating cost are objectionable. In the few instances in which water is available at sufficiently high pressure for efficient carbonation some automatic means must be provided to insure the introduction of both water and gas in suitable amounts into the carbonating chamber and this has been accomplished by pressure controlled water and gas valves mutually connected so as to effect introduction into the carbonator chamber of suitable amounts of water and gas at the same pressure. Such automatic valve devices are less bulky and heavy than pump apparatus but they must be nicely made to insure the requisite balance of water and gas delivery pressures, so that their cost also is unduly high.

It is an object of the present invention to provide an improved water carbonating device capable of operating successfully on unequal pressures of gas and water without resorting to the complication and expense of either motor driven pumping apparatus or pressure controlled water and gas valves, as used in the prior practices above referred to.

More specifically, it is an object of the invention to provide a carbonator in which the above stated object is accomplished through the use of a cycle of operation in which the introduction into the carbonator of water at readily available supply pressures is accomplished by lowering temporarily the gas pressure in the carbonator by means of automatic gas venting devices.

A further object of the invention is to provide apparatus of the character last referred to in which the number and duration of the periods during which the pressure is lowered in the carbonator is minimized so as to correspondingly minimize objectionable variation in the discharge pressure of the carbonator during draft of carbonated water.

It is an added object of the present invention to provide an improved device having the above noted characteristics which is simple in construction, dependable in operation, and relatively inexpensive to manufacture.

Other objects of the invention will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

With the foregoing objects and other more or less incidental or ancillary objects in view, the invention consists in certain constructions, combinations and arrangements of parts as hereinafter described and claimed.

In the drawings:

Fig. 1 is a side view, partly in section, of an improved carbonating device embodying the present invention.

Fig. 2 is a transverse sectional view of the device of Fig. 1, said view being taken, on an enlarged scale, in the direction of the arrows on the section plane passing through the line 2—2 of Fig. 1.

Fig. 3 is a transverse sectional view of the distributing tank, the view being taken, on an enlarged scale, in the direction of the arrows on the section plane passing through the line 3—3 of Fig. 1.

Fig. 4 is a top view of the impeller wheel provided in the mixing tank, the view being taken, on an enlarged scale, in the direction of the arrows on the plane passing through the line 4—4 of Fig. 1.

Before explaining in detail the present invention it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being

practiced or carried out in various ways. Also it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation, and it is not intended to limit the invention claimed herein beyond the requirements of the prior art.

In the drawings there is shown, by way of example, an improved water carbonating device embodying the present invention. The invention is herein illustrated and described as embodied in a device used for carbonating water and dispensing the carbonated water. However, it will be understood that my invention may be successfully applied and embodied in devices used for saturating liquids with gases in general, and is not limited to water and CO_2 gas.

The structure illustrated in the drawings comprises, generally, a mixing tank connected with the sources of gas and water supply, in which tank mixing of the water and gas takes place, and a distributing tank from which the carbonated water is delivered to a dispensing faucet. While the two tanks, as such, are structurally separate and distinct the conduit which connects them is always freely open so that said tanks and conduit constitute a container means having throughout a continuous interior chamber or space within which the water and gas are mixed and from which the carbonated water is distributed or dispensed.

Referring to the drawings, the mixing tank comprises a cylinder 10 closed at its top by a cover 11, and at its bottom by a member 12 which is provided with a port 13 to which is connected a conduit 14 leading from a refrigerator device 15 which, in turn, is connected to a source of water supply. A check valve 16 is interposed in the conduit 14 in order to prevent reverse flow of water. Adjacent the water port 13 there is operatively mounted a water wheel or impeller 17 which operates a mixer 18 mounted preferably but not necessarily on the same shaft with the impeller 17, this latter being operated by the incoming water. A conduit 19 connecting the mixing tank with the source of gas supply opens into the mixing tank with a port 20. A gas diffusing stone 21, which may be made of any suitable material such as carborundum or sandstone, is provided at the bottom of the mixing tank under the water wheel 17. A check valve 22 is operatively interposed in the conduit 19 to prevent reverse flow of the gas.

The top portion of the mixing tank is provided with a connecting conduit or pipe 23 leading to the lower portion of the distributing or dispensing tank into which it opens with a port 24 provided in the member 25 secured to a cylinder 26 having any suitable top closure, the cover 11 of the mixing tank being extended for this purpose in the particular construction shown. A discharge pipe 27 having its inlet near the bottom of the distributing tank leads to a dispensing faucet (not shown). In the cover 11 of the distributing tank there is also provided a relief valve 28 controlling an escape conduit 29 leading into the atmosphere and adapted to be closed by operation of a tension spring 30 connected to a lever 31 carrying the valve member proper 28a of the valve 28.

In the distributing tank there is provided a well 32 open at its top and having a ported bottom 33 provided with a valve 34 made of cork and opening downwardly. The well 32 is secured to the cylinder 26, and has its top disposed near the upper permissible water level, while its bottom is disposed near the lower permissible water level. Thus, the height of the well 32 determines the general range of maximum fluctuations of the water level in the distributing tank, as hereinafter explained.

In the well 32 there is operatively arranged a submerged chambered body 35 connected to the lever 31 by means of a rod 36. In this design I make the body 35 in the form of a hollow ball. It is provided with a draining orifice 37 preferably about one-quarter of an inch in diameter, a gas admitting orifice 38, preferably about one sixty-fourth of an inch in diameter, and an additional gas admitting means in the form of a tube 39 of about one-quarter of an inch in diameter, said tube being arranged within the ball as shown. The weight of the ball and the resistance of the spring 30 are so selected that when the ball is empty, the spring 30 is capable of supporting the ball 35 and closing the valve 28. However, when the ball 35 contains a considerable amount of water, and the well 32 is empty, the spring 30 yields to the weight of the water-loaded ball and opens the valve 28. The spring 30 is also capable of supporting the ball 35 when the same is submerged in water, whether empty or filled, in both cases the load on the spring being less than that produced by the empty ball when the well 32 is also empty.

The operation of my improved carbonizing device is as follows: The water from the pipe line or any other suitable source of water supply enters the conduit 14 usually at a pressure of about forty pounds per square inch and passes through the refrigerator 15 wherein it is cooled to about 40° F. in order to increase its gas absorbing capacity. Passing through the check valve 16 the water issues from the port 13 in a stream capable of rotating the impeller 17 actuating the mixing wheel 18. At the same time CO_2 gas usually under pressure from 60 to 120 pounds per square inch is passing through the conduit 19, check valve 22, port 20, and enters the mixing cylinder through the diffusing stone 21 which acts to separate the gas into a large number of minute streams. Passing up through the stirred water, the gas is absorbed thereby and carbonated water fills the entire tank and passes through the pipe 23 into the distributing tank. In starting operation of the device the draft faucet may be held open until water begins to issue, the vent valve 28 being closed. Then if the faucet is closed pressure begins to build up in the space enclosed by the two tanks. With the pressure in the tanks approximately atmospheric when the inflow of water and gas begins, such inflow will continue in the case of the water until the tank pressure reaches the maximum water pressure in the supply line and after that the inflow of gas continues until the tank pressure reaches approximately that of the maximum pressure in the gas supply line. The rate at which the stone 21 and check valve 22 can pass gas through it is low enough so that an ample amount of water can enter the tanks before the pressure therein rises to the water supply pressure.

The carbonated water enters the distributing tank through the port 24 and fills the tank until the pressure of the gas and air entrapped in the upper part of the distributing tank substantially reaches maximum gas pressure. This occurs when the water reaches the level approximately at the line 40—40.

It will be understood that when the water level

reaches the cork valve **34**, said valve will rise and close the opening in the bottom of the well **32**, but that when the water rises above the top of the well, the well will be filled and the body **35** will be submerged and filled.

If a quantity of carbonated water is now withdrawn from the dispensing faucet, the water will drop to a lower level, say level **41—41**. This will relieve the pressure in the distributing tank and will permit a small quantity of gas to escape from the carbonated water, this being replaced by additional gas seeping in through the porous stone **21**.

It is an important advantage of the present invention that in most withdrawals of carbonated water from the faucet the resulting fluctuations of the water level in the distributing tank do not affect the relief valve **28**, since the well **32** remains filled. Therefore, sudden drops of pressure during withdrawals rarely occur and the carbonated water usually comes out of the faucet in an even stream and without spurting.

When, however, the water level in the distributing tank drops to an undesirably low level, such as **42—42**, and continues to fall, the weight of the water in the well **32** opens the valve **34** and permits discharge of water through the bottom of the well. When the well **32** is emptied to about level **43—43**, the weight of the filled body **35** becomes sufficient to overcome the resistance of the spring **30** and to open the relief valve **28**, thereby venting excess gas and decreasing the pressure in the distributing tank and in the mixing tank to substantially atmospheric pressure. This drop in pressure is made possible by the fact that the gas discharge capacity of valve **28** is much larger than the effective inlet capacity of check valve **22** and diffusing stone **21**. Water from the supply line then rushes into the mixing tank, and carbonated water contained in the mixing tank rushes into the distributing tank filling the same again to the level **40—40**.

By suitably proportioning the relative effective capacities of vent valve **28**, the check valve **22** and diffusing stone **21** and also the relative effective capacities of openings **37** and **38** and of the valve **34** and tube **39**, it is possible to insure that the vent valve **28** will be held open long enough to insure admission of the requisite amount of water from the supply line and yet that the action of the system is rapid enough so that the water will not fall substantially below the level **44—44** in the distributing tank at any time under normal operating conditions.

In Fig. 1 there is shown in full lines the respective positions of the parts in the distributing tank with valve **28** closed and well **32** filled. In dotted lines there are shown positions of the parts when the valve **28** opens.

It is also an important advantage of the present invention that should the water supply fail for any reason no appreciable waste of gas occurs. In my improved device, should the distributing tank be emptied, the water from the body **35** will drain through the orifice **37**, and the spring **30** will then close the valve **28** preventing wasteful escape of gas. When the distributing tank is being emptied rapidly, draining of water from the body **35** is increased in rate by the action of the gas admitting tube **39** which comes into action to aid orifice **38** when the water level in the well **32** falls below the mouth of said tube **39**.

There is thus provided an improved water carbonating device in which the action of the vent valve is not dependent directly on the water level in the distributing tank, and therefore fluctuations of said water level do not affect the operation of the dispensing faucet. The device is automatic in its action. In addition, should the water supply completely fail, the device automatically shuts off the escaping gas preventing undesirable waste thereof.

What I claim is:

1. In liquid-carbonating apparatus, the combination of closed container means having a continuous chamber within which CO_2 gas can be mixed with liquid under pressure and from which the carbonated liquid can be dispensed; a liquid supply conduit opening into the container means: means associated with said conduit for preventing outflow therethrough from the container means; an inlet conduit for CO_2 gas opening into the lower part of the enclosed space of the container means, said conduit having a fixed metering passage and being constructed and arranged to afford constant access of gas to the container means; a discharge conduit for carbonated liquid leading from the container means with its inlet opening below the top of the chamber space of the container means; a gas vent conduit for conducting gas from the upper part of the chamber space of the container means to the atmosphere, the effective gas-conducting capacity of said vent conduit being substantially greater than that of the said inlet conduit for gas; a vent valve for controlling flow through the vent conduit; and means for actuating the vent valve controlled by the rise and fall of the level of liquid within the container means to open the vent conduit when said liquid falls below a predetermined level and to close said conduit when said liquid has risen again above said level.

2. A liquid-carbonating apparatus as claimed in claim 1 in which means is associated with the gas inlet conduit and the container means for dispersing the gas entering the latter.

3. A liquid-carbonating apparatus as claimed in claim 1 in which the means for actuating the vent valve comprises a well disposed within the container means and having an opening in its upper part through which liquid rising in the container means can flow into the well and having an outlet aperture in its lower part, a valve device for the said outlet aperture having a part buoyant in liquid and sensitive to change in the liquid level in the container to maintain said aperture closed while the liquid is above a predetermined level adjacent the lower part of the well and to open said aperture when the liquid falls below that level, and a body disposed in the lower part of the well and operatively connected to the vent valve, said body being sensitive to the liquid level in the well to open the vent valve when the said level falls below a predetermined level and to close it when the said level rises again.

4. A liquid-carbonating apparatus as claimed in claim 1 in which the means for actuating the vent valve comprises a well disposed within the container means and having an opening in its upper part through which liquid rising in the container means can flow into the well and having an outlet aperture in its lower part, a valve device for the said outlet aperture having a part buoyant in liquid and sensitive to change in the liquid level in the container to maintain said aperture closed while the liquid is above a pre-

determined level adjacent the lower part of the well and to open said aperture when the liquid falls below that level, a spring operatively connected to the vent valve tending to close the same, and a drainable chambered body arranged in the well and operatively associated with the vent valve and the said spring, said body being constructed to admit liquid to its interior when immersed in liquid in the well and to discharge the liquid from its interior when not so immersed and having a weight when containing liquid therein and not immersed, but not otherwise, to hold the vent valve open against the force of the said spring.

5. A liquid-carbonating apparatus as claimed in claim 1 in which the container means comprises a tank enclosing the space for mixing the gas and liquid and a second tank having its interior space in open communication with the interior of the first tank to receive therefrom carbonated liquid for distribution, with the vent passage of the apparatus leading from the upper part of the second tank.

6. In liquid-carbonating apparatus, the combination of closed container means comprising a tank within which CO_2 gas can be mixed with liquid under pressure, a second tank having its interior space in open communication with the interior of the first tank to receive therefrom carbonated liquid to be distributed, an interior well arranged in the second tank and having an opening in its upper part through which liquid rising in the said tank can flow into the well and having an aperture in its lower part and a float valve for controlling flow of liquid through said aperture, the last named valve being controlled by change of the liquid level outside the said well to open said aperture when said level falls and to close it when the level rises; a liquid supply conduit opening into the first tank; a check valve associated with said conduit for preventing outflow therethrough from the first tank; an inlet conduit for CO_2 gas opening into the lower part of the first tank, said conduit having a fixed metering passage and being constructed and arranged to afford constant access of gas to said first tank; a discharge conduit for carbonated liquid leading from the second tank with its inlet opening below the top of the chamber space of the said tank; a gas vent conduit for conducting gas from the upper part of the chamber space of the second tank to the atmosphere, the effective gas-conducting capacity of said vent conduit being substantially greater than that of the said inlet conduit for gas; a vent valve for controlling flow through the vent conduit; and means for actuating the vent valve controlled by the rise and fall of the level of liquid within the second tank to open the vent conduit when the said liquid falls below a predetermined level and to close said conduit when said liquid has risen again above said level.

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