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2,249,794

CARBONATOR

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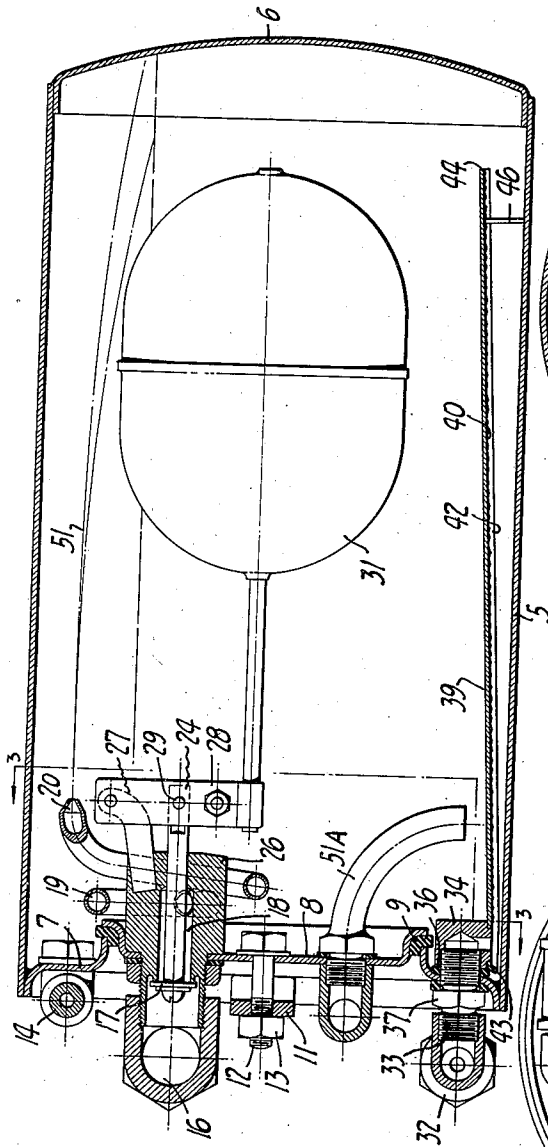


FIG. 1

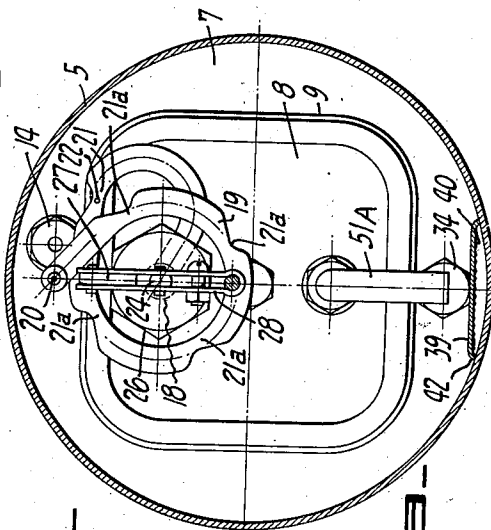


FIG. 2

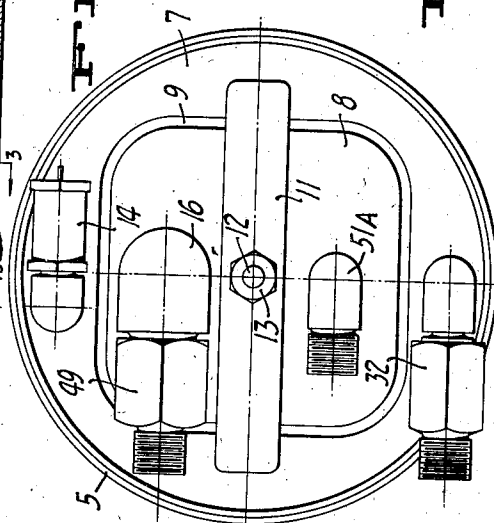


FIG. 3

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CARBONATOR

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5 Claims. (Cl. 261-121)

This invention relates to a liquid carbonation device, particularly one suited to domestic or commercial installation to provide a supply of carbonated water.

It is in general the broad object of the present invention to provide a novel, efficient liquid carbonator practically free of moving parts.

Prior devices for manufacture of carbonated liquids, particularly carbonated water, usually include means for supplying carbon dioxide, means for supplying water, and mechanically operated means as rotated paddles for mixing together the gas and water to the end that the two be brought into equilibrium, and as much carbon dioxide dissolved in the water as is possible under the conditions existing in the carbonator. Such devices are relatively expensive because, involving as they do, an outside power requirement to operate the mechanical mixing device, electric power or some other power source must be provided. In addition, the involved structure must include a stuffing box or gland. These are generally a source of trouble.

While the prior art contains various disclosures of non-mechanical carbonation devices, an examination of these discloses that they are relatively inefficient and ineffective to produce carbonated water with the degree of carbonation today demanded by the public. This, I have found, is because of the inadequate mixing of the water and gas. I have determined that the gas and water, or other liquid to be carbonated, should be continually and vigorously agitated and preferably by a plurality of separate means while in the presence of each other so that if any portion of the liquid comes into equilibrium with the gas, it is constantly renewed and another liquid portion not in equilibrium with the gas is presented to the gas.

The invention includes other objects and features of advantage, some of which, together with the foregoing, will appear hereinafter wherein the present preferred form of carbonator of this invention is disclosed.

In the drawing accompanying and forming a part hereof, Figure 1 is a side elevation, partly in section, through a carbonator embodying my invention.

Figure 2 is an end elevation of the carbonator of my invention, while Figure 3 is a section taken along the line 3-3 in Figure 1.

In accordance with my invention, I provide a suitable vessel 5 adapted to withstand the pressure. The vessel is closed at one end by closure 6 and at the other by an end closure 7 having a

generally rectangular opening therein. A cover plate 8 with a gasket 9 closes the opening in the end closure 7, the opening therein and the plate 8 cooperating to permit of installation and removal of certain operating parts within the vessel. A bar 11 is extended across the ends of the vessel and, together with stud 12 and nut 13 draw and retain the plate 8 in position. This construction is claimed in the applicant's copending application Serial Number 395,409 filed May 27, 1941.

The vessel 5 is normally cylindrical in cross section so that, when arranged horizontally and only partially filled with liquid it provides a liquid body of relatively large free area which, as will presently appear, is exposed to a gas phase therein.

A pressure release valve 14 of a type well known in the art is mounted on closure 7 to relieve any undue pressure created in the vessel. Mounted upon the plate is a water inlet 16 supplying water to a valve member 17 controlling liquid admission through passage 18 into the vessel. In communication with the passage 18 is an elongated tube 19 finally leading upwardly to discharge through a spray nozzle 20 into that space normally occupied by gas in the vessel. It is to be noted that tube 19 has a Venturi throat as at 21, and that apertures 22 are provided in the throat to withdraw gas from the space and mix with the liquid ejected through the venturi and spray head 20 on tube 19 into the gas space in the vessel.

Spray head 20 directs a stream of liquid forcefully onto a free area in the vessel to circulate positively the liquid body therein. To assist mixing of the gas withdrawn from the gas space into the liquid in tube 19, a plurality of restrictions 21 are provided in the tube. These are each preferably Venturi tubes so that a varying pressure effect is secured and the gas and liquid are thoroughly mixed.

Valve member 17 is mounted upon a stem 24 which is in turn slideable in a valve body 26 mounted upon plate 8. Hinged upon a support 27 on valve body 26 is a composite lever 28. This lever is slidably connected as at 29 to valve rod 24, while at its other end it carries float 31. Under the control of the float, the valve member 17 is moved between open and closed positions to admit or cut off liquid supply under pressure to the vessel and maintain the vessel selectively filled with liquid to the liquid level line indicated in the drawing.

Means are provided for supplying gas and in the drawing this has been indicated by an inlet

line 32 connected to a fitting 33 mounted on closure 7.

Fitting 33 is a tube extended through closure 7. At one end and on one side of closure 7 it carries a head 34 and a gasket 36. A nut 37 and another gasket on the other side of closure 7 enable the fitting to be secured in place. A plate 39 is secured to the head 34 and receives gas passed by the head. An outlet or draw-off line 51A is suitably mounted on plate 8 whereby CO₂ saturated liquid can be withdrawn from the vessel.

Plate 39 is generally flat with its under surface roughened as at 40 to give a rolling motion to gas passing along the plate when it is submerged in the liquid in the vessel 5, as appears in Figure 1. The longitudinal edges 42 of the plate are bent over slightly to prevent gas from escaping while the end 43 is rolled over to direct gas up along the plate toward its normally more elevated discharge end 44. Portions 46 of the plate are depressed and form legs supporting the plate in position. The plate effectively carbonates a small volume of water, a large gas concentration being present. The roughened under surface 40 of the plate 39 agitates and tears off the bubble-water interface whereby, as the bubbles roll up the plate, the interface is constantly renewed. The effect of this is to saturate the water beneath the plate and, at the same time, cause it to circulate. The plate, except adjacent its lower end, is spaced from the vessel so that liquid is admitted freely to be carbonated.

When the vessel is filled and neither gas nor liquid is being admitted, the liquid level is as indicated in Figure 1 as the normal liquid level, the horizontal broken line. As carbonated liquid is drawn off through the draw off pipe 51A, the pressure within the vessel falls, gas is admitted to the vessel, the gas regulator valve (not shown) being set to open at a pressure about 10 pounds below the water pressure on water check valve 49. The admission of gas into the vessel continues until the pressure within the vessel is equal to or above that at which the gas regulator valve supplies gas. The check valve 32 is then closed so that carbonated liquid will not go back up the gas line.

The float 31 normally has such a weight relative to its volume that it drops until it is closely adjacent to the plate 39 before valve 17 opens and water is admitted. With this type of float valve, and with check valve 49 inserted in the water line, little water is admitted until valve 17 is open fully and water is admitted freely through nozzle 20. In the drawing I have indicated by broken lines 51 the path of water and gas sprayed through the nozzle 20. However, this representation is not quite accurate, being rather diagrammatic, inasmuch as the spray nozzle 20 is so designed that it jets the water spray out fanwise across the entire surface of the free cross-sectional area of the device to stir and agitate the entire surface of the water body therein forcefully and create circulation through the entire body clockwise in Figure 1. Water admission continues until water is shut off by the float. Gas admission ceases as soon as the pressure within the vessel is equal to or above that at which the gas regulator valve supplies gas. This is usually only after the float has dropped, water is admitted and the float has started return to that position in which it shuts off the water. Even though water continues to

be admitted for some period thereafter, there is sufficient excess gas within the vessel to insure full and complete carbonation of all the water admitted.

It is another feature of the present carbonator that full and adequate carbonation of the liquid can be procured with relatively low gas pressure, of the order of 40 and 50 pounds. Mechanical carbonation devices employ gas of about 100 pounds pressure. Because the present carbonator is so effective, it can ordinarily be operated directly from city water main pressure without any supplemental pumps being required. This feature is of great advantage because it enables the device to be installed at practically any location having an adequate supply of a suitable liquid under pressure.

While the violent liquid ejection through the Venturi throated tube 19 and spraying of the liquid gas mixture onto the liquid body in the vessel agitates that body and presents to the gas phase a constantly renewed liquid-gas interface, I have found that the time required to bring to equilibrium the gas and liquid is relatively long. However, by employing the several means disclosed, by initially contacting the gas and liquid by means of roughened plate 39 to present a constantly renewed gas-liquid interface, by mixing the liquid to be sprayed with gas and by constantly, but non-mechanically, stirring the liquid body to provide a constantly renewed gas-liquid interface, the liquid is quickly saturated to the extent possible at the temperature existing in the liquid. At the normal working liquid level, there is available a gas-liquid interface of appreciable extent, the vessel 5 having a relatively large free horizontal cross-sectional area. Constant stirring of this forcefully circulates the liquid therein and renews the large gas-liquid interface whereby saturation is quickly effected. The spray nozzle 20 is effective to spray the length of the tank and circulate the liquid body positively and forcefully, the liquid passing to the bottom of the vessel where it mixes with gas from plate 39 and then back again. This ensures quick and uniform carbonation.

I claim:

1. In a liquid carbonation device, a closed vessel, means for maintaining said vessel filled with liquid to substantially a predetermined level, including liquid spray means discharging liquid substantially horizontally through a gas space over said liquid and onto said liquid adjacent an end of said vessel to agitate the entire liquid body and a plate positioned in said vessel and submerged in said liquid at a slight angle to the horizontal, said plate terminating at its upper end beneath said water level and spaced from said end of said vessel to release gas into liquid above said plate between said plate end and said vessel end, and means for admitting CO₂ gas beneath said plate adjacent the lower end thereof.

2. In a liquid carbonator, a tubular vessel having a major and a minor axis and arranged with its major axis generally horizontal, means for maintaining said vessel at least partially filled with liquid to provide a liquid body and a space for gas in said vessel, means for forcefully ejecting a liquid directly and substantially horizontally through said gas space and onto a free portion of said liquid body to agitate said body and create a constantly new gas-liquid interface, means submerged in said liquid body and providing a gas-liquid contacting means in said liq-

uid body, and means for admitting CO₂ gas beneath said submerged contacting means.

3. In a liquid carbonator, a vessel, means for maintaining said vessel at least partially filled with liquid to provide a liquid body and a space for gas in said vessel, means for ejecting liquid directly and substantially horizontally onto said liquid body to agitate said body forcefully and create a constantly new gas-liquid interface, a gas-liquid contact plate submerged in said liquid body and having a roughened gas-liquid contact face providing a gas-liquid contacting means in said liquid body, and means for admitting CO₂ gas beneath said plate.

4. In a liquid carbonator, an elongated vessel adapted to be positioned horizontally, means for maintaining a liquid body therein partially filling said vessel, means for admitting gas to said vessel for final passage to space over said liquid, means for spraying liquid through said space substantially horizontally onto said liquid to circulate said liquid positively and forcefully, and

a flat plat positioned in said vessel and normally submerged in said liquid for receiving gas admitted to said vessel, said plate having its gas contact surface roughened to agitate positively gas admitted beneath said plate prior to release into said space.

5. A liquid carbonator comprising a vessel, means for maintaining said vessel partially filled with liquid to provide a free liquid body in said vessel and a gas space in contact therewith, said means including a liquid spray nozzle positioned in said vessel to discharge substantially horizontally, directly and forcefully onto said liquid body adjacent an end thereof to create and maintain positive liquid circulation in said liquid body, a plate positioned substantially horizontally in said liquid body and having gas-liquid contact means, and means for admitting gas to said vessel beneath said plate, said plate discharging gas adjacent one end of said liquid body.

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