United States Patent

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[73] Assignee **Eaton Yale & Town Inc.**

[54] **METHOD OF AND APPARATUS FOR CARBONATING, HAVING INTERSECTING STREAMS OF GAS AND LIQUID**
12 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **222/1,** 222/129.1, 261/121
[51] **Int. Cl.** **B67d 5/56**
[50] **Field of Search** ..... 261/121, 79.1, 19 (X), (Carborator Digest); 222/1, 129.1, 195 (Cursory), 67, 69, 76

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ABSTRACT: A two-stage carbonator for carbonating fluids in a single chamber having a venting system by which the chamber is at least partially vented of pressure to allow entry of fluid from a low-pressure line. The pressurized gas inlet directs the stream of gas tangentially to the liquid outlet through a normally open valve. The gas stream is thus directed into the chamber during discharge and passes adjacent the discharge opening thereby supercharging the exiting fluid, increasing the degree of carbonation.

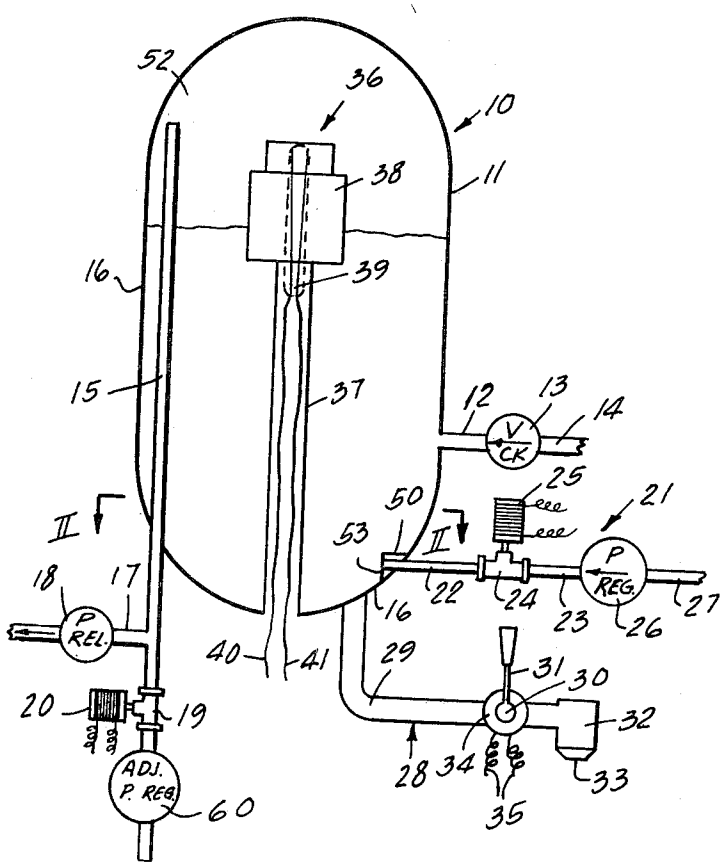


Fig. 1

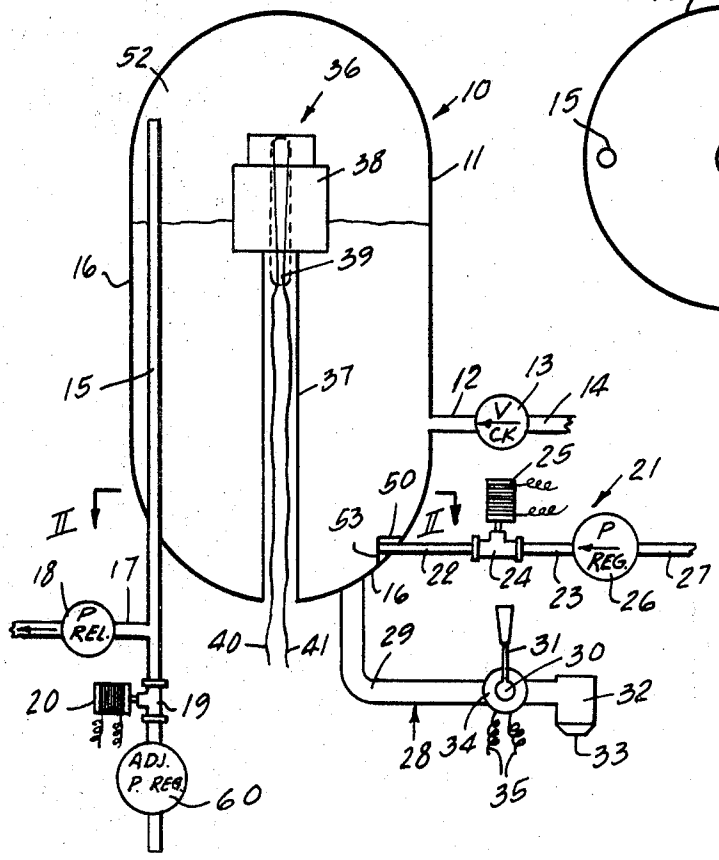
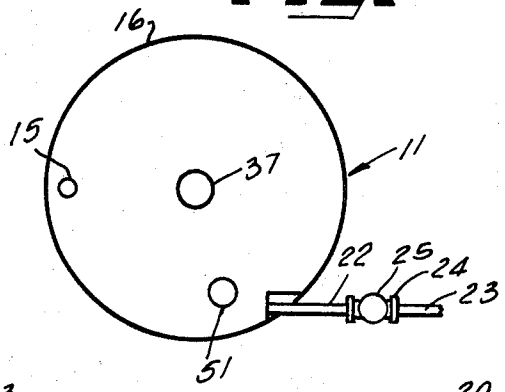


Fig. 2



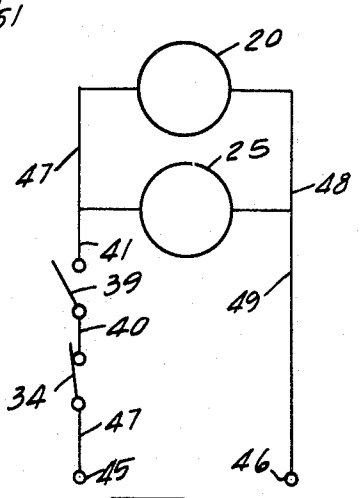


Fig. 3

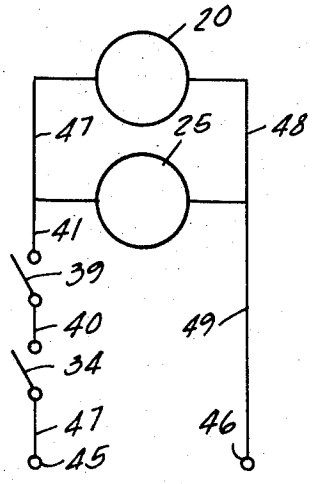


Fig. 4

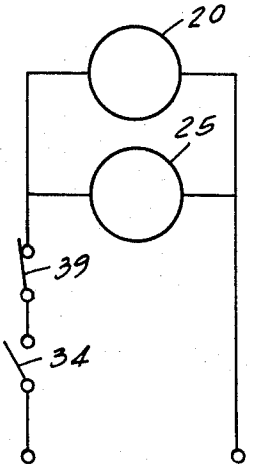


Fig. 5

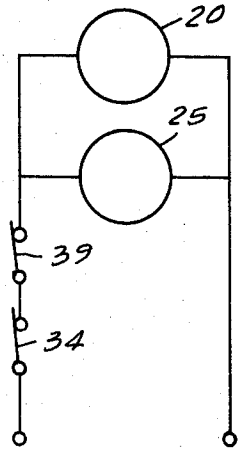


Fig. 6

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METHOD OF AND APPARATUS FOR CARBONATING, HAVING INTERSECTING STREAMS OF GAS AND LIQUID

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to methods, systems and apparatus for the carbonation of fluids and more particularly for carbonating water with CO_2.

2. Prior Art

Devices designed to mix a liquid such as water with a gas such as CO_2 to carbonate the liquid, producing soda water, are known to the prior art. In order to carbonate the liquid, it is necessary to utilize a pressure chamber in which the liquid and gas are intermixed to dissolve a portion of the gas in the liquid. Most prior art devices have maintained pressure in the mixing chamber and have introduced both gas and liquid thereto under pressure. This requires a pump or other such device to feed the liquid to the chamber.

Inasmuch as the amount of CO_2 dissolved into the liquid is dependent upon temperatures and pressures encountered in the system, the amount of carbonation of the withdrawing liquid can vary. Additionally, it may be desirable to add a further carbonation to the system during dispensing to provide a back pressure to force the soda from the mixing chamber. The prior art carbonation devices, while using additional gas flow to the pressure vessel to aid in dispensing soda, have not utilized this gas flow to aid in the carbonation of the dispensed fluid.

SUMMARY OF THE INVENTION

The present invention overcomes the deficiencies in the prior art by providing a fluid carbonator which introduces fluid to the pressure chamber at a normal line pressure and, by appropriate direction of the entering gas stream, adds gas to the pressure chamber during dispensing in such a manner that the added gas supercharges the soda water, hereinafter referred to as soda, fluid or carbonated fluid, being dispensed.

The pressure mixing chamber is provided with a valve-operated vent adapted to vent the interior of the pressure chamber to the atmosphere. This vent is open during the filling operation, thereby allowing the pressure chamber to be filled with fluid from a low pressure line such as a standard water tap. During this operation, the pressurized gas supply system is closed. When the fluid level in the chamber has reached the desired level, as sensed by a buoyant float, the vent is closed and the pressurized gas supply system is opened, thereby allowing the chamber to be pressurized with CO_2. The presence of high-pressure CO_2 in the pressure chamber causes a backflow of pressure into the fluid supply system actuating a check valve to cutoff fluid flow. When the pressure in the chamber rises to a point of equalization with the pressure in the gas supply system, the gas flow ceases. As soda is withdrawn from the chamber, gas again begins to flow into the pressure chamber. The gas inlet is directed substantially tangential (i.e. more tangential than not) relative to the dispensing outlet, thereby causing a gas stream to flow past the fluid being dispensed. A portion of this gas is picked up by the dispensing fluid thereby supercharging the fluid and adding carbonation thereto. After dispensing has been completed, if the fluid level in the pressure chamber has fallen below a desired point, the gas supply system is closed and the vent is opened, thus reducing pressure within the chamber to atmospheric and allowing refill by fluid through the check valve.

An adjustable pressure regulator may be attached to the vent to allow the vent system to selectively retain a desired pressure in the pressure chamber during refilling. This is particularly advantageous in situations where the pressure chamber is attached to a high pressure fluid source. In such situations the adjustable pressure regulator can be set to a pressure slightly below the fluid line pressure but above atmospheric pressure. This provides a saving in CO_2 inasmuch as the pressure chamber is not entirely evacuated during refilling with fluid. In those situations where a low fluid line pressure is encountered, the adjustable pressure regulator attached to the vent system can be set to a lower pressure retention figure or even to atmospheric pressure.

The present invention thereby provides a liquid carbonator which can operate from a low-pressure level fluid source without the need of pumps or other fluid flow enhancers and which supercharges the carbonation of the liquid during dispensing from the mixing chamber.

It is therefore an object of this invention to provide a new and improved liquid carbonator.

It is a further object of this invention to provide a liquid carbonator having a mixing chamber which can receive a flow of fluid from a low-pressure source and which supercharges the fluid upon dispensing from the mixing chamber.

It is a further and more specific object of this invention to provide a liquid carbonator having a mixing chamber with a dispensing orifice and a gas inlet orifice directed with respect to the discharge orifice such that gas entering the chamber supercharges fluid being dispensed therefrom.

It is yet another and more specific object of this invention to provide a liquid carbonator having a mixing chamber with a discharge outlet and a gas inlet therein, the gas inlet directed substantially tangential (i.e. more tangential than not) to the liquid outlet and apparatus for causing gas inflow during discharging of the liquid so that the discharged liquid is supercharged to a higher state of carbonation during discharge.

It is still another object of this invention to provide a liquid carbonator having a mixing chamber vented to atmosphere during refilling with an adjustable pressure regulator for selectively retaining a desirable level of pressure within the chamber less than the fluid inlet pressure during refilling and apparatus for supercharging to a higher level of carbonation dispensing liquid.

Other and further objects of this invention will be apparent to those skilled in this art from the following detailed description of the annexed sheets of drawings which, by way of a preferred embodiment of the invention, illustrate one example of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic view in cross section illustrating the carbonator of this invention.

FIG. 2 is a cross-sectional view taken along the lines II–II of FIG. 1.

FIG. 3 is a schematic diagram of an electrical circuit for the carbonator of this invention illustrating the initial position in the operating sequence.

FIG. 4 is a view similar to FIG. 3 illustrating the second position in the operating sequence thereof.

FIG. 5 is a view similar to FIGS. 3 and 4 illustrating the third position in the operating sequence thereof.

FIG. 6 is a view similar to FIGS. 3, 4 and 5 illustrating the fourth position in the operating sequence thereof.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The carbonator 10 of this invention includes a pressure mixing chamber 11 which is illustrated as being oval but which may be of other configurations. The mixing chamber 11 has a conduit 12 communicating therewith on one end and communicating with a check valve 13 on the other end. The check valve 13 is operatively connected to a conduit 14 adapted to be connected to a fluid supply source, such as a standard water tap line, associated with a fluid at a positive pressure. The check valve 13 is of the type designed to allow fluid flow in one direction only, in this instance into the mixing chamber 11. When the pressure in the mixing chamber 11 is greater than the positive pressure of the fluid in the conduit 14, thereby tending to force fluid back through the conduit. The check valve 13 will block such fluid flow.

A vent pipe 15 projects through a wall 16 of the mixing chamber 11 and terminates near the top thereof. Although the

vent pipe 15 is illustrated as being a simple conduit, it is to be understood that it may take other configurations such as a simple valve opening in the mixing chamber 11.

The vent pipe 15 communicates with a conduit 17 in which is associated in pressure release valve 18 adapted to open if the pressure in the mixing chamber 11 exceeds a safe level. The vent pipe 15 also has associated therewith a normally closed valve 19 which is illustrated as being operated by a solenoid 20. An adjustable pressure regulator 60 may be associated with the vent pipe 15 downstream from the valve 19. The adjustable pressure regulator 60 allows selective regulation of the amount of pressure retained in the pressure chamber during venting.

A gas supply system 21 is operatively connected to the mixing chamber 11 and comprises a conduit 22 which enters the wall 16 of the mixing chamber near the bottom of the chamber and direct the gas substantially tangential (i.e. more tangential than not) to a carbonated fluid discharge opening 51. The conduit 22 is attached to a further conduit 23 through a normally open valve 24 which is illustrated as being operated by a solenoid 25. The conduit 23 is operatively connected to a pressure regulator 26 which in turn is operatively connected to a further conduit 27 adapted to be connected to a source of pressurized CO_2. The pressure regulator 26 is adapted to provide a constant pressure to the mixing chamber 11, as for example 100 lb. per sq. in., even though the pressure in the conduit 27 may be considerably above that.

A dispensing system 28 is associated with the mixing chamber 11 and is illustrated as comprising a conduit 29 one end portion of which is connected to the discharge opening 51, the other end portion extends through the wall 16 of the mixing chamber at the bottom thereof and terminates in a valve 30 operated by a dispensing handle 31. A mixing head 32 having a dispensing opening 33 therein is operatively connected to the valve 30.

In those installations where it is desired to mix the carbonated fluid from the mixing chamber 11 with a flavoring syrup, the syrup supply system can also be infed to the dispensing valve 30 and mixed with the soda in the mixing head 32.

Also associated with the dispensing valve 30 is a normally closed switch 34 having electrical wires 35 attached thereto. The switch is adapted to be operated by the dispensing handle 31 coextensively with the valve 30. The switch 34 can be considered as being a first control system.

A second control system 36 is positioned within the mixing chamber 11 and is adapted to sense the fluid level therein. The second control system is illustrated as comprising a central column 37 extending from the bottom of the mixing chamber 11 to near the top thereof. A buoyant float 38 is positioned around the column 37 and adapted to move up and down thereon. Near the top of the column 37 interior thereof is a reed switch 39. The reed switch 39 is of a type normally closed in its free state. A magnet associated with the float 38 is adapted to open the switch 39 when the float rises to a certain point on the column 37. Opening of the switch 39 breaks the contact between the electrical wires 40 and 41.

OPERATION OF THE CARBONATOR

FIGS. 3 through 6 schematically illustrate a simplified wiring diagram for the carbonator 10. The system comprises two switches 34 and 39 and the two solenoid valve operators 20 and 25 with the switches in series and the valve operators in parallel. As has been stated above, the switches 34 and 39 are normally closed while the valve 24 on the gas inlet 22 operated by the solenoid 25 is normally open.

FIG. 3 illustrates the system as it is pictured in FIG. 1 with the mixing chamber 11 filled with fluid to its desired operating height. At this point, the switch 34 is closed while the switch 39, due to the presence of the magnet carried by the float 38, is held open. Therefore the solenoids 20 and 25 are not energized by the power source to which the ends 45 and 46 of the wires 47, 48 are coupled. The solenoids 20 and 25 are parallelly connected between the wires 47 and 48.

At this point, the valve 19 on the vent pipe 15 is closed while the valve 24 on the gas supply system 21 is open. Therefore pressurized CO_2 is free to pass into the mixing chamber 11 where some of it will be dissolved in the fluid in the chamber while the remainder rises to the upper portion 52 of the chamber pressurizing the chamber to whatever pressure level the pressure regulator 26 is set. The presence of pressure in the chamber 11 greater than the line pressure in the conduit 14 attached to the fluid supply system produces a back pressure in the conduit 12 effective to actuate the check valve 13 thereby preventing flow of fluid into the mixing chamber 11.

When it is desired to withdraw soda from the mixing chamber 11 the handle 31 on the dispensing valve 30 is actuated to open the valve thereby passing soda through the conduit 29 to the mixing head 32 where it may be mixed with flavored syrup or the like. Actuating the valve 30 opens the switch 34 associated therewith producing the electrical configuration shown in FIG. 4. At this point, the valve 19 is still closed, the valve 24 is open and the valve 30 is open. Both the switches 34 and 39 are open, thereby preventing energization of the solenoids 20 and 25. Fluid from the mixing chamber will then be forced out of the chamber due to the presence of high pressure therein. As fluid is withdrawn from the chamber the pressure therein will drop, destroying the pressure equalization in the gas supply system and allowing further gas to enter the chamber 11 in an attempt to continue to pressurize it at the pressure set by the pressure regulator 26. The entering gas from the conduit 22 acts, in a manner hereinafter described, to supercharge the exiting fluid and to continue the pressure in the mixing chamber at the desired level.

As more fluid is withdrawn, the buoyant float 38 will move down the column 37 to a point where the magnets carried by the float will cease to retain the switch 39 in its open position. Contact will therefore be made between the wires 40 and 41 which are illustrated in the schematic drawings as being a part of the wire 47. This condition is illustrated in FIG. 5 where the switch 34 associated with the dispensing valve 30 remains open due to the actuation of the handle 31 while the switch 39 on the central column is now closed due to the removal of the buoyant float 38. The solenoids 20 and 25 will remain unenergized so that the valve 19 remains in its normally closed position and the valve 24 remains in its normally open position.

After the desired amount of soda has been withdrawn from the mixing chamber 11 and the valve 30 is closed by releasing the handle 31, the electrical schematic will be as represented in FIG. 6. The switch 34 associated with the dispensing valve 30 will now be closed connecting the wires 35. Further, because of the reduction in fluid level within the chamber 11, the switch 39 in the central column 37 will also be closed. Therefore electricity may flow from the power source through the wires 41, 47, 48 and 49 energizing the solenoids 20 and 25. Energization of the solenoid 20 will open the normally closed valve thereby venting the interior of the mixing chamber 11 to the atmosphere. At the same time the solenoid 25 will close the valve 24 thus cutting off flow of gas to the interior of the mixing chamber. With the gas cutoff and the vent open, the pressure in the mixing chamber 11 will rapidly drop to atmospheric. Due to the presence of a positive pressure in the liquid supply system conduit 14, the check valve 13 will open. Fluid will thus flow through the conduit 12 into the interior of the mixing chamber 11. As the chamber 11 fills with fluid from the conduit 12, the buoyant float 38 will rise up the central column 37. When the float 38 has reached a position where the magnets carried thereby are in a position to open the switch 39, electrical contact will be broken and the system will revert to that illustrated in FIG. 3.

At that point, the solenoid 20 will be deenergized and the valve 19 will be returned to its normally closed position by means such as springs or the like. This will stop venting of the chamber to the atmosphere. At the same time, deenergization of the solenoid 25 will allow the valve 24 to return to its nor-

mally open position and a flow of gas will begin from the gas supply system through the conduit 22 to the interior of the mixing chamber. This flow is caused by the difference in pressure between the interior of the mixing chamber and the gas supply system downstream of the pressure regulator 26.

As the gas flows into the mixing chamber under pressure, part of it will be dissolved into the liquid thereby changing it into carbonated fluid while the remaining gas will rise to the top of the chamber and pressurize it. The buildup of pressure caused by the entrance of pressurized gas into the mixing chamber will cause a flow back through the conduit 12 closing the check valve 13. As the pressure in the mixing chamber 11 reaches that set on the pressure regulator 26 an equalization of pressure will occur and the flow of gas into the pressure chamber 11 will cease.

It can therefore be seen that the gas flow to the interior of the pressure chamber is always cutoff during filling of the chamber and that the chamber is vented to atmospheric pressure at such times. It is also to be noted that during dispensing of soda from the pressure chamber 11, gas continues to be introduced through the gas supply system 21 to the chamber.

In a modification of the above operation, an adjustable pressure regulator 60 is provided in the vent system. The adjustable pressure regulator 60 allows a selected pressure to be retained in the pressure chamber during venting of the chamber. Therefore in situations where the fluid pressure in the conduit 14 is relatively high, the adjustable pressure regulator 60 can be set at a level below that pressure but above atmospheric pressure thereby retaining a pressure in the pressure vessel even though the valve 19 is open. Such a pressure will not hinder flow of fluid to the pressure chamber in as much as the fluid line pressure still remains greater than the pressure interior of the pressure chamber.

The provision of a flow of gas to the pressure chamber during dispensing is important and it can be seen that even if a small amount of fluid is withdrawn from the chamber during dispensing, the gas flow continues. This is true even though the amount withdrawn is insufficient to allow the float 38 to move down the central column 37 to a point where the reed switch 39 is allowed to close. This is because of the presence of the normally open valve 24 in the gas supply system 21.

It is sometimes desirable to increase the amount of carbonation of the fluid in the mixing chamber. In some instances this has been accomplished through the use of agitating pumps and/or other means. The present invention contemplates the use of a supercharging capacity utilizing the gas flow from the gas supply system 21 during dispensing.

For this purpose, an indentation or ledge 50 is formed in the wall 16 of the pressure vessel 11 near the bottom thereof and adjacent the opening 51 from which the dispensing conduit 29 extends. The conduit 22 terminates at a backwall 53 of the ledge 50 and projects the gas stream into the interior of the pressure vessel 11 through an aperture in the wall 53. The conduit 22 is so located with respect to the opening 51 that the gas stream entering the mixing chamber 11 is directed substantially tangential (i.e. more tangential than not) relative to the opening 51.

Due to the provision of a continuing gas stream during dispensing and due to the location of the entrance of the gas stream with respect to the discharge opening 51, some of the entering CO_2 will be dissolved in the exiting soda, thereby supercharging the exiting soda with CO_2 and by this second stage carbonation, increasing the degree of carbonation of the exiting soda over that which it was in the carbonator prior to dispensing. The remaining CO_2 not picked up by the exiting soda will rise to the upper portion 52 of the mixing chamber 11 to maintain the pressure in the mixing chamber 11 and to aid in forcing the soda out of the discharge opening 51.

Although the entering gas stream is described as being directed tangentially to the opening 51 in order to minimize turbulence, it is to be understood that the gas stream could be passed directly over or chordally to the opening or at some other relative direction thereto. It is also to be understood that a nozzle may be placed on the end of the conduit 22 interior of the mixing chamber 11 to further aid in the direction of the gas stream and to enhance the second stage carbonation of the dispensing fluid.

We claim:

1. In a carbonator for carbonating fluids in a mixing chamber having liquid and gas inlets to the chamber and a dispensing outlet adapted to pass carbonated fluid from the chamber, the improvement of: continuing the gas flow under pressure into the chamber during dispensing of fluid from the chamber and directing the entering gas stream past the dispensing outlet to increase the carbonation level of the fluid being dispensed, the gas inlet conduit terminating in relatively close spaced relation to the outlet opening and the pressured gas stream from said conduit being directed with regard to the outlet such that the fluid stream to the outlet partially intersects the gas stream.

2. The carbonator of claim 1 wherein the gas stream is directed to one side of the dispensing opening.

3. The carbonator of claim 2 wherein the gas stream is directed tangentially to the dispensing opening.

4. A carbonator for carbonating fluids comprising: a pressure vessel mixing chamber, a vent connected to said chamber adapted to vent the interior thereof to the atmosphere, a fluid source connected with said mixing chamber adapted to supply fluid thereto, a relatively high pressure gas source connected to said mixing chamber and adapted to supply pressurized gas thereto, a dispensing opening in said chamber adapted to withdraw fluid from the interior thereof, means for closing the vent, means for shutting off flow of fluid to the mixing chamber, means for shutting off flow of pressurized gas to the mixing chamber, means for stopping withdrawal of fluid from the mixing chamber, means for controlling the vent means and gas means, and means for adding carbonation to fluid being withdrawn from the chamber throughout said dispensing opening, the inlet conduit from the gas source terminating in relatively close spaced relation to the dispensing opening, the gas stream from the conduit being directed at the dispensing opening such that the fluid stream from the chamber through the dispensing opening partially intersects the relatively high pressure gas stream from the conduit.

5. A device for adding carbonation to a fluid comprising:
a pressure vessel mixing chamber;
a vent for said chamber;
a fluid supply system for said chamber;
a pressurized gas supply system for said chamber;
a dispensing system for said chamber;
first valve means adapted to open and close said vent;
second valve means adapted to open and close said fluid supply system;
third valve means adapted to open and close said gas supply system;
fourth valve means adapted to open and close said dispensing system;
first control means;
said first control means responsive to actuation of said fourth valve means;
said first control means adapted to override a second control means;
said second control means responsive to fluid level in said chamber;
said second control means adapted to control said first and third valve means;
said second valve means responsive to pressure in said chamber adapted to supply fluid to said chamber in the absence of pressure in said chamber;
said first control means effective to continue supply of gas through said gas supply system to said chamber during dispensing of fluid from said chamber through said dispensing system;
said dispensing system having a dispensing opening in said chamber;
said pressured gas supply system terminating in said chamber adjacent said dispensing opening;

and said termination of said gas supply system effective to add carbonation to the fluid being dispensed from said chamber during dispensing.

6. The method of carbonating a fluid in a mixing chamber which comprises: providing a fluid in said chamber, adding a relatively highly pressurized carbonating gas to said chamber until a desired pressure is achieved in said chamber thereby carbonating the fluid in said chamber to a first level of carbonation, terminating the supply of fluid to said chamber, dispensing a portion of said fluid from said chamber through an opening in said chamber, supplying an additional amount of said relatively high pressure gas to said chamber in a gas stream during dispensing of said portion of said fluid, supplying said additional gas adjacent said opening, the gas stream at least partially intersecting with the fluid stream exiting through said opening and dissolving a portion of said additional gas in the fluid being dispensed through said opening thereby raising the carbonation of said dispensing fluid to a second level.

7. The method of claim 6 wherein said additional amount of gas is supplied tangentially to said opening.

8. A method of adding carbonation to a carbonated fluid which comprises: containing a carbonated fluid in a chamber, providing a dispensing opening in the chamber, withdrawing a portion of the fluid from the chamber through the opening, providing a stream of relatively high pressure carbonating gas within the chamber adjacent the opening during withdrawal of said portion, providing said stream of relatively high pressure carbonating gas at a point in the chamber positioned relative to the opening whereby the exiting stream of relatively high pressure gas intersects with a portion of the fluid flow stream of said carbonated fluid flowing towards and through the said opening during withdrawal, and dissolving a portion of said gas in the fluid being withdrawn through the opening.

9. The method of claim 8 wherein the gas stream is provided tangentially to said opening.

10. The method of claim 8 wherein the remainder of the gas in said stream is contained in the chamber to pressurize the chamber to aid in forcing of fluid out of the opening.

11. The carbonator of claim 4 wherein an adjustable pressure regulator is connected to said vent effective to retain a selected pressure in said chamber when said vent is opened.

12. The device of claim 5 wherein an adjustable pressure regulator is connected to said vent effective to selectively retain a desired pressure in said chamber less than the pressure in the said fluid supply system when said first valve means is positioned to open said vent.