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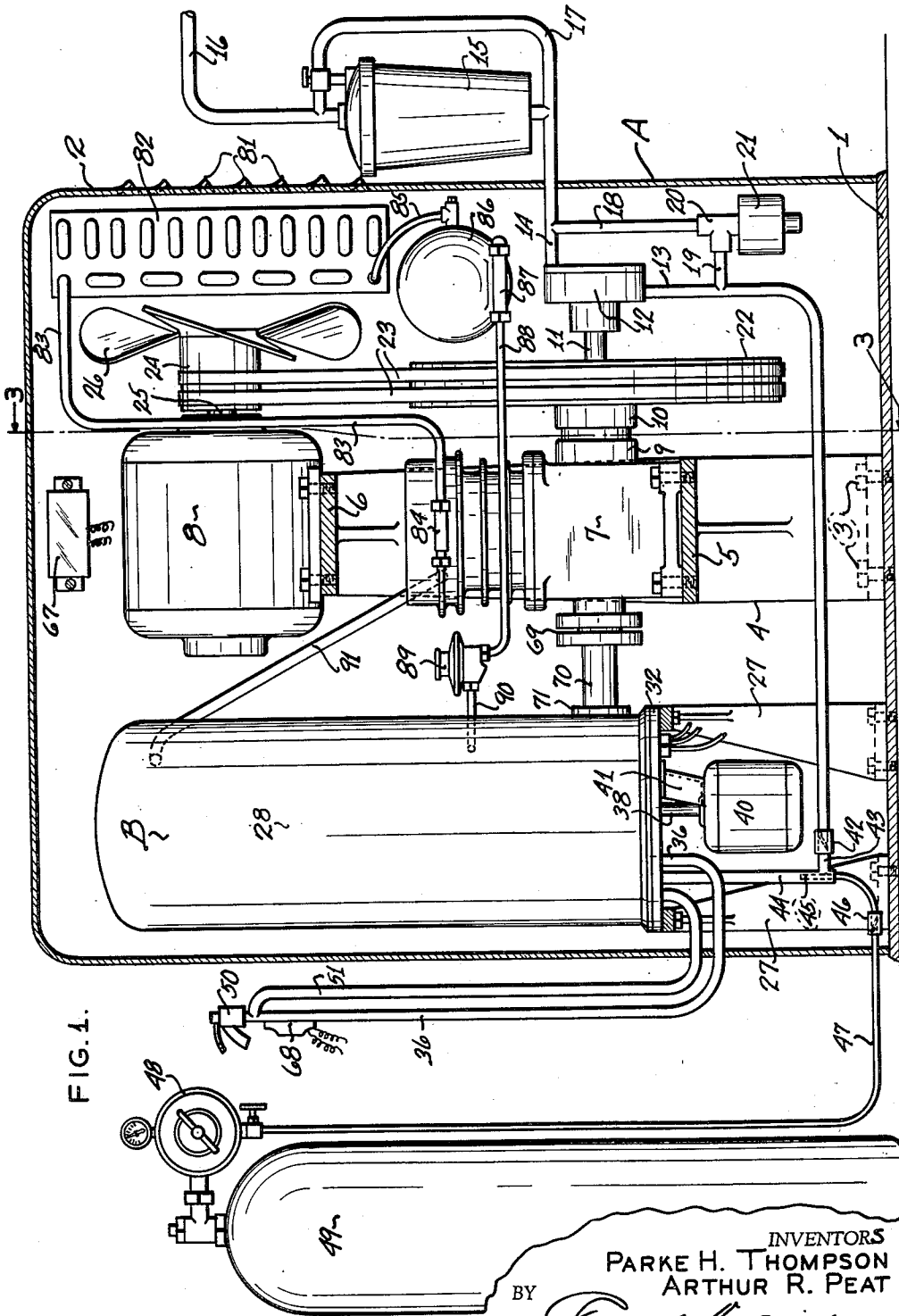
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2,337,783

LIQUID CARBONATOR

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3 Sheets-Sheet 1



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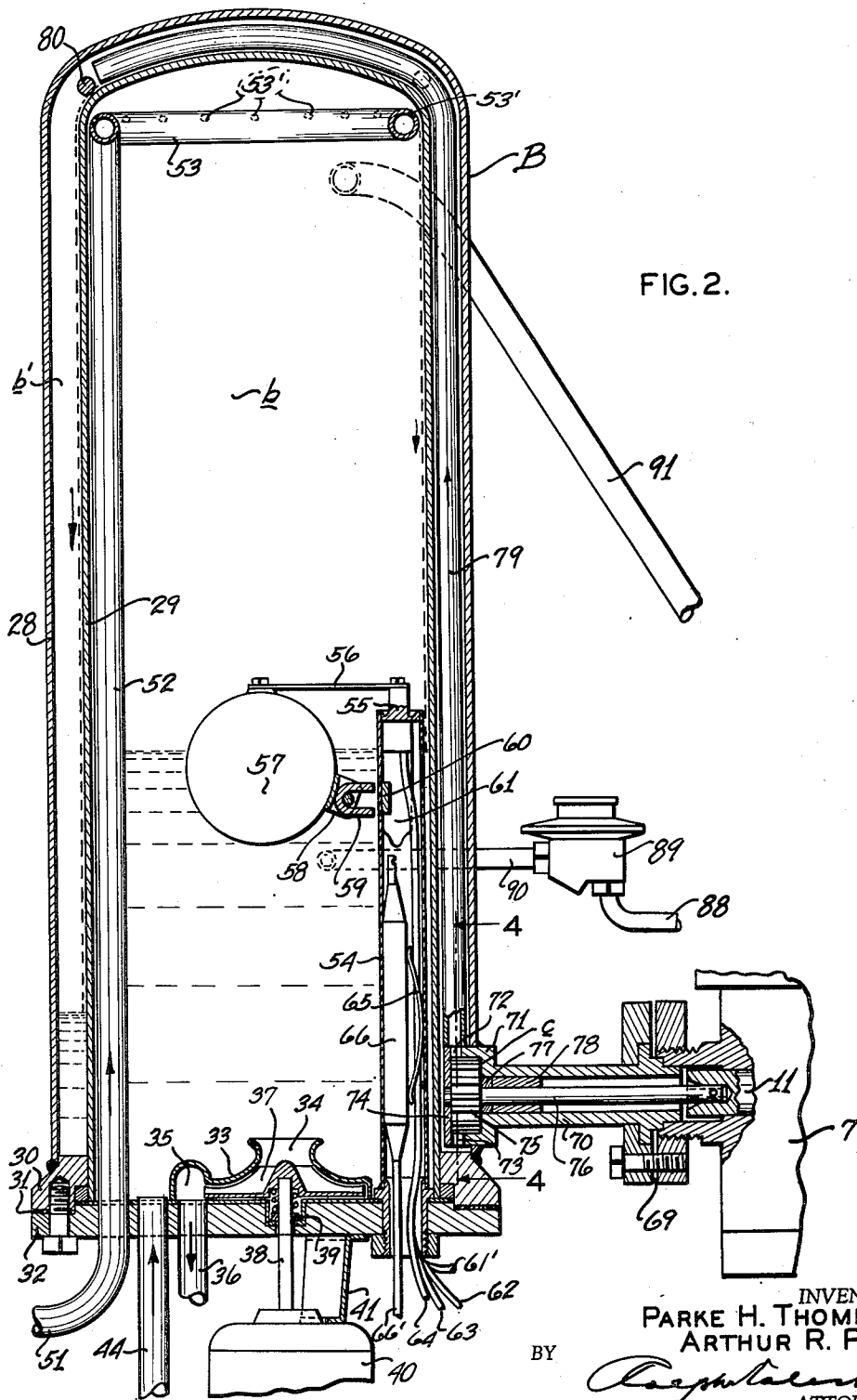
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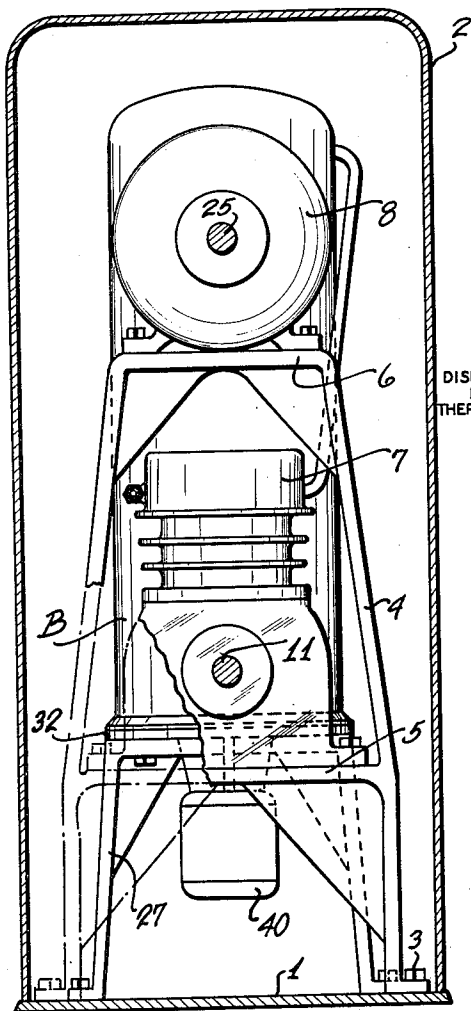


FIG. 3.

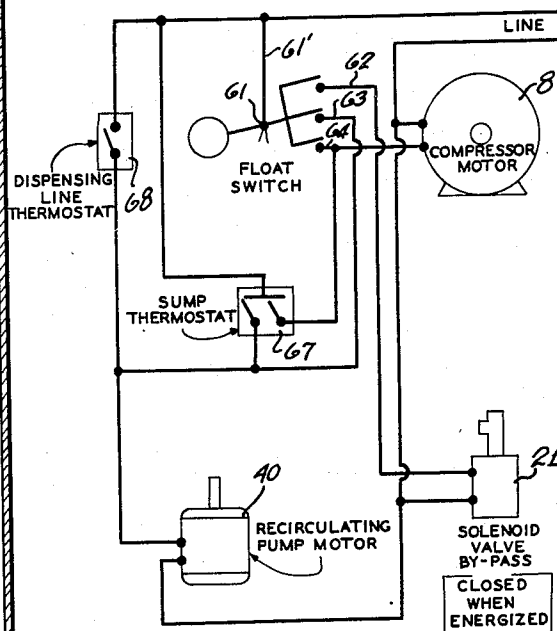


FIG. 5.

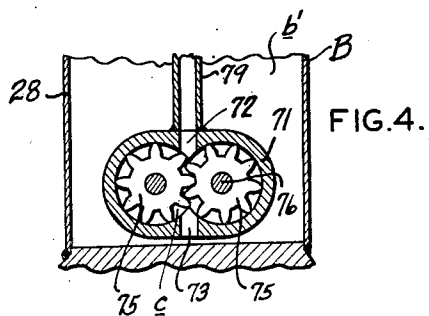


FIG. 4.

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LIQUID CARBONATOR

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Application September 6, 1946, Serial No. 355,635

10 Claims. (Cl. 62-141)

This invention relates to certain new and useful improvements in liquid carbonators.

Our invention has for its primary objects the provision of a carbonator which is uniquely capable of producing carbonated liquid of extremely high gas content, of continuously recirculating the liquid to be carbonated through the carbonation chamber and also recirculating the carbonated liquid through a system having one or more dispensing valves, of maintaining the carbonated liquid at low temperature and high carbon-dioxide concentration throughout the system at all times, and of operating at relatively low gas pressure, thereby increasing precision of control and efficiency of gas absorption.

Our invention has for a further object the provision of a carbonator having the unique characteristics mentioned which is compact in form and structure and adapted for installation in a small or constricted space which may be cheaply and readily constructed, and which is economical in power consumption and maintenance costs and highly satisfactory and efficient in the performance of its stated functions.

And with the above and other objects in view, our invention resides in the novel features of form, construction, arrangement, and combination of parts presently described and pointed out in the claims.

In the accompanying drawings (three sheets),

Figure 1 is an elevational view, partly in vertical section, of a carbonator constructed in accordance with and embodying my present invention;

Figure 2 is an enlarged vertical sectional view of the carbonating-chamber of the carbonator;

Figure 3 is a sectional view of the carbonator taken approximately along the line 3-3, Figure 1;

Figure 4 is a detail sectional view of the refrigerant recirculating pump of the carbonator taken approximately along the line 4-4, Figure 2; and

Figure 5 is a schematic wiring diagram of the electrical connections between the several control elements of the carbonator.

Referring now in more detail and by reference characters to the drawings, which illustrate a preferred embodiment of my invention, the carbonator has a preferably flat oblong rectangular base-plate 1 of cast-iron or other suitable material and provided on its upper face with a removable hollow shell or housing 2 preferably constructed of suitable sheet metal.

Bolted or otherwise secured, as at 3, centrally

upon, and upstanding within the shell 2 from, the base 1, is a main or double bracket 4 comprising superposed horizontal plates 5, 6. Resting upon and suitably fixed to the upper plate 5, is a conventional electric motor.

Disposed horizontally through the compressor 7 and adjacent conventional rotary seals 9, 10, is a main shaft 11 provided at its one or outer end with a preferably rotary pump 12 suitably mounted upon a side wall of the shell 2 and comprising a discharge line 13 and an intake line 14, the latter communicating through a conventional Buhrstone filter 15 with a water intake-line 16. For convenience, an auxiliary or so-called "backwash" line 17 is provided for cleansing the filter 15 when desired. The intake line 14 and discharge line 13 are, respectively, connected through by-pass conduits 18, 19, to a T-fitting 20, in turn, connected to a solenoid operated stop-valve or control 21.

Intermediate the compressor 7 and the pump 12, the shaft 11 is provided with a drive pulley 22 connected by means of belts 23 with a sheave 24 keyed upon the shaft 25 of motor 8 and provided upon its outwardly presented end with an air impelling or cooling fan 26.

Supported, as by means of brackets or standards 27 within the shell 2 and in upwardly spaced relation to the base 1, is a carbonating vessel B, which includes an outer dome-shaped shell 28 and an inner similarly shaped smaller shell 29 welded or otherwise fixed in concentric relation at their lower open ends upon the outer and inner peripheral faces, respectively, of a base ring 30, in turn, equipped with a gasket 31 and bolted upon a horizontally disposed disk-plate 32 in the provision of an interior or carbonating chamber b and an intermediate or jacketing chamber b'.

Mounted within the chamber b upon the upper face of the plate 32, is a recirculation pump 33 preferably of the centrifugal impeller type having an upwardly presented intake orifice 34 and a downwardly presented discharge chamber 35 opening into a distributing pipe or conduit 36. The rotary element 37 of the pump 33 is provided with a shaft 38 extending downwardly through a suitable packing gland 39 in the base plate 32 for direct driving connection with a relatively small electric motor 40 dependently supported beneath the plate 32 by means of a plurality of hanger brackets 41 or the like.

The water-pump discharge line 13 is extended longitudinally over the base plate 1 and terminates under the carbonation vessel B in a suitable check valve 42, in turn, connected by means

of a short conduit 43 to a vertical injector leg 44 extending hermetically through the plate 32 and opening into the carbonating chamber b.

Projecting concentrically through, and sealed in, the lower end of the injector leg 44, is a gas nozzle 45 connected through a suitable check valve 46 and flexible conduit 47 to a conventional pressure reducing valve 48, in turn, mounted upon and having communication with a conventional carbon-dioxide cylinder 49.

The distributing pipe or conduit 36 extends through a side wall of the housing 2 and at its remote end is connected to a dispensing valve or faucet 50. Communicating with pipe 36 adjacent the faucet 50, as seen in Figure 1, is a return line 51, which re-enters the housing 2 hermetically through the plate 32 and extends upwardly along the inner face of the shell 29 in the provision of a recirculation leg 52, the latter opening at its upper end into a ring-like distributing header 53 positioned adjacent the upper or dome-shaped end-portion of the chamber b and provided with a series of spaced orifices 53' for showering the returning liquid over the inner face of the shell 29 in a thin downwardly flowing film.

Also extending through the plate 32 and projecting upwardly into the carbonating chamber b, is a hollow tubular control leg 54 provided at its upper end with a closure-plug 55 having a laterally presented spring leaf 56, in turn, provided with a float-ball 57, welded upon the outer face of which in juxtaposition to the control leg 54, is a suitable bracket 58 for supporting a permanent magnet 59 adapted, when brought into close proximity to the wall of the control leg 54, to attract the armature 60 of a triple contact mercury switch element 61 mounted with the control leg 54 and provided with a main-connection lead 61' and three contact-point leads 62, 63, 64.

Also mounted and yieldingly secured in place preferably by means of a bow-spring 65 within the control leg 54, is a temperature-responsive element 66 connected by means of a conduit 66' to a conventional two-pole relay type.

Finally an auxiliary thermostatic control switch 68, preferably of the single pole relay type, is mounted upon the distributing pipe 36 preferably at a point adjacent the most remote tap or dispensing spigot or faucet in the system, the mercury switch 61, the thermostatic control switches 67, 68, being electrically connected in circuit with the solenoid valve 21, compressor motor 8, and recirculating motor 40, as will presently more fully appear.

Hermetically sealed at one end by means of a conventional gland 69 to the housing of the compressor 7 and extending laterally therefrom coaxially with the compressor drive shaft 11, is a tubular member 70 at its other end with an enlarged somewhat elliptical pump casing 71 extending through, and hermetically sealed in, the outer shell 28 of the carbonating vessel B and internally machined and bored in the formation of a pump chamber c having a discharge orifice 72 and an intake orifice 73, the latter opening directly into the lower portion of the jacketing chamber b'.

Mounted in closure-wise disposition across the end of the casing 71, is an end plate 74, and journaled between the end plate 74 and the back or opposite end-wall of the casing 71, is a pair of meshing gears 75 in the formation of a conventional gear pump, one of the gears 75 being

fixed upon the end of an auxiliary shaft 76 extending concentrically through the tubular member 70 and packing rings 77, 78, disposed therein, for driving connection at its opposite end with the main drive shaft 11 of the compressor 7, all as best seen in Figure 2.

Welded or otherwise suitably fixed upon the outer face of the pump casing 71 for communication with the discharge orifice 72, and projecting vertically upwardly in the jacketing chamber b', is a refrigerant recirculation leg 79, which is extended transversely over the dome-shaped top of the inner carbonator shell 29 and opens into a distributing header formed preferably by a ring 80 spot-welded at spaced points upon the upwardly presented dome-shaped end of the inner carbonator shell 29 for showering refrigerant downwardly over the outer face of the inner shell 29 in a continuous rapidly moving sheet or film.

Mounted upon one of the side walls of the outer housing 2 adjacent ventilation louvers 81 and in front of the fan 26, is a condenser 82 having communication at an end through a suitable conduit 83 with a compressor discharge 84 conventionally mounted on the side of the compressor 7. At its other end, the condenser 82 has communication through a conduit 85 with a conventional liquid receiver 86 connected through a strainer coupling 87 and conduit 88 to a constant pressure expansion valve 89, in turn, connected by means of a conduit 90 to the outer carbonator shell 28 for communication with the intermediate chamber b'. Also sealed in the shell 28 for communication with the upper portion of chamber b', is a suction c or gas-return line 91 connected at its other end to the intake manifold of the compressor 7.

By referring to the wiring diagram Figure 5, it will be seen that the main connection 61' of the mercury-switch 61 and the stationary contact points of the thermostat switches 67, 68, are connected to one side of the main electrical input supply line. Similarly, one pole of the compressor motor 8, the recirculating pump motor 40, and the solenoid by-pass valve 21 are connected to the other side of the main electrical input supply line. The main-switch lead 62 is connected to the other pole of the solenoid valve 21; the mercury-switch lead 63 is connected to the contactor pole of the thermostatic-switch 68, one contactor pole of the relay thermostatic-switch 67, and also to the other pole of the recirculating pump motor; and the mercury-switch lead 64 is connected to the other pole of the compressor motor 8 and to the other contactor pole of the thermostatic-switch 67.

In use and operation, supply water enters the system through the inlet pipe 16, passing through the filter 15 and conduit 14 to the pump 12. When water is required in the inner carbonating chamber b, the water pump by-pass valve 21 will remain closed, allowing the pump 12 to force water through the check valve 42 into the carbonating chamber b. At the same time, carbon-dioxide passes through the reducing valve 48, conduit 47, check valve 46, and injection nozzle 45, entering the carbonator chamber with the inflowing fresh water, a part of the gas being absorbed by the liquid and the remainder passing into the free space within the carbonating chamber b. As soon as the level of liquid in the chamber b rises above the level of the recirculation pump orifice 34, the recirculation pump 33, which is in operation, will force the liquid through

the dispensing system and the recirculation leg 52 to the distributing header 53, from which it will cascade downwardly over the inner face of the shell 29 in a thin rapidly-moving film, thus exposing an extremely large area to the free carbon-dioxide in the chamber b. As will be evident, this recirculation is continuously maintained as long as the recirculation pump or motor 40 is in operation.

At the same time, liquid refrigerant is delivered into the intermediate or chamber space b' and as the level of liquid refrigerant rises above the intake orifice 74 of the refrigerant recirculation pump casing 71, the refrigerant is forced upwardly through the recirculation leg 79 and, by means of the header ring 80, caused to flow over the outer face of the inner shell 29 in a continuous rapidly moving thin film.

When the liquid has reached proper level in the chamber b, the float-ball 57 will ride upwardly, drawing the magnet 59 away from the proximity to the side wall of the control leg 54, releasing the switch armature 60 and permitting the switch 61 to open the control circuits for actuating the solenoid-operated by-pass valve 21 and causing the pump to short-circuit itself through the by-pass conduits 18, 19.

When the temperature of the residual carbonated water within the carbonating chamber b reaches a predetermined low limit, the thermostatic control 66 will operate to shut off the compressor motor 8, stopping the influx of liquid refrigerant into, and at the same time stopping recirculation of refrigerant within, the jacketing chamber b'. The recirculation pump 33, however, continues operation, if necessary, until the temperature of the carbonated water at the most remote point of the dispensing system reaches a predetermined limit. Thereupon, the thermostatic control 68 will operate to shut off the recirculation motor 40 and associated recirculation pump 33 until conditions in the system change.

It will also be noted by reference to Figure 5 that, irrespective of the mercury switch 61, the compressor motor 8 and recirculating motor 40 may be set in operation when the temperature of the carbonated water rises beyond the control temperature for which the thermostatic control switch 67 is set. Thus it will be seen that, during each cooling cycle, the water will be recirculated through the system and over the inner face of the shell 29. In addition, the recirculation motor 40 may be set in operation independently by the thermostatic switch 68 whenever the water in the dispensing system rises above the predetermined temperature for which the control switch 68 is set.

It will further be evident that the percentage of absorbed carbon-dioxide in the water may be varied by manipulating the gas-control valve 48 for producing a desired gas-pressure within chamber b. Once the valve 48 is set for a desired pressure, however, the pressure in chamber b will remain constant until the residual supply of gas in the gas cylinder 49 is substantially exhausted.

It will of course be evident that, by recirculating both the carbonated liquid and refrigerant in concurrent flow and in intimate heat exchange relationship through the inner shell 29, it is possible to obtain a maximum efficiency both as to cooling and carbon-dioxide absorption.

In addition, the recirculated liquid, which will have undergone an indeterminate temperature rise during its course through the distributing

system, will be chilled most quickly, so that there will be no material tendency to release any of its absorbed carbon-dioxide upon re-entry into the carbonator chamber b.

It will also be evident that the continuous recirculation and thinness of the flowing water film, in addition to providing a high degree of carbonation, will also maintain both the temperature and the carbon-dioxide concentration in the system substantially uniform.

Finally, by providing for independent recirculation of the carbonated liquid through the dispensing system, there is no tendency for the liquid to become warm in the pipes adjacent the dispensing taps. This eliminates the necessity for auxiliary refrigeration at the dispensing taps with attendant economies in equipment costs and maintenance and also obviates the troublesome tendency of carbonated liquid to give off its absorbed gas, forming gas pockets and causing explosive sputtering when the dispensing tap is opened.

The carbonator fulfills in every respect the objects stated, and it should be understood that changes and modifications in the form, construction, arrangement, and combination of the several parts of the carbonator may be made and substituted for those herein shown and described without departing from the nature and principle of my invention.

Having thus described my invention, what we claim and desire to secure by Letters Patent is:

1. A liquid carbonator comprising, in combination, a substantially tank-like inner shell, a substantially tank-like outer shell disposed enclosingly about and spaced from the inner shell in the provision of a jacketing space therearound, means for bringing liquid and gas into intimate absorptive contact within the inner shell, and means for introducing a vaporizable refrigerant into said jacketing space for cooling the inner shell and the contents thereof.

2. A liquid carbonator comprising, in combination, a substantially tank-like inner shell, a substantially tank-like outer shell disposed enclosingly about and spaced from the inner shell in the provision of a jacketing space therearound, means for introducing carbon-dioxide into the inner shell, means for flowing water over the inner surface of the inner shell for intimate absorptive contact with the carbon-dioxide within the inner shell, and means for flowing vaporizable liquid refrigerant over the outer face of the inner shell in a direction substantially concurrent with that of the water-flow.

3. A liquid carbonator comprising, in combination, a substantially tank-like inner shell, a substantially tank-like outer shell disposed enclosingly about and spaced from the inner shell in the provision of a jacketing space therearound, means for bringing liquid and carbon-dioxide gas into intimate absorptive contact within the lower part of said inner shell, means for introducing a vaporizable refrigerant into said jacketing space and in heat exchange relationship with the inner shell for cooling the contents thereof, means for supplying carbon dioxide gas in excess of the amount normally taken up by absorptive contact with the liquid and means for recirculating the refrigerant over the outer face of the inner shell during carbonation.

4. In a liquid carbonator, a vessel having a substantially tank-shaped inner shell and a substantially tank-shaped outer shell disposed en-

closely around the inner shell, means for introducing carbon-dioxide into the inner shell under pressure, means for flowing liquid to be carbonated over the inner face of the inner shell, and means for concurrently flowing liquid refrigerant over the outer face of the inner shell.

5. A liquid carbonator comprising, in combination, a substantially tank-shaped shell, a substantially tank-shaped outer jacket disposed enclosingly around and spaced outwardly from the shell in the provision of a jacketing space, means for introducing carbon-dioxide under pressure into the shell, means for introducing liquid into the shell, and means for recirculating the liquid in a thin film over the inner face of the shell for bringing the liquid and gas into adsorptive contact, and means to supply a liquid refrigerant at the top between said shells to flow by gravity in a thin film down over the inner shell.

6. In apparatus of the character described, a carbonator comprising a hollow substantially tank-like vessel having chilled side walls, means for introducing liquid into the bottom of the vessel, means for introducing carbon-dioxide gas into the bottom of the shell below the normal liquid level therein whereby the carbon-dioxide gas is absorptively presented to the liquid with excess gas rising through the liquid and creating a high-pressure atmosphere of gaseous carbon-dioxide in the upper part of the vessel, and means for withdrawing the initially carbonated liquid from the lower part of the vessel and flowing the liquid downwardly over the inwardly presented surface of the chilled side walls of the shell in a substantially uninterrupted thin sheet for direct adsorption of carbon-dioxide gas.

7. In apparatus of the character described, a carbonator comprising a hollow substantially tank-like vessel, means for chilling the side walls of said vessel, means for supplying liquid to be carbonated into the lower portion of said vessel, a liquid distributing header in the upper portion of the vessel adapted for distributing liquid over the inner chilled wall of the vessel in a downwardly flowing thin film, means for supplying carbon-dioxide gas to the lower part of said vessel at a point below the liquid level therein whereby a portion of the gaseous carbon-dioxide is taken up absorptively by the liquid with unabsorbed gas creating a high-pressure atmosphere of gaseous carbon-dioxide in the upper part of the vessel, and means for withdrawing the initially carbonated liquid from the lower portion of the vessel and discharging such liquid through the header to flow in the thin film and thus be presented for surface adsorption during flow over said chilled side wall surfaces.

8. In apparatus of the character described, a carbonator including a hollow, substantially tank-like vessel having a lower portion adapted to receive a body of liquid and an upper portion

adapted to enclose a high-pressure gas atmosphere, said vessel having upstanding side walls, means supplying liquid to be carbonated to the lower portion of the vessel, means to supply gaseous carbon-dioxide to the lower portion of said vessel below the liquid level whereby the gas rises through the body of liquid to charge said liquid absorptively with excess gas rising into the upper part of said vessel, a liquid spray header in the upper part of the vessel, a connection from the lower liquid-containing portion of the vessel to said liquid spray header, and means for withdrawing liquid from the lower portion of the vessel to flow through the connection and to discharge through the spray header against the inner surfaces of the upstanding walls to flow downwardly in a substantially smooth and unbroken film for surface-contact gas adsorption.

9. A carbonator comprising a tank-like vessel having upstanding side walls, means for chilling said side walls, means for introducing liquid to be carbonated into the lower part of said vessel, means introducing gaseous carbon-dioxide into the lower part of said vessel beneath the liquid level therein whereby the liquid is initially carbonated by absorption due to the gas rising there-through with the excess gas accumulating in the upper part of the vessel, level control means for limiting the amount of initially carbonated liquid within the vessel for maintaining an atmosphere of high-pressure gaseous carbon-dioxide in the upper portion of the vessel above the initially carbonated liquid, and means for withdrawing the initially carbonated liquid from the lower part of the vessel and discharging the withdrawn liquid in a rapidly flowing thin film over the chilled inner sides of the walls of the vessel for secondarily carbonating the liquid by adsorption.

10. A carbonator comprising a vessel having inner and outer tank-like shells, means for introducing liquid to be carbonated into the lower part of the inner shell to a level leaving the upper part of said inner shell as a gas chamber, means for introducing gaseous carbon-dioxide into the lower part of said inner shell below the liquid level therein whereby the gaseous carbon-dioxide flows into and through the liquid for absorption carbonization, with excess carbon-dioxide collecting in the gas chamber in the upper part of said inner shell, means for flowing a liquid refrigerant over the outer side of the upper part of said inner shell and consequently cooling the walls of the gas chamber, and means for circulating the initially carbonated liquid from the lower part of said inner container to expose the circulated liquid in a rapidly flowing thin film over the inner side of the chilled walls of the gas chamber of said inner vessel for secondarily carbonating the liquid by adsorption.

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