

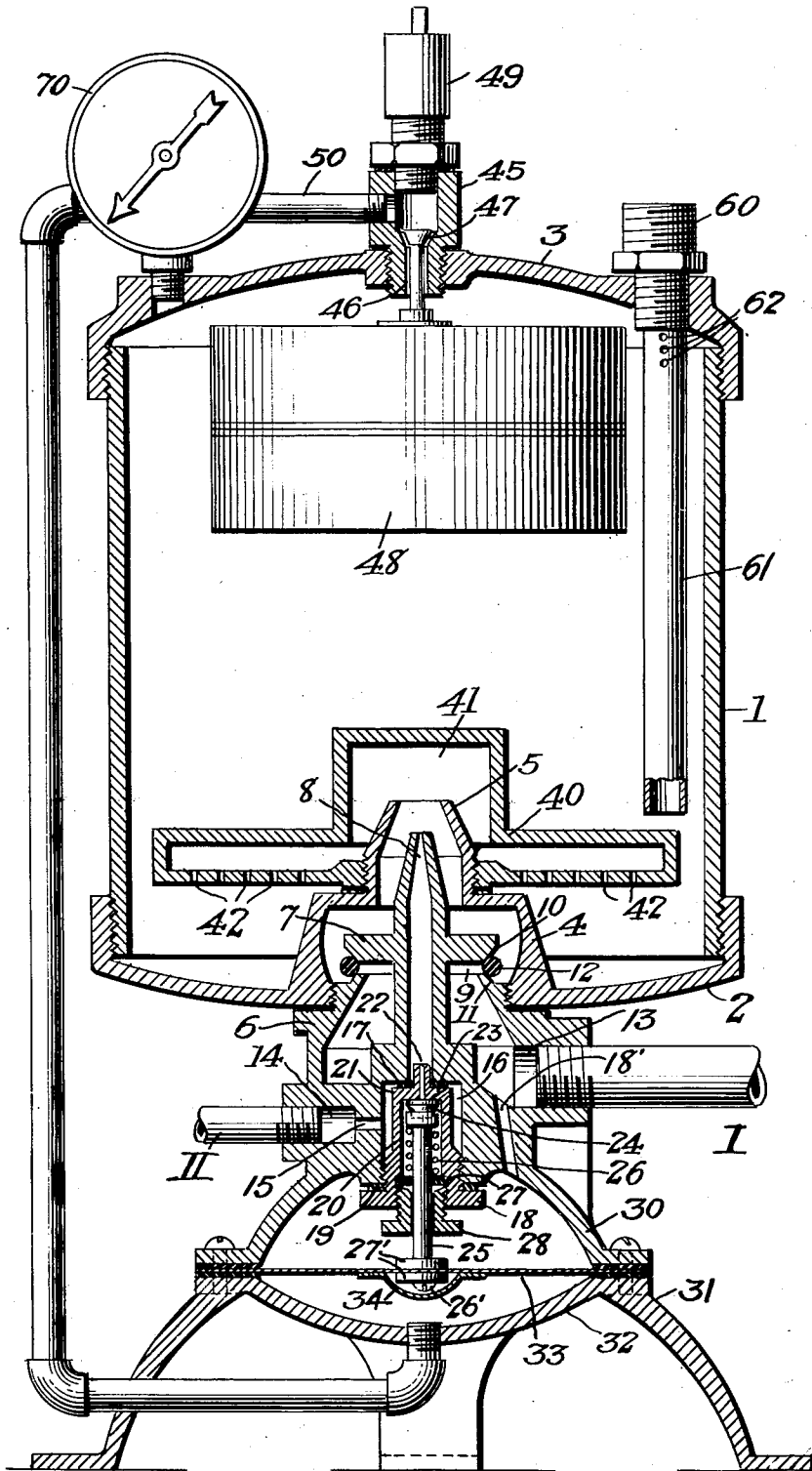
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H. S. STINSON

CARBONATING APPARATUS

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## UNITED STATES PATENT OFFICE.

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## CARBONATING APPARATUS.

Application filed June 21, 1922. Serial No. 569,837.

*To all whom it may concern:*

Be it known that I, HUGH S. STINSON, a citizen of the United States of America, residing at the city of Minneapolis, county of Hennepin, State of Minnesota, have invented certain new and useful Improvements in Carbonating Apparatus; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The invention relates to a self-contained automatic apparatus for impregnating water with gas, and more particularly for carbonating the water supplied to fountains and the like, and has for its object to provide a simple and efficient form of apparatus adapted to be connected with the water supply and with the drum containing the gas, that will operate without the use of auxiliary pumps to supply the requisite quantity of gas to properly impregnate the water, the gas supply being automatically controlled by the withdrawal of the carbonated water from the apparatus, irrespective of any normal variations in the pressures of the water supply and the gas supply, so that wastage of the gas is obviated.

The invention is illustrated in the accompanying drawing, in which the figure is a sectional elevation of the apparatus.

Referring to the drawing, 1 indicates a general cylindrical tank or receptacle having a bottom closure 2 and a top closure 3, preferably connected to the body portion by screw-threaded joints. Preferably formed integrally with the bottom closure 2 and disposed centrally thereof is a chamber 4 terminating in a conical nozzle 5 screw-threaded on its exterior, the lower portion of said chamber being provided with an enlarged central opening, the peripheral edge of which is screw-threaded to receive the screw-threaded extension of a hollow casting 6, suitable packing being provided between the underface of the bottom closure 2 and the casting 6.

The casting 6 is provided with a centrally disposed nozzle 8, the upper discharge end of which is concentric with the nozzle 5, said nozzle 8 having thereon a circular flange or disc 7 spaced from the upper edge of the casting 6 to provide an annular slot which constitutes a passageway between the interior of the casting 6 and the interior

of the hollow extension 4. The peripheral edges of the member 7 and the casting 6 adjacent the slot 9 are tapered toward each other and provide seats 10 and 11 for an elastic ring 12 of rubber or the like, which normally closes the annular slot 9, but which will expand, under conditions hereinafter indicated, to establish free communication between the hollow casting 6 and the interior of the hollow member 4.

One side of the casting 6 is provided with a connection 13 into which is tapped pipe I from the water supply, which may be the ordinary city main, and the other side of the casting is provided with a connection 14 to which is secured pipe II which may be connected to the drum or other source of supply of the gas. The water supply is in direct communication with the hollow interior of the casting 6, as shown. The gas supply is normally cut off from the interior of the apparatus by a special form of pressure regulator, as will be more particularly explained hereinafter.

Forming the central portion of the casting 6 and below the nozzle 8, is a cylindrical chamber 16, which is in communication with the connection 14 by a duct 15. The lower end of the chamber 16 is open and internally screw-threaded to receive a cage or valve body 20, the upper portion of which is provided with a reduced nipple having a passageway 22 therein communicating with the interior of the nozzle 8, and a shoulder 21 which abuts the top wall of the chamber 16 with an interposed packing 17. The lower portion of the valve cage 20 is provided with a flange 18 and a packing gasket 19 which effects a water and gas tight joint between the cage 20 and the adjacent wall of the chamber 16. The upper end of the cage is also provided with a duct or passageway 23 which communicates at one end with the chamber 16, and at the other with the interior of the cage 20 near the inlet end of the duct 22, both ducts terminating in the flat surface at the top of the cage which constitutes a valve seat.

Slidably mounted in the cage 20 is a valve stem 25, the upper end of which terminates in an enlarged recessed head to receive a valve disc 24 of rubber or similar material, which normally engages the flat surface at the top of the cage and closes the ducts or passages 22 and 23, thereby shutting off communication between the gas

supply pipe II and the nozzle 8. The valve stem is surrounded by a helical spring 6, which normally seats the valve, and is held in place by a packing washer 27, which in turn is expanded and retained in place by an adjustable gland 28 screw-threaded in the lower end of the cage 20.

Formed in the lower portion of the casting 6 is a dome-shaped cavity 30, which is in communication with the upper chambered portion of the casting by a duct or passageway 18'. Secured to the lower annular flange of the casting 6 is a base or support 31 having a concave bottom 32, and between the meeting edges of the members 30 and 31 is secured a diaphragm 33, the joint being provided with suitable ring packings to render the same leak-proof. The lower end of the valve stem 25 is secured to the center of the diaphragm 33 by any suitable means, as, for example, by a set-screw 26 and washers 27. In order to prevent leakage at the joint between the valve stem and the diaphragm, the latter has preferably secured to the underface thereof a cap 34 which covers the joint.

Secured to the nozzle 5 is a mixing chamber 40 which is preferably formed as a hollow casting having a relatively shallow disc-like body portion with an enlarged central dome 41 substantially cylindrical in shape, the bottom of the body portion being provided with perforations 42, which establish communication between the interior of the mixing chamber and the main tank 1.

Mounted centrally within the top closure 3 is a hollow casting 45 having a passageway 46 communicating with the interior of the main tank 1 and terminating at its top in a valve seat, with which co-operates a valve 47, the stem of which is connected to a float 48. Said float is preferably formed of cork encased in a sheathing of copper or similar metal, preferably tinned and tightly soldered at all its joints to render the same water and gas tight, the cork filling preventing the float from collapsing under pressure, and the outer metallic covering preventing access of water to the cork so that the latter will not become water-logged. Mounted in the upper end of the coupling 45 is a safety valve 49 of any appropriate form which will prevent the accumulation of excess pressure in the apparatus. Connecting with the interior of the coupling 45 is a pipe 50, the other end of which is connected with the chamber 32 below the diaphragm 33.

Mounted in the top closure 3 is a coupling 60, to which is secured a dip pipe 61 extending downwardly within the main tank 1, to a point adjacent the mixing chamber, and provided near its upper end with series of vent openings 62. The upper end of the coupling 60 is adapted to receive the dis-

charge pipe of the apparatus leading to the soda fountain or other apparatus to which the gas-charged water is delivered.

A pressure gauge 70 is also applied to the upper closure 3, and serves to indicate the pressure in the main chamber at all times.

The operation of the apparatus as described is as follows:—the water supply pipe I being connected to the city main or other source or supply of water under pressure, the gas supply pipe II coupled with the gas drum by a suitable connection and pressure regulating means, the latter being so adjusted that the pressure of the gas supplied to the apparatus is considerably greater than the water pressure supplied by the pipe I, and the soda fountain or other apparatus being connected with the discharge pipe 61 at the coupling 60. Assuming, for example, that the city water pressure is  $62\frac{1}{2}$  lbs. per square inch, and the gas pressure supplied by the pipe II is 120 lbs. per square inch, if the rubber ring 12 requires a force of  $2\frac{1}{2}$  lbs. to expand the same to open communication between the water supply I and the main tank 1, when the latter is full of water, the difference in pressure between the portion of the apparatus below the ring and that portion of the apparatus above the ring will be  $2\frac{1}{2}$  lbs., and this difference will be maintained during the normal operation of the apparatus. The main pressure of  $62\frac{1}{2}$  lbs. per square inch will be exerted on the top of the diaphragm 33 by way of passage 18, while the reduced pressure in the tank 1 will be transmitted past the valve 47 which is held open by the float 28, through pipe 50 into the chamber 32 to the underside of the diaphragm 33. The predominant pressure of  $2\frac{1}{2}$  lbs. per square inch tends to depress the diaphragm 33 and unseat the valve 24 in the valve cage 20, but the spring 26, normally seating valve 24, is sufficient to counterbalance this pressure and retain the valve in engagement with its seat on the face of the top of the cage and close the ducts 22 and 23, and thereby exclude the gas from pipe II from the nozzle 8. When the soda fountain or other apparatus is operated to withdraw the water from the tank 1, the pressure in said tank is immediately reduced, usually from  $2\frac{1}{2}$  to 5 lbs., depending upon the discharge opening in the faucet or draught apparatus. As the water is supplied to the main tank 1 as fast as it is drawn out by way of the discharge pipe 61, the float 48 normally maintains the check valve 47 open so that the reduction of the pressure in the main tank is immediately communicated to the underside of the diaphragm 33 by pipe 50 and the predominant pressure on the upper side of the diaphragm, which is that of the main supply I, is sufficient to force the diaphragm downward, and with it the valve stem 25, which unseats the valve 24

and permits the gas to pass from the supply pipe II to coupling 14, duct 15, chamber 16, duct 23 in the valve cage 20, and thence by duct 22 in the cage into the nozzle 8, the rushing gas being forced out of the constricted end of the nozzle 8 into the body of water passing through nozzle 5, the combined water and gas being violently agitated in the mixing dome 41, and being ultimately discharged into the main tank 1 through the various discharge perforations 42 in the bottom of the mixing chamber. This operation continues so long as the water is being withdrawn from the main tank by the draught or other apparatus, and the gas is thoroughly commingled with and absorbed by the water so that the main body portion of the tank is kept full of gas-charged water. As soon as the draught apparatus is shut off, the pressure in the main tank immediately returns to normal, which, as indicated, is 60 lbs., and this pressure is transmitted by pipe 50 to the underside of the diaphragm 33, so that the difference in pressures between the upper and lower sides of the diaphragm is now only  $2\frac{1}{2}$  lbs., which is insufficient to retain the valve 24 in open position against the tension of the spring 26, and said valve is immediately closed by the spring and shuts off the supply of gas to the nozzle 8.

This operation is repeated each time the draught apparatus is operated to withdraw water from the main tank 1, under all normal conditions of operation, that is to say, unless more gas is being delivered to the apparatus than it is possible for the water to absorb at the pressures employed, or unless the pressure of the water supply varies, under which conditions the apparatus acts as follows: Should it occur that more gas is delivered than the water can take up, the surplus gas which enters the main tank 1 at each operation of the draught apparatus, accumulates at the top of the main chamber, and causes the water level therein to be lowered. When the water level falls to such a point that the float 48 settles and closes the valve 47, the next operation of the soda fountain draught apparatus reduces the pressure in the main chamber 1 but not in the pipe 50, and therefore not on the underside of the diaphragm 33, so that the valve 24 is not unseated, and no further quantity of gas is delivered to the apparatus until substantially enough dead water is allowed to enter the main chamber to absorb the surplus gas and raise the float 48 and re-establish the connection between the main chamber 1 and the underside of diaphragm 33 by way of the pipe 50, which will permit the diaphragm to re-open the valve 24. Whenever an excess of gas collects in the main chamber 1 sufficient to lower the water level until one or more of the holes 62 in the eduction pipe 61 are

uncovered, the water rushing through the pipe 60 entrains the gas which enters the pipe through the open holes, and effects a satisfactory mixture of the gas and water. This has the further effect of releasing the gas cushion at the top of the main chamber and permits the water level to rise, and with it the float 48, which opens the valve 47 and re-establishes communication between the chamber 1 and the lower side of diaphragm 33 of the pressure regulating valve 24, permitting the latter to open and re-establish the supply of gas.

Should the water pressure supplied by pipe I increase above the normal, say to  $67\frac{1}{2}$  lbs. per square inch, it will be apparent that the normal differences in pressure in the apparatus on opposite sides of the ring 12 will be maintained at  $2\frac{1}{2}$  lbs., which represents the force necessary to expand the ring, consequently the same differences in pressure will be maintained on the upper and lower sides of the diaphragm 33 of the pressure regulative valve, and the latter will operate as before, regardless of the position of the valve 47, as the pressure is sufficient to lift the valve should it be closed due to the lowering of the water level in the main tank 1.

If the pressure supplied by the pipe I should fall below the normal, say to  $57\frac{1}{2}$  lbs. per square inch, the pressure on the upper side of the diaphragm 33 will be less than that on the lower side thereof and the valve 24 of the pressure regulator will be held more firmly to its seat. Upon the next operation of the draught apparatus to withdraw the water from the tank 1, the pressure in the main chamber will be quickly lowered until it is again  $2\frac{1}{2}$  lbs. below that of the supply pressure, due to the throttling action of the rubber ring 12, and the normal pressure differences between the upper and lower sides of the ring will be established and the apparatus will operate precisely as it would if the main pressure had remained normal, that is to say, a further reduction of the pressure by the discharge of water from the pipe 61 will be transmitted to the underside of the diaphragm 33 and cause the latter to unseat the valve 24 and admit a proper supply of gas.

It will be seen therefore that the apparatus is entirely automatic and self-regulating, involves no auxiliary pumps or pressure producing devices to effect an admixture of the gas and the water; on the other hand, it is quiet and efficient in operation, and with proper supervision can be nicely regulated to supply just sufficient gas to properly charge the water without danger of wastage of the gas. It will be seen furthermore that even if an excess of gas is supplied under certain circumstances, the same will be ultimately admixed with the

water supplied to the soda fountain or other dispensing apparatus. The structural simplicity of the apparatus greatly reduces the first cost, as well as the cost of maintenance and operation, and the relatively small size and compactness of the device renders it available for use in many cases where a more elaborate and complicated mechanism could not be employed.

While the particular form and relative arrangement of parts as described is preferred, it is to be understood that the invention is not limited thereto but that obvious changes and variations may be made without departing from the fundamental characteristics of the invention and without sacrificing any of the particular advantages thereof. For example, any appropriate form of pressure regulator for controlling the supply of gas may be substituted for the particular device as illustrated, but the latter is preferred because of its extreme simplicity and reliability, especially in respect of the construction and arrangement of the valve cage, which contains the pressure regulating valve, which avoids the necessity of elaborate and troublesome packing, to prevent the leakage of gas. It will be particularly noted that when the valve is closed, the gas is in contact with no moving part of the regulator. Again, while the ring valve 12 has proven entirely effective and satisfactory, it is obvious that the same may be substituted by any other suitable type of valve which operates under similar conditions, as for example, one or more outwardly opening check valves normally held to their seat by spring action and disposed in valve passages formed in the casting 6 to establish communication between the same and the nozzle 5. The ring valve such as 12, however, has proved eminently satisfactory in operation, and resistant to derangement or impairment, so that, all things considered, it represents a preferred form of this particular phase of the invention.

What I claim is:

1. Apparatus for carbonating water and the like, comprising a tank, a discharge connection therefor, liquid and gas supply connections thereto, means to maintain the pressure in the tank below that of the liquid supply, and means responsive to the difference in the pressures in the tank and the liquid supply connection for controlling the supply of gas to the tank.

2. Apparatus for carbonating water and the like, comprising a tank, a discharge connection therefor, liquid and gas supply connections thereto, means to maintain the pressure in the tank below that of the liquid supply, means responsive to the difference in the pressures in the tank and the liquid supply connection for controlling the supply of gas to the tank, and means for receiving

and mixing the gas and liquid and discharging the mixture into the tank.

3. Apparatus for carbonating water and the like, comprising a tank, a discharge connection therefor, liquid and gas supply connections thereto, pressure reducing means interposed between the liquid supply connection and the tank, a pressure regulating valve for controlling the gas supply, and connections between the actuating element of said pressure regulating valve and the liquid supply connection and the interior of the tank respectively whereby a predetermined reduction in the tank pressure will cause the operation of the pressure regulator valve to admit the gas to the tank.

4. Apparatus for carbonating water and the like, comprising a tank, a discharge connection therefor, liquid and gas supply connections thereto, pressure reducing means interposed between the liquid supply connection and the tank, a pressure regulating valve for controlling the gas supply, connections between the actuating element of said pressure regulating valve and the liquid supply connection and the interior of the tank respectively whereby a predetermined reduction in the tank pressure will cause the operation of the pressure regulator valve to admit the gas to the tank and a mixing device for receiving the entering liquid and gas and discharging the mixture into the tank.

5. Apparatus for carbonating water and the like, comprising a tank, a discharge connection therefor, a liquid supply device connected to said tank including a nozzle and pressure reducing means, a gas supply device connected to the tank including a nozzle and a pressure regulating valve, and connections between the actuating element of the pressure regulating valve and the liquid supply connection and the interior of the tank respectively for controlling the admission of gas to the tank.

6. Apparatus for carbonating water and the like, comprising a tank, a discharge connection therefor, a liquid supply device connected to said tank including a nozzle and pressure reducing means, a gas supply device connected to the tank including a nozzle disposed axially within the liquid nozzle and a pressure regulating valve, and connections between the actuating element of the pressure regulating valve and the liquid supply connection and the interior of the tank respectively for controlling the admission of gas to the tank.

7. Apparatus for carbonating water and the like, comprising a tank, a discharge connection therefor, a liquid supply device connected to said tank including a nozzle and pressure reducing means, a gas supply device connected to the tank including a nozzle and a pressure regulating valve, connections

between the actuating element of the pressure regulating valve and the liquid supply connection and the interior of the tank respectively for controlling the admission of gas to the tank, and a mixing chamber receiving the liquid and gas from said nozzles and discharging the mixture into the tank.

8. Apparatus for carbonating water and the like, comprising a tank, a discharge connection in the top thereof, a liquid supply connection in the bottom of the tank including a nozzle and a pressure reducing means within said nozzle, a gas supply connection including a nozzle disposed concentrically within the liquid nozzle, a valve cage located in said gas nozzle and having two passages establishing communication through said nozzle, a valve in said cage controlling both of said passages, a diaphragm connected with said valve, a connection between the upper face of the diaphragm and the liquid supply, and a connection between the lower face of the diaphragm and the interior of the tank; whereby predetermined variations of pressure in the tank will control the operation of said valve and the supply of gas to the tank.

9. Apparatus for carbonating water and the like, comprising a tank, a discharge connection in the top thereof, a liquid supply connection in the bottom of the tank including a nozzle and a pressure reducing means within said nozzle, a gas supply connection including a nozzle disposed concentrically within the liquid nozzle, a valve cage located in said gas nozzle having inlet and outlet passages terminating in a common seat and establishing communication through said nozzle, a spring-pressed valve engaging said seat and controlling both of said passages, a chamber below said nozzles, a diaphragm dividing said chamber into upper and lower sections and connected to said valve, and connections between the upper chamber section and the liquid supply and between the lower chamber section and the interior of the tank; whereby predetermined variations of pressure in the tank will control the operation of said valve and the supply of gas to the tank.

10. Apparatus for carbonating water and the like, comprising a tank, a discharge connection in the top thereof including a dip pipe having outlet perforations near its top, a liquid supply connection in the bottom of the tank including a nozzle and a pressure reducing means within said nozzle, a gas supply connection including a nozzle disposed concentrically within the liquid nozzle, a valve cage located in said gas nozzle having inlet and outlet passages terminating in a common seat and establishing communication through said nozzle, a spring-

pressed valve engaging said seat and controlling both of said passages, a chamber below said nozzles, a diaphragm dividing said chamber into upper and lower sections and connected to said valve, and connections between the upper chamber section and the liquid supply and between the lower chamber section and the interior of the tank; whereby predetermined variations of pressure in the tank will control the operation of said valve and the supply of gas to the tank.

11. Apparatus for carbonating water and the like, comprising a tank, a discharge connection in the top thereof, a liquid supply connection in the bottom of the tank including a nozzle and a pressure reducing means within said nozzle, a gas supply connection including a nozzle disposed concentrically within the liquid nozzle, a valve cage located in said gas nozzle having inlet and outlet passages terminating in a common seat and establishing communication through said nozzle, a spring-pressed valve engaging said seat and controlling both of said passages, a chamber below said nozzles, a diaphragm dividing said chamber into upper and lower sections and connected to said valve, and connections between the upper chamber section and the liquid supply and between the lower chamber section and the interior of the tank; whereby predetermined variations of pressure in the tank will control the operation of said valve and the supply of gas to the tank.

12. Apparatus for carbonating water and the like, comprising a tank, a discharge connection in the top thereof, a liquid supply connection in the bottom of the tank including a nozzle and a pressure reducing means within said nozzle, a gas supply connection including a nozzle disposed concentrically within the liquid nozzle, a valve cage located in said gas nozzle having inlet and outlet passages terminating in a common seat and establishing communication through said nozzle, a spring-pressed valve engaging said seat and controlling both of said passages, a chamber below said nozzles, a diaphragm dividing said chamber into upper and lower sections and connected to said valve, connections between the upper chamber section and the liquid supply and between the lower chamber section and the interior of the tank; whereby predetermined variations of pressure in the tank will control the operation of said valve and the supply of gas to the tank, and a float actuated check valve in the upper part of the tank controlling the connection between the tank and the lower face of the diaphragm.

In testimony whereof I affix my signature.

HUGH S. STINSON.