Feb. 3, 1942. H. H. LEWIS 2,271,896

CARBONATOR

Filed April 27, 1940 2 Sheets-Sheet 1

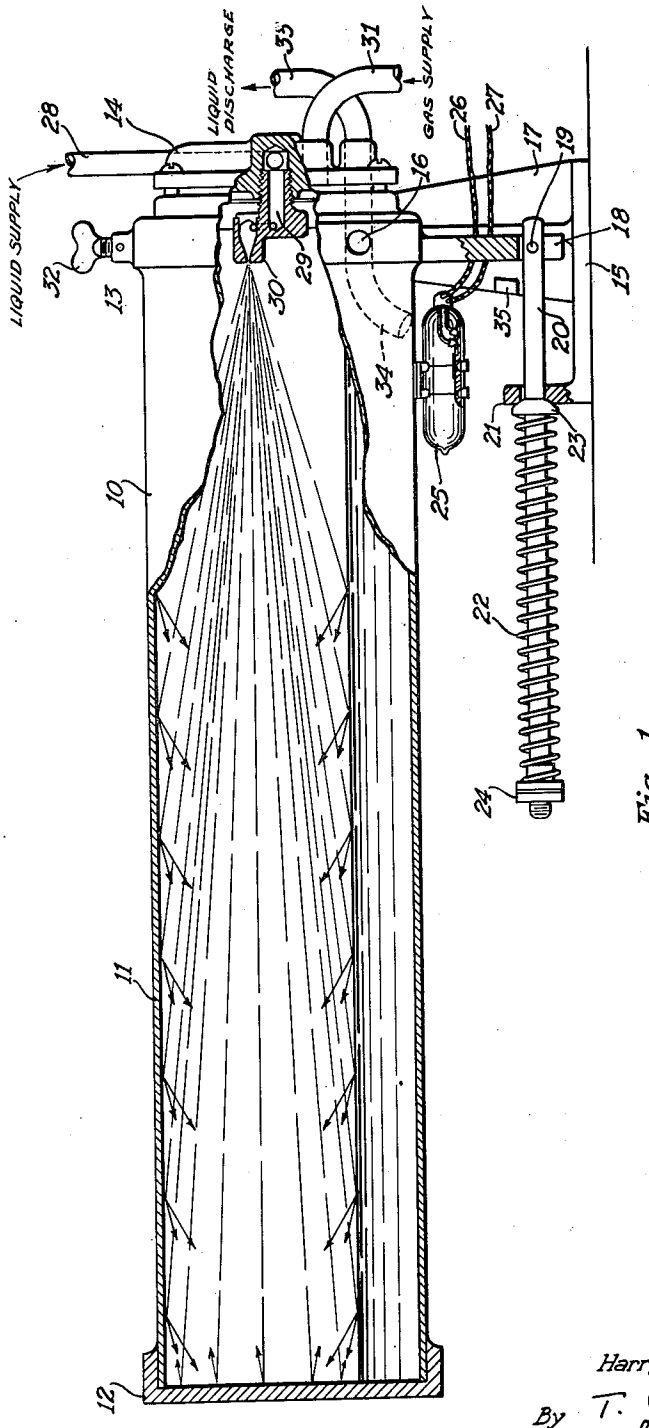


Fig. 1

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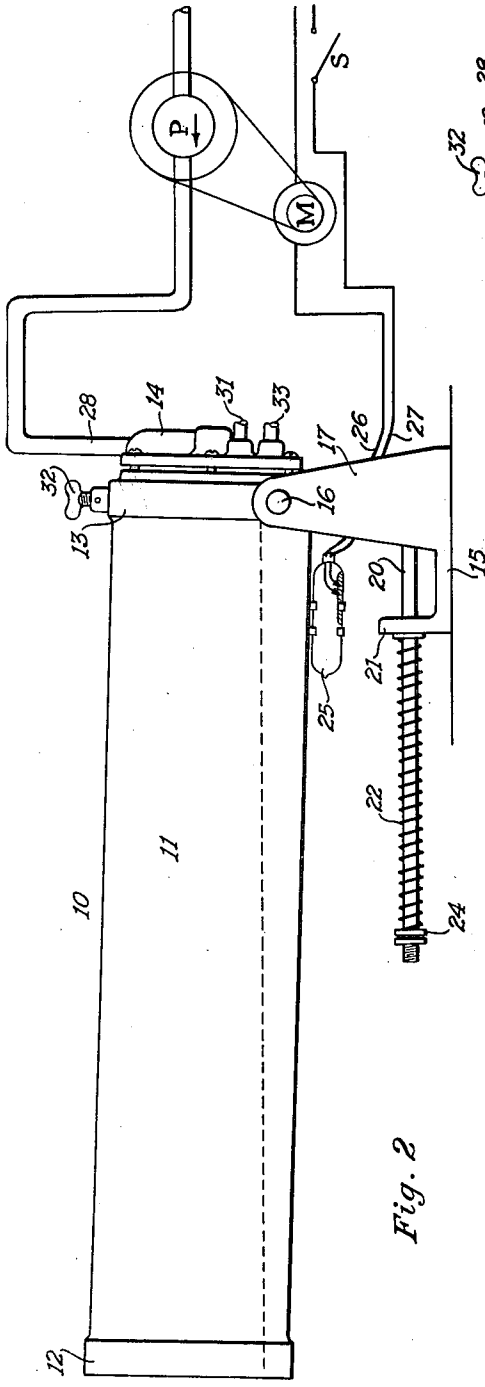


Fig. 2

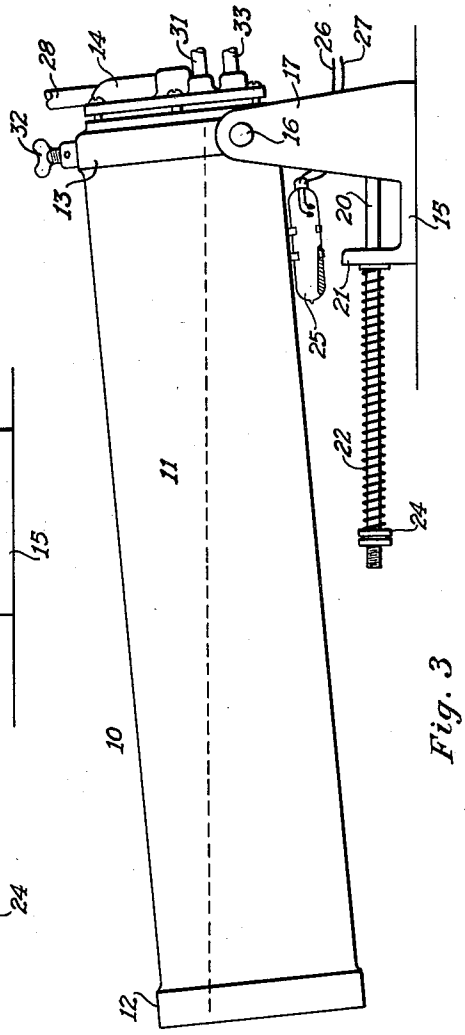


Fig. 3

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CARBONATOR

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6 Claims. (Cl. 261—115)

This invention relates to apparatus for aerating or impregnating liquids with gasses, and, more particularly, for charging liquids with carbonic acid gas, as in making carbonated water for soda fountains and the like, or in carbonating any beverage to be dispensed.

Specifically, this invention concerns a carbonator in which the liquid is sprayed into a chamber of gas, instead of the gas being injected into a volume of liquid.

A problem in all carbonating devices is to obtain the desired carbonating or aerating of the liquid most efficiently but in a minimum length of time, and an object of this invention is to provide an improved device which will be simple and inexpensive of construction but which will insure the proper carbonating of the liquid injected into the device and subsequently withdrawn from it.

Another object of this invention is to provide a carbonating device which will function automatically to maintain a supply of the carbonated liquid and control automatically the passage of liquid into the device without necessitating the use of the common float-operated valve required in most devices of this type.

In certain carbonating devices which have previously been tried out and in which the liquid is sprayed into a chamber containing carbonic acid gas, I have found that ordinarily the passage of the spray or cone of liquid from its entrance into the chamber until is reaches the volume of liquid at the bottom of the chamber does not permit sufficient absorption of gas by the sprayed liquid, and the result with such devices is that the operation either has to be repeated or other means must be employed for mixing the gas with the liquid in the chamber after the sprayed liquid has been collected at the bottom of the chamber. I have discovered, however, that when the liquid is forceably injected in the form of a very fine high velocity spray into the end of an elongated gas-filled chamber, the globules of liquid will be caused to rebound repeatedly from the wall surface in the interior of the chamber, and also from the surface of the liquid at the bottom of the elongated chamber, until finally coming to rest, and this rebounding of the globules of sprayed liquid permits them to become thoroughly impregnated with the gas before they finally settle to rest and join the liquid in the bottom of the chamber, resulting in very high "carbonization" of the liquid.

A further object of this invention, therefore, is to provide a device in which this method of impregnating globules of liquid may be carried out efficiently and under automatic control.

The manner in which I attain these and incidental objects, and also the manner in which the apparatus and controls for the same are constructed and function, will be briefly described with reference to the accompanying drawing constituting part of this specification.

In the drawings:

Figure 1 is a side elevation of my improved carbonator, shown partly in section with certain parts broken away to reveal the interior details of construction, and showing also the courses taken by the globules of the high velocity spray of liquid;

Figure 2 is a similar side elevation showing the position of the charging chamber when the liquid contained has been reduced to a low level; and

Figure 3 is a corresponding view similar to Figure 2 but illustrating the position of the device when the liquid in the chamber has accumulated to the maximum amount provided for.

The charging chamber 10 comprises a tubular shell 11, of length preferably several times its diameter. A blank head 12 seals the outer free end of the shell, and a substantial annular head casting 13, fitted with a removable cover plate or cap 14, constitutes the closure at the other end, these parts being assembled as shown in Figure 1 to form a pressure vessel or carbonating chamber.

The entire chamber or vessel 10 is hingeably supported at one end on a suitable base 15 by means of transversely extending pins 16 which are made fast in the lower part of the annular head casting 13 and which are journaled in spaced upstanding brackets 17 which form part of the fixed base 15. This hinged end of the vessel is provided with a depending arm 18 (see Figure 1), to which a rod 20 is pivotally attached at 19. The rod 20 extends through, and is slideably disposed in a guiding hole arranged in the upstanding shoulder 21 of the base 15. A compression spring 22 is carried on the rod 20 and bears against a loose collar 23 which in turn bears on the outside of the shoulder 21. The outer end of the spring 22 bears against the nut 24 on the end of the rod 20 and the tension of the spring 22 may be adjusted by means of the nut 24. This spring tension is adjusted so as to exert just sufficient pull on the rod 20 to balance the combined weight of the vessel 10 and a predetermined volume of liquid in the bottom of the vessel as indicated in Figure 1.

Thus the spring 22 is so adjusted that when

the amount of liquid in the bottom of the vessel 10 has been reduced to the level indicated by the broken line in Figure 2, the spring will cause the vessel to tilt upwardly; but when the volume of liquid in the vessel is sufficiently increased, for example, until the level of the liquid reaches that indicated by the broken line in Figure 3, the weight of the liquid will cause the spring 22 to compress until the vessel is tilted downwardly as shown in Figure 3. The purpose of this tiltable mounting for the vessel 10 will be hereinafter explained.

A conventional mercuroid electrical switch 25 is attached to the vessel 10 in such manner that when the vessel is in the positions shown in Figures 1 and 2, the mercury within the switch will bridge the gap between the conductors 26 and 27 and thereby act to close the electrical circuit to the driving motor M (Fig. 2), of the pump P which supplies liquid to the vessel. Similarly, when the vessel is tilted downwardly to a predetermined degree, for example, to the position shown in Figure 3, the mercury switch will open the circuit through conductors 26 and 27 and thus prevent further operation of such motor.

The pump P (Fig. 2), connected to the water pipe line, or to any other source from which the liquid to be carbonated is obtained, is connected to the vessel 10 by the flexible tube 28. The end of this tube 28 is secured in the cover plate 14 and leads into a duct 29 in the cover plate 14 (see Figure 1), which in turn is connected to a suitable spray nozzle 30 which is so arranged as to discharge an atomized spray of liquid into the vessel 10 when the water or other liquid is delivered from the pump through the tube 28.

Another flexible tube 31 connects the vessel 10 with a storage tank (not shown) or other suitable source of carbonic acid gas in which the gas is carried under high pressure and from which the gas is delivered through a pressure-reducing valve (not shown), which reduces the pressure to that which is desired to be maintained within the vessel 10, and thence through the flexible tube 31 to the vessel 10. A plug 32 threaded into the head casting 13, provides means for relieving the gas pressure in the vessel 10 should it become necessary to remove the cover plate from the vessel for cleaning or for any other purpose.

The water or other liquid, after being charged with the carbonic acid gas, may be drawn from the vessel as required through the pipe 33 which is disposed in the cover plate 14 and which has an extending end 34 curved downwardly so that the entrance into the end 34 will be submerged in the liquid in the bottom of the vessel at all times. The discharge pipe 33 has a suitable manual control valve (not shown) of the usual type so that the discharge pipe 33 will be shut off at all times except when it is desired to draw charged liquid from the vessel.

When the water or other liquid to be carbonated is delivered to the vessel 10 in the form of a high velocity atomized spray, the globules of liquid from the conically-shaped spray will strike the inside walls of vessel 10, or the surface of any liquid at the bottom of the vessel, at various angles and be deflected in the manner indicated by the arrows in Figure 1. As a result these globules will bounce back and forth more or less, following largely a zig-zag course to the opposite end of the vessel. The reason for making the vessel elongate will now be apparent since the longer these globules of liquid remain in motion, before finally settling to rest in the collected liquid in the bottom of the vessel, the greater will be the opportunity afforded them for absorption of gas with which the vessel is filled under pressure by the gas supplied through tube 31. Thus, I have found that it is essential in the proper carrying out of my invention that the length of the vessel, in comparison with its width, and the force of the atomized spray or velocity of the globules be sufficient to produce this desired result on the traveling globules during their course through the chamber. It is also important that too much liquid should not be allowed to accumulate within the chamber or vessel 10, for of course the action of the globules could not occur and the liquid could not be delivered in a spray if the level of the liquid in the bottom of the vessel were to reach a heighth sufficient to obstruct the nozzle 30.

The operation of my device is very simple. Let it be assumed that the carbonator is to be used for carbonating water. The vessel 10 is connected through tube 31 to the usual carbonic acid gas storage tank, which causes the vessel to be filled with the gas under pressure. When the vessel 10 is empty of liquid the spring 22 will hold the vessel in the upwardly inclined position shown in Figure 2 to start. Water is then supplied through tube 28 by means of the electrically-operated pump P (Fig. 2), and the pump will operate as soon as the electric power is turned on through switch S, inasmuch as the circuit to the pump over the conductors 26 and 27 is closed by the mercury switch 25 as indicated in Figure 2. The water, due to the force of the pump, will be delivered in the end of vessel 10 in the form of an atomized high velocity spray, as previously explained, and the globules of the water, before coming to rest and collecting in the bottom of the vessel, will be impregnated by the carbonic acid gas. As water continues to be sprayed into the vessel a supply of charged water gradually collects in the bottom of the vessel where it is maintained under pressure and from which the charged water may be obtained as needed merely by opening a manual valve or faucet (not shown) at the end of the discharge pipe 33. As the supply of charged water in the bottom of the vessel 10 increases, thus increasing the weight of water in the vessel, the vessel gradually tilts downwardly against the force of the spring 22 until it is finally tilted sufficiently to cause the mercury switch 25 to open the circuit to the pump, which will occur in some position of the vessel as that shown in Figure 3. This automatically stops the operation of the pump and no more water can be collected in the vessel 10 until some of the charged water is first removed. Withdrawal of a sufficient amount of this supply of charged water will cause the spring 22 again to raise the vessel, first to the horizontal position illustrated in Figure 1, and then, if more of the charged water is withdrawn, to the extreme position shown in Figure 2. A suitable stop 35 (Figure 1) is provided to prevent the vessel being tilted upwardly too far. In ordinary use however, the range of the change of position of the vessel will, in most cases, be only between the horizontal position of Figure 1 and the downwardly tilted position of Figure 3.

Thus the action of my apparatus is entirely automatic. All that is necessary is that when one supply tank of the carbonic acid gas is exhausted, another be connected to the tube 31. Unlike some of the other carbonators previously invented, in my device the pump supplying liquid

to the carbonator does not run constantly, but operates only when more liquid is actually needed in the carbonator. Consequently, there is no waste of power. Furthermore the use of all float-control valves is dispensed with entirely, and only a simple and inexpensive mercury switch, attached in any convenient point on the outside of the tiltable vessel, is all that is required. As long as any liquid remains in the vessel 10, the inner end 34 of the discharge pipe 33 will remain submerged, due to the upward tilting of the vessel as the level of liquid becomes lower. The maximum amount of liquid which can collect in the vessel is regulated by adjusting the tension of the screw 22 by means of the nut 24 on the rod 20. All danger of "flooding" the carbonating chamber is prevented. The liquid accumulated in the bottom of the vessel is also kept in a state of agitation, as long as the pump is operating, due to the striking of the surface of the liquid by the globules of liquid set in motion by the spray. This agitation of the accumulated liquid has a desirable effect in causing the liquid to continue to absorb more and more of the gas in the pressure chamber.

In my device the pump supplying the spray of liquid will not be caused to operate every time a small amount of the carbonated liquid is withdrawn from the vessel, due to the fact that a considerable volume of liquid is allowed to accumulate in the vessel. A delay provided by the required tilting of the vessel in order to overcome the increasing resistance of the spring 22 also provides a desirable time differential between the starting and stopping of the pump. This is an important feature of my device and an improvement in this respect over some of the float-control carbonators in which withdrawal of a comparatively small amount of the carbonated liquid is sufficient to cause the motor immediately to start operating. Thus, referring to Figures 2 and 3, it will be noted that as liquid accumulates in the vessel 10 the level of the liquid, and consequently the weight of the liquid, increases much more rapidly at the left end or movable end of the vessel than at the other end, due to the downward tilting of the vessel. The increased rate at which the level and weight of the liquid are augmented at one end, in comparison with the rate occurring at the opposite end, is accompanied by increased resistance offered by the spring 22 as its compression increases, since a greater and greater force is required to produce equal further longitudinal compression of any compression spring. The result of this arrangement is that when the vessel is filled to the predetermined maximum, the withdrawal of a substantial quantity of the collected liquid is necessary before the spring will raise the vessel sufficiently to start the pump again. Were a simple balance substituted for the spring control, the result would be more similar to the operation of a float valve and the device would be more sensitive to withdrawals of small amounts of the liquid, resulting in more frequent operation of the pump.

I have found that any ordinary reciprocating electrically-driven pump may be used with my apparatus and furthermore that it is not necessary to provide any air dome or other pressure chamber between the pump and the delivery nozzle, that it, in fact, is even desirable to have the spray pulsating under the impulses of the reciprocating pump. A pulsating spray I have found to be even better than a steady spray in my device in producing the bouncing motion desired for the globules of liquid. Under the direct pulsating action of the reciprocating pump the pressure at the distributing nozzle will vary between certain high and low limits with each cycle of the pump piston. This variance in the force of the spray from the nozzle will affect not only the force with which the globules are projected into the chamber and against the walls of the chamber, but also the angles at which the globules strike the walls and the corresponding angles of deflection. It will be apparent that this variance in the courses taken by the globules at different moments will result in more widespread distribution of the globules and intermingling of the moving globules with the gas in the chamber than might occur if the globules followed constant courses under a steady pressure spray.

Various modifications of course may be made in the apparatus which I have described without departing from the principles of my invention. All that is necessary is that a high velocity spray of liquid be injected into a gas-filled vessel and the vessel so shaped and arranged that the globules of liquid will be forced to take courses which are sufficiently tortuous and long to afford opportunity for the globules to become properly impregnated with the gas before coming to rest, and that suitable controls be provided. The particular simple controls which I have described, including the adjustable compression spring, mercury switch, and gravity actuated carbonating chamber, I consider to be most preferable in the carrying out of my invention.

I claim:

1. An apparatus for carbonating liquids comprising an elongated sealed substantially horizontal vessel, a stationary support for said vessel, said vessel being pivotally-mounted on said support, one end of said vessel movable in a short vertical arc, a spray nozzle located in one end of said vessel, means for delivering liquid to said nozzle under pressure, said means including a motor, means for supplying gas under pressure to said vessel, a liquid discharging outlet located at the bottom of said vessel, an electric switch in the circuit to said motor operated by the pivotal movement of said vessel, spring means controlling the position of said vessel, said spring means arranged to permit said vessel to tilt when the liquid in said vessel has reached a predetermined maximum to cause said switch to open, whereupon the greatest depth of liquid will be at the end of said vessel opposite said nozzle, and requiring a substantial quantity of liquid then to be drawn from said vessel before said vessel will return to said minimum position and start said motor operating.

2. An apparatus for carbonating liquids comprising an elongated sealed substantially horizontal vessel, its length being several times its width, a stationary support for said vessel, said vessel being pivotally-mounted on said support, one end of said vessel movable in a short vertical arc, a spray nozzle located in one end of said vessel, means for delivering liquid to said nozzle under pressure, said means including a motor, means for supplying gas under pressure to said vessel, a liquid discharging outlet located at the bottom of said vessel near the nozzle supporting end, an electric switch in the circuit to said motor operated by the pivotal movement of said vessel, spring means controlling the position of said vessel, said spring means arranged to hold said vessel tilted slightly upwardly when the liquid in

said vessel has reached a predetermined minimum to close said switch, with the greatest depth of liquid at the nozzle end of said vessel, but to permit said vessel to tilt downwardly to open said switch when the liquid in said vessel has reached a predetermined maximum causing the greatest depth of liquid to be at the opposite end of said vessel.

3. An apparatus for carbonating liquids comprising an elongated sealed cylindrical substantially horizontal vessel, a stationary support for said vessel, one end of said vessel being pivotally-mounted on said support, the other end of said vessel movable in a short vertical arc, a spray nozzle located in the supported end of said vessel, a pump delivering liquid to said nozzle under pressure, a motor operating said pump, means for supplying gas under pressure to said vessel, a liquid discharging outlet located at the bottom of said vessel, an electric switch in the circuit to said motor operated by the pivotal movement of said vessel, spring counter-balancing means for said vessel, said spring means arranged to hold said vessel tilted slightly upwardly when the liquid in said vessel has reached a predetermined minimum to close the switch to said motor, with the greatest depth of liquid at the nozzle end of said vessel, but to permit said vessel to tilt downwardly when the liquid in said vessel has reached a predetermined maximum to open said switch, thus causing the greatest depth of liquid to be at the end of said vessel opposite said nozzle, and to require a substantial quantity of liquid then to be drawn from said vessel before said vessel will return to said minimum position and start said motor operating.

4. An apparatus for carbonating liquids comprising an elongated sealed cylindrical substantially horizontal vessel, its length being several times its diameter, a stationary support for said vessel, said vessel being pivoted to said support at one end, the other end of said vessel movable in a short vertical arc, a spray nozzle located in the supported end of said vessel, a pump delivering liquid to said nozzle under pressure, a motor operating said pump, means for supplying gas under pressure to said vessel, a liquid discharging outlet located near the supported end of said vessel, a mercury switch in the circuit to said motor attached to said vessel operated by the pivotal movement of said vessel, spring counter-balancing means for said vessel, said spring means arranged to hold said vessel tilted slightly upwardly to close said switch when the liquid in said vessel has reached a predetermined minimum, with the greatest depth of liquid at the supported end of said vessel, but to permit said vessel to tilt downwardly to open said switch when the liquid in said vessel has reached a predetermined maximum causing the greatest depth of liquid to be at the opposite end of said vessel, whereby a substantial quantity of liquid must be drawn from said vessel when said vessel is in downward tilted maximum position before said vessel will return to said minimum position and start said motor operating.

5. In an apparatus for carbonating liquids, an elongated sealed cylindrical substantially horizontal vessel, a stationary support for said vessel, said vessel being pivotally-mounted on said support at one end, the other end of said vessel movable in a short vertical arc, a spray nozzle located in the supported end of said vessel, a pump delivering liquid to said nozzle under pressure, a motor operating said pump, means for supplying gas under pressure to said vessel, a liquid discharging outlet located at the bottom of said vessel near the supported end, a mercury switch in the circuit to said motor attached to said vessel operated by the pivotal movement of said vessel, an arm depending from said vessel, a horizontal rod pivotally-attached to said arm, means slidably supporting said rod, a compression spring on said rod so arranged as to offer resistance to the pull on said rod caused by the downward tilting of said vessel, whereby a substantial quantity of liquid must be drawn from said vessel when said vessel is in downward tilted maximum position before said spring will return said vessel to its raised position to start said motor operating.

6. In an apparatus for carbonating liquids, an elongated sealed cylindrical substantially horizontal vessel, its length being several times its diameter, a stationary support for said vessel, said vessel being pivotally mounted on said support at one end, the other end of said vessel movable in a short vertical arc, a spray nozzle located in the supported end of said vessel, means for delivering liquid to said nozzle under pressure, said means including a motor, means for supplying gas under pressure to said vessel, a liquid discharging outlet located near the supported end of said vessel, a mercury switch in the circuit to said motor attached to said vessel operated by the pivotal movement of said vessel, spring counter-balancing means for said vessel, said spring means including an arm depending from said vessel, a horizontal rod pivotally-attached to said arm, means slidably supporting said rod, a compression spring on said rod so arranged as to offer resistance to the pull on said rod caused by the downward tilting of said vessel, whereby, upon the tilting of said vessel, the greatest depth of liquid will be at the end opposite said spray nozzle and said vessel will tilt when it contains its maximum quantity, and whereby a substantial quantity of liquid must be drawn from said vessel when said vessel is in downward tilted maximum position before said vessel will return to said minimum position and start said motor operating.

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