Oct. 25, 1966 J. J. BOOTH ET AL 3,280,587

INSULATED BEVERAGE CARBONATOR

Filed Nov. 10, 1964 2 Sheets-Sheet 1

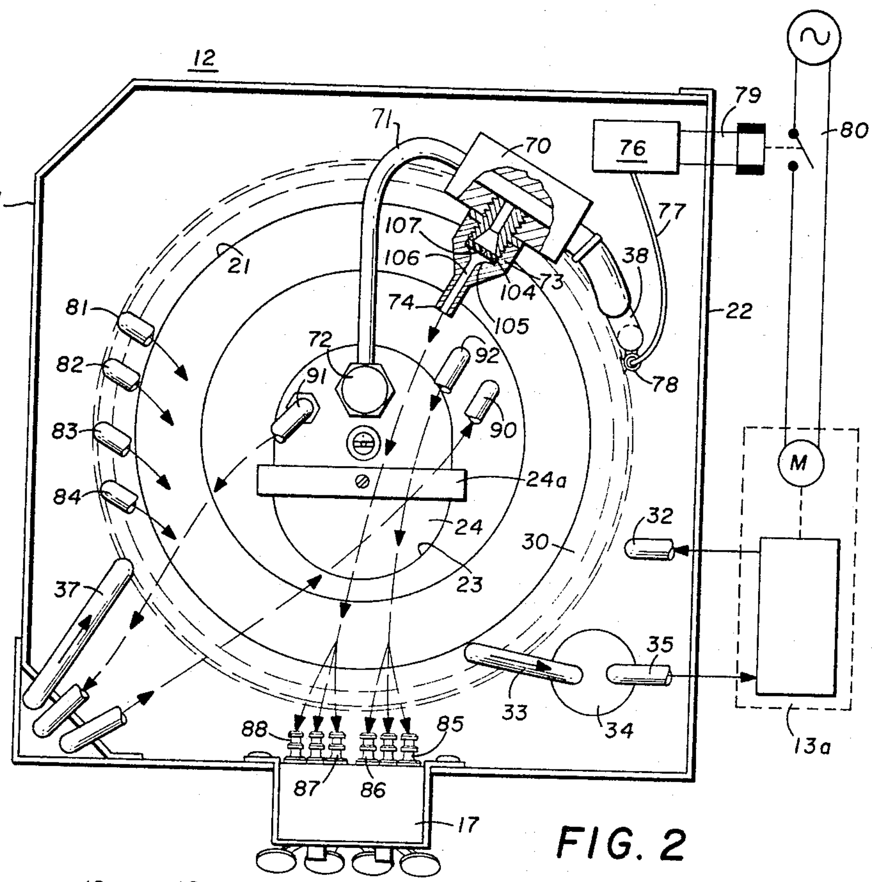

FIG. 2

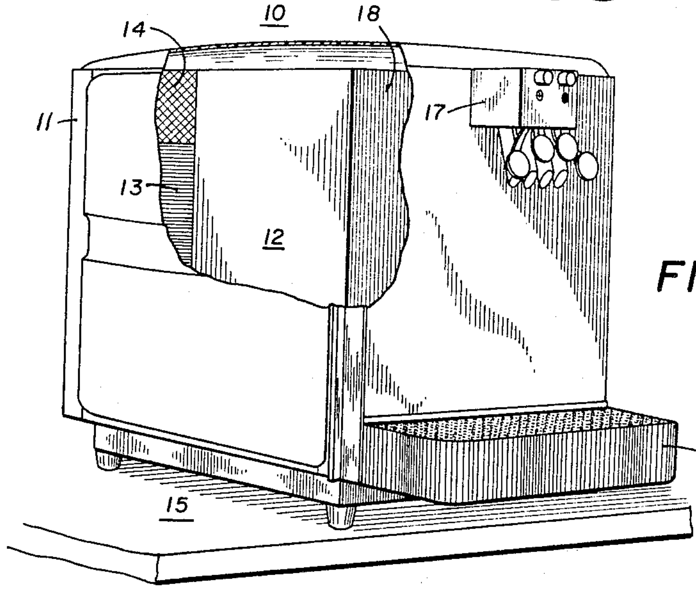

FIG. 1

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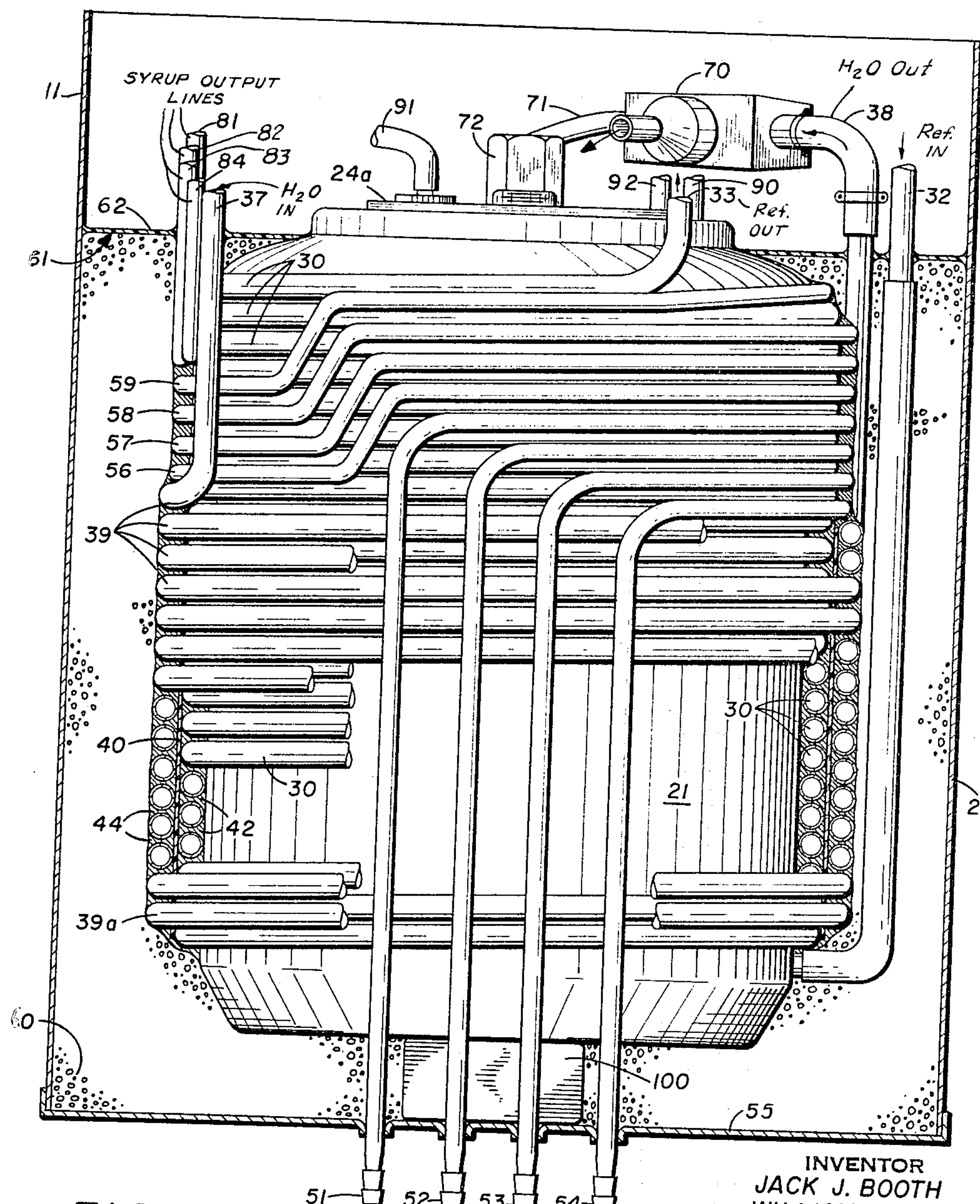

FIG. 3

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INSULATED BEVERAGE CARBONATOR

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This invention relates to a device for dispensing carbonated beverages, and more particularly, to an improved light-weight insulated carbonator.

Carbonated beverages are dispensed in large quantities in open receptacles such as paper cups. Dispensers generally are of either of two types. A first type, a pre-mix dispenser, is a system in which CO_2 gas is introduced into a mixture of syrup and water prior to contact with the gas. The second type is a post-mix system of the type to which the present invention pertains, and involves a system for introducing CO_2 gas into water, following which a stream of the resulting carbonated water is mixed in predetermined proportions with a stream of syrup during flow into a receptacle or cup. A representative pre-mix vending machine is illustrated in U.S. Patent 2,861,433 to J. J. Booth. Representative post-mix dispensers are illustrated in U.S. Patents 2,455,551 and 2,447,782 to J. J. Booth. In the latter patent, a carbonator tank is cast along with refrigeration and supply coils in a metal block so that liquid flowing into the tank by way of the supply coils, along with liquid in the tank, can be maintained at a low temperature, thereby to enhance the absorption of CO_2 gas in the water. It is well known that the lower the water temperature, the more gas will be absorbed and retained, the latter being necessary for dispensing quality drinks. Water is introduced into the tank as a fine spray to pass through a CO_2 atmosphere in the upper portion of the tank. In addition, CO_2 is bubbled upward through the water in the lower portion of the tank, so that a store of chilled, highly carbonated water is present at all times within the carbonator. Pressure of the CO_2 gas in the carbonator is applied to the water in the tank so that it can be dispensed by opening a valve leading to a flow line which extends to the bottom of the tank. At the valve, the flow of carbonated water is intermixed with a stream of syrup. The syrup and the carbonated water become mixed as they flow through the valve and are deposited into the cup.

The present invention is directed to an improved insulated carbonator, which provides for control of the temperature of the syrup flowing to the valve and of the water fed into the carbonator. A relatively inexpensive carbonator structure is provided which is adequate to meet all of the requirements for a system which will deliver carbonated beverages of superior quality.

More particularly, in accordance with the present invention, a pressure tank is provided with a refrigerant coil spirally wound therearound and in direct contact therewith. A water coil leading from a supply source into the tank by way of a float-actuated valve is spirally wound around the tank and is spaced uniformly from the windings of the refrigerant coil as to maintain a predetermined temperature differential between the refrigerant coil and the water coil. At least one syrup coil is wound around the tank in direct contact with the refrigerant coil and extends from a syrup supply source to a dispensing valve. A carbonated water flow line leads from the bottom of the tank to the dispensing valve. A body of confined, separated, spaced air cells encases the tank and the coils to minimize heat transfer except between the refrigerant coil on the one hand and the tank, the water coil, and the syrup coil on the other hand.

In a preferred embodiment, the tank and coils are encased in a unitary body of polyurethane foam. Preferably, the movement of refrigerant in the direction of the axis of the refrigerant coil is opposite to the movement of water in the water coil. By this means, maximum control is achieved over heat transfer from the water sprayed into the tank.

For a more complete understanding of the present invention and for further objects and advantages thereof, reference may now be had to the following description taken in conjunction with the accompanying drawings in which:

FIGURE 1 is a perspective view, partially cut away, illustrating an application of the present invention;

FIGURE 2 is a top view of the carbonator tank of FIGURE 1; and

FIGURE 3 is a cut-away view of the tank of FIGURE 2 illustrating the tank and the coil arrangement.

In FIGURE 1, a dispenser of carbonated beverages is illustrated in a form particularly suitable for countertop use in that the dispenser is relatively small in size and yet has adequate capacity to deliver substantial volumes of beverages. The dispenser **10** is provided with a case **11** which houses a carbonator unit **12** and a compressor unit (not shown) in the compartment **13**. A condenser unit **14** is positioned in compartment **13** above the compressor and is connected to the compressor in the conventional manner.

The unit **10** is designed for operation on a countertop **15** with syrup tanks and a tank of CO_2 gas (not shown) located beneath the countertop **15**. A multi-channel valve head **17** is mounted at the upper edge and on the rear panel of the carbonator unit **12** and extends beyond the rear face of the housing **11**. The valve may be actuated to select any one of a plurality of differently flavored drinks. Chilled syrup may be mixed either with carbonated water or with plain water, as desired. Additionally, either plain water or carbonated water may be selected. A drip tray **19** is provided on which cups may rest while they are being filled.

The present invention is directed to a structural and operational features of the carbonator **12**.

FIGURE 2 is a top view of the carbonator **12**. The carbonator **12** is positioned centrally in a rectangular housing **22**. The tank **21** has an oval mouth **23** in which a lid **24** is normally sealed by a clamp means **24*a***. The tank **21** preferably is of stainless steel and serves to support a plurality of coils wound spirally on the cylindrical surface thereof.

A first coil **30** is wound immediately adjacent to, and in contact with, the surface of the tank **21**. The coil is connected to an input line **32** and leads to an output line **33**. The coil **30** is a refrigerant coil through which Freon flows from the compressor unit **13*a***, in the compartment **13**, FIGURE 1, into input line **32**. Freon flows from the coil **30** through the output line **33** and into an accumulator cylinder **34**. The accumulator cylinder is a small tank of cylindrical form whose axis is parallel to the axis of the tank **21** and is positioned in the corner of the housing **22**. Freon flows from the output line **35** to the input of the compressor **13*a***. A second coil is spirally wound on the outside of the coil **30**.

A second coil on tank **21** is a water coil **39** having an input port **37** and an output port **38**. The coil **39** is wound around the lower portion of the tank, as best shown in FIGURE 3. The coil **39** extends from the bottom region of coil **30** to about midway of the heighth of the tank **21** and the coil **30**. A relatively thin insulating sleeve **40** is positioned between the water coil **39** and the refrigerant coil **30**. The zones between the windings of the coil **30** and the surface of tank **21** are filled with a heat-conductive plastic material or putty **42**, so that substantial heat transfer will be promoted between the tank **21** and the refrigerant coil **30**. In a similar manner, a body of heat-conductive plastic material 44 fills the zones between sleeve 40 and coil 39.

Four syrup lines 51–54 enter the unit through the bottom panel 55, as shown in FIGURE 3, and form spiral coils 56–59. Coils 56–59 each make about one and three-quarters of a turn around the upper half of the tank 21 and are outside the refrigerant coil 30. The syrup coils 56–59 are not isolated from coil 30, as was the case with the water coil, but make contact with the coil 30. The entire surface of the unit, including the coils 30, 39, and 56–59, is covered with the heat-conductive putty. The tank 21, with the six coils wound thereon and secured thereto, is then placed in the housing 22 resting on block 100. The housing is then filled with a unitary body 60 of polyurethane foam which serves as an insulating barrier, greatly limiting the transfer of heat between the tank 21 and its windings, on one hand, and the case 22, on the other hand. The polyurethane foam body 60 extends up to the level 61. At this level, a sealing layer 62 of an epoxy resin material is then formed on the top of the polyurethane foam.

Freon enters coil 30 by way of the line 32. Thus, the Freon starts its course through the coil 30 from the bottom of tank 21 and emerges from the top by way of line 33. In contrast, the water enters the water coil 39 by way of the line 37 and thus begins its course through the coil 39 from the top thereof. Chilled water leaves the water coil 39 from the bottom winding 39*a* and by way of line 38. Thus, the directions of movement axially of the tank 21 of refrigerant and water are opposed to one another.

As above indicated, the tank 21 preferably is made of stainless steel. The refrigerant coil 30 is of copper and is tack-welded to the outer surface of the stainless steel tank 21 to cause it to remain securely fixed thereto. The sleeve 40, forming an insulating barrier, preferably is such as to maintain a temperature gradient across the cylinder of the order of two or three degrees Fahrenheit. Freon in the refrigerant coil 30 normally is maintained at about 29° F. Because of the spacing between coils 30 and 39, the water coursing through the water coil 39 will not freeze but will be lowered to within a degree or so above freezing. Thus, the water flowing from line 38 is chilled before it is sprayed into the tank 21.

As best seen in FIGURE 2, the chilled water from line 38 passes through a fitting 70 and then is connected by way of line 71 to an input fixture 72 on the lid 24. A connection 73 leading from the fitting 70 is a flow regulator. Flow in the line 74 leading to the valve unit 17 supplies chilled non-carbonated water to a selected one of the channels in valve unit 17.

The flow regulator 73 is provided so that water will be delivered through the flow line 74 at a constant flow rate, even though there are variations in the pressure of the water supply line leading to the unit. The water flowing through the line 74 is mixed in the valve 17 with a selected one of the syrups. Syrups are maintained under a constant pressure so that if the flow of water varies, variation in the concentration of a given beverage would result. The flow regulator involves a regulating washer 104 which is mounted adjacent to an output port which is characterized by curved shoulders 105 leading to the output channel 106. As pressure in regulator 73 increases, the washer 104 is deformed to the shape of the shoulders 105. When this takes place, the orifice 107 in the washer 104 is reduced in diameter so that the rate of flow through the washer, which tends to increase in proportion to pressure, concomitantly tends to decrease in proportion to the reduction in size of the orifice. Thus, a constant flow rate may be maintained.

A temperature responsive unit 76 is positioned at the top of the case 22 and has a line 77 which extends into a temperature well 78 which is adjacent to the water output line 38 so that the temperature of the chilled water will be continuously sensed. Control lines 79 lead from

the temperature responsive unit 76 to the control circuit 80 for the compressor 13*a* so that the compressor will be actuated to maintain the temperature of the water in the output line 38 within predetermined limits.

Syrup entering the windings 56–59 by way of the input lines 51–54 emerges at output lines 81–84. The lines 81–84 are connected to four separate input channels in the valve 17. The valve 17 has been indicated only schematically in the drawings. The valve may be of well-known type, such as the Jet Master Touch-Action Valve, manufactured and sold by Specialty Engineering Corporation of Dallas, Texas. The valve permits selectivity in the variety of beverages that can be dispensed therethrough. In the form illustrated, the lines 81–84 would be connected to four syrup inlet fittings on the valve 17 at the locations directly below fittings 85–88. CO_2 gas is introduced into the tank 21 by way of the input line 90. A CO_2 gas output line 91 leads to one of the syrup tanks. Thus, one of the syrup tanks is maintained under pressure by the flow of CO_2 gas through the output line 91. This serves to purge the carbonator tank 21 of foreign gases. The remainder of the syrup tanks are maintained under pressure directly from a conventional pressure regulator (not shown) which feeds the line 90.

Carbonated water from the tank 21 flows by way of line 92 to the valve 17. Carbonated water may be applied to as many of the water input lines of the valve 17 as desired. The flow line 74 from the fitting 70 may also be connected selectively to the water input ports on the valve 17. Thus, carbonated beverages or non-carbonated beverages may be selectively dispensed through the valve 17.

In one embodiment of the invention, the heat-conductive plastic material surrounding the coils was of the type ordinarily used in the manufacture of refrigerating units where a heat-conductive contact, of area greater than the tangent between a coil and a flat or cylindrical surface, is desired. Such materials are well known and are widely used in the manufacture of refrigeration units. In assembly, a layer of such heat-conductive plastic material first is placed on the outer surface of the tank 21. The refrigerant coil 30 is then spirally wound onto the tank 21. The windings of the refrigerant coil 30 preferably are wound as to be tangent one to the other and also tangent to the tank 21. The refrigerant coil preferably is tacked or soldered to the tank 21 at both ends so that it is maintained in position on the tank 21. A layer of the heat-conductive plastic material is then formed over the refrigerant coil 30. The water line 39 is then wound onto and into the layer of heat-conductive putty to provide for heat transfer therethrough.

While the tank illustrated in FIGURES 2 and 3 is one form in which the invention may be employed, it will be recognized that different configurations may be employed while achieving the same results as in the present case. For example, in larger carbonating units, the refrigerant coil and the water coil could be wound spirally with alternate windings and with each winding tangent to the surface of the carbonating tank. In such case, the conductivity provided by the heat-conductivity putty and the layer forming the counterpart of sleeve 40, if employed, would prevent the water flowing in the water coil from freezing, even though positioned closely adjacent to the windings of the refrigerant coil. By conducting heat from the tank into the Freon line, which is at 29° F., the temperature differential between the Freon line and the water line can be maintained so that the water line will not freeze up and interrupt operation of the unit.

The tank 21 with the coils would thereon is then placed in the housing 22. The bottom of the tank 21 rests on a block 100 of non-heatconductive material. Polyurethane foam is then injected into the housing 22 completely to surround the tank 21 and all of the windings thereon.

After the body 60 is set, the surface is then covered by a thin layer 102 of an epoxy resin which seals the body 60 and the points at which the various tubes emerge from the surface. Prevention of water line freeze-up can further be aided by using a larger size tubing for the water coil.

The tank 21, while described above as being made of stainless steel, has the essential characteristics of compatibility with a CO_2 atmosphere and of providing a relatively small temperature difference thereacross, so that the refrigerant coil 30 may be operated at a temperature normally below the freezing point of water and the carbonated water within the tank 21 will not freeze. Thus, a material which will provide heat conduction to the fluid in the tank, and yet will provide a temperature differential thereacross adequate to prevent the water therein from freezing, will be suitable for tank 21.

Thus, in accordance with this invention, a beverage carbonator is provided in which a tank is adapted to be pressurized with CO_2 gas. A refrigerant coil is wound directly onto the tank for removal of heat from the tank. A water coil leading to the tank is wound around the tank and is spaced from the refrigerant coil for attenuated transfer of heat from the water coil. At least one syrup coil is wound directly onto the refrigerant coil. A body of confined separated spaced air cells encases the tank and the coils.

Having described the present invention in connection with certain specific embodiments thereof, it is to be understood that further modifications may now suggest themselves to those skilled in the art and it is intended to cover such modifications as fall within the scope of the appended claims.

What is claimed is:

1. In a beverage carbonator, the combination which comprises:

(a) a tank adapted to be pressurized with CO_2 gas,
(b) a refrigerant coil wound directly onto said tank for removal of heat from said tank,
(c) a water coil leading to said tank and wound around said refrigerant coil and spaced from said refrigerant coil for attenuated transfer of heat from said water coil,
(d) at least one syrup coil wound directly onto said refrigerant coil, and
(e) a body of confined separated spaced air cells encasing said tank and the coils.

2. In a beverage carbonator having supply lines for water, syrup, and CO_2 gas for feeding a control valve, the combination which comprises:

(a) a pressure tank connected to the CO_2 supply line,
(b) a refrigerant coil wound directly onto said tank,
(c) a water coil wound around said refrigerant coil and spaced from said refrigerant coil and leading from the water supply line to said tank,
(d) a syrup line wound directly onto said refrigerant coil and interconnecting the syrup supply line and said valve,
(e) a flow connection between the bottom region of said tank and said valve, and
(e) a unitary body of air cells encasing said tank and the coils.

3. The combination set forth in claim 2 in which said tank is a stainless steel tank.

4. The combination set forth in claim 2 in which a plurality of syrup lines are wound directly onto and in contact with said refrigerant coil.

5. The combination set forth in claim 2 in which said

water coil is formed as an outer layer over a lower section of said refrigerant coil and a sleeve for impeding heat transfer between said refrigerant coil and said water coil is interposed between them.

6. The combination set forth in claim 2 in which a heat-conductive plastic material encases the coils and fills the voids between said coils and said tank.

7. The combination set forth in claim 2 in which said body of air cells is a polyurethane foam.

8. The combination set forth in claim 2 in which refrigerant flows upward through said refrigerant coil and water courses down and through said water coil with an upward return line in said body of air cells spaced from said refrigerant coil and in which a temperature sensing element is located in a well conductively coupled to said return line for control of the temperature of said refrigerant.

9. A beverage carbonator which comprises:

(a) a pressure tank,
(b) a refrigerant coil helically wound on said tank in intimate relation to the surface of said tank,
(c) a water coil wound around and in heat transfer relation to said refrigerant coil and spaced therefrom as to be maintained normally at a predetermined temperature differential with respect to the refrigerant in said refrigerant coil,
(d) at least one syrup coil adjacent to said refrigerant coil,
(e) a flow connection leading from the output of said water coil into said tank,
(f) means for directing refrigerant flow through the refrigerant coil in direction along said tank opposite to the flow of water in said water coil, and
(g) an insulating cellular air body surrounding said tank and the coils thereon to prevent heat flow from said refrigerant coil except to said tank, said syrup coil, and said water coil.

10. A beverage carbonator which comprises:

(a) a pressure tank,
(b) a refrigerant coil helically wound on said tank with turns thereof in tangent relation to the surface of said tank,
(c) a water coil wound outside of said refrigerant coil but spaced therefrom as to be maintained normally at a predetermined temperature differential with respect to the refrigerant in said refrigerant coil,
(d) at least one syrup coil wound directly onto said refrigerant coil,
(e) a flow connection leading from the output of said water coil into said tank,
(f) means for directing refrigerant flow through the refrigerant coil in direction along said tank opposite to the flow of water in said water coil, and
(g) an insulating cellular air body surrounding said tank and the coils to prevent heat flow from said refrigerant coil except to said tank, said syrup coil, and said water coil.

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