Dec. 1, 1936. S. RUPPRICHT 2,062,827

REFRIGERATING SYSTEM

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Fig. 1.

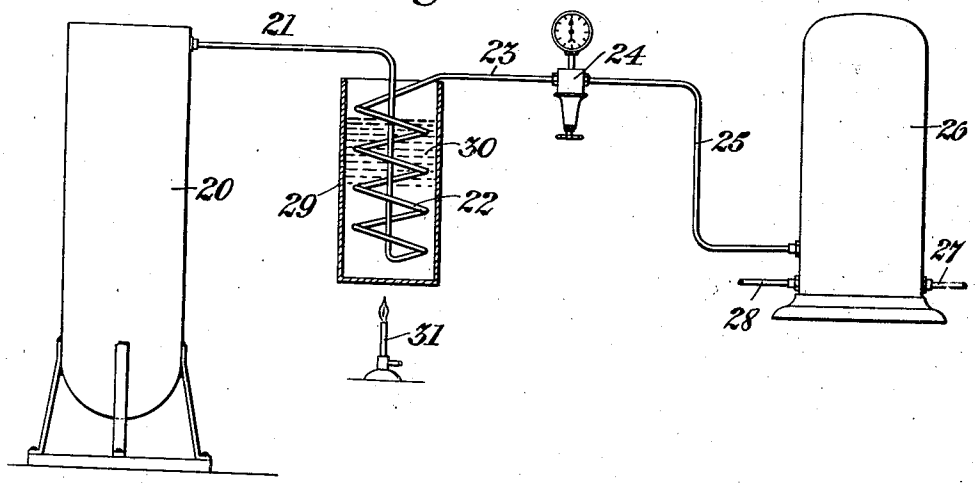
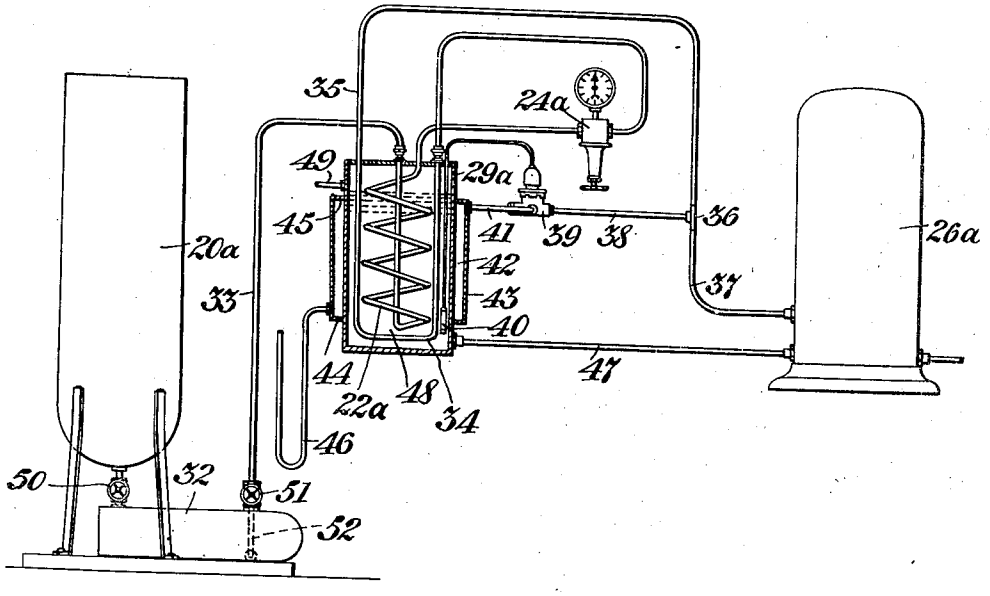



Fig. 2.




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Fig:8.

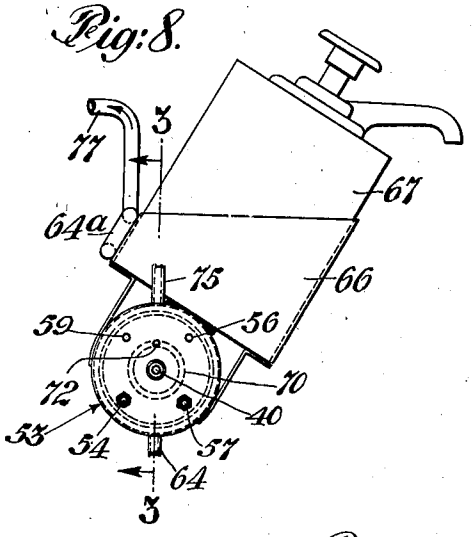



Fig:9.

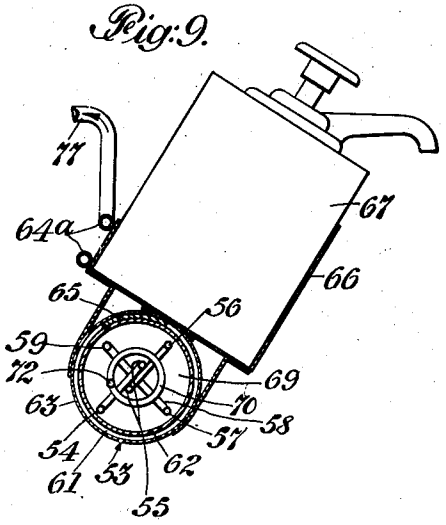



Fig:7.

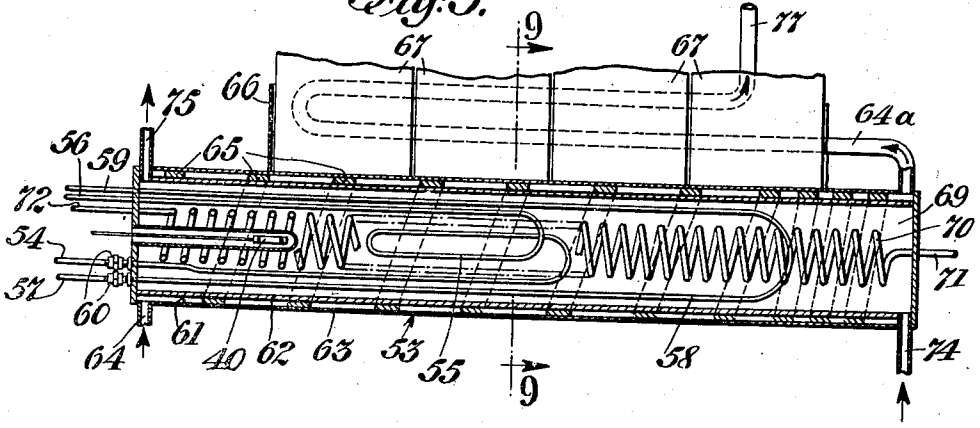



Fig:10.

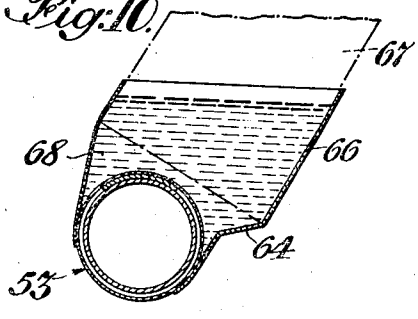
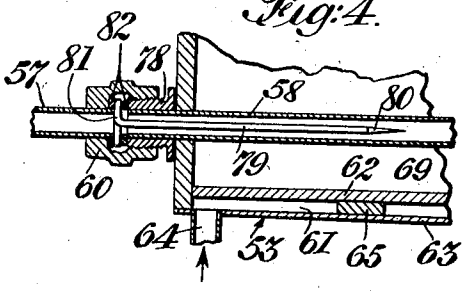



Fig:4.




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REFRIGERATING SYSTEM

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Fig:5.

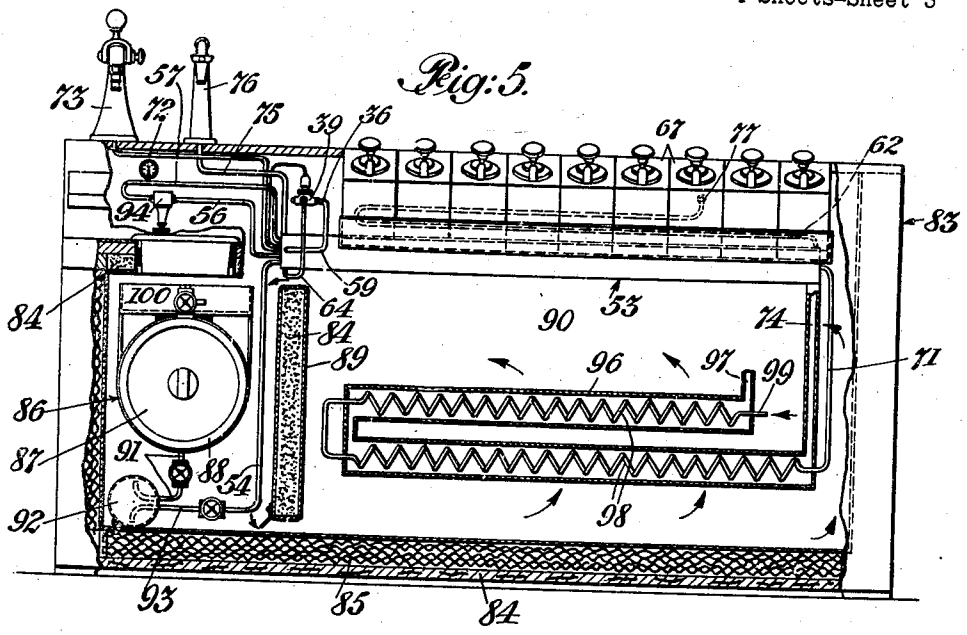



Fig:7.

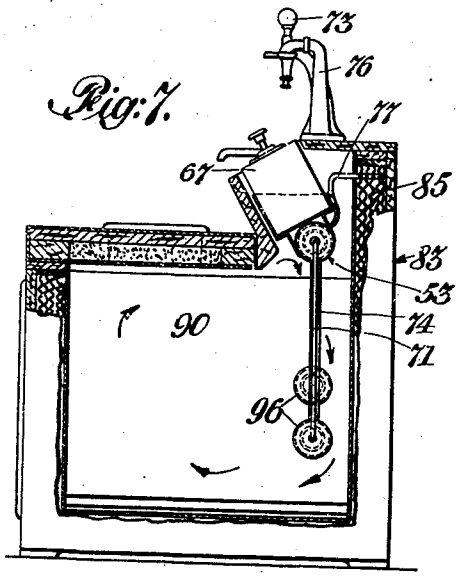



Fig:6.

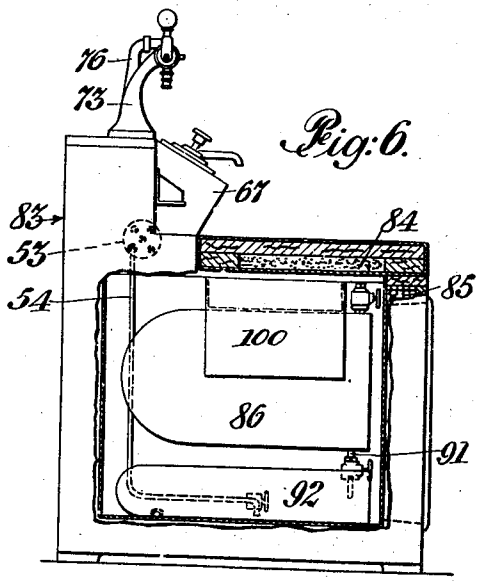
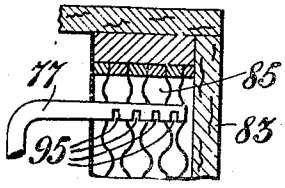



Fig:11.




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Fig. 12.

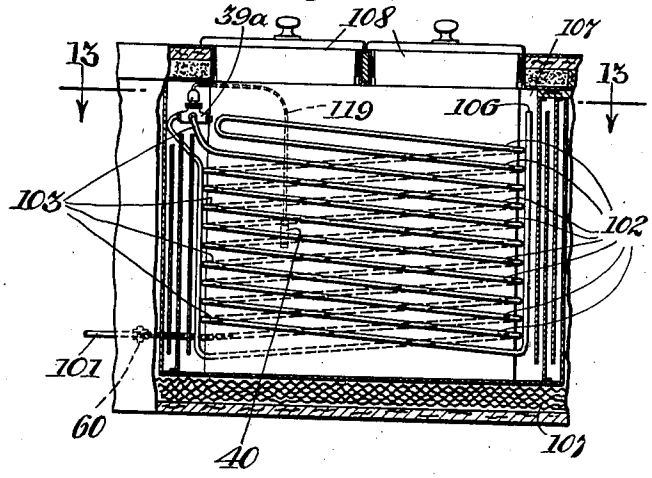



Fig. 13.

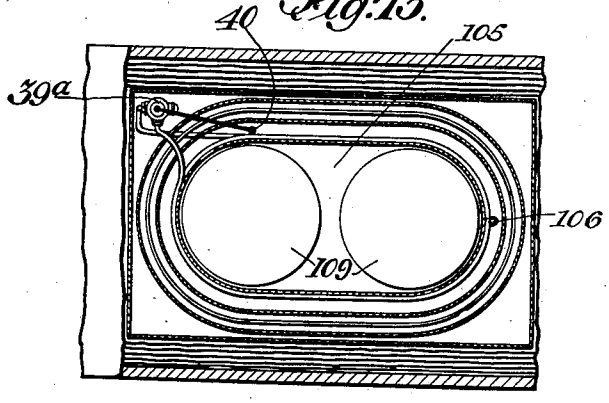
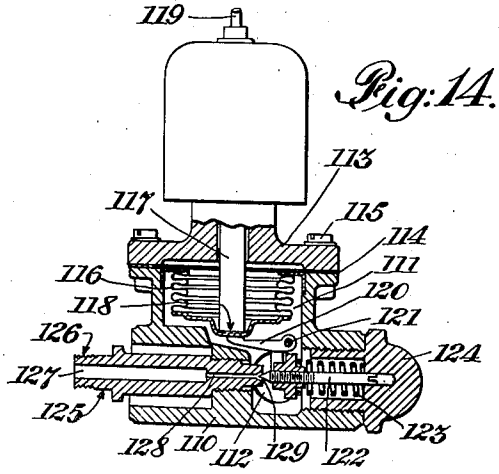



Fig. 14.




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Patented Dec. 1, 1936 2,062,827

# UNITED STATES PATENT OFFICE

2,062,827

## REFRIGERATING SYSTEM

Siegfried Ruppricht, New York, N. Y.

Application September 9, 1932, Serial No. 632,344

20 Claims. (Cl. 62—91.5)

This invention relates to improvements in refrigerating systems and has for an object the provision of means for economically utilizing solid refrigerants, particularly solid $CO_2$.

Heretofore, in using solid $CO_2$ for carbonating water it has been customary to place the ice into a pressure chamber and as the chamber takes up heat the pressure builds up in the chamber and part of the solid $CO_2$ forms gas and part of it liquefies when the pressure becomes high enough. A pipe from the top of the pressure chamber leads $CO_2$ gas through a coil of pipe and via a pressure reducing or regulating valve to a carbonator. The coil of pipe referred to is placed in a water box and a gas flame or other source of heat is applied below the water box to heat up the water therein to prevent the $CO_2$ gas from freezing up the regulating valve. This results in a loss of energy in work that the refrigerating effect of the $CO_2$ could accomplish and the loss of energy constituting the heat applied. Another object of the invention is to utilize this energy that has been heretofore lost.

A further object of the invention is to utilize the liquefied $CO_2$ as a refrigerant in a series of steps, providing means whereby a part of the $CO_2$ may be utilized for carbonating, and finally discharging the spent gas into the walls of a cabinet enclosing the apparatus thereby improving the insulating value of the walls.

Other objects and advantages of the improved refrigerating system will become apparent to those skilled in the art upon a perusal of this specification and the appended claims.

For describing and illustrating the invention a preferred embodiment is shown incorporated into a soda fountain, although it has many other applications.

Referring to the drawings:

Figure 1 is a diagrammatic sketch showing a well known arrangement for using solid $CO_2$ for making carbonated water wherein heat is applied to the coil to prevent the regulating valve from freezing up;

Figure 2 is a diagrammatic sketch along the lines of that shown in Figure 1, showing the invention in simple form utilizing the liquid $CO_2$ for refrigerating purposes before using it otherwise;

Figure 3 is a view, partly in section, showing a horizontal type of cooler constituting part of the invention and suitable for use in the embodiment thereof herein shown;

Figure 4 is a sectional view showing fluid pressure reducing restrictions used in the improved refrigerating system;

Figure 5 is a front elevation, partly in section, incorporating a preferred embodiment of the invention;

Figure 6 is an end elevation, of the left end of the fountain shown in Figure 5, partly broken away to show the arrangement of some of the elements of the system;

Figure 7 is an end elevation, partly broken away, of the right end of the fountain shown in Figure 5;

Figure 8 is a view showing the relation of the syrup jars to the cooler;

Figure 9 is a cross sectional view, similar to Figure 8, taken along the line 9—9 of Figure 3;

Figure 10 is a sectional view showing how a liquid is used to cool the syrup jars;

Figure 11 is a view partly in section showing how the spent $CO_2$ gas is discharged into the walls of the cabinet to improve the insulation thereof;

Figure 12 is an elevation, partly in section, showing the method of cooling ice cream cans and the like by means of the improved refrigerating system;

Figure 13 is a sectional plan of the device shown in Figure 12 along the line 13—13;

Figure 14 is a detailed view partly in section of an improved thermostatically controlled regulating valve suitable for use in the improved refrigerating system.

The diagrammatic sketch Figure 1 is shown in order to give a better understanding of the invention. This diagram shows diagrammatically an arrangement commonly used where dry ice or solid $CO_2$ is utilized for carbonating water. The solid refrigerant is placed in the pressure chamber 20 and the chamber is sealed up. As the dry ice takes up heat, the pressure therein rises and after a time the solid refrigerant begins to liquefy, the liquid collecting in the bottom of the chamber and the gaseous $CO_2$ occupying the remainder of the space in the chamber not occupied by liquid or solid $CO_2$. A pipe 21 leads from the top of the chamber 20 via a coil 22 and a pipe 23 to the pressure-reducing valve 24. The pressure-reducing valve 24 is provided for reducing the pressure of the gas from the liquefying pressure in the chamber 20 to the most favorable pressure for use in carbonating water. The gas, at a reduced pressure, is led via the pipe 25 to the carbonator 26. Water enters the carbonator via the pipe 27. As the method of carbonating water is well known to those skilled in the art it

will not herein be described. The carbonated water is led out from the carbonator via the pipe 28.

In order to prevent the pressure-reducing valve 24 from freezing up, especially in case a slug of liquid passes thereto along with the gas, the coil 22 is submerged in a container or tank 29, containing a suitable liquid 30, and by means of a burner 31 or any other suitable source of heat the liquid 30 may be heated so that any liquid refrigerant (or $CO_2$) in the coil may be thereby evaporated before it can possibly reach the pressure-reducing valve 24.

The diagrammatic arrangement shown in Figure 2 is laid out in a manner similar to the diagram shown in Figure 1, so that the invention may be more readily understood.

A pressure chamber 20a is provided so that solid $CO_2$ may be placed therein and sealed up. When the temperature of the vessel 20a rises and pressure builds up, liquefying some of the $CO_2$, this liquid settles into a receiver 32. The liquid from the receiver passes via the pipe 33 and the coil 22a to the reducing valve 24a. The coil 22a is submerged in the closed tank 29a containing liquid which will presently be described. The refrigerant passing from the valve 24a at a reduced pressure passes through a coil of pipe 34, which is also submerged in the liquid in the tank 29a. A pipe 35 leads the refrigerant from the cooling coil 34 to the T 36 and a pipe 37 leads the $CO_2$ to the carbonator 26a. Part of the $CO_2$ is led from the T via the pipe 38 to a thermostatically-controlled reducing valve 39, which is controlled by a thermo-bulb 40. This valve will presently be described more in detail in connection with Figure 14. $CO_2$ passing from the valve 39 at a further reduced pressure is led via a pipe 41 into an annular space 42 around the tank 29a, which is formed between the wall thereof, the wall 43 and the annular heads 44 and 45. The $CO_2$ passing from the annular space 42 may be led via the pipe 46 to the outside air or to the space between the insulated walls of the device, which will presently be described in connection with Figures 5, 6, 7 and 11.

The tank 29a, with the coils 22a and 34 therein, and the annular space 42 formed thereabout may be termed "cooler" and carbonated water from the carbonator 26a passes via the pipe 47 into the space 48 within the cooler 29a and may be withdrawn via the pipe 49.

A suitable shut-off valve 50 is provided between the pressure chamber 20a and the receiver 32, and a similar shut-off valve 51 is provided between the receiver 32 and the pipe 33. A short length of pipe 52 leads down to the bottom of the receiver so that as long as there is any liquid therein it will pass out by way of this pipe.

Liquid refrigerant, at very low temperature, passes through the pipe 33 to the coil 22a, where it absorbs heat from the water in the cooler 29a. The refrigerant, after having its temperature raised by the carbonated water, passes through the reducing valve 24a, and is again passed through the cooler via the coil 34, where more heat is absorbed from the carbonated water. The refrigerant passes out of the coil 34 through the pipe 35 to the T 36. Part of the refrigerant is utilized in the carbonator 26a and part of it passes through the thermostatically-controlled reducing valve 39 into the annular space 42, where the temperature of the cooler is still further reduced and the spent $CO_2$ passes through the pipe 46 and on out into the open air, or into spaces between the insulations in a cabinet in which the device is installed.

From this, it can readily be seen that in existing arrangements, such as that shown in Figure 1, no advantage is taken of the refrigerating effect of the $CO_2$, as this is allowed to go to waste, and there is a further loss of energy in that heat is applied to the tank 29 so that if any liquid refrigerant gets to the coil 22 it will be immediately evaporated into gas.

In the arrangement shown in Figure 2, which diagrammatically illustrates the invention, the carbonated water is cooled by means of the refrigerating effect of the $CO_2$. The air in a cabinet in which the cooler $29_a$ is placed is also refrigerated, part of the gas is used to carbonate the water and part of the gas is used to improve the insulating qualities of the cabinet in which the apparatus is housed.

Figure 3 shows a horizontal type of cooler which is a modification of the one shown at 29a in Figure 2. This cooler is designated generally by the numeral 53. The cold liquid $CO_2$ is led via pipe 54 with a coil 55 and out via the pipe 56 to a pressure-reducing valve like the one shown at 24a, in Figure 2, where the pressure of the refrigerant is reduced. The refrigerant again passes into the cooler via the pipe 57 through the coil 58 therein and out via the pipe 59. A novel expansion means is introduced in the coil 58 at the point indicated by the numeral 60. This will presently be explained in connection with Figure 4.

Refrigerant passing out of the coil 58 via the pipe 59 branches and some of the $CO_2$ may be utilized to charge the water in the carbonator and some of the $CO_2$ passes via the thermostatically-controlled reducing valve 39 into the annular space 61 formed between the walls 62 and 63 of the cooler 53. The $CO_2$ from the reducing valve 39 passes into the space 61 via the pipe, a portion of which is indicated by the numeral 64.

The space 61 is broken up into a connected series of passages by means of a heavy copper ribbon 65 and it has been found preferable to have these spiral spaces gradually diminish as the end of the cooler is approached, so that gaseous refrigerant therein has its velocity gradually accelerated. The gaseous refrigerant passes out of the series of passages 61 via the pipe 64a.

When this type of cooler is applied to a soda fountain a suitable receptacle 66 is provided to hold the syrup jars 67 (Figures 8, 9 and 10). This receptacle is in heat exchange relation to the outer wall 63 of the cooler 53 and the pipe 64a may have one or more loops formed therein and in contact with the receptacle 66.

To facilitate the heat exchange between the cooler 53 and the syrup jars 67 a suitable liquid 68 may be placed in the receptacle 66. The $CO_2$ gas passing out via the pipe 64, and any loops thereof in contact with the receptacle 66, is then led via the pipe 77 to one or more distributing pipes, which will presently be described.

A cooling coil 70 is provided in the interior 69 of the cooler 53 through which the carbonated water is passed to be cooled. The carbonated water enters the coil 70 via the pipe 71 and leaves the cooler via the pipe 72 from which it may be led to a suitable draft-arm 73. The interior space 69 in the cooler 53 also serves for cooling plain water. This water is led into the space 69 via the pipe 74 and the cooled water passes out of the cooler via the pipe 75, from which it may be led to a suitable water spigot 76.

One of the expansion devices placed in the coils 55 and 58 at the union indicated by the numeral 60 is shown more in detail in Figure 4. The union 60 has a stationary member 78 which is secured to the end of the coil 58. A wire 79 has a long sharp point 80 formed on one end thereof. The other end of the wire 79 is formed into a circular loop 81. This wire is inserted into an end of the coil 58 and the pointed end extends well into the coil in an area thereof which is surrounded by water. The looped end 81 of the wire is secured, along with suitable packing 82, between the face of the stationary member 78 and the interior face of the union 60, being held therein in gas-tight relation to the outside air and stationary preferably concentric with the pipe forming the coil 58. Refrigerant passing thereto via the pipe 57 passes through the restricted area between the pipe 58 and the wire with a resultant reduction in pressure. Due to the fact that the point 80 is well within the pipe, which in turn is surrounded by water, it is impossible for the restriction to freeze up because a large body of water is available for the pipe to absorb heat from. This eliminates a great deal of trouble heretofore encountered with expansion valves freezing up and instead of having the reduction of pressure at one small point it is given gradient by the presence of the wire within the pipe and this gradient may be increased by lengthening the wire or decreased by shortening the wire, but the important feature is the presence of the water about the pipe serving to give up heat to the pipe and thereby remove all possibility of the same becoming frozen up.

The new and improved refrigerating system is shown in Figures 5, 6 and 7 as applied to a soda fountain. The soda fountain designated generally by the numeral 83 is shown having the insulated portions of the walls thereof containing corrugated foil insulation 85. In some portions of the cabinet, on account of strength or for other reasons any other suitable insulation 84 may be used. The insulation 84 may be of cork or any other material having similar qualities. Although cork may also be used in place of the foil insulation 85 the foil is used for two reasons, first, because it is many times lighter than cork, and secondly, $CO_2$ gas may occupy the space between the layers of foil and thereby improve the insulating qualities thereof. This foil insulation may consist of so-called crumpled foil or it may be "preformed" sheets of foil assembled into the space of the cabinet.

A pressure chamber 86 is mounted within the cabinet 83 preferably in a horizontal position. This chamber is provided with a pressure-tight removable door 87 and the same may be made tight in any suitable manner. In one preferred form of construction the pressure chamber 86 has an inwardly extending flange 88 formed therewith. This flange has an eccentric opening and its interior face is provided with suitable packing (not shown). The removable door 87 may also be slightly eccentric so that when the pressure is removed from the chamber the door may be rotated 90° and readily removed. When the solid $CO_2$ is placed in the pressure chamber the door is placed in the position in just the reverse manner as that described for its removal. In other words, it is placed into the end of the chamber and turned 90° and due to the eccentric form of both the cover and the rim enough of the surfaces thereof are in contact with the gasket to hold the pressure in the chamber. This pressure builds up as the outside surface thereof absorbs heat from the cabinet and air circulating in the cabinet due to the presence of the baffle board 89 therein may be traced as follows: Air in contact with the pressure chamber 86 becomes cooled, falls to the bottom of the cabinet and passes underneath the baffle plate 89 into the compartment 90 of the cabinet, becomes warmer and rises, and passing over the top of the baffle 89 it again returns to the pressure chamber to be re-cooled.

As the pressure in the chamber 86 builds up, the $CO_2$ gas therein liquefies and this liquid passes from the pressure chamber via the pipe 91 to the receiver 92. The portion of the pipe 91 inside the receiver is bent upwardly to a point near the upper surface thereof so that the receiver can be almost filled with liquid. Liquid refrigerant passes from the receiver 92 via the pipe 93. The portion of the pipe 93 within the receiver is bent down to a point near the bottom thereof so that substantially all of the liquid can be drawn therefrom. The pipe 93 delivers refrigerant to the coil 55 via the pipe 54. The refrigerant upon passing into the coil 55 passes through a restricted portion of the pipe similar to that shown and described in Figure 4, where a reduction in pressure is effected. This liquid is very cold and upon passing through the coil 55 absorbs heat from the water in the cooler and passes out via the pipe 56 to the reducing valve 94. Refrigerant from the reducing valve 94 passes via the pipe 57 into the cooling coil 58. There is, as was previously described, a reduction in pressure between the pipe 57 and the coil 58 which is accomplished by the novel arrangement described in Figure 4. Refrigerant leaves the coil 58 via the pipe 59, passes via the thermostatically-controlled reducing valve 39 and the pipe 64 into the spiral space 61 between the walls 62, 63 of the cooler 53 and out via the pipe 64*a* through coils formed therein which are in heat exchange relation to the receptacle 66 and via the pipe 77 to the insulated wall 85 of the cabinet 83. Suitable slits 95 may be provided in the end of the pipe 77 to distribute the gas between the various layers of foil 85. A T 36 may be provided in the pipe 59 so that some of the $CO_2$ gas may pass to a carbonater (not shown).

An auxiliary cooler 96 is provided in the compartment 90 to pre-cool the water and the carbonated water before they enter the cooler 53. This cooler may consist of a double casing having a coil of pipe 98 mounted therein. The pipe 97 leading into the auxiliary cooler 96 may be connected to a suitable source of plain water and water passing therein surrounds the coil 98. This water passes out of the auxiliary cooler 96 via the pipe 74 into the interior space 69 of the cooler 53. A pipe 99 connected to a suitable carbonator leads carbonated water through the coils 98 in the auxiliary cooler 96 and via the pipe 71 to the coil 70 in the cooler 53. Carbonated water passing through the coil 70 via the pipe 72 may be led to a suitable draft-arm 73 on the fountain.

The pre-cooler not only serves for cooling the water but it also has a regulating effect upon the system as a whole. There is a co-relation between the cooler 53 and the pre-cooler 96.

When the pressure chamber 86 is first filled with solid $CO_2$, the pre-cooler 96 is cooled by and gives up heat to the pressure chamber 86. The heat from the water in the pre-cooler 96 is given up to the pressure chamber 86, thereby building up pressure therein and liquefying some of the $CO_2$, the liquid passing into the receiver 92 as previously described.

At this stage, the maximum refrigeration is obtained from the pressure chamber 86 which cools and circulates the air in the cabinet as previously described. Up to this point there is no refrigeration produced in the cooler 53 by evaporation of liquid refrigerant. The cooler 53, however, is cooled both by carbonated water and by plain water passing therethrough. This also cools the receptacle 66 and the syrup jars therein.

The refrigerating effect is conserved in the following manner: The cooler which is at first cooled by the water from the pre-cooler passing therethrough, is of low enough temperature to cause the thermo-bulb 40 to close the expansion valve 39 and allow no liquid refrigerant from the receiver 92 to pass into the cooler.

When all of the solid $CO_2$ has become liquefied the liquid refrigerant produces the maximum refrigerating effect in the cooler 53 at which time most of the air circulation in the compartment 90 is effected as follows: Air in contact with the cooler 53 becomes cold and falls to the bottom of the compartment 90, spreading out on the floor thereof, whereupon it rises and passes over to again come in contact with cooler 53 and the process is continued.

When the pressure chamber 86 is first charged up with solid $CO_2$, it (the pressure chamber 86) produces the maximum refrigeration and when all of the $CO_2$ therein is liquefied the liquid produces the maximum refrigeration in the cooler 53, and between these two extremes there is a gradual gradient in temperature and also a gradient between the circulation of air in the compartment 90 and its cooperation with the pressure chamber 86 and with the cooler 53.

One of the most important features of this system is the conservation effect by means of the pre-cooler 96 as described above. This pre-cooler, by giving up heat from the water to the pressure chamber 86, insures the building up of pressure in the chamber and the liquefaction of refrigerant therein

A suitable tray or receptacle 100 may be provided in heat exchange relation to the pressure chamber 86 for freezing ice or ice cubes.

A suitable ice cream compartment may be built into the fountain or a separate ice cream cabinet may be used in an arrangement such as shown in Figures 12 and 13.

To provide refrigeration for the ice cream compartment, the liquid line 54 (Figure 5) may have a T (not shown) placed therein and a branch line therefrom is led via the pipe 101 to the coil 102. Liquid refrigerant passing through the coil 102 absorbs heat from the ice cream compartment 105. The liquid refrigerant, after having its temperature raised in the coil 102, passes through the expansion valve 39a and into the coil 103 in the compartment 105, producing refrigeration therein. The spent gases are discharged at the point indicated by numeral 106 into the walls 107 of the cabinet. Suitable covers 108 are provided in the top of the cabinet for getting access to the ice cream cans 109.

The expansion valve 39 or 39a is shown more in detail in Figure 14. This valve is not only controlled by temperature by having a thermostatic bulb in contact with the evaporator or chamber in which the same is located, but it also controls the admission of refrigerant to the low side, and when the pressure in the low side reaches a predetermined pressure the valve automatically closes regardless of what the temperature is. Therefore, this expansion valve may be termed "a combined expansion and safety valve."

The valve consists of a main body casting 110 having a chamber 111 therein which, by virtue of the opening 112 leading to the evaporator, has a pressure maintained therein substantially the same as that in any evaporator to which the valve is connected. A closure plate 113 is provided for the body casting 110, sealed thereto by a suitable gasket 114 and held in this relation by suitable screws 115. A sylphon or other flexible diaphragm 116 is mounted in the chamber 111 and may be securely held therein by a flanged portion between the body 110 and the closure plate 113. A member 117 is in contact with the sylphon at the point indicated by the numeral 118 and the other end of this member is connected to and adapted to be actuated by a thermo-bulb 40 by means of a capillary tube 119.

A bell crank 120 is pivoted in the chamber 111 on a pivot pin 121. The bell crank 120 has one arm thereof in contact with the sylphon 116 at the point 118, and the other arm of the bell crank controls the motion of the needle 122. A closure nut 124 serves to seal the chamber 111 against the cutside air and also serves as a guide for the needle 122 and for the spring 123.

All parts of the valve described above may be constructed to stand normally low pressures, for example pressures that would be encountered in using methyl chloride as a refrigerant, but as this valve is to be used in connection with $CO_2$ pressures of a thousand pounds or over are encountered.

A nozzle member 125 of the valve is preferably constructed of stainless steel having a high tensile strength. This nozzle has suitable threads 126 for connecting the same to the liquid $CO_2$ line. A suitable passage 127 is provided in the nozzle 125 for the liquid refrigerant and a smaller passage 128 of substantial length is provided therein between the passage 127 and the valve seat 129.

Refrigerant passes through the valve in the following manner; via the passage 127, the reduced passage 128 and the valve seat 129 into the chamber 111 and out via the opening 112 into the evaporator.

As soon as the temperature in the evaporator reaches a predetermined low point the pressure in the thermo-bulb 40 communicated to the sylphon 116 by means of the capillary tube 119 and the member 117 being reduced by virtue of the low temperature allows the pressure of the spring 123 via the bell crank 120 to move the sylphon 116 upward and the needle 122 to the left, as viewed in Figure 14, whereupon the needle seats in the valve seat 129 and allows no more refrigerant to enter the evaporator. When the temperature in the evaporator rises the pressure in the thermo-bulb rises and this pressure communicated to the sylphon by the means previously described, overcomes the pressure of the spring 122 via the bell crank 120 and allows the valve to open so that more refrigerant can pass to the evaporator.

In case the connection between the opening 122 and the evaporator becomes frozen up or clogged, the pressure in the chamber 111 could become as high as that in the passage 127 which may be a thousand pounds to the square inch or more, were it not for the following action.

If the passage or pipe between the opening 112 of the chamber 111 and the evaporator becomes frozen up or clogged the pressure in the cham-

ber 111 immediately begins to build up and this pressure against the sylphon bellows 116 overcomes the pressure imparted to the sylphon in the opposite direction by the thermo-bulb 40, whereupon needle 122 is seated upon the valve seat 129 and no more refrigerant is allowed to enter. Therefore it is impossible to build up an excessive pressure in the chamber 111 although pressures capable of liquefying $CO_2$ are encountered in the system.

Although but one specific embodiment of this invention has been herein shown and described, it will be understood that numerous details of the construction shown may be altered or omitted without departing from the spirit of the invention defined by the following claims.

What is claimed is:

1. The method of using $CO_2$ which consists of confining solid $CO_2$, allowing the same to absorb heat and liquefy, expanding the liquid $CO_2$ in stages to obtain the maximum refrigerating effect therefrom, and by-passing a portion of the $CO_2$ between two of said stages for use in the production of carbonated water.

2. In a refrigerating system, a cabinet, a pressure chamber within the cabinet, a liquid receiver connected to the chamber, a refrigerating coil within the cabinet, connections including a pressure reducing valve between the receiver and the refrigerating coil, and solid $CO_2$ in said pressure chamber adapted to absorb heat from the cabinet and liquefy, the liquefied $CO_2$ also adapted to absorb heat from the cabinet via said refrigerating coil.

3. In a refrigerating system, a cabinet, a pressure chamber within the cabinet, solid $CO_2$ within the chamber adapted to liquefy therein upon the absorption of heat from the cabinet, a liquid receiver connected to said chamber for receiving the liquefied refrigerant, a pressure reducing means and an evaporator connected to said receiver, said evaporator also adapted to absorb heat from the cabinet, and means within said evaporator for cooling water.

4. In a refrigerating system, a cabinet, a pressure chamber within and arranged to refrigerate the cabinet, a solid refrigerant in the chamber adapted to cool the cabinet and to liquefy upon the absorption of heat therefrom, and a liquid cooler in the cabinet including a series of expansion chambers adapted to utilize the liquefied refrigerant in stages for cooling drinking water and for further cooling the cabinet.

5. In a refrigerating system, an insulated cabinet having the insulation thereof in layers, a pressure chamber and an evaporator in the cabinet, solid $CO_2$ in said chamber adapted to refrigerate the cabinet while changing from a solid to a liquid state, means for also refrigerating the cabinet via the evaporator while changing the $CO_2$ in stages from liquid to a gaseous state, means for by-passing between stages a portion of the refrigerant for use in making carbonated water, and means for discharging gaseous refrigerant between the layers of insulation to improve the insulating value of the cabinet.

6. In a refrigerating system of the character described, a cooling unit comprising a cylindrical casing closed at each end and having a plurality of paths therethrough, and means for expanding refrigerant in stages therein, each of said paths constituting one of said stages.

7. In a refrigerating system of the character described, a cooling unit comprising in combination, a casing forming a liquid cooler, a plurality of refrigerating members in heat exchange relation with the liquid in said cooler, said members being serially included in a circuit through which refrigerant is passed, and means in each of the members for effecting expansion therein, said means also being in heat exchange relation with said liquid.

8. In a refrigerating system of the character described, a cooling unit comprising in combination, a casing forming a liquid cooler, a plurality of refrigerating members within said liquid cooler in contact with liquid therein, said members being serially included in a circuit through which refrigerant may be passed, and pressure reducing means in each of said members so positioned therein that the heat of the liquid in the cooler prevents the formation of snow within the members.

9. In a refrigerating system of the character described, a cooling unit comprising in combination, a casing forming a liquid cooler, a plurality of refrigerating members within said liquid cooler in contact with liquid therein, said members being serially included in a circuit through which refrigerant may be passed, and pressure reducing means including restricting wires in each of said members so positioned therein that the heat of the liquid in the cooler prevents the formation of snow within the members.

10. In a refrigerating system of the character described, a cooling unit comprising in combination, a casing forming a liquid cooler, a plurality of refrigerating members within said liquid cooler in contact with liquid therein, said members being serially included in a circuit through which refrigerant may be passed, pressure reducing means in each of said members so positioned therein that the heat of the liquid in the cooler prevents the formation of snow within the members, and a coil within the cooler for carbonated water.

11. In a refrigerating system, a cooler comprising in combination in a unitary structure, a casing through which a liquid to be cooled passes, an evaporator within said casing, a receptacle in heat exchange relation with said evaporator and said casing, syrup containers in said receptacle, and liquid in the receptacle in contact with said containers.

12. In a refrigerating system of the character described, a cooler comprising in combination, a casing through which a liquid to be cooled passes, an evaporator in contact with liquid in said casing, a receptacle in metallic contact with said casing, syrup jars in said receptacle, and liquid in said receptacle in contact with said jars.

13. In a refrigerating system, a cabinet, a pressure chamber within the cabinet, a solid refrigerant in the chamber adapted to liquefy while refrigerating the cabinet, a cooling unit in the cabinet adapted to further refrigerate the same, the refrigeration from the pressure chamber decreasing as the refrigeration from the cooling unit increases, and a pre-cooler within the cabinet adapted to pre-cool water before the same enters said cooling unit, said water serving to cool the cooling unit before any of the solid refrigerant has liquefied.

14. In a system of the character described, a cabinet having a pressure chamber, a water cooler in heat exchange relation with an evaporator and a water pre-cooler therein, and a solid re-

frigerant in said chamber adapted to refrigerate the cabinet and the pre-cooler via the pressure chamber while changing from a solid to a liquid state and adapted to refrigerate the cabinet and the pre-cooler via the evaporator while changing from the liquid to a gaseous state.

15. In a thermostatically controlled expansion valve, a body casing adapted to withstand low pressures, a conduit secured to said body capable of withstanding excessively high pressures, a valve seat in said conduit, a valve in said body cooperating with said seat, and a metallic bellows adapted under control of a thermo-bulb to open or close said valve and also adapted to close said valve when pressure within the body exceeds a predetermined point.

16. In a refrigerating system, a cabinet, a pressure chamber within the cabinet, solid $CO_2$ within the chamber adapted to liquefy therein upon the absorption of heat from the cabinet, a liquid receiver connected to said chamber for receiving the liquefied refrigerant, a pressure reducing means and an evaporator connected to said receiver, said evaporator being adapted to absorb heat from a second cabinet, and a wall between said cabinets having ports formed therein whereby air may circulate therebetween.

17. In a refrigerating system, a cabinet having a plurality of compartments, a pressure chamber within one of said compartments, a solid refrigerant within the chamber adapted to liquefy upon the absorption of heat from said compartment, an evaporator and a pressure reducing device in another of said compartments and connected to the pressure chamber, said evaporator adapted to absorb heat from said second compartment and contents, and a partition between said compartments having ports formed therein communicating with both compartments to allow air to circulate therebetween.

18. In a refrigerating system, a cabinet, a pressure chamber within and in heat exchange relation to the cabinet, a solid refrigerant in the chamber adapted to absorb heat directly from the cabinet and to liquefy, a water coil, and means including an evaporator in heat exchange relation to said coil and the interior of the cabinet utilizing said liquid for further absorbing heat from both the cabinet and water in said coil.

19. In a refrigerating system, a cooler comprising in combination a casing including a conduit through which liquid to be cooled may pass, an evaporator in heat exchange relation with liquid in said conduit, a receptacle in metallic contact with said casing, and a plurality of syrup jars positioned in said receptacle.

20. In a pressure system, a source of fluid medium under high pressure, means adapted to receive said medium at a lower pressure, means defining a passage between said source and said first means, and pressure reducing means in said passage comprising a restricting member, having a length substantially greater than its cross-section, positioned within said passage whereby the surfaces in contact with the medium during its expansion are increased to enable it to absorb sufficient heat during expansion to prevent the formation of solidified medium and the stopping up of the passage.

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