March 9, 1948. H. K. JOHNSON 2,437,257

REFRIGERATOR AND MEANS FOR MAINTAINING THE COMPARTMENTS THEREOF AT DIFFERENT TEMPERATURES

Filed April 2, 1945 2 Sheets-Sheet 1

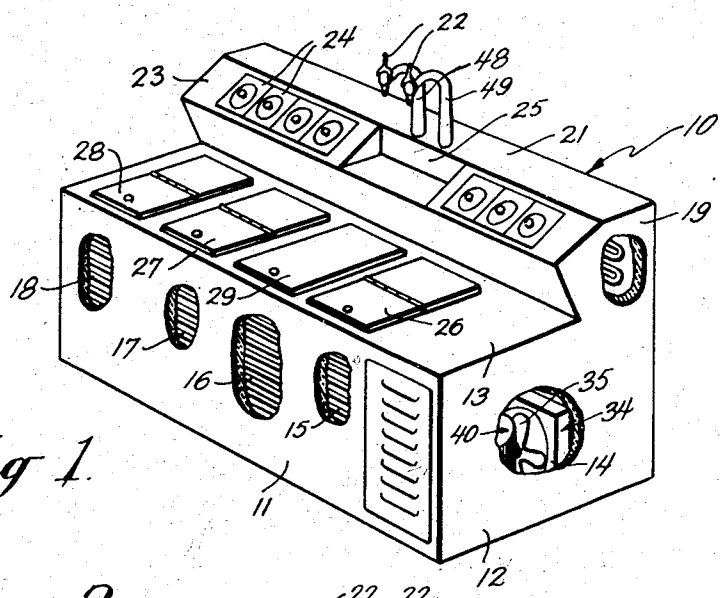


Fig 1.

Fig 2.

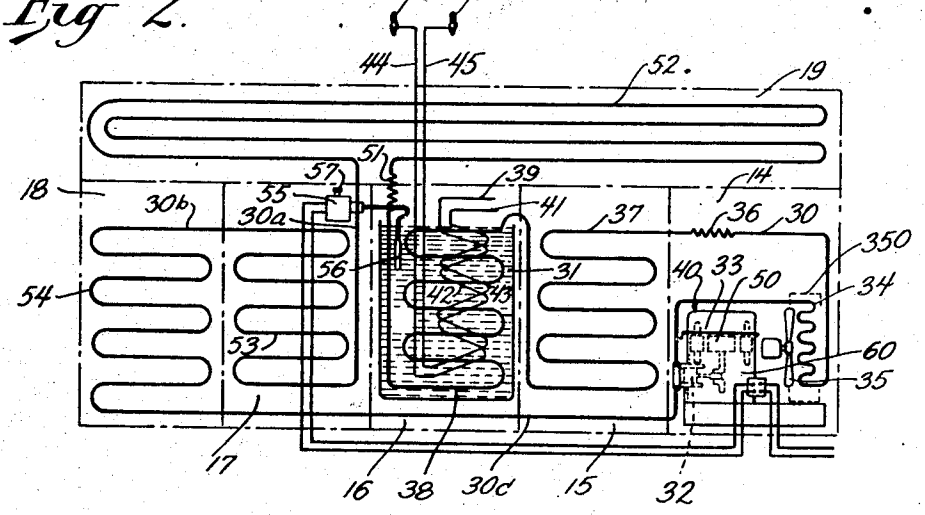
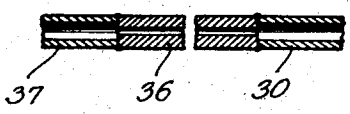


Fig 3.



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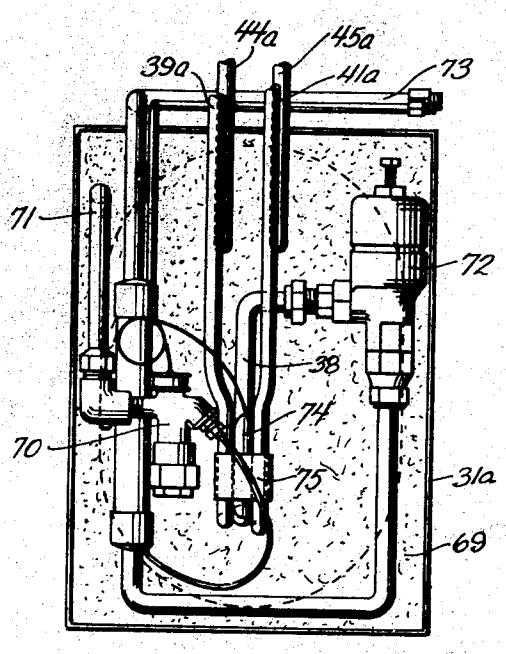


Fig 5.

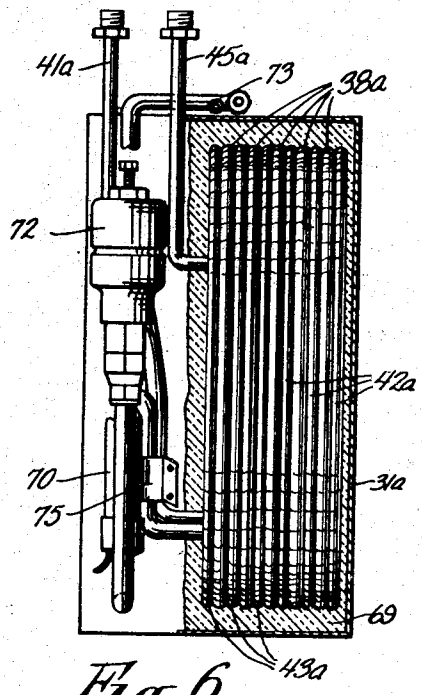
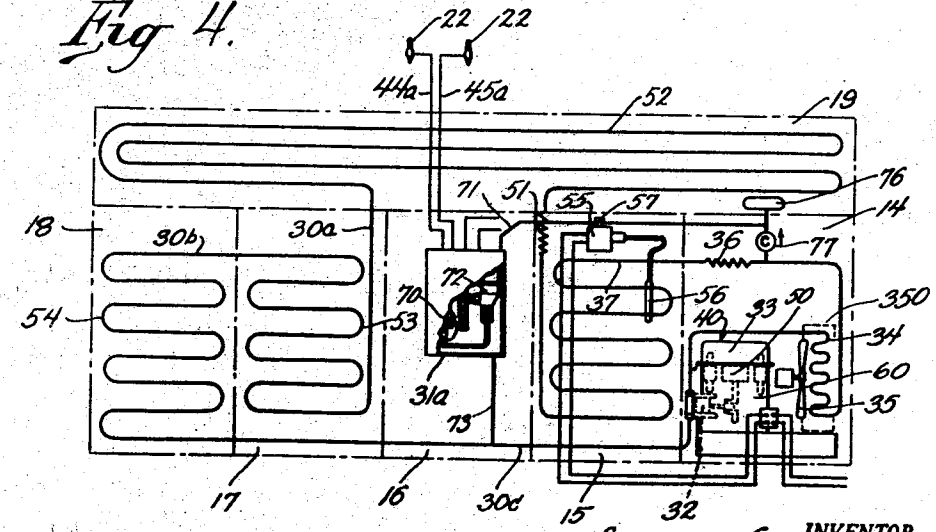


Fig 6.

Fig 4.



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Patented Mar. 9, 1948

2,437,257

UNITED STATES PATENT OFFICE

2,437,257

REFRIGERATOR AND MEANS FOR MAINTAINING THE COMPARTMENTS THEREOF AT DIFFERENT TEMPERATURES

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Application April 2, 1945, Serial No. 586,240

7 Claims. (Cl. 62—7)

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This invention relates to refrigerating apparatus, and more particularly to that type having a plurality of chambers maintained at different temperatures.

One of the objects of the invention is the provision of a new and improved hermetically sealed unit with a plurality of expansion coils so constructed and arranged that the temperatures of the compartments containing the coils are different and will remain substantially constant between predetermined limits.

Another object of the invention is the provision of a multi-compartment refrigeration apparatus provided with refrigerating mechanism comprising an expansion coil for each compartment, with the coils providing different temperatures and all arranged in series for preventing short cycling of the apparatus.

A further object of the invention is the provision of a new and improved hermetically sealed refrigerating unit of the dry type or system that may be assembled as a complete unitary automatically controlled structure normally requiring no attention during its use or during the life of the machine.

A still further object of the invention is the provision of a multi-compartment refrigeration apparatus having new and improved means so constructed and arranged that the compartments may be automatically maintained at different temperatures without the aid of either expansion or differential pressure valves.

Another object of the invention is the provision of a self-contained refrigerating unit or fountain cabinet, and installed apparatus, that is comparatively inexpensive to manufacture, easily assembled, efficient in operation, automatically controlled, and that is extremely simple in its operating and control mechanism.

A further object of the invention is the provision for maintaining a plurality of compartments at different temperatures by a plurality of separate coils connected in series with a single expansion of the refrigerant entering the coils.

Another object of the invention is an improved arrangement for cooling water for drinking and beverage purposes wherein the cooling coil is connected in series with a refrigerant compressor whose operation is controlled in relation to the temperature of any one of a number of other compartments.

Other and further objects and advantages of the invention will appear from the following description, taken in connection with the accompanying drawings, in which

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Fig. 1 is a perspective view of a soda fountain cabinet;

Fig. 2 is a diagrammatic showing of the refrigerating mechanism employed in the fountain;

Fig. 3 is a section of one of the restricted portions of the refrigerating system, with parts broken away;

Fig. 4 is a diagrammatic showing of another arrangement of the invention as embodied in a fountain with the water cooling coils encased in a normally solid material;

Fig. 5 is a front elevation of the water cooler shown in Fig. 4, and

Fig. 6 is a lateral sectional view taken transversely through the construction shown in Fig. 5 as a vertical plane.

In the manufacture and use of refrigerating units especially adapted for counter fountains, and the like, it is common practice to so construct and mount the separate expansion coils for the different compartments that the separate compartments may be maintained at different temperatures. In such an arrangement the expansion coils for the different compartments are usually in parallel, thus necessitating the use of both differential pressure and expansion valves. It has also been considered necessary to employ a comparatively large charge of refrigerant.

The controls of the conventional type of refrigerating units are complicated. As a rule a construction maintaining a multi-compartment unit at different temperatures for the compartments requires the use of motors of greater than one-half horsepower for operating the system. But it is considered to be good practice, where the motor required is greater than one-half horsepower, to employ an electric starting device for starting the motor, which, of course, complicates the structure and adds to the initial cost of the system, and is more or less expensive to operate beside occupying additional space.

The present invention seeks to greatly reduce the original cost of the apparatus and its cost of installation, as well as materially reducing the running expenses of the entire refrigerating apparatus.

The present system requires a minimum of material since numerous parts, as valves and the like, have been eliminated and other parts greatly simplified. The amount of refrigerant is greatly reduced. In a refrigerating apparatus formerly requiring 10 to 12 pounds of Freon (F-12), with a half-horse power motor for operating the refrigerating mechanism, an apparatus of the same capacity requires only 3 to 4

pounds of the same refrigerant, and the device may be operated by a third-horsepower motor.

Furthermore, in maintaining the separate compartments of a dry system refrigerating apparatus at different temperatures, it is common practice to provide a surge tank into which the refrigerant from higher temperature compartments may expand in order to prevent short cycling of the system. But in the present system, where the expansion coils are all in series, the surge tank is eliminated and the charge is greatly reduced. Both of these features are considered of great importance, and especially when taken in connection with the fact that a smaller motor may be employed and that no valves and but one control is required.

The apparatus which includes the cabinet and refrigerating mechanism are assembled as a unit at the factory, the compressor and motor are assembled as a single hermetically sealed unit, as shown diagrammatically at 60 in Fig. 2, and all joints between the coils and connecting conduits are also hermetically sealed, as by brazing, so that the complete apparatus may be manufactured and sold as an hermetically sealed apparatus. This is considered a very important feature of the invention, because it not only conserves material but the assembled unit may be sold at a greatly reduced price.

Referring now to the drawings, the reference character 10 designates a fountain or refrigerating cabinet having a plurality of compartments. The cabinet has front and back side walls 11, end walls 12, and a top wall 13. The cabinet is divided into a plurality of chambers or compartments comprising what, for convenience of description, will be termed a condensing chamber or compartment 14; a storage chamber or compartment 15; a liquid or water bath compartment 16; ice cream compartment 17; and a hardening compartment 18.

The front portion of the cabinet has an upward projection 19, in the form of a compartment extending the full length of the cabinet, and which will be referred to as the jar rail. This jar rail is provided with a top wall 21, on which is mounted the fountain or dispensing arms 48, 49, for the sweet water and for the carbonated water. Contiguous to the top wall 21, and extending downwardly and rearwardly therefrom, is a jar supporting plate 23, within which is mounted the containers for the removable jars 24 containing the various flavored syrups, as is usual in such constructions. A depression 25 is provided beneath the fountain or dispensing valves 22 for providing a seat or support for the glasses or other containers used in serving the public from the dispensing arms.

The compartments 15, 17 and 18 are provided with hinged closures 26, 27 and 28, and the compartment 16 is provided with a removable closure 29. Since the construction of the fountain or cabinet is substantially like those of the conventional type, it is not thought necessary to describe the same more in detail except to state that each one of the compartments, except the compartment 14, is provided with a conventional insulating material on the walls of the compartment. The compartment 16 is filled with water 31, as indicated in Fig. 2 of the drawing, which functions as a heat exchanger fluid as well as a body for storing cold, as will presently appear.

The refrigerating mechanism is so constructed that there will be an evaporating or cooling member for each compartment, which, in the present instance, is in the form of coils. Any suitable refrigerant expansion members may be employed, but for illustrating one embodiment of the invention these expansion members will be described as being in the form of coils or pipes of the usual construction, and of the conventional heat conducting material usually employed in refrigerating apparatus of this type.

The refrigerating system is of the compression type. The condensing unit is shown diagrammatically at 40 in Fig. 2, and comprises a hermetically sealed compressor 32 and a condenser 34. The compressor is operated by a motor 33, the armature 50 of which is indicated in Fig. 2. The compressor is of the multiple cylinder type, only one cylinder being shown in the diagram. These cylinders are located in the air stream of the condenser fan 35, which tends to cool them. The pistons are operated by a crank on the vertical armature shaft, as indicated in Fig. 2. The compressed refrigerant passes from the compressor 32 through the condenser 34, which is air cooled by the fan 35. The condenser or condenser coil 34 is housed in a casing 350 surrounding the fan and condenser. The condenser coil 34 may, if desired, be water cooled, but it is shown as being air cooled in the present construction, so that the unit may be more easily installed.

From the condenser 34 the refrigerant passes along through the main lead, pipe or pressure conduit 30, then through a restrictor section 36 of the refrigerant line 30. This restrictor section is of comparatively short length, and very materially less in internal diameter than the pipe 30, so that it functions as an expansion valve. The refrigerant is expanded into an expansion coil 37, which may be, and preferably is, of larger diameter than that portion of the pipe 30 between the condenser 34 and restrictor section 36. The coil 37 is located in the storage chamber 15 for cooling the latter. It is arranged around the compartment 15 in the usual manner, for cooling the compartment. From the chamber 15 the refrigerant is discharged into the water bath chamber 16, into the coil 38, which is in series with the coil 37 and may be of substantially the same diameter.

The further expansion of the refrigerant in the coil 38 will cool the water 31 in the chamber 16, and this water in turn will cool the sweet water and the carbonated water, which are led into the chamber through the tubes 39 and 41, from suitable sources of supply. These tubes are in communication with corresponding coils 42, 43, which are immersed in the water 31 in the compartment 16. The coils 42 and 43 extend above the cabinet, as shown at 44, 45, respectively, and are connected to the valves 22, 22. These valves are carried by the arms 48, 49, and control the passage of the sweet water and the carbonated water through the chamber 16, where they have their temperatures reduced.

From the compartment 16 the refrigerant passes through a second restrictor section 51, which is in series with the passage 30, 38. The diameter of this tube is considerably smaller than the main line 30, so that this restrictor section 51 also functions as an expansion valve. The refrigerant passing through this restrictor tube expands into a coil 52 in the counter rail compartment 19 for maintaining the jars 24 at the desired temperature. The diameter of the coil 52 may be, but not necessarily so, of slightly less diameter than the coil 38. From the compartment 19 the refrigerant passes into a section line

30a, which is an extension of the main line 30, and into the ice cream compartment through the expansion coil 53 therein.

The main line extension and expansion coil 53 have substantially the same diameters, and preferably, though not necessarily, have a diameter greater than the main line 30 or coil 38. This gives a greater expansion space per foot length of pipe, so that, being nearer the suction end of the main extension line 30a, the temperature in the chamber or compartment 17 may be materially reduced over the temperatures in any of the foregoing compartments. From the coil 53 the refrigerant passes over into the hardening compartment 18 through the pipe 30b, then through the expansion coil 54 for maintaining this compartment at a temperature materially lower than the freezing point of water, and below the temperature in any of the other compartments. From the coil 54 the refrigerant passes through the suction line 30c back to the compressor, thus completing the cycle of operation.

The condenser coil 34, the expansion coils 37, 38, 52, 53 and 54 are all in series with the compressor, and with the restrictor sections 36 and 51. The lengths and diameters of the various coils, and the restrictor tubes or sections, will vary with the different sizes of installations, with the efficiency of the heat insulating material employed for the cabinet, with the room temperature, with the number of compartments employed, with the differences of temperatures maintained in these compartments, and with the amount of refrigeration required, as well as the type of compressor employed and the kind of refrigerant used, and various other factors too numerous to mention.

Suitable means are provided for controlling the operation of the compressor motor 33. As shown, this is accomplished by a conventional thermostatically controlled switch 55, which is adapted to be operated by a volatile fluid in a fluid expansion bulb 56, located in one of the compartments, as is well known in the art. As shown, it is located in the water cooling compartment 16, Fig. 2. The thermostat-controlled switch may be of any or the usual or well known type, such, for instance, as the lever toggle type operated by a bellows that is opposed by a spring, the compression of which is adjustable by the member 57 for adjusting the operation of the control 55 for varying the temperatures in the compartments. By adjusting the set-screw or adjusting member 57 to change the spring compression, it changes the pressure required for operating the switch, and consequently varies the cycling period of the apparatus. With this arrangement the overall temperature of the cabinet can be controlled by a single adjustment.

Since the specific details of this control constitute no part of the present invention other than as used, it is not thought necessary to illustrate or describe the same in detailed structure. Any one of the various thermostat type controls, preferably the snap type for preventing arcing, may be employed for this purpose.

When the temperature in the chamber 16 rises above a predetermined amount the pressure developed by the expansion of the expanding fluid in the bulb 56 will become sufficient to operate the switch 55, and this will in turn close the circuit through the motor 33. Likewise the lowering of the temperature within the water bath compartment, as a result of the operation of the compressor, will cause a contraction of

the fluid in the bulb 56, thus permitting the spring in the thermostatic control to open the switch 55 and stop the motor, as is well understood in the art. Since the motor is not greater than one-half horsepower, it is not necessary to provide a relay starting mechanism for the motor, but the same is started directly by closing the switch 55.

In the construction shown, all of the joints connecting the main line 30 and 30a to the various expansion coils and restrictor sections are brazed, and are all installed in the cabinet, so that the entire apparatus constitutes a unitary hermetically sealed structure that may be sold as a single unit, thereby greatly reducing the cost of equipment and installation.

Since the various coils may be varied in both length and diameter, as well as the kind of material employed, it is not possible to give a definite set of dimensions that will fit all conditions. For instance, the volume capacity of a given expansion coil may be increased by lengthening the coil, or by increasing its diameter. Shorter coils of larger diameter require less space to house, for the same volume capacity, than coils of greater length. On the other hand, coils of smaller diameter have a relatively greater and more rapid heat conducting surface than larger coils.

The following dimensions for a nine foot, forty gallon fountainette, having the compartments described above, and employing a charge of three pounds of Freon (F–12) as the refrigerant, was found to operate satisfactory, and is given as one example. A third or half horsepower motor was employed for operating the compressor, the main line 30 up to the restrictor section 36 from the condenser 34 is ¼" outside diameter and about 7' long, the suction or extension 30a from the coil 54 to the compressor is 8 feet long and is ⅝" outside diameter; the restrictor passage 36 is .037" inside diameter, 36" long; the tube of the coils 37 and 38 are a half inch outside diameter, and together are about 55' long, and are about the same length; the restrictor tube 51 is .070" inside diameter and about 24" long; the tube of the coil 52 is ⅜" outside diameter and about 18' long; and the tubes of the expansion coils 53 and 54 are ⅝" outside diameter and together are about 87' long, and are substantially of the same length. The temperature of the room within which the cabinet was placed was about 86°.

The jar rail was maintained at an average temperature of 41° F.; liquid in the syrup jars was maintained at 46°; the storage compartment at around 32°; ice cream compartment at around 3° above zero, and the hardening compartment at about —5°. The average operating time was approximately 65%. These dimensions are given by way of example only. It is understood that these measurements may be varied within certain limits, even for the same capacity fountain.

It will thus be seen that the refrigerant is circulated in series through the various compartments, and that no expansion or pressure controlled valves are necessary. It will also be appreciated that the motor and compressor unit is hermetically sealed, and that the system is the hermetic type, and, as a result, the apparatus may be readily installed, and that it will only be necessary, in installing the device, to make the proper connection with the sweet water supply pipe and the carbonated water supply pipe when the apparatus is purchased as a complete unitary structure.

Furthermore the water bath serves as a source of cold for periodic rush periods when a large number of drinks are dispensed in rapid succession. The location of the thermo-switch bulb **56** is located where the refrigeration load in the system is subject to rapid change and wide variation, or where the temperature to be maintained is critical.

For instance the bulb is shown located in the liquid bath where the temperature must not drop below the freezing point of the water in the coils **42** and **43**. In those instances, however, where a different water cooler is used, as where space is conserved to the utmost heat exchange may be had through contacting turns of nested coils (Figs. 4, 5 and 6), the control of refrigeration may be had with an expansion coil connected in parallel with the other coils and having an expansion valve inlet and an outlet pressure control valve for adequate and instant control of refrigeration.

In such an arrangement the cabinet control bulb **56** is located in the storage compartment **15**, and although two flow restrictors **36** and **51** are shown, one flow restrictor such as **51** can be eliminated, the one restrictor **36** being enough to control the system adequately.

Referring to Fig. 6 the sweet water coil is indicated at **42***a*, each turn thereof being identified by a lead line, the carbonated water coil is indicated in a like manner at **43***a*, and the refrigeration coil and its turns at **38***a*. The coils are pancaked helices connected together in appropriate relationship by brazing and the assembly placed in a box and covered with Hydrolene or the like to prevent condensation upon the coils.

The outlets of the water coils are indicated at **44***a* and **45***a* with the inlets at **39***a* and **41***a*. The expansion valve is shown at **70** upon the inlet **71** of the refrigeration coil **38***a* and the pressure control valve at **72** upon the outlet **73**. The bulb **74** of the expansion valve is nested with the inlets of the coils as held in heat exchange relationship with each one of them by a clamp **75**.

The respective controls for the water cooler **31***a* are set to operate within the pressure range present ahead of the restricting orifice **36** where the inlet **71** of the refrigeration control is connected, and a small reservoir **76** capable of storing approximately one to two pounds of refrigerant is connected into the refrigerant supply line **71** beyond a check valve **77** which prevents the back flow of refrigerant in the line **71**. The check valve and reservoir store up liquid refrigerant during the "on" cycle of the compressor to take care of extra heavy loads on the water cooler during the "off" cycle of the compressor, the compressor being controlled primarily from the bulb **56**.

If desired, suitable means may be provided whereby the compressor and condenser may be removed from the system for repairs or replacement. While the condenser is shown exterior of the power unit, it is understood that this is the preferred form only, and that the condensing unit may be located within the compressor housing and in the base of the machine in event the condenser is water cooled.

It is thought from the foregoing, taken in connection with the accompanying drawings, that the construction and operation of my device will be apparent to those skilled in the art, and that changes in size, shape, proportion and details of construction may be made without departing from the scope and spirit of the appended claims.

What is claimed is:

1. In a refrigerating apparatus, a plurality of cooling compartments, an expansion coil in each compartment, compressor and condenser mechanism for supplying a refrigerant to said coils, valveless passages connecting said coils in series with said mechanism, said passages having at least two sections in which the internal diameters thereof are restricted to function as expansion valves, each restrictor being anterior to at least two expansion coils in the direction of flow of the refrigerant, the lengths and internal diameters of the coils being such that one of the compartments after the first restrictor will be maintained at a higher temperature than the first compartment and the other compartment, thermo-sensitive means in the second compartment after one of the restrictors for controlling the amount of refrigerant flowing through said coils in a given time, a thermostatically controlled water cooler connected in parallel with said passages across the compressor and condenser mechanism including a check valve proximate to the inlet of the expansion coil of the water cooler, and a reservoir for refrigerant connected to the water cooler refrigerant line between said check valve and expansion coil of the water cooler.

2. In a refrigerating apparatus, a plurality of cooling compartments, an expansion coil in each compartment, a compressor and a condenser for supplying liquefied refrigerant to said coils, valveless passages connecting said coils in series with said compressor and condenser, a section of one of said passages having a reduced internal diameter to form a restrictor, said restrictor being between said compressor and said expansion coils, a water cooler comprising another expansion coil in heat exchange relationship with a body of water, a conduit connecting the condenser with said water cooler expansion coil, a reservoir in communication with said conduit, check valve means in said conduit for preventing the back flow of refrigerant from the reservoir, and thermosensitive means disposed in said water cooler for controlling the flow of refrigerant from said reservoir through said water cooler.

3. In a refrigerating apparatus, a plurality of cooling compartments, and expansion coil in each compartment, compressor and condenser mechanism for supplying a refrigerant to said coils, valveless passages connecting said coils in series with said mechanism, a section of one of said passages having a reduced internal diameter to form a restrictor, said restrictor being anterior to said expansion coils, thermosensitive means for controlling the operation of said mechanism disposed in one of said compartments, a water cooler comprising an expansion coil and means for bringing water in heat exchange relationship with said coil, a conduit connecting that portion of said passages anterior to said restrictor with said water cooler expansion coil, a reservoir in communication with said conduit, and check valve means for preventing the back flow of refrigerant from said reservoir to said passages.

4. For use in a refrigerating apparatus the combination including, a cooling compartment having an expansion coil therein, compressor and condenser mechanism for supplying a refrigerant to said coil, thermosensitive means disposed in said cooling compartment for controlling the operation of said mechanism, a conduit having a restrictor extending from said mechanism to said expansion coil, a water cooler comprising a

second expansion coil and means for maintaining a body of water in heat exchange relationship with said second coil, a conduit having a back flow check valve connecting said second coil to the first mentioned conduit anterior of said restrictor, and a reservoir opening into said second conduit between said check valve and said coil.

5. In a refrigerating apparatus having at least four cooling compartments, an expansion coil in each compartment, compressor and condenser mechanism for supplying a refrigerant to said coils, valveless passages connecting said coils in series with said mechanism, said passages having at least two sections in which the internal diameters thereof are restricted to function as expansion valves, each restrictor being anterior to at least two expansion coils in the direction of flow of the refrigerant, the lengths and internal diameters of the coils being such that one of the compartments after the first restrictor will be maintained at a higher temperature than another compartment after the first restrictor, and thermosensitive means in the second compartment after said first restrictor for controlling the amount of refrigerant flowing through said coils in a given time.

6. In a refrigerating apparatus having at least four cooling compartments, an expansion coil in each compartment, compressor and condenser mechanism for supplying a refrigerant to said coils, valveless passages connecting said coils in series with said mechanism, said passages having at least two sections in which the internal diameters thereof are restricted to function as expansion valves, each restrictor being anterior to at least two expansion coils in the direction of flow of the refrigerant, the lengths and internal diameters of the coils being such that one of the compartments after the first restrictor will be maintained at a higher temperature than another compartment after the first restrictor, thermosensitive means in the second compartment after one of the restrictors for controlling the amount of refrigerant flowing through said coils in a given time, a thermostatically controlled water cooler supplied with refrigerant through a conduit connected across

the compressor and condenser mechanism including a reservoir means for refrigerant in the inlet portion of said conduit.

7. In a refrigerating apparatus, a cabinet having a chamber for housing the operating mechanism, a storage compartment, a water cooling compartment, a jar rail compartment, an ice cream compartment and a hardening compartment, a compressor and condenser within said chamber, coils for sweet and carbonated water in the water cooling compartment, an expansion coil extending through said water cooling compartment, a material within said last named compartment to prevent frosting of the coils, an expansion coil in each of the remaining compartments, conduits connecting said compressor, condenser and expansion coils in a closed circuit through said compartments, a restrictor in said circuit anterior to the expansion coil within said storage compartment, a restrictor in said circuit ahead of the expansion coil in said jar rail compartment, said compressor and restrictors constituting the only obstruction aside from friction to the free flow of refrigerant through said circuit, thermosensitive means controlled by the temperature within said water cooling compartment for controlling the circulation of said refrigerant through said circuit, means for adjusting said last named means and means for connecting the expansion coil in the water cooling compartment to the compressor ahead of the first restrictor.

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