METHOD OF AND MEANS FOR COOLING BEVERAGES

Fig. 1

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1. This invention relates to the art of refrigeration and more particularly to an improved method and means for cooling fluids, space or things.

It is among the objects of my invention to provide a method and means for cooling a liquid white or more "cold" substantially all the way to the spigot or outlet therefrom; to avoid warm spots or warm slugs of fluid in the conduit; to provide uniform cooling thereof over a wide range of rates of flow; and to provide substantially constant, though readily adjustable, delivery temperatures for the fluid dispensed therefrom.

Another object is to provide for cooling more than one space, fluid or thing at different or relatively determinable rates in a single system as from a single compressor. A more specific object is to cool one or more units at the same or different temperatures by means of a flooded system using a high side float to supply the refrigerant from a single condensing unit.

Another object is to eliminate the hazards, uncertainties and complications of cooling fluids, spaces, etc., that attend upon the use of refrigerants in whole or in part the vapor phase in the cooling zone or zones, and a corollary object is to provide circuits and controls that will effect desirable control and apportionment of cooling with one or more "cold" substantially filled with refrigerant in the liquid phase, through the vaporization of which cooling is affected.

Other objects include the provision of a refrigerating system that is simple in construction, economical of manufacture, installation and use, efficient in its operation, and readily adaptable to a wide range of conditions of service, temperature and use.

Other objects and advantages will appear from the following description of a preferred and illustrative embodiment of my invention, reference being had to the accompanying drawings in which Figure 1 is a layout in elevation of an illustrative refrigerating system in a form useful for the cooling and dispensing of beverages, and Figure 2 is an enlargement of the upper right portion of the parts illustrated in Figure 1 including the spigot for the beverages to be dispensed, a control valve for the refrigerant and other details of the construction.

A problem in the refrigeration field, the solution of which by the employment of my invention will illustrate many of the precepts thereof, is that of the cooling and dispensing of beverages such as beer. It will be understood that my invention is not confined to the solution of this particular problem but since the solution illustrates various advantages of my invention and gives an example of its nature and operation it will be described particularly hereinafter.

Referring to Figure 1 of the drawings the installation there depicted contemplates that the chamber 1 may comprise an insulated space for the storage of beer in a keg or cask 2, which chamber 1 is shown, as is often the case, in the basement or below the floor 3 above which is commonly located the bar 4 where the beverage may be withdrawn from time to time through the spigot 5. Suitable pressure may be applied to the beverage in the keg 2 from a source not shown through a conduit 6 whereby to force the beverage through the conduit 7 to the spigot 5. Other kegs or containers, not shown, and not necessarily on tap may also be disposed in the chamber 1.

Substantially the whole of the conduit 7 from a point preferably just within the room or chamber 1 to a point closely adjacent the spigot 5, see also Figure 2, is contained within a larger surrounding conduit 10 which not only houses the conduit 7 but also affords extra capacity to contain refrigerant material so that the conduit 7 may extend substantially throughout its full length in a pool of fluid refrigerant material. The relation of the conduit 7 within the conduit 10 may be likened to the well-known arrangement often employed in heat exchangers in which the fluid contained in the larger conduit may take heat from the smaller conduit and the fluid contained therein. Within the room 1 is also disposed a space cooling coil 20, which, as will presently be described, also contains refrigerant material and receives heat directly from the air in the chamber 1 and from the contents of the chamber such as the beer or other beverage in the keg 2 and/or such other kegs, or things as may be stored in the same chamber preparatory to the consumption thereof.

It will also be observed in Figure 1 that I employ in the practice of my invention a refrigerant compressor 30 which may be of any conventional type, and I have shown more or less diagrammatically a compressor motor 31 appropriately connected to the compressor as by belt drive in the conventional way. Leading from the compressor I also show in the conventional way a cooling condenser 32 through which the compressed refrigerant passes to a trap and container 33 known in the trade as a "Hi-side" float which per se is not part of my invention, but which is characterized in its operation by its float controlled outlet 34 which is closed and kept closed by the float 35 until the level of liquid refrigerant lifts the float to permit the egress of liquid while retaining with the trap or chamber 33 the compressed refrigerant in the vapor or gaseous state. The liquid that leaves the trap 33 is forced therefrom under the influence of the pressure which the compressor maintains in the condenser 32 and within the trap 33. Refrigerant in the gaseous or vapor stage comes to the compressor 30 from the low or return side of the system through the conduit 36. In one preferred em-
bodiment of my invention the pressure in the conduit 36 may be reflected in the pressure responsive control switch 37 which in the conventional fashion will energize the motor 31 when the pressure in the return side of the system in the conduit 36 rises above a selected minimum pressure. Similarly the switch 37 will cut out the motor 31 and let the compressor rest when the pressure in the conduit 36 is lowered down to the desired minimum value. A reservoir 38 comprising in effect an enlargement of the conduit 35 to contain a desired cushioning volume of refrigerant gas or vapor is preferably provided as shown.

Those skilled in the art will understand that refrigerant may be selected from among the several well-known varieties of well established materials such as methal chloride or Freon, and will understand the ordinary kind of adjustments required for the system to correlate its function and operation to particular refrigerant materials.

In the embodiment of my invention shown in Figure 1 the conduit 40 leads liquid refrigerant from the trap 33 to the lower end of the conduit 18 as at 41 whence the liquid refrigerant is conducted through and contained within the whole length of the conduit 10 to the end fitting 11 thereof, see Figure 2. Leading from the highest point of the conduit 10 is the conduit 42 which affords a path of egress for refrigerant from the conduit 10 to a valve 50. A conduit 43 leads refrigerant downwardly, as shown, from the valve 39 to a manifold 44, the upper part of which stand higher than the cooling coil 20 within the chamber 4, and the lower part of which communicates with the lowestmost portion of the coil 20. Preferably the conduit 43 terminates within the manifold 44 somewhat below the upper side outlet 45 thereof with which the conduit 36 communicates. The manifold 44 is shown lower than the valve 50 and at a lower elevation than the upper end of the conduit or element 10. While I have shown the manifold 44 disposed at a lower elevation than the valve 50 as a practicable embodiment for the illustrative beer cooling installation, it must be understood that the manifold 44 may be disposed at a higher elevation than the valve 50 whenever convenience so requires. The elevation of the manifold 44 in relation to the valve 50 does not alter the operation of my invention; the only change in condition being that the contents of the conduit 43 will contain more refrigerant in the liquid phase as the height of the manifold 44 exceeds the height of the valve 50.

In the installation so far described it will be seen that the refrigerant first passes through the cooling element or conduit 10 and then in series relationship through the cooling element 20 and thence through the return conduit 36 which is a common return for both the elements 10 and 20. As will be more fully described below it will further appear that the refrigerant in its liquid state passes through the cooling elements 10 and 20 in a series relationship but that the refrigerant in its gaseous form is returned from both elements through the common conduit 36, i. e., in a parallel return relationship from both the cooling elements.

As shown in Figures 1 and 2 the valve 50 in this exemplary installation has a manually operable wheel or handle 51 shown as extending upwardly through the surface of the bar 4. The handle 51 is secured to the shaft of a screw ad justing means 52 by which the pressure in the spring 53, tending to close the valve, may be manually adjusted. The spring 53 bears upon the upper surface of a flexible diaphragm 54 which in turn bears upon the valve closure member 55 and stem 56. The diaphragm 54 is exposed to atmospheric pressure on its upper side via vent port 57 and is exposed to the pressure of the element 10 on its under side via the conduit 42.

A follower spring 58 holds the head of the stem 55 in contact with the diaphragm 54, raising the stem when fluid pressure below the diaphragm sufficiently exceeds atmospheric pressure and the effort of the adjustably compressed spring 53. The valve 50 will therefore open whenever fluid pressure in the coil 18 and conduit 42 exceeds a selected minimum pressure and thereupon fluid will flow through the valve from the element 10 to the manifold 44 through the conduits 42 and 43. Turning the handle or hand wheel 51 will adjust this minimum pressure to any desired amount within practicable limits with the result that fluid will be permitted to flow from the element 10 through the valve 50 at whatever pressure is selected by adjustment of the spring 53 of the valve 50. In this way the proportion of heat absorbed by the refrigerant in the element 10 as compared with the heat absorbed in the element 20 can be apportioned by adjustment of the valve 50 as will more fully appear below.

As mentioned above the conduit or cooling element 10 terminates, as I prefer, as closely adjacent to the body of the spigot 5 as is practicable.

In the form of my invention shown herein I provide a fitting member 60 which bodily receives the end of the conduit 10 preferably in a sweater or braised-in contact substantially as shown and receives the conduit 1 in sweated or brazed fluid tight engagement as at 61. Preferably the fitting 60 is externally threaded throughout its length and carries a nut 62 which may bear against the inward side of the vertical structure of the bar 63 whilst the spigot 5 receives the threaded end 64 of the fitting 60 in the female threads 65. An appropriate gasket 66 may bear between the bottom of the cavity of the spigot and the end of the fitting 60 to make a fluid tight joint. By these or similar means I prefer to provide that the refrigerant may be brought closely adjacent to the spigot to cool the same by conduction and so that there will be no substantial length of conduit adjacent the spigot in which beer or other beverage may become warm or unpalatable between draughts.

The parts being related and assembled as above described I cause the refrigerating system to be filled with such a quantity of refrigerant that substantially the whole of the elements 10 and 20 will contain refrigerant in its liquid phase when the installation is operating normally according to the precepts of my invention. As a practical matter this will require that the refrigerant in the liquid phase will ordinarily be present in the conduits 10 and 42 up to about the highest point thereof as indicated by the broken line L—L; that refrigerant in the liquid phase will also stand in the manifold 44 in whole or in part in the uppermost level of the coil 20 at about the level of the broken line M—M and will stand in the trap 32 at about the level of the line N—N where the float valve 35 may be just raised from its seat or just about to be raised from its seat depending upon the phase of the cycle of operation of the installation. The
other parts of the refrigerant system will of course contain the refrigerant in the gaseous state as those skilled in the art will appreciate. If the conduit 48 leads upwardly from the valve 55, additional liquid refrigerant will be supplied to fill the conduit 48. In the operation of the exemplary beer dispensing installation herein illustrated and described, it may be assumed that a fresh keg 2 which may or may not have been previously conditioned in the chamber gas or liquid, is appropriately connected to the conduit 7 and through the pump conduit 6 to the well known beer pump or other instrument, not shown, and that the spigot 5 has been manipulated to permit the conduit 7 to be filled with beer. Assuming further that the spigot 6 is then closed, the beer in the conduit 7 will have entered the conduit at the temperature of the contents of the keg 2 which may be higher than desired dispensing temperature at the spigot 6. If the keg 2 has had no opportunity to be chilled in the chamber 1 before being connected to the conduit 7, the beerage may well be in the first instance many degrees higher than its desired dispensing temperature at the spigot 6. In either event the heat of the beer in the conduit 7 will flow to the liquid refrigerant in the conduit 10 inducing boiling of the liquid refrigerant and the liquid pressure in the conduits 10 and 42 and at the inlet side of the valve 56 and under the diaphragm or bellows 54 thereof. Pressure so generated upon exceeding the adjusted resistance of the valve 56 will open the valve permitting the outflow of fluid with or without beer or both through the conduit 43 into the manifold 44. This will raise the pressure throughout the return side of the system and upon the pressure responsive control switch 37. When the pressure in the conduit 36 and the return side of the system rises above the predetermined and adjustable relation to atmospheric pressure the switch 37 will close and energize the compressor 30, which will tend to reduce the pressure in the return side of the system on the one hand and deliver condensed liquid to the conduit 40 on the other hand. The foregoing condition will persist until the content of the conduit 7 is reduced to a temperature which will permit the valve 56 to close. At that point the pressure on the return side of the system may or may not be sufficiently reduced to cut out the switch 37 depending on the adjustment of the switch. The condition in the chamber 1 and the cooling coil 20. If the keg 2 were warm in the hypothesis above stated or if additional warm kegs were placed in the storage chamber 1 when the keg 2 was attached to the line 7 additional cooling would perhaps be required for the chamber 1, and this additional cooling will be reflected in the boiling of liquid refrigerant in the coil 20 and the maintenance of the pressure of the return side of the system with the further or continued operation of the compressor, which in turn, will continue to deliver liquid through the conduit 40 and into the conduit 10. In this instance, however, the increased pressure in the conduits 10 and 42 and below the diaphragm 54 of the valve 56 will open the valve 56 to permit refrigerant in the liquid stage to flow therethrough to the manifold 44 and the coil 20 where its boiling under the condition of reduced pressure maintained by the compressor would continue to take heat from the space 1 until the temperature of that space is desirably reduced. It will be understood that the conduits 42 and 43 as well as the valve 56 and conduits 10 and 40 will be heavily and properly insulated by covering means, not shown, to inhibit undesirable warming of the refrigerant contents thereof.

While the space 1 is being cooled or being kept cool by the operations above mentioned it is contemplated that fluid may be withdrawn from the spigot 6. Movement of warm beverage into the conduit 7 will induce boiling of the fluid in the conduit 10, and in that event both liquid and gaseous refrigerant may be withdrawn through the valve 56 to manifold 44; the liquid finding its way into the manifold 44 and the coil 20 and the gas finding its way, with the gas emanating from the coil 20, through the conduit 36 back to the compressor. Throughout these cycles of operations and the overlappings thereof the temperature of the dispensed beverage may be conveniently and desirably controlled by the adjustment of the valve 56. When the valve 56 is pinched down whereby to require a relatively high pressure in the element 10 to effect the opening of the valve 56 such a condition correspondingly inhibits boiling of the refrigerant therein and thus raises the temperature of the refrigerant. Similarly when the valve 56 is pinched down to require the higher pressure to induce its opening the inhibition thereby induced against the boiling of the refrigerant in the element 10 correspondingly reduces the cooling effect of the element 10 upon the conduit 7 and the contents thereof. In the so-called pinched down condition of the valve 56 a less cooling will be done by the coil 18 without changing the temperature of the coil 20. If, however, it be desired that the temperature of the coil 10 be lowered then the adjustment of the valve 56 is altered to pass fluid at relatively lower pressures. This condition permits the boiling of the fluid in the element 10 at lower temperatures, takes more heat from the contents of the conduit 1 and brings about the passing of a relatively greater proportion of gas than liquid through the valve 56 to the manifold 44. Thus the temperature of the coil 10 can be altered and adjusted by manipulation of the valve 56 as desired while the temperature of the coil 20 is held substantially constant under the selected control and adjustment of the pressure responsive switch element 37.

In the exemplary embodiment of my invention above described it will be seen that through the adjustment of the valve 56 and the pressure responsive control 37 I may bring about any desired apportionment of the cooling load between the elements 10 and 20 in any desired amount and relation within the capacity of the compressor and the quantity and nature of the refrigerant employed, having in mind the radiating areas of the respective cooling elements, and the inherent tendency of the element 20 to have at least as low a temperature as the lowest temperature obtainable in the coil 18 and the compressor 30 and may also treat the thing or things to be cooled to successive treatments having regard for the relative capacity of the elements 10 and 20 in relation to the heat content of the thing or things that may transmit heat thereto. For example with the use of but a single compressor I might use one of the cooling elements such as element 10 for cooling a household refrigerator to about the desirable 40° F. of common practice while using the other element such as the element 20 in a deep freeze unit maintaining a temperature at about 0° F. Where I have shown the element 10 as being a single conduit in heat exchanger.
relation to a single conduit 7, it will be readily appreciated that the function, operation and effect thereof could be preserved in different forms or in a plurality of cooling elements 10 similarly positioned and related to the other elements of the combination, and that while the cooling element 20 as shown is but a single continuous coil it might also take other forms or the form of a plurality of similar coils similarly disposed and related to the manifold 44 and the other elements of the combination hereinabove described.

It will be similarly understood and appreciated that the cooling element 10 need not take the form of heat exchanger and may take any other form within the precepts of my invention so long as its relation to the other elements of the combination is preserved. Likewise the coil 10 may take the form of a heat exchanger instead of a space cooler without altering its mode of operation so long as its relation to the other combinations are similarly preserved.

If it should be desired to refine the control of the coil 10 or separately limit its effect on the temperature in the space 1, it is not without my teaching to place a pair of thermostatically actuated valves, not shown, at the points 21 and 22 of the entrance and exit respectively of the coil 10, preferably providing for the simultaneous operation of such valves in response to the temperature in the space 1. In this way so long as the control 37 and the compressor 38 are set to and capable of inducing a lower temperature in the space 1 than the valves at 21 and 22 permit, the coil 10 and its cooling effect along with its refrigerant content would merely be shutted out of the system except for the periods when the thermostatic control of the valves brought the coil 10 back into play. Similarly by the adjustment of such valves or by the employment of shut-off valves at the points 21 and 22 the coil 10 and its contents may be arbitrarily shutted out of the system leaving the element 10 and the other parts of the system to continue their function and useful operation.

While I have not mentioned especially the desirability of insulation for the chamber of space 1 or the form or amount of proper insulation of the parts such as the coil 10 and the return conduit 42, I assume that the desirability, form and amount thereof will be understood by those skilled in the art. While I have shown the lowermost portion of the conduit 10 and the adjacent part of the conduit 40 as extending within the space 1, so that the corresponding portion of the conduits within the space 1 might, unless insulated therefrom, serve to cool the space 1 as well as the conduit 7, this will be understood to be merely more or less diagrammatic and illustrative of the reasonable facility of adaptation of my invention to the ordinary exigencies and circumstances that may arise under the conditions of service in which my invention may be advantageously employed.

While I have illustrated and described a preferred form and embodiment of my invention, changes, modifications and improvements thereupon will occur to those who understand and practice the precepts thereof and I do not care to be limited in my patent to the preferred embodiment herein described or to the details thereof or in any manner other than by the claims appended hereto.

I claim:
1. The method of cooling a beverage a supply of which is maintained in an enclosed space