METHOD OF AND APPARATUS FOR HEAT TRANSFER

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This invention generally relates to the art of refrigeration and has particular reference to a new and improved system of refrigeration whereby the elements of the system are so arranged as to provide a more efficient system.

This application is a continuation-in-part of my prior application, Ser. No. 114,940, filed December 9, 1936, for method of and apparatus for heat transfer.

A principal object of the invention is to provide a refrigeration system including a single circuit which is adapted to produce refrigeration at two or more different temperatures at the same time.

Another object of the invention is to provide a refrigerating system including two or more evaporators or heat absorbing elements operating at substantially the same suction pressure and which heat absorbing elements are adapted to produce refrigeration at different temperatures when the system is charged with a refrigerant having characteristics like that of the refrigerant heretofore described.

Another object of the invention is to provide a new and improved refrigerating system employing as the refrigerant medium therein two or more refrigerants placed together, which refrigerant medium will have characteristics different than those of said refrigerants.

Other objects and advantages of the invention will be apparent upon a consideration of the following specification taken in conjunction with the accompanying drawing of which there is one sheet and wherein:

Fig. 1 is a diagrammatic illustration of a system of refrigeration embodying my invention:

Fig. 2 is a diagrammatic view illustrating a modified form of a part of the system illustrated in Fig. 1; and

Fig. 3 is a diagrammatic view illustrating a modified form of the low side of the system illustrated in Fig. 1.

As illustrated in Fig. 1 of the drawing, the invention is shown as a refrigerating system adapted for use in a heat insulated cabinet of the household type, wherein a heat insulated compartment is adapted to provide a food storage compartment within which provisions may be stored and also wherein water and other liquids may be frozen or stored in a frozen condition. It is to be understood, however, that the invention is not limited to use in connection with household refrigeration but may be used generally wherever refrigeration is desired by adapting the various elements of the system to the particular requirements of any specific application.

In Fig. 1 of the drawing, my invention is disclosed as being embodied in a refrigeration system of the compressor-condenser-expander type including a conventional compressor 10, a condenser 12, a receiver 14 and a plurality of evaporator elements arranged within a heat insulated cabinet 16. The compressor 10 is adapted to be driven by a motor 15 and the motor circuit 18 may be controlled by a switch 20, which switch 20 is operated by a thermostatic device having a bulb 22 thermally associated with one of the evaporator elements. The compressor 10 is adapted to operate responsive to variations of temperature of one of the evaporator elements above and below preselected temperatures and in so operating will maintain the temperature of such evaporator elements within certain predetermined limits. The switch 20 preferably includes provisions whereby the preselected temperatures may be varied for changing the temperature at which the motor circuit 18 will be opened and closed.

Refrigerant is discharged from the compressor 10 under pressure and conveyed to the condenser 12 where condensation of the refrigerant takes place and such refrigerant is then collected in the receiver 14 from which receiver it is conveyed by means of a liquid line or conduit 24 to the evaporator elements arranged within the heat insulated compartment 16. The condensing unit which comprises the motor, compressor, condenser and receiver is arranged externally of the heat insulated compartment 16.

The heat absorbing means or evaporator elements arranged within the heat insulated compartment may comprise a pair of evaporators or coils indicated generally at 26 and 28. The evaporator or freezer coil 26 may be arranged, as illustrated in Fig. 1, within a closed compartment or chamber 27 arranged within the compartment 18 so that the coil 26 is disposed in a space separate from that in which the coil 28 is arranged, as a result of which arrangement, one of the evaporator elements may be subjected to a heat load substantially independently of the other of the evaporator elements. The walls of the chamber or compartment 27 may be formed of sheet metal 30 as to permit conductivity of heat through the walls of said chamber and also may be provided with an access opening and a closure therefor (not illustrated). If little or no heat transfer is desired, the walls of the compartment 27 may be formed of insulating material. The freezer coil 26 may consist of a length of tubing arranged to provide a plurality of shelves 39 and if desired a sheet metal plate 31 may be connected to each of the shelves 39 so as to form a support for trays 32 which are adapted to be removably seated upon the shelves 39.

The other evaporator element 28 may be termed a box cooling coil and, as illustrated, consists of a length of tubing coiled in such a manner as to provide a length sufficient to cool the interior of the chamber of the compartment 16 and preferably said tubing may have con-
nected to it metallic fins 34 which provide a large heat transfer surface and aid in absorbing the heat from the circulating air within the compartment 16 and conducting such heat to the refrigerant circulating within the tubing.

The liquid line 24 from the receiver 14 may be conducted through a heat exchange device 36 and from there by a conduit 33 to an expansion valve 40 and then to the freezer coil 28. From the freezer coil the refrigerant is conducted by a conduit 41 through the heat exchange device 36 and then by means of a conduit 42 to the box cooling coil 28, the other end of the box cooling coil 28 having connected thereto a suction line 44 which is connected to the intake side of the compressor 10 for conducting vaporous refrigerant from the evaporator elements to the compressor. The expansion valve 40 is arranged to regulate the flow of liquid refrigerant into the coil 28 and the refrigerant is free to pass from the freezing coil 28 through the heat exchange device 36 into the box cooling coil 28. The heat exchanger 36 is arranged between the liquid lines 24 and 33 and the liquid line 42 and is provided for the purpose of cooling the liquid refrigerant before the same enters the freezing coil 28. The expansion valve 40 may be thermostatically controlled and operated in response to the temperature of one of the evaporator elements, such as the box cooling coil 28. For operating the expansion valve 40, there may be provided a bulb 46 thermally associated with the tail end of the box cooling coil 28 and connected by means of a conduit 48 to the expansion valve 40 for operating the same. The conduit 48 and bulb 46 may be filled with a liquid which upon expansion and contraction thereof in accordance with the temperature of the box cooling coil 28, will operate the expansion valve 40 for regulating the flow of liquid refrigerant into the freezing coil 28. Preferably the liquid within the conduit 48 and bulb 46 is the same as the refrigerant used in the system. The valve 40 is controlled by both the pressure in the evaporator and the temperature of the liquid. The box cooling coil 28 may be exposed to the air within the compartment 16 and adapted for cooling the same. On account of the fact that there is no restriction between the freezing coil 28 and the box cooling coil 28, the suction pressures prevailing in both of these evaporator elements will be substantially the same.

In the system as described, liquid refrigerant flows from the receiver 14 to the heat interchanger 36 where the refrigerant will be appreciably cooled. From the heat interchanger the cooled liquid refrigerant flows to the expansion valve 40 where the pressure is reduced and the liquid is cooled to evaporating temperature. During the process of evaporation liquid flows through the freezing coils, then through the interchanger and finally to the box cooling coil where the evaporation of liquid refrigerant is completed. When a refrigerant medium consisting of a fluid such as sulphur dioxide (SO₂) or methyl chloride (CH₃Cl) is used, the temperature of the freezing coil and the box cooling coil will be the same.

For obtaining different temperatures in the different sections of the system, such as a lower temperature in the freezer section 28 than in the air cooling section 28, there may be employed as a refrigerant medium a liquid which comprises a mixture or solution resulting from placing together two or more refrigerants each having a different volatility, said liquid having a boiling point different than the boiling point of any of its components. Examples of refrigerant mediums are:

- Sulphur dioxide (SO₂) and carbon tetrachloride (CCl₄)
- Sulphur dioxide (SO₂) and dichlorodifluoromethane (CCl₂F₂) (F-12)
- Sulphur dioxide (SO₂) and trichloromonofluoromethane (CCl₃F) (F-11)
- Sulphur dioxide (SO₂) and dichloromonofluoromethane (CH₂Cl₂F) (F-21)
- Sulphur dioxide (SO₂) and ethyl chloride (C₂H₅Cl)
- Sulphur dioxide (SO₂) and methyl chloride (CH₃Cl)
- Sulphur dioxide (SO₂) and methylene chloride (CH₂Cl₂)
- Sulphur dioxide (SO₂) and propane (C₃H₈)
- Sulphur dioxide (SO₂) and normal butane (C₄H₁₀)
- Sulphur dioxide (SO₂) and isobutane (C₄H₁₀)
- Sulphur dioxide (SO₂) and dimethyl ether (C₂H₆O)
- Sulphur dioxide (SO₂) and methyl formate (CH₂OOC₂H₅)
- Sulphur dioxide (SO₂) and dibutyl phthalate (C₉H₄OOC₂H₅)CH₃
- Sulphur dioxide (SO₂) and dimethyl phthalate (C₉H₈OOC₂H₅)CH₃
- Sulphur dioxide (SO₂) and methyl alcohol (CH₃OH)
- Sulphur dioxide (SO₂) and monochlorobenzene (C₆H₅Cl)
- Sulphur dioxide (SO₂) and methyl isobutyl ketone (CH₃COCH₂C₄H₉)
- Sulphur dioxide (SO₂) and isopropyl acetate (CH₃COOCH₂H₃)
- Sulphur dioxide (SO₂) and amyl chloride (C₅H₁₁Cl)
- Methyl chloride (CH₃Cl) and methylene chloride (CH₂Cl₂)
- Methyl chloride (CH₃Cl) and isopropyl acetate (CH₃COOCH₂H₃)
- Methyl chloride (CH₃Cl) and methyl isobutyl ketone (CH₃COCH₂C₄H₉)
- Methyl chloride (CH₃Cl) and dimethyl ether (C₂H₆O)
- Methyl chloride (CH₃Cl) and methyl alcohol (CH₃OH)
- Methyl chloride (CH₃Cl) and carbon tetrachloride (CCl₄)
- Methyl chloride (CH₃Cl) and tetrachloroethane (C₂H₅Cl₂)
- Methyl chloride (CH₃Cl) and toluene (C₆H₅CH₃)
- Methyl chloride (CH₃Cl) and tetrachloroethene (C₂H₅Cl₂)
- Methyl chloride (CH₃Cl) and amyl chloride (C₅H₁₁Cl)
- Methyl chloride (CH₃Cl) and monochlorobenzene (C₆H₅Cl)
"F-11," "F-12," "F-21" and "F-114" are simply the commercial names of some of the refrigerants indicated, and are used principally for the purpose of convenience.

In addition to the foregoing mixtures or solutions, other mixtures or solutions of two or more components may be used.

Of the refrigerants in the foregoing list, propane (C3H8), normal butane (C4H10) and isobutane (C4H10) are classified as aliphatic hydrocarbon compounds;

Ethyl chloride (C2H5Cl), methyl chloride (CH3Cl), ethylene chloride (C2H4Cl2), amyl chloride (C5H11Cl), carbon tetrachloride (CCl4), tetrachloroethane (C2HCl4) and tetrachloroethylenes (C2Cl4) are classified as halogen derivatives of aliphatic hydrocarbon compounds; and

Dichlorodifluoromethane (CCl2F2), trichlorofluoromethane (CCl3F), dichlorotetrafluoroethane (CCl2F2), and dichlorodifluoromethane (CHClF2) may be classified as halogen derivatives of aliphatic hydrocarbons as or fluorine derivatives of an aliphatic halogen compound.

In operation a system such as the one illustrated in Fig. 1 may be charged with a quantity of refrigerant medium, which is a liquid mixture made up by placing together a plurality of different refrigerants each having a different volatility or boiling range, such as a 50% solution of methyl chloride (CH3Cl) in sulphur dioxide (SO2). Apparatus is not committed as regards expansion or refrigeration elements in which the methyl chloride and sulphur dioxide are placed together to constitute the refrigerant medium. However, the important thing to be observed is that fact that with this refrigerant medium the more volatile one boils off from the evaporator and boils out in the freezing zone or compartment to produce freezing of the ice cubes while the less volatile component is carried over to the cooling compartment and there evaporated at a higher temperature to produce cooling therein. The terms solution and mixture, as used herein, are not to be construed only in their technical sense, but have reference to a liquid body or refrigerating medium made up of a plurality of refrigerants associated in whatever manner such refrigerants will associate when placed together in a refrigerating system, so long as the medium retains the above described fractionating property.

The refrigerant medium, in circulating through the system, is discharged from the compressor into the condenser 12 where condensation of the vaporized refrigerant takes place and thence the liquid refrigerant passes to the receiver 14 from whence it flows through the conduit 24 and the heat exchanger 36 to the expansion valve 40 and the freezer section 26 of the evaporator.

From the freezer section 26 of the evaporator the refrigerant is fed through the conduit 41 and heat exchanger 36 to the air cooling section of the evaporator. The refrigerant in both the freezer section 26 and the air cooling section 28 of the evaporator is exposed to substantially the same suction pressure. In passing through the freezer coil or section 26, the addition of heat to the refrigerant will effect the evolution of gas and the gas coming off of the refrigerant in the freezer section will contain a greater percentage of the higher volatile component having the higher volatility or lower boiling point, with the result that the residual refrigerant which is conducted through the conduit 41 and the heat exchanger 36 into the air cooling section 28 will have a lower percentage of the higher volatile component in it than is present in the mixture or solution in the freezer section 26. Therefore the refrigerant which gets into the air cooling section 28 will have a higher boiling point than the boiling point of the refrigerant solution when delivered to the freezer section 26. Since the refrigerant in the freezer section 26 has a lower boiling point than the refrigerant in the air cooling section 28, it follows that a lower temperature will be produced in the freezing section 26 of the evaporator than in the air cooling section 28. In the freezer section 28, the higher volatile component, which in the present instance is methyl chloride, will come off of the mixture in a gas phase in a much higher concentration than 50% and will thereby reduce the concentration of the methyl chloride so that the mixture which is delivered to the air cooling section 28 will contain a materially less percentage of methyl chloride than 50%. As the sections 26 and 28 comprise essentially a single continuous coil, the composition of the higher volatile component of the refrigerant in the coil will gradually decrease from the expansion valve toward the end of the air cooling section 28. The heat interchanger 38 functions to increase the temperature differential between the evaporator elements in that the refrigerant flowing through the conduit 41 will absorb heat from the refrigerant flowing through the conduits 24 and 38 on its way to the expansion valve 40 so as to reduce the temperature of the refrigerant mixture to the boiling temperature. The temperature spread between the evaporator sections 26 and 28 will vary materially with the heat load on the cabinet, due to the fact that the available refrigeration per pound of mixture circulated is constant, and since more pounds of refrigerant mixture are circulated at higher loads, more refrigeration is available at the lower temperature level in the freezer section 26.

In a system of this type, the addition of the secondary refrigerant, in the instance under consideration, methyl chloride, tends to increase the condenser head pressure and thereby increase the power input to the compressor. However, it has been found that in a well built compressor with low friction losses, the increase in head pressure increases the power input very slightly, and there is an over-all gain in power consumption per day because the suction pressure increases slightly and the evaporator is more efficient as a heat exchange device, due to the improved ebullition, because of the increased quantity of gas flowing through it. The temperature differential between the various sections of the evaporator can be varied by using different compositions of the refrigerant medium or different percentages of the components thereof.

The refrigerant passes in series through both sections of the evaporator, and the vaporous refrigerant resulting from the freezing and the air cooling sections likewise passes through the coils of the evaporator to the suction line 44, which conducts such refrigerant vapor, together with whatever lubricant may be entrained therein to the intake side of the compressor 10. The average composition of the gas passing through the suction line will always be the same as the gas composition of the liquid entering the evaporator.

The thermostatic expansion valve 40, controlled by both the pressure in the evaporator and the temperature of bulb 46, may be set to operate off the box cooling coil temperature when the cabinet temperature is above 36° F.
As the cabinet temperature drops below 38° F., the thermostatic valve 48 tends to close and reduce the effective area of the box-cooling coil. It reduces the suction pressure, and as a result thereof the temperature of the freezing coil is reduced. Under these circumstances the box-cooling coil 28 acts largely as a superheater for the gas coming off of the freezing coil 26 and most of the box cooling would be done by the side of the freezing coil, that is, by passage or conductivity of heat through the walls of the shell 27 of the freezing coil. The operation of the thermostatic expansion valve is to maintain a constant superheat at the bulb. This will be true if the bulb is charged with the same refrigerant as is used in the system. If, however, the bulb is charged with some other refrigerant the superheat can be increased or decreased as the bulb temperature lowers.

As another example of a refrigerant medium which may be used, I have found that a solution of 5% to 25% of sulphur dioxide (SO2) in trichloromonofluoromethane (CClF2) will operate in the system herebefore described to produce refrigeration at a different temperature with the box-cooling coil 28. Fractional distillation of the refrigerant takes place in the freezing coil 26 and that vaporization of the higher volatile components of the refrigering medium will take place in the box-cooling coil 28. The remaining liquid, containing a greater percentage of the lower volatile component will pass over into the box-cooling coil where vaporization of all of the residual refrigerant medium will take place. After the vaporization of the higher volatile components of the refrigerant medium takes place in the freezing coil, the boiling point of the remaining liquid is raised; hence evaporation of the remaining liquid takes place at a higher temperature, which produces refrigeration at a higher temperature in the box-cooling coil than that produced in the freezing coil. The temperature differential between the two evaporating coils will be determined by the percentages of the various components of the refrigerant medium.

There is illustrated a modified arrangement wherein a by-pass conduit 50 is provided between the heat exchanger 126 and the suction line 144 so as to permit the transfer of refrigerant vaporized in the freezing coil and/or in the heat exchanger to the suction line without passing through the box-cooling coil 128. The system otherwise is like that illustrated in Fig. 1 and will operate in substantially the same manner as that illustrated in Fig. 1.

One of the evaporator elements has been designated a “freezing coil” and the other of the evaporator elements a “box-cooling coil.” These terms have been adopted merely to illustrate the fact that different temperatures are produced in each of these coils and it is to be understood that both may be used for freezing purposes or for box-cooling purposes. Further, more than two coils might be used in the system as illustrated in Fig. 1 and more than two refrigerant liquids might be used in the refrigerator medium. The principal object of using a refrigerant medium of mixture of two or more refrigerant fluids is to obtain fractional distillation of the refrigerant medium at different temperatures and in order that such distillation will occur at different temperatures, it is essential that the characteristics of the medium be substantially different than any of its components, otherwise the system would work as a standard system to produce refrigeration at a single temperature throughout each of the coils or evaporator elements.

In the modification disclosed in Fig. 3, an application for my invention for which patent is illustrated, and this modification comprises a duct 200 through which air is adapted to be circulated in the direction indicated by the arrow 202 by means of a fan 204 driven by a source of power, such as an electric motor 268 located at the bottom comprising a series of finned coils 208, 210 and 212 arranged within the duct 200 so that the circulating air therein will pass over the surfaces of the finned coils 208, 210 and 212. The finned coils 208, 210 and 212 each comprise a length of tube, bent to form a coil, and having meric fins secured in good thermal contact with the coils so as to increase the heat transfer surface thereof. Each of the coils is adapted to provide a space within which refrigerant may be evaporated and, as illustrated, each of the coils is connected in series so that liquid refrigerant will be supplied with liquid refrigerant at the bottom thereof. The coils 208, 210 and 212 are connected in series so that liquid refrigerant will be supplied to each of the coils. Liquid refrigerant from the condensing unit, such as that illustrated in Fig. 1, is adapted to be supplied through a liquid supply line 224 to the bottom of the coil 208. The top of the coil 208 is connected to a header 225 to which the suction line 244 is connected. A conduit 241 affords communication between the bottom of the header 225 and the bottom of the coil 210 for supplying liquid refrigerant thereto. The upper end of the coil 210 is connected to a header 227, and this header also is connected to the suction line 244. The bottom of the header 227 is connected by a conduit 243 to the top of the coil 208 for supplying liquid refrigerant thereto, and the top of the coil 212 is connected to the suction line 244. A thermostatic expansion valve 240 having a bulb 248 thermally associated with the suction line 244 just beyond the connection thereof with the upper end of the coil 212, said bulb 248 being in series with the vacuum line 248 to the expansion valve 240 for operating the same, is adapted to control the admission of liquid refrigerant to the coil 208. The thermostatic expansion valve 240 may be exactly like that illustrated in connection with the embodiment disclosed in Fig. 1, and operate in the same manner, that is, the expansion valve 240 preferably is controlled by both the pressure in the evaporator and the temperature of the bulb 248. A thermostatically controlled switch, like the switch 20, may be utilized in connection with the low side illustrated in Fig. 3 for controlling the operation of the condensing unit.

The coils 208, 210 and 212 may be considered as a single coil with by-passes between the intermediate parts thereof and the suction line 244, or the coils may be used as separate evaporating units, but the suction pressure in each of the coils 208, 210 and 212 will be substantially the same. The gas evolved in the coils 208 may pass directly to the suction line 244 from the heater 225, while the liquid from the header 227 is admitted to the coil 210. Likewise the gas evolved in the coil 210 may pass from the header 227 into the suction line 244, while the liquid refrigerant will pass through the conduit 243 into the coil 212. By employing as a
refrigerant medium, a liquid comprising a plurality of liquid components, such as one of the mixtures or solutions heretofore indicated, it will be possible to obtain temperatures at the coils different from the temperatures in the other coils, that is, refrigeration at one temperature will be produced in the coil 288; refrigeration at a somewhat higher temperature will be produced in the coil 210; and refrigeration at a still higher temperature will be produced in the coil 212. Of course, the number of the coils might be varied and the coils might be arranged in various ways to carry out the idea of producing refrigeration at several different temperatures within the different parts of the coils arranged in an air duct.

As illustrated in Fig. 3, the highest temperature at which refrigeration will be produced will be in the coil 212, which is the first coil through which the air to be cooled is passed, and refrigeration at the lowest temperature will be produced in the coil 288, which is the last coil through which air to be cooled is passed. By using the coil arrangement illustrated in Fig. 3, it is possible to obtain a much more efficient use of the refrigerating apparatus, that is, by operating the different coils at different temperatures the apparatus will have a greater capacity than systems in which the coils are operated at the same temperature, the other conditions being equal, and as a result thereof the coefficient of performance of the system is higher than that of a system in which the coils are operated at the same temperature and the temperature differential between the various coils may be varied by using different percentages of the components of the liquid refrigerant and also by using different combinations of liquid refrigerant. In any case, the higher volatile components will vaporize out first in the coil, with the result that the boiling temperature of the liquid refrigerant as it reaches the tail end of the coil will be increased.

While the invention has been described with some detail, it is to be understood that the description is for the purpose of illustration only and is not definitive of the limits of the inventive idea. The right is reserved to make such changes in the details of construction and arrangement of parts as will fall within the purview of the attached claims.

1. Claim:

1. Refrigerating apparatus comprising a pair of evaporator elements, a fluid connection therebetween, a conduit connected to one of said elements for supplying a liquid refrigerant medium thereto, said refrigerant medium being made up by putting together a plurality of separate refrigerants, each having a different boiling range, a suction conduit connected to the other of said elements for conducting vaporous refrigerant therefrom, a heat exchange device arranged between said connection and said liquid supply conduit, and an expansion valve arranged in said liquid supply conduit for controlling the admission of liquid refrigerant to said evaporator elements, said expansion valve having a thermostatic element thermally associated with said evaporator element to which said suction line is connected.

2. Refrigerating apparatus comprising a closed refrigerating system charged with a refrigerant medium comprising two or more refrigerants placed together, each having a different volatility, said system including a pair of evaporators, a connection between said evaporators for conveying refrigerant medium from one to the other, a supply line connected to one of said evaporators for supplying said refrigerant medium thereto, a suction line connected to the other of said evaporators for conducting refrigerant from, and a heat exchange device operatively disposed between said connection and said liquid supply line.

3. In a refrigerating apparatus comprising a closed refrigerating system including a compressor and condenser, said system being charged with a refrigerant medium comprising a plurality of different refrigerants each having a different volatility, said medium having characteristics as a refrigerant materially different than that of either of said components, said system further including a pair of evaporator elements, a connection between said evaporator elements whereby the same are arranged in series, a conduit connected to one of said evaporators and to said condenser for supplying said medium in a liquid state to said one of said evaporators, a suction line connecting the other of said evaporators to said compressor, said refrigerant medium supply line and the connection between said evaporators being arranged in heat exchange relation, and a thermostatic expansion valve disposed in said liquid supply line and having a thermostatic element thermally associated with said evaporator to which said suction line is connected.

4. Refrigerating apparatus comprising a pair of evaporators, a connection therebetween, a liquid supply line connected to one of said evaporators for supplying thereto a refrigerant medium comprising a plurality of different refrigerants placed together, said refrigerants each having a different volatility, a suction line connected to the other of said evaporators, a bypass between said connection and said suction line and around said evaporator to which said suction line is connected, and means arranged in said liquid supply line for controlling the admission of liquid refrigerant to said evaporators.

5. Refrigerating apparatus comprising a freezing coil and a box cooling coil arranged within a heat insulated compartment, means for operating said freezing coil at a lower temperature than that of said box cooling coil including a metallic shell inclosing said freezing coil and adapted to shield said freezing coil from the circulating air in said compartment, but to readily permit the transfer of heat through the walls thereof, said box cooling coil being exposed to the circulating air within said compartment, a refrigerant medium supply line connected to said freezing coil, said refrigerant being made up by putting together a plurality of separate refrigerants, each having a different volatility, a suction line connected to said box cooling coil, a connection between said coils for conducting refrigerant from said freezing coil to said box cooling coil, a valve disposed in said liquid supply line for controlling the admission of liquid refrigerant to said freezing coil, and means thermally associated with said box cooling coil and adapted for controlling said valve for regulating the flow of liquid refrigerant in accordance with the temperature condition of said box cooling coil.

6. Refrigerating apparatus comprising a pair of evaporators arranged within a heat insulated compartment, one of said evaporators being exposed to the circulating air within said compartment and constituting a box cooling coil, the other of said evaporators comprising a plurality of refrigerated shelves, a metallic shell for shield-
ing said shelves from the circulating air within said compartment, said shelves being adapted for the reception of liquid holding trays, a conduction between said evaporators, said refrigerated shelves including a freezing coil, means for operating said freezing coil at a lower temperature than that of said box cooling coil comprising a conduit for supplying a liquid refrigerant medium to said freezing coil, said refrigerant being made up by putting together a plurality of separate refrigerants, each having a different volatility, a suction line connected to said box cooling coil, a valve arranged in said liquid supply line, and means thermally associated with said box cooling coil for operating said valve to regulate the supply of liquid refrigerant to said freezing coil.

7. The method of transferring heat which includes supplying a refrigerant medium made up of a plurality of different refrigerants having different volatility to a heat exchange device, vaporizing at least part of the more volatile of said refrigerants in said heat exchange device, supplying the residual liquid refrigerant from said heat exchange device to another heat exchange device exposed to the same suction pressure as said first mentioned heat exchange device, vaporizing said residual liquid refrigerant in said other heat exchange device and utilizing a part of the residual refrigerant liquid from said first mentioned heat exchange device for cooling said refrigerant medium prior to the entry thereof into said first mentioned heat exchange device.

8. The method of producing refrigeration which comprises forming a refrigerant medium by placing together a plurality of liquid refrigerants of different volatility, one of which comprises \( \text{SO}_2 \), and another of which comprises a chlorine substituted lower aliphatic hydrocarbon, evaporating the more volatile one of said refrigerants from said medium in a first evaporating zone to produce refrigeration at one temperature, transferring the resultant refrigerant medium to form a body of refrigerant in a second zone having a boiling point different than that of said medium in said first zone, evaporating refrigerant from said body to produce refrigeration at a temperature different than that produced by evaporating refrigerant from said medium in said first zone, condensing the refrigerant vapor and returning the same to liquid form to said medium.

9. The method of producing refrigeration which comprises forming a refrigerant medium by placing together a plurality of liquid refrigerants each having a different volatility, one of which refrigerants comprises \( \text{SO}_2 \), and another of which refrigerants comprises \( \text{C}_2\text{H}_4\text{Cl}_2 \), evaporating refrigerant from said medium to produce refrigeration at one temperature, transferring liquid from said solution to form a body of refrigerant at another point having a boiling point different than that of said solution, evaporating refrigerant from said body to produce refrigeration at a temperature different than that produced by evaporating refrigerant from said medium, condensing the refrigerant vapor and returning the same in liquid form to said medium.

10. The method of producing refrigeration which comprises forming a refrigerant medium by placing together a plurality of liquid refrigerants each having a different volatility, one of which refrigerants comprises \( \text{SO}_2 \), and another of which refrigerants comprises \( \text{C}_2\text{H}_4\text{Cl}_2 \), evaporating refrigerant from said refrigerant medium to produce refrigeration at one temperature in a first evaporating zone, transferring liquid from said medium to form a body of refrigerant in a second evaporating zone having a boiling point different than that of said medium in said first zone, condensing the refrigerant vapor and returning the same in liquid form to said medium.

11. The method of producing refrigeration which comprises forming a refrigerant medium made up by placing together a plurality of liquid refrigerants each having a different volatility, one of which refrigerants comprises \( \text{SO}_2 \), and another of which refrigerants comprises \( \text{C}_2\text{H}_4\text{Cl}_2 \), evaporating refrigerant from said medium to produce refrigeration at one temperature in a first evaporating zone, transferring liquid from said medium to form a body of refrigerant in a second evaporating zone having a boiling point different than that of said medium in said first zone, evaporating refrigerant from said body to produce refrigeration at a temperature different than that produced by evaporating refrigerant from said medium in said first zone, condensing the refrigerant vapor and returning the same in liquid form to said medium.

12. In a refrigerating apparatus including a pair of separate evaporator coils connected in series, means including a conduit connected to a first one of said coils to supply a refrigerant medium thereto, a suction conduit connected to the other of said coils for conducting vaporous refrigerant therethrough, means for increasing the temperature spread between the temperatures at which said coils operate, said means comprising a heat exchanger connected between said coils, the outlet from said first coil being conducted through said heat exchanger in heat exchange relation to the incoming supply of refrigerant medium to said first coil for improving the temperature spread between said coils.

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