

June 17, 1941.

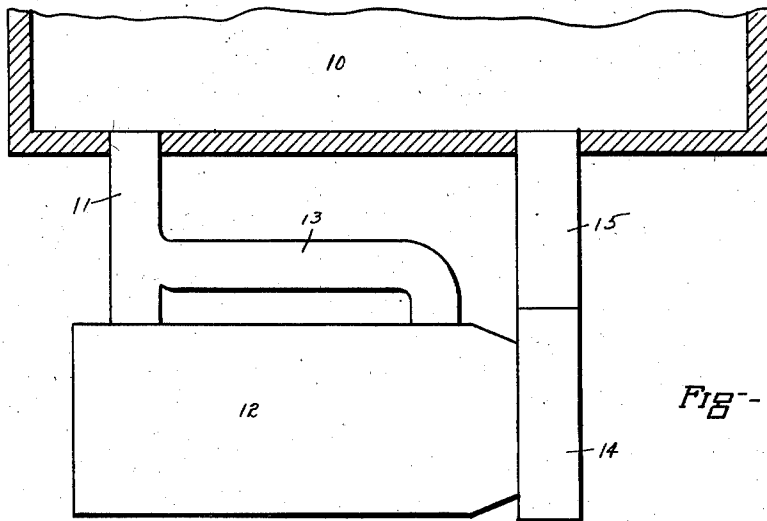
R. W. WATERFILL ET AL

2,246,401

METHOD AND MEANS FOR PROVIDING REFRIGERATION

Filed Oct. 3, 1933

4 Sheets-Sheet 1



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4 Sheets-Sheet 2

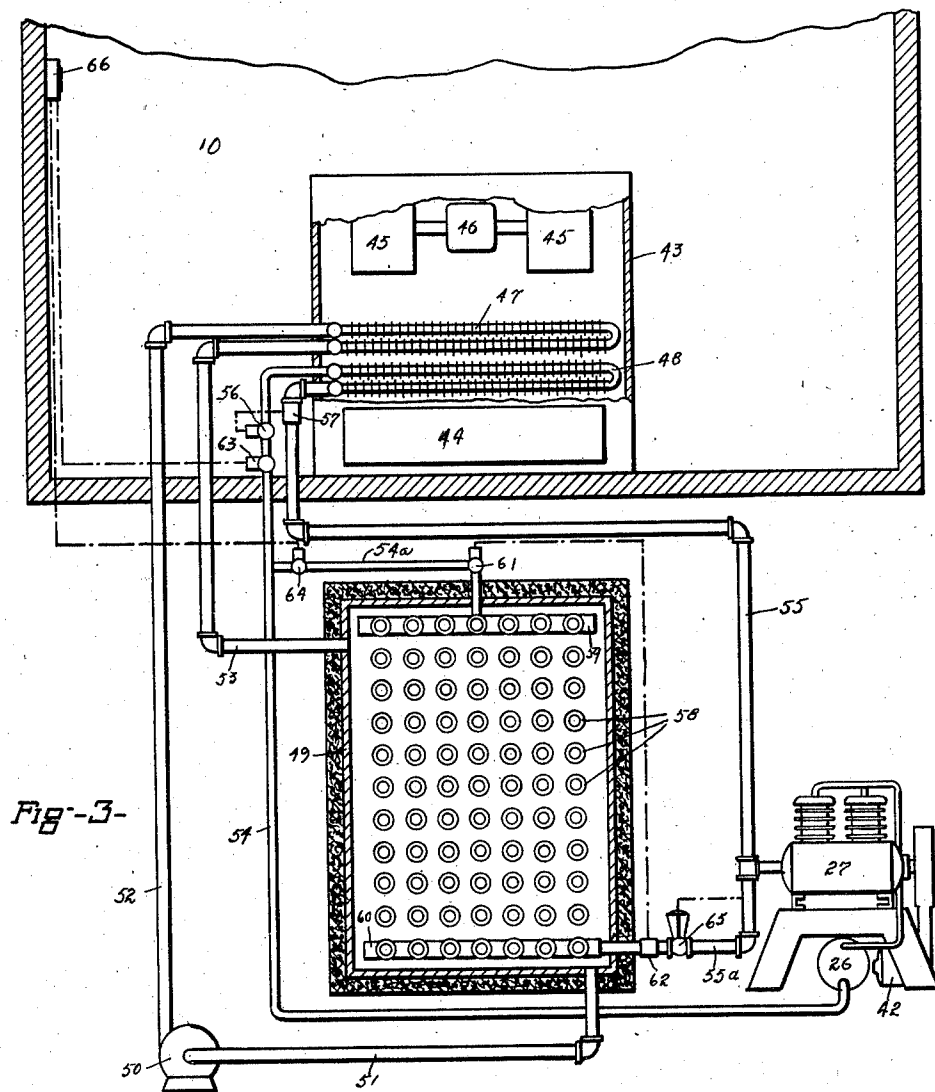


Fig-3-

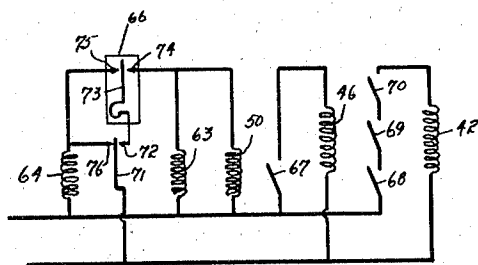


Fig-4-

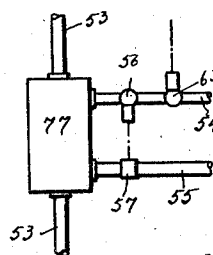


Fig-5-

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4 Sheets-Sheet 3

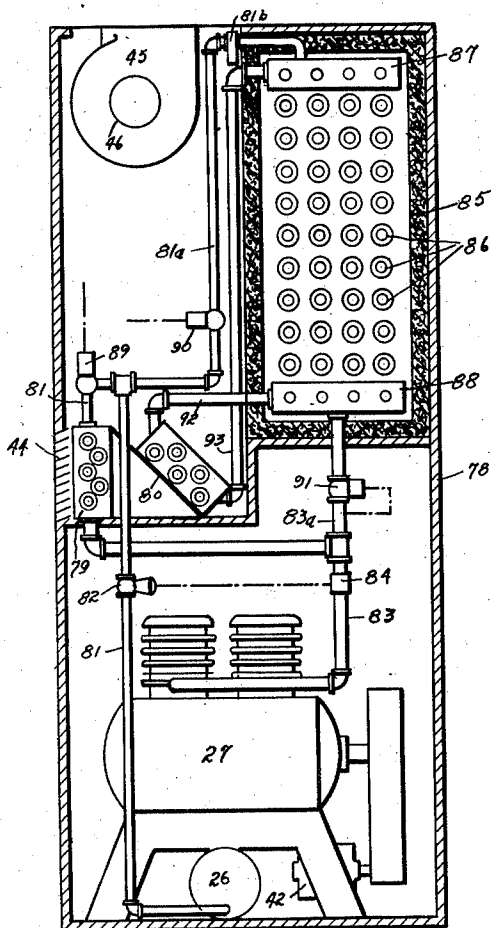


Fig-6-

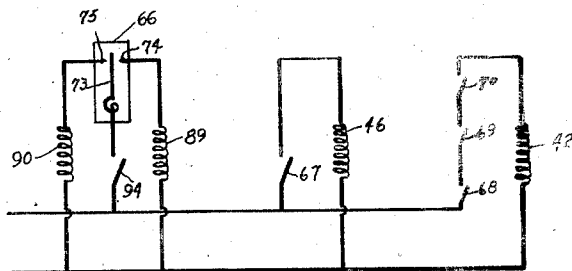


Fig-7-

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2,246,401

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4 Sheets-Sheet 4

Fig-8-

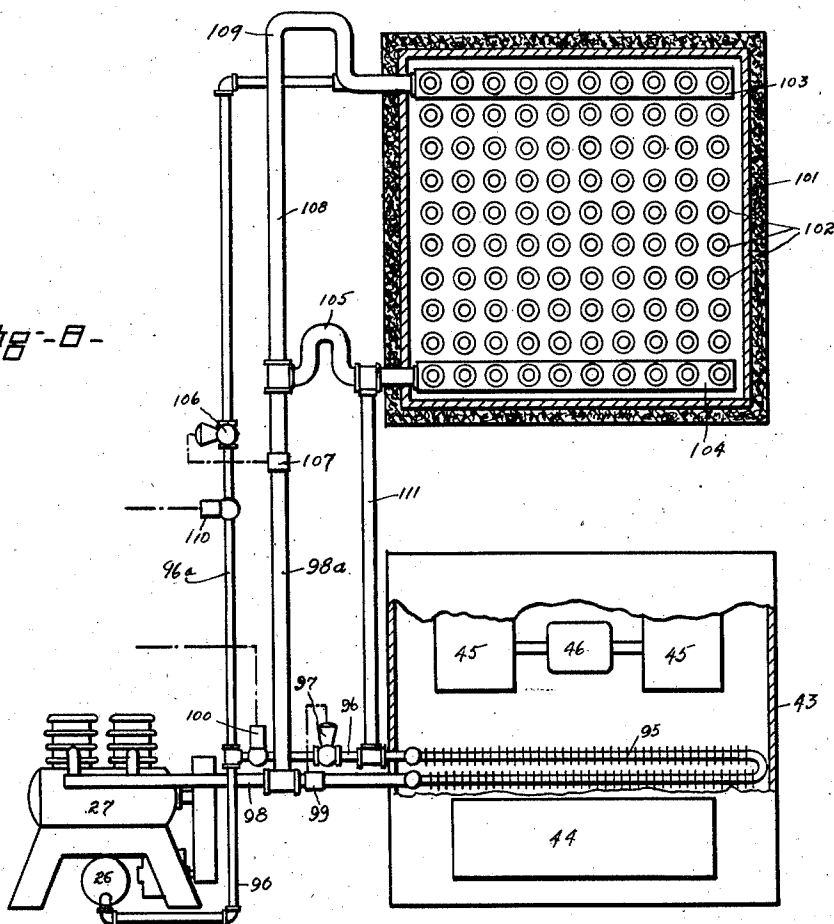
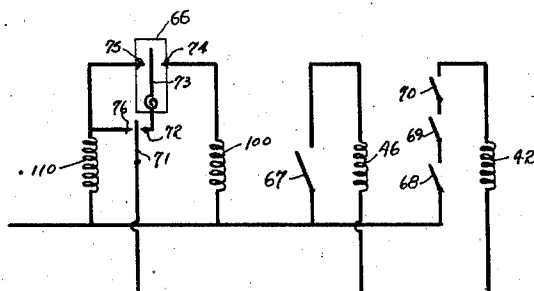


Fig-9-



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2,246,401

METHOD AND MEANS FOR PROVIDING REFRIGERATION

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Application October 3, 1933, Serial No. 691,928

18 Claims. (Cl. 62—6)

This invention relates to methods of and means for storing refrigeration, and more particularly to a method for use with an air conditioning system, wherein the refrigerating effect of a relatively small machine is stored during low air conditioning load periods, and the storage drawn upon to augment the capacity of the machine during high air conditioning load periods.

In designing an air conditioning system for an enclosure, it is necessary to estimate the maximum heat load to which the building will be subjected. While this maximum may be much greater than the average condition, it has heretofore been necessary to provide refrigeration capacity sufficient to cool the enclosure under any extreme condition. In other words, the refrigeration capacity is sufficient to take care of rare peak load conditions, and hence, under ordinary conditions, the capacity is excessive. Further, since the heat load is an estimate, not a precise calculation, various safety factors are generally included. In this way, the capacity is further pyramided. When it is remembered that the average machine operates only about eight hours per day, it is apparent that the capacity, over and above the other mentioned factors, is about three times as great as would be necessary if it could be operated twenty-four hours per day. Consequently, the first cost is excessive. If, as is usual, the machine is electrically driven, the connected load is, and hence, the demand (a fixed operating cost), and other charges are, unduly great.

It is an object of the invention to provide a means for storing refrigeration during low load periods, and for drawing upon this storage during high load periods.

It is another object of this invention to provide an air conditioning system in which the required capacity of the refrigerating machine is reduced far below the capacity of the refrigerating machines in comparable present day systems.

A further object of the invention is to provide an air conditioning system in which substantial savings in first and operating costs are effected.

Still another object of the invention is to provide an air conditioning system sufficiently flexible to overcome errors which occur in the estimation of heat load requirements.

A further object of the invention is to provide means for increasing the peak refrigeration capacity of an air conditioning system without increasing the refrigerating machine capacity.

A feature of the invention resides in the use

of a relatively small refrigerating machine which is operated for relatively long periods of time, as opposed to present day practice in which a large machine is operated for a short time.

A further feature of the invention resides in the use of a small refrigerating compressor in conjunction with a low temperature evaporator for freezing ice during low air conditioning load periods, and in conjunction with a high temperature evaporator, for cooling air, either directly, or through an intermediary heat transfer medium, during high air conditioning load periods.

Another feature of the invention resides in the use of a low temperature evaporator to freeze ice during low air conditioning load periods, and the use of the ice to condense refrigerant vapors during the high air conditioning load periods.

Still a further feature of the invention resides in the provision of two direct expansion evaporators in an air stream, one of which is supplied with liquid refrigerant from a refrigerating machine, and the other of which is supplied with liquid refrigerant from an ice storage tank.

Still another feature resides in the provision of a coil which is used alternately as a refrigerant evaporator and a refrigerant condenser.

Various other objects and features of the invention, making for simplicity, economy, and efficiency, will be more apparent from the description and accompanying drawings, in which:

Fig. 1 is a diagrammatic plan view of a system for air conditioning an enclosure.

Fig. 2 is an elevation, in section, of an air conditioning device, embodying one form of applicants' invention, which may be used in connection with the system of Fig. 1.

Fig. 3 is a sectional elevation of an enclosure and a device for conditioning it, which device embodies another form of applicants' invention.

Fig. 4 is a wiring diagram showing the automatic control of the elements of Fig. 3.

Fig. 5 illustrates an evaporator which may be substituted for certain elements of the system of Fig. 3.

Fig. 6 is an elevation, partly in section, of a unit, embodying another form of the invention, which may be utilized for cooling the enclosure of Fig. 3.

Fig. 7 is a wiring diagram for the unit of Fig. 6.

Fig. 8 is an elevation, partly in section, of an air conditioning unit embodying another variation of the invention, and

Fig. 9 is a wiring diagram for the unit of Fig. 8.

Essentially, this invention contemplates the

use, in an air conditioning system, of a refrigerating machine of relatively small capacity in conjunction with two evaporators. One evaporator is used, during off-load periods, for storing refrigeration by freezing ice. The other evaporator is used during on-load periods, either directly or through an intermediary heat transfer medium, for cooling a volume of air. Whenever the air conditioning load exceeds the capacity of the refrigerating machine, the storage is drawn upon to make up the deficiency. The refrigerating machine, obviously, is operated for longer periods of time than is the air conditioning system. While each of the accompanying figures shows two evaporators, it is entirely possible to carry out the invention with only one.

Applicants have found two general ways in which the stored refrigeration may be used to augment the capacity of the machine, to wit, either cooling liquid, or condensing a portion of the refrigerant vapors. Several variations of each method are illustrated in the drawings.

In the drawings, similar designations referring to similar parts, Fig. 1 shows a simple air conditioning system in which air is withdrawn from an enclosure 10 through conduit 11, treated in conditioner 12, attenuated by untreated air through bypass conduit 13, and discharged by fan 14 through conduit 15 back into the enclosure 10. The conditioner 12 (Fig. 2) comprises a casing 16 divided by a horizontal partition 17 into an upper or spray chamber 18, and a lower or freezing-storage chamber 19. A weir 20, in cooperation with a side of the casing 16 and the partition 17 forms a well 21 for collecting water from the sprays 22. Any excess water flows over weir 20 and passes through holes 23 into the freezing chamber 19. A first (high temperature) evaporator 24, located in and adapted to cool the collected water in well 21, is supplied with a refrigerant, through pipe 25, from the condenser 26 of a refrigerating machine 27. Similarly, a second (low temperature) evaporator 28, located in the freezing chamber 19, is supplied with refrigerant from condenser 26 through pipe 25a. Refrigerant vapor from evaporator 24 is returned to the compressor of refrigerating machine 27 through pipe 29, while vapor from evaporator 28 is returned through pipe 29a. An expansion valve 30 regulates the admission of refrigerant to evaporator 24 in response to variations in superheat in suction line 29, as indicated by thermal element 31. In this manner, water collecting in well 21 is cooled to any desired point, 45 degrees F. for example.

In a similar manner, the supply of refrigerant to evaporator 28 is controlled by expansion valve 32 responding to variations in superheat as registered by thermal element 33. A stop valve 34, preferably of the quick acting type, opens or closes suction line 29a, preferably in response to variations in the suction pressure as indicated by broken line 35. The valve 34 is so adjusted as to snap open whenever the suction pressure falls below a value corresponding to a temperature of 28 degrees F., and snaps closed whenever the suction pressure rises above a point corresponding to 32 degrees F. A pump 36 withdraws cooled water from well 21, through pipe 37, and discharges this water through spray heads 22. Air passing through spray chamber 18, under the influence of fan 14, contacts with the sprays and is cooled thereby. If, as will be hereinafter explained, the dewpoint temperature of the air leaving the sprays is above a desired point, 52

degrees F. for example, thermostat 38 operates mixing valve 39, thereby partially closing pipe 37 and partially opening pipe 40. As a result, water from chamber 18, cooled to approximately 32 degrees F. by ice 41 on evaporator 28, is mixed with water from well 21 which, as was previously stated, is cooled to approximately 45 degrees F. by evaporator 24. If the resulting mixture is not capable of cooling the air to the desired dewpoint, then thermostat 38 will act to increase the proportion of water withdrawn from chamber 19. Conversely, if the mixture is too cool, thermostat 38 will act to increase the water drawn from well 21. The quantity of water withdrawn from chamber 19 spills over weir 20 and passes through holes 23 back into chamber 19.

In operation, assuming that there is no air conditioning load, it is apparent that there is little, or no, heat to be withdrawn from the water in well 21. Consequently, the pressure in pipe 29 falls. When the pressure drops to a point corresponding to 28 degrees F., valve 34 opens, thus establishing a circulation of refrigerant through evaporator 28. The refrigerant absorbs heat from the water in chamber 19, and since the refrigerant temperature is below thirty-two degrees F., this water freezes, thereby forming ice on evaporator 28. The formation of ice effects a reduction in suction pressure, as is readily understood. When the pressure drops to a predetermined value, thus indicating that a desired thickness of ice has been built up on evaporator 28, this fall in pressure may be utilized to stop motor 42, by operation of a well known low-pressure cut-off (not shown). If, however, the air conditioning load has increased, thereby causing a rise in suction pressure to a point corresponding to a temperature of 32 degrees F., valve 34 will snap closed, thereby stopping the circulation of refrigerant through evaporator 28, and causing an increased circulation in evaporator 24. As the load continues to rise, the entire capacity of machine 27 will be utilized in holding the temperature of water in well 21 at the desired 45 degrees F. As the load increases above the capacity of machine 27, the temperature of water in well 21 rises above the desired 45 degrees F., and consequently, the dewpoint temperature of air in spray chamber 18 rises. It is at this point that thermostat 38 operates valve 39 in the manner and for the purpose hereinbefore explained, thus drawing upon the stored refrigeration to augment the capacity of machine 27. It is of importance to note that a peak load of any magnitude may be handled in this way.

In the arrangement of Fig. 3, applicants provide a conditioning unit located within the enclosure 10. The unit comprises generally casing 43 having an air inlet opening 44 near its base, a pair of fans 45, a motor 46 for driving the fans, and two heat transfer coils 47 and 48, located in the air stream at a point between the air inlet 44 and fans 45. Cold water from freezing tank 49 is circulated by pump 50 through inlet pipe 51, supply pipe 52, coil 47 and return pipe 53. Heat transfer coil 48, a direct expansion evaporator, is supplied with refrigerant from condenser 26 of refrigerating machine 27, through pipe 54. Refrigerant vapors are returned to the compressor of machine 27 through suction line 55. A suitable expansion valve 56, responding to changes in superheat in suction pipe 55, as indicated by thermal element 57, regulates the admission of refrigerant to coil 48. Freezing tank 49 is provided with an evapo-

rator comprising a number of pipe coils 58, preferably finned to increase the available heat transfer surface, and joined at their opposite ends by an inlet header 59 and a discharge header 60. Refrigerant from condenser 26 is supplied to inlet header 59 through pipe 54a, and vapors are returned to machine 27 through suction line 55a. The admission of refrigerant to coils 58 is controlled by an expansion valve 61 responding to changes in super heat as indicated by thermal element 62. Electrically operated solenoid valves 63 and 64 are provided in supply pipes 54 and 54a respectively to open and close these pipes under the control of thermostat 66, located within enclosure 10, in a manner and for reasons hereinafter to be made clear. A pressure operated stop valve 65, similar in all respects to valve 34 of Fig. 2, opens suction line 55a whenever the suction pressure falls to a point corresponding to a temperature of 28 degrees F., and closes when the suction pressure rises above 32 degrees F.

It is of importance to note that the air conditioning unit of Fig. 3 is of the off-on type, i. e., fans 45 maintain a continuous circulation of air within enclosure 10, but the heat transfer coils operate intermittently in response to temperature changes within the enclosure as indicated by thermostat 66.

Considering the operation of the unit (Figs. 3 and 4), fans 45 are placed in operation by closing hand switch 67, thus completing the electrical circuit including motor 46. The refrigeration machine is started by the closing of hand switch 68, thus completing the electrical circuit including high pressure cut-out 69, low pressure cut-out 70, and compressor motor 42. Hand switch 71 is closed to make contact at 72. Assuming that enclosure 10 requires cooling (above 75 degrees F., for example), arm 73 of thermostat 66 will make contact at 74, thus completing the electrical circuit including switch 71, contacts 72, thermostatic arm 73, contact 74, solenoid valve 63, and pump 50. As a result, valve 63 is opened against the tension of a spring, and pump 50 starts a circulation of water through coil 47. The opening of 63 admits refrigerant to coil 48. Air in taken through 44, by fans 45, gives up its heat to coil 48. Any heat in excess of the capacity of coil 48 is absorbed by water circulating in coil 47. If the air conditioning load is light, coil 48 does all of the work; if heavy, coil 47 makes up the deficiency. Thermostat 66, preferably, is of the quick-acting type, i. e., arm 73 moves from one extreme position (contact 74) to the other extreme position (contact 75). When the temperature of the enclosure drops to a desired point, 72 degrees F., for example, thermostatic arm 73 breaks the circuit at 74, thus stopping pump 50, and allowing solenoid valve 63 to close under the tension of its associated spring. Simultaneously, arm 73 makes contact at 75, thus closing the electrical circuit including switch 71, contact 72, arm 73, contact 75 and solenoid valve 64. As a result, valve 64 opens, preferably against the tension of an associated spring, to admit refrigerant to evaporator coils 58. When the suction pressure is below a point corresponding to 28 degrees F., valve 65 opens and refrigerant circulation is thereupon established. Since the refrigerant is below 32 degrees F., it is self-evident that ice will be formed on coils 58.

If enclosure 10 does not require cooling, dur-

ing the late evening, night, and early morning, for example, hand switch 71 may be moved to break the circuit at 72 and to complete a circuit including switch 71, contact 76, and solenoid valve 64. Machine 27 will then maintain a circulation of refrigerant in coil 58 until the formation of ice attains a desired thickness, whereupon low pressure cut-out 70 will break the circuit to stop compressor motor 42.

If, as might occur during a continuous high peak load, all of the ice in tank 49 were melted, the entire load would be placed upon coil 48. Since the capacity of the machine is designedly less than this peak load, the pressure in the coil 48 would rise, and consequently, the pressure in condenser 26 would rise. To prevent the creation of a dangerously high pressure, a high pressure cut-out 69 of well known construction, is placed in the circuit to stop motor 42 whenever the condenser pressure attains a predetermined maximum.

In certain cases, particularly those involving the renovation of existing systems, it is desirable to eliminate the direct expansion evaporator 48. To this end, applicants contemplate the insertion of an evaporator 77, of shell and tube construction, for example, in the return pipe 53. All other elements may be just as illustrated in Fig. 3. Refrigerant is supplied to 77 and vapors are returned to machine 27 through pipes 54 and 55 in exactly the same manner as was previously described in connection with Fig. 3; and likewise, the control may be identical. In operation, whenever enclosure 10 requires cooling, water returning from coil 47 is primarily cooled by evaporator 77. If the load is greater than the capacity of the machine, the deficiency is made up by the melting of ice in freezing tank 49.

In each of the systems hereinbefore described it is of note that the capacity of the refrigerating machine 27 is augmented by melting ice to cool a liquid which is thereafter circulated through the air conditioning system. Hence, each of these arrangements requires the use of a pump. In Fig. 6, applicants illustrate a unit for conditioning enclosure 10 in which the storage effect is utilized in a slightly different way, thereby to eliminate the use of a pump. Generally, the unit comprises a casing 78 having an upper chamber in which the air conditioning and refrigeration storage elements are located, and a lower chamber for housing a suitable refrigeration machine 27.

Fan 45, mounted at the top of the unit, draws air through inlet 44, over the high temperature evaporator 79, over the low temperature evaporator 80, and discharges the air into enclosure 10. Evaporator 79 is supplied with refrigerant from condenser 26 through pipe 81 under the regulation of expansion valve 82 responding to changes in superheat in suction line 83, as indicated by a thermal element 84. Freezing tank 49 is provided with pipe coils 86, preferably of finned construction, joined at their opposite ends by an inlet header 87 and a discharge header 88. Refrigerant from condenser 26 is supplied to header 87 through pipe 81a, and vapor is returned to machine 27 through suction pipe 83a. Electrical solenoid valves 89 and 90 open and close lines 81 and 81a respectively in response to changes in temperature in enclosure 10, as indicated by a thermostat 86 in the enclosure to be conditioned. A valve 91 (similar in all respects to valve 34 of Fig. 2) opens and closes suction pipe 83a in accordance with changes in suction pressure. Evap-

orator 80 is supplied with refrigerant from header 58 through pipe 92. Vapor is returned from 80 to header 87 through pipe 93.

Considering the operation of the unit, fans 45 are started by closing hand switch 67, thus completing an electrical circuit including fan motor 46. The closing of hand switch 68 completes a circuit including high pressure cut-out 69, low pressure cut-out 70 and compressor motor 42. Thermostat 86 of Fig. 7 is identical with thermostat 66 of Figs. 3 and 4. Assuming that enclosure 10 does not require cooling, thermostatic arm 73 will be making contact at 75. Closing of hand switch 94 will, therefore, complete an electrical circuit including arm 73, contact 75, and solenoid valve 90. As a result, valve 90 is opened, preferably against the tension of a spring, to admit refrigerant to receiver 81b and header 87, hence coils 86. Valve 91 will open under the influence of a suction pressure corresponding to 28 degrees F., thereby establishing refrigerant circulation through coils 86. Consequently, a coating of ice will be formed in coils 86. When the coating is of a desired thickness, as indicated by a reduced suction pressure, low pressure cut-off 70 will open the electrical circuit including compressor motor 42, thus stopping machine 27.

Assuming that the temperature of the enclosure has increased to a predetermined point, 75 degrees F. for example, thermostatic arm 73 will break the electrical circuit at 75. Valve 90 will immediately close under the tension of its associated spring. Simultaneously, since thermostat 86 is of the quick acting type, arm 73 will make contact at 74, thus completing a circuit including solenoid valve 89. As a result, valve 89 opens against the tension of an associated spring, to admit refrigerant to evaporator 75. Refrigerant vapor pressure in the suction line 83 will immediately rise, thereby closing valve 91 (closed above 32 degrees F.), and simultaneously, allowing low pressure cut-out 70 to close the circuit including compressor motor 42, hence starting machine 27. Circulation of refrigerant through 79 accomplishes a cooling of air passing thereover.

It is apparent that the closing of solenoid valve 90, and pressure valve 91, traps a volume of refrigerant in coils 86; and a volume of liquid in receiver 81b. Any vapor will, of course, be condensed by ice on the coils. The liquid in receiver 81b will be evaporated by absorbing heat from the air passing thereover; and the resulting vapor will pass into coils 86, there to be condensed. The condensate flows, by gravity, from header 88, through pipe 92 into evaporator 80. Air passing over 80 will give up its heat causing refrigerant in the evaporator to boil. The resulting vapors will pass through pipe 93 into header 87, thence into coils 86, where they condense by giving up heat to the surrounding ice. The quantity of refrigerant evaporated in 80 will vary as the difference between the capacity of machine 27 and the air conditioning load varies. In this way, the stored refrigeration is utilized to augment the capacity of machine 27. High pressure cut-out 69 functions, just as in Figs. 3 and 4, to cut-off machine 27 whenever the condenser pressure rises above a desired point.

In Fig. 8, applicants illustrate another system operating upon the principles disclosed in connection with Fig. 6. The air conditioning unit comprises generally a casing 43 having an air inlet 44 near the base thereof, fans 45, fan mo-

tor 46, and an evaporator coil 95 located in the casing between the inlet opening and the fans. Coil 95 is supplied with refrigerant from condenser 26 of machine 27 through pipe 96 under the regulation of expansion valve 97 responding to changes in superheat in suction pipe 98 as indicated by a thermal element 99. Solenoid valve 100 opens and closes line 96 under the control of a thermostat 66 responding to temperature changes in enclosure 10.

A freezing tank 101, located above evaporator 95, is provided with finned coils 102 joined at their opposite ends by an inlet header 103 and a discharge header 104. Refrigerant from condenser 26 is supplied to inlet header 103, hence, coils 102, by pipe 96a, and vapors are returned to machine 27 from discharge header 104 through trap 105 and suction pipe 98a. A suitable expansion valve 106 regulates the admission of refrigerant under the control of thermal element 107 responding to changes in superheat in suction line 98a. Solenoid valve 110 opens and closes pipe 96a under the control of thermostat 66 in enclosure 10. Pipe 108, provided with a trap 109 joins inlet header 103 and suction pipe 98a. Pipe 111 connects discharge header 104 to pipe 96 between coil 95 and expansion valve 97.

Considering Figs. 8 and 9, fans 45 are placed in operation by closing hand switch 67, thus completing an electrical circuit including motor 46. Closing of hand switch 68 completes a circuit including high pressure cut-out 69, low pressure cut-out 70, and compressor motor 42, thereby starting machine 27. Assuming that enclosure 10 does not require cooling, arm 73, of quick-acting thermostat 86 will be making contact at 75. Therefore, closing of hand switch 71 at contact 72 will complete a circuit including arm 73, contact 75 and solenoid valve 110. Valve 110 opens against the tension of an associated spring to admit refrigerant to coils 102. The resulting refrigerant circulation will cause the formation of a coating of ice on coils 102. Assuming that enclosure 10 is now calling for cooling, thermostatic arm 73 will break the circuit at 75, hence valve 110 will close under the tension of its spring. Simultaneously, arm 73 will make contact at 74 to complete a circuit including valve 100. The opening of valve 100 admits refrigerant coil 95, thereby cooling air passing through casing 43. Any refrigerant trapped in 102 will be condensed by the melting of ice. Whenever the air conditioning load exceeds the capacity of machine 27, this refrigerant from 102 flows by gravity from header 104 through 111 and into coil 95, thus making up the deficiency of machine 27. Machine 27 takes its full vapor capacity through line 98, and the excess vapor, corresponding to liquid admitted from 111, passes upward through pipes 98a, 108, trap 109, and into coils 102, wherein it is again condensed.

Whenever cooling is not required, as during the night, hand switch 71 may be moved to break the circuit at 72, thus closing valve 100, and to make a circuit at 76, thereby opening valve 110. Opening of 110 starts the formation of ice on 102 as previously described. Low pressure cut-out 69, just as was explained in connection with Figs. 2-7, may be set to stop motor 42 when a sufficiently thick ice coating has been formed. Likewise, as was previously described, high pressure cut-out 69 protects the system by stopping machine 27 whenever the condenser pressure reaches a predetermined value.

Since certain changes may be made in the

described embodiments of the invention, and since numerous control circuits may be designed to effect the automatic operation of the system, applicants intend that the matter shown and described shall be interpreted as illustrative only.

We claim as our invention:

1. The method of providing refrigeration for an air conditioning system having a varying heat load which comprises evaporating a refrigerant from a central source of supply at relatively low temperatures to freeze water during low air conditioning load periods, evaporating a refrigerant from the same source at relatively high temperatures to cool air during high air conditioning load periods, and melting the ice to augment the refrigerating effect secured by said high temperature refrigerant evaporation.

2. In an apparatus for cooling the atmosphere of an enclosure having a varying heat load, a refrigerating machine having a relatively small capacity, a refrigerant circuit including an evaporator normally receiving refrigerant supplied thereto at a relatively high suction pressure, an ice storage tank, a second refrigerant circuit including an evaporator in said storage tank normally receiving refrigerant supplied thereto at a relatively low suction pressure, and means operative responsive to variations in the heat load on said enclosure for causing said machine to serve said second refrigerant circuit when the suction pressure falls below a predetermined point and for cutting off the supply of refrigerant to said second refrigerant circuit when the suction pressure rises above a predetermined point.

3. In an apparatus for cooling the atmosphere of an enclosure, a first refrigerant circuit including an evaporator normally receiving refrigerant supplied thereto at a relatively high suction pressure, a second refrigerant circuit including an evaporator normally receiving refrigerant supplied thereto at a relatively low suction pressure, a refrigerating machine, and means including a valve responsive to suction pressure for opening and closing said second refrigerant circuit in accordance with variations in heat load in said enclosure.

4. In a conditioning system, a conditioning unit including air cooling means, an ice freezing chamber, means for supplying water from said freezing chamber to said air cooling means, means for returning water from said cooling means to said freezing chamber, and means including a refrigerant evaporator for cooling said water prior to its return to said freezing chamber during periods of high air conditioning heat load.

5. In an air conditioning system for an enclosure having a varying heat load, a first air cooling evaporator, a second air cooling evaporator, an ice freezing chamber, heat transfer coils in said chamber, a refrigerating machine, means for supplying refrigerant from said machine to said heat transfer coils during low air conditioning load periods, means for supplying refrigerant from said machine to said first air cooling evaporator during high air conditioning load periods, and means for supplying refrigerant from said heat transfer coils to said second air cooling evaporator during high air conditioning load periods.

6. The method of providing refrigeration for an air conditioning system having a varying heat load which comprises evaporating in a first ex-

pansion coil a refrigerant at relatively low temperatures to freeze ice during low air conditioning load periods, evaporating in a second expansion coil a refrigerant at relatively high temperatures to cool water during high air conditioning load periods, and melting the ice to provide an additional source of cooled water.

7. The method of providing refrigeration for an air conditioning system having a varying heat load which comprises evaporating a refrigerant in one cooling coil at relatively low temperatures to freeze water during low air conditioning load periods, evaporating a refrigerant in a second separately fed cooling coil at relatively high temperatures to cool water during high air conditioning load periods, and further cooling the water during high air conditioning load periods by melting the ice.

8. The method of providing refrigeration for an air conditioning system having a varying heat load which comprises evaporating a refrigerant at relatively low temperatures to freeze ice during low air conditioning load periods, evaporating a refrigerant at relatively high temperatures to cool air, and melting said ice during high air conditioning periods to condense a portion of the refrigerant evaporated to cool the air.

9. The method of absorbing heat from a source having a widely varying load factor which comprises evaporating a refrigerant to freeze a liquid during low heat load periods, evaporating a refrigerant at a temperature greater than the freezing temperature of said liquid by absorbing heat from said source during high heat load periods, and melting the frozen liquid to augment the heat absorption secured by the second evaporation step.

10. The method of providing refrigeration for absorbing heat from a source having a widely varying heat load factor which comprises evaporating a refrigerant in a first circuit to freeze a liquid during low heat load periods, evaporating refrigerant of the same character in a second circuit at a temperature greater than the freezing temperature of said liquid to absorb heat during high heat load periods, and melting the frozen liquid to augment the cooling effect secured by refrigerant evaporation in the second circuit, said first and second circuits being in parallel arrangement.

11. The method of absorbing heat from a source having a widely varying load factor which comprises evaporating a refrigerant in a first circuit to freeze ice during low heat load periods, evaporating a refrigerant in a second refrigerant circuit to cool water during high heat load periods, melting the ice during high air conditioning load periods, mixing the resulting cold water with the water cooled by evaporation of refrigerant in the second refrigerant circuit, and utilizing the mixture to absorb heat from the source.

12. The method of providing refrigeration for an air conditioning system having a varying heat load which comprises evaporating at a relatively low temperature a refrigerant from a central source of supply to store up refrigeration effect during low air conditioning load periods, evaporating at a relatively high temperature refrigerant from the same source during high air conditioning load periods to cool air, and drawing upon the stored refrigeration to assist in cooling said air during high air conditioning load periods.

13. In an apparatus for cooling the atmosphere of an enclosure having a varying heat load, a conditioning unit, air cooling means in said unit, a

storage tank in which water is adapted to be frozen, means separate from the air cooling means for cooling water in said ice storage tank below the freezing point, means including a refrigerating machine of lesser capacity than the capacity of said conditioning unit for supplying refrigeration during high air conditioning load periods to said air cooling means only, and means operative responsive to a drop in suction pressure below a predetermined point for supplying refrigeration, during low air conditioning load periods, to said water cooling means in said tank, and means for utilizing the water from said tank to augment the capacity of said air cooling means.

14. In an air conditioning system having a varying heat load, a first evaporator normally receiving refrigerant supplied thereto at a relatively high suction pressure, a second evaporator for freezing water normally receiving refrigerant supplied thereto at a relatively low suction pressure, means for supplying refrigerant to said first evaporator during high air conditioning load periods and means operative when the suction pressure is below a predetermined point for supplying refrigerant to said second evaporator during low air conditioning load periods, and means for utilizing the refrigerating effect of said frozen water to augment the cooling capacity of said first evaporator.

15. In an air conditioning system, a freezing chamber, means for freezing water in said freezing chamber during low air conditioning load periods, a water cooling chamber, means for cooling water in said cooling chamber during high air conditioning load periods, and means for melting the ice in said freezing chamber to augment the capacity of the cooling means in said water cooling chamber.

16. The method of providing refrigeration for an air conditioning system having a varying heat

load which comprises evaporating refrigerant at a relatively low temperature in one expansion chamber to store up refrigeration effect during low air conditioning load periods, evaporating refrigerant of the same character at a relatively high temperature in another expansion chamber to cool air during high air conditioning load periods, and drawing upon the stored refrigeration to assist in cooling said air during high air conditioning load periods.

17. In combination, a compartment to be cooled, a refrigerant liquefying unit, means for operating said unit, a refrigerant evaporator in refrigerant flow relationship with said unit and having means for cooling air for said compartment, a holdover tank, holdover in said tank, an evaporator in thermal exchange relationship with said holdover and in refrigerant flow relationship with said unit, and means for circulating holdover from said tank in thermal exchange with air for said compartment.

18. In an air conditioning system for an enclosure having a varying heat load an air cooling apparatus containing an air cooling evaporator, a freezing tank, a water freezing evaporator in said freezing tank, a refrigerating machine, means for supplying refrigerant from said machine to said water freezing evaporator during low air conditioning load periods, means for supplying refrigerant from said machine to said air cooling evaporator during high air conditioning load periods, and means for supplying cold water from said freezing tank to augment the refrigerating effect of said air cooling evaporator during high air conditioning load periods when the load in the enclosure exceeds a predetermined peak.

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