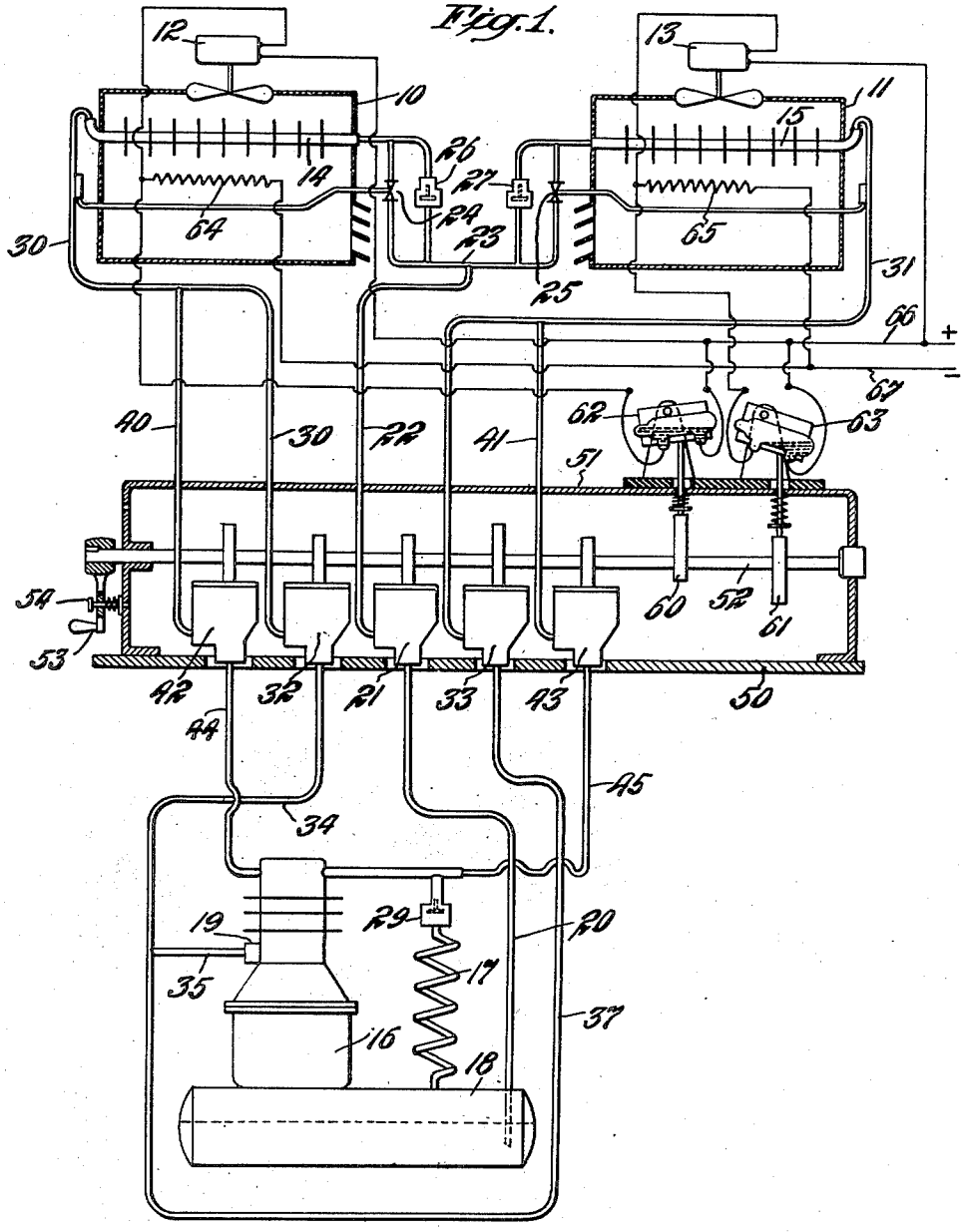
Jan. 31, 1950 S. M. BÄCKSTRÖM 2,496,143

REFRIGERATION APPARATUS

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2 Sheets-Sheet 1

Fig. 1.



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Fig. 2.

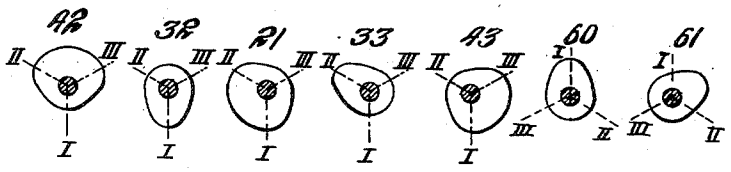
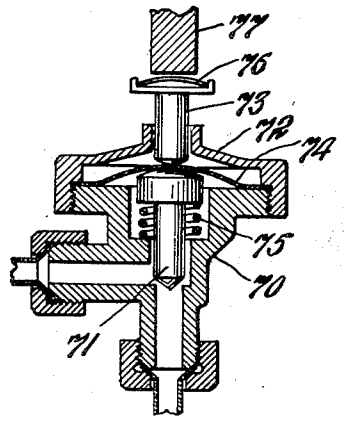


Fig. 3.



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REFRIGERATION APPARATUS

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24 Claims. (Cl. 62—3)

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My invention relates to an arrangement in compressor refrigerating machines of the kind in which the operation of the plant is regulated by reversing two or more paths of flow for the refrigerant, and has for its object to simplify the attendance of the plant and eliminate the possibility of the paths of flow being incorrectly reversed in a manner injurious to the plant.

In compressor-operated refrigerating plants of both small and large capacity it often happens that paths of flow for the refrigerant need, for different reasons, to be changed. This is generally the case, when an evaporator is to be defrosted. In this case it is the common practice to reverse the plant in such a manner that warm refrigerant vapours flow into the ice-coated evaporator, whereas the refrigerant condensed thereby is supplied to another evaporator or is evaporated in any other way in other members intended for said purpose. In most refrigerating plants of this type it is, however, necessary, for effecting the change, to reverse a plurality of regulating members, generally in the form of valves. In this case it may happen that the operator forgets to reverse one or more valves of this kind or reverses one of them incorrectly, if for example, the same valve controls a plurality of paths of flow. Such incorrect reversals may have serious consequences, as for instance, liquid refrigerant should not generally be allowed to be sucked into the compressor. The reversal may also have for its consequence that the production of cold in a certain cooling element intended for example, to cool a space filled with goods is unintentionally stopped, thus destroying the goods. According to the invention all these drawbacks are eliminated due to the fact that all members required for the reversal of two or more paths of flow, possibly together with electric connecting members for heat-regulating elements, fans or the like, are connected to a common actuating member which forces each of the reversing or regulating members respectively into the position required for obtaining the desired combination of paths of flow.

The invention will be described in further detail with reference to the embodiment shown in the accompanying drawings for which also other characteristic features of the invention will be seen.

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Fig. 1 shows diagrammatically a refrigerating plant in which the arrangement according to the invention is used.

Fig. 2 shows a number of details of the actuating member according to Fig. 1, and Fig. 3 shows likewise diagrammatically a valve suited to arrangements of this kind.

In Fig. 1, 10 and 11 designate two cooling elements intended to cooperate with fans 12 and 13. Each cooling element contains an evaporator coil 14 and 15 fed from a compressor 16 of a kind known per se. The condenser of the machine is designated by numeral 17. A container for liquid refrigerant (receiver) is designated by 18, and a connecting member on the suction side by 19. From the container 18 liquid refrigerant is supplied through a conduit 20, a valve 21 and a conduit 22 to a branching point 23 from which the two evaporators 14 and 15 are fed by way of thermostatic expansion valves 24 and 25, both of a kind known per se. In parallel to the expansion valves 24 and 25 there are arranged check valves 26 and 27. A check valve 29 is also connected to the condenser circuit. The evaporators 14 and 15 respectively are connected by a conduit 30, a valve 32, a conduit 34 and a conduit 35, a conduit 31, a valve 33, a conduit 37 and the conduit 35, to the suction side of the compressor. The above-mentioned part of the plant is formed in a manner known per se, and functions as a refrigerating compressor with two evaporators connected in parallel.

To the conduits 30 and 31 there are connected conduits 40 and 41 respectively which, through the medium of valves 42 and 43 and conduits 44 and 45, supply under certain conditions warm refrigerant vapours from the pressure side of the compressor to the evaporator 14 and 15. The introduction of such high-pressure vapour has for its object to effect defrosting. All valves 42, 32, 21, 33 and 43 serve for the reversal of the paths of flow for refrigerant condensate or refrigerant vapours, respectively. For allowing the plant to function in the desired manner, not only should said valves be adjusted to certain determined positions, some to closed positions, other to open positions, but said positions should generally be taken up in a certain order. The reversal of the valves is therefore positively controlled. The valves are mounted on a common

plate, rail or the like 50, over which a bracket 51 is arranged. In this bracket a shaft 52 is journalled. The shaft may, by a crank, hand wheel or the like 53, be turned a certain number of degrees. Preferably the hand wheel or the crank should be provided with a stopping device 54 of a kind known per se which maintains the crank in the position desired in each special case, so that it cannot be unintentionally displaced. The crank is adapted to be locked fast in three positions with an angular displacement of about 120°. These three positions correspond to three connecting positions I, II and III, namely defrosting the evaporator 14, defrosting the evaporator 15 and normal working of the evaporators. The table below indicates the positions of the different valves in the three connecting phases referred to. In the table O means open valve, and C closed valve.

	When defrosting the system 10, 14	When defrosting the system 11, 15	Normal working without defrosting
Valve controlled by disc 42	O	C	C
Valve controlled by disc 43	C	O	C
Valve controlled by disc 32	C	O	O
Valve controlled by disc 33	O	C	O
Valve controlled by disc 21	C	C	O
Fan 13 controlled by disc 61	Running	Standing still	Running.
Fan 12 controlled by disc 60	Standing still	Running	Running.

As appears from the table, however, it is not only the valves that are governed by the cam shaft 52, there being arranged on said shaft further control discs 60 and 61 which control two mercury switches 62 and 63 of a kind known per se. These switches are connected in parallel with the fans 12 and 13 in such a manner, that, when they are closed, the fans are short-circuited. Heating bodies 64 and 65 are connected in series with the fans. When a source of current is connected to the two terminals 66, 67 of the plant, a current flows, in the position of the switches shown, on the one hand through the fan 13 and the heating body 65, and on the other hand through the switch 62 and the heating body 64. This means that the heating body 64 stands practically under full voltage, whereas the voltage is divided on the fan 13 and the heating body 65. The resistance of the heating bodies is, however, so slight in comparison with the resistance of the associated fan that, when the latter is connected in series with a heating body, only a slight part of the voltage is taken up by the heating body. The development of heat in the latter will therefore be slight under said conditions. When the cam shaft 52 is turned into position II, so that the switch 62 is opened and the switch 63 closed, the same conditions will apply to the fan 12 and the heating body 64 as those described with regard to the fan 13 and the heating body 65. In other words, when the evaporator 14 is on a defrosting cycle the fan 12 is stopped and heating element 64 is energized to the extent that this heating element supplies external heat to this evaporator. This heat, together with the heat from the hot vapors flowing into this evaporator, hastens the defrosting of this evaporator. Likewise, when the evaporator 15 is being defrosted, fan 13 is stopped and heating element 65 is energized to the extent that this heating element supplies external heat to evaporator 15. In the third position of the cam shaft both switches 62 and 63 are open, both fans 12 and 13 thus functioning.

The control discs on the cam shaft 52 may be of different shapes and may be constructed in different manners. It is, however, not usually sufficient to impart to them the form of circular eccentric discs as due to this, the various positions will not be sufficiently clearly defined. In the embodiment shown the discs have thus the shape shown in Fig. 2. The Roman figures I, II and III indicate the three points which should be directed downward in the three respective positions of the cam shaft.

The action of the control discs on the valves is effected by means of a special transmitting member, as shown in Fig. 3. This figure shows diagrammatically a longitudinal section of such a valve. The valve box is designated by numeral 70, the valve needle by 71 and the cover of the valve box by 72. In this cover there is journalled a plunger 73 which rests on an upwardly arched resilient diaphragm 74 bearing against the correspondingly shaped upper part of the valve needle and through which the valve is hermetically sealed. The valve is biased toward open position by a spiral spring 75. When the corresponding control disc designated by numeral 77 is in such a position that it exerts a pressure on the plunger 73 and thereby, through the medium of the diaphragm 74, on the valve needle 71, the valve is forced into closed position. Generally, considerable power is needed for closing the valves. For this reason different resilient elements are provided which cooperate in such a manner that, on the one hand, the valve will always, at each reversal, be subjected to a sufficient pressure and that, on the other hand, all valves, to be closed in a certain adjusted position of the cam shaft are actually given the necessary pressure on the valve needle. This may obviously be obtained by different spring devices producing the necessary resiliency of the plunger 73. It has been proven advantageous to impart to the spring member the form of an arched plate 76 against which the respective control disc is pressed. A plane spring of this kind, which may suitably be circular, may be given very satisfactory resilient properties. Said spring may in certain cases be composed of a plurality of individually resilient layers, possibly of different material. It is advantageous that the layer bearing against the control disc is made of a hard material resistant to wear. It is naturally most advantageous that this material at the same time possesses the required resilient properties, but any deficiencies in this respect may be easily compensated by a suitable selection of material for the underlying spring layer.

The invention is not limited to the embodiment shown, but may be varied in a plurality of ways, without departing from the spirit of the invention. Thus, the shape of the control discs may be varied in several ways, and be adjusted to the kind of valves which are used in different cases. When two-way or multi-way valves are used, the control discs must naturally be adjusted accordingly. Especially in large plants or in plants

working with high pressure it may be advantageous to replace the valves by magnet valves, the control discs being replaced by electric contact devices or being adapted to cooperate with such devices which, in turn, break and make the circuit by means of the magnet device of the valves.

The electric equipment of the plant may also be varied in many ways. It is thus not always advantageous to connect in series the electric heating bodies with respective fans. In such case separate circuits must generally be arranged for the fan and heating bodies, each circuit of said kind being equipped with switches controlled by the actuating member 52, 53.

What I claim is:

1. A refrigerating system comprising a number of parts including a compressor, a condenser, an evaporator, means including a conduit connecting said condenser and said evaporator for conducting liquid refrigerant to said evaporator, means including a conduit connecting said evaporator and said compressor for conducting cold refrigerant vapor to said compressor, means including a conduit connecting said compressor and said evaporator for conducting hot refrigerant vapor to said evaporator, a control means in each of said conduits, and regulating means having only a single manually operable control member for substantially simultaneously actuating all of said control means.

2. A refrigerating system comprising a number of parts including a compressor, a condenser, an evaporator, means including a conduit connecting said condenser and said evaporator for conducting liquid refrigerant to said evaporator, means including a conduit connecting said evaporator and said compressor for conducting cold refrigerant vapor to said compressor, means including a conduit connecting said compressor and said evaporator for conducting hot refrigerant vapor to said evaporator, valve means in each of said conduits, and regulating means having only a single manually operable control member for substantially simultaneously actuating all of said valves.

3. A refrigerating system comprising a number of parts including a compressor, a condenser, an evaporator, means including a conduit connecting said condenser and said evaporator for conducting liquid refrigerant to said evaporator, means including a conduit connecting said evaporator and said compressor for conducting cold refrigerant vapor to said compressor, a valve in each of said conduits, means including a fan for causing air to flow over said evaporator to be cooled thereby, a heating element for heating said evaporator, and a common actuating means for substantially simultaneously actuating all of said valves and for selectively controlling the energization of said fan and said heating element.

4. A refrigerating system comprising a number of parts including a compressor, a condenser, an evaporator, means including a conduit connecting said condenser and said evaporator for conducting liquid refrigerant to said evaporator, means including a conduit connecting said evaporator and said compressor for conducting cold refrigerant vapor to said compressor, means including a conduit connecting said compressor and said evaporator for conducting hot refrigerant vapor to said evaporator, a valve in each of said conduits, means including a fan for causing air to flow over said evaporator to be cooled thereby, a heating element for heating said evaporator,

and a common actuating means for substantially simultaneously actuating all of said valves and for selectively controlling the energization of said fan and said heating element.

5. A refrigerating system including a compressor, a condenser, a plurality of evaporators, means connecting said condenser to said evaporators, for flow of liquid refrigerant to said evaporators, means connecting said evaporators, and said compressor for flow of refrigerant vapor to said compressor, means connecting said compressor and said evaporators for flow of refrigerant vapor to said evaporators, valves in said connecting means, and a common control mechanism for substantially simultaneously actuating said valves, the aforesaid connecting means associated with said evaporators including provisions to enable liquid refrigerant to flow from one to another of said evaporators, the construction and arrangement being such that with one adjustment of said control mechanism liquid refrigerant flows from said condenser to said evaporators and vaporous refrigerant flows from said evaporators to said compressor, and with a second adjustment of said control mechanism hot refrigerant vapor flows from said compressor to said one evaporator wherein said vapor is condensed, the latent heat of condensation is utilized to melt accumulated frost from said one evaporator and the liquefied refrigerant flows from said one evaporator into said other evaporator.

6. A refrigerating system including a compressor, a condenser, a pair of evaporators, means connecting said condenser to said evaporators for flow of liquid refrigerant to said evaporators, means connecting said evaporators and said compressor for flow of refrigerant vapor to said compressor, means connecting said compressor and said evaporators for flow of refrigerant vapor to said evaporators, valves in said connecting means, and a common control mechanism for substantially simultaneously actuating said valves, the aforesaid connecting means associated with said evaporators including provisions to enable liquid refrigerant to flow from either one of said evaporators to the other evaporator, the construction and arrangement being such that with a first adjustment of said control mechanism liquid refrigerant flows from said condenser to said evaporators and vaporous refrigerant flows from said evaporators to said compressor, and with second and third adjustments of said control mechanism hot refrigerant vapor flows from said compressor selectively to either one of said evaporators wherein said vapor is condensed, the latent heat of condensation is utilized to melt accumulated frost from said one evaporator and the liquefied refrigerant flows from said one evaporator into the other of said evaporators.

7. A refrigerating system including a compressor, a condenser, a pair of evaporators, means connecting said condenser to said evaporators for flow of liquid refrigerant to said evaporators, means connecting said evaporators and said compressor for flow of refrigerant vapor to said compressor, means connecting said compressor and said evaporators for flow of refrigerant vapor to said evaporators, valves in said connecting means, circulating means for causing air to flow over said evaporators, and a common control mechanism for substantially simultaneously actuating said valves and for controlling said air circulating means, the aforesaid connecting means associated with said evaporators including provisions to enable liquid refrigerant to flow from

one to another of said evaporators, the construction and arrangement being such that for one adjustment of said control mechanism liquid refrigerant flows from said condenser to said evaporators, vaporous refrigerant flows from said evaporators to said compressor and air is caused to flow over said evaporators, and with a second adjustment of said control mechanism hot refrigerant vapor flows from said compressor to said one evaporator wherein said vapor is condensed, the latent heat of condensation is utilized to melt accumulated frost from said one evaporator, the liquefied refrigerant flows from said one evaporator into said other evaporator and air is caused to flow only over said other evaporator.

8. An air conditioning system comprising a number of parts including a cooling element, means including piping for conducting liquid refrigerant to the inlet of said cooling element, means including a fan to cause air to flow over said cooling element to be cooled thereby, means for applying heat to said cooling element to melt accumulated frost therefrom, valve means of a non-modulating type connected in said piping which is only operable independently of conditions existing in the system, and a single control means so constructed and arranged that when set in one position said valve means is open to enable liquid refrigerant to be conducted to said cooling element and said fan is energized, and when set in another position said valve means is closed to stop the supply of liquid refrigerant to said cooling element and heat is applied to said cooling element and said fan is deenergized.

9. An air conditioning system comprising a number of parts including a cooling element, means for conveying liquid refrigerant to said cooling element, means including a fan to cause air to flow over said cooling element to be cooled thereby, means for applying heat internally and externally to said cooling element to melt accumulated frost therefrom, and a single control means so constructed and arranged that when set in one position liquid refrigerant is conveyed to said cooling element and said fan is energized, and when set in another position heat is applied both internally and externally of said cooling element and said fan is deenergized.

10. An air conditioning system including a plurality of cooling elements, means for conveying liquid refrigerant to said cooling elements, means including fans for causing air to flow over said cooling elements to be cooled thereby, means for applying heat to said cooling elements to melt accumulated frost therefrom, and a single control means so constructed and arranged that when set in one position liquid refrigerant in the system is conveyed to one of said cooling elements, the fan causing air to flow over this one cooling element is energized, heat is applied to another of said cooling elements and the fan normally causing air to flow over this other cooling element is deenergized.

11. An air conditioning system including a plurality of cooling elements, means for conveying liquid refrigerant to said cooling elements, means including fans for causing air to flow over said cooling elements to be cooled thereby, means for applying heat internally and externally to said cooling elements to melt accumulated frost therefrom, and a single control means so constructed and arranged that when set in one position liquid refrigerant in the system is conveyed to one of said cooling elements, the fan causing air to flow over this one cooling element is energized, heat is applied both internally and externally to another of said cooling elements and the fan normally causing air to flow over this other cooling element is deenergized.

12. An air conditioning system including a plurality of cooling elements, conduits for conveying liquid refrigerant to said cooling elements to be vaporized therein and produce refrigeration, means for causing air to flow over said cooling elements to be cooled thereby, connecting means for selectively conveying vaporous refrigerant to any one of said cooling elements to be condensed therein and the latent heat of condensation utilized to defrost said cooling elements, means for conveying liquefied refrigerant formed in any one of said cooling elements to another of said cooling elements, and a control mechanism, said control mechanism including means so constructed and arranged that when adjusted to one position liquid refrigerant is conveyed to said cooling elements and air is caused to flow over said cooling elements, and when adjusted to another position refrigerant vapor is selectively conveyed to one of said cooling elements wherein said vapor is condensed, liquid refrigerant is conveyed from said one cooling element to another of said cooling elements and air is caused to flow over said other cooling element.

13. An air conditioning system including a pair of cooling elements, means for conveying liquid refrigerant to said cooling elements, means including fans for causing air to flow over said cooling elements to be cooled thereby, means for applying heat to said cooling elements to melt accumulated frost therefrom, and a single control mechanism for controlling the operation of said system, said control mechanism being so constructed and arranged that when set in one position liquid refrigerant is conveyed to one of said cooling elements, the fan causing air to flow over this one cooling element is energized, heat is applied to the other of said cooling elements and the fan normally causing air to flow over this other cooling element is deenergized; when said control mechanism is set in a second position liquid refrigerant is conveyed to the other of said cooling elements, the fan causing air to flow over this other cooling element is energized, heat is applied to the first of said cooling elements and the fan normally causing air to flow over this first cooling element is deenergized; and when said control mechanism is set in a third position liquid refrigerant is conveyed to both of said cooling elements and both fans are energized.

14. In a refrigeration system comprising a number of parts including a compressor, a condenser, an evaporator having two sections, and connections for the aforementioned parts for supplying liquid refrigerant to both evaporator sections from said condenser to effect cooling, means embodied in the system for selectively supplying to one of said evaporator sections refrigerant in vapor phase to effect defrosting and for conducting liquid refrigerant formed as the result of such defrosting to the other of said evaporator sections to effect cooling, and means including a single movable member for controlling the last-mentioned means.

15. In a refrigeration system comprising a plurality of parts including a compressor, a condenser, a number of evaporators, and connections for the aforementioned parts for supplying liquid refrigerant to said evaporators from said condenser to effect cooling, means embodied in

the system to render said condenser inoperative and to selectively employ any one of said several evaporators as a condenser for supplying liquid refrigerant to another evaporator which continues to produce cooling effect, and control means having a single actuating member for controlling the last-mentioned means to operate said system with all evaporators producing cooling effect or with a particular selected evaporator serving as a condenser.

16. In a refrigeration system as set forth in claim 15 including circulating means to cause air to flow in thermal exchange relation with said evaporators, and heating means to effect heating of said evaporators, said control means being effective to render said heating means ineffective and said circulating means operable to cause air to flow in thermal exchange relation with said evaporators when the latter all are producing cooling effect, to render the heating means operable to effect heating of any evaporator when it is serving as a condenser, and to render said circulating means ineffective to cause flow of air in thermal exchange relation with any evaporator when serving as a condenser.

17. In a refrigerating system comprising a compressor, a condenser, several cooling elements, and connecting means for the aforementioned parts for normally circulating refrigerant therethrough to effect cooling by said cooling elements, means to modify said normal operation including piping associated with said connecting means providing paths of flow for conducting warm refrigerant vapor in the system to said cooling elements and for returning refrigerant therefrom to the low pressure side of said compressor in vapor phase, means including a plurality of controls embodied in said connecting means and piping movable to effect said normal operation or selectively flow warm refrigerant vapor to any one of the several cooling elements to effect said modified operation, and regulating means having only a single manually operable member for actuating said controls to effect said normal operation or one of several modified operations.

18. In a refrigerating system as set forth in claim 17 in which said means to modify said normal operation includes piping providing paths of flow for conducting warm refrigerant vapor from the high pressure side of said compressor to said cooling elements and for returning refrigerant to the low pressure side of said compressor in vapor phase from said cooling elements in paths of flow including another cooling element.

19. In a refrigerating system as set forth in claim 17 in which said means to modify said normal operation includes piping providing paths of flow for conducting warm refrigerant vapor from the high pressure side of said compressor to said cooling elements in which the vapor is condensed and the heat of condensation is utilized to cause melting of any frost accumulated thereon, and for returning refrigerant from said cooling elements to the low pressure side of said compressor in paths of flow including another of said cooling elements in which the condensed refrigerant vaporizes by heat abstracted from the surroundings before reaching said compressor.

20. In a refrigerating system comprising a compressor, a condenser, two cooling elements, and connecting means for the aforementioned parts for normally circulating refrigerant therethrough to effect cooling by said cooling elements, means to modify said normal operation including

piping associated with said connecting means providing a path of flow for conducting warm refrigerant vapor in the system to one of said cooling elements and a path of flow for returning refrigerant therefrom to the low pressure side of said compressor in vapor phase, means including a plurality of controls embodied in said connecting means and piping movable to effect said normal or modified operation, and regulating means having only a single manually operable member for actuating said controls to effect said normal or modified operation.

21. In a refrigerating system comprising a compressor, a condenser, two cooling elements, and connecting means for the aforementioned parts for normally circulating refrigerant therethrough to effect cooling by said cooling elements, means to modify said normal operation including piping associated with said connecting means providing a path of flow for conducting warm refrigerant vapor from the high pressure side of said compressor to one of said cooling elements and a path of flow including another of said cooling elements for returning refrigerant therefrom to the low pressure side of said compressor in vapor phase, means including a plurality of controls embodied in said connecting means and piping movable to effect said normal or modified operation, and regulating means having only a single manually operable member for actuating said controls to effect said normal or modified operation.

22. In a refrigerating system comprising a number of parts including a compressor, a condenser, a cooling element subject to formation of frost thereon, and connecting means therefor for normally circulating refrigerant in the system to effect cooling by said cooling element, means to modify said normal operation to effect defrosting of said cooling element including piping associated with said connecting means providing a path of flow for conducting warm refrigerant vapor from the high pressure side of the system to said cooling element in which the vapor is condensed in the act of melting frost thereon and for conducting such condensate to another part of the system communicating with the low pressure side of said compressor and in which vaporization of the condensate is effected, means including a plurality of controls embodied in said connecting means and piping movable to effect said normal or modified operation, and regulating means having only a single manually operable control member actuating said controls to effect said normal or modified operation.

23. In a refrigerating system comprising a number of parts including a compressor, a condenser, a cooling element, and connecting means therefor for normally circulating refrigerant in the system to effect cooling by said cooling element, means to modify said normal operation including piping associated with said connecting means providing a path of flow for conducting warm refrigerant vapor in the system to said cooling element and for conducting refrigerant therefrom to another part in the system, means including a plurality of controls embodied in said connecting means and piping movable to effect said normal or modified operation, and regulating means having only a single manually operable member for actuating said controls to effect said normal or modified operation.

24. In a refrigeration system comprising a number of parts including a compressor, a condenser, an evaporator subject to formation of frost thereon, and connections for the aforementioned parts

for normally supplying liquid refrigerant from said condenser to said evaporator to effect cooling, means embodied in the system to modify said normal operation and to supply warm refrigerant in vapor phase to said evaporator, especially when defrosting is desired, and regulating means having a single manually operable control member for controlling the last-mentioned means.

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