

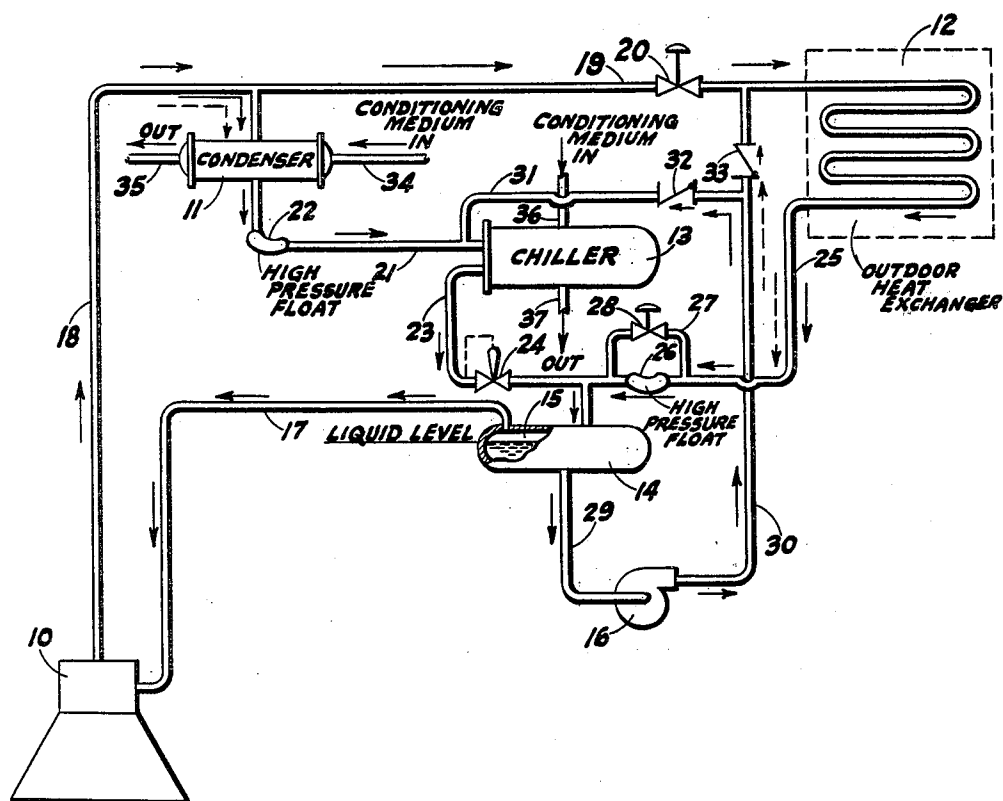
Nov. 5, 1963

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3,109,298

REFRIGERATING SYSTEMS

Filed April 2, 1962



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REFRIGERATING SYSTEMS

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Filed Apr. 2, 1962, Ser. No. 184,410
9 Claims. (Cl. 62—324)

This invention relates to refrigerating systems for heating and cooling conditioning medium to be supplied to an enclosure to be conditioned. The invention, more particularly, relates to a refrigerating system capable of concurrently supplying both heated and chilled conditioning mediums.

The system is characterized by simplicity of operation and low cost of installation.

In carrying out the invention, a refrigerating system comprising a compressor, a condenser, a chiller, an outdoor heat-exchanger, a surge drum, including a vapor space therein, and a refrigerant pump are provided, all inter-connected into a closed refrigerating circuit. From the compressor, refrigerant flows to the condenser, and, at times, also to the outdoor heat-exchanger. The condenser is inter-connected with the chiller by refrigerant piping, including a high pressure float therein. Refrigerant condensed in the condenser always flows to the chiller. The outdoor heat-exchanger is utilized both as a refrigerant condenser and as a refrigerant evaporator. Refrigerant is always supplied from the outdoor heat-exchanger to the surge drum, which is always a part of the low (pressure) side of the system. However, when the outdoor heat-exchanger is utilized as a condenser, then the refrigerant is supplied the surge drum via a second high pressure float. When the outdoor heat-exchanger is utilized as a refrigerant evaporator, then the refrigerant is supplied to the surge drum via a line bypassing the aforementioned second high pressure float. The refrigerant pump receives liquid from the surge drum, and pumps it to either the outdoor heat-exchanger, the chiller, or both simultaneously. The compressor is connected to the vapor space of the surge drum.

During a summer cycle of operation when the cooling load is greater than the heating load, hot refrigerant gas is supplied from the compressor to both the condenser and the outdoor heat-exchanger then functioning as a condenser, while, at the same time, the refrigerant pump pumps liquid received from the surge drum to the chiller.

During a winter cycle of operation, when the heating load is greater than the cooling load, then all the hot refrigerant gas is supplied from the compressor to the condenser. The refrigerant pump circulates liquid from the surge drum to the outdoor heat-exchanger, then functioning as a refrigerant evaporator. The mixture of refrigerant and gas then flows from the outdoor heat-exchanger to the surge drum from whence the liquid is recirculated to the outdoor heat-exchanger by the pump with the gas flowing to the compressor for supply to the condenser for utilization of the heat picked up therein.

The invention consists of the novel constructions, arrangements and devices to be hereinafter described and claimed. The following is a description of a preferred embodiment of the invention described with reference to the accompanying drawing, in which:

The FIGURE is a diagrammatic representation of a refrigerating system according to the invention.

In carrying out the invention, there are provided a compressor 10, a condenser 11, an outdoor heat-exchanger 12, a chiller 13, a surge drum 14, including a vapor space 15 therein, and a refrigerant pump 16. A refrigerant line 17 connects the vapor space 15 of surge drum 14 with the suction of compressor 10. A hot gas

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line 18 connects the discharge of compressor 10 to condenser 11. A hot gas line 19, including a two-way throttling valve 20 therein, is connected between hot gas line 18 and the outdoor heat-exchanger 12. A refrigerant liquid line 21, having a high pressure float 22 therein, connects condenser 11 to chiller 13. Refrigerant, in passing through high pressure float 22, has its pressure and corresponding temperature reduced, all as is well known in the art. A refrigerant line 23 connects the outlet of chiller 13 with surge drum 14. Line 23 has a pressure regulating valve 24 therein for purposes to be hereinafter brought out. A refrigerant line 25 is connected between heat-exchanger 12 and refrigerant line 23. Refrigerant line 25 has a high pressure float 26 therein. A bypass line 27, including a two-position valve 28 therein, is provided for bypassing high pressure float 26. High pressure float 26 functions, as does high pressure float 22, to reduce the pressure and corresponding temperature of any refrigerant passing therethrough. A refrigerant line 29 connects surge drum 14 with the suction of pump 16. A refrigerant line 30 is connected between refrigerant pump 16 and the heat-exchanger 12. A refrigerant line 31 is connected between refrigerant line 30 and refrigerant line 21 leading from condenser 11 to chiller 13, and has a one-way valve 32 therein. A one-way valve 33 is provided in refrigerant line 30 between its junction with lines 31 and 19. A line 34 is provided for leading a conditioning medium to be heated to condenser 11. The medium exits the condenser via a line 35. Similarly, a line 36 leads a conditioning medium to be chilled to chiller 13. The medium exits the chiller by way of a line 37.

Operation

Solid arrows indicate the flow of refrigerant during the summer cycle, which was herein-before defined as that time of year when the heating load of the enclosure to be conditioned is less than the heat available from the cooling load plus the heat of compression.

Dotted arrows indicate the flow of refrigerant during the winter cycle, which was herein-before defined as that time of year when the heating load of the enclosure to be conditioned is greater than the heat available from the cooling load plus the heat of compression.

Directional arrows on the refrigerant flow lines themselves indicate that the refrigerant flow takes place in the direction of the arrows, irrespective of the particular cycle the apparatus happens to be operating on.

Summer cycle.—During the summer cycle of operation, two-way valve 20 will be partially or fully open, permitting compressed refrigerant gas to flow from compressor 10 to heat-exchanger 12. At the same time, two-position valve 28 in bypass line 27 will be closed, forcing condensed refrigerant flowing from heat-exchanger 12 to surge drum 14 to flow through high pressure float 26. Since, by definition, more heat will be picked in the enclosure than can be utilized therein for heating purposes, it will be apparent that only a portion of the refrigerant compressed by compressor 10 will flow to condenser 11, with the remainder flowing to heat-exchanger 12. The heat in that portion of compressed refrigerant gas supplied to condenser 11 can be used for useful heating, while that in refrigerant supplied in heat-exchanger 12 must be dissipated by any suitable means, such as outside air. The rate of heat rejection from heat-exchanger 12 must be controlled so that sufficient heat is available to satisfy the heating load through condenser 11. The rate of heat rejection through heat-exchanger 12 can be controlled by 2-way throttling valve 20, or by any of the common methods of controlling condensing temperature (not shown) such as varying the air flow, backing up liquid in the condenser with bypass gas or liquid throttling valves, etc. Condenser 11

is, therefore, self-regulating since it only takes as much refrigerant gas as can be condensed by the conditioning medium supplied thereto. Refrigerant condensed in condenser 11 flows through line 21 to chiller 13, wherein it acts to remove heat from conditioning medium supplied to chiller 13 by way of line 36. In flowing through high pressure float 22, it has its pressure and corresponding temperature reduced. Refrigerant condensed in heat-exchanger 12 flows through line 25 to surge drum 14. In passing through high pressure float 26, the pressure and corresponding temperature of the refrigerant is reduced. From surge drum 14, refrigerant is picked up by refrigerant pump 16 and pumped by way of lines 30 and 31 to chiller 13, wherein it is also utilized for removing heat from the conditioned medium flowing through chiller 13, since insufficient refrigerant, by definition, is condensed in condenser 11 to carry the entire cooling load. Even though one-way valve 33 permits refrigerant flow therethrough in the direction of the refrigerant flow through line 30 from pump 16, it will be readily apparent that no refrigerant can flow therethrough to heat-exchanger 12 because of the high condenser pressure which exists on the downstream side of valve 33 as against the low pressure existing on the upstream side of the valve. From the chiller 13, a mixture of gas and liquid refrigerant flows through line 23 to surge drum 14. The refrigerant gas collects in vapor space 15 of surge drum 14 and flows therefrom via line 17 to compressor 10. Liquid refrigerant is recirculated through chiller 13 by pump 16. This, then, completes the summer cycle.

Winter cycle.—During the winter cycle, two-way valve 20 is closed and two-position valve 28 is open. All of the refrigerant compressed in compressor 10 then flows to condenser 11, since, by definition, the winter cycle is that time of the year wherein more heat is needed than is picked up from the enclosure to be conditioned. As in the summer cycle, refrigerant from condenser 11 flows directly to chiller 13. Since two-way valve 20 is closed, no refrigerant can flow from compressor 10 to heat-exchanger 12. However, liquid refrigerant picked up from surge drum 14 by pump 16 is pumped by way of line 30 to heat-exchanger 12. In heat-exchanger 12, the refrigerant picks up heat from the air flowing thereover, and a mixture of gaseous and liquid refrigerant then flows by way of line 25 and bypass line 27 to surge drum 14. From surge drum 14, the gaseous refrigerant flows to the suction of compressor 10 to be supplied to condenser 11 to provide the additional heat needed for the enclosure. Pump 16 is so sized as to supply more refrigerant to heat-exchanger 12 than can be evaporated therein, so that the tube surfaces may always be wetted.

During the winter cycle, pressure regulating valve 24 acts to throttle refrigerant flowing therethrough to maintain the pressure and corresponding temperature of refrigerant in the chiller sufficiently high so that no freeze-ups can occur therein.

Refrigerant flowing through line 30 from pump 16 generally will flow to heat-exchanger 12 rather than through one-way valve 32 to chiller 13, since the pressure existing in line 31 will generally be higher than that existing in heat-exchanger 12 because of the pressure drop through pressure regulating valve 24. There will, however, be times of the year when, even though the apparatus is on the winter cycle, the temperature will be sufficiently high such that there will be only a small pressure drop through pressure regulating valve 24. The fixed pressure across pump 16 may then raise the pressure of the refrigerant sufficiently high so that it will flow concurrently to heat-exchanger 12 and chiller 13. A two-position valve may be substituted for valve 32, illustrated as a check valve, if concurrent flow to both heat-exchanger 12 and chiller 13 is objectionable on certain applications.

It will be apparent that, although the embodiment shown

describes a single-stage compression system, the same basic principles can be applied to multi-stage compression systems. It will be further apparent that the specific refrigerant flow lines and valving arrangements shown for pumping refrigerant to the outdoor heat-exchanger and returning it therefrom to the surge drum may be varied to suit varying demands and requirements without departing from the scope of the invention. Still other changes will undoubtedly become apparent to those skilled in the art for modifying the specific embodiment shown without departing from the principles thereof. I, therefore, wish it to be understood that my invention is not to be limited to the specific constructions and arrangements shown and described, except only insofar as the claims may be so limited.

What is claimed is:

1. In a refrigerating system for heating and cooling a conditioning medium, a compressor; a condenser; an outdoor heat-exchanger; a chiller; a surge drum for receiving liquid and gaseous refrigerant, said surge drum including a vapor space therein; a refrigerant pump for receiving liquid refrigerant from said surge drum; refrigerant lines connecting said components into a closed refrigerating circuit, said compressor being connected with said vapor space of said surge drum; means for directing refrigerant from said compressor concurrently to said condenser and said outdoor heat-exchanger and from said pump to said chiller during a summer cycle when the cooling load is greater than the heating load; and means for directing refrigerant from said compressor to said condenser and from said pump to said outdoor heat-exchanger during a winter cycle when the heating load is greater than the cooling load.

2. In the refrigerating system as set out in claim 1, means for directing refrigerant from the condenser to the chiller and for reducing the pressure thereof; and means for directing refrigerant from the outdoor heat-exchanger to the surge drum and for reducing the pressure thereof during the summer cycle.

3. In the refrigerating system as set out in claim 2, means for directing refrigerant from the pump concurrently to the outdoor heat-exchanger and the chiller in the winter cycle.

4. In the refrigerating system as set out in claim 1, means for directing refrigerant from the pump concurrently to the outdoor heat-exchanger and the chiller in the winter cycle.

5. In a refrigerating system for heating and cooling a conditioning medium, a compressor; a condenser; an outdoor heat-exchanger; a chiller; a surge drum for receiving liquid and gaseous refrigerant, said surge drum including a vapor space therein; a refrigerant pump for receiving liquid refrigerant from said surge drum; refrigerant lines connecting said components into a closed refrigerating circuit, said compressor being connected with said vapor space of said surge drum; means for directing refrigerant from said condenser to said chiller; means for directing refrigerant from said chiller and said outdoor heat-exchanger to said surge drum; means for directing refrigerant from said compressor concurrently to said condenser and said outdoor heat-exchanger, and from said pump to said chiller during a summer cycle when the cooling load is greater than the heating load; and means for directing refrigerant from said compressor to said condenser, and from said pump to said outdoor heat-exchanger during a winter cycle when the heating load is greater than the cooling load.

6. In a refrigerating system for heating and cooling a conditioning medium, a compressor; a condenser; an outdoor heat-exchanger; a chiller; a surge drum for receiving liquid and gaseous refrigerant, said surge drum including a vapor space therein; a refrigerant pump for receiving liquid refrigerant from said surge drum; refrigerant lines connecting said components into a closed refrigerating circuit, said compressor being connected with said vapor

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space of said surge drum; means for directing refrigerant from said condenser to said chiller and for reducing the pressure thereof; means for directing refrigerant from said chiller and said outdoor heat-exchanger to said surge drum; means for reducing the pressure of refrigerant flowing from the outdoor heat-exchanger to the surge drum; means for bypassing the last mentioned pressure reducing means; means for directing refrigerant from said compressor concurrently to said condenser and said outdoor heat-exchanger, and from said pump to said chiller during a summer cycle when the cooling load is greater than the heating load; means for directing refrigerant from said compressor to said condenser, and from said pump to said outdoor heat-exchanger during the winter cycle when the heating load is greater than the cooling load; and means for directing refrigerant flowing from the outdoor heat-exchanger to the surge drum through the last mentioned pressure reducing means during the summer cycle and through the bypass means during the winter cycle.

7. In the refrigerating system as set out in claim 5, means for directing refrigerant from the pump concurrently to the outdoor heat-exchanger and the chiller in the winter cycle.

8. A refrigerating system for heating and cooling a conditioning medium comprising a compressor; a condenser; a chiller; an outdoor heat-exchanger; a surge drum for liquid and gaseous refrigerant, said surge drum including a vapor space therein; a refrigerant pump; a refrigerant line connecting said vapor space of said surge drum with said compressor; a refrigerant line connecting the discharge of said compressor to said condenser; a refrigerant line connecting the discharge of said compressor to said outdoor heat-exchanger; a refrigerant line connecting said condenser to said chiller, said line including

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first refrigerant expansion means therein; a refrigerant line connecting said chiller to said surge drum; a refrigerant line connecting said outdoor heat-exchanger to said surge drum, said line including second refrigerant expansion means therein; a bypass refrigerant line around said second refrigerant expansion means; a refrigerant line connecting said surge drum to said refrigerant pump; a refrigerant line connecting said pump to said outdoor heat-exchanger; a refrigerant line connecting said pump to said chiller; means for directing refrigerant from said compressor concurrently to said condenser and said outdoor heat-exchanger and from said pump to said chiller during a summer cycle when the cooling load is greater than the heating load; means for directing refrigerant from said outdoor heat-exchanger through said second refrigerant expansion means to said surge drum during the summer cycle; means for directing refrigerant from said compressor to said condenser and from said pump to said outdoor heat-exchanger during a winter cycle when the heating load is greater than the cooling load; and means for directing refrigerant from said outdoor heat-exchanger and through said bypass line around said second refrigerant expansion means to said surge drum during the winter cycle.

9. The refrigerating system set out in claim 7 further including means for directing refrigerant from said pump concurrently to said outdoor heat-exchanger and said surge drum in the winter cycle.

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