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REFRIGERATING APPARATUS

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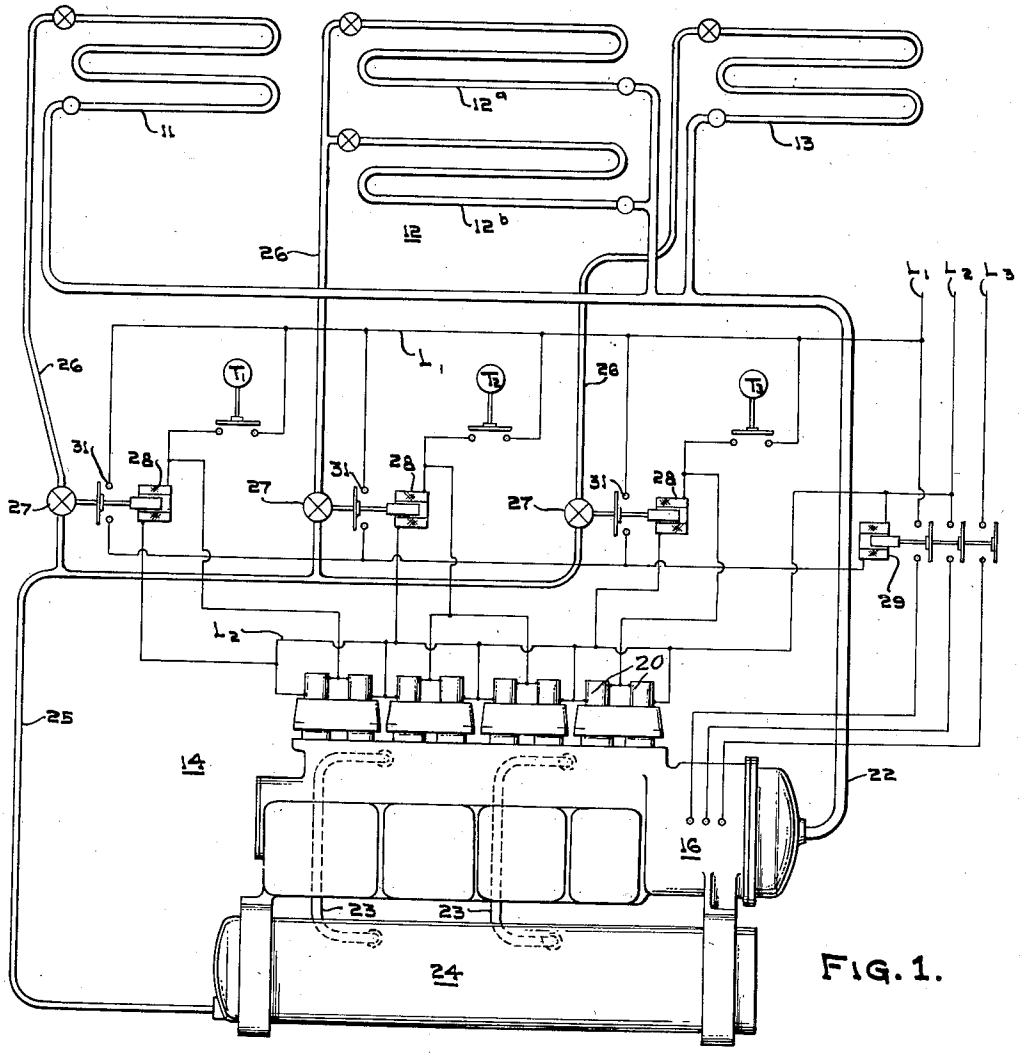


FIG. 1.

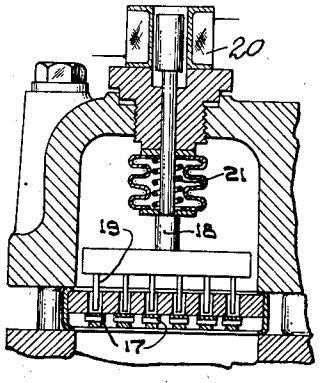


FIG. 2.

WITNESSES:

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REFRIGERATING APPARATUS

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11 Claims. (Cl. 62—4)

My invention relates to refrigerating apparatus, more particularly to refrigerating apparatus including a plurality of evaporators and a variable capacity compressor, and it has for an object to provide improved apparatus.

An object is to provide improved means for varying the compressor capacity in accordance with the capacity of the evaporators that are in operation.

In accordance with my invention, I associate with each evaporator a definite cylinder or group of cylinders of sufficient capacity to serve the evaporator, and I provide a control whereby the associated cylinder or cylinders are loaded when the evaporator is rendered effective and unloaded when the evaporator is rendered ineffective. Thus, the compressor capacity at all times substantially equals the evaporator capacity that is rendered effective, so that the suction pressure is maintained at a suitable value. A control is provided for at least one and preferably each evaporator whereby the same may be rendered effective or ineffective. Such control may comprise a thermostat or other instrument for automatically controlling the evaporator in accordance with the cooling demand on the evaporator. Provision is also made for operating the compressor when any evaporator is rendered effective and for shutting down the same when all the evaporators are rendered ineffective.

Fig. 1 is a diagrammatic view of refrigerating apparatus incorporating my invention; and

Fig. 2 is a detail sectional view showing the unloader.

Referring to the drawing in detail, I show an evaporator 11, an evaporator unit or group 12, comprising evaporators 12*a* and 12*b*, and an evaporator 13. The evaporators 12*a* and 12*b* serve a common cooling demand, are simultaneously controlled, and may be considered so far as the present invention is concerned, as one evaporator. The evaporators 11, 12 and 13 may serve independent cooling demands, or they may be arranged in any other desired manner. It is to be understood that the evaporators are illustrated diagrammatically on the drawing. They may be enclosed in suitable casings and provided with forced air circulation, all of which is well understood in the art and the illustration of which has been omitted in order to simplify the drawing and make the invention more apparent.

The motor compressor unit 14 includes a compressor having eight cylinders and a motor 16 for driving the same. Each cylinder is provided with any suitable form of unloader mechanism whereby the cylinder may be unloaded. One form of such mechanism is illustrated in Fig. 2, in which the suction valves 17 are held open for unloading the cylinder. The unloader mechanism includes a movable member 18 having fingers 19 adapted to engage the valves 17, a spring 21 adapted to bias the member 18 downwardly with sufficient force to hold the valves in open position for unloading, and a solenoid 20 adapted, when energized, to raise the movable member 18 and permit the valve 17 to close for loading the cylinder. It is to be understood that any other suitable unloader mechanism may be substituted without departing from the invention.

A suction conduit 22 connects the several evaporators to the motor compressor unit, and is preferably arranged to convey the vaporized refrigerant through the motor-containing portion of the casing.

The refrigerant compressed by the compressor is conveyed through conduits 23 to a combined condenser and receiver 24. From the latter, the condensed refrigerant is conveyed through a liquid line 25 and branch conduits 26 to the several evaporators.

The flow of liquid refrigerant to each evaporator is preferably controlled by a shut-off valve 27 in the branch conduit 26. Each evaporator is provided with suitable means for controlling the associated valve 27 in response to the cooling demand of the evaporator. Inasmuch as the evaporators 11, 12 and 13 of the present embodiment serve independent cooling demands, they are provided with thermostats T_1, T_2 and T_3, respectively, each thermostat being responsive to the temperature maintained at a low value by the evaporator. As will be apparent, each thermostat may be disposed in the enclosure cooled by the evaporator. Each thermostat controls its valve 27 through a solenoid 28, the latter being arranged to open the valve when it is energized and to close the valve when it is deenergized.

In the illustrated embodiment, the first two cylinders are associated with the evaporator 11, the next four cylinders are associated with the evaporator 12, the latter comprising twice as much surface as either of the other evaporators, and the last two cylinders are associated with the evaporator 13. Accordingly, the unloader solenoids 20 of the first two cylinders are connected in parallel with the solenoid 28 of the first evaporator, as will be fully apparent from the drawing. Similarly, the remaining unloader

solenoids 20 are connected in parallel with the solenoids 28 of the associated evaporators.

The motor 16 is supplied with electric current from line conductors L_1, L_2 and L_3, the supply being controlled by a starter coil or relay 29. Each of the solenoids 28 is adapted, when energized, to close a pair of contacts 31. The several contacts 31 are connected in parallel between the line conductor L_1 and the coil 29 so that energization of any one of the coils 28 energizes the coil 29 and closes the circuit to the compressor motor.

Operation

Assuming the temperature of the space or enclosure served by the evaporator 11 to increase above the value desired to be maintained therein, the thermostat T_1 closes its contacts, thereby energizing the solenoid 28 and the unloader solenoids associated therewith. The solenoid 28 opens the valve 27 to supply liquid refrigerant to the evaporator 11 and the unloader mechanisms operate to load the first two cylinders, thereby providing the amount of compressor capacity required for proper operation of the evaporator 11.

The solenoid 28 of the evaporator 11 also closes its contacts 31 for energizing the coil 29, so that current is supplied to the compressor motor and operation of the compressor is effected.

Similarly, if the space cooled by the evaporator unit 12 exceeds the predetermined value desired to be maintained therein, the thermostat T_2 closes its contacts, thereby supplying refrigerant to the evaporators 12*a* and 12*b* and loading the four intermediate cylinders. Likewise, the thermostat T_3 is adapted to effect admission of refrigerant to the evaporator 13 and to load the last two cylinders to serve the evaporator 13.

Each of the thermostats is adapted to open its contacts in response to a temperature supply below that at which it closes its contacts. The associated solenoid 28 is thereby deenergized and closes the valve 27 to terminate flow of liquid refrigerant to the associated evaporator. The associated unloader solenoids 20 are also deenergized so that the associated cylinders are unloaded.

Inasmuch as operation of each evaporator causes loading of the number of associated cylinders required to serve the evaporator, it will be apparent that the total number of cylinders that are loaded will have sufficient capacity to serve all of the evaporators that are rendered effective, that is, supplied with liquid refrigerant. One advantage is that the suction pressure is maintained at a sufficiently high value for efficient operation and to prevent frosting of the evaporators.

It will also be apparent that the motor compressor unit is operated whenever any thermostat closes its contacts to render the associated evaporators effective, and that the motor compressor unit is shut down when all of the evaporators are rendered ineffective by opening all of the thermostatic contacts.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

What I claim is:

1. A refrigerating system comprising a plurality of evaporators, a compressor comprising a plurality of compressor elements, a motor for driving said compressor, means associated with one evaporator for initiating and terminating flow of refrigerant thereto automatically in response to a load condition thereof and simultaneously therewith loading and unloading, respectively, one of said compressor elements.

2. A refrigerating system comprising a plurality of evaporators, a compressor comprising a plurality of compressor elements, a motor for driving said compressor, means associated with one evaporator for selectively rendering the same effective or ineffective, and means controlled by the last-mentioned means for loading and unloading one of said compressor elements when said one evaporator is rendered effective and ineffective, respectively.

3. In refrigerating apparatus, the combination of a plurality of evaporators, a compressor having a compressor element or elements associated with each evaporator, a motor for driving said compressor, and means associated with each evaporator for initiating and terminating flow of refrigerant thereto and for simultaneously loading and unloading, respectively, the associated compressor element or elements.

4. Apparatus as set forth in claim 3, and further including means for automatically energizing said motor whenever any evaporator is rendered effective and for deenergizing said motor when all evaporators are rendered ineffective.

5. In refrigerating apparatus, the combination of a plurality of evaporators, a compressor having a compressor element or elements associated with each evaporator, a motor for driving said compressor, a circuit associated with each evaporator and having means for selectively opening and closing the same, means controlled by each circuit for rendering the evaporator effective and ineffective and for loading and unloading the associated compressor element or elements upon closing and opening of the circuit, respectively.

6. In refrigerating apparatus, the combination of a plurality of evaporators, a compressor having a compressor element or elements associated with each evaporator, a motor for driving said compressor, automatic means associated with each evaporator for initiating and terminating flow of liquid refrigerant thereto in response to a load condition thereof and for simultaneously loading and unloading, respectively, the associated compressor element or elements, and means for automatically energizing said motor in response to the action of any of said automatic means in initiating flow of liquid refrigerant.

7. In a refrigerating system, the combination of a plurality of evaporator elements, a variable capacity compressor comprising a plurality of cylinders, a motor for driving said compressor, means associated with each evaporator and operable automatically in response to an operating condition thereof for rendering the evaporator effective and ineffective, means for varying the compressor capacity automatically in accordance with the total effective evaporator capacity by unloading one or more cylinders while another cylinder or cylinders are loaded, and means for automatically energizing said motor whenever any evaporator is rendered effective and for deenergizing said motor when all evaporators are rendered ineffective.

8. In a refrigerating system, the combination of a plurality of evaporators, a compressor having one or more compressor elements associated with each evaporator, means associated with each evaporator for automatically and simultaneously rendering both the associated compressor element or elements and the evaporator effective and ineffective in response to a cooling load condition of the evaporator, and means for automatically energizing said motor when any evaporator is rendered effective and deenergizing the same when all the evaporators are rendered ineffective.

9. In a refrigerating system, the combination of a plurality of evaporator elements, a multicylinder variable capacity compressor, a motor for driving said compressor, means associated with each evaporator for controlling the admission of liquid refrigerant thereto in response to a temperature maintained at a low value by the evaporator, and means operable automatically in response to the action of said controlling means for energizing and deenergizing said motor and for loading and unloading a cylinder or cylinders of the compressor to vary the compressor capacity in operation.

10. In a refrigerating system, the combination of a plurality of evaporator elements, a multicylinder variable capacity compressor, a motor for driving said compressor, means associated with each evaporator for automatically controlling the admission of liquid refrigerant thereto in response to a predetermined value of a physical condition established by the evaporator, means operable automatically to energize said motor when any control means operates to admit liquid refrigerant to the associated evaporator and for deenergizing said motor when no control means operates to admit liquid refrigerant to its associated evaporator, and means for loading and unloading a plurality of the cylinders of said compressor in response to the action of the several control means in such manner as to maintain the total compressor capacity in operation substantially proportional to the admission of liquid refrigerant to said evaporators.

11. In a refrigerating system, the combination of a plurality of evaporator elements, a variable capacity compressor comprising a plurality of cylinders, a motor for driving said compressor, means associated with each evaporator and operable automatically in response to a load condition thereof for controlling the admission of refrigerant thereto, and means operable automatically in accordance with the total demand of said evaporators for fluid translation to vary the capacity of said compressor by unloading one or more cylinders while another cylinder or cylinders are loaded, and means for automatically energizing said motor whenever any evaporator demands fluid translation and for deenergizing said motor when no evaporator demands fluid translation.

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