

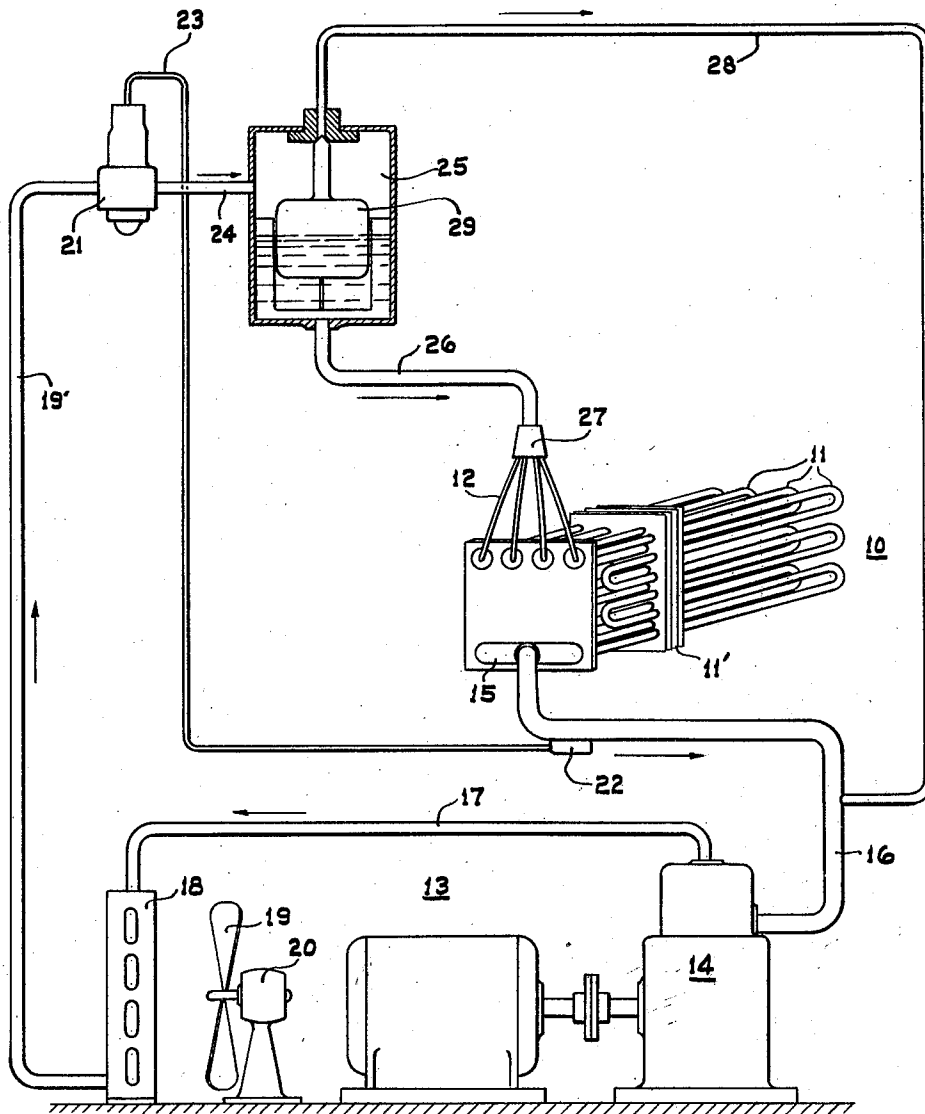
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COOLING APPARATUS

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WITNESSES:

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COOLING APPARATUS

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My invention relates to cooling or refrigerating apparatus, more particularly to refrigerating apparatus having a plurality of evaporator passages, and it has for an object to provide improved operation thereof.

A further object is to improve the distribution of liquid refrigerant to the several evaporator passages.

Another object is to increase the cooling effect of the evaporator passages.

In refrigerating apparatus of the mechanical compression type, as the pressure of the refrigerant is reduced for admission into the evaporator, a portion of the refrigerant is vaporized, thereby providing a mixture of liquid and vaporous refrigerant. Where an evaporator is employed having a plurality of passages arranged in parallel with respect to flow of refrigerant, difficulty is encountered in distributing the refrigerant to the evaporator passages in such manner that the several passages shall receive liquid and vaporous refrigerant in the same proportions. Also, the vaporous refrigerant has done most of its work in cooling the liquid refrigerant.

In accordance with my invention, I provide a separator between the expansion valve or other pressure-reducing means and the means for distributing refrigerant to the several evaporator passages. The vaporous refrigerant is separated and preferably returned to the inlet of the compressor, only liquid refrigerant being conveyed to the distributing means.

The above and other objects are effected by my invention as will be apparent from the following description and claims taken in connection with the accompanying drawing, forming a part of this application, in which:

The single figure is a diagrammatic view of apparatus embodying my invention.

Referring to the drawing in detail, I show an evaporator 10 comprising a plurality of coils 11, which are arranged in parallel with respect to flow of refrigerant. The fluid to be cooled is circulated in heat exchange relation with the coils, for example, air for an enclosure to be cooled may be conveyed by suitable means in contact with the several coils, flowing over the several coils in parallel or in series. The coils 11 are preferably provided with transversely-extending fins 11' to increase the air cooling surface. Capillary or flow-resistance tubes 12 are provided for distributing the refrigerant to the several coils. When the fluid to be cooled flows over the coils in parallel, these tubes are identical

and distribute refrigerant in equal quantities, while if the fluid to be cooled flows over the coil successively, the tubes 12 are proportioned to admit refrigerant in successively decreasing quantities in accordance with the respective capacities of the several coils.

The refrigerating or condensing unit, for supplying liquid refrigerant to the evaporator 10, is indicated generally by the reference numeral 13. It comprises a compressor 14 whose inlet is connected to the outlet 15 of the evaporator 10 by a suction conduit 16. The outlet of the compressor is connected by a conduit 17 to a condenser 18. The latter is cooled in any suitable manner, for example, a fan 19, driven by a motor 20 may be provided for circulating air over the condenser for cooling the same. The outlet of the condenser is connected through a conduit 19' with an expansion valve 21. The latter is preferably of the type known in the art as a thermostatic expansion valve, having a thermostatic bulb 22 responsive to the temperature of the refrigerant discharged from the evaporator through the suction conduit 16 and connected to the valve by a tube 23. This type of expansion valve regulates the flow of refrigerant so as to admit such quantity of liquid refrigerant to the evaporator as will be completely evaporated therein. It is to be understood, however, that any other device for reducing the pressure of the refrigerant may be employed.

The outlet of the expansion valve is connected through a conduit 24 to a separating chamber 25. The lower portion of this chamber is connected through a conduit 26 and a connection or fitting 27 to the inlet ends of the capillary tubes 12. The upper portion of the separating chamber 25 is connected through a conduit 28 to the suction conduit 16. A float valve 29 may be provided in the separating chamber 25 to restrict the escape of vaporous refrigerant to the conduit 28 if the level of liquid refrigerant rises in the chamber.

The operation of the above-described apparatus is as follows: Vaporized refrigerant is withdrawn from the evaporator by the compressor 14 and the compressed refrigerant discharged through conduit 17 to the condenser 18. It is condensed therein and conveyed through conduit 19' to the expansion valve 21 in which its pressure is reduced. As the pressure of the refrigerant is reduced, the boiling point or saturation temperature thereof is reduced below the temperature of the refrigerant, so that a portion of the refrigerant is vaporized in reducing

the temperature of the remaining liquid portion. The mixture of vaporous and liquid refrigerant flows through the conduit 24 into the separating chamber 25, the liquid refrigerant collecting in the bottom portion of the chamber and the vaporous refrigerant collecting in the upper portion of the chamber. The vaporous refrigerant flows through the conduit 28 to the suction conduit 16 through which it is returned to the compressor to be again compressed and recirculated, this portion of the refrigerant having effected substantially its share of cooling work in reducing the temperature of the liquid refrigerant.

The vaporous refrigerant having been separated, only liquid refrigerant flows through the conduit 26 and the connection 27 to the capillary tubes. Inasmuch as the fluid flowing into the several tubes is identical, said tubes distribute the refrigerant at all times in proportion to their flow capacities which, as stated above, may be identical or in successively-decreasing proportions, or which may be in any other desired proportions. As the liquid refrigerant flows through the several coils, it is vaporized by the extraction of the heat from the fluid being cooled and the vaporized refrigerant is discharged through the outlet 15 to the suction conduit 16 to be recirculated.

If desired, the float valve 29 may be provided in the chamber 25. As the level of liquid in the chamber tends to rise, the float valve reduces the flow of vaporous refrigerant into the conduit 28, thereby maintaining a substantially constant level of liquid in the chamber 25 and preventing the possibility of liquid refrigerant escaping through the conduit 28.

From the above description, it will be seen that I have provided an arrangement whereby refrigerant fluid of uniform character is supplied to the distributing means, so that refrigerant is supplied to the several evaporator coils or passages at all times in desired proportions. A further advantage of the above arrangement is that only liquid refrigerant which has capacity to absorb latent heat is admitted to the several coils, thereby increasing their effectiveness per unit area of cooling surface, the vaporized refrigerant which has done its work in cooling the liquid refrigerant by-passing the distributing means and the evaporator passages.

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. In refrigerating apparatus, the combination of a plurality of evaporator passages, means for compressing and condensing the vaporized refrigerant discharged from said evaporator passages, means for reducing the pressure of the liquid refrigerant from the last-mentioned means, means for distributing liquid refrigerant from the pressure-reducing means to the several evaporator passages, and for regulating the flow thereof in accordance with the quantity of liquid refrigerant that can be completely vaporized in the evaporator passages and means for separating the vaporized refrigerant between the pressure-reducing means and the distributing means and for mixing the same with the vapor-

ized refrigerant discharged from the evaporator passages before the latter is compressed.

2. In refrigerating apparatus, the combination of an evaporator, means for withdrawing vaporized refrigerant from said evaporator and providing a supply of liquid refrigerant, means for at least partially reducing the pressure of said liquid refrigerant thereby effecting partial vaporization thereof, a separating chamber communicating directly with said pressure reducing means so that substantially all of the liquid refrigerant leaving said pressure reducing means is delivered to said separating chamber in liquid state, means communicating with said separating chamber adjacent the bottom thereof for conveying liquid refrigerant from said separating chamber to the evaporator, means communicating with said separating chamber adjacent the top thereof for discharging vaporous refrigerant from the separating chamber, and means responsive to the liquid level within the separating chamber for controlling the discharge of vaporous refrigerant therefrom.

3. In refrigerating apparatus, the combination of a plurality of evaporator passages arranged in parallel with respect to flow of refrigerant, means for withdrawing vaporized refrigerant from said evaporator passages and providing a supply of liquid refrigerant, means for at least partially reducing the pressure of said liquid refrigerant thereby effecting partial vaporization thereof and for regulating the flow thereof in accordance with the quantity of liquid refrigerant that can be completely vaporized in the evaporator passages, means for distributing liquid refrigerant from the last-mentioned means to the several evaporator passages, and means for separating the vaporized refrigerant between the pressure-reducing means and the distributing means.

4. In refrigerating apparatus, the combination of a plurality of evaporator passages arranged in parallel with respect to flow of refrigerant, means for withdrawing vaporized refrigerant from said evaporator passages and providing a supply of liquid refrigerant, means for at least partially reducing the pressure of said liquid refrigerant thereby effecting partial vaporization thereof and for regulating the flow thereof in accordance with the quantity of liquid refrigerant that can be completely vaporized in the evaporator passages, means for distributing liquid refrigerant from the last-mentioned means to the several evaporator passages, and means for separating the vaporized refrigerant between the pressure-reducing means and the distributing means and returning the same to the first-mentioned means.

5. In refrigerating apparatus, the combination of means for supplying liquid refrigerant under pressure, expansion valve means for reducing the pressure of the refrigerant, an evaporator comprising a plurality of passages, means for distributing refrigerant to the several evaporator passages, a separator between the expansion valve means and the distributing means for separating the gaseous refrigerant from the liquid refrigerant, and means responsive to level of liquid refrigerant in the separator for controlling the discharge of gaseous refrigerant therefrom.

6. In refrigerating apparatus, the combination of a plurality of evaporator passages, means for withdrawing vaporized refrigerant from said evaporator passages and providing a supply of liquid refrigerant, means for at least partially

reducing the pressure of said liquid refrigerant thereby effecting partial vaporization thereof, flow-resistance tubes for distributing refrigerant to the several evaporator passages, and means for separating vaporized refrigerant between the pressure reducing means and the flow-resistance tubes, whereby only liquid refrigerant is delivered to the latter.

7. In refrigerating apparatus, the combination of a compressor, a condenser, an evaporator comprising a plurality of passages arranged in parallel with respect to flow of refrigerant, flow-resistance tubes for distributing refrigerant to the several passages of the evaporator, expansion valve means for at least partially expanding the refrigerant before admission to the flow-resistance tubes, and means for separating vaporized refrigerant between the expansion valve means and the flow-resistance tubes and for conveying said vaporized refrigerant to the inlet of the compressor, said vapor by-passing the flow-resistance tubes and the evaporator.

8. In refrigerating apparatus, the combination of a plurality of evaporator passages, means for compressing and condensing the vaporized refrigerant discharged from said evaporator passages, means for reducing the pressure of the condensed refrigerant thereby effecting partial vaporization thereof and for regulating the flow thereof in accordance with the quantity of liquid refrigerant that can be completely vaporized in the evaporator passages, a separating chamber receiving the liquid and vaporous refrigerant from said pressure-reducing means, a plurality of flow-resistance passages for distributing liquid refrigerant from the lower portion of said separating chamber to said evaporator passages, and means for removing vaporous refrigerant from the upper portion of said separating chamber and mixing the same with the vaporized refrigerant discharged from the evaporator passages before the latter is compressed.

9. In refrigerating apparatus, the combination of a plurality of evaporator passages for carrying a common cooling load, means for re-

moving vaporized refrigerant from said passages at substantially the same pressure and compressing the same, means for condensing the compressed refrigerant, means for reducing the pressure of the condensed refrigerant and controlling the flow thereof, means for separating the vaporized and the liquid refrigerant discharged from said pressure reducing means and mixing the former with the vaporized refrigerant discharged from said evaporator passages before the latter is compressed, means for distributing liquid refrigerant in predetermined proportions to said evaporator passages comprising passages of constant flow resistance, and means providing only liquid refrigerant from said separating means to said distributing means at the point at which the liquid refrigerant is divided among said evaporator passages.

10. In refrigerating apparatus, the combination of a plurality of evaporator passages for carrying a common cooling load, means for removing vaporized refrigerant from said passages at substantially the same pressure and compressing the same, means for condensing the compressed refrigerant, means for reducing the pressure of the condensed refrigerant and regulating the flow thereof in response to an operating condition of said evaporator passages so that all of the liquid refrigerant supplied thereto is vaporized before being discharged therefrom, means for separating the vaporized and the liquid refrigerant discharged from said pressure reducing means and mixing the former with the vaporized refrigerant discharged from said evaporator passages before the latter is compressed, means for distributing liquid refrigerant in predetermined proportions to said evaporator passages comprising restricted distributor passages of fixed flow resistance communicating with the respective evaporator passages, and means providing only liquid refrigerant from said separating means to said distributing means at the point at which the liquid refrigerant is divided among said distributor passages.

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