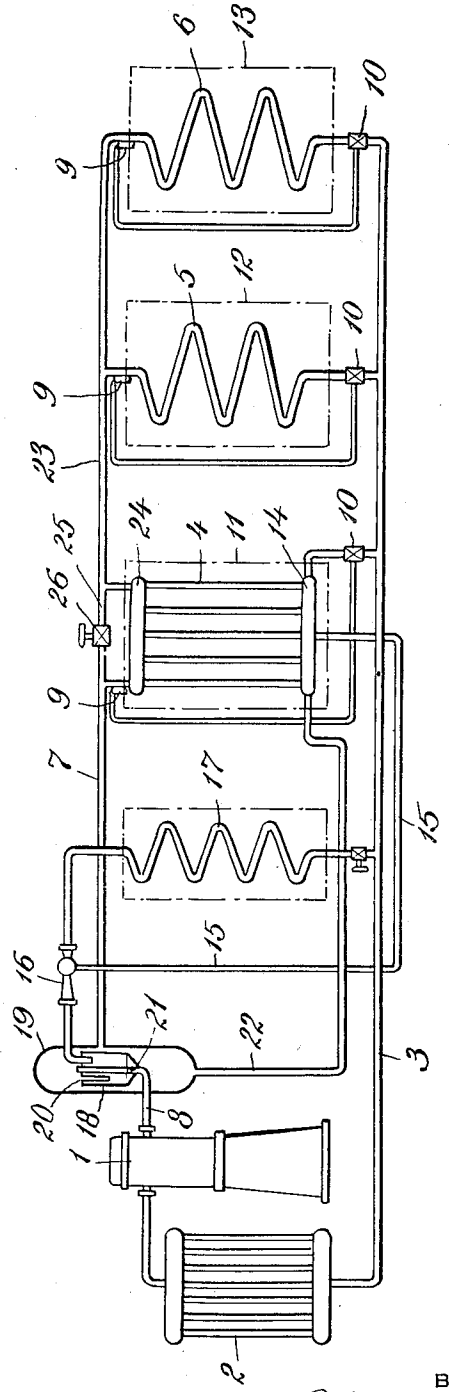
April 18, 1939. E. KÄGI 2,154,905

REFRIGERATING SYSTEM

Filed Dec. 2, 1936



INVENTOR.
Emil Kägi
BY
Pennie Davis Marvin & Edmonds
ATTORNEYS

Patented Apr. 18, 1939 2,154,905

UNITED STATES PATENT OFFICE

2,154,905

REFRIGERATING SYSTEM

Emil Kägi, Winterthur, Switzerland, assignor to Sulzer Frères Société Anonyme, Winterthur, Switzerland

Application December 2, 1936, Serial No. 113,785
In Switzerland December 26, 1935

8 Claims. (Cl. 62—115)

This invention relates to refrigeration and has for its object the provision of an improved apparatus and method for the return of oil from the evaporator to the compressor of a refrigerating system. It is a particular object of the invention to provide apparatus having an injector connected to means for accumulating lubricant separated from evaporated refrigerant and to a collector which is connected between the injector and the compressor, whereby lubricant is injected into the collector and admixed in regulated amounts with refrigerant before it enters the compressor.

The apparatus of the invention, in its more complete aspects, comprises a compressor and associated condenser means for providing a plurality of evaporators with liquid refrigerant, including an auxiliary evaporator, a flooded-evaporator (evaporator having an associated vessel in which refrigerant and lubricant accumulate), and one or more direct-acting evaporators, all of which are appropriately connected by conduit means. The apparatus includes an injector (jet actuated injector) and a collector so interconnected to the compressor and evaporators that lubricant separated from the refrigerant in the evaporators may be injected into the collector, wherein a desired quantity of lubricant may be admixed with the refrigerant returned to the compressor. The collector is so constructed and arranged that the excess lubricant and liquid refrigerant are returned to the flooded-evaporator. Moreover, means are provided, in association with the evaporators whereby oil and liquid which are entrained in the vaporized refrigerant leaving the direct-acting evaporators, may be returned to the flooded-evaporator.

It is advantageous to construct the direct-acting evaporators, which have no oil separator, so as to increase the speed of flow of the refrigerant in such a way that the oil contained in the refrigerant of the direct-acting evaporators is lead into the flooded-evaporator. The refrigerant from the flooded-evaporator, at least, can be led into the collector, from which the liquid portion thereof is conveyed back into the flooded-evaporator and the evaporated portion is conveyed to the compressor.

In accordance with the method of the invention, a portion of the condensed refrigerant is supplied to the auxiliary evaporator, wherein it evaporates and passes through the injector, thereby sucking accumulated lubricant from the vessel of the flooded-evaporator and charging it into the collector. In the collector, a part of the lubricant becomes admixed with, or incorporated in, the refrigerant in the desired amount, before it is directed into the compressor.

An example of a practical embodiment of apparatus in accordance with the invention is illustrated in the accompanying drawing. The compressor 1 pumps the refrigerant in the compressed state into the condenser 2, in which it is liquefied. The liquid refrigerant flows through the pipe 3, then to the flooded-evaporator 4 and to the direct-acting evaporators 5 and 6. After evaporation, the refrigerant passes to the compressor through pipes 7 and 8.

Each evaporator has a regulating device consisting of a feeler 9 and a throttle valve 10, which device, when the temperature of the refrigerant flowing from the evaporator rises, increases the amount of liquid flowing to the evaporator, and when the temperature falls, lessens the amounts of liquid. Each evaporator is mounted within a cooling chamber or space 11, 12 or 13 shown in dash-dot lines.

A portion of the liquid refrigerant flowing from the condenser 2 through pipe 3 enters the auxiliary evaporator 17, wherein it evaporates and passes into the injector 16. On the bottom of the vessel 14, the lubricant carried along by the refrigerant from the compressor accumulates, which lubricant is sucked by the injector 16 through the pipe 15. The oil conveyed by the injector 16 first passes into a vessel 18 of the collector 19 arranged in the suction line 7, 8. The vessel 18 has a slit 20 through which any liquid refrigerant that may possibly have been carried along can fall to the bottom of the collector 19. The pipe 8 has a small hole 21 therein just above the bottom of the vessel 18 and the separated lubricant passes through the hole in the desired amount and is admixed with the refrigerating vapors passing through the pipe 8 to the compressor. The liquid refrigerant collecting on the bottom of the collector flows back through the pipe 22 into the vessel 14 of the evaporator 4.

The evapofators 5 and 6 are so constructed that the refrigerant flowing through them attains a sufficient velocity to entrain the lubricant. At least, at starting, the refrigerant collecting in the pipe 23 flows into the vessel 24 of the evaporator 4. The greater part of the liquid refrigerant then remains behind in the evaporator 4, as does also the lubricant and only the evaporated refrigerant (under circumstances mixed with portions of the liquid refrigerant) can pass through

the pipe 7 to the collector 19. There any liquid that may have been carried along falls to the bottom, while only the evaporated part can be drawn by the compressor through the pipe 8.

The pipes 7 and 23 are also connected by a pipe 25, which contains a shut-off valve 26. During normal operation, the valve 26 may be open because then the evaporators 5 and 6 no longer convey liquid into the pipe 23. However, when an evaporator is started, it is necessary to close the valve in order to conduct the evolving liquid and the lubricant into the tank 24 of the evaporator 4.

In addition to the evaporators shown in the drawing, more evaporators may be connected to the refrigerating machine. The auxiliary evaporator may be used either separately for cooling purposes or along with another evaporator. The flooded-evaporator, which because of the pressure conditions has a somewhat smaller refrigerating output, may be used for a cooling chamber in which only a relatively smaller degree of refrigeration is required.

The collector in the suction line may have any desired form. The velocity of the refrigerant in the flooded-evaporator is to be controlled so that the oil and the liquid are not carried along or entrained. Instead of the regulating devices described for the individual evaporators, others also may be used, for example those which regulate in dependence on a pressure or in dependence on the room temperature, etc.

I claim:

1. Refrigerating apparatus comprising in combination, a compressor, at least one direct-acting evaporator, a flooded-evaporator, an auxiliary evaporator, means for providing each evaporator with liquid refrigerant from the compressor, means for admixing lubricant with the refrigerant from the evaporators and before it enters the compressor, and means for passing lubricant and liquid refrigerant separated from the vaporized refrigerant to the flooded-evaporator.

2. Refrigerating apparatus comprising in combination, a compressor, at least one direct-acting evaporator, a flooded-evaporator, an auxiliary evaporator, means for providing each evaporator with liquid refrigerant from the compressor, a collector, an injector, conduit means connecting the collector to the compressor and to the flooded-evaporator, and the injector to the collector, the auxiliary evaporator and the flooded-evaporator, and conduit means connecting the direct-acting evaporator to the collector, said collector being arranged to receive oil and refrigerant from the injector and to admix a desired quantity of oil with the refrigerant passing into the compressor.

3. In refrigerating apparatus the combination, comprising a compressor, a condenser connected by a pipe to the compressor, at least one evaporator connected to a pipe leading to the condenser adapted to receive liquid refrigerant directly therefrom, means for accumulating oil separated from refrigerant which passed to said evaporator, an auxiliary evaporator connected by the second mentioned pipe to the condenser, a collector connected by a pipe to the compressor, the evaporators and to the means for collecting oil, and means actuated by vapor from the auxiliary evaporator for charging the accumulated oil into the collector, said collector being arranged to admix oil in regulated amount with refrigerant and permit the mixture to pass into the compressor and to return the excess oil to the means for accumulating oil.

4. A refrigerating apparatus which comprises in combination a compressor, a condenser, a plurality of evaporators connected to the compressor, at least one of which is a flooded evaporator, an auxiliary evaporator in which a partial amount of the refrigerant is evaporated, conduit operatively interconnecting the compressor, condenser, evaporators, and auxiliary evaporator, and an injector connected by conduit with the flooded evaporator, the auxiliary evaporator and the compressor, said injector being adapted to suck oil from the flooded evaporator and pass it into the compressor.

5. Refrigerating apparatus which comprises in combination a compressor, a condenser connected to the compressor, at least one direct-acting evaporator, a flooded evaporator, an auxiliary evaporator, means for providing each evaporator with liquid refrigerant from the condenser, a collector, an injector, conduit means connecting the collector to the compressor, to the direct-acting evaporator and to the flooded evaporator, conduit means connecting the injector to the collector, and conduit means connecting the injector to the flooded evaporator and to the auxiliary evaporator, said collector being arranged to receive oil and refrigerant from the injector and to admix a desired quantity of oil with the refrigerant passing into the compressor.

6. The method of operating a refrigerating system which includes a compressor, a condenser and a plurality of evaporators, said method comprising withdrawing admixed liquefied refrigerant and lubricant from the condenser and supplying it to said plurality of evaporators, accumulating lubricant in one of the evaporators, utilizing the vapors from a different evaporator to entrain the lubricant accumulated in said one of the evaporators, collecting the vapors from the plurality of evaporators, mixing a predetermined quantity of lubricant in the collected vapors, and passing the resulting mixture of vapor and lubricant to the compressor.

7. The method of operating a refrigerating system including a compressor, a condenser, a flooded evaporator and an auxiliary evaporator, which comprises the steps of compressing refrigerant in the compressor and charging it into the condenser, thereby liquefying the refrigerant, conducting the liquefied refrigerant to the evaporators, separating in the flooded evaporator lubricant entrained in the refrigerant, evaporating the refrigerant in each evaporator, returning the vapors from the evaporators to the compressor, causing the vapors from the auxiliary evaporator to flow with sufficient force to withdraw from said flooded evaporator the separated lubricant and incorporate it with the last mentioned vapors, and mixing a predetermined proportion of the incorporated lubricant with the vapor passing to the compressor.

8. A refrigerating apparatus according to claim 4 in which at least one of the evaporators is a direct-acting evaporator, the said conduit connecting the flooded evaporator to the direct-acting evaporator being provided with a valve controlling the direct flow of lubricant to the compressor, and means for bi-passing the refrigerant from the direct-acting evaporator around the valve and into the flooded evaporator.

EMIL KÄGI.