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K. M. NEWCUM  
REFRIGERATING APPARATUS

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Fig. 2

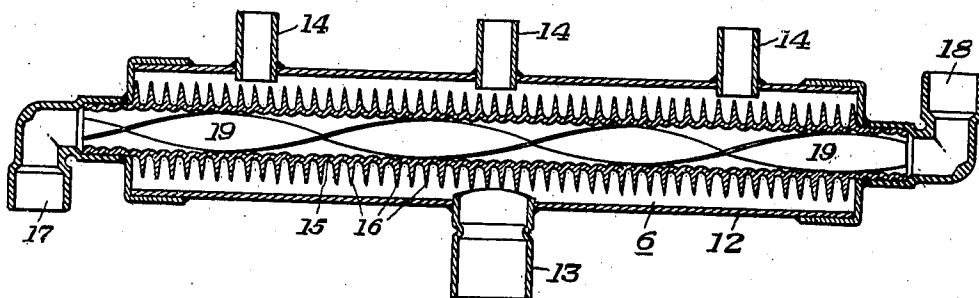
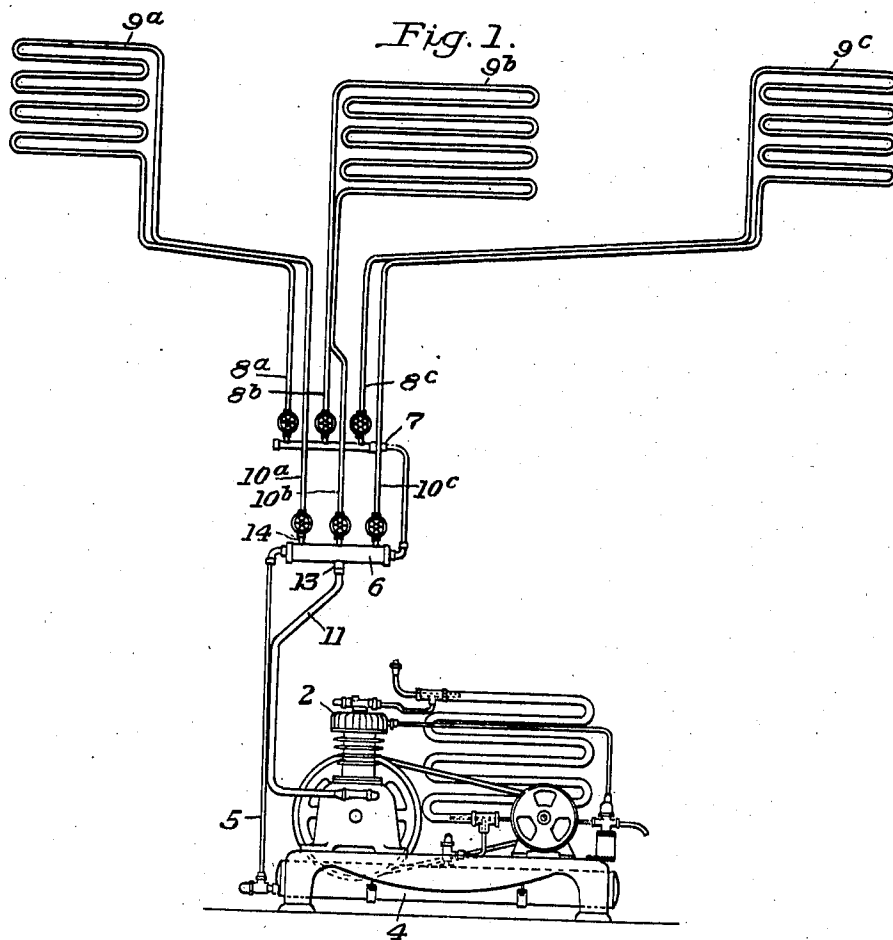


Fig. 1



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## UNITED STATES PATENT OFFICE

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## REFRIGERATING APPARATUS

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## 1 Claim. (Cl. 62—115)

My invention pertains to refrigerating apparatus and more particularly to refrigerating apparatus of the type wherein a plurality of evaporators are connected in a closed fluid circulating system with a single condensing unit. Refrigerating systems of this type are common to the art and are generally referred to as multiple systems.

Multiple refrigerating systems as are known to the art comprise a condensing unit consisting of a compressor, a condenser and liquid receiver, and a plurality of lowside units more commonly known as evaporators. The refrigerant is conducted from the liquid receiver to the evaporators, there being valves or metering devices for controlling the flow of liquid refrigerant into the evaporators, the volume of liquid being controlled according to the cooling requirements of the evaporators. A multiple system having two or more evaporators operating at a similar temperature commonly are called "single temperature" multiple systems, whereas a multiple system having one or more of said evaporators operating at a lower or higher temperature than the other evaporator or evaporators is more commonly termed "two temperature" multiple systems. A typical two temperature multiple system may exist, for example, in a delicatessen store where there is an ice cream cabinet, a storage refrigerator, and a refrigerated display counter.

My invention provides for improvement in the operation of either single temperature or two temperature multiple refrigerating systems and effect an economy in installation cost and increases the capacity of the system and reduces the hazard of damage to the working parts of the compressor, as will be apparent from the following description.

The process of compressing and condensing a refrigerant is accompanied by an appreciable increase in temperature of the condensed refrigerant. The process of evaporating a liquid refrigerant within said evaporators is accompanied by a reduction in temperature of the fluid. When the liquid refrigerant is conducted from the receiver to the evaporator, it is delivered to the metering device at the evaporator at a higher temperature than has to be maintained in the evaporator, and considerable loss occurs merely through the cooling of the condensed refrigerant in the evaporator. That is, before the refrigerant can be effective for cooling, its own heat must be removed until its temperature is that maintained in the evaporator. Also, in many

cases uncondensed refrigerant (known as flash gas) is carried to the evaporators and this flash gas accompanying the liquid has no heat removing ability, hence its presence is undesirable because it occupies space in the evaporator normally used by active refrigerant.

My invention, as will be revealed by further explanation, eliminates flash gas and effectively cools the liquid refrigerant before it is admitted to the evaporators.

To take full advantage of all the heat absorbing surface of all the evaporators in a multiple system, it is common practice to adjust the metering devices, previously referred to, to admit active refrigerant (liquid or saturated vapor) to and through the entire lengths of the pipes or tubing comprising the evaporators. It is also commonly known to the art that the metering devices are often adjusted to allow a quantity of active refrigerant to flow beyond the evaporators into the suction or gathering lines; or for metering devices to get out of adjustment, or stick open, thus allowing active refrigerant to flow into the suction lines, hence to the compressor.

The presence of active refrigerant in the compressor causes the oil contained therein to boil or foam violently and thus be picked up by the refrigerant and forced through the delicate valve mechanism in the compressor, which are normally designed to pass only gaseous refrigerant. The passing of oil, more commonly known as "oil slugging" results in frequent breakage of the compressor valves and shortage of oil in the compressor. Valve breakage results in expensive repair bills and heavy product losses and shortage of oil in the compressor allows the compressor to run with improper lubrication, resulting in undue wear on the working parts.

My invention accomplishes two principal purposes in that it is designed to cool the liquid refrigerant and eliminate the flash gas before it enters the evaporator and to heat the returning refrigerant before it enters the compressor to make certain that only inactive, completely evaporated refrigerant is thus admitted. Further than this, my invention accomplishes certain economies of installation and piping that render it useful.

According to the present invention a heat exchanger is provided in the system through which all of the refrigerant passing from the compressor to the evaporators flows before any division of the flow takes place to the individual evaporators. All of the refrigerant returning from the evaporators flows back through this heat ex-

changer and from the heat exchanger to the compressor. The cold fluid returning from the evaporators thus absorbs heat from the refrigerant flowing to the evaporators. This has the double advantage of cooling the compressed refrigerant and warming the spent refrigerant. This eliminates liquid refrigerant flowing back to this compressor. Through the fact that all of the compressed refrigerant and all of the returning fluid flows through a single heat exchanger, it is unnecessary to provide a heat exchanger for each individual evaporating unit, and it is unnecessary to provide as much heat exchange capacity in a single unit as where an individual heat exchanger for each evaporator is required.

The invention further contemplates the provision of a combined heat exchanger and manifold whereby all of the spent refrigerant is collected into a single channel in the heat exchanger and no provision, therefore, has to be made for any separate manifold in the system. This materially simplifies the piping arrangement in a refrigerating system of this character. It enables heat exchangers to be economically used where heretofore the expense of using a heat exchanger has been too great to justify its use.

The invention may be readily understood by reference to the accompanying drawing in which Figure 1 is a more or less schematic view illustrating a multiple refrigerating system embodying my invention; and

Figure 2 represents a longitudinal section through a combined heat exchanger and manifold embodying my invention.

Referring to Figure 1 of the drawing, 2 designates a condensing unit which compresses and condenses the refrigerant and delivers it to the receiver 4, and from the receiver 4 the liquid refrigerant which is at a relatively high temperature as compared with the temperature existing in the evaporators, is led through pipe 5 to a heat exchanger 6 and then to a manifold 7. Branching from manifold 7 are a plurality of pipes 8a, 8b, and 8c leading to evaporators 9a, 9b, and 9c respectively and the flow therein is controlled by the metering valves previously mentioned, and diagrammatically indicated at X in Figure 1.

Liquid refrigerant within the evaporators evaporates, subject to the control of the metering valves, and then either in the form of low temperature gas, gas and liquid, or gas and saturated vapor leaves the evaporators and returns to the combined heat exchanger and manifold 6 via pipes 10a, 10b, and 10c respectively.

From the heat exchanger manifold unit 6 the refrigerant returns through pipe or pipes 11 to the compressor. Valves may be provided in the individual lines leading to and from each evaporator, as illustrated in the drawing, but the use or non-use of valves does not alter the purpose of my invention.

The unit 6 is shown in Fig. 2. It comprises an outer shell 12 having an outlet connection 13 at the bottom thereof preferably adjacent the middle and having a plurality of spuds 14 thereon forming the intake pipe connections, the shell providing a manifold structure. Passing axially through the shell is a central metal tube 15 with extended surfaces 16 on the exterior thereof to increase the heat transfer surface thereof. There is a pipe connection 17 at one end of the central tube and a pipe connection 18 at the other end.

Within the central tube there may be a swirler such as a spiral strip 19.

With the condensing unit in operation it will be seen that all of the high temperature liquid refrigerant enroute to the several evaporators passes through the single heat exchanger tube from connection 17 to connection 18. The flow of refrigerant to the several evaporators is not divided until after the refrigerant passes through the heat exchanger and enters the manifold 7.

Simultaneous with the flow of high temperature liquid refrigerant through the inside tube 17 is the flow of lower temperature refrigerant from any or all of the evaporators, through the space outside tube 15 and inside the shell 12 thence out the common passage 13 to the line 11.

Thus all of the low temperature refrigerant returning from the evaporators is brought into heat exchange relation with all of the higher temperature liquid refrigerant going to all of the evaporators.

The effect of a common heat exchanger and/or a combination heat exchanger and manifold is novel in that it may happen that liquid refrigerant is returning from one evaporator while completely vaporized refrigerant may be returning from another. In the common heat exchanger and/or combination heat exchanger and manifold, the colder refrigerant from lower temperature evaporators may mingle with the warmer refrigerant from higher evaporators and by this fact alone reduce likelihood of oil slugging through liquid refrigerant being returned to the compressor. In addition, the liquid enroute to the evaporators will be more effectively cooled than would be the case if the flow of refrigerant were divided before it passes through a heat exchanger such as would be the case if a separate heat exchanger were provided for each evaporator, because it will all be cooled to the mean temperature of the refrigerant from the several evaporators which would not be the case if separate heat exchangers were employed.

By providing a manifold and a heat exchanger in a common structure, the advantages of a heat exchanger for each evaporator may be gained for not more than the cost of one single heat exchanger, and also, considerable economy is effected through a saving of installation materials such as piping and fittings and in the space required for the installation of separate heat exchangers. The heat exchange unit as herein disclosed also reduces the labor of setting up an installation.

Another useful purpose embodied in this invention of a common heat exchanger or combination heat exchanger and manifold located adjacent to the condensing unit and effecting all of the refrigerant in the distribution lines and suction gathering lines is the oil scrubbing and separating effect of the heat exchange tube 15.

It is commonly known to those skilled in the art that the oil which circulates with the refrigerant through the evaporators is returned to the compressor in the form of a fog, the fog being formed by minute bubbles of refrigerant within a film of oil. The thickness of the oil film depends to a large extent upon the temperature of the returning refrigerant. The higher the temperature of the returning refrigerant the greater is its volume and consequently the thinner the oil film. It is not uncommon for "slugs" of oil and refrigerant to return in liquid form to the crankcase in a system not provided with a heat exchanger as described herein.

However, with the common heat exchanger or combination heat exchanger and manifold as described herein, the bubbles of oil-encased refrigerant are brought into the heat exchanger where two positive changes are effected. First, the temperature of the returning fluid is increased because of its thermal contact with the exterior of the tube 15, hence the bubble is increased in size and the oil film decreased in thickness, and second, the bubbles are agitated or "scrubbed" by physical contact with the extended surfaces of the inside tube 15 to a point where the oil film is broken and the oil returns to the compressor in the form of individual drops and the liberated refrigerant returns to the compressor as a dry gas, free or nearly free of oil. The heat exchange unit is preferably close to the condensing unit, so that there is little opportunity for the oil and gas to again emulsify.

Returning the oil, separated from the gas, to the compressor permits it to drop by gravity to the bottom of the crankcase and hence is not recirculated to the same extent as would be the case if the bubbles of oil and gas were supplied to the compressor. In the latter case a large percentage of the mechanical energy of the condensing unit is required to circulate oil laden re-

frigerant. With the oil separated from the refrigerant an appreciable increase in displacement capacity is effected.

While I have illustrated and described one particular embodiment of my invention, it will be understood that this is by way of illustration and that various changes and modifications may be made within the scope of the following claim.

I claim:

A refrigerating system comprising a plurality of evaporators, a common compressor unit and a common heat exchanger having two separate passageways therethrough separated by a heat transfer wall, and pipe connections so arranged that refrigerant is conducted from the compressor unit through one passage of the common heat exchanger and thereafter flows to the separate evaporators and all of the refrigerant returning from the evaporators passes through the other passage of the common heat exchanger and then back to the compressor unit, the said heat transfer wall having projections thereon extending into the last named passage and providing a scrubbing surface for mechanically disintegrating bubbles of refrigerant and oil.

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