Dec. 8, 1936. A. F. HOESEL 2,063,380

REFRIGERANT DISTRIBUTOR

Filed Oct. 18, 1935 2 Sheets-Sheet 1

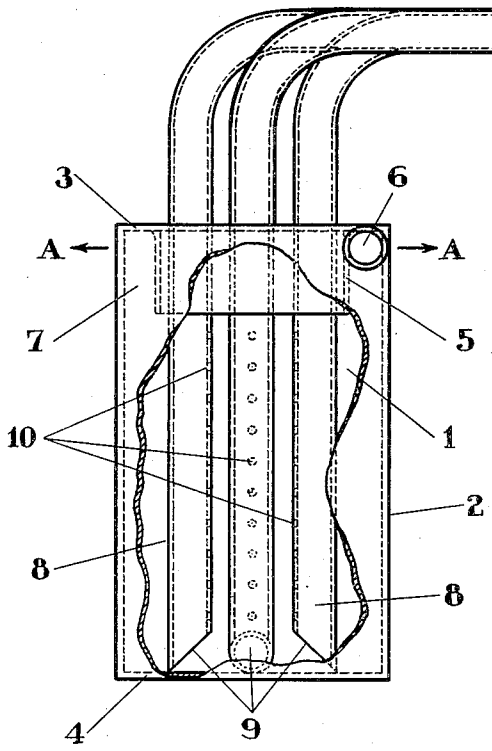


Figure 1

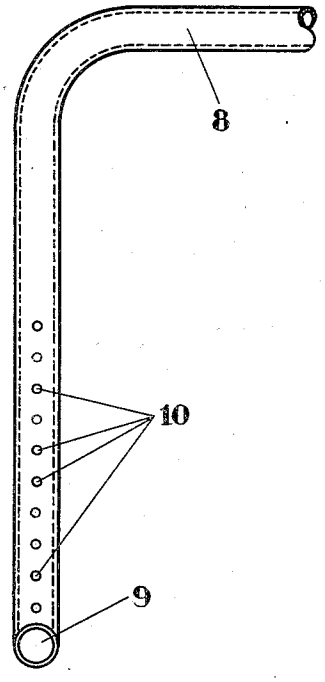


Figure 3

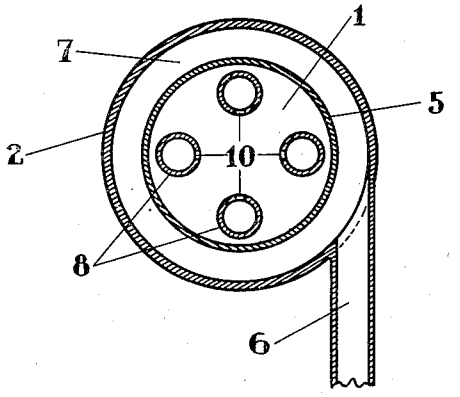


Figure 2

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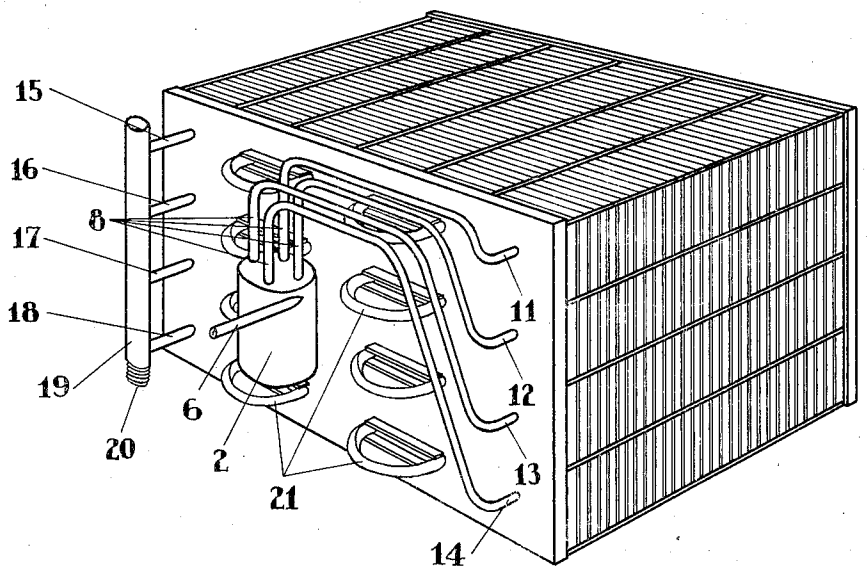


Figure 4

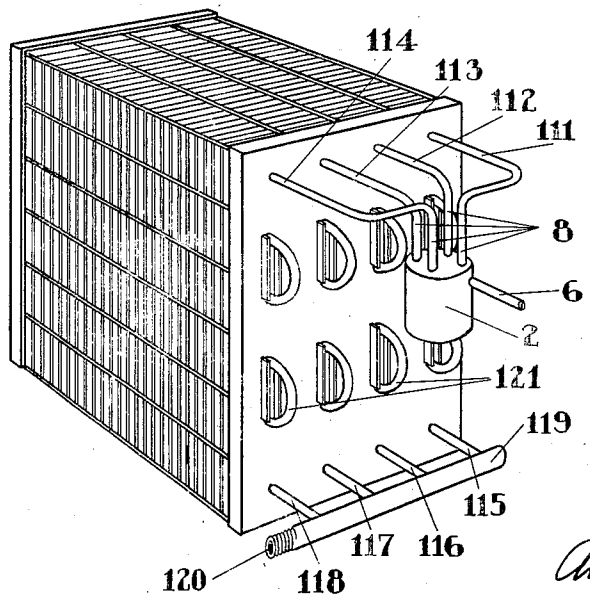


Figure 5

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UNITED STATES PATENT OFFICE

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REFRIGERANT DISTRIBUTOR

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Application October 18, 1935, Serial No. 45,587

10 Claims. (Cl. 62—126)

While there are several types of refrigerant distributors in present day use, none of them are as inexpensively constructed, nor do they proportion the refrigerant feed, as accurately as my invention.

Refrigerant distributors are employed to feed refrigerant fluid, proportionally to the various circuits of a multiple circuit direct expansion cooling unit, so that each, of the various circuits, will operate at maximum efficiency.

These cooling units are the expander side of a compressor-expander series circuit refrigerating system, in which a volatile refrigerant is circulated. These refrigerating systems are so well known in the art that a further description of the same is unnecessary, except to point out that the refrigerant liquid, in its passage from the compressor side to the expander side, through a form of pressure throttling means, drops in pressure and generates a flash vapor, the amount of which depends upon the refrigerant liquid temperature, prior to its passage through the throttling means, and the pressure to which the refrigerant liquid is expanded.

Immediately after the refrigerant liquid passage through the throttling means, we have a mixture of flash vapor and unvaporized refrigerant liquid, both of which must be proportionally fed to the various circuits of the direct expansion cooling unit, in which the remaining unvaporized refrigerant liquid is vaporized due to the absorption of heat by the cooling unit surfaces.

One of the objects, of the invention, is to provide a refrigerant distributor which is simple in construction.

Another object, of the invention, is to provide a refrigerant distributor which has a greater degree of accuracy, of proportional feeding, than obtains in any of the devices in present commercial use.

A further object, of the invention, is to provide a refrigerant distributor in which the proportional feed is not materially affected by the entrance of foreign material.

Other objects are disclosed in the following.

Referring to the drawings:

Figure 1 is an elevational view, partly broken to more clearly portray the construction, of a distributor embodying the invention.

Figure 2 is a cross-sectional view along line A—A of Figure 1.

Figure 3 is an elevational view of a distributor feed tube as used in Figure 1.

Figure 4 is an isometric view of a finned type direct expansion cooling unit employing the invention, and as used for cooling a horizontal circulation of air.

Figure 5 is an isometric view of a finned type direct expansion cooling unit employing the invention, and as used for cooling a vertical circulation of air.

In the drawings, Figures 1, 2 and 3, a chamber 1, bounded by the cylindrical wall 2, top 3 and bottom 4, has an internal ring 5, pendent from the top 3. A tangential inlet 6 discharges into the annular space 7 between the cylindrical wall 2 and the ring 5.

The top 3 is pierced for the feed tubes 8, which project downwardly and are beveled at their lower open ends 9 which, contacting the bottom 4, ensures that the flash vapor orifices 10 lie in common planes prior to the joining, of the tubes 8 to the chamber 1, by soldering, welding or otherwise.

It will be noticed that all of the tubes 8 have an equal vertical height.

Having described the construction of the refrigerant distributor, I shall now describe its operation. Assuming an expanded refrigerant flowing through the tangential inlet 6, the annular space 7 whirls the mixture and the unvaporized refrigerant liquid, due to centrifugal force generated by the whirling motion, hugs the cylindrical wall 2, down which it flows, in a spiral form, to the liquid level in the chamber 1.

We shall now assume the refrigerant distributor in normal operation and the liquid level such as will allow four of the flash vapor orifices 10 nearest the top, of each feed tube 8, to be uncovered. There is then a slightly greater pressure in the chamber 1, than at the top of the tubes 8, in consequence of which flash vapor flows through the four upper flash vapor orifices 10 of each tube 8. This flash vapor flow being insufficient to establish pressure equilibrium between the chamber 1 and the inside of the feed tubes 8, at the uncovered orifices 10, the liquid height in the fed tubes 8 tends to carry at a higher level than the liquid level in the chamber 1, and consequently the flash vapor and liquid mixture tends to feed in equally proportional quantities through all of the tubes 8.

Assume the refrigerant feed, through the tangential inlet 6, to be further throttled. The amount of flash vapor will then decrease, and the pressure difference, between the chamber 1 and the upper portion of the feed tubes 8, will also decrease, thereby decreasing the differential in liquid level between the chamber 1 and the feed tubes 8. Since the flash vapor and the unvapor-

ized refrigerant liquid are both entering the chamber 1 at certain volume rates, the liquid level in the chamber 1 rises and covers one or more of the previously uncovered flash vapor orifices 10, and thereby substantially reestablishes a pressure differential; however, since less flash vapor passes through each feed tube 8, the amount of liquid refrigerant feed is proportionally reduced in each feed tube 8 and the liquid level in the chamber 1 reaches a point of equilibrium.

Assume the refrigerant feed, through the tangential inlet 6, to be throttled as in the preceeding paragraph, but, due to some cause or other, we shall assume that the refrigerant liquid prior to its passage through the throttle means and the tangential inlet 6 has an abnormally high temperature, which will generate a greater volume of flash vapor than in the preceding paragraph. If this condition occurred instantaneously, the following would happen. There would be an increase of pressure differential, between the chamber 1 and the inside of the feed tubes 8, which would establish a greater liquid level differential between the chamber 1 and the inside of the feed tubes 8, thereby rapidly evacuating refrigerant liquid from the chamber 1 and establishing a new refrigerant liquid level therein; the said level being such as would uncover a sufficient number of the flash vapor orifices 10, which would maintain the proper pressure differential for that condition of operation.

Under certain circumstances I shall employ flash vapor orifices of graduated size, thereby controlling the variation in liquid level within close limits during a very wide range of capacity of the distributor.

In the fabrication of distributors, of this type, scale may be formed due to the joining operations of welding, etc., or some foreign body may enter the chamber during operation. Supposing some foreign body might enter the system and plug a flash vapor orifice 10 on a particular tube. If the plugged orifice is below the refrigerant liquid level, nothing can occur since the open end 9 is more than ample to pass the maximum amount of refrigerant liquid necessary. If the plugged orifice is above the refrigerant liquid level, in the chamber 1, then automatically, due to decreased flash vapor passage into that particular feed tube 8, there would be an increased pressure differential between that particular feed tube 8 and the chamber 1, and the liquid level would rise higher in that particular feed tube 8 as compared with the rest of the feed tubes 8 and the feed then would be practically the same as before the plugging of the flash vapor orifice 10.

From the above, it is evident that the proportional feeding, of the various circuits, is entirely automatic under all conditions of operation.

In Figure 4, I show a conventional type of finned cooling coil as used for air conditioning and through which the air, to be cooled, is blown in a horizontal direction. This particular cooling coil comprises four refrigerant conduit circuits superposed one above the other. The conduit circuits have inlets 11, 12, 13 and 14 connected to their respective feed tubes 8, which are brought to a common height, as shown. The conduit circuits have outlets 15, 16, 17 and 18, which discharge into a suction header 19 threaded at its lower end 20 for connection to the suction line of the compressor. Between the inlets 11, 12, 13 and 14, and the outlets 16, 17, 18 and 20, of the various conduit circuits, are parallel courses of finned conduit joined by the return bends 21.

In Figure 5, I show a conventional type of finned cooling coil as used for air conditioning and through which the air, to be cooled, is blown in a vertical direction. Since these types of coils are so well known in the art and, furthermore, since they do not form an integral part of the invention but are used merely to illustrate the application of the invention, it will suffice to point out that the individual circuits, in Figure 5, are vertical as against the horizontal circuits of Figure 4, and in Figure 5 the equivalent numerals are used for the equivalent parts, except that 100 is added to the numerals of Figure 4.

From Figures 4 and 5, it will be noted that the refrigerant flow and the air flow are counterflow, which, while ensuring the maximum possible efficiency, also ensures that the various circuits, of either coil, have equal refrigerant vaporizing capacity.

It will be noted that, with my invention, I am enabled to place my distributor below the cooling coil inlets. This is not true of other types, which necessitate their placement above the cooling coil inlets; therefore, I am enabled to use a much smaller cooling coil enclosing air duct, with my invention, whenever employed in duct system of air conditioning.

While I have shown a preferred embodiment of my invention, it is understood that modifications of the same may be employed without departing from the spirit and scope of the same, which is limited only by the following claims.

I claim:

1. In a distributor for proportionally feeding a refrigerant, partly in a liquid phase and partly in a vapor phase, to a plurality of refrigerant circuits, the combination of a chamber, an inlet adjacent the top of the chamber, a plurality of feed tubes extending into the chamber from its top, an annular space, at the top of the chamber, into which the inlet discharges, the said annular space being open to the chamber.

2. In a distributor for proportionally feeding a refrigerant, partly in a liquid phase and partly in a vapor phase, to a plurality of refrigerant circuits, the combination of a chamber, an inlet adjacent the top of the chamber, a plurality of feed tubes extending into the chamber from its top, an annular space, at the top of the chamber, into which the inlet discharges, the said annular space being open to the chamber, and the said feed tubes having spaced apertures.

3. In a distributor for proportionally feeding a refrigerant, partly in a liquid phase and partly in a vapor phase, to a plurality of refrigerant circuits, the combination of a chamber, an inlet adjacent the top of the chamber, a plurality of feed tubes extending into the chamber from its top, an annular space, at the top of the chamber, into which the inlet discharges, the said annular space being open to the chamber, and the said feed tubes being open at their lower end and having spaced apertures.

4. In a distributor for proportionally feeding a refrigerant, partly in a liquid phase and partly in a vapor phase, to a plurality of refrigerant circuits, the combination of a chamber, an inlet adjacent the top of the chamber, a plurality of feed tubes extending into the chamber from its top, an annular space, at the top of the chamber, into which the inlet discharges, the said annular space being open to the chamber, and the said

inlet being substantially tangent to the annular space.

5. In a distributor for proportionally feeding a refrigerant, partly in a liquid phase and partly in a vapor phase, to a plurality of refrigerant circuits, a chamber having a plurality of feed tubes extending downwardly therein and being apertured for a vapor flow from the chamber to the tubes, the said apertures facing the center of the chamber.

6. An evaporator comprising in combination a manifold adapted to receive liquid refrigerant and a plurality of tubes leading upward therefrom, the lower ends of said tubes projecting into said manifold and having lateral apertures through which vaporized refrigerant enters the tubes from the manifold.

7. An evaporator comprising in combination a manifold adapted to receive liquid refrigerant and a plurality of tubes extending upward from said manifold, the lower ends of said tubes projecting through the top of the manifold into the same and to a point below the liquid level therein, said projecting ends being formed with lateral perforations.

8. An evaporator comprising in combination a manifold adapted to receive liquid refrigerant and a plurality of tubes extending upward from said manifold, the lower ends of said tubes projecting through the top of the manifold into the same and to a point below the liquid level therein, said projecting ends being formed with lateral perforations graduated in size.

9. An evaporator comprising in combination a manifold adapted to receive liquid refrigerant and a plurality of tubes leading upward therefrom, the lower ends of said tubes projecting into said manifold and having lateral apertures through which vaporized refrigerant enters the tubes from the manifold, the upward leading portions of the tubes being carried to a substantially common level above the manifold.

10. An evaporator comprising in combination a manifold adapted to receive liquid refrigerant and a plurality of tubes extending upward from said manifold, the lower ends of said tubes projecting through the top of the manifold into the same and to a point below the liquid level therein, said projecting ends being formed with lateral perforations, the upward extensions of the tubes being carried to a substantially common level above the manifold.

ANTHONY F. HOESEL.