May 16, 1939. J. G. BERGDOLL 2,158,716

REFRIGERATION

Filed Dec. 19, 1933

Fig. 2

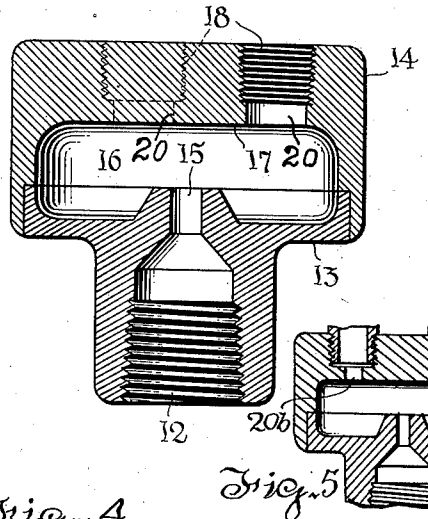
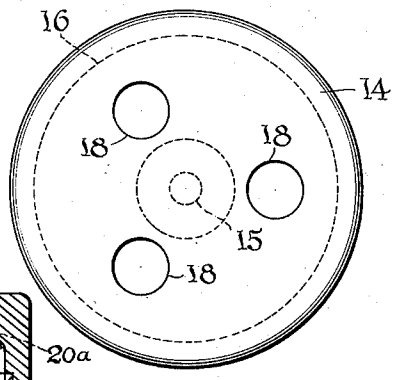


Fig. 3



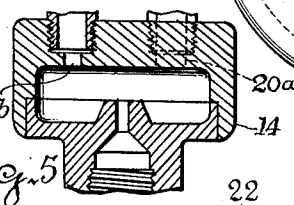


Fig. 5

Fig. 4

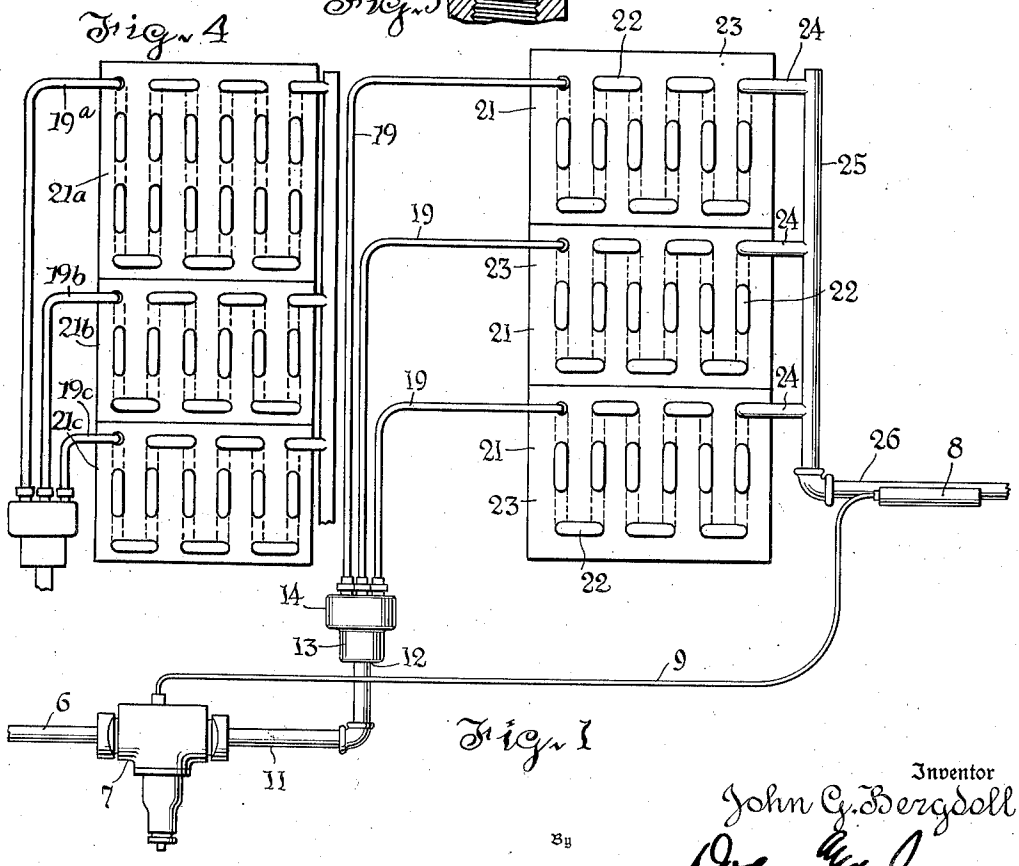


Fig. 1

Inventor

John G. Bergdoll

By Dodge and Sons

Attorneys

Patented May 16, 1939 2,158,716

UNITED STATES PATENT OFFICE

2,158,716

REFRIGERATION

John G. Bergdoll, York, Pa., assignor to York Ice Machinery Corporation, York, Pa., a corporation of Delaware

Application December 19, 1933, Serial No. 703,141

7 Claims. (Cl. 62—127)

This invention relates to refrigeration, and particularly to means for supplying volatile refrigerant to a plurality of evaporators connected in parallel.

In certain commercial installations it is desirable to connect a plurality of evaporators in parallel and feed them with refrigerant by means of a single expansion valve. The expansion valve may be manually controlled or it may be automatically controlled. For example, a commercial expansion valve controlled in response to the temperatures of the vapors leaving the evaporators may be used.

The reasons for using such a plurality of evaporators involve practical considerations concerned with manufacture and installation, and since they are not material to the question of invention here presented, are not discussed in detail.

Since the pressure on the refrigerant changes in passage through the expansion valve, a part of the refrigerant will vaporize upon passage through the valve and consequently the discharge from the expansion valve can be regarded as a mixture of liquid refrigerant and refrigerant vapor. In any case, and particularly in cases where the evaporators are located at different heights, there is a tendency for certain of the evaporators to receive undue proportions of the liquid refrigerant, whereas others receive undue proportions of the vaporized refrigerant, with the result that the refrigerative effects of the different evaporators are unequal. The prime purpose of the present invention is to insure that uniform proportions of liquid and vapor are delivered to each of the various evaporators.

A further object of the invention, useful where a thermally responsive expansion valve is used, is to insure control of the valve by the average temperature of vapor leaving all the connected evaporators.

A preferred embodiment of the invention is illustrated in the accompanying drawing, but as various specifically different arrangements, within the scope of the invention, are possible, this is to be regarded as exemplary and not limiting.

Fig. 1 is an elevation showing three evaporators connected in parallel to be fed by a single expansion valve of the thermally controlled type.

Fig. 2 is a vertical axial section of a distributor constructed in accordance with the present invention.

Fig. 3 is a plan view thereof.

Fig. 4 is a view similar to Fig. 1 showing a distributor used with evaporators of different capacities.

Fig. 5 is a view similar to Fig. 1 showing the modification.

Referring first to Fig. 1, 6 represents the liquid line which leads from a receiver or other source of liquid refrigerant to an automatic expansion valve 7, of known commercial form. This thermostatic valve includes a thermometric bulb 8 which contains a volatile liquid, so chosen that it will develop a suitable pressure at the desired temperature of the vaporous refrigerant leaving the evaporator. The pressure thus developed in the bulb 8 is transmitted through a tube 9 to the expansion valve 7 and there acts upon a pressure motor mechanism, which is, as usual, connected to actuate the valve element of the expansion valve.

Leading from the expansion valve 7 is a pipe 11 which receives a mixture of refrigerant liquid and vapor discharged from the valve 7. The pipe 11 leads to the inlet connection 12 of a distributing fitting made up of two parts, 13 and 14, which are hermetically sealed together in any suitable manner.

In line with the entrance connection 12 is a nozzle 15 to which the pipe 11 delivers, the dimension of the nozzle being so chosen that it will discharge refrigerant at a velocity of the order of 600 feet per minute. This nozzle discharges in line with the axis of a circular chamber 16 whose diameter preferably materially exceeds its axial dimension.

In the example illustrated, the jet discharged by the nozzle 15 impinges upon a flat surface 17 at right angles to said nozzle, and the effect is to produce rotary turbulence in the chamber 16, the turbulent flow occurring in what may be described as a ring or torus in the outer portion of the chamber 16. Since the ring-shaped turbulence thus induced, is symmetrical with reference to the nozzle 15, the effect is to insure a uniform mixture of liquid and vapor in all portions of the chamber 16.

Leading from the chamber 16 are a plurality of discharge connections 18, one for each evaporator to be fed. In the example illustrated there are three evaporators, and consequently three such connections. These connections are out of line with the jet discharging from the nozzle 15 and are symmetrically arranged with respect thereto.

Leading from the connections 18 are corresponding discharge pipes 19, each of which leads to a different evaporator, the evaporators being indicated generally by the numeral 21. The exact form of the evaporators is immaterial, but for illustrative purposes there has been chosen a familiar type comprising zig-zag tubes 22 passing through and contacting with a series of spaced radiating plates, one of which, in the case of each evaporator, is indicated at 23. Each evaporator has a discharge connection 24 leading to a discharge manifold 25 which in turn is connected with the suction line 26.

In order to subject the thermometric bulb 8 to the average discharge temperature in the various

evaporators, the bulb is mounted in contact with the suction line 26 close to its junction with manifold 25. It is common practice in this art to place the bulb inside the pipe, and there is nothing in the present invention to preclude such practice if preferred.

The function of the fitting 13, 14, is to insure the distribution of a uniformly proportioned mixture of liquid and vapor to a plurality of connected evaporators, and a number of factors can be coordinated to insure a satisfactory result. In the first place, the result is promoted if the connections 18 are all of approximately the same size and shape. It is important that the surface in the chamber 16, adjacent each connection 18, be of similar character as to smoothness and finish. The arrangement shown, in which the fitting 13, 14, is mounted with its axis vertical, is also important as minimizing the effect of gravity on the distribution of liquid. The simplest possible arrangement is secured when the connections 18 are all of the same size, the evaporators 21 are all of the same size, and the pipes 19 are all of the same size and as nearly as practicable of equal length.

Where the evaporators are necessarily of different sizes or where the pipes 19 are necessarily of substantially different lengths, a correction factor may be introduced by changing the bore of the pipe 19 or the size of the orifice 20 in the fitting 14 or connection 18, or both. Fig. 4 shows the use of tubes of different sizes, with evaporators of different sizes and different locations. The large evaporator 21*a* is above the smaller evaporators 21*b* and 21*c* and the tube 19*a* is, therefore, made somewhat larger than the tubes 19*b* and 19*c*. The tubes are proportioned to balance the distribution. In Fig. 5 an alternative arrangement is suggested in which the orifice 20*b* in the distributor head is smaller than the orifice 20*a* in the same distributor head, the size of the orifice being proportioned to the size of the evaporator to which it is connected, the connecting tubes all being of the same size. Precise rules for the proportioning of the pipe or orifice, cannot be given, but satisfactory results may readily be had by trial and error.

The important point is that the invention is not limited to the use of identical evaporators though identity in the size of the evaporators does simplify the attainment of the desired result.

When the system is in operation the expansion valve 7 discharges into the pipe 11 a mixture of liquid and vapor refrigerant, the rate of such delivery being controlled in response to temperature of refrigerant leaving the manifold 25, by the operation of the thermometric bulb 8. The contracted orifice 15 insures high velocity discharge of the liquid and vapor into chamber 16, and the jet thus formed impinges on the flat surface at the center of chamber 16 and induces a violent rotary turbulence at the point of subdivision of the off-flowing mixture, so that all of the connections 18 receive a mixture of uniform character, whether or not the quantities of mixture flowing through the various connections are equal. If the evaporators are all of the same capacity the quantities will be equal, but if the evaporators have different capacities the quantities will be different. The invention can be used to attain either result, and the effect is to insure a condition in which no one evaporator receives an undue proportion of liquid as compared to vapor. Consequently, all the evaporators function efficiently, and the regulatory effect of the bulb 8 is satisfactory for the evaporators considered as a group.

Broadly considered, the invention involves the interposition between a single expansion valve and a plurality of evaporators connected to be fed in parallel thereby, of means effective at the point of subdivision of the streams flowing from the expansion valve to the various evaporators to induce violent turbulence, and specifically to induce such turbulence as the result of flow of the refrigerant itself. This idea is capable of embodiment in various specifically different forms, and while the form illustrated is preferred, because of its simplicity and demonstrated efficiency, the possibility of other embodiments is recognized, and the structure above described in detail is for purposes of illustration, and implies no limitations other than those expressed in the claims.

What is claimed is,

1. The method of insuring the supply of uniform mixtures of liquid and vaporous refrigerant from a single expansion device to a plurality of evaporators arranged in parallel, which comprises subdividing the stream of mixture delivered by such expansion device, and immediately in advance of such subdivision inducing, by the flow of the refrigerant itself, violent rotary turbulence in the flowing stream of refrigerant.

2. Means for distributing to a plurality of branch lines uniform mixtures of liquid and vapor delivered by an expansion device, comprising a chamber and a related supply nozzle arranged to induce turbulent flow in the chamber, said nozzle being fed by said expansion device and the chamber having a plurality of discharge passages leading therefrom out of line with the jet discharged by said nozzle and similarly arranged with reference to such turbulent flow.

3. The combination of an expansion valve; a plurality of evaporators adapted to be fed in parallel with refrigerant delivered by said expansion valve; and a branch fitting interposed between said expansion valve and said evaporators, said fitting having a high velocity injection nozzle connected with the discharge of the expansion valve, a chamber in which the jet discharged by the nozzle induces turbulent flow, and symmetrically arranged outlet passages leading from said chamber to respective evaporators.

4. The combination defined in claim 2, in which the jet discharged by the nozzle is directed vertically.

5. The combination defined in claim 3, in which the jet discharged by the nozzle is directed vertically.

6. The combination defined in claim 3, in which the evaporators are of unequal refrigerative capacities and the outlet passages are of sizes proportioned to the capacities of the evaporators fed thereby.

7. An expansion mechanism for refrigeration evaporators, comprising an expansion valve, a distributor head, a plurality of outlets in said head leading to a plurality of evaporators, a plurality of orifices connecting with said outlets, a channel connecting said orifices with the output side of said valve, and means within said channel for spinning the gas and liquid during its travel therethrough to prevent their segregation.

JOHN G. BERGDOLL.