April 9, 1940. T. C. GLEASON 2,196,858

DISTRIBUTOR HEAD

Filed Dec. 3, 1938 2 Sheets-Sheet 1

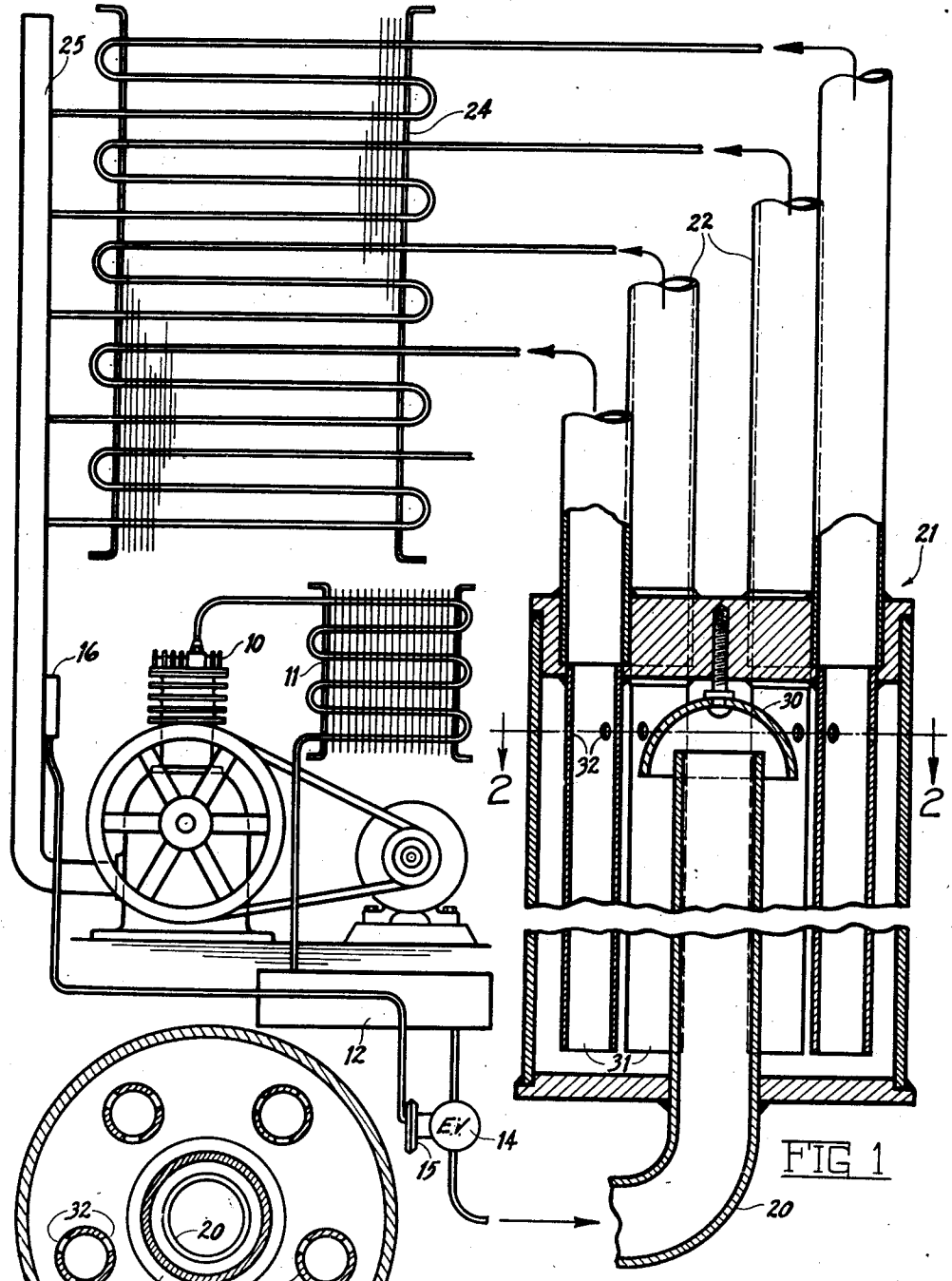


FIG 1

FIG 2

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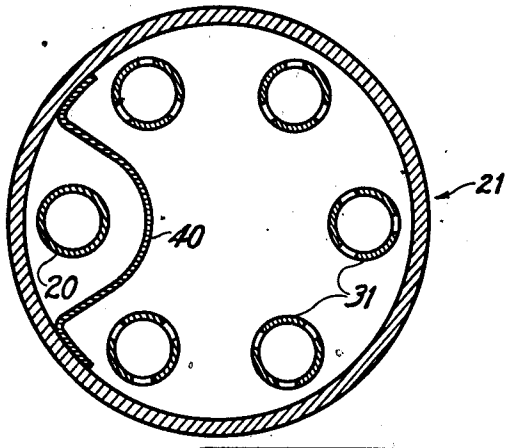


FIG 4

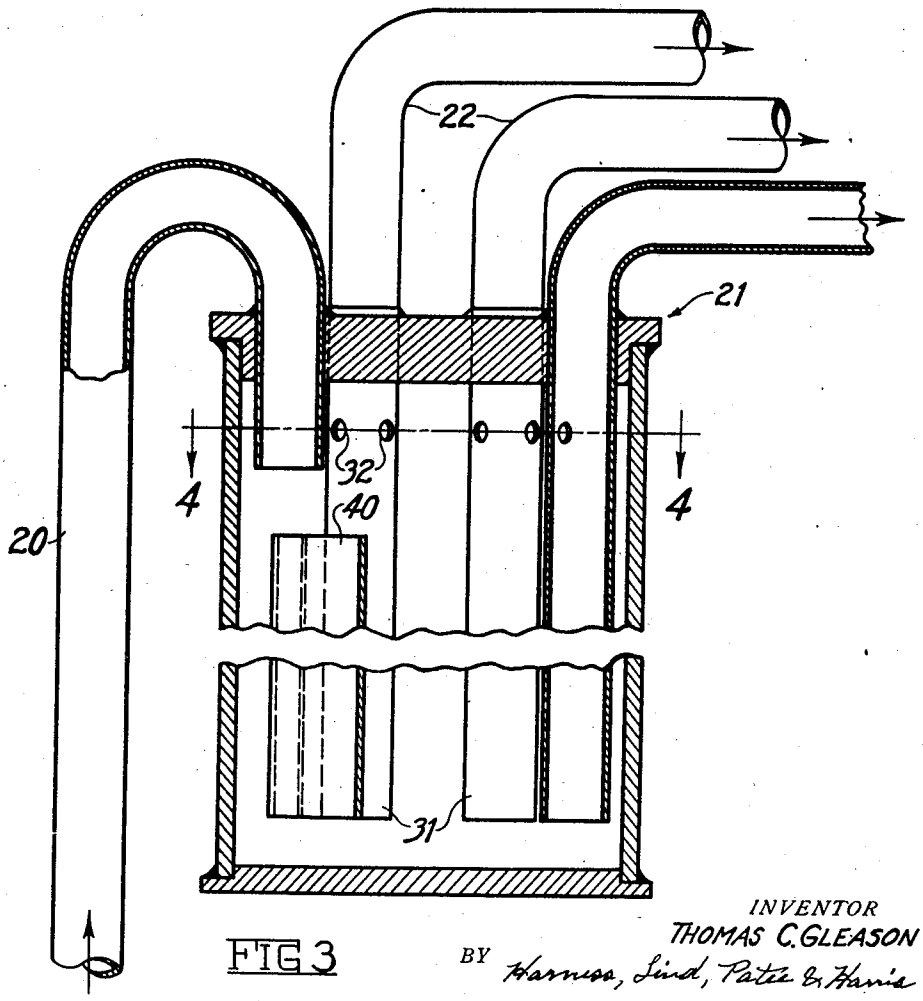


FIG 3

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UNITED STATES PATENT OFFICE

2,196,858

DISTRIBUTOR HEAD

Thomas C. Gleason, Ferndale, Mich., assignor to Chrysler Corporation, Highland Park, Mich., a corporation of Delaware

Application December 3, 1938, Serial No. 243,832

3 Claims. (Cl. 62—127)

My present invention relates to an improvement in the art of refrigeration, having particular reference to the branch of refrigeration pertaining to air conditioning. The particular improvement comprises an improved method and means for distributing refrigerant to the several passes of a multiple pass evaporator used in a compressor-condenser-evaporator system of refrigeration.

The principal object of my invention is to distribute the refrigerant equally among the several passes of a multiple pass evaporator coil, having particular regard to distributing the refrigerating effect equally among the several passes by equally distributing and proportioning the expanded and liquid refrigerant subsequent to passage of the refrigerant through the expansion valve of the system. A further object of my invention is to obtain improved results in a multiple pass evaporator without depending upon an expansion valve and a control bulb for each pass of the coil, thereby eliminating expensive equipment heretofore found necessary. A further result of my invention is that positive control of the proportioning and distributing of expanded and liquefied refrigerant to the various passes is assured, whereas in a system using a multiplicity of expansion valves, unequal proportions and distribution might result from failure to adjust all valves equally or from the mechanical failure of one or more valves.

It has been determined that when refrigerant passes the expansion valve a certain amount of expansion takes place, so that the refrigerant leaving the expansion valve usually consists of about eight per cent by volume of unexpanded liquid and ninety-two per cent by volume of expanded gaseous refrigerant. It is the ability of the remaining eight per cent by volume of liquid refrigerant to change its state from liquid to gas in the evaporator coil which permits the coil to do its greatest amount of work. If any refrigerant is permitted to leave the evaporator coil in liquid form it may have picked up a very small amount of heat by having its temperature raised a few degrees; obviously, however, most of the work done in the coil is that performed by the transfer of heat to the refrigerant when it changes state from a liquid to a gas. Hence, an efficient coil is so arranged that all of the liquid refrigerant possible is transformed into a gas within the confines of the evaporator coil. Heretofore, it has been found essential that each pass of a multiple pass evaporator be provided with an expansion valve and control bulb in order that there might be some possibility of meeting the demand for cooling at each pass of the coil. However, such an arrangement is expensive, quite often results in one or more passes being flooded and one or more passes being starved, is very difficult to adjust properly, and quite often fails due to faulty adjustment or mechanical failure of one or more expansion valves. The present invention is designed to distribute the liquid which is capable of being transformed into a gas equally, or perfectly, among the several passes of the coil.

Other objects and advantages of my invention will be apparent from a study of the following specification taken in connection with the accompanying drawings wherein like numerals refer to like parts throughout.

In the drawings, Fig. 1 is a view schematically setting forth a compressor-condenser and multiple pass evaporator system in small scale with the improvement in the system comprising my present invention set forth on an enlarged scale;

Fig. 2 is a cross section taken through the distributor head along line 2—2 of Fig. 1; Fig. 3 is a vertical section through a modified form of distributor head; and Fig. 4 is a horizontal section taken along line 4—4 of Fig. 3.

In Fig. 1 there is represented a compresser 10 from which refrigerant is passed through a condenser 11 where the refrigerant is liquefied and from which the liquid refrigerant passes into a receiver 12. From the receiver the liquid passes through the usual liquid line in which is interposed an expansion valve 14 under control of a valve motor 15 having an operating thermostatic bulb 16, as is usual practice. The refrigerant which is permitted to pass the expansion valve flows through an inlet tube 20 into the distributor head 21 comprising the present invention. The distributor head 21 is provided with a plurality of outlets 22 each of which communicates with one of the passes of a multiple pass evaporator coil 24 over which the air to be conditioned is permitted to flow. Each pass of the evaporator coil communicates with a suction header 25 by means of which the expanded refrigerant is collected and returned to the compressor 10. The control bulb 16, which is filled with a thermostatically expansible fluid, is preferably attached to the surface of the suction header between the last pass of the evaporator coil and the compressor in order to determine the proper setting of the expansion valve 14 in response to the back pressure of the refrigerant, which is a meas-

ure of the load on the coil 24 and, hence, is a measure of the demand for refrigerant.

In order to distribute refrigerant in liquid form equally to each pass the inlet tube 20 passes into a closed chamber forming the body of the distributor head 21. The tube 20 preferably terminates adjacent the top of the chamber and a bell 30 may be provided in order to direct the refrigerant downwardly toward the bottom of the chamber. The outlet tubes 22 communicate with open-ended distributor tubes 31 extending from the top wall of the chamber to a point closely adjacent the bottom wall, each of which is provided with a plurality of openings 32 adjacent the top wall of the chamber. The tubes 31 are all of the same size and length and the openings 32 are all of the same size and equidistant from the top of the chamber. The mixture of eight per cent by volume of liquid and ninety-two per cent by volume of gas flows through the inlet tube 20 and is turned downwardly by the bell 30, the liquid seeking the lower level of the chamber and occupying from one-third to possibly two-thirds of the chamber and the gas occupying the upper remaining portion. Since the openings 32 are equal in size the same amount of gas enters each of the distributor tubes 31. The liquid at the bottom of the chamber is forced upwardly through the distributor tubes 31 by the pressure of the gas, and since the tubes are equal in all characteristics an equal amount of liquid will pass into each distributor tube 31 and, thence, into each outlet tube 22 and each pass of the coil 24.

If the passes of the evaporator coil are arranged in parallel with respect to the air flow thereover, theoretically, at least, the heat load upon each pass of the coil will be identical, which means that an equal amount of evaporation will be necessary to satisfy the requirements of each pass. If an equal amount of refrigerant is expanded in each pass of the coil the back pressure in each pass will be equal; hence, the pressure existing in the tubes 22 will be equal and an exactly equal amount of liquid and gaseous refrigerant will be permitted to enter each pass of the coil. If it should happen that a greater amount of hot air is permitted to pass over one pass of the coil than over the remaining passes, the pressure in the outlet tube 22 connected thereto will rise above the pressure in the other tubes resulting in an increased pressure within the distributor head chamber. This, however, cannot effect the equal proportioning of liquid and gas to each of the passes since the openings 32 and the ends of the tubes 31 are all equally affected by the increase or decrease of pressure in any pass. However, if the increase in pressure should result in an increase in superheat of the refrigerant returning to the compressor, such as to indicate that a greater demand for refrigerant exists than can be taken care of by the entire amount of refrigerant, the expansion valve 14 will be opened to a greater extent permitting more refrigerant to pass into the distributor head and hence more liquid into each of the tubes.

The above description is for use of the invention with an evaporator coil arranged with the passes in parallel with respect to air flow thereover and the operation of the distributor is such that it tends to pass equal quantities of liquid through the various passes at all times. Variation in the sizes of the gas orifices 32 should not materially affect the distribution of liquid to the various passes since the only effects of varying the orifice sizes would be, first, to cause a difference in pressure drop in the various coil passes, and, secondly, to cause a difference in the impact losses at the point of mixture between the liquid coming up through the tubes 31 and the gas entering through the orifices 32, both of which effects are negligible. In order intentionally to unequalize the quantity of liquid refrigerant going to each of the various coil passes, it would be necessary to make each distributor tube 31 of a different size and/or length in order that the amount of liquid entering the lower end of each distributor tube would be different for each tube. With the distributor tubes 31 of equal diameter and length the amount of liquid refrigerant will be equal in each pass, and if used with a coil arranged for series flow of the air thereover the result would be to starve the first row or rows where the demand would be highest and to flood the last rows of the coil. The invention could be modified for series arrangement only by determining the diameter and length of each distributor tube 31 necessary to properly regulate the flow of refrigerant to each pass, a determination which would require solution by trial and error, and if solved for air of one temperature might not be effective for air of another temperature.

In Figs. 3 and 4, a distributor head is shown in modified form, the improvement consisting in so constructing the chamber that holes need only be drilled in one plate, by causing the inlet tube 20 to enter through the end plate through which the outlet tubes 22 extend. In this case again the inlet tube terminates adjacent the upper wall and the distributor tubes terminate adjacent the lower wall, the distributor tubes being provided with gas inlet openings 32 adjacent the upper wall. In this case, however, a dam or shield 40 is provided in such position as to confine the entering stream of liquid and thereby prevent inaccuracy due to agitation of the principal body of liquid in the lower portion of the distributor head. The dam 40 may assume various shapes, it being well known that various shapes and manners of dams will prevent agitation of the body of liquid in a receptacle by an entering stream. The only requirement of the dam is that it terminate well below the end of the inlet tube 20 in order to permit free exit of the entering gas through the openings 32.

Having described two forms of my invention it should be apparent that the same may assume modification in arrangement and detail. All such modifications as come within the scope of the following claims are considered to be a part of my invention.

I claim:

1. A distributor head for proportioning refrigerant among the several passes of a multiple pass evaporator in a refrigerating system including refrigerant liquefying means and an expansion valve in which liquid refrigerant is converted into a mixture of liquid and gaseous refrigerant, comprising a chamber having an inlet at the top thereof for admitting refrigerant from said expansion valve, a turbulence preventing dam dividing said chamber into a refrigerant receiving portion and a main refrigerant holding portion, said dam extending vertically of said chamber and having a lower edge adjacent the bottom of said chamber so that liquid may enter said main refrigerant holding portion beneath

the bottom of said dam and said dam terminating adjacent the top of said chamber so that gaseous refrigerant may enter said main refrigerant holding portion over the top of said dam, and a plurality of distributor tubes extending into said holding portion and communicating individually with the passes of said evaporator, said distributor tubes being of equal size and length and extending from the top of said chamber toward the bottom thereof, said tubes having liquid receiving openings of equal size adjacent the bottom of said chamber and gas receiving openings of equal size adjacent the top of said chamber.

2. A distributor head for proportioning refrigerant among the several passes of a multiple pass evaporator in a refrigerating system including refrigerant liquefying means and an expansion valve in which liquid refrigerant is converted into a mixture of liquid and gaseous refrigerant, comprising a chamber having an inlet at the top thereof for admitting refrigerant from said expansion valve, a turbulence preventing dam dividing said chamber into a refrigerant receiving portion and a main refrigerant holding portion, said dam extending vertically of said chamber and having a lower edge adjacent the bottom of said chamber so that liquid may enter said main refrigerant holding portion beneath the bottom of said dam and said dam terminating adjacent the top of said chamber so that gaseous refrigerant may enter said main refrigerant holding portion over the top of said dam, and a plurality of distributor tubes extending into said holding portion and communicating individually with the passes of said evaporator, said distributor tubes being of equal size and length and extending from the top of said chamber toward the bottom thereof, said tubes having liquid receiving openings of equal size closely adjacent to and at the same height from the bottom of said chamber and gas receiving openings of equal size adjacent the top of said chamber.

3. A distributor head for proportioning refrigerant among the several passes of a multiple pass evaporator in a refrigerating system including refrigerant liquefying means and an expansion valve in which liquid refrigerant is converted into a mixture of liquid and gaseous refrigerant, comprising a chamber having an inlet at the top thereof for admitting refrigerant from said expension valve, a turbulence preventing dam dividing said chamber into a refrigerant receiving portion and a main refrigerant holding portion, said dam extending vertically of said chamber and having a lower edge adjacent the bottom of said chamber so that liquid may enter said main refrigerant holding portion beneath the bottom of said dam and said dam terminating adjacent the top of said chamber so that gaseous refrigerant may enter said main refrigerant holding portion over the top of said dam, and a plurality of distributor tubes extending into said holding partion and communicating individually with the passes of said evaporator, said distributing tubes being of equal size and length and extending from the top of said chamber toward the bottom thereof, said tubes having liquid receiving openings of equal size closely adjacent to and at the same height from the bottom of said chamber and gas receiving openings of equal size closely adjacent to and at the same distance from the top of said chamber.

THOMAS C. GLEASON.

CERTIFICATE OF CORRECTION.

Patent No. 2,196,858. April 9, 1940.

THOMAS C. GLEASON.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, second column, line 27, claim 3, for "partion" read --portion--; line 29, same claim, for the word "distributing" read --distributor--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 4th day of June, A. D. 1940.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)