United States Patent [19]

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[11] **3,864,938**

[45] **Feb. 11, 1975**

[54] **REFRIGERANT FLOW CONTROL DEVICE**

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[22] Filed: **Sept. 25, 1973**

[21] Appl. No.: **400,475**

[52] **U.S. Cl.** **62/504,** 62/511, 62/525, 137/14, 137/561

[51] **Int. Cl.** **F25b 39/02**

[58] **Field of Search** 62/504, 511, 525, 527, 62/522; 137/14, 561

[56] **References Cited**

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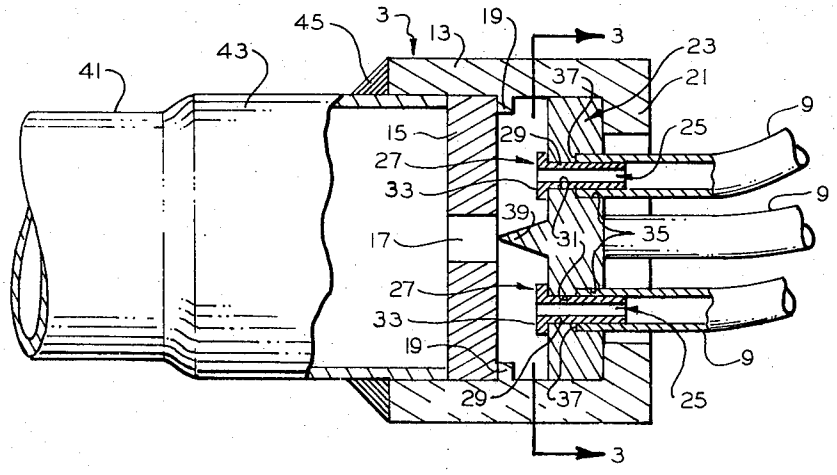
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[57] **ABSTRACT**

A device for controlling the flow of refrigerant to the circuits of a multi-circuit evaporator in a refrigeration system, comprising an orifice plate having a refrigerant expansion orifice and a distributor plate having passages into which interchangeable metering jets are inserted. Refrigerant flows first through the expansion orifice and experiences a first pressure drop, and then through the metering jets which complete the expansion of the refrigerant. Refrigerant feedlines lead from the distributor plate passages to each of the evaporator circuits.

5 Claims, 3 Drawing Figures



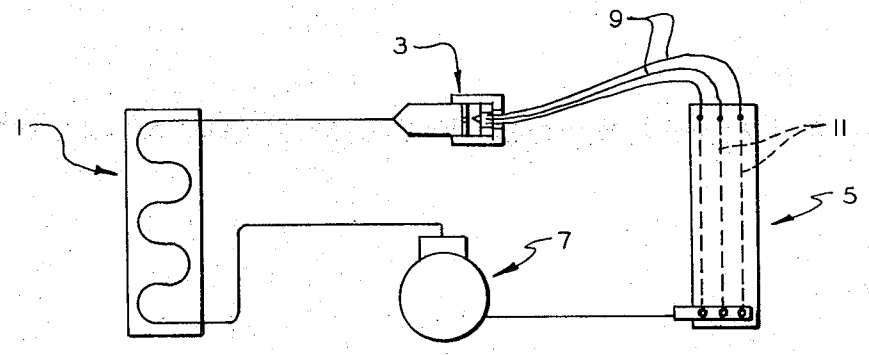


FIG. 1

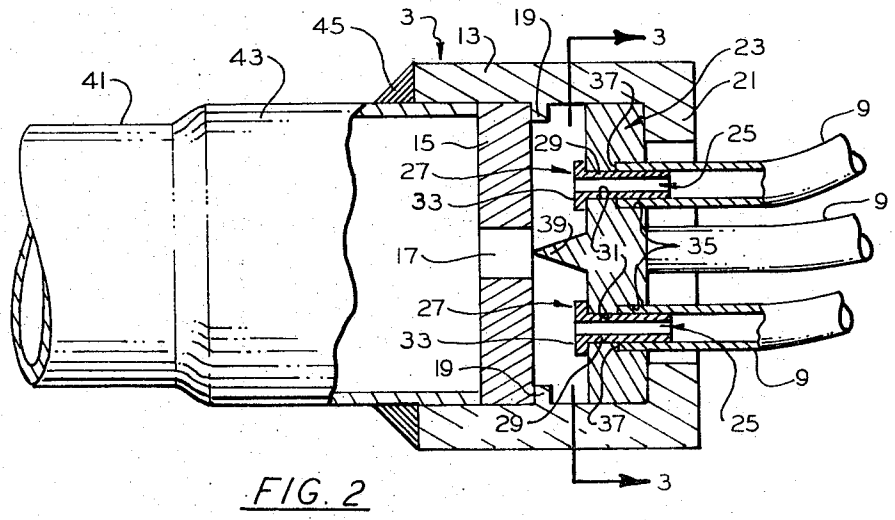


FIG. 2

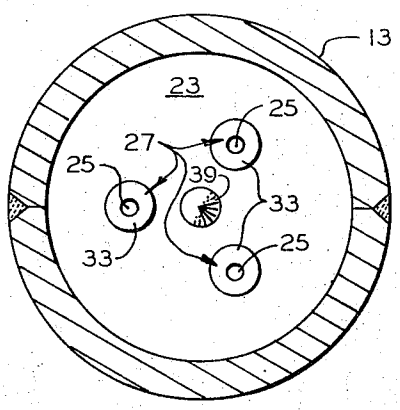


FIG. 3

REFRIGERANT FLOW CONTROL DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to the control of refrigerant flow from a condenser to a multi-circuit evaporator in a refrigeration system, and in particular to the expansion of the refrigerant and to the distribution of the refrigerant to the evaporator circuits.

2. Description of the Prior Art

In compression refrigeration systems, refrigerant liquid flows from a condenser, through an expansion device and into an evaporator. Refrigerant vapor proceeds from the evaporator to a compressor, and then back to the condenser to complete the cycle. Some evaporators have a plurality of refrigerant flow paths extending therethrough, and these evaporators require the use of a distribution device on the upstream side of the evaporator for directing refrigerant to each of the circuits.

It is known in the art to incorporate in a single device means for both metering refrigerant flowing toward the evaporator and means for distributing refrigerant among the evaporator circuits. For example, U.S. Pat. No. 2,803,116 discloses a flow regulating device which comprises a unitary metal element having an inlet passage at one end from which a plurality of refrigerant passages fan out to the outlet of the device. A venturi is provided at the junction of these passages for expanding refrigerant flowing through the device. It is not feasible to modify such a distributor to vary its expansion characteristics.

However, expansion devices are known which incorporate interchangeable inserts having different sizes of restriction orifices. Expansion devices of the latter type are taught by U.S. Pat. Nos. 2,676,470 and 3,311,131. The foregoing devices do not serve to distribute refrigerant among a plurality of circuits.

SUMMARY OF THE INVENTION

An object of the invention is to provide an improved refrigerant flow control device for expanding refrigerant flowing from the condenser to a multi-circuit evaporator in a compression refrigeration system and for distributing the refrigerant among the evaporator circuits.

A more particular object of the invention is to provide a refrigerant flow control device of the preceding type which is adaptable for use in various compression refrigeration systems.

Specifically, it is an object of the present invention to provide a refrigerant flow control device of the foregoing type which can easily be modified to change the expansion characteristics of the device.

A further object of the invention is to provide a device of the foregoing type which can be modified for use with a separate expansion device.

Yet another object of the invention is to provide a refrigerant flow control device for expanding and distributing refrigerant flowing through a refrigeration system, which device can be inspected and cleaned easily.

Other objects will be apparent from the description to follow and from the appended claims.

The preceding objects are achieved according to the preferred embodiment of the invention by the provision of a refrigerant flow control device which serves the dual functions of expanding refrigerant flowing through a compression refrigeration system and of distributing that refrigerant among the circuits of a multi-circuit evaporator in the system. The device comprises a cup-shaped casing in which are mounted an orifice plate having restriction for imparting a first pressure drop to the refrigerant flowing therethrough and a distributor plate having passages in which are inserted both metering jets for completing the expansion of the refrigerant and feedlines leading to the evaporator circuits. The metering jets are removable and interchangeable whereby different size jets can be used to change the expansion characteristics of the device. The device can be disassembled easily for inspection and for cleaning, and the metering jets can be removed from the device entirely when it is to be used in conjunction with another expansion device.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows in schematic form a compression refrigeration system including a refrigerant flow control device according to the present invention, a part of which is cut away to reveal the inner components thereof.

FIG. 2 is a partially cross-section detailed view of the refrigerant flow control device shown in FIG. 1.

FIG. 3 is a view taken in the direction of 3—3 as indicated in FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention in its preferred form comprises a refrigerant flow control device for expanding refrigerant and for distributing the refrigerant to the circuits of a multi-circuit evaporator. The device is adaptable for use under various operating conditions and it can easily be disassembled for inspection and cleaning. The device includes an orifice plate at its inlet end wherein a restriction imparts a first pressure drop to refrigerant liquid flowing from a condenser, and a distributor plate having refrigerant passages in which are inserted interchangeable metering jets for imparting a final pressure drop to the refrigerant. The passages are adapted to receive feedlines which lead to each of the circuits of a multi-circuit evaporator.

Referring now to FIG. 1, a refrigeration system is depicted which includes a condenser 1, a flow control device 3 according to the invention, a multi-circuit evaporator 5, and a compressor 7. Compressed refrigerant gas proceeds from compressor 7 to condenser 1 where it gives up heat and condenses. The liquid refrigerant proceeds through device 3 where it is expanded, and it flows through a set of feedlines 9 which direct the refrigerant to the various refrigerant circuits 11 in evaporator 5. The refrigerant absorbs heat in the evaporator and vaporizes, and the vaporized refrigerant returns to compressor 7.

Flow control device 3 is illustrated in detail in FIG. 2. The device has an outer casing 13 which has a generally cup-shaped configuration. An orifice plate 15 in the form of a disc having a central restriction orifice 17 is located on rim 19 extending inwardly from the side walls of casing 13. End wall 21 of casing 13 locates a distributor plate 23 in a position parallel to that of orifice plate 15. Distributor plate 23 includes a set of passages 25 for conducting refrigerant through the plate. As indicated more clearly in FIG. 3, there are three such passages — one for each circuit in evaporator 5. Each passage 25 is configured to receive a tubular me-

tering jet 27 and the end of a feedline 9. Metering jets 27 are interchangeable inserts comprising tubular portions 29 dimensioned for insertion into a narrow portion 31 of passages 25, and cap 33 for abutting against the upstream face of distributor plate 23. Passages 25 include a widened portion 35 on the downstream side of distributor plate 23 for receiving the ends of feedlines 9. Feedlines 9 are insertable into passages 25 until they abut against shoulders 37 which separate the narrow and wide portions of each of passages 25. Metering jets 27 may be longer than the length of portion 31 of passages 25, in which case the metering jets are in a telescoping relationship with the ends of each of feedlines 9. Metering jets 27 are preferably removable inserts as described more fully below, but feedlines 9 can be permanently bonded to the distributor plate 23 by some appropriate means such as brazing, epoxy, etc.

Distributor plate 23 has on its upstream face a centrally located conical portion 39 for reducing the effective size of orifice 17 to increase the expansion of the refrigerant and for directing refrigerant flowing through orifice 17 toward the upstream face of distributor plate 23.

Refrigerant is directed into device 3 by a refrigerant line 41 which can include an expanded portion 43 for containing a strainer which functions to remove impurities from the refrigerant. Refrigerant line 41 can be connected to casing 13 of device 3 by means of a braze 45, or by some other suitable means.

Refrigerant from condenser 1 flows through refrigerant line 41 and passes through orifice 17 of orifice plate 15. As liquid regrigerant passes through the orifice, some of the liquid flashes to its gaseous state. The gas-liquid mixture is guided in part by the conical surface of element 39 into metering jets 27. By virtue of length and diameter of each of metering jets 27, the remaining liquid refrigerant further expands and flows into feedlines 9 leading to circuits 11 of evaporator 5.

Flow control device 3 can easily be modified to change its refrigerant expansion capabilities. To accomplish this, orifice plate 15 is removed giving access to the upstream side of distributor plate 23. Then, using an appropriate tool, metering jets 27 are removed and exchanged for other jets having the desired expansion capabilities. It is also possible to replace orifice plate 15 with another plate having a different size orifice. Likewise, should it be desired to inspect or clean the interior of metering device 3, orifice plate 15 can be removed and jets 27 can be visually inspected. They can be removed, and if obstructions are present therein, they can be cleaned or replaced. Moreover, when device 3 is to be used in a system having a thermal expansion valve or in some other arrangement wherein the device is to function solely as a distributor, it is practicable to remove metering jets 27. Orifice plate 15 can be removed as well.

The refrigerant flow regulating device according to this invention can be tailor fit to refrigeration systems wherein the circuits in evaporator 5 vary among themselves. In situations where the circuits require different amounts of refrigerant expansion for optimum efficiency, it is entirely feasible to insert appropriate metering jets 27 into distributor plate 23 according to the particular circuit 11 being supplied by the jet. Once device 3 has been assembled and it becomes necessary to open the device up to give access to the interior thereof, it may be necessary to break braze 45 and to subsequently rebraze the juncture between refrigerant line 41 and casing 13. This would present no great difficulty and it could be done in the field.

The components of flow control device 3 can be fabricated from brass or from some other corrosion-resistant metal or plastic, using conventional manufacturing techniques.

The invention has been described in detail with particular reference to a preferred embodiment thereof, but it is to be understood that variations and modifications within the scope of the invention may occur to those skilled in the art to which this invention pertains.

I claim:

1. A refrigerant flow control device for controlling the flow of refrigerant to a multi-circuit evaporator in a refrigeration system, said device comprising:
   - a distributor plate including refrigerant passages for passing refrigerant to feedlines leading to each of the circuits in the evaporators;
   - metering jets having tubular means extending into said refrigerant passages, said tubular means being dimensioned to expand refrigerant flowing therethrough according to the load on the particular circuit receiving refrigerant from the respective metering jets;
   - a casing; and
   - an orifice plate having orifice means dimensioned to expand refrigerant flowing therethrough;
   - said orifice plate and said distributor plate being mounted in spaced parallel relation in said casing.

2. A refrigerant flow control device according to claim 1 wherein said metering jets are removably inserted in said refrigerant passages.

3. A refrigerant flow control device according to claim 1 wherein said refrigerant passages in said distributor plate are configured to receive said metering jets and feedlines leading to each of the evaporator circuits, in a telescoping relationship to the tubular means.

4. A refrigerant flow control device according to claim 1 wherein said metering jets each further include a cap for abutting against said distributor plate when the tubular means is inserted into a passage in said distributor for locating said metering jet in the passage.

5. The invention according to claim 1 wherein the tubular means of at least one of said metering jets is dimensioned differently from the tubular means of others of said metering jets.

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