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54 Improvements in refrigerant distributors and method of setting up the same.

57 An improved distributor for refrigerant in a refrigeration system comprises a nozzle plate (3) in a chamber (2) which plate can be removed directly from the chamber (2) via a plugged passage (12) without disconnecting the inlet (6) or outlets (7) communicating with the chamber (2).

A second nozzle plate (4) can be linked to the first (3) via a sprung linkage (5).

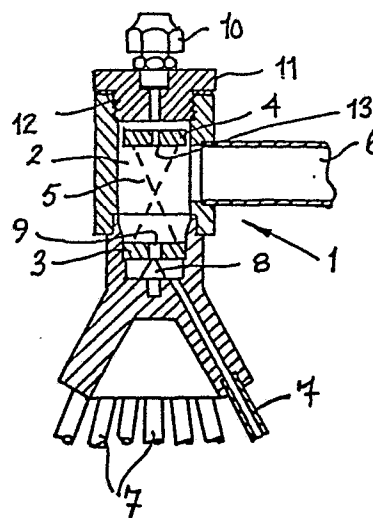


FIG.1

Improvements in refrigerant distributors
and method of setting up the same

This invention relates to a distributor used to feed refrigerant to the component circuits of a multi-circuit evaporator in a direct expansion refrigeration system, and to a method of setting-up such a distributor.

- 5 The even distribution of refrigerant in a multi-circuit evaporator is absolutely essential to maintain stable, efficient operation of the evaporator and consequently the refrigeration system.

10 The universal method used to distribute the refrigerant in a direct expansion evaporator coil to each individual circuit is through small diameter feeder pipes connected together in an accurately machined cone-shaped header so that each pipe is aligned with its neighbour in both position and angle.

- 15 The cone-shaped header is located downstream of the expansion valve (or other refrigerant metering device) and thus has to divide a mixed liquid/vapour to the separate feeder pipes. Although the size of the feeder pipes does, by creating a pressure drop, help considerably
20 with the distribution of the refrigerant, due to the application range, type of refrigerant and site conditions which can occur, they can only partly cope.

25 The basic problem is that unless the refrigerant liquid and "flash gas" mixture, produced at the outlet of the refrigerant metering device and consequently the inlet of the distributor, is a perfect homogeneous mixture when it comes to being shared between the different feeder pipes, poor distribution will occur.

30 For some time, devices of United States manufacture have been used to distribute the liquid refrigerant

between circuits by employing a nozzle plate removably fitted into a cavity just upstream of a cone-shaped deflector to create a mixing point for the refrigerant just prior to its distribution through the separate distribution feeder pipes.

A series of tabulations are given for the selection of the hole size required in the nozzle plate and feeder pipe sizes to suit a particular application and whilst in theory this works satisfactorily, in practice there are limitations.

Due to the varying conditions that occur in practice the actual design parameters are seldom achieved so that the first nozzle size selected is seldom more than just satisfactory and consequently the refrigeration system on initial set-up does not achieve its maximum efficiency.

Although the nozzle plates are removably mounted in the distributor, they can be changed only with difficulty because a considerable amount of refrigeration pipework has to be disconnected and the nozzle plate "fished out" from the cavity which is always difficult and in a low temperature cold room rapidly becomes a most unpleasant task.

Since the changing of a nozzle plate takes a considerable time to effect, and the refrigeration pipework is open to contamination from the atmosphere for so long as the change-over takes, the longer it takes to change the nozzle plate the worse the risk of this contamination becomes.

The selection of a replacement nozzle plate cannot be a precise decision so that nozzle plate change-overs may have to be effected several times before the ideal nozzle plate is in place.

The present invention relates inter alia to an improved refrigerant distributor which reduces the severity of some of the problems detailed above.

According to one aspect of the present invention,
5 a refrigerant distributor comprising a housing defining a refrigerant chamber, an inlet for refrigerant to the chamber and a plurality of outlets for refrigerant from the chamber with a nozzle plate disposed in the chamber is characterised in that the housing includes a nozzle
10 plate removing passage opening into the chamber and seal means for closing said passage.

By having a separate seal means giving access to the chamber containing the nozzle plate, it is only necessary to let down the pressure in the system to gain
15 ready access to the nozzle plate without even minor disconnection of pipework.

Preferably the chamber is large enough to accommodate two nozzle plates, a first in the flowpath of refrigerant from the inlet to the outlets and a second, linked to
20 the first, adjacent to the location where the nozzle plate removing passage opens into the chamber. The second nozzle plate can be provided with a pilot recess or hole of smaller bore than that in the first nozzle plate so that it can be drilled out as required following removal
25 from the housing.

Suitably the linkage between the first and second nozzle plates includes a measure of resilience.

Preferably the housing also includes a pressure measuring point which opens into the chamber upstream
30 of the nozzle plate.

Normally the first nozzle plate would be located

just upstream of a cone-shaped deflector around which are arranged the refrigerant outlets.

Thus in accordance with the invention the tried and proven nozzle type distribution system is used but
5 with the advantage that the nozzle plate is more accessible and consequently it is quicker for an installer of a refrigerating system to change it.

Charts would be provided with each distributor so that predicted nozzle bores could be determined after
10 running the refrigeration system at or close to its operating conditions with the "standard" or first nozzle plate in place in the housing.

By noting the various system pressures and temperatures using a pressure measuring point provided on the
15 housing for obtaining one of those pressures, the predicted nozzle size can be expected to be determined in one operation, thus making just one opening of the chamber for nozzle plate removal necessary.

Another aspect of the invention represents an improved method of setting-up a refrigeration plant using
20 a distributor as defined above and this is featured in the following claim 8.

The invention will now be further described by way of example with reference to the accompanying drawings
25 in which:-

Figure 1 shows a section through a preferred form of distributor,

Figure 2 shows the linked nozzle plates of the distributor of Figure 1 removed from the housing,

Figure 3 shows a further form of distributor with an adjustable valve therein, and

Figure 4 is a graph used for setting-up the refrigerant distributor of Figure 1 or Figure 3.

5 The distributor shown in Figure 1 has a housing 1 defining a chamber 2 that contains a pair of nozzle plates 3 and 4 linked by a linkage generally shown at 5. A refrigerant inlet 6 and a plurality of outlets 7 are provided in the usual manner. A conical deflector 8 is provided centrally below the bore 9 in the plate 3.

A pressure-sensing connection 10 is provided in the housing 1 as is a plug 11 closing a passage 12 large enough to permit removal of the linked plates 3, 4.
15 The plate 4 can have a pilot hole 13 in it so that following removal from the housing 1 it can be drilled out easily to the required bore size.

The pressure sensing connection 10 has been shown in the upper surface of the plug 11 since this is advantageous having regard to manufacturing cost and accessibility for connection to a pressure gauge. However the connection 10 could be located elsewhere, for example in the wall of the housing 1.
20

The pressure sensing connection 10 may be a simple flare connection or it could be a Schröder valve to facilitate the connection of a pressure valve thereto.
25

The linkage 5 can be rods 5a, 5b as shown in Figure 2 which spring load the plates 3, 4 away from each other and aid in retaining the operating nozzle plate 3 in its correct position relative to the conical deflector 8.
30

Figure 3 shows a modified arrangement in which the same reference numerals have been used as were used in Figure 1 but with the addition of a prime.

In the distributor of Figure 3 the chamber 5 2' includes a nozzle plate 3' and the housing 1' includes a valve 13 attached to a spindle 14 which is threadedly engaged in the plug 11'. The valve 13 includes a spigot 15 sliding in a recess 16 to keep the valve 13 central in the aperture 9' in the nozzle plate 3'.

10 This arrangement shown in Figure 3 allows for adjustment without having to break into the refrigerant system at all.

A further possibility is the use of a spring-loaded nozzle with a guide, so that on reverse refrigerant flow 15 conditions (e.g. a reverse cycle defrost) the liquid refrigerant will lift the nozzle and bypass this liquid around the nozzle hole rather than through it to reduce the pressure losses. This arrangement could improve the effectiveness and efficiency of the reverse cycle 20 defrost. Upon restoration of the normal refrigeration effect the nozzle would return to its seat under the action of the spring and guide.

To set-up the distributor shown in Figures 1 and 2, the pressure drop occurring across the distributor 25 needs to be measured during normal operation of the system. This can be assessed with sufficient accuracy by pumping the system down to atmospheric pressure and fitting a suitable pressure gauge to the connection 10. On restarting the system, the difference in pressure (ΔP) between 30 that indicated on the gauge and the suction pressure of the system is noted.

Using the graph shown in Figure 4, provided the

measured ΔP is on the solid part of the respective curve 20 or 21 for the refrigerant (R12 or R22 and 502) used, a ratio can be read off that corresponds to the measured ΔP . This ratio indicates the change required in the diameter of the hole 9. Thus, for example, if the measured ΔP indicated a ratio of 1.25 and the hole has a diameter of 10 mm, the likely new hole diameter would be 12.5 mm and a reboring to at least 12 mm should be made before the ΔP is remeasured.

10 If the ratio is greater than unity, the hole 9 can easily be bored out further, but if the ratio is less than unity, a new nozzle plate with a smaller hole (e.g. plate 4) must be used for the reboring operation.

15 If the measured ΔP is well spaced from the two points 22 indicated on the curves 20 and 21, it is desirable to leave the hole 9 slightly undersize and then to recheck the pressure drop ΔP and obtain a new ratio for a second rebore of the hole 9.

20 To adjust the distributor of Figure 3, the pressure gauge can be connected to the connection 10' and the spindle 14 adjusted to bring the ΔP down to the value shown by the respective normal point 22.

CLAIMS

1. A refrigerant distributor comprising a housing (1) defining a refrigerant chamber (2), an inlet (6) for refrigerant to the chamber (2) and a plurality of outlets (7) for refrigerant from the chamber (2) with
5 a nozzle plate (3) disposed in the chamber (2) characterised in that the housing (1) includes a nozzle plate removing passage (12) opening into the chamber (2) and seal means (11) for closing said passage (12).

2. A distributor as claimed in claim 1, characterised in that the chamber (2) is large enough to accommodate two nozzle plates (3, 4), a first (3) in the flowpath of refrigerant from the inlet (6) to the outlets (7) and a second (4), linked to the first, adjacent to the location where the nozzle plate removing passage (12)
15 opens into the chamber (2).

3. A distributor as claimed in claim 2, characterised in that the second nozzle plate (4) is provided with a pilot hole (13) of smaller bore than that (9) in the first nozzle plate (3) so that it can be drilled
20 out as required following removal from the housing (1).

4. A distributor as claimed in claim 2 or claim 3, characterised in that the linkage (5a, 5b) between the first (3) and second (4) nozzle plates includes a measure of resilience.

25 5. A distributor as claimed in any preceding claim, characterised in that the housing (1) also includes a pressure measuring point (10) which opens into the chamber (2) upstream of the or the first nozzle plate (3).

6. A distributor as claimed in any preceding claim,
30 characterised in that the or the first nozzle plate (3) is located just upstream of a cone-shaped deflector (8)

around which are arranged the refrigerant outlets (7).

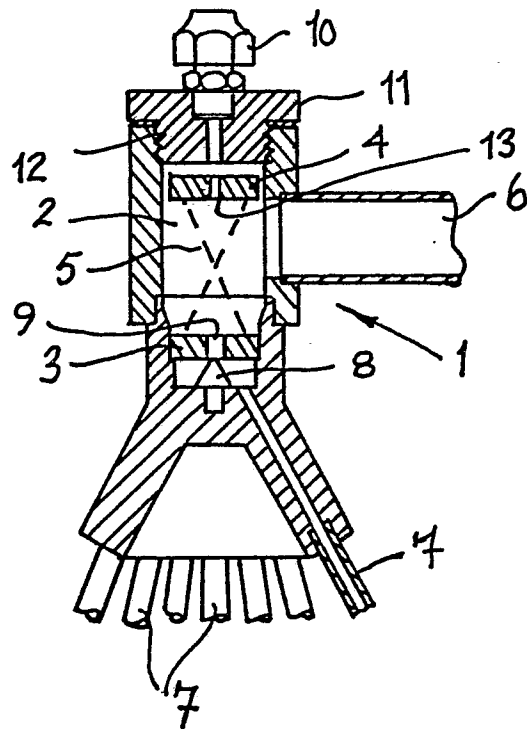
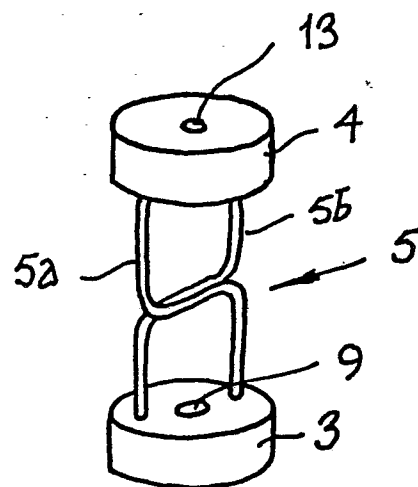
7. A refrigerant distributor comprising a housing (1') defining a refrigerant chamber (2'), an inlet for refrigerant to the chamber (2') and a plurality of outlets (7') for refrigerant from the chamber (2') with a nozzle plate (3') disposed in the chamber (2') characterised in that the housing (1') includes a valve (13), adjustably mounted within the nozzle plate (3') and means (14) accessible from outside the chamber (2') to permit the position of the valve (13) to be adjusted within the nozzle plate (3').

8. A method of setting-up a refrigerant distributor interposed between a refrigerant inlet (6) of a refrigeration system and a plurality of refrigerant outlet pipes (7), of the system, which distributor comprises a housing (1) having a chamber (2) into which the inlet (6) opens, which chamber (2) includes a nozzle plate (3) upstream of a cone-shaped deflector (8), in which method the system is operated and the nozzle plate (3) removed to permit its aperture (9) therein to be enlarged on the basis of the performance of the system with the then-existing aperture (9) in the nozzle plate (3), characterised in that the pressure drop (ΔP) across the distributor is measured during operation of the system and the new aperture (9) is determined from a graph (Figure 4) which plots ΔP against the ratio of existing to new apertures.

9. A method as claimed in claim 8, characterised in that the nozzle plate (3) is removed from the chamber (2) via a normally-plugged passage (12) opening directly into the chamber (2).

10. A method as claimed in claim 8, characterised in that the aperture is adjusted by means of a valve (13) operated by means (14) from outside the chamber (2).

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FIG. 1FIG. 2

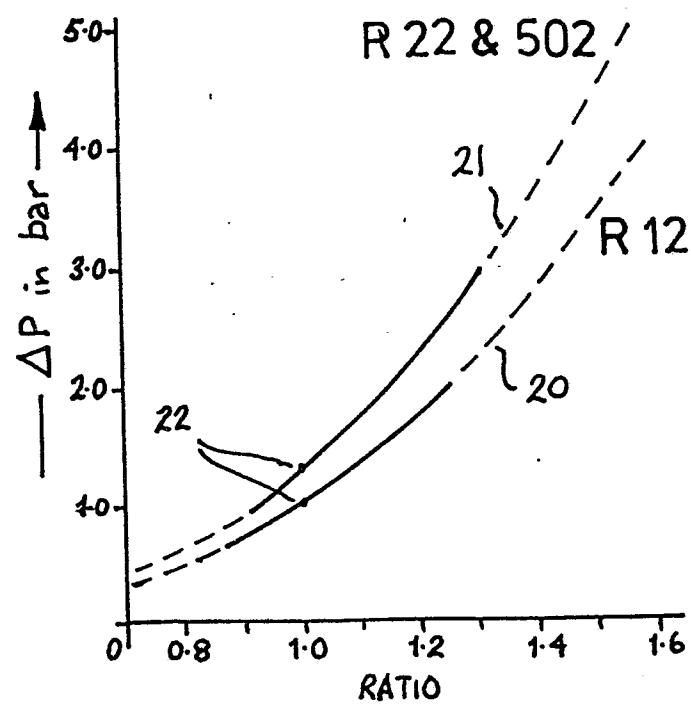
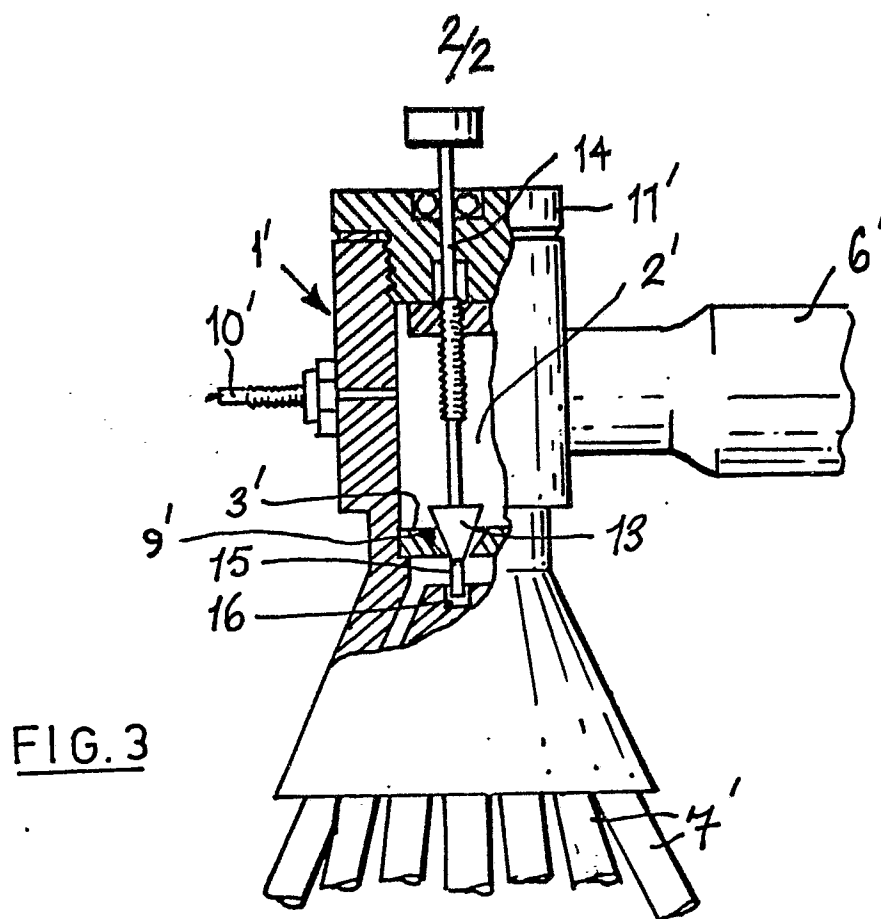


FIG. 4