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54 **Apparatus for the sensing of refrigerant temperature for the control of an evaporator valve.**

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Description

This invention is concerned with a method and apparatus for the sensing of refrigerant temperatures in refrigerator systems and particularly with a method and apparatus for the control of refrigerant loading in refrigerator evaporators. An apparatus having the features defined in the precharacterising portions of claims 1,7 and 9 is disclosed in document US-A-4 229 949.

The standard refrigeration compressor-operated system consists of a closed circuit in which cool low-pressure refrigerant vapour from a suction line enters a compressor which compresses it to a hot high pressure vapour, this hot vapour then flowing through a discharge line to a condenser coil or coils where it is cooled below its condensing temperature and becomes liquid. The liquid flows from the condenser through a return line into a liquid receiver, and from the receiver through a liquid line to an indicator and filter/drier, from whence it passes to a thermostatically controlled expansion valve which maintains at an optimum value the flow of the liquid refrigerant into an evaporator coil or coils, in which it evaporates with consequent temperature drop and cooling of the coils and their environment; the resultant vapour passes through the suction line back to the compressor to complete the circuit.

It is essential to control the expansion valve (usually called the TX valve) so as to prevent any liquid refrigerant from reaching the compressor, which would damage it, and this valve control usually consists of a remote temperature sensing fluid-containing bulb connected by a metal capillary tube to a charged diaphragm capsule in the valve. The capsule responds to changes in temperature of the sensing bulb to regulate the flow through the valve. Equivalent electrical sensors have also been developed. The sensor bulb or its equivalent normally is clamped tightly to the suction line at the exit from an outlet manifold into which the evaporator coil or group of coils discharge so as to sense the temperature of the vapour at this point. The temperature characteristic of a vapourizing body of liquid is very standard in that its temperature will remain relatively constant at about the respective vapourizing (saturation) temperature as long as there is some liquid present to vapourize, and then will rise relatively rapidly when all the liquid is gone. To ensure that no liquid escapes from the evaporator the sensor is set for an operating temperature sufficiently higher than the saturation temperature, and the difference between these two temperatures is known as the superheat. As an example, a quite usual range of values for the saturation temperature of such a system is about -7°C to about 4.5°C (20°F to 40°F), while a quite

usual value for the superheat is about 5.5°C (10°F), so that the range of control temperatures for such systems will be -1°C to 10°C (30°F to 50°F).

In theory it should be possible to use a much lower superheat value, say 1°C (2°F), but it is found in prior art practice that this has not been sufficient to ensure the complete absence of liquid refrigerant from the evaporator manifold outlet and the higher value is therefore almost universally used. As the superheat value varies around the predetermined amount the TX valve opens and closes, and in theory should be operable to maintain it quite accurately at that value, but in practice there is a time lag between the sensing of the temperature by the sensor and the operation of the TX valve, which also usually cannot respond fast enough, resulting in a fluctuating superheat value necessitating the higher amount, thereby reducing the efficiency of the system. There is therefore a continuing need for a temperature sensor for such systems which can more accurately determine the temperature of the refrigerant vapour in the suction line and thus improve the efficiency.

In commercial refrigerators, most evaporators consist of a large number, often as many as fifty, separate "circuit coils" connected in parallel so as to obtain sufficient cooling capacity without the individual coils being of too great length with consequent high pressure drop. These circuit coils are arranged in sets, each set having its own expansion valve and a common distributor interposed between the valve and the coils of the set, the purpose of the distributor being to divide the flow as equally as possible between individual small diameter feed pipes of equal length leading from the distributor to the respective circuit coil pipe inlets. All of the circuit coil pipe outlets are connected to a common outlet manifold or stand-pipe. Despite the care that is taken to try to make the valve and distributor feed equal amounts of liquid refrigerant to the circuit coils, and to make all of the circuit coils as equal in length and flow characteristic as possible, it is in practice always found that liquid refrigerant vapourizes in some of the coils at a different rate than in the others, due to variables such as differences in the flow of air over the different coils, and small differences in the pressure drop through each coil. The consequence is that the circuit coil or coils which absorb the least amount of ambient heat allow the liquid refrigerant to flow further along it or them before vapourizing, so that it is this coil or coils that control the TX valve and close it down, starving the remainder of the coils of liquid refrigerant and excessively superheating the refrigerant vapour in the starved coils, and thereby reducing the cooling capacity of the system. This reduction can be as

much as from about 25 to 35% of the total capacity.

This unequal loading of the evaporator circuit coils can usually be observed by visual inspection of the coils once the system has been in operation of a short time, when the starved circuit coils are less frost coated toward the outlet end than the others. This unequal loading is often mistakenly attributed to unequal distribution of the refrigerant liquid among the coils.

There are disclosed in U.S. Patents Nos. 3,555,845 and 3,740,967, both issued to Danfoss A/S of Denmark, a forced flow evaporator for compression type refrigerating equipment in which part of the evaporator tube, or a tube immediately following the evaporator tube, has its inner wall lined with gauze fabric to provide a capillary system that will absorb any liquid refrigerant, the gauze fabric occupying less than one-half of the cross-sectional area of the tubing, so that a substantial central passage is left through which the vapour passes at high speed without mixing with the liquid retained by the gauze fabric, which thereby effectively forms a relatively stagnant layer on the wall of the tube.

U.S. Patent No. 4,229,949, issued to Stal Refrigeration AB of Sweden, discloses a refrigerator system in which a flow disturbing element is located in the suction pipe downstream of the evaporator, the element operating on the fluid in the pipe to give the two phases found therein, namely liquid particles and superheated vapour, an increased mutual relative speed to increase the heat transfer rate between them and ensure that the refrigerant exits exclusively in the vapour phase. This element consists of a disc provided with openings and arranged perpendicularly to the flow direction of the refrigerant, the disc creating turbulence that accelerates the temperature equalisation.

It is therefore a principal object of the present invention to provide new apparatus for the sensing of refrigerant temperatures in refrigerator systems, and in particular new apparatus by which the temperature of the refrigerant exiting from an evaporator coil is sensed more efficiently by the temperature sensor controlling the TX valve for more precise superheat control.

It is another principal object to provide new apparatus for the control of refrigerant loading in refrigerator evaporator coils.

In accordance with the present invention there is provided apparatus for the sensing of the temperature of refrigerant exiting from a refrigeration system evaporator coil outlet and for the control in accordance with the sensed temperature of a controllable evaporator valve feeding liquid refrigerant to the evaporator coil inlet, the apparatus having an

inlet and an outlet for refrigerant and having therein a refrigerant flow path;

wherein at least part of an exterior wall of the apparatus is of heat conductive material for sensing the interior refrigerant temperature through the wall part;

and the apparatus provides turbulence and mixing producing means in the flow path intercepting the entire refrigerant flow and creating turbulence and mixing of the refrigerant with changes in the direction of the entire refrigerant flow to ensure turbulence and mixing of all liquid and vapour refrigerant phases present and contact of only mixed phases with the wall part.

In accordance with the invention from a first aspect the turbulence and mixing producing means comprises first and second passages having a wall in common between them, the refrigerant flowing from the first passage to the second passage with an abrupt change in direction of the flow and with impingement of the flow against a first surface of the second passage to produce the said turbulence and mixing of the flow in the second passage, and the apparatus being adapted to have in heat conductive contact with the wall part temperature sensing means for sensing the interior refrigerant temperature and for controlling the evaporator valve in accordance with the sensed temperature.

Preferably the said common wall between the first and second passages has therein a plurality of bores through which the refrigerant flows from the first passage to the second passage, the bores thereby producing the said abrupt change in direction of the flow with impingement of the flow against a first surface of the second passage.

The first passage may be provided by a first tubular member, and the second passage may be provided by a second tubular member surrounding the first tubular member to form an annular second passage between them, the said bores being provided in the wall of the first tubular member and directing the refrigerant flow against the inner wall of the second tubular member. One open end of the first tubular member may constitute an inlet to the first passage, and the other end of the member may be closed for impingement of the refrigerant flow against the closed end and resultant turbulence in the first passage. The first passage may be filled with a body of porous turbulating and mixing medium through which the refrigerant must pass from the inlet to the plurality of bores.

In accordance with the invention from a second aspect the turbulence and mixing producing means comprise first junction means dividing the refrigerant flow into two or more separate streams, second junction means subsequently combining the said separate streams with impingement of the streams against one another to create turbulence and mix-

ing between them, and conduit means connecting the first and second junction means for flow of the separate streams between them;

the apparatus being adapted to have the temperature sensing means in heat conductive contact with a wall part at the second junction.

The first junction means may divide the refrigerant flow into two or more separate streams with turbulence producing impingement of the streams against a surface of the junction means transverse to the direction of flow of the refrigerant into the apparatus.

In accordance with the invention from a third aspect the turbulence and mixing producing means comprises an enclosure having an inlet and an outlet and containing within the enclosure a body of porous turbulating and mixing medium through which the refrigerant must pass from the inlet to the outlet;

the flow direction of the inlet and the outlet to the enclosure being radial to the direction of flow of refrigerant through the enclosure and spaced from another along the length of the enclosure to cause corresponding abrupt changes of direction thereof;

the temperature sensing means being adapted to be in heat conductive contact with a wall part adjacent the outlet.

The porous turbulating and mixing medium may be selected from metallic wool, metallic foam, metallic screen, plastic foam or porous ceramic foam.

According to a further embodiment the apparatus of the invention may be characterised by two turbulating and mixing apparatuses connected in series with one another to increase the turbulence and mixing of the refrigerant and improve temperature sensing, temperature sensing means being in heat conductive contact with the downstream of the two apparatuses.

According to a still further embodiment the apparatus of the invention may also be characterised in its use in a refrigeration system having an evaporator coil comprising a plurality of circuit coils connected in parallel with one another so that all are supplied with refrigerant for evaporation from a common control valve;

a common turbulating and mixing device receiving the refrigerant from all of the circuit coils; and

a common superheat temperature sensor sensing the temperature of the refrigerant in the common apparatus and operatively connected to the control valve for control thereof.

Methods and apparatus of the invention will now be described, by way of example with reference to the accompanying schematic and diagrammatic drawings, wherein:

Figure 1 is a schematic diagram illustrating a typical refrigeration system and including a device that is a first embodiment of the invention;

Figure 2 is a longitudinal cross-section to a larger scale of the device of Figure 1;

Figure 3 is a cross-section similar to Figure 2, illustrating a device that is a second embodiment;

Figure 4 is a longitudinal cross-section through an apparatus comprising two devices of Figure 2 in series;

Figure 5 is a longitudinal cross-section through a device that is a fourth embodiment;

Figure 6 is a longitudinal cross-section through an apparatus comprising a device of Figure 5 in series with a device of Figure 2;

Figure 7 is a longitudinal cross-section through a device that is a fifth embodiment; and

Figure 8 is a longitudinal cross-section through an apparatus comprising a device of Figure 7 in series with a device of Figure 2.

The same or similar parts are given the same reference in all the figures of the drawing, wherever that is possible.

Referring now to Figure 1, a typical refrigeration system to which the method and apparatus of the invention can be applied comprises a refrigerant compressor 10 having a suction inlet 12 and a high pressure outlet 14, the compressor feeding the hot compressed refrigerant fluid via conduit 15 to a condenser coil 16 having an inlet 18 and an outlet 20. Cooled refrigerant from the coil 16 passes via conduit 21 to a liquid accumulator 22, and thence via conduit 24 through a filter/drier 26, a liquid indicator 28 and a common thermostatically controlled refrigerant flow control TX valve 30 into a distributor 32, from which it flows into two parallel-connected circuit coils 34a and 34b of an evaporator coil. For convenience in illustration only two circuit coils are shown, but in practice there can be as many as fifty in a single large evaporator coil, each circuit coil being connected by a respective inlet pipe 36a and 36b to the common distributor 32. Again in practice care is taken to make all of the circuit coils 34a, 34b, etc., and all of the pipes 36c, 36b, etc., of the same length and as equal as possible, so that the refrigerant will be distributed as equally as possible among them.

Each circuit coil has an inlet 38a, 38b respectively and an outlet 40a and 40b respectively, the latter all being connected to a common header pipe 42 (sometimes also called a stand-pipe or manifold), the single outlet 44 of which is connected to inlet 46 of a turbulator and mixing device 48 of the invention. A superheat temperature sensing bulb 50 by which the TX valve 30 is controlled is tightly clamped to the exterior of the device 48 by a clamp 51 to be in good heat exchange with its

interior and is connected by a capillary tube 52 to the valve 30. The outlet 54 of the device 48 is connected by conduit 56 to the pump inlet 12 to complete the system circuit. The usual fans 58 and 60 are provided to circulate ambient air over the coils 16 and 34a, 34b respectively. The numerous other circuit elements, controls and indicating devices that such a system normally includes do not constitute part of this invention and therefore do not need to be illustrated. The direction of flow of the refrigerant is indicated by the broken arrows.

Referring now also to Figure 2, this particular device 48 is made of high conductivity metal, such as copper or brass, and consists of a first inner cylindrical pipe 62, one end of which is flanged and constitutes the inlet 46, and the other end 64 of which is closed. A second outer cylindrical pipe 66 of larger diameter surrounds the first inner pipe coaxial therewith and is sealed to the pipe at one end adjacent the inlet 46, while the other end is flanged and constitutes the outlet 54. The interior of the inner pipe is filled with a spirally wound coil 67 of stainless steel open mesh material. The inner pipe has a plurality of holes 68 distributed uniformly along its length and around its periphery, which holes direct the refrigerant vapour entering the inlet 46, together with any liquid entrained therein, forcibly against the inner wall of the outer pipe 66. The pipes and the bores therefore provide within the interior of the device a direction-changing flow path between the inlet and the outlet, the combination of the multitude of tortuous paths formed by the mesh coil 67, the abrupt changes in direction of the fast-flowing fluid, the turbulence in the inner pipe 62 because of the impingement of the fluid against the closed end, and the turbulence in the annular chamber 70 between the two pipes because of the said impingement against the outer pipe inner wall, ensuring that the entire refrigerant flow in the flow path, whether in the liquid or vapour phase, is all thoroughly mixed and rendered turbulent, and particularly without any possibility of the relatively high velocity vapour phase being able to flow through the device separately from the liquid phase. Moreover, the vigorous impingement of the high velocity fluid against the outer pipe inner wall ensures that any relatively stagnant barrier layer of refrigerant, or of the lubricating oil that is always entrained therein, is thoroughly disrupted and removed from the inner wall, so that it cannot prevent the efficient transfer of heat from the refrigerant through the wall to the sensor bulb 50. The bulb is therefore sensing only the temperature of a completely turbulent mixed and temperature averaged refrigerant flow as received from the outlet of the header pipe 42, and in addition is much more sensitive to changes in the refrigerant temperature and more accurately measures the device

interior temperature which corresponds to the averaged refrigerant temperature. This turbulating and mixing function of the device 48 is effective in this manner whatever the evaporator coil structure employed in the system.

When the device is used with a system as specifically described, namely with multiple circuit coils, then in addition to turbulating and mixing the fluid flow in each evaporator circuit coil it also performs a multiple mixing function, whereby the fluid flows from all of the circuit coils are thoroughly mixed together, so that all of their separate temperatures are averaged, and it is this average circuit coil temperature that is detected by the bulb 50. Moreover, this very thorough turbulence and mixing ensures that if one or more of the circuit coils is not evaporating all of its supply of refrigerant, then the small quantities of liquid reaching the mixing device are immediately atomized and consequently easily vapourized by heat from the superheated vapour from the remaining coils. The supply of refrigerant to the starved coil or coils can therefore be increased until the superheated vapour they produce is not able to vaporise the liquid refrigerant from the underloaded coil or coils.

The diameters of the pipes 62 and 66 are such that the flow capacities of the resultant flow passages are about that of the remainder of the suction tube 56, while the number and size of the apertures 68 are such that about the same flow capacity is achieved. These flow capacities can vary between about 0.5 and 1.5 times the usual flow capacity of the suction tube; it may be preferred to reduce the flow capacity of the apertures 68 somewhat below that of the suction tube in order to obtain sufficiently forceful impingement of the fluid against the outer tube inner wall.

In one specific embodiment intended for use in a system of about 3-5 h.p. the outer pipe 66 is about 20-25 cm (8-10 ins.) long and 4.0 cm. (1.6 ins.) outside diameter; the inner pipe 62 is 2.75 cm (1.1 in.) outside diameter and is provided with 40 uniformly spaced holes 68 of 0.47 cm (0.19 ins.) diameter. The mesh insert 67 consisted of a piece of stainless steel fine wire mesh corrugated diagonally to its length measuring 10cm by 15cm (4ins by 6ins) wound into a spiral sufficiently tightly to permit its insertion into the pipe, where it will expand to completely fill the space. It will be understood that it is not possible to accurately illustrate such a tightly rolled spiral in the drawings.

In another embodiment intended for a system of about 10-15 h.p. the outer pipe 66 is 5.25 cm (2.1 in.) outside diameter, the inner pipe 62 is 4.0 (1.6 in.) outside diameter and the holes 68 are 0.6 cm (0.25 in.) diameter. It is found in practice that the pressure drop through the devices of the invention is sufficiently low, usually less than about 1

p.s.i., that it does not produce any appreciable loss of efficiency, and any loss for this reason is amply compensated by the overall considerably improved efficiencies that usually are obtained. The drop is sufficiently small that it is difficult, if not impossible, to detect with the pressure gauges that are used in standard refrigeration service practice.

Despite the lengthy period of time for which these problems have existed it does not appear to have been understood how to provide turbulator means and/or mixing means that will sufficiently improve the temperature detection and control of the TX valve, and also in multiple coil systems to average the temperatures of the refrigerant flows from the large number of individual circuit coils for the same purpose, and to the best of my knowledge none of the arrangements proposed in U.S. Patent Nos. 3,555,845; 3,740,967 and 4,222,949 are in commercial use. Thus, the current literature in the industry of which I am aware seems to assume that all that can be done is to make the lengths of the circuit coils as equal as possible, to discharge all of the circuit coils into a common header pipe, and to clamp the sensor bulb to the outside of the outlet pipe from the header pipe, when the temperature will be measured as accurately as possible and the flows will be mixed to the maximum obtainable extent.

I believe that this mistaken assumption may have resulted from a lack of adequate appreciation of the flow conditions of the refrigerant fluid in the evaporator coils and the outlet pipe or manifold. The refrigerant enters the coils as a low volume liquid and is evaporated in the confined spaces thereof to a high volume vapour, with the result that the exit speed of the vapour is relatively high, to the extent that in the absence of the highly positive turbulating and/or mixing method and corresponding apparatus of the invention, involving the entire fluid flow or flows, the flows in the coils remain laminar and any liquid particles remain entrained without mixing, while there is little or no opportunity for the flows from the different coils to mix and average. Consequently there is little opportunity for any small quantities of liquid refrigerant to be evaporated, before the temperature must be sensed by the bulb 50. It is essential for the turbulating and mixing to be carried out across the entire cross-section of the flow path, since any gaps will allow the corresponding portion or portions of the high velocity fluid passing through them to remain laminar with liquid particles entrained and defeat the purpose of the device. The situation would not be made much better in the prior art apparatus by placing the sensor bulb 50 further along the suction pipe 56, since the flows will still remain relatively laminar along the pipe, and any additional distance of the bulb from the evaporator outlet and from the

TX valve introduces additional difficulty because of the increased time delay for operation of the valve.

As evidence of this current lack of appreciation of the problem there is and has been considerable discussion of the best physical arrangement for the coils to ensure that are equally loaded, and it has been considered important in prior refrigeration systems to locate the sensor bulb 50 appropriately on the circumference of the suction pipe in order to sense the superheat temperature as accurately as possible and operate with minimum superheat. The manufacturers of TX valves in their installation manuals stress the importance of proper location of the sensor bulb, but do not give a definitive location for it. They advise that preferably the bulb should be fastened preferably to a horizontal portion of the suction line, and clamped at different places around its circumference at different places depending on the diameter, but the location is finally chosen by the installer depending upon what appears to be suitable and/or practicable for that installation, often with poor results. The theoretically ideal location is at 6 o'clock on the circumference of a horizontal suction pipe, where it should be able to sense most accurately any small quantity of liquid refrigerant passing in the pipe, and would therefore permit the smallest amount of superheat. In practice this has not been a satisfactory location because of the presence of lubricant oil in the refrigerant, which flows along the bottom of the pipe and would thermally insulate the sensor bulb from the refrigerant fluid. The usual location for the bulb has therefore been at four or eight o'clock on the pipe circumference. It is found that with the thorough turbulence and mixing provided that the location of the sensor bulb around the circumference of the device is quite immaterial, and it can be placed at the most convenient location from the point of view of installation as close to the valve as possible and subsequent access for service. It will also be seen that the sensor need not be located directly on the wall of the mixing device enclosure, which is the preferred location, but should be located as close as possible to the device outlet. In addition it is now found quite unnecessary to locate the sensor bulb on a horizontal portion of the suction line, and the attitude of the device has no effect upon its performance. It has also been found that the device is relatively insensitive to being installed so that the inlet is the outlet, and vice versa, although of course this is not recommended; a small decrease in efficiency of operation has been noted when this has occurred.

The effectiveness of a device of the invention can readily be seen by visual inspection of the evaporator coil before and after its installation. Before installation it is usually found that the frost deposition on the different circuit coils is non-

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uniform with some of them completely frosted up to the outlet, while others are not frosted for a substantial distance back from the outlet, showing that the latter are starved of refrigerant and are working much below their maximum cooling capacity. Also the evaporator common outlet member is only partially frosted. With the device installed all of the circuit coils become more or less equally frosted, as well as the entire length of the suction manifold, indicating that all of the circuit coils are now operating at their full designed capacity. It is now found possible safely to reduce the amount of superheat from the prior value of about 5.5°C (10°F) to as low as 2°C (4°F). In some installations the resultant improvement in cooling capacity of the system can reach as much as 25-35%, indicating that the system previously was operating at only 74-80% of the available capacity.

As a specific example, in an installation employing compressors totaling 200 H.P. and eight forced air evaporator coils the system prior to the installation of the devices of the invention took 3 hours, 10 minutes to cool the room temperature from 13°C (55°F) to -19°C (-2°F). With the devices installed the time taken was reduced to 2 hours, 10 minutes, an improvement of 29% in efficiency or equivalent to increasing the output of the compressors to about 258 H.P.

An important advantage that has been found to follow from use of the invention, demonstrating its unexpected nature, is the flexibility that is obtained upon installation in not having to closely match the size of the TX valve to the evaporator coil capacity without the valve losing control of the refrigerant flow. The capacity of a TX valve is determined both by the size of its flow aperture and the head pressure across the aperture, and it has been important in prior art installations for this match to be as close as possible. For example, one manufacturer provides 21 different sizes of valve to cover the range 0.5-180 tons, those in the range 0.5 - 3 tons being rated in 0.5 ton increments, with progressively increasing intervals up to the maximum. If the valve is too large then with the high superheat values employed the valve hunts, overfeeding and underfeeding the evaporator with resultant poor efficiency and danger of liquid reaching the compressor because of the over-large flow capacity of the valve while open. On the other hand, with the valve and coil sizes closely matched it becomes necessary to maintain the head pressure above a minimum value, since otherwise the valve flow capacity becomes too low. This penalizes the system in winter when the air cooled condensers are very efficient and could operate with lower head pressure; instead it is necessary to maintain it artificially high by various techniques that are available. This means that the power required to compress the

refrigerant must also be maintained at a corresponding high uneconomical value.

This loss of control is easily observed in practice. For example, if the evaporator fan stops for some reason, perhaps a broken fuse, or the flow of product being cooled is interrupted, the load on the coil drops suddenly, faster than can be controlled by the valve, and liquid floods the compressor, which then becomes covered with frost when it should be frost-free. The liquid refrigerant washes out the lubricant, and can cause valve breakage and damage. Again, if the automatic coil defrost system is not operating satisfactorily and the coils become coated with ice the load on each coil drops and control can be lost; this of course is easily detected by visual inspection of the coils.

Upon installation of a device or devices of the invention it is found that this close match of load capacities is no longer necessary and an oversize valve can be employed successfully. In a specific example, in a system with a 1.5 ton evaporator the original 2 ton rated valve was replaced with an 8 ton rated valve; adequate control was maintained with the superheat value fluctuating about 0.5° - 1°C (1° - 2°F). Thus with a larger orifice TX valve it is no longer necessary to keep the head pressure at an artificially high value to maintain adequate refrigerant flow through the valve, and instead it could be allowed to drop to a lower level and still maintain proper superheat control with maximum evaporator capacity. This not only maximizes the efficiency of the system but also provides the possibility of reducing the number of different sizes of valves required for a full range of installation sizes.

As described above, the sensor bulb preferably is installed on the device as close as possible to the device outlet 54 where the maximum mixing has occurred. In the embodiment of Figure 3 the external tube 66 is provided with an integral elongated neck portion 66a constituting the outlet 54 to facilitate fastening of the bulb to the device. In this embodiment the interior of the inner pipe 62 is completely filled with metallic wool 86 as a mixing medium, in place of the rolled screen of the embodiment of Figure 1

Figure 4 shows another arrangement in which a second turbulating/mixing device 48b of the invention, of essentially the same body structure as the first device 48, now having the reference 48a, is connected in series with the first device, the sensor bulb 50 being installed on the downstream device 48a. The second device provides additional mixing with correspondingly improved performance of the TX valve, without too great an increase in pressure drop along the suction line, by suitable choice of the flow capacities of the respective internal passages and the bores 68. A mesh coil 67 (or body 86 of metallic wool) can be installed in

either or both of the devices and is shown installed in device 48a.

Figure 5 shows an embodiment in which the refrigerant flow path is provided by conduits forming two T-shaped junctions 74 and 76 connected by U-shaped connectors 78a and 78b; the connectors may be of smaller internal cross-section diameter to produce an increase in flow velocity of the refrigerant. The junction 74 divides the refrigerant flow from the common header 42 into two separate approximately equal sub-streams which are rendered turbulent by their impact against the transverse wall of the T cross-bar, the two streams moving separately at high velocity in the connectors 78a and 78b and being re-combined with a "head-on" collision in the cross-bar of the junction 76 back into a single stream. This collision of the two turbulent sub-streams produces even more turbulent mixing thereof, so that effective mixing and turbulence takes place before the refrigerant is delivered to the leg 77 of the second T-shaped junction to which the bulb 50 is attached. Although in this embodiment the refrigerant flow is divided into only two separate streams in other embodiments it may be divided into more than two, all of which are simultaneously or sequentially recombined.

Figure 6 shows an arrangement in which the device 72 is followed by a device 48 so as to obtain the combined effect of the two devices, the bulb 50 being in this case attached to the downstream device 48.

Figure 7 shows a further embodiment wherein the device consists of a container 80 having an inlet 82 for unturbulated, unmixed refrigerant and an outlet 84 for turbulent mixed refrigerant spaced from another along the length of the container, the inlet and outlet both being disposed radially with respect to the longitudinal axis of the container, so that abrupt changes in direction of the fluid flow path are produced. The interior of the container is filled with a porous turbulating and mixing medium 86 through which all of the refrigerant must pass in moving from the inlet to the outlet. The movement of the refrigerant fluid through the myriad of random interconnected channels in the medium 86 ensures the necessary thorough turbulence and/or mixing thereof. A suitable medium is for example metallic wools, foams or screens, or other suitable metallic media, particularly of stainless steel or aluminum, packed sufficiently densely to achieve the desired amount of turbulence and mixing without too great a pressure drop. Other media such as open-celled porous plastic and ceramic foams can also be used. Sensor bulb 50 is firmly clamped to the container exterior wall, which is sufficiently heat conductive, as close as possible to the outlet 84. In an example the container 80 was 10cm (4ins) in

diameter and 25cm (10ins) long and was packed with stainless steel wool. Advantageously the body of wool is surrounded by at least a single layer of wire mesh to ensure that pieces of the wool cannot break off and enter the system.

Figure 8 shows an arrangement in which the device 80 of Figure 7 is used as a pre-turbulator and pre-mixer for a second downstream device 48, so as again to obtain the combined effect of the two devices.

Claims

1. Apparatus (48) for the sensing of the temperature of refrigerant exiting from a refrigeration system evaporator coil outlet (40a, 40b) and for the control in accordance with the sensed temperature of a controllable evaporator valve (30) feeding liquid refrigerant to the evaporator coil inlet (38a, 38b), the apparatus having an inlet (44) and an outlet (54) for refrigerant and providing therein a refrigerant flow path;
 - wherein at least part of an exterior wall (66) of the apparatus is of heat conductive material for sensing the refrigerant interior temperature through the wall part;
 - and the apparatus comprises turbulence and mixing producing means (62, 64, 68) in the flow path intercepting the entire refrigerant flow and creating turbulence and mixing of the refrigerant with changes in the direction of the entire refrigerant flow to ensure turbulence and mixing of all liquid and vapour refrigerant phases present and contact of only mixed, phases with the wall part;
 - characterised in that the turbulence and mixing producing means comprises first and second (70) passages having a wall in common between them, the refrigerant flowing from the first passage to the second passage with an abrupt change in direction of the flow and with impingement of the flow against a first surface of the second passage to produce the said turbulence and mixing of the flow in the second passage;
 - the apparatus being adapted to have in heat conductive contact with the wall part temperature sensing means (50) for sensing the refrigerant temperature within the device and for controlling the evaporator valve (30) in accordance with the sensed temperature.
2. Apparatus as claimed in claim 1, characterised in that the said common wall between the first and second passages has therein a plurality of bores (68) through which the refrigerant flows from the first passage to the second passage (70), the bores thereby producing the said

abrupt change in direction of the flow with impingement of the flow against a first surface of the second passage.

3. Apparatus as claimed in claim 2, characterised in that the first passage is provided by a first tubular member (62), and the second passage is provided by a second tubular member (66) surrounding the first tubular member to form an annular second passage (70) between them, the said bores (68) being provided in the wall of the first tubular member (62) and directing the refrigerant flow against the inner wall of the second tubular member (66).
4. Apparatus as claimed in claim 3, characterised in that one open end of the first tubular member (62) constitutes an inlet (46) to the first passage, and the other end (64) of the member is closed for impingement of the refrigerant flow against the closed end and resultant turbulence in the first passage.
5. Apparatus as claimed in any one of claims 1 to 4, characterised in that the first passage is filled with a body (67) of porous turbulating and mixing medium through which the refrigerant must pass from the inlet to the plurality of bores.
6. Apparatus as claimed in claim 5, characterised in that the said porous turbulating and mixing medium (67) is selected from metallic wool, metallic foam, metallic screen, plastic foam or porous ceramic foam.
7. Apparatus for the sensing of the temperature of refrigerant exiting from a refrigeration system evaporator coil outlet (40a, 40b) and for the control in accordance with the sensed temperature of a controllable evaporator valve (30) feeding liquid refrigerant to the evaporator coil inlet (38a, 38b), the apparatus having an inlet (74) and an outlet (76) for refrigerant and providing therein a refrigerant flow path;
 - wherein at least part of an exterior wall of the apparatus is of heat conductive material for sensing the refrigerant interior temperature through the wall part;
 - and the apparatus comprises turbulence and mixing producing means (74, 76, 78a, 78b) in the flow path intercepting the entire refrigerant flow and creating turbulence and mixing of the refrigerant with changes in the direction of the entire refrigerant flow to ensure turbulence and mixing of all liquid and vapour refrigerant phases present and contact of only mixed phases with the wall part;

characterised in that the turbulence and mixing producing means comprises first junction means (74) dividing the refrigerant flow into two or more separate streams, second junction means (76) subsequently combining the said separate streams with impingement of the streams against one another to create turbulence and mixing between them, and conduit means (78a, 78b) connecting the first and second junction means (74, 76) for flow of the separate streams between them;

the apparatus being adapted to have in heat conductive contact with a wall part at the second junction temperature sensing means (50) for sensing the refrigerant temperature within the apparatus and for controlling the evaporator valve (30) in accordance with the sensed temperature.

8. Apparatus as claimed in claim 7, characterised in that the first junction means (74) divide the refrigerant flow into two or more separate streams with turbulence producing impingement of the streams against a surface of the junction means transverse to the direction of flow of the refrigerant into the apparatus.
9. Apparatus for the sensing of the temperature of refrigerant exiting from a refrigeration system evaporator coil outlet (40a, 40b) and for the control in accordance with the sensed temperature of a controllable evaporator valve (30) feeding liquid refrigerant to the evaporator coil inlet (38a, 38b), the apparatus having an inlet (82) and an outlet (84) for refrigerant and providing therein a refrigerant flow path;
 - wherein at least part of an exterior wall (80) of the apparatus is of heat conductive material for sensing the refrigerant interior temperature through the wall part;
 - and the apparatus comprises turbulence and mixing producing means (82, 84, 86) in the flow path intercepting the entire refrigerant flow and creating turbulence and mixing of the refrigerant with changes in the direction of the entire refrigerant flow to ensure turbulence and mixing of all liquid and vapour refrigerant phases present and contact of only mixed phases with the wall part;
 - characterised in that the turbulence and mixing producing means comprises an enclosure (80) having an inlet (82) and an outlet (84) and containing within the enclosure a body (86) of porous turbulating and mixing medium through which the refrigerant must pass from the inlet to the outlet;
 - the flow direction of the inlet (82) and the outlet (84) to the enclosure being radial to the

direction of flow of refrigerant through the enclosure and spaced from another along the length of the enclosure (80) to cause corresponding abrupt changes of direction thereof;

the apparatus being adapted to have in heat conductive contact with a wall part adjacent the outlet (84) temperature sensing means (50) for sensing the refrigerant temperature within the apparatus and for controlling the evaporator valve (30) in accordance with the sensed temperature.

10. Apparatus as claimed in claim 9, characterised in that the said porous turbulating and mixing medium (86) is selected from metallic wool, metallic foam, metallic screen, plastic foam or porous ceramic foam.

11. Apparatus as claimed in any one of claims 1 to 10, characterised by two turbulating and mixing apparatuses (48, 72, 80) connected in series with one another to increase the turbulence and mixing of the refrigerant and improve temperature sensing, temperature sensing means (50) being adapted to be in heat conductive contact with the downstream of the two apparatuses.

12. Apparatus as claimed in any one of claims 1 to 11, characterised in its use in a refrigeration system having an evaporator coil comprising a plurality of circuit coils (34a, 34b) connected in parallel with one another so that all are supplied with refrigerant for evaporation from a common control valve (30);

a common turbulating and mixing device (48, 76, or 80) receiving the refrigerant from all of the circuit coils; and

a common superheat temperature sensor (50) sensing the temperature of the refrigerant in the common apparatus and operatively connected to the control valve (30) for control thereof.

Patentansprüche

1. Vorrichtung (48) zum Kühlmitteltemperaturfühlen, wobei das Kühlmittel aus einem Ausgang (40a, 40b) einer Kühlmittelanlagenverdampferspule austritt, und zum Kontrollieren, in Übereinstimmung mit der gefühlten Temperatur, eines kontrollierbaren Verdampferventils (30), das das flüssige Kühlmittel einem Eingang (38a, 38b) der Verdampferspule zuführt, wobei die Vorrichtung einen Eingang (44) und einen Ausgang (54) für das Kühlmittel aufweist und in ihrem Inneren einen Kühlmittelflußweg zur

Verfügung stellt; zumindest ein Teil einer äußeren Wand (66) der Vorrichtung aus wärmeleitendem Material zum Fühlen der inneren Kühlmitteltemperatur durch diesen Wandteil besteht; und die Vorrichtungen Verwirbelungs- und Vermischungsmittel (62, 64, 68) in dem Flußweg aufweist, die den kompletten Kühlmittelfluß unterbricht und Verwirbelungen sowie Vermischung des Kühlmittels unter Richtungsänderung des kompletten Kühlmittelflusses hervorruft, um Verwirbelung und Vermischung aller vorhandenen flüssigen und gasförmigen Kühlmittelphasen sowie das Kontaktieren nur gemischter Phasen mit dem Wandteil sicherzustellen; dadurch gekennzeichnet, daß das Verwirbelungs- und Vermischungsmittel eine erste Durchführung und eine zweite Durchführung (70) aufweist, wobei die Durchführungen zwischen sich eine gemeinsame Wand haben und das Kühlmittel von der ersten Durchführung zu der zweiten Durchführung unter abrupter Richtungsänderung des Flusses und unter Auftreffen des Flusses auf eine erste Oberfläche der zweiten Durchführung fließt, um besagte Verwirbelungen und Vermischung des Flusses in der zweiten Durchführung herzustellen; und daß die Vorrichtung einen Wärmeleitkontakt mit dem Wandteiltemperaturfühlmittel (50) zum Kühlmitteltemperaturfühlen innerhalb der Vorrichtung und zum Kontrollieren des Verdampferventils (30) in Übereinstimmung mit der gefühlten Temperatur haben kann.

2. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß besagte gemeinsame Wand zwischen der ersten Durchführung und der zweiten Durchführung eine Vielzahl von Bohrungen (68) aufweist, durch welche der Kühlmittelfluß von der ersten Durchführung zu der zweiten Durchführung (70) fließt, wobei die Bohrungen besagte abrupte Richtungsänderung des Flusses beim Auftreffen des Flusses auf eine erste Oberfläche der zweiten Durchführung erzeugen.

3. Vorrichtung nach Anspruch 2, dadurch gekennzeichnet, daß die erste Durchführung durch ein erstes Röhrenteil (62) bereitgestellt ist, und die zweite Durchführung durch ein zweites Röhrenteil (66) bereitgestellt ist, das das erste Röhrenteil umgibt, um eine ringförmige zweite Durchführung (70) zwischen diesen Röhrenteilen zu bilden, wobei besagte Bohrungen (68) in der Wand des ersten Röhrenteils (62) zur Verfügung gestellt sind und den Kühlmittelfluß gegen die innere Wand des zweiten Röhrenteils (66) lenken.

4. Vorrichtung nach Anspruch 3, dadurch gekennzeichnet, daß ein offenes Ende des ersten Röhrenteils (62) einen Eingang (46) in die erste Durchführung bildet, und das andere Ende (64) des Teils zum Auftreffen des Kühlmittelflusses auf das geschlossene Ende verschlossen ist, was zur Verwirbelung in der ersten Durchführung führt. 5
5. Vorrichtung nach einem der Ansprüche 1 bis 4, dadurch gekennzeichnet, daß die erste Durchführung mit einem Körper (67) aus einem porösen Verwirbelungs- und Vermischungsmedium gefüllt ist, durch welches das Kühlmittel von dem Eingang zu der Vielzahl der Bohrungen fließen muß. 10 15
6. Vorrichtung nach Anspruch 5, dadurch gekennzeichnet, daß als besagtes poröse Verwirbelungs- und Vermischungsmedium (67) Metallwolle, Metallschaum, ein Metallsieb, 20 Plastikschaum oder poröser Keramikschaum gewählt ist.
7. Vorrichtung zum Kühlmitteltemperaturfühlen, wobei das Kühlmittel aus einem Ausgang (40a, 25 40b) einer Kühlmittelanlagenverdampferspule austritt, und zum Kontrollieren, in Übereinstimmung mit der gefühlten Temperatur, eines kontrollierbaren Verdampferventils (30), das das flüssige Kühlmittel dem Eingang (38a, 38b) der Verdampferspule zuführt, wobei die 30 35 40 45 50 55
- Vorrichtung einen Eingang (44) und einen Ausgang (76) für das Kühlmittel aufweist und in ihrem Inneren einen Kühlmittelflußweg bereitstellt; zumindest ein Teil einer äußeren Wand der Vorrichtung aus wärmeleitendem Material zum Fühlen der inneren Temperatur des Kühlmittels durch den Wandteil besteht; und die Vorrichtung ein Verwirbelungs- und Vermischungsmittel (74, 76, 78a, 78b) in dem Flußweg umfaßt, das den kompletten Kühlmittelfluß unterbricht und Verwirbelung und Vermischung des Kühlmittels unter Richtungsänderung des kompletten Kühlmittelflusses hervorruft, um Verwirbelung und Vermischung aller vorhandenen flüssigen und gasförmigen Kühlmittelphasen und das Kontaktieren nur gemischter Phasen mit dem Wandteil sicherzustellen; dadurch gekennzeichnet, daß das Verwirbelungs- und Vermischungsmittel ein erstes Verzweigungsmittel (74), das den Kühlmittelfluß in zumindest zwei unterschiedliche Ströme aufteilt, ein zweites Verzweigungsmittel (74), das anschließend besagte unterschiedliche Strömungen unter Zusammenstoßen der Strömungen aufeinander verbindet, um Verwirbelung und Vermischung zwischen denselben hervorzurufen, und Leitungen (78a, 78b) umfaßt, die das erste und zweite Verzweigungsmittel (74, 76) verbinden, um den Fluß der unterschiedlichen Strömungen zwischen diesen zu ermöglichen; und daß die Vorrichtung einen wärmeleitenden Kontakt mit einem Wandteil an dem Temperaturfühlmittel (50) des zweiten Verzweigungsmittels zum Fühlen der Kühlmitteltemperatur innerhalb der Vorrichtung und zum Kontrollieren des Verdampferventils (30) in Übereinstimmung mit der gefühlten Temperatur haben kann.
8. Vorrichtung nach Anspruch 7, dadurch gekennzeichnet, daß das erste Verzweigungsmittel (74) den Kühlmittelfluß in zumindest zwei verschiedene Strömungen aufteilt, wobei Auftreffen der Strömungen auf eine Oberfläche des Verzweigungsmittels quer zur Kühlmittelflußrichtung in die Vorrichtung Verwirbelung hervorruft.
9. Vorrichtung zum Kühlmitteltemperaturfühlen, wobei das Kühlmittel aus einem Ausgang (40a, 40b) einer Kühlmittelanlagenverdampferspule austritt, und zum Kontrollieren, in Übereinstimmung mit der gefühlten Temperatur, eines kontrollierbaren Verdampferventils (30), das das flüssige Kühlmittel einem Eingang (38a, 38b) der Verdampferspule zuführt, wobei die Vorrichtung einen Eingang (82) und einen Ausgang (84) für das Kühlmittel aufweist und in ihrem Inneren einen Kühlmittelflußweg bereitstellt; zumindest ein Teil einer äußeren Wand (80) der Vorrichtung aus wärmeleitendem Material zum Fühlen der inneren Kühlmitteltemperatur durch diesen Wandteil besteht; und die Vorrichtung ein Verwirbelungs- und Vermischungsmittel (82, 84, 86) in dem Flußweg umfaßt, das den kompletten Kühlmittelfluß unterbricht und Verwirbelung und Vermischung des Kühlmittels unter Richtungsänderung des kompletten Kühlmittelflusses hervorruft, um Verwirbelung und Vermischung aller vorhandenen flüssigen und gasförmigen Kühlmittelphasen und das Kontaktieren nur von gemischten Phasen mit dem Wandteil sicherzustellen; dadurch gekennzeichnet, daß das Verwirbelungs- und Vermischungsmittel eine Einfassung (80) mit einem Eingang (82) und einem Ausgang (84) und innerhalb der Einfassung einen Körper (86) aus porösem Verwirbelungs- und Vermischungsmedium aufweist, durch welches das Kühlmittel von dem Eingang zu dem Ausgang fließen muß; daß die Flußrichtung innerhalb des Eingangs (82) und die innerhalb des Ausgangs (84) radial bezüglich der Kühlmittelflußrichtung durch

die Einfassung verlaufen und voneinander durch den Abstand der Einfassung (80) getrennt sind, um entsprechend abrupte Richtungsänderungen des Kühlmittelflusses hervorzurufen; und

daß die Vorrichtung einen Wärmeleitkontakt mit dem Wandteil haben kann, der benachbart zu dem Ausgang (84) des Temperaturfühlmittels (50) zum Fühlen der Kühlmitteltemperatur innerhalb der Vorrichtung und zum Kontrollieren des Verdampferventils (30) in Übereinstimmung mit der gefühlten Temperatur ist.

10. Vorrichtung nach Anspruch 9, dadurch gekennzeichnet, daß als besagtes poröse Verwirbelungs- und Vermischungsmedium (86) Metallwolle, Metallschaum, ein Metallsieb, Plastikschaum oder poröser Keramikschaum ausgewählt ist.

11. Vorrichtung nach einem der Ansprüche 1 bis 10, dadurch gekennzeichnet, daß zwei Verwirbelungs- und Vermischungseinrichtungen (48, 72, 80) in Serie miteinander verbunden sind, um die Verwirbelung und Vermischung des Kühlmittels zu erhöhen und die Temperaturführung zu verbessern, wobei das Temperaturfühlmittel (50) in wärmeleitendem Kontakt mit dem Ausstrom der beiden Einrichtungen sein kann.

12. Vorrichtung nach einem der Ansprüche 1 bis 11, gekennzeichnet durch seine Verwendung in einer Kühlmittelanlage mit einer Verdampferspule, die eine Vielzahl von Umlaufspulen (34a, 34b) umfaßt, die parallel zueinander verbunden sind, so daß sie alle mit Kühlmittel zum Verdampfen aus einem gemeinsamen Kontrollventil (30) beliefert werden;

eine gemeinsame Verwirbelungs- und Vermischungseinrichtung (48, 76 oder 80), die das Kühlmittel von all den Umlaufspulen empfängt; und

einen gemeinsamen Überhitzungstemperatursensor (50), der die Temperatur des Kühlmittels in der gemeinsamen Vorrichtung fühlt und im Betrieb mit dem Kontrollventil (30) zum Kontrollieren desselben verbunden ist.

Revendications

1. Appareil (48) pour la détection de la température d'un réfrigérant sortant par une sortie (40a,40b) d'un serpentin évaporateur d'un système de réfrigération et pour la commande en fonction de la température détectée d'une soupape d'évaporateur commandable (30) alimentant en liquide réfrigérant l'entrée (38a,38b) du

serpentin évaporateur, l'appareil ayant une entrée (44) et une sortie (54) pour le réfrigérant et fournissant intérieurement un trajet d'écoulement de réfrigérant ;

dans lequel une partie au moins d'une paroi extérieure (66) de l'appareil est en matériau conducteur de la chaleur pour détecter la température intérieure du réfrigérant à travers la partie de paroi ;

et l'appareil comprend des moyens de production de turbulence et de brassage (62,64,68) dans le trajet d'écoulement interceptant la totalité de l'écoulement de réfrigérant et créant une turbulence et un brassage du réfrigérant avec changement de direction de la totalité de l'écoulement de réfrigérant pour assurer la turbulence et le brassage de l'ensemble des phases de réfrigérant liquide et vapeur présentes et le contact exclusivement de phases mélangées avec la partie de paroi ;

caractérisé en ce que les moyens de production de turbulence et de brassage comprennent des premier et second (70) passages ayant entre eux une paroi en commun, le réfrigérant s'écoulant du premier passage au second passage avec un changement brutal de direction de l'écoulement et avec collision de l'écoulement contre une première surface du second passage pour produire lesdits turbulence et brassage de l'écoulement dans le second passage ;

l'appareil étant propre à comporter des moyens de détection de température (50) en contact conducteur de chaleur avec la partie de paroi pour détecter la température du réfrigérant à l'intérieur du dispositif et pour commander la soupape d'évaporateur (30) en fonction de la température détectée.

2. Appareil selon la revendication 1, caractérisé en ce que dans la paroi commune entre les premier et second passages est ménagée une multiplicité de trous (68) à travers lesquels le réfrigérant s'écoule du premier passage au second passage (70), les trous produisant ainsi ledit changement brutal de direction de l'écoulement avec collision de l'écoulement contre une première surface du second passage.

3. Appareil selon la revendication 2, caractérisé en ce que le premier passage est fourni par un premier élément tubulaire (62) et le second passage par un second élément tubulaire (66) entourant le premier élément tubulaire pour former un second passage annulaire (70) entre eux, lesdits trous (68) étant prévus dans la paroi du premier élément tubulaire (62) et dirigeant le courant de réfrigérant contre la paroi

intérieure du second élément tubulaire (66).

4. Appareil selon la revendication 3, caractérisé en ce qu'une extrémité ouverte du premier élément tubulaire (62) constitue une entrée (42) vers le premier passage, et que l'autre extrémité (64) du même élément est fermée pour la collision du courant de réfrigérant contre l'extrémité fermée et la turbulence résultante dans le premier passage. 5
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5. Appareil selon l'une des revendications 1 à 4, caractérisé en ce que le premier passage est rempli d'un corps (67) d'un milieu poreux de turbulence et de brassage à travers lequel le réfrigérant doit passer pour aller de l'entrée à la multiplicité de trous. 15
6. Appareil selon la revendication 5, caractérisé en ce que ledit milieu poreux de turbulence et de brassage (67) est choisi parmi une laine métallique, une mousse métallique, une grille métallique, une mousse plastique et une mousse céramique poreuse. 20
7. Appareil pour la détection de la température d'un réfrigérant sortant par une sortie (40a,40b) d'un serpentin évaporateur d'un système de réfrigération et pour la commande en fonction de la température détectée d'une soupape d'évaporateur commandable (30) alimentant en liquide réfrigérant l'entrée (38a,38b) du serpentin évaporateur, l'appareil ayant une entrée (74) et une sortie (76) pour le réfrigérant et fournissant intérieurement un trajet d'écoulement de réfrigérant ; 25
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- dans lequel une partie au moins d'une paroi extérieure de l'appareil est en matériau conducteur de la chaleur pour détecter la température intérieure du réfrigérant à travers la partie de paroi ;
et l'appareil comprend des moyens de production de turbulence et de brassage (74,76,78a,78b) dans le trajet d'écoulement interceptant la totalité de l'écoulement de réfrigérant et créant une turbulence et un brassage du réfrigérant avec changement de direction de la totalité de l'écoulement de réfrigérant pour assurer la turbulence et le brassage de l'ensemble des phases de réfrigérant liquide et vapeur présentes et le contact exclusivement de phases mélangées avec la partie de paroi ; caractérisé en ce que les moyens de production de turbulence et de brassage comprennent des premiers moyens de jonction (74) divisant l'écoulement de réfrigérant en deux courants séparés ou plus, des seconds moyens de jonction (76) combinant ensuite

- lesdits courants séparés avec collision des courants les uns contre les autres pour créer une turbulence et un brassage entre eux, et des moyens de conduite (78a,78b) reliant les premiers et seconds moyens de jonction (74,76) pour l'écoulement des courants séparés entre ceux-ci ;
l'appareil étant propre à comporter des moyens de détection (50) en contact de conduction de chaleur avec une partie de paroi à la seconde jonction pour détecter la température du réfrigérant à l'intérieur de l'appareil et pour commander la soupape d'évaporateur (30) en fonction de la température détectée.
8. Appareil selon la revendication 7, caractérisé en ce que les premiers moyens de jonction (74) divisent l'écoulement de réfrigérant en deux courants séparés ou plus avec une collision génératrice de turbulence des courants contre une surface des moyens de jonction transversale à la direction d'écoulement du réfrigérant dans l'appareil.
9. Appareil pour la détection de la température d'un réfrigérant sortant par une sortie (40a,40b) d'un serpentin évaporateur d'un système de réfrigération et pour la commande en fonction de la température détectée d'une soupape d'évaporateur commandable (30) alimentant en liquide réfrigérant l'entrée (38a,38b) du serpentin évaporateur, l'appareil ayant une entrée (82) et une sortie (84) pour le réfrigérant et fournissant intérieurement un trajet d'écoulement de réfrigérant ;
dans lequel une partie au moins d'une paroi extérieure (80) de l'appareil est en matériau conducteur de la chaleur pour détecter la température intérieure du réfrigérant à travers la partie de paroi ;
et l'appareil comprend des moyens de production de turbulence de brassage (82,84,86) dans le trajet d'écoulement interceptant la totalité de l'écoulement de réfrigérant et créant une turbulence et un brassage du réfrigérant avec changement de direction de la totalité de l'écoulement de réfrigérant pour assurer la turbulence et le brassage de l'ensemble des phases de réfrigérant liquide et vapeur présentes et le contact exclusivement de phases mélangées avec la partie de paroi ;
caractérisé en ce que les moyens de production de turbulence et de brassage comprennent une enceinte (80) ayant une entrée (82) et une sortie (84) et contenant à l'intérieur de l'enceinte un corps (86) d'un milieu poreux de turbulence et de brassage à travers lequel le réfrigérant doit passer pour aller de l'entrée à

la sortie ;

la direction d'écoulement à l'entrée (82) et à la sortie (84) de l'enceinte étant radiale par rapport à la direction de l'écoulement de réfrigérant à travers l'enceinte et espacée d'une autre selon la longueur de l'enceinte (80) pour provoquer des changements brutaux correspondants de direction de celui-ci ;

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l'appareil étant propre à comporter des moyens de détection de température (50) en contact conducteur de chaleur avec une partie de paroi adjacente à la sortie (84) pour détecter la température du réfrigérant à l'intérieur de l'appareil et pour commander la soupape d'évaporateur (30) en fonction de la température détectée.

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- 10.** Appareil selon la revendication 9, caractérisé en ce que ledit milieu poreux de turbulence et de brassage (86) est choisi parmi une laine métallique, une mousse métallique, une grille métallique, une mousse plastique et une mousse céramique poreuse.
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- 11.** Appareil selon l'une des revendications 1 à 10, caractérisé par deux appareils de turbulence et de brassage (48,72,80) raccordés en série l'un à l'autre pour augmenter la turbulence et le brassage du réfrigérant et améliorer la détection de température, les moyens de détection de température (50) étant propres à être en contact conducteur de chaleur avec celui des deux appareils situé en aval.
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- 12.** Appareil selon l'une des revendications 1 à 11, caractérisé par son utilisation dans un système de réfrigération ayant un serpentin évaporateur comprenant une multiplicité de serpentins de circuit (34a,34b) reliés en parallèle les uns aux autres de façon à être alimenté en réfrigérant à évaporer à partir d'une soupape de commande commune (30) ;
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- un dispositif de turbulence et de brassage commun (48,76, ou 80) recevant le réfrigérant de tous les serpentins de circuit ; et
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- un détecteur de température de surchauffe commun (50) détectant la température du réfrigérant dans l'appareil commun et relié fonctionnellement à la soupape de commande (30) pour la commande de celle-ci.
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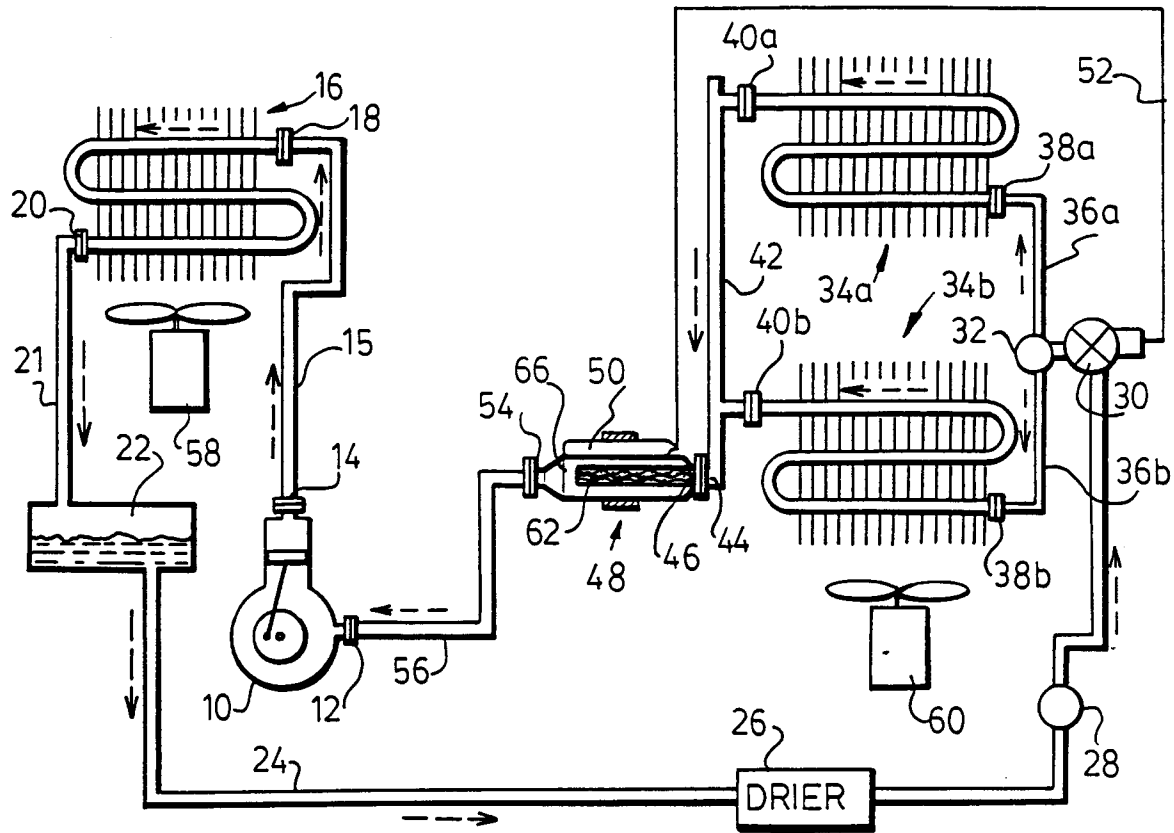


FIG.1

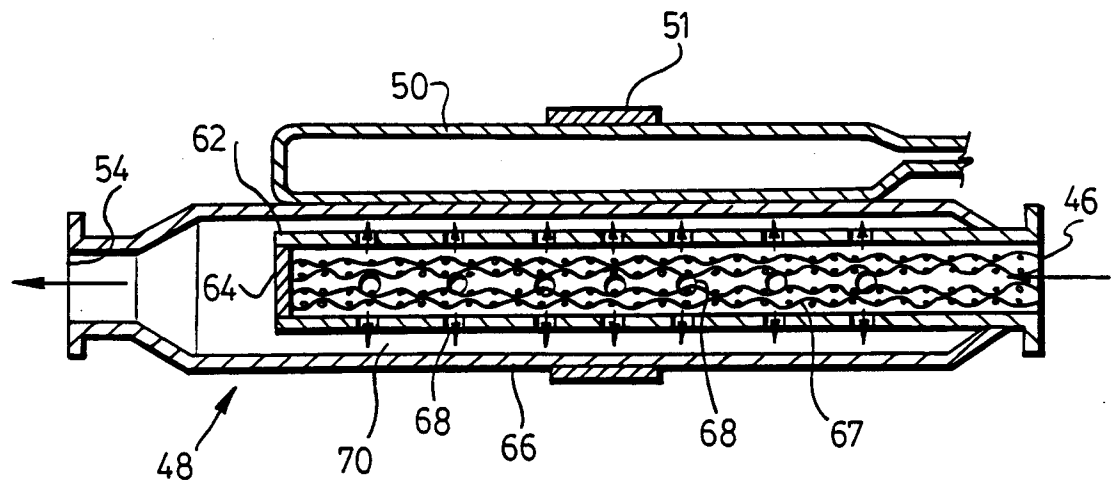


FIG.2

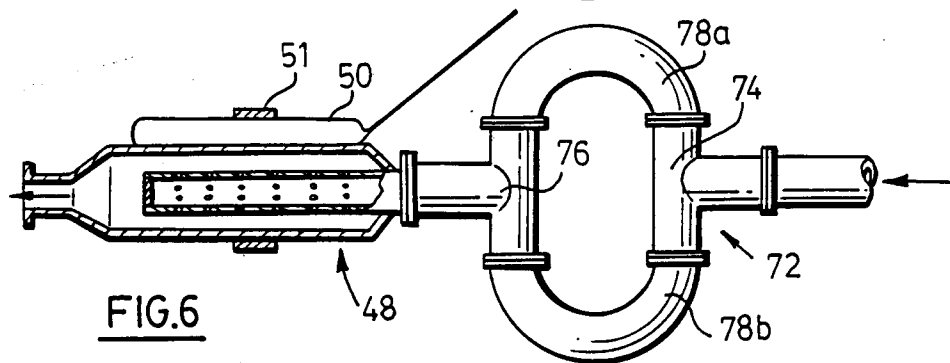
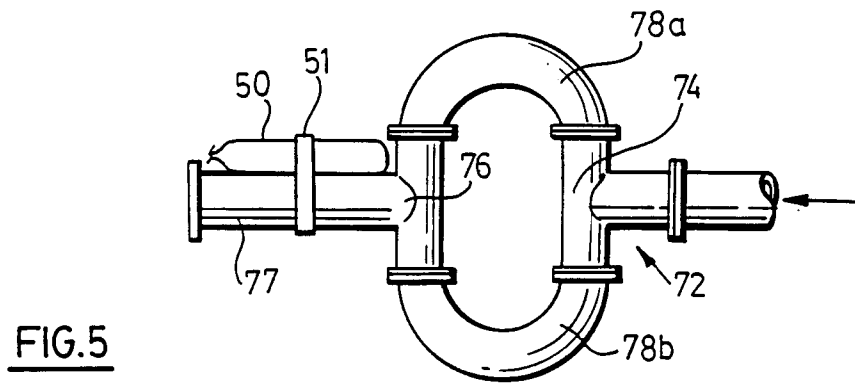
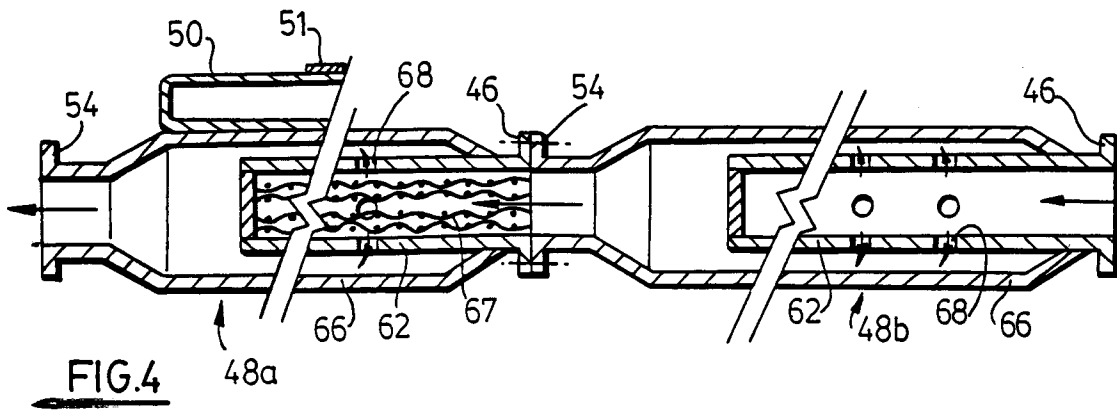
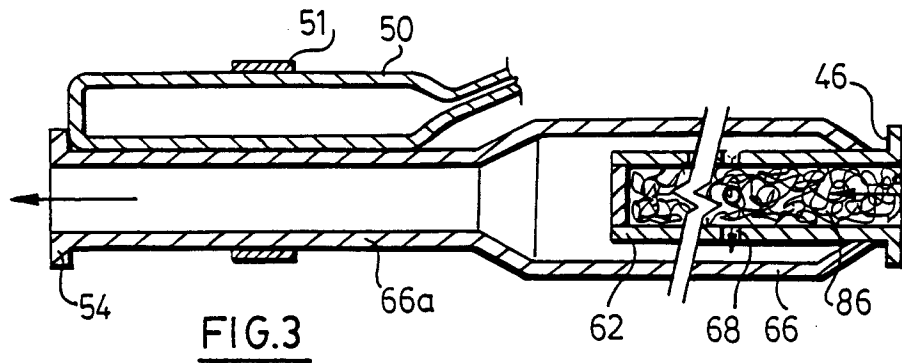


FIG.7

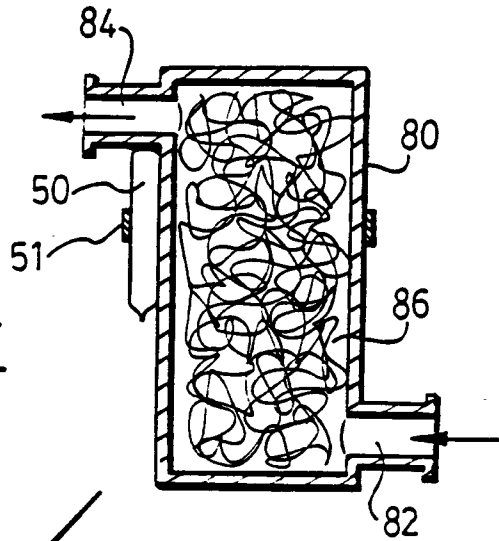


FIG.8

