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(54) **A refrigerating plant comprising a plate-type flooded evaporator**

(57) A refrigerating plant (1; 11) comprising a flooded evaporator (2), a compressor (3), a condenser (4) and a thermal expansion valve (6). The flooded evaporator (2) is of the plate type and the regenerative exchanger (5) is connected to the evaporator through the thermal expansion valve (6; 13) for letting the refrigeration liquid

through and for receiving the refrigeration liquid coming from the condenser (4). In the regenerative exchanger (5) there taking place a vaporization step of the biphasic mixture coming from the flooded evaporator (2) by means of a high thermal inertia of the condensed refrigeration liquid.

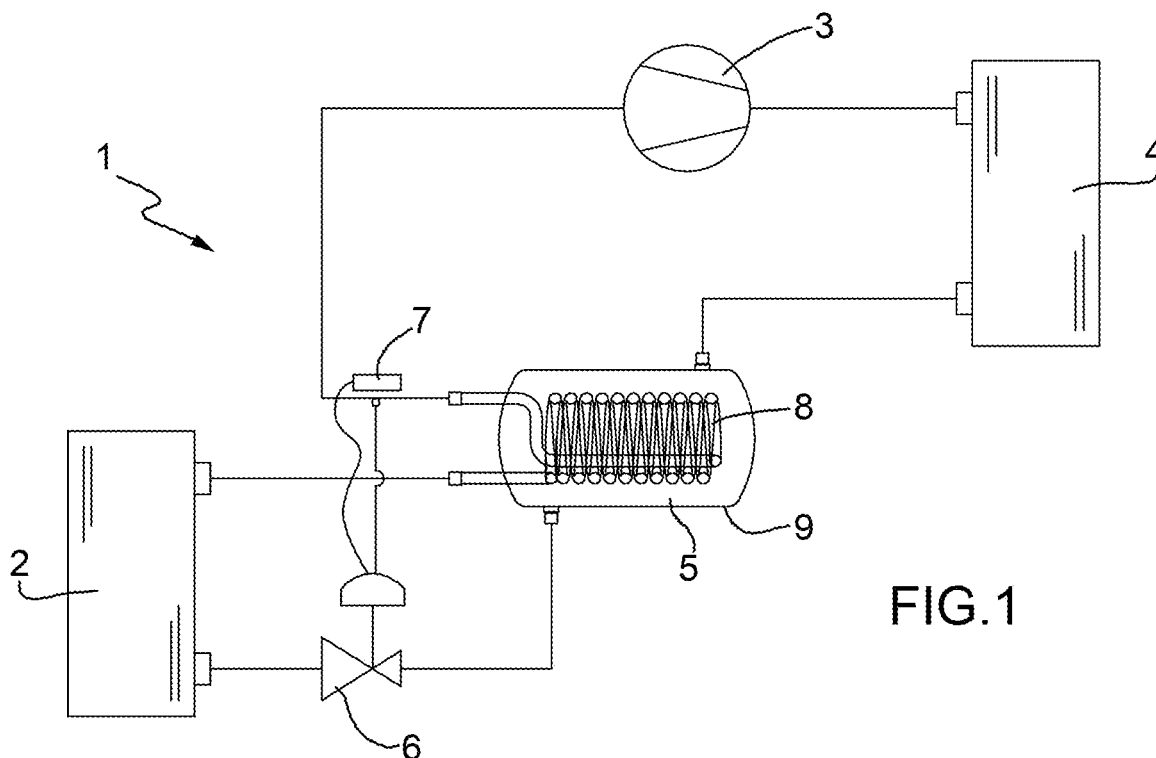


FIG.1

Description

[0001] The present invention relates to a refrigerating plant comprising a plate-type flooded evaporator.

[0002] Evaporators are known as "flooded" evaporators when the exchange surface is completely covered with refrigeration liquid. A phase separator is normally used downstream of the evaporator to receive the biphasic mixture coming from the evaporator and the condensed liquid supplied by the thermal expansion valve. The biphasic mixture is separated in the separator due to the force of gravity and the liquid phase is recirculated in the evaporator with the condensed liquid that flows through the valve, while the vapour is drawn out by the compressor.

[0003] The uniform distribution of the fluid in the ducts flowing into the evaporator is helped by the fact that it is a liquid rather than a low mass fraction biphasic mixture, thus avoiding the possibility of some ducts being supplied with vapour only, which would result in a drastic reduction in heat exchange.

[0004] Due to the particular way in which they work, flooded evaporators require a condensate expansion valve to guarantee a constant level of liquid in the separator.

[0005] In particular, flooded evaporators can be smaller than dry evaporators in that an area of the surface is not used for overheating, but they need more refrigeration liquid.

[0006] Moreover, in flooded evaporators the evaporating fluid and that to be cooled usually flow in the same direction, so that the maximum differences in temperature correspond with the low heat exchange coefficients of the fluid in the liquid phase with low vapour concentrations. The main characteristic of flooded evaporators is that they allow small differences in temperature between the evaporating fluid and the fluid to be cooled so that, with the same output temperature of the fluid to be cooled, the evaporator achieves higher vaporization temperatures and thus a higher performance coefficient.

[0007] Despite the advantages of flooded evaporators over dry evaporators, plate-type flooded evaporators are difficult to use in refrigerating plants.

[0008] With a plate-type flooded evaporator in a refrigerating plant comprising a traditional regenerative exchanger, for instance a tube-in-tube or spiral heat exchanger, the degree of sensitivity with which the temperature is measured would produce an "oscillatory" phenomenon corresponding with an opening and closing phase of the flow of the refrigeration liquid controlled by the thermal expansion valve and thus result in sudden and exaggerated reactions of the plant to external stress factors. In other words, the behaviour of the thermal expansion valve affects the action of the regenerative exchanger creating a vicious cycle both in the case of low overheating and in the case of high overheating causing the aforesaid oscillation.

[0009] The object of the present invention is to provide

a refrigerating plant comprising a plate-type flooded evaporator that overcomes the problems typical of the prior art solutions.

[0010] The object of the present invention is a refrigerating plant the essential characteristics of which are claimed in Claim 1, and the preferred and/or secondary characteristics are claimed in Claims 2-5.

[0011] In order to better understand the present invention, some non-limiting embodiments thereof will now be described by way of example with the help of the figures in the accompanying drawing, in which:

figure 1 is a schematic illustration of a refrigerating plant according to the present invention; and
figure 2 is a schematic illustration of another refrigerating plant according to the present invention.

[0012] In figure 1 designated as a whole by number 1 is a refrigerating plant with some parts removed for the sake of simplicity.

[0013] The plant 1 comprises a plate-type flooded evaporator 2, a compressor 3, a condenser 4, a regenerative exchanger 5 and a thermostatic valve 6 of the self-adjusting mechanical type.

[0014] As the evaporator 2 is of the flooded type, the purpose of the thermostatic valve 6 is to guarantee a constant level of liquid in said evaporator 2.

[0015] The thermostatic valve 6 receives the warm refrigeration liquid from the regenerative exchanger 5 which, in turn, receives it from the condenser 4.

[0016] In particular, as well as receiving the warm refrigeration liquid coming from the condenser 4, the regenerative exchanger 5 also receives the biphasic liquid/vapour mixture coming from the evaporator 2 and having a vapour concentration of approx. 0.95. Inside the regenerative exchanger 5 the mixture coming from the evaporator 2 evaporates completely and the resulting vapour is carried into the compressor 3 to continue the refrigeration cycle. A temperature and pressure sensor 7 is arranged to read the temperature and pressure of the vapour leaving the regenerative exchanger 5.

[0017] The vaporization phase inside the regenerative exchanger 5 according to the present invention takes place by means of a high thermal inertia of the condensed refrigeration liquid independent of the operation of the thermostatic valve 6. Said effect is obtained by means of a regenerative exchanger comprising a flow path of the biphasic mixture to be vaporized immersed in a volume of pressure-condensed refrigeration liquid. The ratio in volume of the flow path of the biphasic mixture to be vaporized and the volume of the condensed refrigeration liquid is such to guarantee said high thermal inertia. In particular, the above flow path consists of a spiral tube 8 arranged with its axis in a horizontal or vertical position and immersed in a cylindrical tank 9 full of pressure-condensed refrigeration liquid.

[0018] In figure 2 designated as a whole by number 11 is a refrigerating plant with some parts removed for the

sake of simplicity. The parts identical to those of the plant 1 in figure 1 are indicated by the same numbers and not described again.

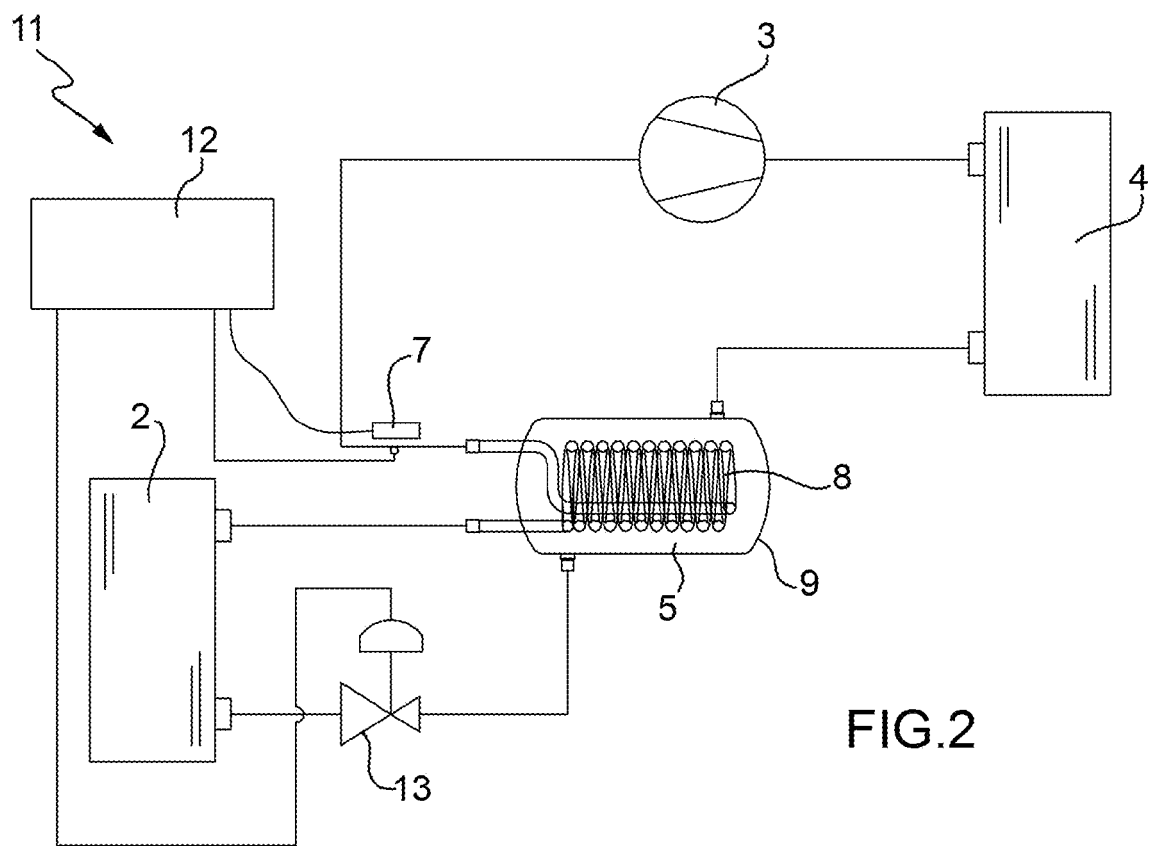
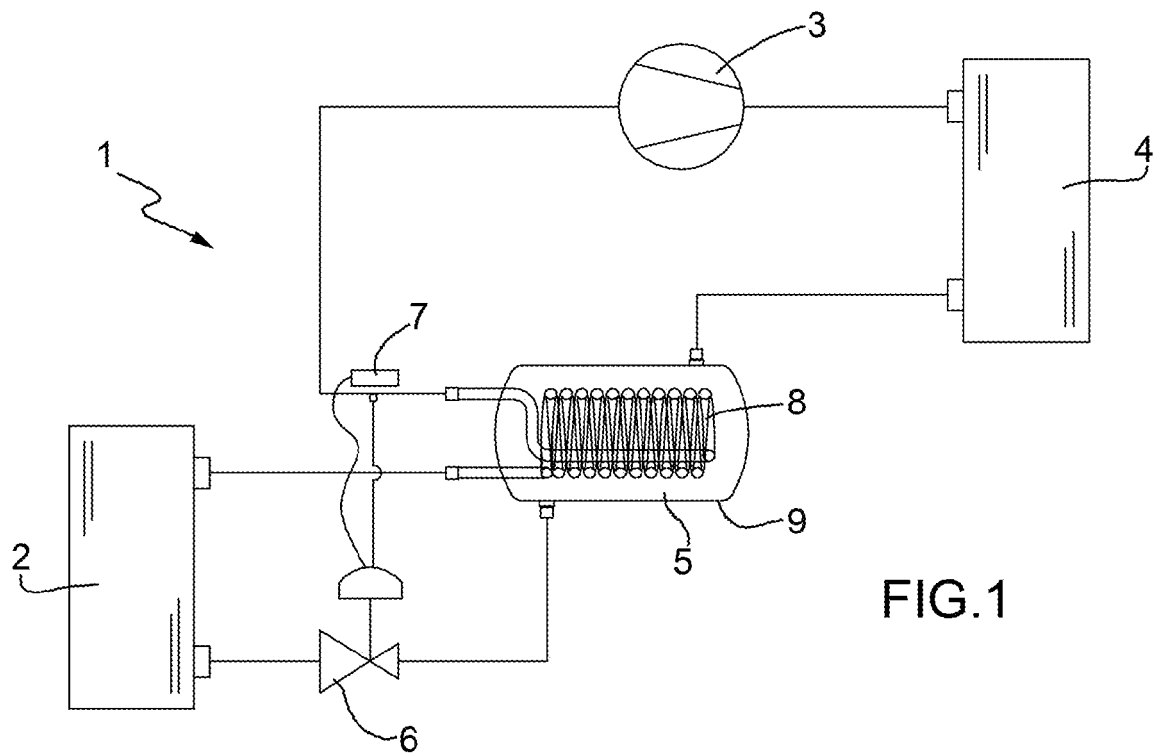
[0019] In the specific case, the plant 11 differs from the plant 1 due to the presence of a microprocessor 12 capable of guaranteeing the electronic control of overheating by the management of the software of an electric expansion-type valve 13.

[0020] It will be apparent to the person skilled in the art that with the plant according to the present invention overheating can be controlled by means of the thermostatic valve without the oscillatory phenomenon typical of plants using a traditional regenerative exchanger. The mass of warm refrigeration liquid ensures considerable stability in relation to the exchange of heat between the biphasic mixture to be evaporated and said warm refrigeration liquid.

sion valve (13) being of the modulating type with electrical control.

Claims

1. Refrigerating plant (1; 11) comprising a flooded evaporator (2), a compressor (3), a condenser (4) and a thermal expansion valve (6); said refrigerating plant being **characterized in that** said flooded evaporator (2) is of the plate type and **in that** it comprises a regenerative exchanger (5), connected to said evaporator through said thermal expansion valve (6; 13) for letting the refrigeration liquid through and for receiving the refrigeration liquid coming from the condenser (4); there taking place in said regenerative exchanger (5) a vaporization step of the biphasic mixture coming from said flooded evaporator (2) by means of a high thermal inertia of the condensed refrigeration liquid.
2. Refrigerating plant (1; 11) according to Claim 1, **characterized in that** said regenerative exchanger comprises a flow path of the biphasic mixture to be vaporized immersed in a volume of pressure-condensed refrigeration liquid.
3. Refrigerating plant (1; 11) according to Claim 2, **characterized in that** the flow path is a spiral tube (8), whose axis is horizontally or vertically arranged, and which is immersed in a cylindrical reservoir (9) full of pressure-condensed refrigeration liquid.
4. Refrigerating plant (1) according to any one of the preceding Claims, **characterized in that** said thermal expansion valve (6) is a self-adjusting mechanical thermostatic expansion valve.
5. Refrigerating plant (11) according to any one of Claims 1-3, **characterized in that** it comprises a microprocessor (12) to guarantee the electronic control of overheating by the management of the thermal expansion valve (13) software; said thermal expan-





EUROPEAN SEARCH REPORT

Application Number
EP 10 15 7976

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	JP 2004 069142 A (JAPAN CLIMATE SYSTEMS CORP) 4 March 2004 (2004-03-04) * abstract; figures 1, 2 *	1-5	INV. F25B40/00
X	JP 11 248294 A (SHOWA ALUMINUM CORP) 14 September 1999 (1999-09-14) * abstract; figures 1, 3 *	1-5	
X	US 2 892 320 A (QUICK LESTER K) 30 June 1959 (1959-06-30) * figure 1 * * column 2, lines 19-59 *	1-5	
X	JP 2000 205706 A (ZEXEL CORP) 28 July 2000 (2000-07-28) * abstract; figures 1, 2, 3 *	1-5	
A	US 2 116 100 A (JOHN CRACKNELL RICHARD) 3 May 1938 (1938-05-03) * figure *	1-5	
			TECHNICAL FIELDS SEARCHED (IPC)
			F25B
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 8 July 2010	Examiner Yousufi, Stefanie
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 10 15 7976

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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08-07-2010

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
JP 2004069142	A	04-03-2004	JP 4098580 B2	11-06-2008
JP 11248294	A	14-09-1999	NONE	
US 2892320	A	30-06-1959	NONE	
JP 2000205706	A	28-07-2000	NONE	
US 2116100	A	03-05-1938	NONE	