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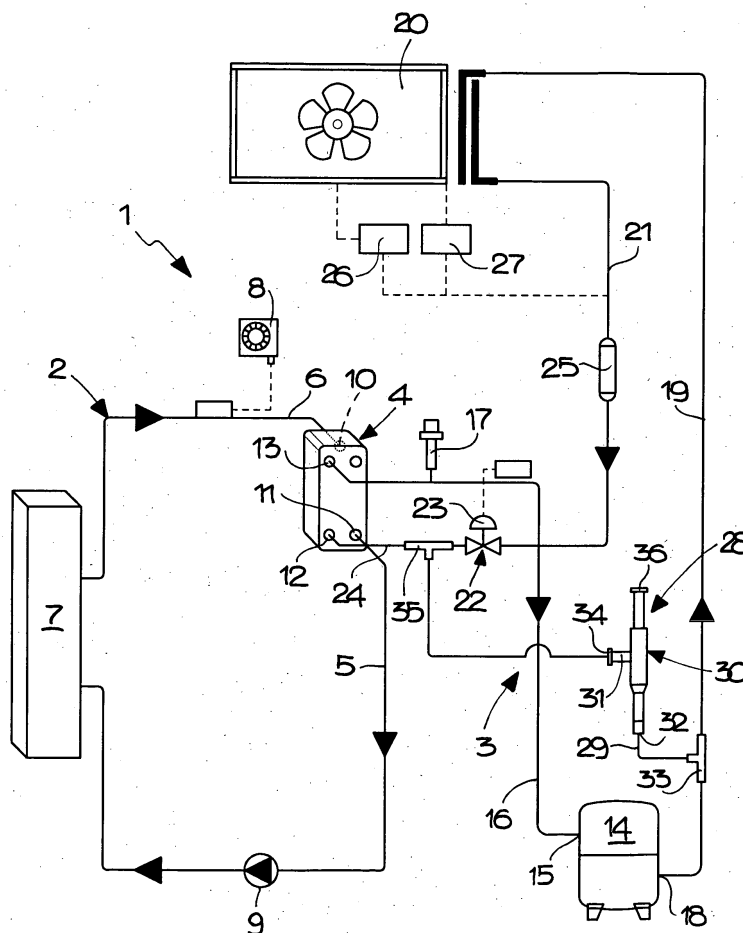
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(54) **Water refrigeration unit**

(57) A water refrigeration unit (1), comprising a device for preventing the freezing of the cooling fluid inside the corresponding evaporator (4), which is adapted to

mix the fluid in input (12) to the evaporator substantially as a mixture of liquid and saturated steam with a stream of the fluid taken substantially as superheated steam.



Description

[0001] The present invention relates to a water refrigeration unit.

[0002] Water refrigeration units, particularly low-power ones, are generally known which comprise a heat exchanger for the water and the refrigeration fluid of the type with braze-welded plates.

[0003] The water to be cooled, sent to user devices by a suitable circulation pump, before flowing into the exchanger, passes through an accumulation tank, which is fitted in order to increase the overall volume of the water in the system and to act as a so-called "thermal flywheel", avoiding excessively frequent starting of the volumetric compressor of the unit, which can over-heat its electric motor and damage it irreparably.

[0004] The plate exchanger, hereinafter termed evaporator for the refrigeration fluid for the sake of convenience in description, is sometimes subject to severe impediments to operation linked to the failure of the braze welds of the plates, which occurs when the refrigeration fluid inside it reaches temperatures at which it freezes, as a consequence of the motion of the compressor, which aspirates at each cycle a constant volume of fluid independently of the conditions in which the evaporator is working.

[0005] These impediments occur especially in particular operating conditions, for example in case of insufficient or no flow of water to be cooled in the evaporator, or by working at excessively low temperatures of said water in input: more frequently, both causes are present simultaneously.

[0006] Among the most widely used remedies to obviate the problem of the freezing of the cooling fluid in the evaporator, antifreeze mixtures have been introduced and a suitable antifreeze safety thermostat has been inserted on the circuit of the water to be cooled and located downstream of the evaporator: these solutions are not always applicable and are rarely reliable.

[0007] The technical aim of the present invention is to obviate the cited drawbacks, providing a water refrigeration unit that allows to avoid the freezing of the refrigeration fluid inside the evaporator when the flow-rate of circulating water or the temperature of said water at the inlet of the evaporator is low.

[0008] Within the scope of this technical aim, an object of the present invention is to provide a water refrigeration unit in which it is possible to keep the corresponding compressor moving even if the water to be cooled has reached the preset optimum temperature, avoiding excessively frequent starting of the compressor, which as such is harmful to said compressor.

[0009] Another object of the present invention is to provide a water refrigeration unit that does not require the fitting of an accumulation tank that has a "thermal flywheel" function upstream of the evaporator.

[0010] Another object of the present invention is to provide a water refrigeration unit in which it is possible

to adjust precisely the refrigeration capacity according to the requirements of the user.

[0011] Another object of the present invention is to provide a water refrigeration unit that does not require the fitting of an antifreeze safety thermostat on the water circuit downstream of the evaporator.

[0012] Another object of the present invention is to provide a water refrigeration unit that allows to achieve relatively low water temperatures even without using antifreeze mixtures.

[0013] Another object of the present invention is to achieve said aim with a structure that is simple, relatively easy to provide in practice, safe in use, effective in operation, as well as relatively low in cost.

[0014] This aim and these objects are achieved by the present water refrigeration unit, characterized in that it comprises a device for preventing the freezing of the cooling fluid inside the corresponding evaporator, which is adapted to mix said fluid in input to said evaporator substantially as a mixture of liquid and saturated steam with a stream of said fluid taken substantially as superheated steam.

[0015] Further features will become better apparent from the detailed description of a preferred but not exclusive embodiment of a water refrigeration unit according to the invention, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

the only figure is a schematic view of the water refrigeration unit according to the invention.

[0016] With reference to the figure, the reference numeral 1 generally designates a water refrigeration unit according to the invention.

[0017] The refrigeration unit comprises, in a known manner, a circuit for water to be cooled 2 and a circuit for refrigeration fluid 3, which are associated by means of an evaporator 4, preferably of the type with braze welded plates.

[0018] The water circuit 2 comprises an intake duct 5 and a return duct 6 for connection to corresponding cold water user devices, generally and schematically designated by the reference numeral 7, which receive in input a stream of water at a preset temperature that can be preset by the operator by way of a corresponding operating thermostat 8, which is located upstream of the evaporator 4 on the return duct 6. The circuit 2 for the water to be cooled is provided with a circulation pump 9, which is arranged downstream of the evaporator 4 along the intake duct 5.

[0019] The evaporator 4 has an inlet 10, which is connected to the return duct 6, and an outlet 11 for the water, which is connected to the intake duct 5. The evaporator is also affected by an inflow port 12 and by an outflow port 13 for the refrigeration fluid.

[0020] The circuit 3 for the refrigeration fluid comprises a volumetric compressor 14, for example of the rotary type, which is connected by way of its intake port 15 to

the outflow port 13 of the evaporator 4 by means of a first portion of duct 16; a minimum-pressure switch 17 is furthermore inserted along said first portion 16, is functionally connected to the compressor 14, and is adapted to stop said compressor if the pressure of the refrigeration fluid at the output of the evaporator 4 drops below a convenient minimum preset value.

[0021] The delivery port 18 of the compressor 14 is connected, by means of a second duct portion 19, to the inlet of a condenser 20, for example of the type that removes heat by ventilation, in which the outlet is connected, by means of a third duct portion 21; to a laminar flow element 22, preferably a thermostatic expansion valve 23, which is adapted to adjust the flow of the refrigeration fluid toward the evaporator 4 along a fourth duct portion 24, depending on the degree of overheating of the fluid at the output of said evaporator.

[0022] The third duct portion 21 is provided with a unit 25 for filtering and accumulating the refrigeration fluid and is connected to a speed regulator 26 for the fan of the condenser 20 and to a maximum-pressure switch 27, which is functionally connected to the compressor 14 and is adapted to stop said compressor if the pressure of the refrigeration fluid at the delivery rises above a convenient preset maximum value.

[0023] According to the invention, the refrigeration unit comprises a device 28 for preventing the freezing of the refrigeration fluid inside the evaporator 4, which is adapted to mix the fluid entering said evaporator substantially as a mixture of liquid and saturated steam with a stream of said fluid drawn substantially as superheated steam.

[0024] The antifreeze device 28 is constituted by a bypass branch 29, which is inserted between the delivery port 18 of the compressor 14 and the inflow port 12 of the evaporator 4, and is controlled by corresponding valve means 30.

[0025] The valve means 30 are constituted by a valve of the pressure-controlled type 31, which has an inlet 32 connected to a first T-shaped connector 33 and inserted along the second duct portion 19 directly downstream of the delivery port 18, and an outlet 34 that is connected to a second T-shaped connector 35 that is arranged along the fourth duct portion 24, directly downstream of the expansion valve 23. The pressure-controlled valve 31 is adapted to open selectively the inlet 32, which is normally closed, by means of a suitable mechanical adjustment that can be performed for example on a suitable calibration spring 36, allowing a stream of refrigeration fluid in the state of superheated steam to flow through it, said stream increasing as the pressure of said fluid decreases at the inlet port 12 of the evaporator 4.

[0026] The operation of the refrigeration unit according to the invention is as follows: if the stream of water to be cooled that passes through the evaporator 4 decreases excessively due to user requirements, or if it reaches a relatively low outlet temperature, the pressure and temperature of the refrigeration fluid decrease ac-

cordingly at the inflow port 12 of the evaporator 4, due to the action of the compressor 14, which aspirates a constant volume of fluid at each cycle, with the risk of freezing said refrigeration fluid.

[0027] Depending on the mechanical registration of the calibration spring 36, said decrease of the pressure of the fluid causes said valve 31 to open, so that an appropriate fraction of the stream of refrigeration fluid that flows from the delivery port 18 of the compressor 14 to the condenser 20 is directed, through the bypass branch 29, at the inflow port 12 of the evaporator, thus increasing the pressure and temperature inside said evaporator and avoiding the risk of freezing.

[0028] The refrigeration unit for water according to the invention, in addition to eliminating substantially the danger of failure due to freezing of the evaporator 4, allows to avoid the need to fit an accumulation tank for water to be cooled and an antifreeze thermostat, and also allows to avoid the use of antifreeze refrigeration mixtures.

[0029] Furthermore, the refrigeration unit allows to achieve a precise adjustment of the refrigeration capacity, keeping the compressor 14 running even in conditions of optimum temperature of the water thanks to the presence of the bypass branch 29, therefore requiring a smaller number of start-ups per hour of said compressor.

[0030] The circulation pressure required to ensure the circulation of the refrigeration fluid and to allow the correct operation of the expansion valve 23 is ensured by the intervention of the speed regulator 26 of the fan of the condenser 20.

[0031] It has thus been shown that the invention achieves the intended aim and objects.

[0032] The invention thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the inventive concept.

[0033] All the details may furthermore be replaced with other technically equivalent ones.

[0034] In practice, the materials used, as well as the shapes and the dimensions, may be any according to the requirements without thereby abandoning the scope of the protection of the appended claims.

[0035] The disclosures in Italian Patent Application no. BO2002A000025, from which this application claims priority, are incorporated herein by reference.

[0036] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the scope of each element identified by way of example by such reference signs.

Claims

1. A water refrigeration unit, **characterized in that it**

comprises a device for preventing the freezing of the cooling fluid inside the corresponding evaporator, which is adapted to mix said fluid in input to said evaporator substantially as a mixture of liquid and saturated steam with a stream of said fluid taken substantially as superheated steam. 5

2. The refrigeration unit according to claim 1, **characterized in that** said antifreeze device comprises a bypass branch that is provided between the delivery port of the volumetric compressor of said unit and the inflow port of said evaporator for said fluid, said bypass branch being controlled by corresponding valve means. 10

3. The refrigeration unit according to claims 1 and 2, **characterized in that** said valve means are constituted by a valve of the pressure-controlled type, which has an inlet that is connected to said delivery port of said compressor and an outlet that is connected to said inflow port of said evaporator. 15 20

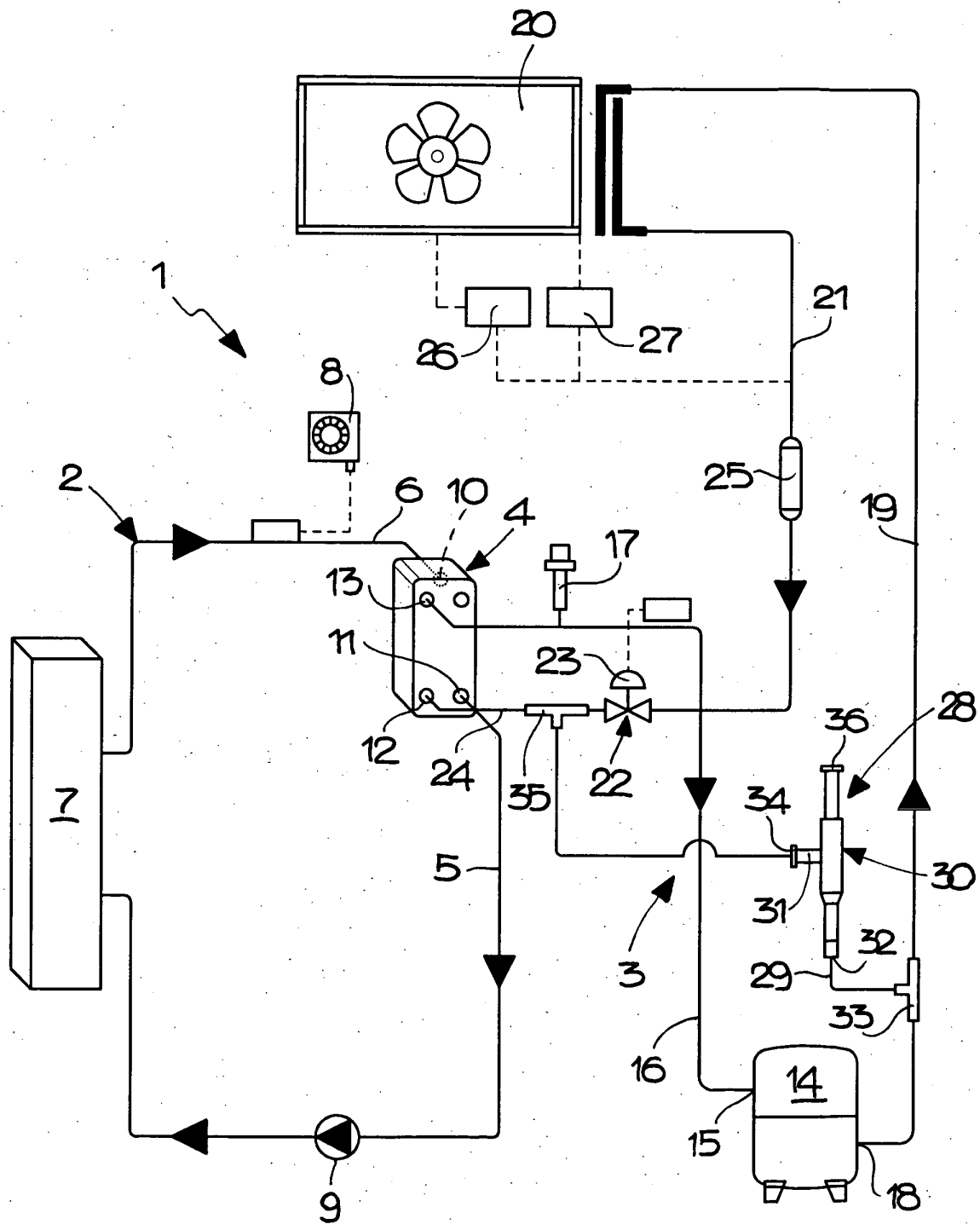
4. The refrigeration unit according to one or more of the preceding claims, **characterized in that** said valve is adapted to open selectively, by mechanical adjustment, said inlet, allowing the flow through said valve of a stream of said fluid as superheated steam that arrives from said delivery port of said compressor, said stream increasing as the pressure of said fluid at said inflow port of said evaporator decreases. 25 30

5. The refrigeration unit according to one or more of the preceding claims, **characterized in that** said valve is adapted to operate in a circuit for refrigeration fluid that is associated, by means of said evaporator, with a circuit for water to be cooled which does not have an accumulation tank, in order to maintain the reliability of the electric motor of said compressor. 35 40

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EUROPEAN SEARCH REPORT

Application Number
EP 03 00 1279

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	US 4 949 552 A (ASAMS) 21 August 1990 (1990-08-21) * column 3, line 38 - line 45 * * column 4, line 1 - line 12 *	1-3,5	F25B41/04 F25B47/00 F25D21/04
A	* claim 2 *	4	
X	US 6 216 918 B1 (SAVELIEV) 17 April 2001 (2001-04-17) * column 17, line 14 - line 20 * * column 17, line 35 - line 40 * * column 17, line 24 - line 27 *	1-4	
X	US 3 481 151 A (SEELEY) 2 December 1969 (1969-12-02) * column 5, line 8 - line 19 * * claim 4 * * column 3, line 34 - line 42 *	1-3,5	
X	US 5 076 068 A (MIKHAIL) 31 December 1991 (1991-12-31) * column 2, line 28 - line 34 * * column 2, line 58 - line 63 * * column 3, line 33 - column 34 *	1-3,5	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			F25B F25D B67D
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
THE HAGUE		7 May 2003	SOGNO, M
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 03 00 1279

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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07-05-2003

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4949552 A	21-08-1990	GB 2242332 A , B	25-09-1991
US 6216918 B1	17-04-2001	AU 1596801 A	06-06-2001
		CA 2391233 A1	17-05-2001
		EP 1237783 A1	11-09-2002
		WO 0134470 A1	17-05-2001
		US 2001010318 A1	02-08-2001
US 3481151 A	02-12-1969	NONE	
US 5076068 A	31-12-1991	EP 0411172 A1	06-02-1991
		DE 58903363 D1	04-03-1993