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(54) **REFRIGERATION SYSTEM**

KÜHLSYSTEM

SYSTÈME DE RÉFRIGÉRATION

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(56) References cited:
CN-U- 205 079 513
JP-A- H0 926 254
JP-A- H01 258 725
JP-A- H01 260 279
JP-A- 2000 205 731
JP-A- 2001 116 198
JP-A- 2015 001 372
US-A1- 2007 074 865

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Description

OBJECT OF THE INVENTION

[0001] The invention relates to a refrigeration system having an air cooler installed in a cold room that enables a certain temperature to be maintained in said cold room greater than, equal to or less than 0 °C.

[0002] One object of the invention is to provide a refrigeration installation that enables maximum use of a coolant, coming from a liquefied natural gas (LNG) regasification port installation, recirculating it and supplying the right amount for maintaining the appropriate temperature, further preventing the formation of frost.

BACKGROUND OF THE INVENTION

[0003] There are currently numerous solutions developed in the field of refrigeration systems and devices, most of them with compressors and capacitors.

[0004] However, many of said solutions, despite being simple, supply a coolant directly to the cold room. This causes the coolant to be supplied at the temperature at which it is stored, which may not coincide with the desired temperature inside the cold room, for which reason the temperature of the cold room is difficult to control. Likewise, it will cause the temperature in the room to not be homogeneous, since the area from which the coolant is supplied will be at a lower temperature.

[0005] A commonly used solution to the temperature control problem is to introduce more coolant when further cooling is required and to limit the flow when the desired temperature is reached. However, this solution does not enable the temperature to be accurately maintained inside the cold room, and it generates areas of uneven temperature, in other words, areas of non-homogeneous temperature. Likewise, the use of coolant at the temperature at which it is stored implies a limited efficiency, since it does not allow the entire cooling capacity thereof to be used.

[0006] Other more complex solutions make use of turbomachines and several heat exchangers, increasing the cost of the installation and reducing efficiency due to the losses in the turbomachines and heat exchangers. The installations known in the state of the art have at least one compressor and one capacitor. JP2000205731A discloses a relevant refrigeration installation.

DESCRIPTION OF THE INVENTION

[0007] The present invention relates to a refrigeration system, according to claim 1, having an air cooler installed in a cold room in order to maintain it at a certain temperature, whether it is a temperature above or below 0 °C. The refrigeration installation of the invention enables an optimal use of a coolant, preferably Temper ®, which circulates inside it, preventing the direct introduction thereof into the cold room at an excessively low temperature, which can generate problems such as the appearance of frost. The coolant is supplied by means of an external supply line at low temperature that comes from a liquefied natural gas (LNG) regasification port installation.

[0008] The refrigeration installation of the invention comprises at least one air cooler. The air cooler is located inside the cold room in order to enable a heat exchange between the coolant and the cold room. The air cooler comprises a set of tubes, through which the coolant circulates. The set of tubes comprising an inlet for the coolant and an outlet and, preferably, it may comprise a set of fins intended to increase the heat transfer between the tubes and the cold room.

[0009] The refrigeration installation further comprises a pipe circuit that introduces the coolant into the cold room. The pipe circuit is connected to the air cooler, with the inlet and the outlet. Thus, the pipe circuit recirculates the coolant that comes out of the air cooler and reintroduces it through the inlet thereof.

[0010] The coolant is pumped through the pipe circuit and the air cooler using a pump.

[0011] In order to maintain the temperature of the coolant that enters the air cooler at a certain temperature, and, therefore, maintain the temperature inside the cold room, the refrigeration installation comprises a supply conduit for introducing coolant at a lower temperature than the coolant circulating inside the pipe circuit of the air cooler. In order to adjust the mixture of the coolant supplied by means of the supply conduit and the coolant that circulates through the pipe circuit of the air cooler, the refrigeration installation comprises an adjustable three-way valve.

[0012] The three-way valve is located in the pipe circuit downstream from the pump and is connected to an outlet conduit, wherein a first shut-off valve is arranged, which adjusts the amount of coolant that is evacuated from the pipe circuit. Moreover, the coolant that passes through the three-way valve is mixed with the coolant supplied by means of the supply conduit, which is connected with the pipe circuit. The three-way valve enables the mixture to be adjusted, for this purpose it opens or closes proportionally depending on the inlet temperature of the coolant at the inlet of the air cooler, so that, if the inlet temperature of the coolant rises, the three-way valve opens so that coolant supplied by means of the supply conduit enters which will be mixed with the coolant that circulates through the pipe circuit, obtaining coolant at the desired temperature at the inlet of the air cooler. The amount of coolant that is supplied through the supply conduit is determined by the action of a second shut-off valve. Likewise, the refrigeration installation further comprise one or more temperature sensors connected to the adjustable three-way valve, and to the shut-off valves in order to know the temperature of the coolant in different portions of the refrigeration installation and select the amount of coolant supplied through the supply conduit

and the flow of coolant that comes out of the pump and remains in the pipe circuit, controlling the temperature of the coolant that enters the air cooler.

[0013] The control of the three-way valve, the pump and the air cooler is carried out by means of a control unit that uses the data provided by the temperature and pressure sensors in order to determine the opening or closing thereof. In the case of the shut-off valves, these can be controlled either by means of the control unit or manually.

[0014] Moreover, the air cooler can further comprise one or more fans. The fans generate a turbulent air stream that enables the heat transfer between the tubes and the cold room to be increased.

[0015] Preferably, the pump of the refrigeration installation of the invention has an inverter system for adjusting the flow of coolant, for which reason the refrigeration installation further comprises one or more pressure sensors connected to the pump. Specifically, at least one first pressure sensor can be located upstream from the pump and at least one second pressure sensor can be located downstream from the pump.

[0016] The refrigeration installation further comprises a defrost system, controlled by means of the control unit, which may comprise a set of resistors located inside the air cooler which, when heated, prevent the generation of frost. Alternatively, it can comprise a supply system by means of using solar energy and/or aerothermal energy in order to prevent said generation of frost by heating the inside of the cold room.

DESCRIPTION OF THE FIGURES

[0017] As a complement to the description provided herein, and for the purpose of helping to make the features of the invention more readily understandable, in accordance with a preferred exemplary embodiment thereof, said description is accompanied by a set of figures constituting an integral part of the same, which by way of illustration and not limitation, represent the following:

Figure 1 shows a schematic view of a preferred embodiment of the refrigeration installation of the invention.

Figure 2 shows a schematic view of a preferred embodiment of the air cooler of the refrigeration installation of the invention.

Figure 3 shows a schematic view of the connections with the control unit in a preferred embodiment of the refrigeration installation of the invention.

PREFERRED EMBODIMENT OF THE INVENTION

[0018] The invention comprises a refrigeration installation intended to be installed in a refrigeration room that enables said refrigeration room to be maintained at a certain temperature by means of the efficient use of a coolant, ostensibly reducing the consumption of electrical energy. The coolant is supplied at a constant temperature to the cold room in order to adapt the temperature inside said cold room.

[0019] Figure 1 shows a schematic view of the refrigeration installation of the invention, which comprises an air cooler (1), a pipe circuit (2), a pump (3), pressure sensors (6) and temperature sensors (7, 15, 17), an adjustable three-way valve (4), a first shut-off valve (12) and a second shut-off valve (13), a supply conduit (5) for coolant, an outlet conduit (14) and a set of resistors (8).

[0020] Figure 2 shows the air cooler (1), which further comprises a set of tubes (9) inside of it through which the coolant circulates, such that an energy exchange occurs between the coolant and the cold room. The set of tubes (9) may comprise a set of fins (11) which increase the heat transfer surface and therefore enable the capacity of the air cooler (1) to reduce the temperature of the cold room to be increased. The air cooler (1) further comprises one or more fans (10) that generate a turbulent air stream that enables the heat transfer ratio between the coolant and the cold room to be increased.

[0021] The coolant enters the air cooler (1) from the pipe circuit (2) at -28 °C. The temperature at which the cold room is intended to be maintained is usually -20 °C. Thus, after passing through the set of tubes (9) of the air cooler (1), the coolant absorbs a portion of the heat from the cold room, cooling it. In this process, the coolant is heated to -24 °C. The set of tubes (9) of the air cooler (1) delivers the coolant to the pipe circuit (2), in order to recirculate it.

[0022] The coolant is moved through the pipe circuit (2) and the set of tubes (9) of the air cooler (1) by means of a pump (3). The pump (3) has an inverter system which enables the flow of the coolant to be controlled. To do so, it further has two pressure sensors (6), one located before the pump (3) and the other located right after, in order to obtain the pressure of the coolant before and after being pumped.

[0023] Likewise, there is a temperature sensor (7) in the pipe circuit (2) that determines the temperature of the coolant at the inlet of the air cooler (1). The pump (3), the air cooler (1) and the three-way valve (4) are controlled by means of a control unit (16), in this case a programmable logic controller (PLC), with the information collected by the pressure (6) and temperature (7, 15) sensors.

[0024] The first shut-off valve (12) adjusts the amount of coolant at -35 °C that is supplied by means of the supply conduit (5). The second shut-off valve (13) is located in an outlet conduit (14) and controls the amount of coolant that comes out of the pump (3) which is evacuated from the pipe circuit (2). The shut-off valves (12, 13) can be controlled either manually or by means of the control unit (16).

[0025] There is a three-way valve (4) located downstream from the pump (3), which acts as a flow diverter valve. This valve opens/closes proportionally depending

on the inlet temperature of the coolant into the air cooler (1).

[0026] If the inlet temperature of the coolant rises, the three-way valve (4) opens so that coolant supplied by means of the supply conduit (5) enters at -35 °C, which will be mixed with the coolant that circulates through the pipe circuit (2) at -24 °C, from this mixture coolant at -28 °C will be obtained, which enters the air cooler (1) once again.

[0027] In order to prevent the formation of frost in the air cooler, a set of resistors (8) is further provided which heat the areas of the air cooler wherein frost is most likely to form.

[0028] Figure 3 shows a diagram of the connections with the control unit (16). The control unit (16) is connected to the pressure (6) and temperature (7, 15, 17) sensors, from which it receives information regarding the pressure and temperature at different points of the refrigeration installation and processes the information received and sends instructions to the various elements.

Claims

1. A refrigeration system comprising:

- a liquefied natural gas (LNG) regasification installation;
- a cold room; and
- a refrigeration installation connected to the liquefied natural gas (LNG) regasification installation by means of a supply line of coolant at low temperature and configured to maintain the cold room at a certain temperature, the refrigeration installation comprising:

  - at least one air cooler (1), placed inside the cold room and which comprises a defrost system and a set of tubes (9),
  - a pipe circuit (2) connecting an outlet of the set of tubes (9) of the air cooler (1) to an inlet of said set of tubes (9), for recirculating outputted coolant from the air cooler (1);
  - a pump (3), placed on the pipe circuit (2) connected to the outlet of the set of tubes (9) for moving the outputted coolant through the pipe circuit (2),
  - an adjustable three-way valve (4), located in the pipe circuit (2) downstream the pump (3) and connected to an outlet conduit (14) in order to enable the evacuation of the outputted coolant that comes out of the pump (3), adjusting the amount of coolant that is maintained in the pipe circuit (2);
  - a supply conduit (5) connected to the supply line of the LNG regasification installation and connected to the pipe circuit (2) downstream the pump (3) for introducing the coolant at a lower temperature than the outputted coolant that comes from the air cooler (1), thus producing a mixed coolant in the pipe circuit (2),
  - a control unit (16), connected with the air cooler (1), the pump (3), and the adjustable three-way valve (4);
  - a first shut-off valve (12) located in the supply conduit (5), connected to the control unit (16) and which adjusts the amount of coolant provided by said supply conduit (5); and
  - a second shut-off valve (13) located in the outlet conduit (14), connected to the control unit (16) and which adjusts the amount of coolant that is evacuated from the pipe circuit (2).

2. The system according to claim 1, wherein the air cooler (1) further comprises one or more fans (10), for increasing the heat transfer between the tubes and the cold room.

3. The system according to claim 1, wherein the refrigeration installation further comprises one or more pressure sensors (6) connected to the control unit (16) for adjusting the flow of coolant.

4. The system according to claim 3, wherein the refrigeration installation comprises at least one first pressure sensor (6) located upstream from the pump (3) and at least one second pressure sensor (6) located downstream from the pump (3).

5. The system according to claim 1, wherein the refrigeration installation further comprises a set of resistors (8) located inside the air cooler in order to prevent the generation of frost and connected to the control unit (16).

6. The system according to claim 1, wherein the refrigeration installation further comprises a supply system by means of using solar energy in order to prevent the generation of frost inside the air cooler and connected to the control unit (16).

7. The system according to claim 1, wherein the refrigeration installation further comprises a heat supply system by means of aerothermal energy in order to prevent the generation of frost inside the air cooler and connected to the control unit (16).

8. The system according to claim 1, wherein the set of tubes (9) of the air cooler (1) further comprises a set of fins (11) intended to increase the heat transfer between the tubes and the cold room.

9. The system according to claim 1, wherein the tem-

perature of the coolant at the inlet of the air cooler (1) is -28 °C.

10. The system according to claim 1, wherein the temperature of the coolant supplied by the supply conduit (5) is -35 °C.

11. The system according to claim 1, which further comprises one or more temperature sensors (7, 15, 17) connected to the control unit (16) for controlling the temperature of the coolant at the inlet of the air cooler (1) varying by means of the three-way valve (4) the amount of coolant at a lower temperature supplied by the supply conduit (5) and, consequently, the temperature of the cold room.

12. A method for enabling an optimal use of a coolant for maintaining a cold room at a certain temperature, using the refrigeration system described in any of claims 1 to 11, the method comprising:

- introducing a coolant coming from a supply conduit (5) from the LNG regasification port installation to a pipe circuit (2), which connects with an inlet and an outlet of a set of tubes (9) of an air cooler (1), placed inside the cold room;
- recirculating the outputted coolant coming out from the outlet of the set of tubes (9) of the air cooler (1), by pumping the outputted coolant using a pump (3);
- adding coolant from the supply conduit (5) for producing mixed coolant, thus, controlling the temperature of the mixed coolant at the inlet of the set of tubes (9) of the air cooler (1); and
- controlling the amount of coolant flowing in the pipe circuit (2) by means of a three-way valve located in the pipe circuit (2) between the pump (3) and the supply conduit (5) and which is connected to an outlet conduit (14) in order to enable the evacuation of the outputted coolant that comes out of the pump (3).

Patentansprüche

1. Ein Kältesystem, Folgendes umfassend:

- eine Anlage zur Rückvergasung von Flüssigerdgas (LNG);
- einen Kühlraum; und
- eine Kälteanlage, die mit der Anlage zur Rückvergasung von Flüssigerdgas (LNG) über eine Zufuhrpipeline für ein Kühlmittel mit niedriger Temperatur verbunden und ausgebildet ist, um den Kühlraum auf einer gewissen Temperatur zu halten, wobei die Kälteanlage Folgendes umfasst:
- mindestens einen Luftkühler (1), der im Inneren des Kühlraums platziert ist und ein Entfrostungssystem und einen Satz von Rohren (9) umfasst,
- einen Rohrleitungskreislauf (2), der einen Auslass des Satzes von Rohren (9) des Luftkühlers (1) mit einem Einlass des Satzes von Rohren (9) verbindet, um das aus dem Luftkühler (1) ausgelassene Kühlmittel zurückzuführen;
- eine Pumpe (3), die auf dem Rohrleitungskreislauf (2) platziert ist, der mit dem Auslass des Satzes von Rohren (9) verbunden ist, um das ausgelassene Kühlmittel durch den Rohrleitungskreislauf (2) zu bewegen,
- ein einstellbares Dreiwegeventil (4), das in dem Rohrleitungskreislauf (2) stromabwärts der Pumpe (3) gelegen und mit einer Auslassleitung (14) verbunden ist, um die Ableitung des ausgelassenen Kühlmittels zu ermöglichen, das aus der Pumpe (3) austritt, wobei die Menge des im Rohrleitungskreislauf (2) gehaltenen Kühlmittels eingestellt wird;
- eine Zufuhrleitung (5), die mit der Zufuhrpipeline der Anlage zur Rückvergasung von LNG verbunden ist und mit dem Rohrleitungskreislauf (2) stromabwärts der Pumpe (3) verbunden ist, um das Kühlmittel mit einer niedrigeren Temperatur als das ausgelassene Kühlmittel, das aus dem Luftkühler (1) kommt, einzuleiten, wobei daher ein gemischtes Kühlmittel in dem Rohrleitungskreislauf (2) hergestellt wird,
- eine Steuereinheit (16), die mit dem Luftkühler (1), der Pumpe (3) und dem einstellbaren Dreiwegeventil (4) verbunden ist;
- ein erstes Absperrventil (12), das in der Zufuhrleitung (5) gelegen ist, mit der Steuereinheit (16) verbunden ist und die von der Zufuhrleitung (5) bereitgestellte Menge an Kühlmittel einstellt; und
- ein zweites Absperrventil (13), das in der Auslassleitung (14) gelegen ist, mit der Steuereinheit (16) verbunden ist und die Menge des aus dem Rohrleitungskreislauf (2) abgeleiteten Kühlmittels einstellt.

2. System nach Anspruch 1, wobei der Luftkühler (1) ferner ein oder mehrere Gebläse (10) umfasst, um die Wärmeübertragung zwischen den Rohren und dem Kühlraum zu erhöhen.

3. System nach Anspruch 1, wobei die Kälteanlage ferner einen oder mehrere Drucksensoren (6) umfasst, die mit der Steuereinheit (16) verbunden sind, um den Durchfluss des Kühlmittels einzustellen.

4. System nach Anspruch 3, wobei die Kälteanlage mindestens einen ersten Drucksensor (6), der stromaufwärts der Pumpe (3) gelegen ist, und mindestens einen zweiten Drucksensor (6) umfasst, der

stromabwärts der Pumpe (3) gelegen ist.

5. System nach Anspruch 1, wobei die Kälteanlage ferner einen Satz von Widerständen (8) umfasst, die im Inneren des Luftkühlers gelegen sind, um die Entstehung von Frost zu verhindern, und die mit der Steuereinheit (16) verbunden sind.

6. System nach Anspruch 1, wobei die Kälteanlage ferner ein Zufuhrsystem umfasst, das Solarenergie verwendet, um die Entstehung von Frost im Inneren des Luftkühlers zu verhindern, und mit der Steuereinheit (16) verbunden ist.

7. System nach Anspruch 1, wobei die Kälteanlage ferner ein Wärmezufuhrsystem mittels aerothermischer Energie umfasst, um die Entstehung von Frost im Inneren des Luftkühlers zu verhindern, und das mit der Steuereinheit (16) verbunden ist.

8. System nach Anspruch 1, wobei der Satz von Rohren (9) des Luftkühlers (1) ferner einen Satz von Rippen (11) umfasst, die dazu bestimmt sind, die Wärmeübertragung zwischen den Rohren und dem Kühlraum zu erhöhen.

9. System nach Anspruch 1, wobei die Temperatur des Kühlmittels am Einlass des Luftkühlers (1) -28 °C beträgt.

10. System nach Anspruch 1, wobei die Temperatur des von der Zufuhrleitung (5) zugeführten Kühlmittels -35 °C beträgt.

11. System nach Anspruch 1, das ferner einen oder mehrere Temperatursensoren (7, 15, 17) umfasst, die mit der Steuereinheit (16) verbunden sind, um die Temperatur des Kühlmittels am Einlass des Luftkühlers (1) zu steuern, wobei mittels des Dreiwegeventils (4) die Menge des Kühlmittels mit einer niedrigeren Temperatur, die von der Zufuhrleitung (5) zugeführt wird, und folglich die Temperatur des Kühlraums, verändert wird.

12. Verfahren zur Ermöglichung einer optimalen Verwendung eines Kühlmittels zur Aufrechterhaltung eines Kühlraums auf einer gewissen Temperatur, unter Verwendung des in einem der Ansprüche 1 bis 11 beschriebenen Kühlsystems, wobei das Verfahren Folgendes umfasst:

- Einleiten eines Kühlmittels, das aus einer Zufuhrleitung (5) der Hafenanlage für die Rückvergasung von LNG stammt, in einen Rohrleitungskreislauf (2), der mit einem Einlass und einem Auslass eines Satzes von Rohren (9) eines Luftkühlers (1) verbunden ist, der innerhalb des Kühlraums platziert ist;
- Rückführen des ausgelassenen Kühlmittels, das aus dem Auslass des Satzes von Rohren (9) des Luftkühlers (1) austritt, durch Pumpen des ausgelassenen Kühlmittels unter Verwendung einer Pumpe (3);
- Hinzufügen von Kühlmittel aus der Zufuhrleitung (5) zum Herstellen von gemischtem Kühlmittel, wobei daher die Temperatur des gemischten Kühlmittels am Einlass des Satzes von Rohren (9) des Luftkühlers (1) gesteuert wird; und
- Steuern der Menge des im Rohrleitungskreislauf (2) fließenden Kühlmittels mittels eines Dreiwegeventils, das im Rohrleitungskreislauf (2) zwischen der Pumpe (3) und der Zufuhrleitung (5) gelegen ist und mit einer Auslassleitung (14) verbunden ist, um die Ableitung des ausgelassenen Kühlmittels zu ermöglichen, das aus der Pumpe (3) kommt.

Revendications

1. Système de réfrigération comprenant :

- une installation de regazéification de gaz naturel liquéfié (GNL) ;
- une chambre froide ; et
- une installation de réfrigération reliée à l'installation de regazéification de gaz naturel liquéfié (GNL) au moyen d'une conduite d'alimentation en réfrigérant à basse température et configurée pour maintenir la chambre froide à une certaine température, l'installation de réfrigération comprenant :
- au moins un refroidisseur d'air (1), placé à l'intérieur de la chambre froide et qui comprend un système de dégivrage et un ensemble de tubes (9),
- un circuit de tuyaux (2) reliant une sortie de l'ensemble de tubes (9) du refroidisseur d'air (1) à une entrée dudit ensemble de tubes (9), destiné à faire recirculer le réfrigérant sortant du refroidisseur d'air (1) ;
- une pompe (3), placé sur le circuit de tuyaux (2) relié à la sortie de l'ensemble de tubes (9) destiné à déplacer le réfrigérant sortant à travers le circuit de tuyaux (2),
- une vanne à trois voies réglable (4), située dans le circuit de tuyaux (2) en aval de la pompe (3) et reliée à un conduit de sortie (14) afin de permettre l'évacuation du réfrigérant sortant issu de la pompe (3), régler la quantité de réfrigérant qui est maintenue dans le circuit de tuyaux (2) ;
- un conduit d'alimentation (5) relié à la conduite d'alimentation de l'installation de regazéification de GNL et relié au circuit de tuyaux (2) en aval de la pompe (3) pour introduire le réfrigérant à

une température inférieure à celle du réfrigérant sortant issu du refroidisseur d'air (1), produisant de ce fait un réfrigérant mixte dans le circuit de tuyaux (2),
- une unité de commande (16), reliée au refroidisseur d'air (1), la pompe (3) et la vanne à trois voies réglable (4) ;
- une première vanne d'arrêt (12) située dans le conduit d'alimentation (5), connectée à l'unité de commande (16) et qui règle la quantité de réfrigérant fournie par ledit conduit d'alimentation (5) ; et
- une seconde vanne d'arrêt (13) située dans le conduit de sortie (14), reliée à l'unité de commande (16) et qui règle la quantité de réfrigérant qui est évacuée du circuit de tuyaux (2).

2. Système selon la revendication 1, dans lequel le refroidisseur d'air (1) comprend en outre un ou plusieurs ventilateurs (10), pour augmenter le transfert de chaleur entre les tubes et la chambre froide.

3. Système selon la revendication 1, dans lequel l'installation de réfrigération comprend en outre un ou plusieurs capteurs de pression (6) connectés à l'unité de commande (16) pour régler le débit de réfrigérant.

4. Système selon la revendication 3, dans lequel l'installation de réfrigération comprend au moins un premier capteur de pression (6) situé en amont de la pompe (3) et au moins un second capteur de pression (6) situé en aval de la pompe (3).

5. Système selon la revendication 1, dans lequel l'installation de réfrigération comprend en outre un ensemble de résistances (8) situées à l'intérieur du refroidisseur d'air afin d'éviter la génération de givre et reliées à l'unité de commande (16).

6. Système selon la revendication 1, dans lequel l'installation de réfrigération comprend en outre un système d'alimentation en utilisant de l'énergie solaire afin d'éviter la génération de givre à l'intérieur du refroidisseur d'air et relié à l'unité de commande (16).

7. Système selon la revendication 1, dans lequel l'installation de réfrigération comprend en outre un système d'alimentation en chaleur au moyen d'énergie aérothermique afin d'éviter la génération de givre à l'intérieur du refroidisseur d'air et relié à l'unité de commande (16).

8. Système selon la revendication 1, dans lequel l'ensemble de tubes (9) du refroidisseur d'air (1) comprend en outre un ensemble d'ailettes (11) destinées à augmenter le transfert de chaleur entre les tubes et la chambre froide.

9. Système selon la revendication 1, dans lequel la température du réfrigérant à l'entrée du refroidisseur d'air (1) est de -28 °C.

10. Système selon la revendication 1, dans lequel la température du réfrigérant fourni par le conduit d'alimentation (5) est de -35 °C.

11. Système selon la revendication 1, qui comprend en outre un ou plusieurs capteurs de température (7, 15, 17) reliés à l'unité de commande (16) pour commander la température du réfrigérant à l'entrée du refroidisseur d'air (1) en variant au moyen de la vanne à trois voies (4) la quantité de réfrigérant à une température inférieure fournie par le conduit d'alimentation (5) et, par conséquent, la température de la chambre froide.

12. Procédé destiné à permettre une utilisation optimale d'un réfrigérant pour maintenir une chambre froide à une certaine température, à l'aide du système de réfrigération décrit dans l'une quelconque des revendications 1 à 11, le procédé comprenant :

- l'introduction d'un réfrigérant issu d'un conduit d'alimentation (5) depuis l'installation du port de regazéification de GNL vers un circuit de tuyaux (2), qui se relie à une entrée et une sortie d'un ensemble de tubes (9) d'un refroidisseur d'air (1), placé à l'intérieur de la chambre froide ;
- la recirculation du réfrigérant sortant issu de la sortie de l'ensemble de tubes (9) du refroidisseur d'air (1), en pompant le réfrigérant sortant à l'aide d'une pompe (3) ;
- l'ajout de réfrigérant du conduit d'alimentation (5) pour produire un réfrigérant mixte, de ce fait, commander la température du réfrigérant mixte à l'entrée de l'ensemble de tubes (9) du refroidisseur d'air (1) ; et
- commander la quantité de réfrigérant circulant dans le circuit de tuyaux (2) au moyen d'une vanne à trois voies située dans le circuit de tuyaux (2) entre la pompe (3) et le conduit d'alimentation (5) et qui est reliée au conduit de sortie (14) afin de permettre l'évacuation du réfrigérant sortant issue de la pompe (3).

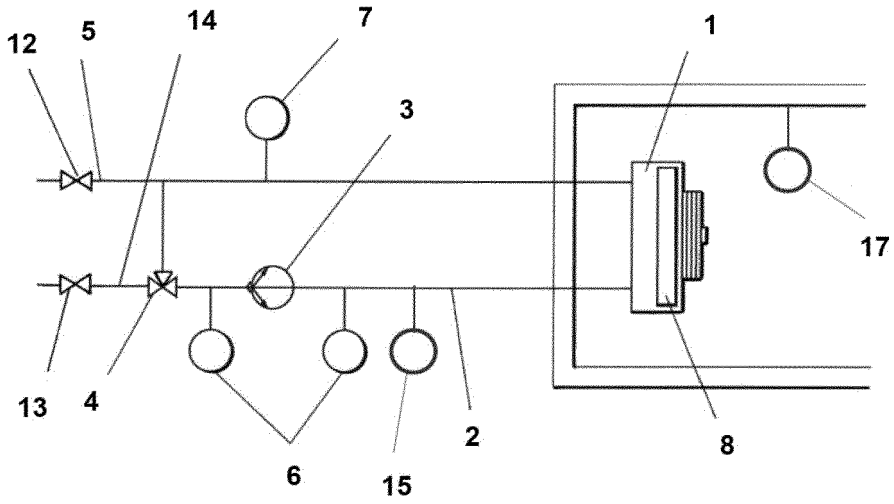

FIG. 1

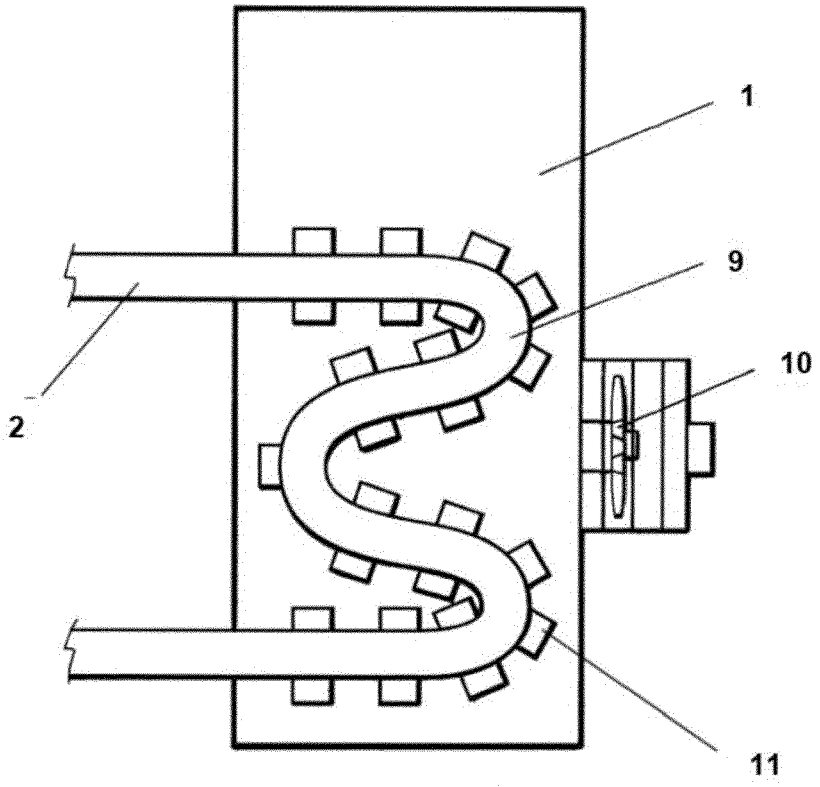

FIG. 2

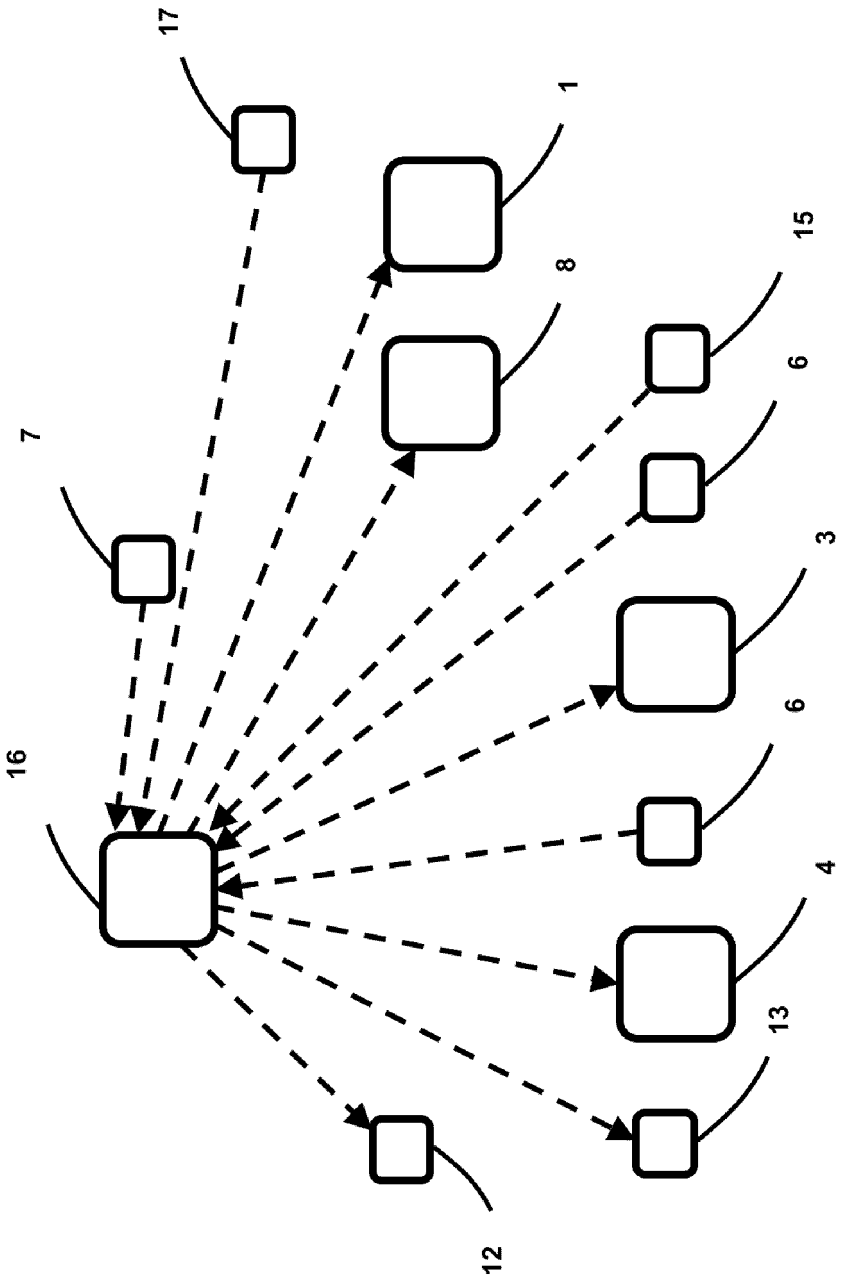

FIG. 3

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2000205731 A **[0006]**