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(54) **A PROCEDURE FOR CONTROLLING REFRIGERATING MACHINES AND A SYSTEM FOR CARRYING OUT SAID PROCEDURE**

VERFAHREN ZUR STEUERUNG VON KÜHLMASCHINEN UND SYSTEM ZUR DURCHFÜHRUNG DES VERFAHRENS

PROCEDE DE REGULATION DE REFRIGERATEURS ET SYSTEME ASSOCIE

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- **DATABASE WPI Week 200121, Derwent Publications Ltd., London, GB; AN 2001-206096, XP002971760 NAKA N.: 'Operating method of brine cooling system for refridgerator showcases, involves increasing fixed temperature of brine based on load reduction signal of showcase transmitted by timer' & JP 2001 021247 A (NAKANO REIKI KK) 26 January 2001**
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Description

[0001] The present invention is directed towards a procedure for controlling a cooling system having the features of the first part of claim 1, and to such a cooling system having the features of the first part of claim 8.

[0002] A variety of principles of control are available to the person skilled in the art. One way is to adjust the temperature of the coolant in the equalization tank by controlling the run-time of the compressor. Another way is to adjust the outgoing temperature of the coolant by shunting at the equalization tank, see for example CH 265303, figure 2, or by bypassing the heat-sink, see for example US 5 743 102 A, which discloses the features of the preamble of claim 1.

[0003] Presently, there are no procedures for controlling the run-time of the compressor using the refrigeration requirements of the system, thus, one can not adjust the temperature in the coolant tank to meet the real cooling requirement.

[0004] It is not possible to adjust the evaporating temperature to the expansion valve since an expansion valve is constructed in such a manner as to provide an evaporation that in every operational case is as effective as possible. It is not constructed to regulate temperatures in evaporators. It is always the dimensioning of the evaporator as well as temperatures and flows on the secondary side of the evaporator, in combination with the capacity of the compressor, that determine the evaporating temperature. If, for example the expansion valve is closed in order to reduce the capacity the compressor can jam since high temperatures in the compressor, and if the valve is opened in order to, for example increase the capacity, fluid can be drawn into the compressor which, as a result, can cause serious damage in the compressor on valves, pistons, etc. One of the most important criteria in the dimensioning of refrigerating plants is to adjust the compressor, the expansion valve and the evaporator to each other in order to obtain optimal operational conditions at the so called point of operation.
By shunting out the correct temperature to the cooling objects does not give any true adjustment to the refrigeration load since the major part of the volume in the system is kept at a very low temperature, and the refrigerating unit is also working at low temperatures and thus with a low COP.

[0005] Known cooling systems for cooling food for example are dimensioned for the worst possible conditions. This means that the refrigerated display case is dimensioned for the greatest load of both customers- and goods in accordance to EN441. According to this standard, the refrigerated display cases are divided into different temperature classes depending upon the field of application. It has also been defined at which ambient temperature the cooling system is to be used. In Sweden the most common class is ISO2 which means that the ambient temperature is +22°C and that the relative humidity is 60%. Further, the refrigerating machines are dimensioned to provide the intended cooling effect even during hot summer days. Generally, the refrigerating machine will provide the intended cooling effect at an outdoor temperature of +27°C as well as ensure that highpressure release at considerably higher temperatures does not occur. Taken together, this result in that the cooling plant is heavily over-dimensioned for the most part of the year. The nominal power demand is usually about 70% of the installed effect. This heavy over-dimensioning results in serious drawbacks concerning efficiency and will be unnecessarily expensive for the storekeeper and for the customers.

[0006] Figures 1 and 1A of the present application schematically illustrate how the present-day, energy preserving, indirect cooling systems are structured.

[0007] The most common principle of regulation for a refrigerating machine is as follows:

> The compressors are capacity controlled so that the outgoing temperature of the coolant always is -8°C, independent of the incoming coolant.

[0008] To ensure a minimum flow over the evaporator of the refrigerating machine a two-circuit system with a fixed flow between the evaporator and an equalization tank is used. A pump P2 ensures this flow. The temperature in the refrigerated display cases is controlled by thermostats which open and close the valves V1-V3 respectively according to the requirement of the refrigerated display case.

[0009] To compensate for the increased or decreased flow requirement of the system pumps with multiple steps or speed controlled pumps P3 are used. A fixed pump P2 can also be used and so-called overflow valves which shunt the flow over the refrigerated display cases. These valves then uphold the pressure drop at a constant level in the machine regardless of the system load.

[0010] Figure 1 discloses a general temperature condition of a known system during normal operation. One can clearly see the drawbacks of letting the refrigerating machine work with a temperature of -8°C when the real need is just -6°C. This condition exists during the most part of the year.

[0011] The introduction of energy-saving measures is often followed by installing of night covers and blinds on the refrigerated display cases in order to reduce energy loss. In some cases the energy demand of the refrigerated display cases can be reduced by nearly 50%. As seen in figure 1A the temperature conditions in the system change but the refrigerating machines keep working with the same temperatures as before.

[0012] The reason for this is that there is no system on the market that allows an easy way of changing the temperature setting of the refrigerating machine to adjust it to requirements of the system. This operational condition is common during nights and during days when the store is closed. As is clearly seen, 80% of the annual time of operation the refrigerating machine works under ex-

tremely unfavourable conditions and thus not economically.

[0013] Therefore, the main object of the present invention is primarily, with simple measures and means, to effectively and safely solve said problem.

[0014] Said object is fulfilled by means of a procedure for controlling a cooling system as initially referred to and which has the features of the characterizing part of claim 1.

[0015] Known means for refrigerating control does not make it possible to achieve the desired control so that the temperature, in an effective and economical way, is set at a correct level.

[0016] Therefore, a further object of the present invention is to find a system that can solve the above stated problem. The object is also fulfilled by means of a cooling system as initially referred to having the characterizing features of claim 8.

[0017] Referring to the appended drawings, a preferred embodiment of the invention will be described. In the drawings:

Figure 1 and figure 1A illustrate known solutions for controlling the cooling system for refrigerated display cases, and

Figure 2 and figure 3 illustrate control systems according to the present invention during normal operation and during night conditions, respectively.

[0018] According to the present invention a pipe 1, for supplying coolant, is connected to a present pump 2 arranged to pump coolant through said pipe 1, through the refrigerating unit and where 3 indicates its evaporator. A similar system 4 which is arranged to allow a variable flow, comprising means 5 for sensing the temperature difference between the incoming and outgoing coolant, and to use this obtained value as input to the capacity controlling of the present refrigerating machine. A pump 2 of said refrigerating machine includes a speed regulator 8 which affects the value of the outgoing temperature of the coolant. In the example disclosed the refrigerated display cases are in the drawings assigned the numbers 18-20.

[0019] Said pipe 1 supply coolant to and divert coolant away from said refrigerated display cases 18-20.

[0020] One method for controlling refrigerating machines and the temperature of their coolants with a system, which is carried out according to what has been stated above, comprises adjustment of the outgoing temperature of the present refrigerating unit to the real demand for refrigeration, and thereby creating a cooling system 4 that works with a dynamic temperature of the coolant. Thus, the system 4 is coupled as a one-circuit system with a variable flow rate through the refrigerating unit.

[0021] By using the temperature difference between incoming and outgoing coolant as input to the capacity controlling of the refrigerating machine, and allowing the speed regulator 8 of the pump 2 to affect this value, the desired effect can easily be obtained.

[0022] When the valves in the system are beginning to close, the flow in the system decreases and the pump adjusts its capacity by decreasing its speed. With a decreased flow through the evaporator, the temperature difference between incoming and outgoing coolant increase. The capacity controlling of the refrigerating system then decreases the speed of the compressor in order to maintain the temperature difference. This means that the outgoing temperature will increase and the evaporating temperature rises. Concurrently with the rise of the temperature of the system the valves will begin to open again and the pump will increase its capacity until balance is achieved.

[0023] The refrigerating machine cannot run at full effect until the pump runs at full capacity and this condition can only be achieved when all the valves are open.

[0024] In order to guarantee the quality of, for example groceries in the intended refrigerated display cases, restrictions regarding the highest and lowest temperature of the coolant can be introduced.

[0025] By use of the present system solution many problems are solved and for the system many advantages are provided: A simpler system solution provides a simpler and less expensive installation, e.g. the cost for equipment in the store can be reduced by around SEK 100.000. Reduced energy loss in the piping system. Heavily increased COP. Very high energy saving potential. Can be applied to basically all new and already existing systems. Higher food quality through a more even temperature. The risk of freezing of sensitive groceries is eliminated.

[0026] The refrigerating compressor 9 is connected to yet another line circuit 10. The numbers 11-13 denote a plurality of control valves within the system 4 and which are connected to the line circuit 1 which in said pump 2 functions, as well as connects, the refrigerated display cases 18-20.

[0027] The numbers 14, 15 denote two pressure sensors while two temperature sensors are denoted by the numbers 16, 17, and which are a part of said line circuit 1.

[0028] Thus, the temperature difference between the incoming and the outgoing coolant is used as signal input to the capacity controlling of the refrigerating machine and the speed regulator of the pump 2 thereby affects this said value.

[0029] The flow in the system is set to decrease when, for example the valves 11-13 in system 4 are beginning to close, whereby the pump 2 adjusts its capacity by decreasing its speed.

[0030] By decreasing the flow through the evaporator 3, the temperature difference between the incoming and outgoing coolant increases.

[0031] The speed of the compressor can be reduced by said capacity controlling in the refrigerating machine in order to maintain the difference in temperature between the incoming and outgoing coolant and thereby

obtain an increase of the outgoing temperature and also an increase of the evaporation temperature.

[0032] In order to optimise the condition between the evaporating temperature and the temperature of the coolant, a pressure- and temperature sensor 50 in the evaporating circuit 10 can in some cases be used which gives a signal to the system's capacity control. A further circuit 25 leads from a condenser 27 to a coolant cooler 26 of, for example a known type, and a pump 6 is connected to said circuit 25. A speed regulator 7 is arranged to be able to affect the value of the heat-carrier and said pump 6.

[0033] The invention is not limited to the above described nor to the disclosed embodiment in the appended drawings. Modifications are possible, especially regarding the character of the different parts, or by the use of similar technology without departing from the scope of the invention such as defined in the claims. The invention can be applied to any refrigerating application and thus not exclusively to refrigerated display cases for groceries as exemplified above.

Claims

1. A procedure for controlling a cooling system (4) comprising an evaporating circuit (10), which comprises an evaporator (3), a refrigerating compressor (9), and a pump (2) with a speed regulator (8) and which is connected to a line circuit (1) supplying, via control valves (11, 12, 13), coolant to, and diverting coolant from, a number of display cases (18, 19, 20), said display cases being connected to the evaporating circuit (10) by means of the line circuit (1),
characterized in
that it comprises the steps of:

   - detecting the temperature of coolant incoming to the display cases (18, 19, 20) and of coolant outgoing from the display cases (18, 19, 20) using temperature sensors (16, 17);
   - inputting signals with the detected temperatures, and an operation data signal from the speed regulator (8) of the pump (2) and in the pump (2) arranged pressure sensors (14, 15), to processing means (5);
   - establishing, in the processing means (5), the difference between the temperature of the incoming coolant and the temperature of the outgoing coolant, and using said temperature difference and the operation data signal for capacity control of the refrigerating system by controlling the speed of the refrigerating compressor (9) and allowing adjustment of the speed of the pump (2) by means of the speed regulator (8) to create a variable dynamic temperature of the coolant input to the display cases (18, 19, 20) which is adapted to a real demand for cooling.

2. A procedure according to claim 1
characterized in
that the speed regulator (8) adjusts the capacity of the pump (2) to existing flow requirement of the system, when the control valves (11, 12, 13) close.

3. A procedure according to any of the claims 1-2,
characterized in
that the speed regulator (8) decreases the speed of the pump (2), hence adjusting its capacity, when the flow of the refrigerating system (4) decreases when the control valves (11, 12, 13) of the system (4) are beginning to close.

4. A procedure according to any of the claims 1-3,
characterized in
that when the flow through the evaporator (3) of the system (4) decreases, and hence the temperature difference between incoming coolant and outgoing coolant increases, the capacity of the refrigerating compressor (9) is decreased in order to maintain the temperature difference between the coolant incoming to the display cases (18, 19, 20) and coolant outgoing from the display cases (18, 19, 20), hence the evaporating temperature is increased.

5. A procedure according to claim 1,
characterized in
that when the need for cooling of the display cases increases and the control valves (11, 12, 13) begin to open, the capacity of the pump (2) is increased and the capacity of the refrigerating compressor (9) is increased until balance is obtained.

6. A procedure according to claim 5,
characterized in
that the pump (2) and the refrigerating compressor (9) are arranged to run at full capacity when a maximum of refrigeration is needed, for example when all of the control valves (11, 12, 13) are open.

7. A procedure according to any of the claims 1-6,
characterized in
that the processing means (5) provide limitations of highest and lowest allowed temperature of the coolant.

8. A cooling system (4) comprising an evaporating circuit (10), which comprises an evaporator (3), a refrigerating compressor (9), and a pump (2) with a speed regulator (8) and which is connected to a line circuit (1) arranged to supply, via control valves (11, 12, 13), coolant to, and to divert coolant from, a number of display cases (18, 19, 20), said display cases being connected to the evaporating circuit (10) by means of the line circuit (1),
characterized in
that it comprises temperature sensors (16, 17)

adapted to detect the temperature of coolant incoming to the display cases (18, 19, 20) and of coolant outgoing from the display cases (18, 19, 20), and to provide signals with the detected temperatures to a processing means (5),
that the speed regulator (8) of the pump (2) and in the pump (2) arranged pressure sensors (14, 15) are adapted to provide an operation data signal to the processing means (5),
that the processing means (5) are adapted to establish the difference between the detected temperatures and to use the temperature difference and the operation data signal to control the capacity of the refrigerating system (4) by controlling the speed of the refrigerating compressor (9) and allowing adjustment of the speed of the pump (2) by means of the speed regulator (8) such that the system will operate with an input of coolant with a variable dynamic temperature to the display cases (18, 19, 20) which is adapted to a real demand for cooling.

Patentansprüche

1. Verfahren zum Steuern eines Kühlsystems (4), umfassend einen Verdampfungskreislauf (10), der einen Verdampfer (3), einen Kühlkompressor (9), und eine mit einer Geschwindigkeitsregulierung (8) versehene Pumpe (2), die mit einem Leitungskreislauf (1) verbunden ist, der über Steuerventile (11, 12, 13) eine Vielzahl an Schaukästen (18, 19, 20) mit Kühlmittel versorgt und von den Steuerventilen (11, 12, 13) aus umlenkt, wobei die Schaukästen mit dem Verdampfungskreislauf (10) über den Leitungskreislauf (1) verbunden sind,
dadurch gekennzeichnet, dass
das Verfahren die Schritte umfasst:

   - Ermitteln der Temperatur des Kühlmittels, das in die Schaukästen (18, 19, 20) kommt, und des Kühlmittels das die Schaukästen (18, 19, 20) verlässt, verwendend die Temperatursensoren (16, 17),
   - Eingeben von Signalen mit den erfassten Temperaturen und ein Betriebsdatensignal von der Geschwindigkeitsregulierung (8) der Pumpe (2) und von in der Pumpe (2) angeordneten Drucksensoren (14, 15) in eine Verarbeitungseinrichtung (5),
   - Ermitteln des Unterschiedes zwischen der Temperatur des eingehenden Kühlmittels und der Temperatur des ausgehenden Kühlmittels in der Verarbeitungseinrichtung (5) und Verwenden des Temperaturunterschiedes und des Betriebsdatensignals zur Förderleistungssteuerung des Kühlungssystems durch Steuern der Geschwindigkeit des Kühlkompressors (9) und des Zulassens einer Einstellung der Geschwindigkeit der Pumpe (2) mittels der Geschwindigkeitsregulierung (8), um eine variable dynamische Temperatur des Kühlmitteleingangs der Schaukästen (18, 19, 20) zu erzeugen, die der echten Nachfrage nach Kühlung angepasst ist.

2. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** die Geschwindigkeitsregulierung (8) die Förderleistung der Pumpe (2) an den bestehenden Durchflussbedarf des Systems anpasst, wenn die Steuerventile (11, 12, 13) sich schließen.

3. Verfahren nach einem der Ansprüche 1-2, **dadurch gekennzeichnet, dass** die Geschwindigkeitsregulierung (8) die Geschwindigkeit der Pumpe (2) reduziert, wodurch ihre Förderleistung eingestellt wird, wenn der Fluss des Kühlsystems (4) abnimmt, wenn die Steuerventile (11, 12, 13) des Systems damit beginnen sich zu schließen.

4. Verfahren nach einem der Ansprüche 1-3, **dadurch gekennzeichnet, dass** wenn der Fluss durch den Verdampfer (3) des Systems (4) abnimmt und folglich der Temperaturunterschied zwischen dem eingehenden und ausgehenden Kühlmittel steigt, die Förderleistung des Kühlkompressors (9) verringert wird, um den Temperaturunterschied zwischen dem in die Schaukästen (18, 19, 20) eingehenden Kühlmittel und dem von den Schaukästen abgehenden Kühlmittel (18, 19, 20) zu halten, wodurch die Verdampfungstemperatur erhöht wird.

5. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** wenn der Bedarf zum Kühlen der Schaukästen steigt und die Steuerventile (11, 12, 13) damit beginnen sich zu öffnen, die Förderleistung der Pumpe (2) gesteigert wird und die Förderleistung die Kühlkompressors (9) gesteigert wird bis ein Gleichgewicht erhalten wird.

6. Verfahren nach Anspruch 5, **dadurch gekennzeichnet, dass** die Pumpe (2) und der Kühlkompressor (9) angeordnet sind, um mit voller Förderleistung zu laufen, wenn ein maximaler Kühlbedarf gebraucht wird, beispielsweise wenn alle die Steuerventile (11, 12, 13) geöffnet sind.

7. Verfahren nach einem der Ansprüche 1-6, **dadurch gekennzeichnet, dass** die Verarbeitungseinrichtung (5) Grenzen für die höchste und geringste zulässige Kühlmitteltemperatur vorsieht.

8. Kühlsystem (4), umfassten einen Verdampfungskreislauf (10), der einen Verdampfer (3), einen Kühlkompressor (9) und eine mit einer Geschwindigkeitsregulierung (8) versehene Pumpe (2), die mit einem Leitungskreislauf (1) verbunden ist, der über Steuerventile (11, 12, 13) eine Vielzahl an Schaukästen

(18, 19, 20) mit Kühlmittel versorgt und von den Steuerventilen (11, 12, 13) aus umlenkt, wobei die Schaukästen mit dem Verdampfungskreislauf (10) über den Leitungskreislauf (1) verbunden sind, umfasst, **dadurch gekennzeichnet, dass** das Kühlsystem (4) Temperatursensoren (16, 17) umfasst, die ausgebildet sind, um eine Temperatur des in die Schaukästen (18, 19, 20) eingehenden Kühlmittels und des von den Schaukästenn (18, 19, 20) abgehenden Kühlmittels zu erfassen und um eine Verarbeitungseinrichtung (5) mit Signalen der erfassten Temperaturen zu versehen,
dass die Geschwindigkeitsregulierung (8) der Pumpe (2) und in der Pumpe (2) angeordnete Temperatursensoren (14, 15) ausgebildet sind, um die Verarbeitungseinrichtung (5) mit einem Betriebsdatensignal zu versehen,
dass die Verarbeitungseinrichtung (5) ausgebildet ist, um den Unterschied zwischen den erfassten Temperaturen zu ermitteln und den Temperaturunterschied und das Betriebsdatensignal dazu zu verwenden, die Förderleistung des Kühlsystems (4) durch Steuern der Geschwindigkeit des Kühlkompressors (9) zu steuern und die Einstellung der Geschwindigkeit der Pumpe (2) mittels der Geschwindigkeitsregulierung (8) zuzulassen, so dass das System mit einem Kühlmitteleingang mit einer variablen dynamischen Temperatur hin zu den Schaukästen (18, 19, 20) betrieben wird, die der echten Nachfrage nach Kühlung angepasst ist.

Revendications

1. Procédure pour commander un système de refroidissement (4) comprenant un circuit d'évaporation (10), qui comprend un évaporateur (3), un compresseur de réfrigération (9) et une pompe (2) avec un régulateur de vitesse (8) et qui est relié à un circuit de ligne (1) délivrant, par l'intermédiaire de vannes de commande (11, 12, 13), un agent de refroidissement à un certain nombre d'enceintes de présentation (18, 19, 20), et dérivant un agent de refroidissement à partir de celles-ci, lesdites enceintes de présentation étant reliées au circuit d'évaporation (10) à l'aide du circuit de ligne (1),
caractérisée en ce qu'elle comprend les étapes consistant à :

   - détecter la température d'un agent de refroidissement entrant dans les enceintes de présentation (18, 19, 20) et d'un agent de refroidissement sortant des enceintes de présentation (18, 19, 20) à l'aide de capteurs de température (16, 17) ;
   - entrer des signaux avec les températures détectées, et un signal de données de fonctionnement venant du régulateur de pression (8) de la pompe (2) et de capteurs de pression (14, 15) disposés dans la pompe (2), dans des moyens de traitement (5) ;
   - établir, dans les moyens de traitement (5), la différence entre la température de l'agent de refroidissement entrant et la température de l'agent de refroidissement sortant, et utiliser ladite différence de température et le signal de données de fonctionnement pour la commande de capacité du système de réfrigération par la commande de la vitesse du compresseur de réfrigération (9) et le fait de permettre le réglage de la vitesse de la pompe (2) à l'aide du régulateur de vitesse (8) afin de créer une température dynamique variable de l'agent de refroidissement entrant dans les enceintes de présentation (18, 19, 20) qui est adaptée à une demande réelle de refroidissement.

2. Procédure selon la revendication 1, **caractérisée en ce que** le régulateur de vitesse (8) règle la capacité de la pompe (2) à une exigence de débit d'écoulement existante du système, lorsque les vannes de commande (11, 12, 13) se ferment.

3. Procédure selon l'une quelconque des revendications 1 à 2, **caractérisée en ce que** le régulateur de vitesse (8) diminue la vitesse de la pompe (2), réglant ainsi sa capacité, lorsque le débit d'écoulement du système de réfrigération (4) diminue lorsque les vannes de commande (11, 12, 13) du système (4) commencent à se fermer.

4. Procédure selon l'une quelconque des revendications 1 à 3, **caractérisée en ce que**, lorsque le débit d'écoulement à travers l'évaporateur (3) du système (4) diminue, et que, par conséquent, la différence de température entre l'agent de refroidissement entrant et l'agent de refroidissement sortant augmente, la capacité du compresseur de réfrigération (9) est diminuée afin de maintenir la différence de température entre l'agent de refroidissement entrant dans les enceintes de présentation (18, 19, 20) et l'agent de refroidissement sortant des enceintes de présentation (18, 19, 20), grâce à quoi la température d'évaporation est augmentée.

5. Procédure selon la revendication 1, **caractérisée en ce que**, lorsque le besoin de refroidissement des enceintes de refroidissement augmente et que les vannes de commande (11, 12, 13) commencent à s'ouvrir, la capacité de la pompe (2) est accrue et la capacité du compresseur de réfrigération (9) est accrue jusqu'à ce qu'un équilibre soit obtenu.

6. Procédure selon la revendication 5, **caractérisée en ce que** la pompe (2) et le compresseur de réfrigération (9) sont configurés de façon à fonctionner à

pleine capacité lorsqu'un maximum de réfrigération est requis, par exemple lorsque toutes les vannes de commande (11, 12, 13) sont ouvertes.

7. Procédure selon l'une quelconque des revendications 1 à 6, **caractérisée en ce que** les moyens de traitement (5) produisent des limitations des températures la plus haute et la plus basse admises de l'agent de refroidissement.

8. Système de refroidissement (4), comprenant un circuit d'évaporation (10), qui comprend un évaporateur (3), un compresseur de réfrigération (9), et une pompe avec un régulateur de vitesse (8) et qui est reliée à un circuit de ligne (1) configuré de façon à délivrer, par l'intermédiaire de vannes de commande (11, 12, 13), un agent de refroidissement à un certain nombre d'enceintes de présentation (18, 19, 20), et à dériver un agent de refroidissement à partir de celles-ci, lesdites enceintes de présentation étant reliées au circuit d'évaporation (10) à l'aide du circuit de ligne (1),
caractérisé en ce que :

il comprend des capteurs de température (16, 17) adaptés de façon à détecter la température d'un agent de refroidissement entrant dans les enceintes de présentation (18, 19, 20) et d'un agent de réfrigération sortant des enceintes de présentation (18, 19, 20), et à délivrer des signaux avec les températures détectées à des moyens de traitement (5),
le régulateur de vitesse (8) de la pompe (2) et les capteurs de pression (14, 15) disposés dans la pompe (2) sont adaptés de façon à délivrer un signal de données de fonctionnement aux moyens de traitement (5),
les moyens de traitement (5) sont adaptés de façon à établir la différence entre les températures détectées et à utiliser la différence de température et le signal de données de fonctionnement pour commander la capacité du système de réfrigération (4) par la commande de la vitesse du compresseur de réfrigération (9) et le fait de permettre le réglage de la vitesse de la pompe (2) à l'aide du régulateur de vitesse (8), de telle sorte que le système fonctionne avec une entrée d'agent de refroidissement avec une température dynamique variable vers les enceintes de présentation (18, 19, 20) qui est adaptée à une demande réelle de refroidissement.

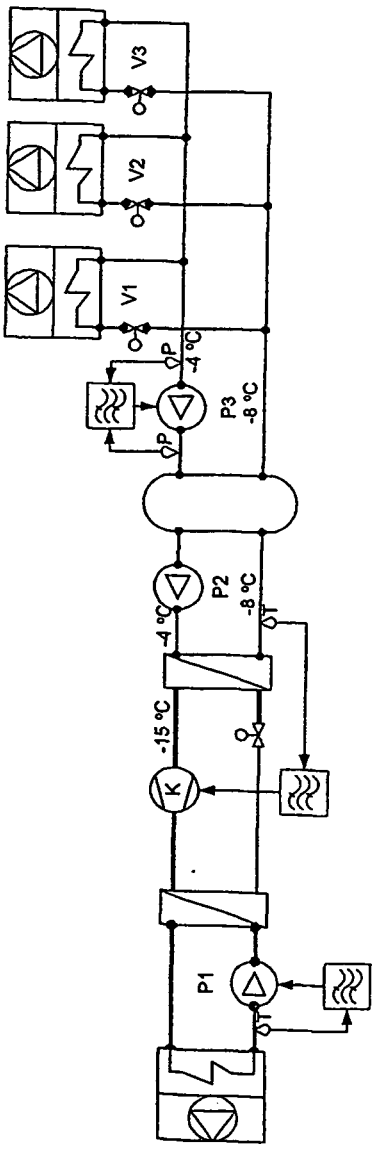

V3
V2
V1
P
-4 °C
P3
-8 °C
P
P2
-8 °C
-4 °C
-15 °C
K
P1
T

FIG.1

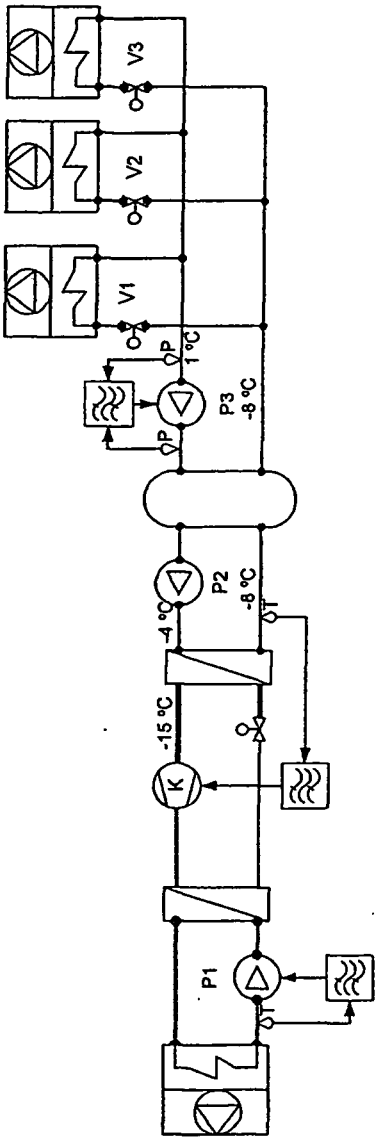

V3
V2
V1
P
1 °C
P3
-8 °C
P
P2
-8 °C
-4 °C
-15 °C
K
P1
T

FIG.1A

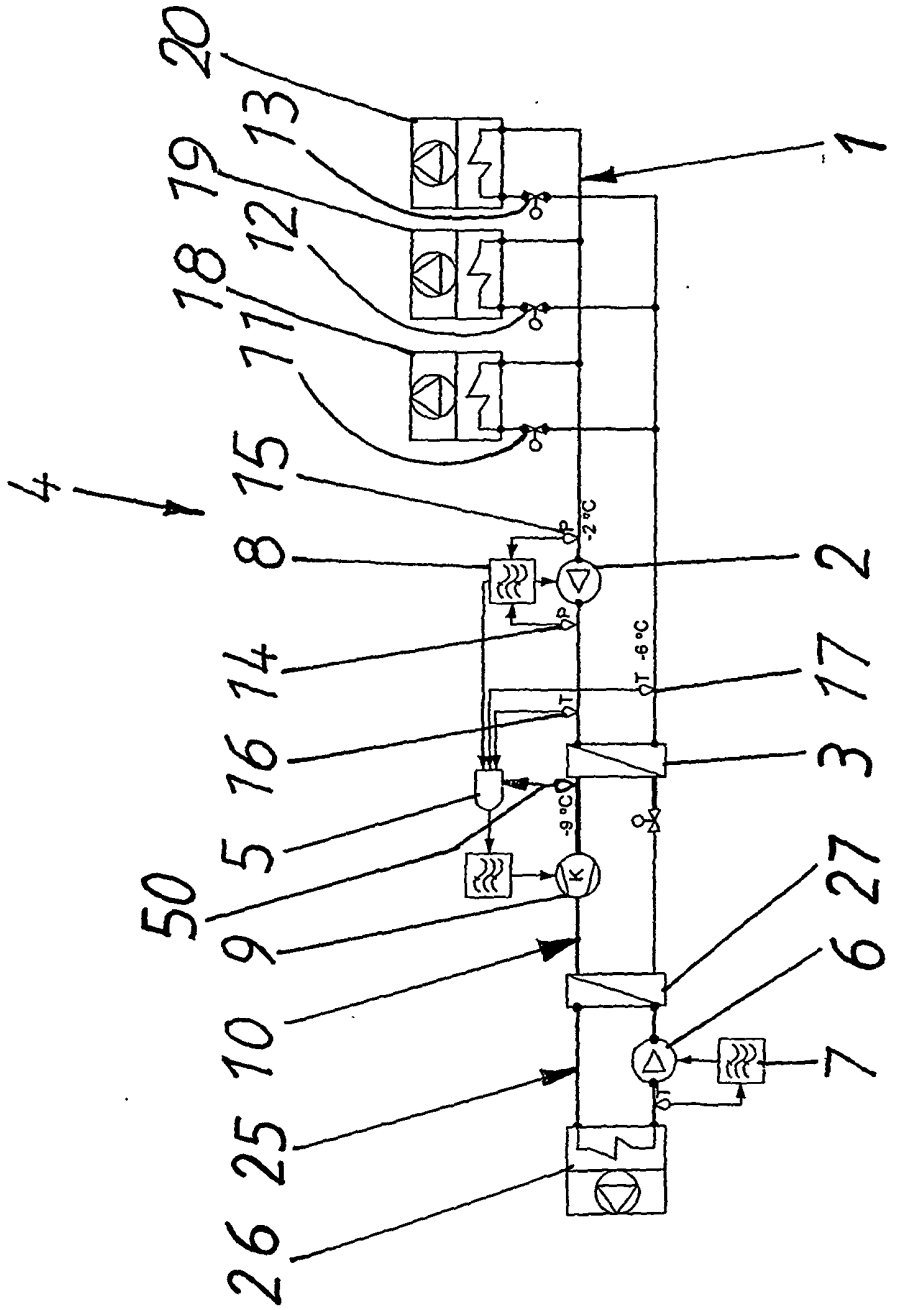


FIG.2

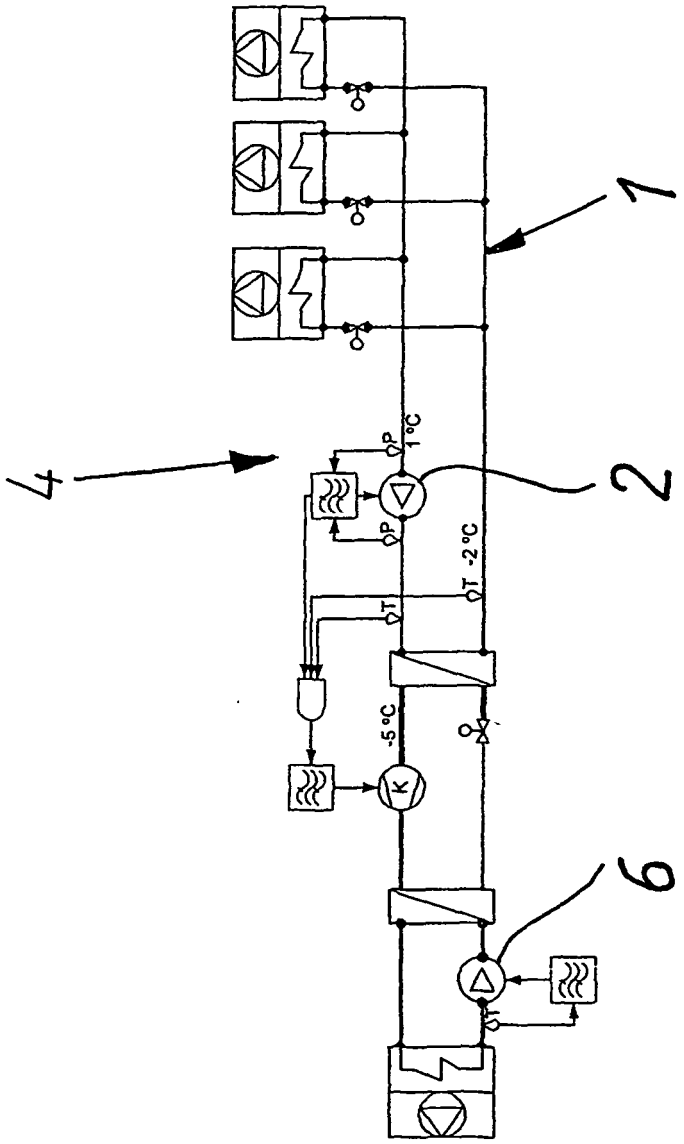


FIG.3

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CH 265303 **[0002]**
- US 5743102 A **[0002]**