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**(54) METHOD OF DETERMINING OPTIMAL COEFFICIENT OF PERFORMANCE IN A TRANSCRITICAL VAPOR COMPRESSION SYSTEM AND A TRANSCRITICAL VAPOR COMPRESSION SYSTEM**

VERFAHREN ZUR ERMITTLUNG DES OPTIMALEN LEISTUNGSKOEFFIZIENTEN IN EINEM  
TRANSKRITISCHEN DAMPFKOMPRESSIONSSYSTEM UND EIN TRANSKRITISCHES  
DAMPFKOMPRESSIONSSYSTEM

PROCEDE DE DETERMINATION DE COEFFICIENT OPTIMAL DE PERFORMANCE DANS UN  
SYSTEME DE COMPRESSION DE VAPEUR TRANSCRITIQUE ET UN SYSTEME DE  
COMPRESSION DE VAPEUR TRANSCRITIQUE

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(73) Proprietor: **Carrier Corporation**

**Farmington, CT 06034-4015 (US)**

(72) Inventor: **PARK, Young, K.**

**Simsbury, Connecticut 06070 (US)**

(74) Representative: **Taylor, Adam David et al  
Dehns**

**St Bride's House  
10 Salisbury Square  
London EC4Y 8JD (GB)**

(56) References cited:

|                            |                            |
|----------------------------|----------------------------|
| <b>US-A1- 2004 069 011</b> | <b>US-A1- 2004 261 435</b> |
| <b>US-A1- 2005 066 675</b> | <b>US-B1- 6 343 486</b>    |
| <b>US-B1- 6 505 476</b>    | <b>US-B1- 6 568 199</b>    |

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## Description

**[0001]** The present invention relates generally to a method for optimizing the coefficient of performance of a transcritical vapor compression system by detecting a gas cooler exit temperature and determining an optimal high side pressure of the vapor compression system based solely on the gas cooler exit temperature to optimize the coefficient of performance.

**[0002]** Carbon dioxide is an environmentally friendly refrigerant that is commonly used in transcritical vapor compression systems. Carbon dioxide has a low critical point, and most vapor compression systems utilizing carbon dioxide as the refrigerant run transcritically or partially above the critical point. The pressure of a subcritical fluid is a function of temperature under saturated conditions (when both liquid and vapor are present). However, when the temperature of the fluid is higher than the critical temperature (supercritical), the pressure becomes a function of the density of the fluid and is independent of the heat sink temperature. Therefore, for any set of heat sink conditions, it is possible to operate at many high side pressures. However, a maximum coefficient of performance exists that corresponds to one high side pressure. Therefore, it is important to regulate the high side pressure of the transcritical vapor compression system because the high side pressure has a large effect on the capacity and efficiency of the system.

**[0003]** In one prior vapor compression system, both the temperature and the pressure of the refrigerant at the outlet of the gas cooler is measured. From both these measurements, the optimal high side pressure is determined. The high side pressure is then adjusted to the optimal high side based on both these measurements according to a pre-determined control strategy to optimize the coefficient of performance. The optimal high side pressure is selected to optimize the capacity and efficiency of the vapor compression system for a cooling mode. In another prior vapor compression system, the high side pressure and the low side pressure are measured and then coupled according to a pre-determined control strategy to optimize the coefficient of performance.

**[0004]** A drawback to prior vapor compression systems is that at least two sensors are needed to determine the optimal high side pressure. In the first example, both a temperature sensor and a pressure sensor are needed to determine that optimal high side pressure. In the second example, two pressure sensors are needed to determine the optimal high side pressure.

**[0005]** There is a need for a method of optimizing the coefficient of performance of a vapor compression system that optimizes the capacity and efficiency during a heating mode, that uses only one sensor and that overcomes the drawbacks and shortcomings of the prior art.

**[0006]** US 2004/261435 discloses a system of the type described in the preamble of claim 1.

**[0007]** The invention provides a transcritical vapor

compression system comprising: a compression device to compress a refrigerant to a high pressure; a gas cooler for cooling the refrigerant, and the refrigerant exits the gas cooler at a gas cooler exit temperature; an expansion device for reducing the refrigerant to a low pressure; an evaporator for evaporating the refrigerant; and a control to determine a desired high pressure of the refrigerant based solely on a characteristic indicative of the gas cooler exit temperature of the refrigerant and to adjust the high pressure to the desired high pressure; characterised in that the dependence of the desired high pressure as a function of the gas cooler exit temperature is determined based on the performance of the compression device and the gas cooler, the dependence being obtained based on experimental data or a predetermined model programmed into the control, wherein the control includes a correlation that relates the gas cooler exit temperature to the optimal high side pressure and the correlation is used to determine the desired high side pressure based on the gas cooler exit temperature, which is measured by a sensor.

**[0008]** Refrigerant circulates through the closed circuit vapor compression system. Preferably, carbon dioxide is employed as the refrigerant. High pressure refrigerant flowing through the gas cooler may be cooled by a fluid, such as water, that flows in an opposing direction through a heat sink. The refrigerant exits the gas cooler at a gas cooler exit temperature.

**[0009]** In a transcritical vapor compression system, the high side pressure is independent of the operating conditions of the vapor compression system. Therefore, for any set of operating conditions, it is possible to operate the system at a wide range of high side pressures. However, there is an optimal high side pressure which corresponds to an optimal coefficient of performance. The optimal high side pressure is dependent on the gas cooler exit temperature, regardless of the outdoor air temperature. For any gas cooler exit temperature, a single optimal high side pressure optimizes the coefficient of performance of the vapor compression system.

**[0010]** The dependence of the optimal high side pressure as a function of the gas cooler exit temperature is preferably programmed into a control based on values obtained experimentally or obtained through a pre-determined model. A sensor preferably measures the gas cooler exit temperature. Based on the measured gas cooler exit temperature and the information programmed into the control, the optimal high side pressure may be determined. The high side pressure may be determined solely on the gas cooler exit temperature. The high side pressure is preferably not sampled. The high side pressure is preferably only changed based on the measured gas cooler exit temperature.

**[0011]** These and other features of the present invention will be best understood from the following specification and drawings.

**[0012]** In a further aspect the invention provides a method of optimizing a coefficient of performance of a

transcritical vapor compression system comprising the steps of: compressing a refrigerant to a high pressure using a compression device; cooling the refrigerant in a gas cooler, and the refrigerant exits the gas cooler at a gas cooler exit temperature; expanding the refrigerant to a low pressure; evaporating the refrigerant; measuring a characteristic indicative of the gas cooler exit temperature of the refrigerant; determining a desired high pressure of the refrigerant based solely on the characteristic indicative of the gas cooler exit inlet temperature; and adjusting the high pressure to the desired high pressure; characterised in that the dependence of the desired high pressure as a function of the gas cooler exit temperature is determined based on the performance of the compression device and the gas cooler, the dependence being obtained based on experimental results or a predetermined model, wherein a correlation is constructed that relates the gas cooler exit temperature to the optimal high side pressure, the gas cooler exit temperature is measured via a sensor and the correlation is used to determine the desired high pressure based on the measured temperature.

**[0013]** The various features and advantages of the invention will become apparent to those skilled in the art from the following detailed description of the currently preferred embodiment. The drawings that accompany the detailed description can be briefly described as follows:

Figure 1 illustrates a schematic diagram of a transcritical vapor compression system of the present invention;

Figure 2 illustrates a graph relating high side pressure to a coefficient of performance in the transcritical vapor compression system for a specific set of operating conditions;

Figure 3 illustrates a graph relating a gas cooler exit temperature to an optimal high side pressure at various outdoor air temperatures; and

Figure 4 illustrates a flow chart of the method of the present invention.

**[0014]** Figure 1 illustrates a schematic diagram of a vapor compression system 20. The vapor compression system 20 includes a compressor 22, a gas cooler 24, an expansion device 26, and an evaporator 28. Refrigerant circulates through the closed circuit vapor compression system 20. The refrigerant exits the compressor 22 at a high pressure and a high enthalpy and flows through the gas cooler 24 and loses heat, exiting the gas cooler 24 at a low enthalpy and a high pressure. A fluid medium accepts heat from the refrigerant passing through the gas cooler 24. The refrigerant then passes through the expansion device 26 and is expanded to a low pressure. After expansion, the refrigerant flows through the evaporator 28 and rejects heat to a fluid medium. The refrigerant exits the evaporator 28 at a high enthalpy and a low pressure. The refrigerant then enters the compressor

22, completing the cycle.

**[0015]** Preferably, carbon dioxide is used as the refrigerant. While carbon dioxide is described, other refrigerants may benefit from this invention. Because carbon dioxide has a low critical point, vapor compression systems utilizing carbon dioxide as the refrigerant usually run transcritically.

**[0016]** In a transcritical vapor compression system 20, the high side pressure is independent of the operating conditions (such as the outdoor air temperature) of the vapor compression system 20. Therefore, for any set of operating conditions, it is possible to operate the vapor compression system 20 at many high side pressures. However, for any set of operating conditions, there is an optimal high side pressure which corresponds to an optimal coefficient of performance of the vapor compression system 20.

**[0017]** The coefficient of performance represents the efficiency of the vapor compression system 20. The coefficient of performance equals the total useful heat transferred by the vapor compression system 20 divided by the work put into the vapor compression system 20 by system components, such as fans. The high side pressure influences the coefficient of performance, and it is therefore important to regulate the high side pressure to optimize the coefficient of performance of the vapor compression system 20.

**[0018]** Figure 2 illustrates the relationship between the high side pressure of the vapor compression system 20 and the coefficient of performance at a given set of operating conditions. For the given set of operating conditions, one high side pressure (the optimal high side pressure) corresponds to the optimum coefficient of performance. In the illustrated example, the coefficient of performance varies between approximately 2.7 and 3.1 and reaches a maximum of approximately 3.1 at a high side pressure of approximately 1350 psia.

**[0019]** The optimal high side pressure of the vapor compression system depends strongly on the gas cooler exit temperature. The gas cooler exit temperature is the temperature of the refrigerant exiting the gas cooler 24 and is measured by a sensor 30. Figure 3 illustrates the relationship between the gas cooler exit temperature and the optimum high side pressure at various outdoor air temperatures. At gas cooler exit temperatures less than 100° F, the optimal high side pressure is independent of the outdoor air temperature. However, at gas cooler exit temperatures greater than 100°F, the outdoor air temperature has an effect on the optimal high side pressure. Therefore, the optimal high side pressure is generally only a function of the gas cooler exit temperature.

**[0020]** Figure 4 illustrates a flowchart showing the method of determining the optimal high side pressure of the vapor compression system 20. First, the dependence of the optimal high side pressure as a function of the gas cooler exit temperature (the heat sink temperature) is determined based on the performance of the compressor 22 and the gas cooler 24. The dependence can be ob-

tained either experimentally or through a pre-determined model. The results of the previous testing or the pre-determined model are programmed into a control 32.

**[0021]** A correlation is constructed that relates the gas cooler exit temperature to the optimal high side pressure. This information generates the graph shown in Figure 3. An outdoor air temperature correction factor can also be included in the correlation if needed. This information is also programmed in the control 32.

**[0022]** The gas cooler exit temperature is then detected by the sensor 30. The constructed correlation is then used to relate the gas cooler exit temperature detected by the sensor 30 to determine the optimal high side pressure that optimizes the coefficient of performance. The constructed correlation is based solely on the gas cooler exit temperature and not on the pressure. The sensor 30 detects the gas cooler exit temperature and provides this information to the control 32. Based only on the gas cooler exit temperature detected by the sensor 30, the control 32 uses the correlation to determine the optimal high side pressure based on the data preset into the control 32 and the detected gas cooler exit temperature. This approach is implemented using the linear relationship between the optimal high side pressure and the gas cooler exit temperature, as shown in Figure 3. The optimal high side pressure is determined and selected independent of the outdoor air conditions. The optimal high side pressure of the vapor compression system 20 is determined based solely on measured gas cooler exit temperature detected by the sensor 30. The high side pressure is not sampled when determining the optimal high side pressure. Therefore, the efficiency and the capacity of the vapor compressor system 20 can be maximized when running in a heating mode.

**[0023]** If the control 32 determines that the gas cooler exit temperature measured by the sensor 30 changes, the control 32 uses the detected gas cooler exit temperature to determine the new optimal high side pressure based on the data programmed into the control 32. The control 32 then determines the proper expansion device 26 setting and adjusts the expansion device 26 to change the high side pressure to the optimal high side pressure. The high side pressure is adjusted until the gas cooler exit temperature detected by the control is the optimal high side pressure. By determining the optimal high side pressure by measuring the gas cooler exit temperature with the sensor 30 and adjusting the expansion device 26 to maintain the optimal high side pressure, the optimum coefficient of performance can be maintained over a wide range of operating conditions.

**[0024]** If the high side pressure is above the optimal high side pressure, the control 32 sends a signal to the expansion device 26 to open the expansion device 26 and allow more refrigerant to flow through the expansion device 26. This decreases the high side pressure. The high side pressure is adjusted until the gas cooler exit temperature detected by the control 32 is the optimal high side pressure.

**[0025]** Alternately, if the high side pressure is below the optimal high side pressure, the control 32 sends a signal to the expansion device 26 to close the expansion device 26 and allow less refrigerant to flow through the expansion device 26. This increases the high side pressure. The high side pressure is adjusted until the gas cooler exit temperature detected by the control 32 is the optimal high side pressure.

**[0026]** Alternately, the sensor 30 detects the heat sink temperature to determine the optimal high side pressure to maximize the coefficient of performance. This is the temperature of the fluid in the gas cooler 24. The fluid can be water or air.

**[0027]** The foregoing description is only exemplary of the principles of the invention. Many modifications and variations of the present invention are possible in light of the above teachings. The preferred embodiments of this invention have been disclosed, however, so that one of ordinary skill in the art would recognize that certain modifications would come within the scope of this invention. It is, therefore, to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specially described. For that reason the following claims should be studied to determine the true scope and content of this invention.

## Claims

1. A transcritical vapor compression system comprising:

a compression device (22) to compress a refrigerant to a high pressure;  
a gas cooler (24) for cooling the refrigerant, and the refrigerant exits the gas cooler at a gas cooler exit temperature;  
an expansion device (26) for reducing the refrigerant to a low pressure;  
an evaporator (28) for evaporating the refrigerant; and  
a control (32) to determine a desired high pressure of the refrigerant based solely on a characteristic indicative of the gas cooler exit temperature of the refrigerant and to adjust the high pressure to the desired high pressure;

**characterised in that** the dependence of the desired high pressure as a function of the gas cooler exit temperature is determined based on the performance of the compression device (22) and the gas cooler (24), the dependence being obtained based on experimental data or a pre-determined model programmed into the control (32), wherein the control (32) includes a correlation that relates the gas cooler exit temperature to the optimal high side pressure and the correlation is used to determine the desired high side pressure based on the gas cooler exit tem-

- perature, which is measured by a sensor (30).
2. The system as recited in claim 1 wherein the control (32) adjusts the high pressure to the desired high pressure by adjusting the expansion device (26). 5
  3. The system as recited in claim 1 or 2 wherein the desired high pressure corresponds to an optimal coefficient of performance.
  4. The system as recited in any preceding claim wherein the refrigerant is carbon dioxide.
  5. The system as recited in any preceding claim wherein the desired high pressure is selected to optimize a capacity and an efficiency of the vapor compression system when operating in a heating mode. 15
  6. A method of optimizing a coefficient of performance of a transcritical vapor compression system comprising the steps of: 20
    - compressing a refrigerant to a high pressure using a compression device (22);
    - cooling the refrigerant in a gas cooler (24), and the refrigerant exits the gas cooler at a gas cooler exit temperature; 25
    - expanding the refrigerant to a low pressure;
    - evaporating the refrigerant;
    - measuring a characteristic indicative of the gas cooler exit temperature of the refrigerant; 30
    - determining a desired high pressure of the refrigerant based solely on the characteristic indicative of the gas cooler exit inlet temperature; and 35
    - adjusting the high pressure to the desired high pressure;
    - characterised in that** the dependence of the desired high pressure as a function of the gas cooler exit temperature is determined based on the performance of the compression device (22) and the gas cooler (24), the dependence being obtained based on experimental results or a pre-determined model, wherein a correlation is constructed that relates the gas cooler exit temperature to the optimal high side pressure, the gas cooler exit temperature is measured via a sensor (30) and the correlation is used to determine the desired high pressure based on the measured temperature. 40 45 50
  7. The method as recited in claim 8 wherein the step of adjusting the high pressure includes adjusting a degree of expansion of an expansion device (26). 55
  8. The method as recited in claim 6 or 7 wherein the refrigerant is carbon dioxide.

9. The method as recited in any of claims 6 to 8 further including the step of programming data relating the gas cooler exit temperature to the desired high pressure.
10. The method as recited in any of claims 6 to 9 wherein the desired high pressure corresponds to an optimal coefficient of performance.
11. The method as recited in any of claims 6 to 10, further including the step of optimizing a capacity and an efficiency of the vapor compression system when operating in a heating mode.

## Patentansprüche

1. Transkritisches Dampfkompensationssystem, umfassend:
  - eine Kompressionsvorrichtung (22) zum Verdichten eines Kältemittels auf einen hohen Druck;
  - einen Gaskühler (24) zum Kühlen des Kältemittels, und das Kältemittel verlässt den Gaskühler bei einer Gaskühleraustrittstemperatur;
  - eine Expansionsvorrichtung (26) zum Reduzieren des Kältemittels auf einen niedrigen Druck;
  - einen Verdampfer (28) zum Verdampfen des Kältemittels; und
  - eine Steuereinrichtung (32) zum Bestimmen eines gewünschten Hochdrucks des Kältemittels ausschließlich auf Grundlage eines Kennwerts, der die Gaskühleraustrittstemperatur des Kältemittels angibt, und den Hochdruck auf den gewünschten Hochdruck einzustellen;
  - dadurch gekennzeichnet, dass** die Abhängigkeit des gewünschten Hochdrucks als eine Funktion der Gaskühleraustrittstemperatur auf Grundlage der Leistung der Kompressionsvorrichtung (22) und des Gaskühlers (24) bestimmt wird, wobei die Abhängigkeit auf Grundlage von Versuchsdaten oder eines vorgegebenen Modells erlangt wird, das in die Steuereinrichtung (32) einprogrammiert ist, wobei die Steuereinrichtung (32) eine Korrelation aufweist, die die Gaskühleraustrittstemperatur mit dem optimalen hochseitigen Druck in Beziehung setzt und die Korrelation dazu benutzt wird, den gewünschte hochseitigen Druck auf Grundlage der Gaskühleraustrittstemperatur zu bestimmen, die durch einen Sensor (30) gemessen wird.
2. System nach Anspruch 1, wobei die Steuereinrichtung (32) den Hochdruck durch Einstellen der Expansionsvorrichtung (26) auf den gewünschten Hochdruck einstellt.

3. System nach Anspruch 1 oder 2, wobei der gewünschte Hochdruck einem optimalen Leistungskoeffizienten entspricht.
4. System nach einem der vorangehenden Ansprüche, wobei das Kältemittel Kohlendioxid ist.
5. System nach einem der vorangehenden Ansprüche, wobei der gewünschte Hochdruck dazu ausgewählt wird, eine Kapazität und eine Effizienz des Dampfkompensionssystems beim Betrieb in einem Heizmodus zu optimieren.
6. Verfahren zum Optimieren eines Leistungskoeffizienten eines transkritischen Dampfkompensionssystems, folgende Schritte umfassend:
 

Verdichten eines Kältemittels auf einen Hochdruck unter Verwendung einer Kompressionsvorrichtung (22);

Kühlen des Kältemittels in einem Gaskühler (24), und das Kältemittel verlässt den Gaskühler bei einer Gaskühleraustrittstemperatur;

Expandieren des Kältemittels auf einen niedrigen Druck;

Verdampfen des Kältemittels;

Messen eines Kennwerts, der die Gaskühleraustrittstemperatur des Kältemittels angibt;

Bestimmen eines gewünschten Hochdrucks des Kältemittels ausschließlich auf Grundlage des Kennwerts, der die Gaskühleraustrittstemperatur angibt; und

Einstellen des Hochdrucks auf den gewünschten Hochdruck;

**dadurch gekennzeichnet, dass** die Abhängigkeit des gewünschten Hochdrucks als eine Funktion der Gaskühleraustrittstemperatur auf Grundlage der Leistung der Kompressionsvorrichtung (22) und des Gaskühlers (24) bestimmt wird, wobei die Abhängigkeit auf Grundlage von Versuchsdaten oder eines vorgegebenen Modells erlangt wird, wobei eine Korrelation aufgebaut wird, die die Gaskühleraustrittstemperatur mit dem optimalen hochseitigen Druck in Beziehung setzt, die Gaskühleraustrittstemperatur durch einen Sensor (30) gemessen wird und die Korrelation dazu benutzt wird, den gewünschte hochseitigen Druck auf Grundlage der gemessenen Temperatur zu bestimmen.
7. Verfahren nach Anspruch 8, wobei der Schritt des Einstellens des Hochdrucks das Einstellen eines Expansionsgrades einer Expansionsvorrichtung (26) einschließt.
8. Verfahren nach Anspruch 6 oder 7, wobei das Kältemittel Kohlendioxid ist.

9. Verfahren nach einem der Ansprüche 6 bis 8, ferner aufweisend den Schritt des Programmierens von Daten, die die Gaskühleraustrittstemperatur mit dem gewünschten Hochdruck in Beziehung setzen.
10. Verfahren nach einem der Ansprüche 6 bis 9, wobei der gewünschte Hochdruck einem optimalen Leistungskoeffizienten entspricht.
11. Verfahren nach einem der Ansprüche 6 bis 10, ferner aufweisend den Schritt des Optimierens einer Kapazität und einer Effizienz des Dampfkompensionssystems beim Betrieb in einem Heizmodus.

## Revendications

1. Système de compression de vapeur transcritique, comprenant :
 

un dispositif de compression (22) servant à comprimer un réfrigérant à haute pression ;

un refroidisseur de gaz (24) servant à refroidir le réfrigérant, et où le réfrigérant sort du refroidisseur de gaz à une température de sortie de refroidisseur de gaz ;

un dispositif d'expansion (26) servant à réduire le réfrigérant à une basse température ;

un évaporateur (28) servant à vaporiser le réfrigérant ; et

une commande (32) servant à déterminer une haute pression souhaitée du réfrigérant en fonction uniquement d'une caractéristique indiquant la température de sortie du refroidisseur de gaz du réfrigérant et à ajuster la haute pression à la haute pression voulue ;

**caractérisé en ce que** la dépendance de la haute pression voulue en fonction de la température de sortie du refroidisseur de gaz est déterminée en fonction des performances du dispositif de compression (22) et du refroidisseur de gaz (24), la dépendance étant obtenue en fonction des données expérimentales ou d'un modèle prédéterminé, programmé dans la commande (32), la commande (32) comprenant une corrélation qui associe la température de sortie du refroidisseur de gaz à la pression latérale élevée optimale, et la corrélation sert à déterminer la pression latérale élevée optimale en fonction de la température de sortie du refroidisseur de gaz (24), qui est mesurée par un capteur (30).
2. Système selon la revendication 1, dans lequel la commande (32) ajuste la haute pression à la pression élevée voulue par ajustement du dispositif d'expansion (26).
3. Système selon la revendication 1 ou 2, dans lequel

la haute pression souhaitée correspond à un coefficient optimal de performance.

4. Système selon l'une quelconque des revendications précédentes, dans lequel le réfrigérant est du dioxyde de carbone. 5
5. Système selon l'une quelconque des revendications précédentes, dans lequel la haute pression souhaitée est choisie pour optimiser une capacité et une efficacité du système de compression de vapeur lorsqu'on le fait fonctionner dans un mode de chauffage. 10
6. Procédé d'optimisation d'un coefficient de performances d'un système transcritique de compression de vapeur, comprenant les étapes suivantes : 15

la compression d'un réfrigérant à une pression élevée à l'aide d'un dispositif de compression (22) ; 20

le refroidissement du réfrigérant dans un refroidisseur de gaz (24), et le réfrigérant sort du refroidisseur de gaz à une température de sortie du refroidisseur de gaz (24) ; 25

l'expansion du réfrigérant à une basse pression ;

l'évaporation du réfrigérant ;

la mesure d'une caractéristique indicative de la température de sortie du refroidisseur de gaz du réfrigérant ; 30

la détermination d'une haute pression voulue du réfrigérant en fonction uniquement de la caractéristique indicative de la température d'entrée de sortie du refroidisseur de gaz ; 35

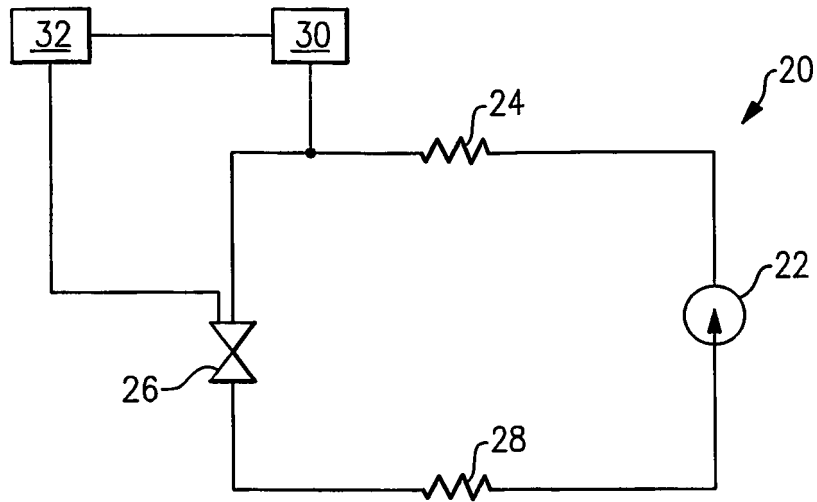
l'ajustement de la haute pression à la haute pression voulue ;

**caractérisé en ce que** la dépendance de la haute pression voulue en fonction de la température de sortie du refroidisseur de gaz est déterminée en fonction des performances du dispositif de compression (22) et du refroidisseur de gaz (24), la dépendance étant obtenue en fonction des résultats expérimentaux sur un modèle prédéfini, une corrélation étant construite qui relie la température de sortie du refroidisseur de gaz à la pression latérale élevée optimale, la température de sortie du refroidisseur de gaz étant mesurée par le biais d'un capteur (30) et la corrélation servant à déterminer la haute pression voulue en fonction de la température mesurée. 40 45 50

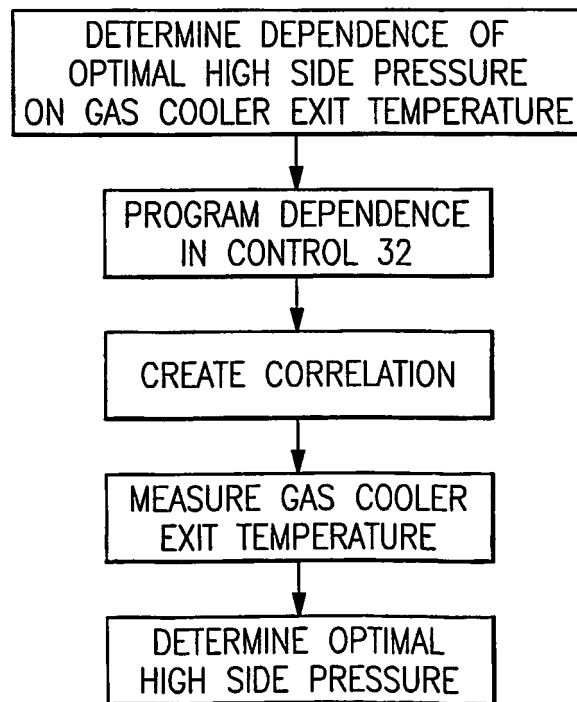
7. Procédé selon la revendication 8, dans lequel l'étape d'ajustement de la haute pression comprend l'ajustement d'un degré d'expansion d'un dispositif d'expansion (26). 55
8. Procédé selon la revendication 6 ou 7, dans lequel

le réfrigérant est du dioxyde de carbone.

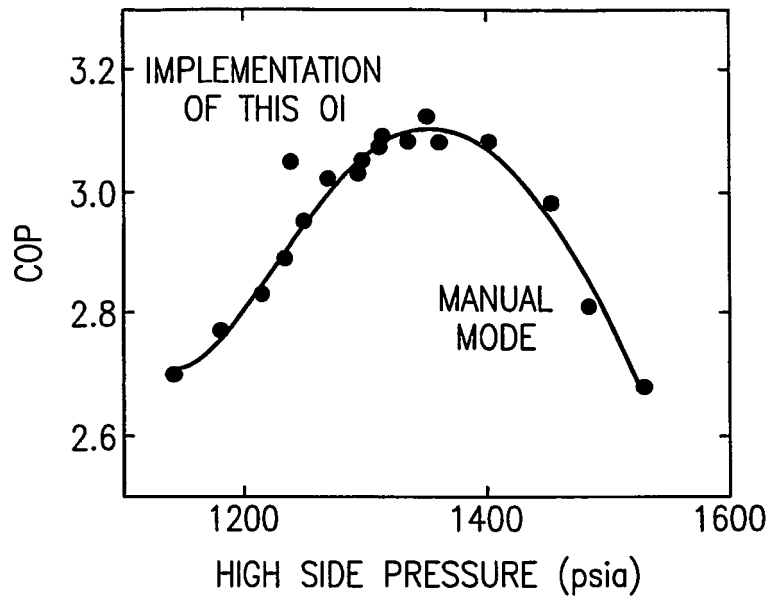
9. Procédé selon l'une quelconque des revendications 6 à 8, comprenant en outre l'étape de programmation de données associant la température de sortie du refroidisseur de gaz à la haute pression voulue.
10. Procédé selon l'une quelconque des revendications 6 à 9, dans lequel la haute pression voulue correspond à un coefficient optimal de performance.
11. Procédé selon l'une quelconque des revendications 6 à 10, comprenant en outre l'étape d'optimisation d'une capacité et d'une efficacité du système de compression de vapeur lorsqu'on opère dans un mode de chauffage.



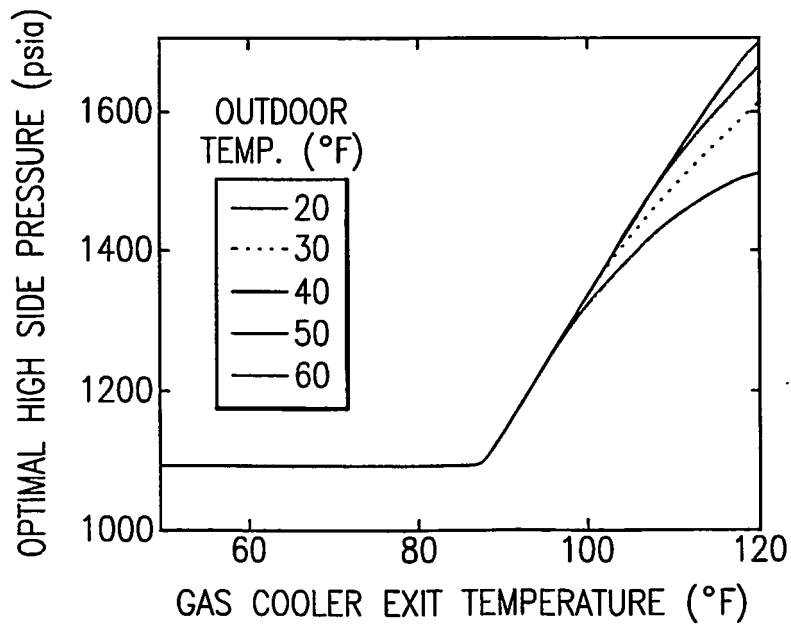
**FIG.1**



**FIG.4**



**FIG. 2**



**FIG. 3**

**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

- US 2004261435 A [0006]