

Description

This invention relates generally to control systems for dynamic or centrifugal compressors. More particularly, but not exclusively, the invention relates to chilled water control systems and to chilled water systems incorporating such control systems.

A refrigeration cycle is utilized to chill water for use in one or more processes. The cycle includes an evaporator through which water to be chilled is passed and in which expanding coolant is utilized to draw heat from the water. The coolant is supplied to the evaporator over a coolant circuit containing a compressor, a condenser, and a control valve for controlling the amount of cooling effect.

To conserve energy, it is desirable to optimize chilled water temperature by critically controlling the flow of coolant and the use of power in the coolant cycle as well as the chilled water cycle. This requires a properly integrated compressor control.

As is known, there are two major control loops in a compressor. The one loop is used for controlling a process variable (such as chilled water temperature) by manipulating the compressor load. The other loop is used for protecting the compressor against surging; namely, surge control for a stable operation. These two control loops, when independently operated in separate non-integrated loops, interact and cause unnecessary oscillations. When the compressor operates near the surge line, these oscillations become damaging.

There are known surge controls based on both surge detection and compressor load variation. However, the surge control is used to initiate compressor load variation rather than integrate the surge control with the load demand of the compressor. An example of such a surge control system may be found in US Patent No. US-A-4 142 838. Nor are there any known control systems which coordinate compressor operation with surge protection to ensure optimized operation of the two for optimized chilled water delivery.

In US Patent No. US-A-3 555 844 there is described an integrated control system for a compressor which controls both the load output and the surge protection of the compressor. Control of these two parameters is effected by respective non-integrated control loops, thereby resulting in the disadvantages mentioned above.

According to the invention there is provided an integrated control system for a compressor for simultaneously controlling both the load output and the surge protection of the compressor, the system comprising:

- compressor flow control means for controlling fluid flow through the compressor;
- bypass flow means for providing a controllable flow bypass across the compressor;
- compressor control logic means for estab-

lishing a first control signal indicative of desired compressor load output; and

compressor surge control logic means for establishing a second control signal indicative of required flow bypass across the compressor, wherein the bypass flow means is controlled in response to the second control signal;

characterised by:

coordinating control logic means connected between the compressor control logic means and the compressor flow control means for establishing a biased first control signal by biasing the first control signal with a bias signal derived from the second control signal to compensate for the flow bypass across the compressor caused by the bypass flow means, the compressor flow control means being controlled in response to the biased first control signal.

A preferred embodiment of the present invention described hereinbelow solves or at least alleviates the problems associated with the prior art systems by providing a chilled water temperature control system having an integrated control of both output and surge of a centrifugal compressor of the system. To accomplish this, an output of a compressor control logic circuit is modified by a coupling or coordination logic circuit prior to allowing the compressor control logic circuit to act on the compressor. This coordinating circuit utilizes an output of a surge control circuit to establish a biasing signal to the output of the compressor control logic circuit to increase compressor output to compensate for the amount of bypassed compressor output due to the surge control. There is thus provided an integrated compressor control for both compressor output and surge protection, in particular, but not exclusively, for a chilled water system.

The invention will now be further described, by way of illustrative and non-limiting example, with reference to the accompanying drawings, in which:

Figure 1 is a block diagram of a chilled water system embodying the present invention;

Figure 2 is a function block diagram of a primary control logic block of the system of Figure 1;

Figure 3 is a function block diagram of surge control logic of the system of Figure 1; and

Figure 4 is a function block diagram of integrating or coordinating control logic of the system of Figure 1.

Figure 1 shows a basic water chiller system 10 having a centrifugal compressor 12 for pumping fluid from an evaporator 14 to a condenser 16. The amount of fluid pumped by the compressor 12 will be controlled by a valve 18 which is located between the evaporator 14 and the inlet of the compressor 12 and which will restrict the amount of fluid drawn by the compressor 12 depending upon the controlled position of the valve 18.

(11)

The valve 18 is controlled by a coordinating logic control module 20. This control module 20 combines control signals from a primary control logic module 22 and a surge control logic module 24 into an integrated control signal for the compressor 12 which will bias the chilled water demand signal from the primary control logic module 22 with a signal from the surge control logic module 24.

The surge control signal from module 24 is indicative of the amount of bypass flow across the compressor 12 allowed by a bypass valve 26 controlled by the surge control logic module 24 and represents a required increase in compressor 12 output required to compensate for this bypass. This bypass is required to protect the compressor 12 from surge oscillations caused by the compressor 12 having to sometimes operate beyond the manufacturer's established compressor 12 surge line in either a restricted inlet flow or pressure output condition.

The primary control logic module 22 is basically a feed forward-cascade control module for establishing a main load demand output signal along line 28 to the coordinating control logic module 20. The main demand signal to the primary control logic module 22 is received along line 30 from an optimizing temperature control logic system 32 described in our co-pending European Patent Application No. 84301388.9 (Publication No. 0 127 265 A) filed 2 March 1984 and entitled "Control of chilled water temperature".

The reader is referred thereto for further information and details thereof. The main function of this system 32 is to optimize chilled water demand on a cost efficiency basis. The feed forward control variable of the module 22 is the temperature TT_2 of the evaporator 14 inlet as sensed by transmitter 34 and connected to the primary module 22 along line 36. The cascade control signal variable is mass flow through the compressor 12 and uses the flow FT measurement into the compressor 12 as measured by transducer 38 measuring the flow through an orifice 40. The transmitter 38 sends its signal to the primary module 22 along line 42. To give a true mass flow measurement to the primary control logic module 22 compensating measurements of compressor inlet fluid pressure PT, and temperature TT_3 are taken respectively by transducers 44 and 46 and conducted to the module 22 along respective lines 48 and 50.

Turning to Fig. 2, the details of the primary control logic module 22 are shown in standard SAMA control logic symbols representative of electronic, pneumatic, or mechanical implementation.

The demand signal 30 is first sent to a difference station 52 and compared with the output of a set point station 54 which may be manual and would be used to allow operator override or input of the main demand signal 30. The signal from the difference station 52 is then added with the feed forward control signal of evaporator inlet temperature TT_2 in summing station 56. The feed

forward control signal is modified in the proportional and integral controller 58 prior to sending it to the summing station 56 to conform it to the dynamics of the control loop.

The feed forward temperature control signal is a secondary variable signal which disturbs the primary variable signal and hence acts as an anticipatory signal of a future change in the primary variable. In our case, the primary variable; namely, optimized chilled water output 30 will be affected by the evaporator 14 inlet temperature TT_2 and, hence, this is a proper feed forward secondary variable to initiate corrective action in the system before the primary variable error develops.

The output of the summing station 56 is then sent to a comparator station 60 where the output is compared with a cascade control signal of mass flow through the compressor 12. The mass flow signal is developed in a mass flow logic module 62 utilizing the flow input FT, pressure input PT_1 , and the temperature input TT_3 . The mass flow output signal from module 62 is modified for control loop dynamics in a proportional integral controller 64 prior to comparison in the comparator station 60. The function of this cascade control is to provide a corrected output of compressor flow. The demand signal from summing station 56 sets up a certain compressor flow requirement and the cascade signal ensures that that particular mass flow requirement is being provided.

The output of the comparing station 60 is then sent to a main controller 66 for the primary control loop. This controller 66 is a proportional integral controller and may be used to directly control the final control element such as the valve 18 through its connection with the coordinating control logic module 20. Such control is used for compressors 12 that are constant speed and utilize vane control or inlet throttling.

For systems that utilize variable speed driven compressors, the output of the controller 66 is sent through a manual/auto station 68 to a difference station 70 where the compressor desired output as desired speed is compared with the actual compressor speed as measured in a speed transmitter 72. The output of the difference station 70 is then smoothed out by a controller 74.

Thus, the output 28 of the primary control logic module 22 is a signal representative of a compressor 12 output which is fast responding and stabilized by feed forward-cascade control and may be used for compressor control. However, if the compressor is in a surge condition, the output of the compressor 12 will be partially bypassed through the valve 26 back to the inlet and the demand signal 28 will not take account of such a bypassed compressor 12 output.

To better see the action of the surge control logic module, we refer to Figs. 3 and 1. Each compressor has a manufacturer's determined surge curve of which pressure vs flow defines proper compressor operation to the right of the surge line and starved inlet flow oscillating oper-

ation to the left of the surge line. To prevent an inlet starved operating condition, the surge control logic module 24 controllably opens the valve 26 to bypass compressor 12 outlet flow back to the inlet along a bypass line 76.

The surge control logic module defines the surge line for the compressor 12 by comparing the suction pressure PT_1 and the discharge pressure PT_2 in a difference station 78. The particular value for suction pressure PT_1 is measured by the transmitter 44 and is sent to the surge control logic module along line 80 while a particular discharge pressure PT_2 is measured by a transducer 82 and is sent to the surge control logic module 24 along line 84. Thus, a point on the surge line is defined. A point on a surge control line offset from the surge line by a distance K is set up in the multiplying station 86 which defines a flow point on the surge control line. This surge control line flow point is compared in a proportional, integral, and derivative controller 88 with the actual flow FT measured by transducer 38 to determine what side of the surge control line the actual flow appears. If the actual flow FT is less than the output of the multiplier 86, the controller 88 will act through the manual/auto station 90 to open the valve 26 along control line 92. The condition of the valve 26 will also be transmitted along line 94 to the coordinating logic control module 20.

Fig. 4 shows in SAMA logic symbols the details of the coordinating logic module 20. The output from the surge control logic module 24 is sent through a lead/lag controller 96 to a difference station 98 as well as directly to the difference station 98 along a bypass line 100. The lead/lag controller 96 is a transfer function representing a first order lag with T as the time constant of the lag. Thus the difference station will subtract the decaying signal of the controller 96 from the surge control logic signal 94 until the two are equal to stabilize the surge control logic signal 94. The signal from the difference station 98 is then sent to a multiplying station 102 where it is multiplied by the difference in compressor inlet and outlet pressure as determined by the difference station 104 which is connected to both the inlet pressure PT_1 transmitter 44 and the outlet pressure PT_2 transducer 82. The multiplying station 102 is used to amplify the effect of a high pressure difference across the compressor as being indicative of an extremely hazardous surge condition. The output of the multiplying station 102 is sent to a correction factor multiplying station 106 where the signal is multiplied by a factor K to compensate for system induced errors such as compressor 12 wear as well as to match the signal to the control loop. The signal from the multiplying station 106 thus forms the bias signal for the output 28 of the primary logic control module 22 by being added to the signal 28 in a summing station 108 the output 110 of which is used to control the compressor by way of the valve 18.

Clearly, certain modifications and improve-

ments will occur to those skilled in the art upon perusal of this specification. By way of example, the valve 18 could be the compressor 12 speed or vane control or the surge control logic module could use other known surge control schemes.

Claims

1. An integrated control system for a compressor (12) for simultaneously controlling both the load output and the surge protection of the compressor (12), the system (10) comprising:
 - compressor flow control means (18) for controlling fluid flow through the compressor (12);
 - bypass flow means (26) for providing a controllable flow bypass across the compressor (12);
 - compressor control logic means (22) for establishing a first control signal indicative of desired compressor load output; and
 - compressor surge control logic means (24) for establishing a second control signal indicative of required flow bypass across the compressor (12), wherein the bypass flow means (26) is controlled in response to the second control signal;
 - characterised by:
 - coordinating control logic means (20) connected between the compressor control logic means (22) and the compressor flow control means (18) for establishing a biased first control signal by biasing the first control signal with a bias signal derived from the second control signal to compensate for the flow bypass across the compressor (12) caused by the bypass flow means (26), the compressor flow control means (18) being controlled in response to the biased first control signal.
 - 2. An integrated control system according to claim 1, wherein the coordinating control logic means (20) includes:
 - means (104, 44, 82) for establishing a pressure control signal as a function of the pressure at the inlet and outlet of the compressor (12); and
 - multiplying means (102) for combining the second control signal from the compressor surge control logic means (24) with the pressure control signal of the pressure control signal establishing means (104, 44, 82) to form the bias signal of the coordinating control logic means (20).
 - 3. An integrated control system according to claim 1 or claim 2, wherein the coordinating control logic means (20) includes:
 - a lead-lag control (96) having an input connected to receive the second control signal of the compressor surge control logic means (24); and
 - a difference station (98) having inputs connected to an output of the lead-lag control (96) and to receive the second control signal of the compressor surge control logic means (24) to establish an output indicative of the difference between the two inputs.
 - 4. An integrated control system according to claim 1, claim 2 or claim 3, wherein the compressor flow control means comprises a valve (18) in a fluid flow line of the compressor (12).
 - 5. A chilled water system comprising a cen-

ation to the left of the surge line. To prevent an inlet starved operating condition, the surge control logic module 24 controllably opens the valve 26 to bypass compressor 12 outlet flow back to the inlet along a bypass line 76.

The surge control logic module defines the surge line for the compressor 12 by comparing the suction pressure PT_1 and the discharge pressure PT_2 in a difference station 78. The particular value for suction pressure PT_1 is measured by the transmitter 44 and is sent to the surge control logic module along line 80 while a particular discharge pressure PT_2 is measured by a transducer 82 and is sent to the surge control logic module 24 along line 84. Thus, a point on the surge line is defined. A point on a surge control line offset from the surge line by a distance K is set up in the multiplying station 86 which defines a flow point on the surge control line. This surge control line flow point is compared in a proportional, integral, and derivative controller 88 with the actual flow FT measured by transducer 38 to determine what side of the surge control line the actual flow appears. If the actual flow FT is less than the output of the multiplier 86, the controller 88 will act through the manual/auto station 90 to open the valve 26 along control line 92. The condition of the valve 26 will also be transmitted along line 94 to the coordinating logic control module 20.

Fig. 4 shows in SAMA logic symbols the details of the coordinating logic module 20. The output from the surge control logic module 24 is sent through a lead/lag controller 96 to a difference station 98 as well as directly to the difference station 98 along a bypass line 100. The lead/lag controller 96 is a transfer function representing a first order lag with T as the time constant of the lag. Thus the difference station will subtract the decaying signal of the controller 96 from the surge control logic signal 94 until the two are equal to stabilize the surge control logic signal 94. The signal from the difference station 98 is then sent to a multiplying station 102 where it is multiplied by the difference in compressor inlet and outlet pressure as determined by the difference station 104 which is connected to both the inlet pressure PT_1 transmitter 44 and the outlet pressure PT_2 transmitter 82. The multiplying station 102 is used to amplify the effect of a high pressure difference across the compressor as being indicative of an extremely hazardous surge condition. The output of the multiplying station 102 is sent to a correction factor multiplying station 106 where the signal is multiplied by a factor K to compensate for system induced errors such as compressor 12 wear as well as to match the signal to the control loop. The signal from the multiplying station 106 thus forms the bias signal for the output 28 of the primary logic control module 22 by being added to the signal 28 in a summing station 108 the output 110 of which is used to control the compressor by way of the valve 18.

Clearly, certain modifications and improve-

ments will occur to those skilled in the art upon perusal of this specification. By way of example, the valve 18 could be the compressor 12 speed or vane control or the surge control logic module could use other known surge control schemes.

Claims

1. An integrated control system for a compressor (12) for simultaneously controlling both the load output and the surge protection of the compressor (12), the system (10) comprising:

compressor flow control means (18) for controlling fluid flow through the compressor (12);

bypass flow means (26) for providing a controllable flow bypass across the compressor (12);

compressor control logic means (22) for establishing a first control signal indicative of desired compressor load output; and

compressor surge control logic means (24) for establishing a second control signal indicative of required flow bypass across the compressor (12), wherein the bypass flow means (26) is controlled in response to the second control signal;

characterised by:

coordinating control logic means (20) connected between the compressor control logic means (22) and the compressor flow control means (18) for establishing a biased first control signal by biasing the first control signal with a bias signal derived from the second control signal to compensate for the flow bypass across the compressor (12) caused by the bypass flow means (26), the compressor flow control means (18) being controlled in response to the biased first control signal.

2. An integrated control system according to claim 1, wherein the coordinating control logic means (20) includes:

means (104, 44, 82) for establishing a pressure control signal as a function of the pressure at the inlet and outlet of the compressor (12); and

multiplying means (102) for combining the second control signal from the compressor surge control logic means (24) with the pressure control signal of the pressure control signal establishing means (104, 44, 82) to form the bias signal of the coordinating control logic means (20).

3. An integrated control system according to claim 1 or claim 2, wherein the coordinating control logic means (20) includes:

a lead-lag control (96) having an input connected to receive the second control signal of the compressor surge control logic means (24); and

a difference station (98) having inputs connected to an output of the lead-lag control (96) and to receive the second control signal of the compressor surge control logic means (24) to establish an output indicative of the difference between the two inputs.

4. An integrated control system according to claim 1, claim 2 or claim 3, wherein the compressor flow control means comprises a valve (18) in a fluid flow line of the compressor (12).

5. A chilled water system comprising a cen-



trifugal compressor (12) and an integrated control system according to any one of the preceding claims.

6. A chilled water system according to claim 5, wherein the compressor control logic means (22) includes:

means (56) for combining a compressor main control signal (30) of optimum chilled water demand from the chilled water system with a feed forward control signal indicative of the actual output temperature of the output of the chilled water system to form a first combined control signal; and

means (60) for combining a cascade control signal indicative of the mass flow through the compressor (12) with the first combined control signal to form a second combined control signal for indicating desired compressor load output.

Patentansprüche

1. Integriertes Regelsystem für einen Kompressor (12) zum gleichzeitigen Regeln sowohl des Massenausstoßes als auch des Pumpschutzes des Kompressors (12), wobei das System (10) aufweist:

eine Flußregelvorrichtung (18) für den Kompressor zum Regeln des Fluidflusses durch den Kompressor (12);

eine Bypass-Flußvorrichtung (26) zum einen regelbaren Bypass-Fluß an dem Kompressor (12) vorbei vorzusehen;

eine Regellogikeinrichtung (22) für den Kompressor zum Bereitstellen eines ersten Regelsignals, welches eine Anzeige eines gewünschten Kompressormassenausstoßes ist; und

eine Regellogikeinrichtung (24) für das Kompressor-pumpen, zum Bereitstellen eines zweiten Regelsignals, welches eine Anzeige eines erforderlichen Bypass-Flusses über den Kompressor (12) ist, wobei die Bypass-Flußvorrichtung (26) unter Ansprechen auf das zweite Regelsignal geregelt wird;

gekennzeichnet durch:

eine Koordinationsregellogikeinrichtung (20), welche zwischen der Regellogikeinrichtung (22) für den Kompressor und der Regelvorrichtung (18) für den Kompressorfluß angeschlossen ist, zum Bereitstellen eines vorgespannten ersten Regelsignals durch Vorspannen des ersten Regelsignals mit einem Vorspannsignal, welches von dem zweiten Regelsignal abgeleitet wird, um entsprechend dem Bypass-Fluß an dem Kompressor (12) vorbei, der durch die Bypass-Flußvorrichtung (26) bewirkt wird, zu kompensieren, wobei die Regelvorrichtung (18) für den Kompressorfluß unter Ansprechen auf das vorgespannte erste Regelsignal geregelt wird.

2. Integriertes Regelsystem nach Anspruch 1, wobei die Koordinationsregellogikeinrichtung (20) aufweist:

Mittel (104, 44, 82) zum Bereitstellen eines Druckregelsignals als Funktion des Druckes am Einlaß und Auslaß des Kompressors (12); und

eine Multiplikationseinrichtung (102) zum Kom-

binieren des zweiten Steuersignals aus der Regellogikeinrichtung (24) für das Kompressor-pumpen mit dem Druckregelsignal der Einrichtung (104, 44, 82), die das Druckregelsignal bereitstellt, um das Vorspannungssignal der Koordinationsregellogikeinrichtung (20) zu bilden.

3. Integriertes Regelsystem nach Anspruch 1 oder 2, wobei die Koordinationsregellogikeinrichtung (20) aufweist:

eine Leitungsverzögerungsregelung (96), welche einen Eingang hat, der so angeschlossen ist, daß er das zweite Steuersignal von der Regellogikeinrichtung (24) für das Kompressor-pumpen empfängt; und

eine Differenzstation (98), welche Eingänge hat, die an einen Ausgang der Leitungsverzögerungsregelung (96) und zum Empfang des zweiten Steuersignals von der Regellogikeinrichtung (24) für das Kompressor-pumpen angeschlossen sind, um einen Ausgang bereitzustellen, der eine Anzeige für die Differenz zwischen den beiden Eingängen ist.

4. Integriertes Regelsystem nach Anspruch 1, 2 oder 3, wobei die Kompressorflußregelvorrichtung ein Ventil (18) in einer Fluidflußleitung des Kompressors (12) aufweist.

5. Gekühltes Wassersystem mit einem Zentrifugalkompressor (12) und einem integrierten Regelsystem nach einem der vorstehenden Ansprüche.

6. Gekühltes Wassersystem nach Anspruch 5, wobei die Regellogikeinrichtung (22) für den Kompressor aufweist:

eine Einrichtung (56) zum Kombinieren des Hauptsteuersignals (30) des Kompressors für den Bedarf von optimal gekühltem Wasser aus dem gekühlten Wassersystem mit einem Vorwärtszufuhrsteuersignal, welches eine Anzeige für die momentane Ausgangstemperatur des Ausganges des Systems für gekühltes Wasser ist, um ein erstes kombiniertes Steuersignal zu bilden; und

eine Einrichtung (60) zum Kombinieren eines Kaskadenregelungssignals, welches eine Anzeige für den Massenfluß durch den Kompressor (12) ist, mit dem ersten kombinierten Steuersignal, um ein zweites kombiniertes Steuersignal für die Anzeige eines gewünschten Massenausstoßes des Kompressors zu bilden.

Revendications

1. Système de commande intégré pour compresseur (12) assurant à la fois le réglage de la puissance débitée et la protection contre les à-coups du compresseur (12), le système (10) comprenant:

— un moyen de réglage de débit de compresseur (18) pour le réglage du débit auquel le fluide traverse le compresseur (12);

— un moyen d'écoulement en dérivation (26) pour l'établissement d'une dérivation à débit réglable de franchissement du compresseur (12);

— un moyen logique de commande de compresseur (22) pour l'établissement d'un premier signal de commande représentatif de la puissance de sortie souhaitée pour le compresseur; et



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— un moyen logique de maîtrise des à-coups du compresseur (24) pour l'établissement d'un second signal de commande représentatif du débit de franchissement souhaité du compresseur (12) en dérivation, le moyen d'écoulement en dérivation (26) étant commandé en réponse au second signal de commande;

Caractérisé par:

— un moyen logique de commande coordinateur (20) monté entre le moyen logique de commande du compresseur (22) et le moyen de commande de débit de traversée du compresseur (18) pour établir un premier signal de commande polarié en polarisant le premier signal de commande au moyen d'un signal de polarisation dérivé du second signal de commande pour compenser le franchissement en dérivation du compresseur (12) dû au moyen de franchissement en dérivation (26), le moyen de commande de débit de traversée du compresseur (18) étant commandé en réponse au premier signal de sortie polarisé.

2. Système de commande intégré selon la revendication 1, dans lequel le moyen logique de commande coordinateur (20) comporte:

— un moyen (104, 44, 82) pour l'établissement d'un signal de réglage de pression en fonction des pressions régnant à l'entrée et à la sortie du compresseur (12); et

— un moyen multiplicateur (102) destiné à combiner le second signal de réglage provenant du moyen logique de maîtrise des à-coups du compresseur (24) avec le signal de réglage de pression du moyen d'établissement de signal de réglage de pression (104, 44, 82) pour constituer le signal de polarisation du moyen logique de commande coordinateur (20).

3. Système de commande intégré selon la revendication 1 ou la revendication 2, dans lequel le moyen logique de commande coordinateur (20) comporte:

— une commande d'avance-retard de phase (96) présentant une entrée montée de façon à recevoir le second signal de réglage du moyen logique de maîtrise des à-coups du compresseur (24); et

— un poste de différence (98) présentant des entrées reliées à une sortie de la commande d'avance-retard de phase (96) et destiné à recevoir le second signal de réglage du moyen logique de maîtrise des à-coups du compresseur (24) pour établir un signal de sortie représentatif de la différence entre les deux signaux d'entrée.

4. Système de commande intégré selon la revendication 1, la revendication 2 ou la revendication 3, dans lequel le moyen de commande de débit de traversée du compresseur comprend une vanne (18) posée sur une conduite d'écoulement de fluide du compresseur (12).

5. Réseau d'eau refroidie comprenant un compresseur centrifuge (12) et un système de commande intégré suivant l'une quelconque des revendications précédentes.

6. Réseau d'eau refroidie selon la revendication 5, dans lequel le moyen logique de commande de compresseur (22) comporte:

— un moyen (56) destiné à combiner un signal principal de réglage de compresseur (30) de la demande d'eau refroidie optimale émanant du réseau d'eau refroidie avec un signal de réglage à action directe représentatif de la température de sortie réelle de la sortie du réseau d'eau refroidie pour former un premier signal de réglage combiné; et

— un moyen (60) destiné à combiner un signal de réglage en cascade représentatif du débit massique de traversée du compresseur (12) avec le premier signal de réglage combiné pour former un second signal de réglage combiné afin d'indiquer la charge de sortie de compresseur désirée.

