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ADVANCES IN INSTRUMENTATION, vol. 31, no. 1, 1976, pages 587/1-587/15, PITTSBURGH, US; J.D. WARNOCK: "Typical compressor control configuration"

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Description

This invention relates to surge control systems for compressors and to methods of controlling surge in compressors.

Surge conditions occur in a centrifugal compressor when the inlet flow is reduced to the extent that the compressor, at a given speed, can no longer pump against the existing pressure head. At this point, a momentary reversal of flow occurs, along with a drop in pressure head. Normal compression resumes and the cycle repeats. This causes a pulsation and shock to the entire compressor and piping arrangement. If left uncontrolled, damage and danger to the compressor could result.

All centrifugal compressors are supplied with characteristic and setpoint curves defining the zones of operation for the compressor. These compressor "maps" illustrate the surge area and the "stonewall" area or pumping limit of the turbomachinery. As shown in Figure 1a of the accompanying drawings, the surge limit line is plotted against a discharge pressure versus flow rate relationship. Taking into account no changes in speed, flow, pressure, or inlet gas temperature the surge control line can be plotted with this equation.

(EQ.1)

$$\text{SURGE CONTROL LINE} = \%\ \text{OF CONTROL MARGIN DESIRED} \times \frac{\Delta\ \text{P ACROSS COMPRESSOR}}{\Delta\ \text{P ACROSS INLET ORIFICE}}$$

Three common forms of presently used surge control lines are shown in Figures 1a to 1c of the accompanying drawings. The one position of this line is parallel to the surge limit line (Figure 1a). To minimize recirculation, the surge control line should be set as close to the surge limit line as possible. Setting the control line with a slope less than that of the limit line (Figure 1b) can lead to excess recirculation at high pressures, and surge at low pressures during stopping and startup. The third method is to select a minimum safe volumetric flow, and set a vertical control line (Figure 1c). This can lead to excess recirculation at low pressures, and surge at high pressures. Many systems measure flow in the discharge without correcting for suction conditions. This gives maximum recirculation with minimum surge protection.

In the various surge controls, control is accomplished by opening a bypass valve around the compressor or blowing off gas to atmosphere to maintain minimum flow through the compressor. Since bypassing or blowing off gas wastes power, it is desirable to determine surge flow as accurately as possible to avoid bypassing gas unnecessarily while maintaining safe operation. However, determining surge flow is often not a simple matter, but a complex one. Surge flow for a compressor is not a fixed quantity, but is related to other variables. Where other variables substantially affect surge flow, they must be measured and included in the surge system. However, present surge systems control surge only as a function of surge control line and make no provisions for anticipatory action from a controlled variable by way of a feed forward signal of such variable.

Surge control systems for centrifugal compressors are disclosed in an article by J. D. WARNOCK, entitled "Typical compressor control configuration", that is published in ADVANCES IN INSTRUMENTATION, Vol. 31, No. 1, 1976, pages 587/1—587/15, PITTSBURGH, US. This article explains that a centrifugal compressor control system generally includes a surge control loop to maintain the compressor in a stable operating range, and that surge control is effected by opening a bypass valve around the compressor or blowing off gas to atmosphere to maintain minimum flow through the compressor. Various different surge control systems are described. One such system, illustrated in Figure 12 of the article, is responsive to a first signal indicative of the pressure differential across an orifice in an inlet line of the compressor and a second signal indicative of the differential pressure across the compressor to control a surge condition by controlling blowing off to atmosphere.

According to the present invention there is provided a centrifugal compressor having a surge control system, the surge control system being responsive to a first signal indicative of the pressure differential across an orifice in an inlet line of the compressor and a second signal indicative of the differential pressure across the compressor to control a surge condition, and the surge control system being characterised by:

first signal generating means that includes: a function generator responsive to said first and second signals to establish an output representative of a main surge control line which is substantially parallel to a surge line of the compressor and is spaced a predetermined distance therefrom in terms of flow rate; and a comparison station operative to compare the main surge control line output with a signal indicative of the speed of the compressor to generate a signal identifying a point of centrifugal compressor operation on the main surge control line;

second signal generating means for establishing a feed forward control signal of a process variable which may cause a surge condition in the centrifugal compressor;

summing means for combining the signals of the first signal generating means and second signal generating means to provide an anticipatory surge control line offset from the main surge control line of the first signal generating means in proportion to the magnitude of the signal from the second signal generating means and a control signal indicative thereof; and

bypass valve control means connected to the summing means for varying the amount of bypass in a bypass path connected across the centrifugal compressor in response to the control signal from the summing means.

The invention also provides a method of controlling surge in a centrifugal compressor, the method employing a first signal indicative of the pressure differential across an orifice in an inlet line of the compressor and a second signal indicative of the differential pressure across the compressor, and the method being characterised by:

establishing, as a function of said first and second signals, an output representative of a main surge control line offset, in terms of flow rate, from a surge line of the compressor;

comparing the main surge control line output with a signal indicative of the speed of the compressor to generate a signal identifying a point of centrifugal compressor operation on the main surge control line;

generating a feed forward control signal which is a function of a system variable which may cause a surge condition in the compressor; and

establishing an anticipatory surge control line offset from the main surge control line as a function of the signal identifying a point of centrifugal compressor operation on the main surge control line and the generated feed forward control signal.

A preferred embodiment of the present invention described hereinbelow solves or at least alleviates the problems associated with prior art surge controls by providing a surge control system for a compressor which will anticipate a surge condition in advance of the normal surge control line and will initiate anti-surge action prior to that initiated by the surge control line. To accomplish this, a feed forward control signal from a controlled variable other than one used to establish the surge control line is utilised to establish a second or anticipatory surge control line which is offset from the main surge control line and which will initiate anti-surge protection in advance of the main surge control line. This second surge control line will provide a variably offset control point from the main surge control line which will depend on the variation of the controlled variable. Thus, a large change in the controlled variable will provide a larger offset than a small change and will give more advanced warning of an oncoming surge. The preferred surge control system thus has an advanced warning capability of an oncoming surge condition, and has more advance warning for larger anticipated surge conditions.

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 series of three curves showing prior art or known compressor surge control lines;

Figure 2 is a schematic view of reciprocating and centrifugal compressors using a surge control system embodying the present invention;

Figure 3 is a schematic view of the surge control system of Figure 2; and

Figure 4 is a curve of compressor discharge pressure vs flow rate showing the relationship of an anticipatory surge control line of the system embodying the present invention to the known compressor surge control lines.

Figure 2 of the drawings shows a parallel compressor system 10 having a reciprocating compressor 12 parallel connected to a centrifugal compressor 14 used to provide an output pressure at an output line 16. The reciprocating compressor 12 acts as a base load machine and can operate normally in one of two different capacities; 50% and 100% of its output pressure. This change of capacity from 100% to 50% initiates a surge condition in the compressor 14 and forms the basis of the advance warning system for a surge control system 18.

The centrifugal compressor 14 acts as a booster in the parallel arrangement, and because it is a dynamic machine (vs positive displacement like the reciprocating compressor 12) it has the potential of surging because of the decrease in flow.

As a command from a MNL/AUTO (manual/automatic) station 20 for the base load compressor decreases the demand from the reciprocating compressor 12 from 100% to 50%, an incipient surge condition is produced.

This potential surge condition is provided as an input along a line 22 to the surge control system 18 which, as may be best seen in Figure 4, establishes an offset anticipatory surge control line 24 offset from the usual surge control line 26. Thus, control of the bypass valve 28 allowing the bypass of flow across the centrifugal compressor along a line 30 is initiated by the surge control system 18 prior to the surge being initiated across the centrifugal compressor 14.

With particular reference to Figures 3 and 4, the surge control system 18 is schematically depicted in SAMA Standard RC22—11—1966 notation with the symbols applicable to mechanical, pneumatic, or electronic control systems.

Measured variables ΔP_o and ΔP_c represent, respectively, the pressure differentials across an orifice 32 in an inlet line 34 of the centrifugal compressor 14 and the differential pressure across the centrifugal compressor. These measured variables are inputted into a function generator 36 which develops an output at a line 40 representative of the surge control line 26 which is substantially parallel to a compressor surge line 38 and a predetermined distance K to the right of the surge line 38.

A comparison station 42 compares the surge control line output developed at the line 40 with the measured speed S_T of the centrifugal compressor 14, thus locating the intersection point 44 of a particular compressor rotation speed performance line N_I and the surge control line 26.

This intersection point 44 is transmitted along a line 46 to an adding station 48 where the anticipatory surge signal is added from the line 22. This anticipatory signal is from a process variable; namely, a manual or automatic demand variation on the base load, which will cause the surge condition. Clearly, the greater the signal from this process variable the greater the additive signal to the summing station 48 and the greater the offset of the anticipatory surge control line 24 from the main surge control line 26. Thus, the end result of the summing station 48 is to move the point 44 to a point 50 on the line 24.

This point 50 defines a certain flow rate of the compressor 14 which is compared in a difference station 52 with an actual measured compressor flow rate F_T supplied along a line 54 to the difference station 52. This adds a cascaded control to the surge control system 18 by providing a measured secondary variable to the feed forward anticipatory variable, thus providing better performance by coupling stability with fast response and rapid compensation for process disturbances.

The output of the difference station 52 is provided along a line 55 to a proportional and integral action controller 56 having a predetermined set point which will then control the final control element 28; namely, the valve controlling the amount of bypass in the line 30 to stop the surge condition by allowing the starved compressor 14 inlet 34 to utilise compressor 14 outlet fluid from a line 58.

The proportional plus integral controller 56 has an antiwindup feature. The antiwindup feature is necessary due to the nature of the proportional and integral functions. Normally, the compressor 14 operates in an area some distance from the surge control line 16, resulting in an offset between the measurement and the set point of the controller 56. As a result, the output signal winds up to its high or low limit.

Antiwindup adjusts the integral loading to shift the proportional band to the same side of the control line that the measurement is on when the controller reaches its output limit. Then, if the control line is approached rapidly, the measurement enters the proportional band and control starts before the valve reaches the control line. Therefore, overshoot is eliminated.

Derivative control is not used, because it can open the anti-surge valve far from the surge line and can cause system oscillations. Rapid oscillations in flow, even in the safe operating zone, can cause the valve to open because of the characteristics of the derivative response.

As soon as the controller 56 sees a deviation in set point and process variable, it will commence to control the valve 28 to open to offset an incipient surge condition. This is the normal mode of control. Because of the anticipatory feed forward signal along the line 22 to the summing station 48, this control of the surge condition will occur before the compressor 14 begins to see the effects and large or small surge causing conditions are easily taken care of by providing earlier anticipation for larger surge conditions.

Claims

1. A centrifugal compressor (14) having a surge control system (18), the surge control system (18) being responsive to a first signal indicative of the pressure differential (ΔP_o) across an orifice (32) in an inlet line (34) of the compressor (14) and a second signal indicative of the differential pressure (ΔP_c) across the compressor (14) to control a surge condition, and the surge control system being characterised by:

first signal generating means (36, S_T, 42) that includes: a function generator (36) responsive to said first and second signals to establish an output representative of a main surge control line (26) which is substantially parallel to a surge line (38) of the compressor (14) and is spaced a predetermined distance (K) therefrom in terms of flow rate; and a comparison station (42) operative to compare the main surge control line output with a signal indicative of the speed (S_T) of the compressor (14) to generate a signal identifying a point (44) of centrifugal compressor operation on the main surge control line;

second signal generating means (20, 22) for establishing a feed forward control signal of a process variable which may cause a surge condition in the centrifugal compressor (14);

summing means (48) for combining the signals of the first signal generating means (36, S_T, 42) and second signal generating means (20, 22) to provide an anticipatory surge control line (24) offset from the main surge control line (26) of the first signal generating means in proportion to the magnitude of the signal from the second signal generating means and a control signal indicative thereof; and

bypass valve control means (56) connected to the summing means (48) for varying the amount of bypass in a bypass path (30) connected across the centrifugal compressor (14) in response to the control signal from the summing means.

2. A centrifugal compressor according to claim 1, wherein the second signal generating means (20, 22) includes a control station (20) for varying the load requirements of the centrifugal compressor (14).

3. A centrifugal compressor according to claim 1, wherein:

a reciprocating compressor (12) is parallel connected with the centrifugal compressor (14); and

the second signal generating means (20, 22) comprises a control station (20) for varying the output pressure of the reciprocating compressor (12) and a control line (22) connected between the control station (20) and the summing means (48) for allowing the anticipatory surge control line (24) to be offset by the pressure change requirements on the reciprocating compressor (12).

4. A centrifugal compressor according to claim 1, claim 2 or claim 3, wherein a difference station (52) is

connected between the summing means (48) and the bypass valve control means (56) and is operative to combine a signal (54) indicative of compressor flow with the control signal from the summing means (48) to provide a cascaded signal to the control means (56) to ensure a predetermined flow through the centrifugal compressor (14).

5. A method of controlling surge in a centrifugal compressor (14), the method employing a first signal indicative of the pressure differential (ΔP_o) across an orifice (32) in an inlet line (34) of the compressor (14) and a second signal indicative of the differential pressure (ΔP_c) across the compressor (14), and the method being characterised by:

establishing (36), as a function of said first and second signals, an output representative of a main surge control line (26) offset, in terms of flow rate, from a surge line (38) of the compressor (14);

comparing (42) the main surge control line output with a signal indicative of the speed (S_T) of the compressor (14) to generate a signal identifying a point (44) of centrifugal compressor operation on the main surge control line;

generating a feed forward control signal which is a function of a system variable which may cause a surge condition in the compressor (14); and

establishing (48) an anticipatory surge control line (24) offset from the main surge control line (26) as a function of the signal identifying a point (44) of centrifugal compressor operation on the main surge control line and the generated feed forward control signal.

6. A method according to claim 5, wherein the main surge control line (26) is established substantially parallel to the surge line (38) and offset, in terms of flow rate, a predetermined amount (K) therefrom.

7. A method according to claim 6, wherein the anticipatory surge control line (24) is offset from the main surge control line (26), in terms of flow rate, by an amount proportional to the magnitude of the generated feed forward control signal.

8. A method according to claim 5, claim 6 or claim 7, wherein a reciprocating compressor (12) is parallel mounted with the centrifugal compressor (14) and has a switchable pressure output operation, the feed forward control signal being a signal monitoring the condition of the switchable pressure output.

9. A method according to claim 8, wherein a valve (28) for controlling the flow of fluid in a bypass path (30) across the centrifugal compressor (14) is controlled according to the relative position of a measured point with respect to the anticipatory surge control line (24).

Patentansprüche

1. Zentrifugalverdichter (14) mit einem Pumpkontrollsystem (18), wobei das Pumpkontrollsystem (18) auf ein erstes Signal anspricht, welches eine Anzeige für die Druckdifferenz (ΔP_o) über einer Blendenöffnung (32) in einer Einlaßleitung (34) des Verdichters (14) ist, sowie auf ein zweites Signal anspricht, welches eine Anzeige des Differenzdruckes (ΔP_c) über den Verdichter (14) ist, um einen Pumpzustand zu kontrollieren, und wobei das Pumpkontrollsystem gekennzeichnet ist durch:

erste Signalerzeugende Einrichtungen (36, S_T, 42), welche aufweisen: einen Funktionsgenerator (36), der auf die ersten und zweiten Signale anspricht, um eine Ausgangsgröße bereitzustellen, die einer Hauptpumpkontrollkurve (26) entspricht, welche im wesentlichen parallel zu einer Pumpkurve (38) des Verdichters (14) verläuft und, ausgedrückt in Einheiten der Durchflußrate, um einen vorbestimmten Abstand (K) von dieser beabstandet ist; und eine Vergleichsstation (42), welche im Betrieb den Ausgangswert der Hauptpumpkontrollkurve mit einem Signal vergleicht, welches eine Anzeige der Geschwindigkeit (S_T) des Verdichters (14) ist, um ein Signal zu erzeugen, welches einen Punkt (44) des Betriebes des Zentrifugalverdichters auf der Hauptpumpkontrollkurve darstellt;

zweite Signalerzeugungseinrichtungen (20, 22) zum Bereitstellen eines Vorwärtsschubsteuersignales einer Prozeßvariablen, welche möglicherweise einen Pumpzustand in dem Zentrifugalverdichter (14) verursacht;

einer Summiereinrichtung (48) zum Kombinieren der Signale aus der ersten Signalerzeugungseinrichtung (36, S_T, 42) und der zweiten Signaleinrichtung (20, 22), um bereits im Vorgriff eine Pumpkontrollkurve (24) bereitzustellen, welche gegenüber der Hauptpumpkontrollkurve (26) der ersten Signalerzeugungseinrichtung proportional zur Größe des Signals von der zweiten Signalerzeugungseinrichtung versetzt ist, sowie ein Steuersignal, welches eine Anzeige hierfür ist; und

eine Bypaßventilsteuereinrichtung (56), welche mit der Summiereinrichtung (48) verbunden ist, um den Betrag des Bypasses in einer Bypaßleitung (30), welche in Überbrückung des Zentrifugalverdichters (14) angeschlossen ist, unter Ansprechen auf das Steuersignal aus der Summiereinrichtung.

2. Zentrifugalverdichter nach Anspruch 1, wobei die zweite Signalerzeugungseinrichtung (20, 22) eine Kontrollstation (20) aufweist, um die Belastungsbedingungen des Zentrifugalverdichters (14) zu verändern.

3. Zentrifugalverdichter nach Anspruch 1, wobei:

ein Kolbenverdichter (12) parallel zu dem Zentrifugalverdichter (14) angeschlossen ist; und

die zweite Signalerzeugungseinrichtung (20, 22) eine Kontrollstation (20) zum Verändern des Ausgangsdruckes des Kolbenverdichters (12) aufweist, sowie eine Steuerleitung (22), welche zwischen der Kontrollstation (20) und der Summiereinrichtung (48) angeschlossen ist, um zu erlauben, daß die Pumpkontrollkurve (24) im Vorgriff durch die Druckänderungsbedingungen an dem Kolbenverdichter (12) versetzt wird.

4. Zentrifugalverdichter nach Anspruch 1, 2 oder 3, wobei eine Differenzstation zwischen der Summiereinrichtung (48) und der Bypaßventilsteuereinrichtung (56) angeschlossen und so betreibbar ist, daß sie ein Signal (54), welches eine Anzeige des Verdichterflusses ist, mit dem Kontrollsignal von der Summiereinrichtung (48) kombiniert, um ein kaskadenartiges (stufenweises) Signal für die Kontrolleinrichtung (56) bereitzustellen und so einen vorbestimmten Fluß durch den Zentrifugalverdichter (14) sicherzustellen.

5. Verfahren zum Kontrollieren des Pumpens in einem Zentrifugalverdichter (14), wobei das Verfahren ein erstes Signal verwendet, welches eine Anzeige für die Druckdifferenz (ΔP_o) über einer Blendenöffnung (32) in einer Einlaßleitung (34) des Verdichters (14) ist, sowie unter Verwendung eines zweiten Signales, welches eine Anzeige des Differenzdruckes (ΔP_c) über dem Verdichter (14) ist, wobei das Verfahren gekennzeichnet ist durch:

Bereitstellen (36) eines Ausgangssignales, welches, als Funktion der ersten und zweiten Signale, representativ für eine Verschiebung einer Hauptpumpkontrollkurve (26) gegenüber einer Pumpkurve (38) des Verdichters (14) ist, ausgedrückt in Einheiten der Durchflußrate,

Vergleichen (42) des Ausgangswertes für die Hauptpumpkontrollkurve mit einem Signal, welches eine Anzeige für die Geschwindigkeit (S_T) des Verdichters (14) ist, um ein Signal zu erzeugen, welches einen Punkt (44) des Zentrifugalverdichterbetriebes auf der Hauptpumpkontrollkurve identifiziert bzw. festlegt,

Erzeugen eines Steuersignales für einen Vorwärtsschub, welches eine Funktion einer Systemvariablen ist, die möglicherweise einen Pumpzustand in dem Verdichter (14) verursacht, und

Bereitstellen (48) einer Pumpkontrollkurve (24) im Vorgriff, welche gegenüber der Hauptpumpkontrollkurve (26) versetzt ist als Funktion des Signales, welches einen Punkt (44) des Zentrifugalverdichterbetriebes auf der Hauptpumpkontrollkurve identifiziert, sowie des erzeugten Steuersignales für die Zufuhr in Vorwärtsrichtung.

6. Verfahren nach Anspruch 5, wobei die Hauptpumpkontrollkurve (26) im wesentlichen parallel zur Pumpkurve (38) bereitgestellt wird und, ausgedrückt in Einheiten der Durchflußrate, um einen vorbestimmten Betrag (K) gegenüber dieser versetzt ist.

7. Verfahren nach Anspruch 6, wobei die vorweggenommene Pumpkontrollkurve (Pumpkontrollkurve im Vorgriff) (24) gegenüber der Hauptpumpkontrollkurve (26), ausgedrückt in Einheiten der Durchflußrate, um einen Betrag versetzt ist, der proportional der Größe des erzeugten Steuersignales für die Zufuhr in Vorwärtsrichtung ist.

8. Verfahren nach Anspruch 5, 6 oder 7, wobei ein Kolbenverdichter (12) parallel zu dem Zentrifugalverdichter (14) montiert ist und schaltbaren Druckausgangsbetrieb aufweist, wobei das Steuersignal für die Zufuhr in Vorwärtsrichtung ein Signal ist, welches den Zustand des schaltbaren Druckausganges steuert bzw. überwacht.

9. Verfahren nach Anspruch 8, wobei ein Ventil (28) zum Steuern des Fluidflusses in einer Bypaßleitung (30) in Überbrückung des Zentrifugalverdichters (14) entsprechend der relativen Lage eines gemessenen Punktes bezüglich der vorweggenommenen Pumpkontrollkurve (24) gesteuert wird.

Revendications

1. Compresseur centrifuge (14) possédant un système de commande de surpression (18), le système de commande de surpression (18) étant sensible à un premier signal représentatif du différentiel de pression (ΔP_o) aux bornes d'un orifice (32) dans une canalisation d'admission (34) du compresseur (14) et à un second signal représentatif du différentiel de pression (ΔP_c) aux bornes du compresseur (14) pour commander une condition de surpression, et le système de commande de surpression étant caractérisé par:

des premiers moyens de génération de signaux (36, S_T, 42) qui comprennent: un générateur de fonction (36) sensible auxdits premier et second signaux pour établir un signal de sortie représentatif d'une courbe de commande de surpression principale (26) qui est sensiblement parallèle à une courbe de surpression (38) du compresseur (14) et en est espacée d'une distance prédéterminée (K) exprimée en débit; et un poste de comparaison (42) agissant pour comparer le signal de sortie représentatif de la courbe de commande de surpression principale à un signal représentatif de la vitesse (S_T) du compresseur (14) pour générer un signal identifiant un point (44) de fonctionnement du compresseur centrifuge sur la courbe de commande de surpression principale;

des seconds moyens de génération de signaux (20, 22) pour établir un signal prédictif de commande d'une variable de processus pouvant provoquer une condition de surpression dans le compresseur centrifuge (14);

des moyens d'addition (48) pour combiner les signaux des premiers moyens de génération de signaux (36, S_T, 42) et des seconds moyens de génération de signaux (20, 22) pour établir une courbe de commande de surpression (24) anticipative décalée de la courbe de commande de surpression principale (26) des premiers moyens de génération de signaux proportionnellement à l'amplitude du signal des seconds moyens de génération de signaux et d'un signal de commande représentatif de celle-ci; et

des moyens de commande à soupape de dérivation (56) reliés aux moyens d'addition (48) pour faire varier la quantité de dérivation dans un trajet de dérivation (30) relié aux bornes du compresseur centrifuge (14) en réponse au signal de commande des moyens d'addition.

2. Compresseur centrifuge selon la revendication 1, dans lequel les seconds moyens de génération de signaux (20, 22) comprennent un poste de commande (20) pour faire varier les exigences de charge du compresseur centrifuge (14).

3. Compresseur centrifuge selon la revendication 1, dans lequel un compresseur alternatif (12) est monté en parallèle avec le compresseur centrifuge (14); et

les seconds moyens de génération de signaux (20, 22) comprennent un poste de commande (20) pour faire varier la pression de sortie du compresseur alternatif (12) et une canalisation de commande (22) reliant le poste de commande (20) et les moyens d'addition (48) pour permettre à la courbe de commande de surpression anticipative (24) d'être décalée par les exigences de changement de pression sur le compresseur alternatif (12).

4. Compresseur centrifuge selon l'une quelconque des revendications précédentes, dans lequel un poste de différence (52) est monté entre les moyens d'addition (48) et les moyens de commande à soupape de dérivation (56) et est actionné pour combiner un signal (54) représentatif du débit du compresseur avec le signal de commande des moyens d'addition (48) pour délivrer un signal en cascade aux moyens de commande (56) pour assurer un débit à travers le compresseur centrifuge (14).

5. Procédé de commande de surpression dans un compresseur centrifuge (14), procédé utilisant un premier signal représentatif du différentiel de pression (ΔP_o) aux bornes d'un orifice (32) dans une canalisation d'admission (34) d'un compresseur (14) et un second signal représentatif du différentiel de pression (ΔP_c) aux bornes du compresseur (14), caractérisé par les étapes consistant à:

établir (36), en tant que fonction desdits premier et second signaux, un signal de sortie représentatif d'une courbe de commande de surpression principale (26), décalée d'une quantité exprimée en débit par rapport à une courbe de commande (38) du compresseur (14);

comparer (42) le signal de sortie représentatif de la courbe principale de commande de surpression à un signal représentatif de la vitesse (S_T) du compresseur (14) pour générer un signal identifiant un point de fonctionnement (44) du compresseur centrifuge sur la courbe de commande de surpression principale;

générer un signal prédictif de commande qui est une fonction d'une variable du système pouvant provoquer une condition de surpression dans le compresseur (14); et

établir (48) une courbe de commande de surpression anticipative (24) décalée par rapport à la courbe de commande de surpression principale (26) en fonction du signal identifiant un point de fonctionnement (44) du compresseur centrifuge sur la courbe de commande de surpression principale et du signal prédictif de commande généré.

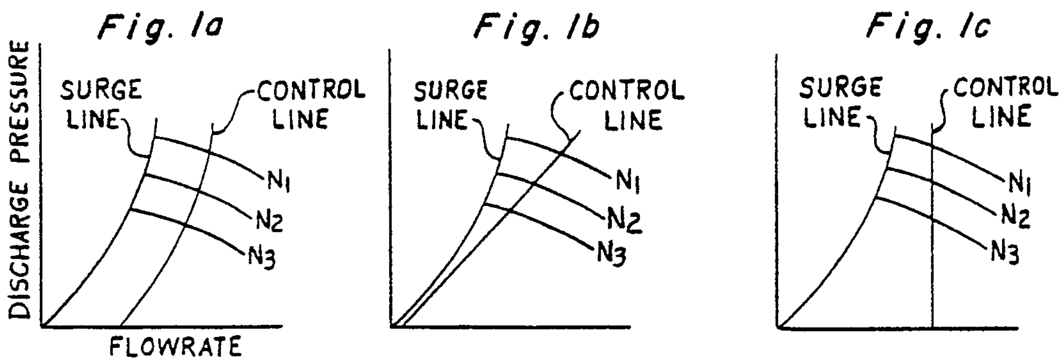
6. Procédé selon la revendication 5, dans lequel la courbe de commande de surpression principale (26) est établie sensiblement parallèlement à la courbe de commande (38) et décalée par rapport à celle-ci d'une quantité prédéterminée (K) exprimée en débit.

7. Procédé selon la revendication 6, dans lequel la courbe de commande de surpression anticipative (24) est décalée de la courbe de commande de surpression principale (26), d'une quantité, exprimée en débit, proportionnelle à l'amplitude du signal prédictif de commande généré.

8. Procédé selon l'une quelconque des revendications 5 à 7, dans lequel un compresseur alternatif (12) est monté en parallèle sur le compresseur centrifuge (14) et possède un fonctionnement de sortie de pression commutable, le signal prédictif de commande étant un signal contrôlant la condition de sortie de pression commutable.

9. Procédé selon la revendication 8, dans lequel une soupape (28) en vue de commander l'écoulement de fluide dans le trajet de dérivation (30) aux bornes du compresseur centrifuge (14) est commandée selon la position relative d'un point mesuré par rapport à la courbe de commande de surpression anticipative (24).

Prior art :



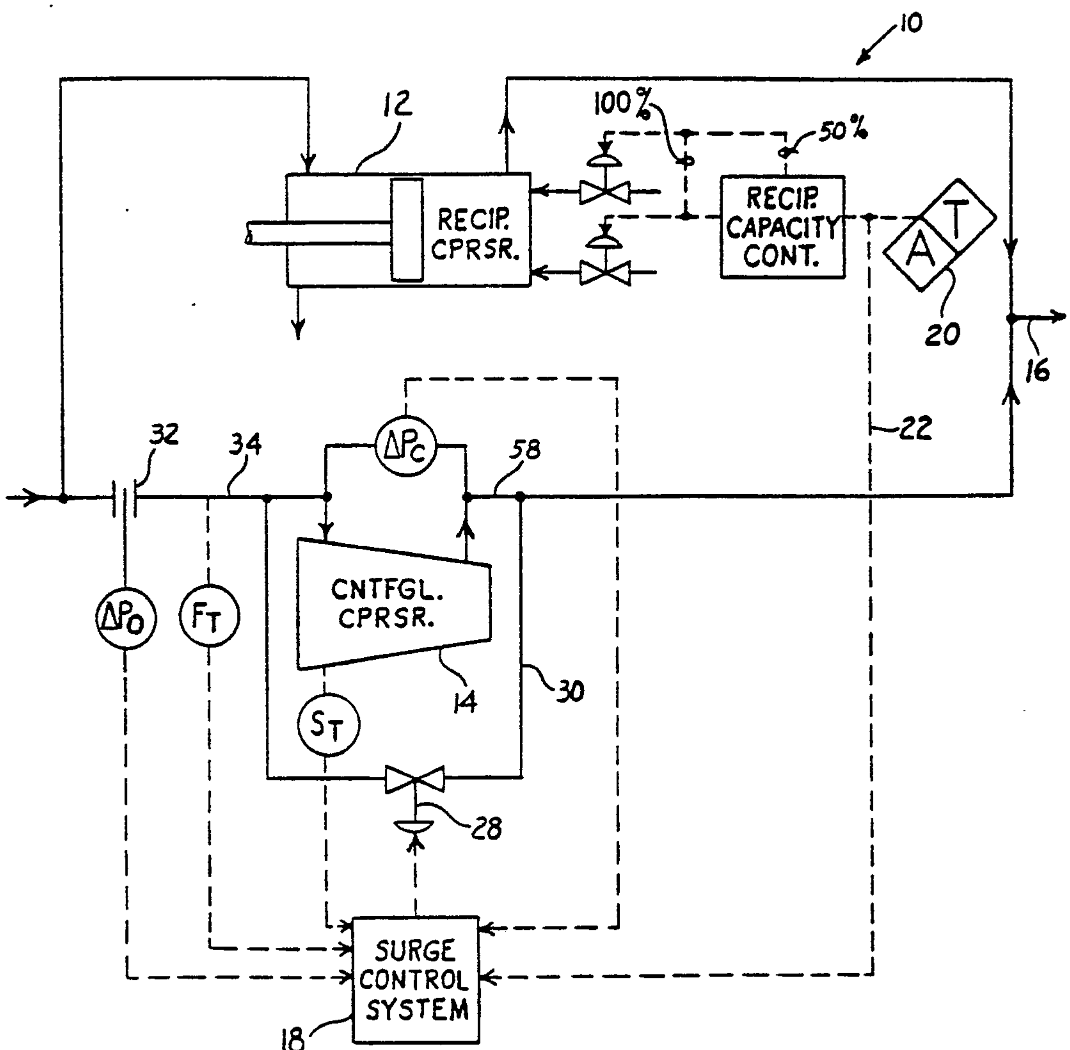


Fig. 2

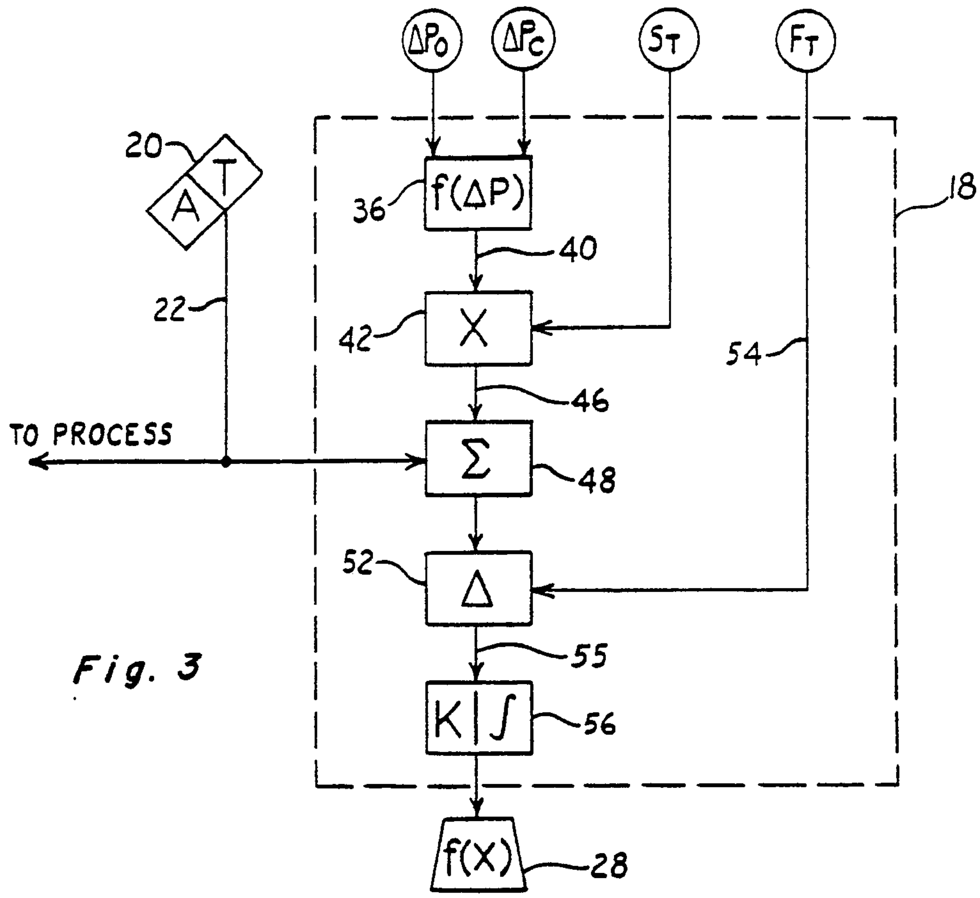

ΔP₀
ΔPc
S_T
F_T
20
A
T
18
36
f(ΔP)
40
22
42
X
54
46
TO PROCESS
Σ
48
52
Δ
55
K
∫
56
f(X)
28

Fig. 3

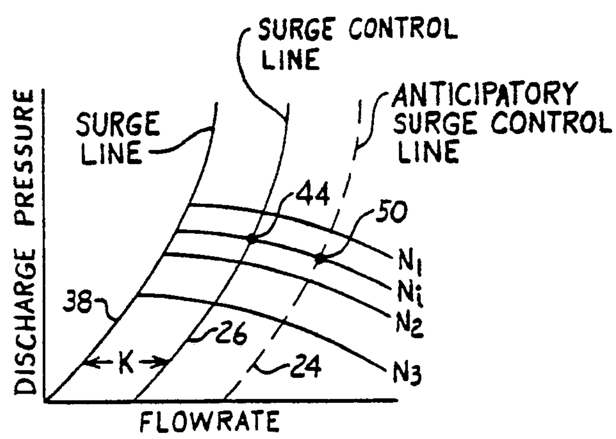

SURGE CONTROL LINE
ANTICIPATORY SURGE CONTROL LINE
SURGE LINE
DISCHARGE PRESSURE
44
50
N1
Ni
N2
N3
38
K
26
24
FLOWRATE

Fig. 4