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(54) **Rotary compressor with improved working efficiency and relative method**

Rotationsverdichter mit verbesserter Leistung und dazugehöriges Verfahren

Compresseur rotatif à efficacité de fonctionnement améliorée et procédé associé

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(56) References cited:
EP-A1- 1 522 430
GB-A- 613 303
JP-A- 3 081 595
JP-A- 5 133 374
JP-A- 62 178 784
JP-A- 2002 138 958
JP-A- 2004 330 839

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Description

[0001] The invention relates to the area of air compressors, more particularly the present invention relates to a compressed air installation comprising a rotary compressor with improved working efficiency and a method for increasing the working efficiency of rotary air compressors.

[0002] Air compressors of the standard industrial type are used to supply and maintain a certain pressure value inside a tank, wherefrom the user machines take air. When a user machine consumes an appreciable quantity of pressurised air and the rated value of the pressure in the tank consequently decreases, the compressor automatically actuates to re-establish the rated pressure value set. In practice the compressor is subjected to constant transitions from the on load mode of operation to the off load mode of operation and vice versa, which take place cyclically even several times an hour. During operation in on load mode the compressor supplies pressurised air to the tank and, when the pressure value set is reached, an electronic or mechanical valve automatically closes the intake channel of the compressor. At this point the compressor starts to operate in off load mode, consuming approximately 70% of the power absorbed during operation in on load mode. This absorption of power is due to the fact that the rotor of the compressor in any case continues to rotate and therefore performs compression work. As soon as the intake is closed, in fact, the compression channel of the rotor closest to the intake is subjected to a certain degree of vacuum until, having arrived in the proximity of the delivery manifold, it intakes air from the delivery manifold in communication with the chamber of the compressor. The quantity of intake air is in turn expanded and re-compressed at each turn of the rotor. The difficulty of this spurious process, known as re-compression, is on a par with the extent to which a high pressure is maintained inside the compressor chamber. In order to decrease the absorption of power during off load operation, modern compressors have a system of gradual depressurisation of the tank, in pressure equilibrium with the compressor chamber, in such a way that the compression ratio that characterises the compressor in off load operation decreases progressively. With this system the compressor succeeds after a certain transient period in absorbing only 25% of the power absorbed in on load operation, with a considerable energy saving compared to the initial 70%. This system however has some limitations: first of all the compressor changes from 100% absorption to approximately 25% absorption gradually, and therefore causes a transient in which considerable energy is still wasted. Moreover, in the case of oil-lubricated compressors, depressurisation of the air-oil separation tank from a relative pressure value, for example of 7-8 bars, to a relative pressure value of 2-3 bars also affects the oil injection circuit, and hence the cooling radiator. This radiator, made in very lightweight sheet aluminium, undergoes considerable mechanical stress at each cycle of pressurisation and depressurisation, which in the long term could jeopardise its intactness and proper functioning. The Applicant has developed a compressor able to save energy further, since it is no longer subject to the current absorption of power typical of air compressors in off load operation, but instead able to change instantaneously from 100% absorption of energy typical of on load operation, to not more than 25% of absorption typical in off load operation. The Applicant has also developed a method for increasing the working efficiency of a rotary compressor thanks to the reduction in the absorption of power due to re-compression.

[0003] The documents JP 621 78 784 and EP 1 522 430 disclose compressed air installations with two tanks.

[0004] The object of the present invention is therefore that of providing compressed air installation comprising a rotary air compressor with improved working efficiency which exceeds the abovementioned energy saving limits, allowing the immediate reduction in the power absorbed during operation in off load mode to no more than 25% of the power absorbed during on load operation.

[0005] Another object of the present invention is that of providing a compressed air installation comprising rotary air compressor with improved working efficiency which maintains the air-oil separation tank and the oil injection circuit at the rated working pressure also during operation in off load mode, thus avoiding the mechanical stress of the oil injection circuit parts due to the cycles of pressurisation and depressurisation which could jeopardise durability thereof.

[0006] A further object of the present invention is that of providing a method for increasing the working efficiency of a rotary compressor, reducing the energy waste thereof thanks to the immediate drop in absorbed power during operation in off load mode to no more than 25% of the power absorbed during operation in on load mode.

[0007] A final yet equally important object of the present invention is that of providing a method for increasing the working efficiency of a rotary compressor that can be applied to any type of rotary compressor and is sufficiently flexible to be able to be adapted to compressors already installed and functioning.

[0008] All these objects are achieved by compressed air installation comprising a rotary compressor according to claim 1.

[0009] According to another aspect of the invention a method is provided for increasing the working efficiency of the rotary compressor, characterised in that:

- during operation in on load mode the compression chamber of the compressor supplies the pressurised mixture of air solely in the first, high-pressure chamber of the compressor;
- during operation in off load mode the compression chamber of the compressor carries out re-compression by exchanging air with the second, low-pressure chamber of the compressor.

[0010] The present invention will be made clearer on reading the following two preferred embodiments of the rotary compressor, illustrated by way of a non-limiting example of the more general principle claimed. The description refers to the accompanying drawings, in which:

Figure 1 shows a diagram of a first preferred embodiment of the compressed air installation according to the present invention;

Figure 2 shows a diagram of a second preferred embodiment of the compressed air installation according to the present invention;

Figure 3 shows the graph of the pressure trend in relation to time during a cycle of operation of a traditional rotary compressor.

Figure 4 shows the graph of the pressure trend in relation to time during a cycle of operation of a rotary compressor according to the present invention.

[0011] Figure 1 shows a diagram of a compressed air installation comprising a compressor 1 according to the present invention of the rotary and dry type, i.e. self-lubricated and air-cooled. The compressor 1 intakes air at ambient pressure from the intake 2, and supplies compressed air at a relative pressure of approximately 7-8 bars from the delivery 3 to a first chamber of the compressor, which in the example in Figure 1 is the first, high-pressure tank 4 connected to said delivery 3 via a delivery line 5. The compressor 1 is also provided with a second chamber of the compressor, which in the example in Figure 1 is the second, low-pressure tank 6 connected to said delivery 3 via an auxiliary line 7. Downstream of the delivery 3 of the compressor 1 and upstream of the delivery line 5 and auxiliary line 7 means for deviation of the delivery air flow are positioned. These means are a three-way valve 8 whereto both the delivery line 5 and the auxiliary line 7 are connected. During operation in on load mode of the compressor 1, the three-way valve 8 keeps the delivery line 5 open and the auxiliary line 7 dosed, in such a way that the delivery 3 supplies pressurised air to the first, high-pressure tank 4 until reaching the rated pressure value set. Once this value has been reached, a solenoid valve closes in a known manner the intake 2 of the compressor 1, which from that time onwards functions in off load mode. At the time of closure of the intake, the three-way valve 8 closes the delivery line 5 and opens the auxiliary line 7, so that the compressor 1 discharges the final quantity of high-pressure air into the second, low-pressure tank 6, which has a relative pressure value of approximately 1 bar which does not vary appreciably following the final supply of high-pressure air received. At this point the compressor 1 carries out re-compression by immediately exchanging low-pressure air with said second, low-pressure tank 6. In this way the energy consumption drops immediately from the 100% of operation in on load mode to less than 25% in offload mode. Advantageously the pressure in the second, low-pressure tank is lower than the pressure that can be obtained after decompression of the high-pressure tank with the traditional method, so that the compressor 1 according to the present invention is found to consume straightaway much less than the traditional compressor downstream of the depressurisation transient. When a sufficient quantity of air is taken from the high-pressure tank 4, the compressor once again returns to operating in on load mode. The intake 2 is reopened and simultaneously the three-way valve 8 closes the auxiliary line 7 and reopens the delivery line 5, so that the compressor 1 can supply pressurised air to the high-pressure tank 4. Advantageously the high-pressure tank 4 is at a pressure value which is still the rated value decreased by a delta due to the user.

[0012] Since there has been no depressurisation, the compressor 1 saves the re-pressurisation work and supplies exclusively that delta of pressure required for re-establishing the rated value.

[0013] Figure 2 illustrates the diagram of another preferred embodiment of an installation comprising the compressor according to the present invention, wherein the identical elements of Figures 1 and 2 maintain the same reference numerals. The compressor 1 is of the rotary and oil-lubricated type and is provided with a first, high-pressure chamber of the compressor formed by the first, high-pressure air-oil separation tank 4 and a second, low-pressure chamber formed by the second, low-pressure air-oil separation tank 6. The compressor 1 is provided with means for deviation of the air-oil mixture flow placed downstream of the delivery 3, in the form of a first three-way valve 8 which opens and closes selectively the delivery line 5 and the auxiliary line 7. The high-pressure separator tank 4 is appropriately connected to a line 9 for recirculation of the oil at high pressure, provided with a radiator 10 for the cooling of the oil. Similarly also the second, low-pressure separator tank 6 is connected to a line 11 for recirculation of the oil at low pressure, which however does not need any radiator, for reasons which will be explained herein below. Both lines for recirculation of the oil at high and low pressure 9, 11 converge to means for the selective injection of oil in the compressor 1, which in the example in Figure 2 are in the form of a second three-way valve 12 placed upstream of the injectors, which opens and closes selectively said lines for recirculation of the oil at high and low pressure 9, 11. During operation in on load mode of the compressor 1, the first three-way valve 8 holds the delivery line 5 open and auxiliary line 7 closed, while the second three-way valve 12 keeps the line 9 for recicirculation of the oil at high pressure open and the low pressure one 11 closed. The compressor 1 supplies pressurised air to the first, high-pressure separator tank 4 until the rated pressure value set is reached, while the oil circulates via the line 9 for recirculation of oil at high pressure and is cooled by the radiator 10. When said first tank 4 reaches the rated

value, the compressor 1 enters off load operation mode. When the intake 2 is closed in a known manner, the first three-way valve 8 opens the auxiliary line 7 and closes the delivery line 5, and simultaneously the second three-way valve 12 closes the line 9 for recirculation of the oil at high pressure and opens the line 11 for recirculation of the oil at low pressure. The compressor 1 then performs re-compression by immediately exchanging low-pressure air with said second tank 6. Given that during off load mode operation the compressor according to the present invention immediately absorbs less than 25% of the power absorbed in on load operation mode, the power dissipated in heat is low and the oil no longer needs to be cooled with a radiator. The second, low-pressure tank 6 separates the air-oil mixture at a relative pressure of approximately 1-2 bars, a lower pressure value than that which can be obtained after depressurisation with the traditional system. The compressor according to the present invention instead has a second separator tank 6 wherein the relative pressure has to be merely sufficient for not allowing vibrations of the rotor, which would arise if the relative pressure were close to zero. When in the high-pressure tank 4 the pressure drops below a certain threshold, the compressor 1 starts to function again in on load mode: at the same moment wherein the intake 2 is opened, the first three-way valve 8 opens the delivery line 5 and closes the auxiliary line 7, while the second three-way valve 12 opens the high-pressure recirculation line 9 and closes the low-pressure one 11. Advantageously, the circuit for recirculation of oil at high pressure does not undergo any depressurisation and re-pressurisation cycle, more particularly the radiator 10, made in thin aluminium, maintains approximately the pressure of the high-pressure tank. This virtually stationary pressure condition avoids mechanical stresses for the radiator due to the above-mentioned cycles, and extends durability and good functioning thereof.

Figure 3 shows the graph of the trend of the pressure in the traditional compressor as a function of time during an operation cycle. At time t0 the compressor is actuated and in on load operation mode makes the pressure rise fast up to the maximum value set PM, which is reached at time t1. From that time onwards the compressor operates in off load mode and the pressure decreases slowly due to depressurisation of the tank of the compressor until the pressure Pm is reached, which is approximately 2-3 relative bars. The compressor maintains that pressure until the preset time t2, then de-actuates and the pressure returns to the ambient value. The interval of time t2-t1 is preset by the user and changes according to the applications. The work performed by the compressor is strictly proportional to the pressure inside the compressor and therefore an area L1 of spurious work can be seen wherein the compressor progressively absorbs through re-compression and friction from 70% to 25% of the power absorbed in on load operation mode, which can be identified as the sub-area L1' and wherein the compressor re-compresses air at the pressure Pm and absorbs 25% of the power which it absorbs in on load operation mode which can be identified with the sub-area L1".

[0014] Figure 4 instead shows a graph like that in Figure 3 yet relating to the compressor according to the present invention. It can immediately be seen that the spurious work L2, in this case, relates to the work of re-compression at the pressure Pm' lower than Pm. In other words there is a total saving of the work of re-compression relating to the sub-area L1' of Figure 3, and a considerable reduction in the work of re-compression at lower pressure equal to the difference L1 "-L2.

[0015] The present invention also relates to a method for increasing the working efficiency of a generic rotary compressor, of the type provided with a high-pressure chamber. This method consists of adding a second, low-pressure chamber and means for selective deviation of the delivery flow in the first, high-pressure chamber or alternatively in the second, low-pressure chamber. The means for deviation of the flow can be a three-way valve placed downstream of the delivery. In the case of oil-lubricated rotary compressors the first chamber will be a high-pressure air-oil separation tank and the second chamber will be a low-pressure oil-air separation tank, both provided with an autonomous oil recirculation line at high and low pressure respectively. In the case of oil-lubricated rotary compressors the two high and low-pressure oil recirculation lines converge to means for the selective injection of oil in the compressor. These oil injection means can be a three-way valve placed upstream of the oil injectors of the compressor. It is clear that the principle of operation of the compressor and of the method according to the present invention is to be understood in its generality, therefore variations cannot depart from the scope of protection outlined by the following claims.

Claims

1. A compressed air installation comprising a rotary air compressor (1) comprising at least one compression chamber provided with an intake air flow inlet (2) and a delivery air-oil mixture or air flow outlet (3), a controlled valve or the like for the closure of the intake in off load mode, a first high pressure tank (4), i.e. operating at the typical operating pressure of the compressor at full load, a second low pressure tank (6), i.e. operating at a pressure close to the atmospheric value, conduits connecting said outlet (3) with said high pressure tank (4) by means of a delivery line (5) and connecting said outlet (3) with said low pressure tank (6) by means of an auxiliary line (7), a controlled three-way valve (8) or the like, positioned downstream of the outlet (3) and connected to both said delivery line (5) and auxiliary line (7), by which the flow of the compressed fluids can be directed either into the low pressure or the high pressure tanks, **characterised in that** during operation

in on load mode said three-way valve (8) holds the delivery line (5) open and the auxiliary line (7) closed so that the compressor (1) supplies air or a pressurised mixture to said high-pressure tank (4) and wherein during the operation in off load mode the three-way valve (8) closes the delivery line (5) and opens the auxiliary line (7), in such a way that the compressor (1) performs re-compression by exchanging low-pressure mixture or air with said second, low-pressure tank (6).

2. A compressed air installation according to claim 1, wherein the compressed (1) is of the oil-lubricated type and said high pressure tank (4) and low pressure tank (6) are both air-oil separation tanks.

3. A compressed air installation according to claim 2, wherein said high-pressure separator tank (4) is connected to a line (9) for recirculation of oil at high pressure and the second low-pressure separator tank (6) is connected to a line (11) for recirculation of oil at low pressure.

4. A compressed air installation according to claim 3, wherein the lines (9, 11) for recirculation of oil at high and low pressure converge to means for the selective injection of oil in the compressor (1).

5. A compressed air installation according to claim 4, wherein these means for the selective injection of oil are at least one second three-way valve (12) placed upstream of said lines (9, 11) for recirculation of oil at high and low pressure.

6. A compressed air installation according to claim 5, wherein during operation in on load mode the at least second three-way valve (12) holds the line (9) for recirculation of oil at high pressure open and the line (12) for recirculation of oil at low pressure closed, while during operation in off load mode said at least second three-way valve (12) closes the line (9) for recirculation of oil at high pressure and opens the line (11) for recirculation of oil at low pressure.

7. A method for increasing the working efficiency of a rotary compressor (1) as in the preamble of claim 1, wherein there is selective deviation of the delivery flow in the first, high-pressure tank (4) of the compressor in on load mode or alternatively in the at least second low-pressure tank (6) of the compressor in off load mode.

8. A method according to claim 7, wherein in the case of oil-lubricated compressors (1) the first, high-pressure tank (4) and the at least second low-pressure tank (6) are air-oil separation tanks, provided with an autonomous line (9, 11) for recirculation of oil at high and low pressure respectively.

9. A method according to claim 8, wherein said lines (9, 11) of the recirculation of oil at high and low pressure converge to means for the selective injection of oil in the compressor (1).

Patentansprüche

1. Druckluftanlage, bestehend aus einem mindestens eine Verdichtungskammer umfassenden Rotationsverdichter (1), ausgerüstet mit einem Lufteinlass (2) und einem Zufluss-Luft-Öl-Gemenge- oder Luftablass (3), einem gesteuerten Ventil oder dgl. für die Schliessung des Einlasses im Nulllastbetrieb, einem ersten Hochdruckbehälter (4), d.h. arbeitend bei dem typischen Betriebsdruck des Verdichters im Volllastbetrieb, einem zweiten Niederdruckbehälter (6), d.h. arbeitend bei einem dem atmosphärischen Druck ähnlichen Druckwert, weiters Rohrleitungen, welche genannten Ablass (3) mit genanntem Hochdruckbehälter (4) durch eine Zuführungsleitung (5) verbinden und genannten Ablass (3) mit genanntem Niederdruckbehälter (6) durch eine Hilfsleitung (7) verbinden, einem dem Ablass (3) nachgelagerten und sowohl mit der Zuführungsleitung (5) als mit der Hilfsleitung (7) verbundenen gesteuerten 3-Weg-Ventil oder dgl., durch das der Strom der verdichteten Flüssigkeiten entweder in die Niederdruck- oder in die Hochdruckbehälter gerichtet werden kann, **dadurch gekennzeichnet, dass** während des Vorgangs im Volllastbetrieb genanntes 3-Weg-Ventil (8) die Zuführungsleitung (5) offen und die Hilfsleitung (7) geschlossen hält, so dass der Verdichter (1) Luft oder ein Druckgemenge an genannten Hochdruckbehälter (4) liefert und in der während des Vorgangs im Nulllastbetrieb das 3-Weg-Ventil (8) die Zuführungsleitung (5) schliesst und die Hilfsleitung (7) öffnet, sodass der Verdichter (1) eine erneute Kompression durch den Austausch des Niederdruckgemenges oder der Luft mit genanntem Niederdruckbehälter (6) durchführt.

2. Druckluftanlage nach Anspruch 1, in der der Verdichter (1) ölgeschmierter Art ist und sowohl der genannter Hochdruck- (4) als der Niederdruckbehälter (6) Luft-Öl-Trennbehälter sind.

3. Druckluftanlage nach Anspruch 2, in der der genannter Hochdrucktrennbehälter (4) an eine Leitung (9) für die Rückführung der Öls bei Hochdruck angeschlossen ist und der zweite Niederdrucktrennbehälter (6) an eine Leitung (11) für die Rückführung des Öls bei Niederdruck angeschlossen ist.

4. Druckluftanlage nach Anspruch 3, in der die Leitungen (9, 11) für die Rückführung des Öls bei Hoch- und Niederdruck an Mitteln für das wahlweise Einspritzen des Öls in den Verdichter (1) zusammen-

treffen.

5. Druckluftanlage nach Anspruch 4, in der diese Mitteln für das wahlweise Einspritzen des Öls aus mindestens einem zweiten den genannten Leitungen (9, 11) vorgelagerten 3-Weg-Ventil (12) für die Rückführung des Öls bei Hoch- und Niederdruck bestehen.

6. Druckluftanlage nach Anspruch 5, in der während des Vorgangs im Volllastbetrieb das mindestens zweite 3-Weg-Ventil (12) die Leitung (9) für die Rückführung des Öls bei Hochdruck offen und die Leitung (12) für die Rückführung des Öls bei Niederdruck geschlossen hält, während beim Vorgang im Nulllastbetrieb genanntes mindestens zweite 3-Weg-Ventil (12) die Leitung (9) für die Rückführung des Öls bei Hochdruck schliesst und die Leitung (11) für die Rückführung des Öls bei Niederdruck öffnet.

7. Verfahren zum Verbessern der Arbeitseffizienz eines Rotationsverdichters (1) nach Oberbegriff des Anspruchs 1, in dem eine wahlweise Umleitung des Zuführungsstroms in den ersten Hochdruckbehälter (4) des Verdichters im Volllastbetrieb oder wahlweise in den mindestens zweiten Niederdruckbehälter (6) des Verdichters im Nulllastbetrieb vorhanden ist.

8. Verfahren nach Anspruch 7, in dem im Fall von ölgeschmierten Verdichtern (1) der Hochdruckbehälter (4) und der mindestens zweite Niederdruckbehälter (6) Luft-Öl-Trennbehälter sind, ausgestattet mit einer unabhängigen Leitung (9, 11) für die Rückführung des Öls bei Hoch- bzw. Niederdruck.

9. Verfahren nach Anspruch 8, in dem genannte Leitungen (9, 11) für die Rückführung des Öls bei Hoch- und Niederdruck an Mitteln für das wahlweise Einspritzen von Öl in den Verdichter (1) zusammenlaufen.

Revendications

1. Une installation d'air comprimé comprenant un compresseur rotatif à air (1), constitué au moins d'une chambre de compression, équipé d'une prise d'air d'entrée (2) et d'une sortie de distribution d'une mixture air/huile ou de sortie du flux d'air (3), d'une soupape contrôlée ou similaire pour la fermeture de la prise d'air en mode de décharge, d'un premier réservoir sous haute pression (4), c'est-à-dire fonctionnant à la pression typique de fonctionnement du compresseur à pleine charge, d'un second réservoir à basse pression (6), c'est-à-dire fonctionnant à une pression proche de la pression atmosphérique, de conduites raccordant ladite sortie (3) audit réservoir haute pression (4) au moyen d'une ligne de distribution (5) et en raccordant ladite sortie (3) audit réservoir à basse pression (6) au moyen d'une ligne auxiliaire (7), d'une soupape de contrôle à trois voies (8) placée en aval de la sortie (3) et raccordée auxdites deux lignes de distribution (5) et à la ligne auxiliaire (7), à travers lesquelles le flux des fluides comprimés peut être dirigé soit dans le réservoir à basse pression soit dans celui à haute pression, **caractérisée par le fait que** durant le fonctionnement en mode chargement, ladite soupape à trois voies (8) maintient la ligne de distribution (5) ouverte et la ligne auxiliaire (7) fermée afin que le compresseur (1) produise de l'air ou une mixture sous pression audit réservoir à haute pression (4) et dans laquelle, durant le fonctionnement en mode de décharge, la soupape à trois voies (8) ferme la ligne de distribution (5) et ouvre la ligne auxiliaire (7), de manière à ce que le compresseur (1) effectue la re-compression en échangeant la mixture à basse pression ou air avec ledit second réservoir à basse pression (6).

2. Une installation d'air comprimé selon la revendication 1, dans laquelle le compresseur (1) est de type lubrifié à l'huile et ledit réservoir à haute pression (4) et ledit réservoir à basse pression (6) sont tous les deux des réservoirs de séparation air/huile.

3. Une installation d'air comprimé selon la revendication 2, dans laquelle ledit réservoir séparateur à haute pression (4) est raccordé à une ligne (9) pour la recirculation d'huile à haute pression et le second réservoir séparateur à basse pression (6) est raccordé à une ligne (11) pour la recirculation d'huile à basse pression.

4. Une installation d'air comprimé, selon la revendication 3, dans laquelle les lignes (9, 11) pour la recirculation de l'huile à haute et basse pression convergent vers des moyens pour l'injection sélective d'huile dans le compresseur (1).

5. Une installation d'air comprimé selon la revendication 4, dans laquelle ces moyens d'injection sélective d'huile sont au moins une seconde soupape à trois voies (12) placée en amont desdites lignes (9, 11) pour la recirculation de l'huile à haute et à basse pression.

6. Une installation d'air comprimé, selon la revendication 5, dans laquelle durant le fonctionnement en mode de chargement au moins la seconde soupape à trois voies (12) maintient la ligne (9) pour la recirculation de l'huile à haute pression ouverte et la ligne (12) pour la recirculation de l'huile à basse pression fermée, tandis que durant le fonctionnement en mode de déchargement au moins ladite seconde soupape à trois voies (12) ferme la ligne (9) de recirculation de l'huile à haute pression et ouvre la ligne (11) de

recirculation de l'huile à basse pression.

7. Une méthode pour améliorer l'efficacité de fonctionnement d'un compresseur rotatif (1) comme dans le préambule de la revendication 1, selon laquelle il y a la déviation sélective du flux de distribution dans le premier réservoir à haute pression (4) du compresseur en mode de chargement ou alternativement dans au moins le second réservoir à basse pression (6) du compresseur en mode de déchargement.

8. Une méthode selon la revendication 7, selon laquelle dans le cas de compresseurs lubrifiés à l'huile (1) le premier réservoir à haute pression (4) et au moins le second réservoir à faible pression (6) sont des réservoirs de séparations air/huile, fournis d'une ligne autonome (9, 11) pour la recirculation de l'huile respectivement à haute ou basse pression.

9. Une méthode selon la revendication 8, selon laquelle lesdites lignes (9, 11) de la recirculation de l'huile à haute et basse pression convergent vers des moyens pour l'injection sélective d'huile dans le compresseur (1).

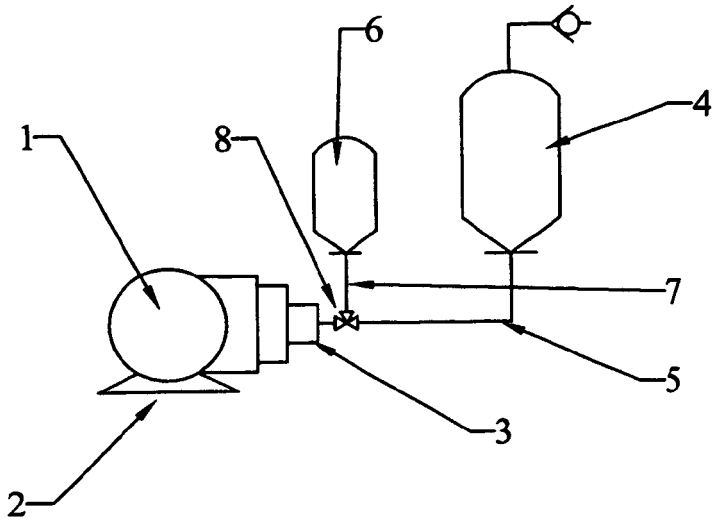


Fig. 1

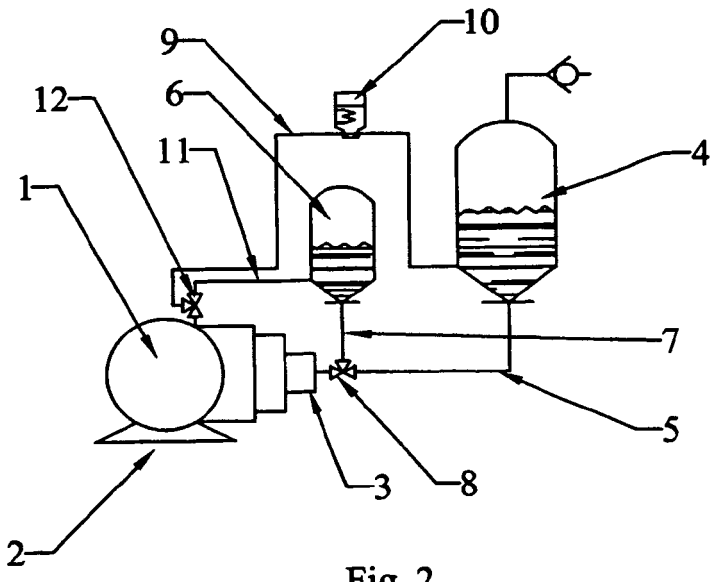


Fig. 2

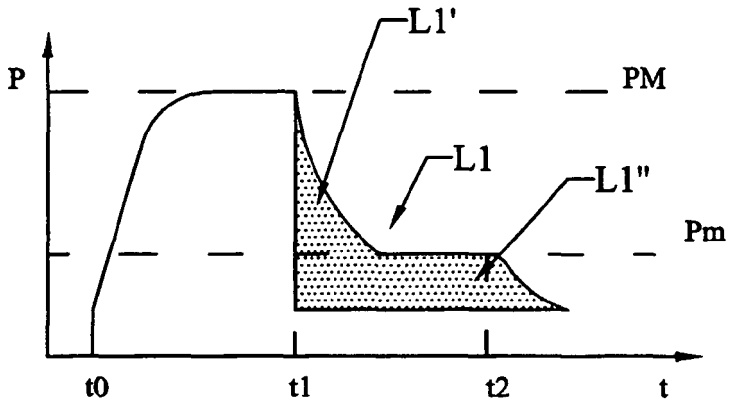


Fig. 3

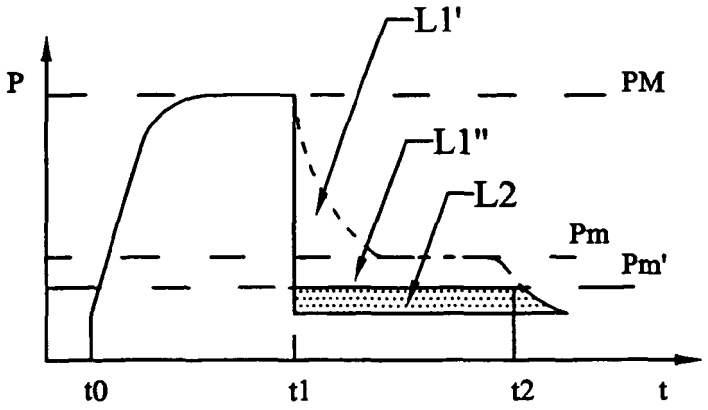


Fig. 4

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 62178784 B **[0003]**
- EP 1522430 A **[0003]**