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(54) **Rotary air compressor.**

(57) An air compressor of the rotary type comprising an external body (10) defining the oil chamber (13) and an internal cylindrical body (11) or stator defining an air compression chamber (14) in which a radial fin rotor (15) rotates. The compression or rotor chamber (14) is connected on one side to an air inlet (21) and, on the other, to an exit port (37) through means for separating the oil from the air under pressure, in which the said oil separating means comprises a labyrinth path (38) inside the compressor (10), delimited by diaphragms (40) and annular fins (39) placed in alternating radial planes in the oil chamber (13), and in which the first diaphragm (40) counting from the air exit port (37) from the compression chamber (14), presents an upper part (40a) coplanar with the first fin (39) and extending downwards, on the two sides beyond the air exit port (37) from the compression chamber (14).

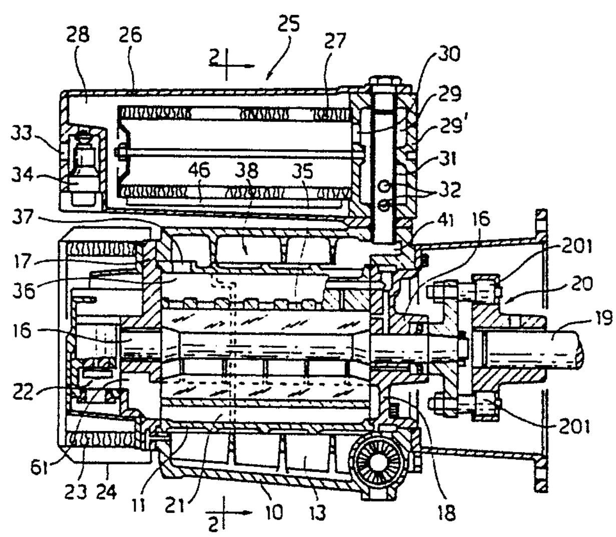

Fig. 1

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Rotary air compressor

The present invention refers to rotary air compressors and in particular to a radial fin air compressor, provided with a special circuit for separating the oil form the compressed air, capable of supplying multiple separation phases.

The above-mentioned type of rotary air compressor, with fin rotor, generally comprises an external cylindrical body, defining the oil chamber, and a cylindrical body inside the preceding one, hereafter also referred to as stator, which defines an air compression chamber in which a radial fin rotor rotates, operated by an appropriate motor. The compression chamber, also referred to as rotor chamber, is connected on one side to an air intake chamber through a suction filter, while on the other side it is connected to a compressed air exit, through an oil separation circuit. The compressor is also provided with special automatic control devices, which control its working cycle.

One of the problems of particular importance in air compressors, regards the separation of the air from the lubrication oil of the compressor, during its working, that is carried out along a circuit comprising a labyrinth path, inside the oil chamber of the compressor.

The use of labyrinth path in the oil chamber, in general is accompanied with further final separation devices or filters; finally, the presence of automatic control devices for the working of the compressor, which comprise several control valves differently located, considerably complicates the structure of the compressor, making the assembly and maintenance operations of the machine onerous and difficult to perform.

One object of the present invention is to supply a rotary air compressor, of the fin type, which is provided with particularly efficacious means for separating the oil from the air under pressure, such as to improve the primary separation phase which takes place in the oil chamber, by using constructionally simple means that do not substantially modify the structure of the compressor.

A further object of the present invention is to supply an air compressor as defined above, in which the same labyrinth air separation path, improved according to the present invention, can be used to gather and contain the foam that is liberated from the oil during decompression, after the compressor stops working.

A still further object of the present invention is to supply a rotary air compressor of the kind cited above, which, in combination with the above-mentioned advantages, presents an improved structure, constructionally simple, which allows the removal, through the front part of the compressor, of the entire stator unit together with the entire control valve unit, without having to detach the motor from the compressor body.

According to the invention, therefore, a rotary air compressor of the type with radial fins is supplied, the principal characteristics of which consist in a particular conformation of the labyrinth circuit for primary separation of the lubrication oil, which is defined by a set of annular diaphragms inside the oil chamber and circular fins outside the stator body, arranged in alternating planes and axially spaced apart or positioned at intervals, in which the first diaphragm of the oil chamber, counting from the compressed air exit from the stator chamber, presents an offset upper part coplanar with the first fin of the stator, the said upper part of the diaphragm extendin downwards on both sides of the oil chamber, from an upper point and beyond the air exit port from the stator, in such a way as to divide in two the flow of air coming out from the rotor chamber, lengthening its path, so as to substantially improve the action of separation of the air from the oil.

According to a further characteristic of the present invention, the internal diaphragms in the oil chamber, in the highest point of their labyrinth oil separation path, present air venting apertures, which enable the foam to rise and occupy the volume normally utilized for the primary separation; in this way, the dimensions of the compressor are reduced.

Moreover, through a particular disposition of the air exit port from the compression chamber, it is possible to arrange in such a way that the foam which is liberated by the oil during decompression, after the stopping of the compressor, does not penetrate into the stator; in this way, it is possible to avoid the foam invading the rotor chamber.

These and further characteristics and objects of the present invention, will be seen from the description that follows of a particular embodiment, referring to the attached drawings, in which :

Fig. 1 is a longitudinal sectional view of the compressor;

Fig. 2 is a cross-sectional view according to the line 2-2 of the preceding figure;

Fig. 3 is an enlarged cross-sectional view of the oil separation circuit;

Fig. 4 is an enlarged cross-sectional view of the air intake valve and the modulation servo valve, shown according to the section line 4-4 of Fig. 5;

Fig. 5 is an enlarged view of the vacuum relief valve, sectioned according to the line 5-5 of Fig. 4;

Fig. 6 is an enlarged particular of the non-return and minimum-pressure valve, provided on the body of the end separator;

Fig. 7 is a cross-sectional view of the pressure relief valve.

With reference to Figures 1 and 2, the air compressor according to the present invention, comprises an external cylindrical body 10, inside which is a second cylindrical body 11, which together with the first defines a chamber 13, also referred to as lubrication oil chamber, since this chamber 13 is normally half-filled with a suitable quantity of oil for the lubrication and cooling of the rotor of the compressor.

The inner cylindrical body 11, also referred to as stator body, defines in its turn a second cylindrical chamber 14 inside which rotates a rotor 15, placed in a position off-centre, having radially movable fins 15′ which, because of the centrifugal force, are pushed to adhere against the inner surface of the chamber 14 or air compression chamber, in a way per se known. The shaft 16 of the rotor, on one side is rotatably supported by a cover 17, which closes the front side of the chambers 13 and 14, while on the other side it is rotatably supported by a second cover 18, which closes the rear side of the chambers 13 and 14; at the same time the said shaft 16 is connected to the shaft 19 of a drive motor (not shown) through a joint 20 having axially removable rubber pads 201.

The stator chamber 14 is connected at the bottom to a intake chamber 61 through an inlet channel 21, an intake valve 22 and an air filter 23 supported frontally and coaxially to the stator; the filter 23 is enclosed in a cover 24. The compressor also comprises an oil separator 25 comprising in its turn a hollow cylindircal body 26 having a horizontal axis, placed at the top and parallel to the compressor body 10. Inside the separator body 26 is a cylindrical filter 27, which divides the separator chamber 28 from an auxiliary chamber 29 with which it communicates through an air passage 30. The auxiliary chamber 29 in its turn communicates with the inside of the oil chamber 13, in its upper part, through a tubular channel 31 and a set of holes 32, as described more fully further on. The chamber 28 of the final separator 25 in its turn communicates with a compressed air exit port 33, through a minimum-pressure and non-return valve, indicated as a whole with 34.

The stator chamber 14 presents, in its upper part, a set of apertures 35, which open into a manifold 36 having at one of its extremities a compressed air exit port towards the upper part not occupied by the oil of the compressor chamber 13. In the case illustrated, the air exit port 37 from the manifold 36, hereafter referred to also as the air exit port from the compression chamber, is situated on the same side of the suction filter, which is opposite that of communication between the upper part of the oil chamber 13 and the end separator 25.

Inside the compressor, between the outer body 10 and the inner body 11, there is provided a labyrinth path 38 capable of allowing a separation phase of the oil entrained by the compressed air, also referred to as primary separation; the labyrinth path is situated inside the oil chamber 13 in its upper part, this being normally only about half-filled with the quantity of oil desired. As shown in the figures from 1 to 3, the labyrinth path 38 for the primary separation is defined by a set of circular fins 39 arranged radially on the external surface of the stator 11, in axially spaced apart planes, and by a set of annular diaphragms 40 which, with the exception of the first on the left in Figures 1 and 3, are arranged in alternating planes intermediately to the planes of the fins 39 of the stator. All the fins 39 present the same maximum diameter equal to or slightly less than the minimum diameter on the internal edge of the annular diaphragms of the compressor body 10, so as to allow the axial removal of the entire stator, through the fornt part (the left part in Fig. 1), together with the suction filter, as will be explained further on.

The combination of the fins 39 of the stator and the annular diaphragms 40 of the oil chamber 13, forms, in the upper part of the same chamber 13, a tortuous labyrinth path, between the compressed air exit port 37 from the manifold of the compression chamber and the compressed air exit port 41 from the oil chamber 13 towards the separator 25; therefore the air allows the greater part of the oil entrained by it to be deposited here, to fall and collect in the underneath part of the chamber 13 itself.

A first particularly innovative element in the oil separation circuit of the compressor according to the present invention, is constituted by the fact that the first diaphragm 40 of the oil chamber 13, met by the air coming from the manifold exit port 37, that is to say the first annular diaphragm on the left in Figures 1 and 3, presents its upper part 40a, which is in an offset position as compared with the underneath part, in such a way as to be placed coplanar to the first stator fin 39 with the opposite edges brought very close together in such a way as to impede a direct axial passage of the air under pressure, towards the right. Since the upper part 40a of the first diaphragm met by the air, extends downwards on both sides, beyond the air exit port 37, keeping itself however above the maximum oil level allowed for the working of the compressor, the flow of air coming from the compression chamber is forced to invert its direction, deviating first downwards, and then to divide itself into two separate flows, directed radially and upwards, again inverting its direction so as to be able to find the passage towards the labyrinth path defined by the diaphragms and the successive fins. The sudden change of direction resulting from the particular conformation of the first diaphragm and the disposition of its upper part 40a coplanar to the first fin 39, and the extension of the path deriving from this, allow a better degree of separation of the oil from the air under pressure, in the primary separation phase.

The same volume of the upper part of the oil chamber 13 which, during the running of the copressor, is utilized for the primary separation phase, as described above, is utilized for receiving the foam that is produced by the oil during the decompression phase, which follows each stopping of the compressor. The said volume in traditional compressors, is not entirely utilizable and therefore must be sufficiently large to prevent the foam from reaching the air exit port from the stator chamber, and through this, to penetrate into the compression chamber 14 bringing oil to the intake valve 22, with the consequent danger of a hydraulic blockage between the fins of the rotor, at the successive starting of the compressor. The above-mentioned volume of the primary separation path must also be such as to prevent the oil foam from reaching the air exit 41 and consequently the final separator 25, saturating the filter 27 with oil, with consequent damage to same and the danger of oil being entrained out of the compressor, at the successive restarting. Therefore, in traditional compressors, the volume of the oil chamber designed to be used for the primary separation must be calculated sufficiently large to contain all the foam, thus avoiding the above-mentioned inconveniences. This leads to an over-dimensioning of the oil chamber and therefore to large dimensions of the compressor and comparatively high costs.

Therefore, according to the present invention, the volume of the oil chamber 13 has been contained to the maximum, with consequent advantages in dimensions and costs, but at the same time the above-mentioned inconveniences have been obviated, thanks to a particular disposition of the air exit port 37 from the stator and a particular conformation of the diaphragms 40 along the primary separation path. In fact, as is better evidenced in the enlarged view shown in Fig. 3, the upper edge 37a of the air exit port 37 is placed in a higher position as compared with the internal edge, at its highest point, of the offset upper part 40a of the first diaphragm 40; in this way, the said upper part 40a of the first diaphragm comes to form, with the wall of the outer body 10 of the compressor, an air chamber 42 with the aperture turned downwards, which impedes the foam that rises from penetrating there and reaching the air exit port 37 from the stator. In the successive diaphragms 40, in correspondence with their highest point, small venting apertures 43 have been provided instead, tangent to the internal surface of the peripheral wall of the oil chamber 13. In such a way, the air entrapped between the said diaphragms can be pushed out through the said apertures 43 by the same foam that rises, towards the higher parts of the oil chamber and towards the separator 25, thus allowing the said foam to occupy the relative internal spaces left free by the air, which normally remain unutilized for this specific purpose. Like this, it is possible to increase considerably the space available for the containment of the foam, equal to the volume of the oil chamber, in a traditional compressor, or reduce substantially the dimensions of the compressor itself.

The oil separation circuit in the compressor according to the present invention, besides the primary separation means due to the labyrinth path inside the oil chamber 13, as previously described, comprises secondary separation means, disposed between the primary separation path, at the exit of the compressor chamber 13, and the final separator 25. These secondary separation means, as already mentioned, comprise the intermediate chamber 29 in the hollow cover 29′ of the separator 25, which communicates with the inside of the filter 27 of the separator through the lateral aperture 30, respectively communicating with the inside of the oil chamber of the compressor, by means of the hollow bolt or threaded tubular element 31, which serves also for the fixing of the separator body 26 to the compressor body 10.

The double-walled cover 29′ defines an auxiliary separation chamber, upstream from the final separation filter; therefore the compressed air which enters the chamber 29 through the lower extremity of the tubular element 31 and the lateral holes 32, deposits a certain quantity of oil, as a consequence of the decrease in speed and the changes of direction it undergoes in the chamber; this oil is drained and taken back to the inside of the compression chamber 14 through a return valve 44.

The final separation of the oil from the compressed air takes place in the final separator 25.

The air passes from the cover 29′ of the separator to the inside of the filter 27 through the aperture 30 situated on the wall of the cover itself, and it arrives, purified of oil, in the chamber 28 of the above-mentioned separator.

The de-oiling filter 27 is contained horizontally in the separator body 25 in such a way that between it and the internal surface of the body there remains a space just sufficient to allow the separation of the oil from the air.

During the passing through the wall of the filter 27, the droplets of oil and the oil vapours still entrained by the air condense in heavier drops, which, on arrival at the external wall of the filter, fall downwards along this and, having reached the lower generating line of the wall filter, they become detached from the filter and are deposited on the bottom of the separator body.

The oil collected here is drained by means of the valves 45 at the two extremities of the body 26, so that this can take place whatever the inclination of the body is, and it is put back into circulation by means of an appropriate channel that takes it back to the compression unit.

The air separated from the oil is directed instead towards the upper part of the separator, where the exit port is situated.

The horizontal disposition of the de-oiling filter 27 and a very reduced space between the filter and its container could however present the snag of a certain entrainment of oil by the air, because of the fact that, at the time when the oil detaches from the lower part of the filter element, it is assailed both by the radial air flow from the same filter and by the longitudinal air flow directed towards the exit port from the separator.

This difficulty has been eliminated by applying a longitudinal element 46 of equal length underneath the de-oiling filter 27 and adhering to it; this element can be realized in any way, for example with a simple plastic tube, which serves as a drip collector for the oil.

In this way, the oil that drips down along the external surface of the filter 27 is collected by this and conducted by superficial tension into the proper part underneath, and contemporaneously the radial air flow coming from the filter is deviated from the point where the oil leaves the drip collector 46.

Besides, the oil may deposit in the lower part of the separator body before detaching itself completely from the above-mentioned element, and in any case the detachment takes place in the lowest area where the longitudinal air flow has a minimum speed, since it is mainly directed upwards to reach the exit port.

The application of a longitudinal drip collector in the lower part of a de-oiling filter positioned horizontally constitutes an innovative fact and allows a degree of separation of the oil from the air equal to that which is normally reached with a vertical disposition of the de-oiling filter.

At the compressed air exit port 33 of the final separator 25 there is a minimum pressure non-return valve 34. The said valve is inserted directly in the body of the separator, as shown in the detailed drawing, Fig. 6. The fact that the piston 47 of the valve works vertically, turned upwards, with the seat 48 of the disk 49 turned downwards, constitutes an innovative element. The disk 49 is supported in a sliding way with its rod 50 in a dead hole 51 of the piston 47, since the latter is subject on one side to compressed air pressure, in correspondence with the disk 49, and on the other to atmospheric pressure, through the hole 52 and respectively at the balancing spring 53.

This disposition has been adopted in order to have the air exit port from the separation chamber in its highest part; in this way, the droplets of oil that are collected and detached from the filter in the lowest part, cannot be entrained outwards by the air, since the air flows in a diametrically opposite area.

Moreover, both assembling and disassembling of the valve body 54 are very much facilitated with the piston 47 and the disk 49 turned upwards, insofar as in the contrary case both the piston and the valve disk would fall into the relative housing of the separator body.

The reduction in dimensions and the possibility of being able to utilize part of the oil chamber both as volume for the primary separation and for the collection of the foam that forms during decompression, have been made possible by a further characteristic of the compressor according to the present invention, which provides for the grouping of the valves constituting the regulating device of the compressor, in a single frontal space inside the suction filter 23, in the empty space, normally not utilized, of the filter cartridge itself. This particular disposition, once the cover 24 and the filter 23 have been removed, allows easy access to the delivery regulating device, both for calibration and for control or maintenance. Besides, once the necessary bolts that fix the closure cover 17 of the frontal side of the compressor have been loosened or removed, the entire stator-rotor group 11, 15, complete with a semi-joint, can be taken out or simply slid out through the end opening of the chamber 13, without it being necessary to separate the motor from the body of the compressor.

The regulating device of the compressor, which has its place inside the suction filter 23, is represented in detail in the figures 4, 5 and 7 of the attached drawings, showing further innovative characteristics of the present invention. The regulating device substantially comprises the intake valve 22, shown in detail in Fig. 4, which opens and closes the air entrance to the compressor, the servo valve 55 for modulation of delivery, also shown in Fig. 4, which commands the gradual opening and closing of the intake valve 22, the stand-by vacuum valve 56, which circulates a small quantity of air from the delivery to the suction of the compressor while it is running idle (Fig.1 and Fig. 5), the idle-running valve 57 (Fig. 4), which effects the total closure of the intake valve 22 and discharges the pressure inside the compressor during the idle-running phase.

The above-mentioned valves are gathered together in a single valve body 58 applied frontally to the cover 17 which is positioned on the side opposite that of the connection of the rotor to the drive motor; the valve body 58, as previously mentioned, occupies the space inside the cartridge 23 of the suction filter, so as to be easily accessible. This disposition makes it possible to obtain notable constructional simplicity since the interdependent valves are in direct communication with each other by means of holes or passages in the valve body 58 itself, and considerable facility in installation and control.

In particular, from Fig. 4, it is to be noted that the intake valve 22 comprises a valve seat 60 communicating on one side towards the outside through the filter 23 (Fig. 1), and on the other with the intake chamber 61, which opens towards the compression chamber inside the stator 11. The intake valve 22 therefore comprises a disk type closing member 62 having a rod 63 sliding axially in the hole of a guide sleeve 64 inside a cylindrical seat 65; in the seat 65, a piston constituted of a cup-shaped element 66 runs; this has one side leant against the rod 63 of the intake valve, and on the other side it leans against a central ledge of a second disk 67 in such a way as to define an annular canal 68, which can communicate with the output 69 of the idle-running valve 57; the disk 67 of the control piston therefore is subject, on one side, to the pressure of the oil, respectively of the compressed air coming through the valve 57, as described further on, and on the other side to atmospheric pressure. A spring 70 is disposed between the cup-shaped element 66 of the control piston and the guide sleeve 64 of the disk 62 of the intake valve. A further innovative element of the present invention, consists precisely in the idle-running control valve for the total closure of the intake valve described above. The idle-running valve 57 makes use of the air pressure of the compressor to control the closure of the valve 22 in the completely idle running of the compressor and, alternatively it makes use of the oil under pressure during the phases of delivery modulation.

The idle-running valve 57 therefore comprises a ball closing element 71 which, by means of a spring 72, is pushed to form a seal against a first conical seat at the extremity of a perforated sleeve 73 which, by means of an axial passage 74, a channel 75 and a solenoid valve 76, controlled by a pressure switch 77, is connected to the chamber 28 of the final separator 25. The passage 74, on the other hand, serves also as a discharge for air under pressure, towards the atmosphere.

The ball element 71 of the valve 57 is also capable of forming a seal against a second valve seat 78 opposite the preceding one and formed at the extremity of the channel 79, in which the thrust spring 72 is housed, said channel communicating with the outlet 80 of the valve 55 for the modulation of delivery.

The valve 55 comprises a piston 81 sliding in a cylindrical hole 82 in the valve body 58. The piston 81 is pushed downwards by a spring 83, which on one side leans against the upper extremity of the piston 81, constituting the closing member of the valve, and on the other side leans against a sliding counter-element 84, the position of which can be adjusted by acting on a grub screw 85 to vary the load at the spring 83 on the piston 81. The piston 81 of the modulation valve comprises a short rod 86 at its lower extremity in correspondence with which the hole 82 communicates, by means of the channel 87, with the oil chamber 13 in order to receive oil under pressure from it; the piston 81 also comprises an annular groove 88 which puts the exit 80 of the valve in communication with a small discharge hole 89 towards the suction side 61 of the compressor.

The modulation of the delivery is therefore effected by the servo valve 55 described previously. Because of a determined oil pressure value in the chamber 13, the piston 81 begins to uncover the passage 87 of the oil towards the passage 80, 79 and towards the piston 66 of the intake valve 22 and contemporaneously towards the small discharge hole 89 into the intake chamber.

In this way, because of a small variation in pressure in the oil chamber 13, the pressure that acts on the operator piston 66 of the intake valve 22 will assume the values necessary to overcome the force of the spring which contrasts the piston itself, so that it can complete the whole of its travel downwards.

Therefore the disk 62 of the intake valve 22 will pass from the position of full opening shown, to that of complete closure against the seat 60, thus effecting a continuous modulation of the delivery.

However, before the intake valve 22 arrives at complete closure, it is necessary to ensure a small circulation of air inside the rotor-stator unit, in order to facilitate the evacuation of the oil injected into the stator, and to reduce the entity of the depression to the suction, which causes vibrations of the fins.

For this purpose the vacuum relief valve 56 (Fig. 5) has been provided; this consists of a piston 90 in communication on one side with the atmospheric pressure, and on the other side with the intake chamber through the channel 91.

The said piston 90 acts through a rod 92 on a ball valve 93, which closes the passage of air under pressure coming from the inside of the compressor along the channel 94.

When a certain degree of vacuum is established in the intake chamber 61, then the piston advances overcoming the resistance opposed by the ball 93, pushed against the valve seat by the depression of the air.

In this way, a by-pass 94, 95 will be opened from the chamber under pressure to the intake chamber 61 of the compressor, and the said passage will remain open until there is a reduction of the vacuum on the piston 90 of the valve, because of a greater opening of the intake valve 22 through an increase in the demand for air.

The control of the delivery of the compressor takes place in two phases: in the first phase the modulation of the delivery as described above takes place, as a result of requests for air of a certain entity, while in the second phase, when the request for air is reduced further, the compressor works with an intermittent control, at full load and running idle with discharge of the internal pressure.

In this way, the absorption of power in running idle is reduced to the minimum.

The idle running of the compressor is controlled by the pressure switch 77 setted just under the maximum delivery pressure controlled by the servo valve during the modulation working.

The said pressure switch operates the solenoid valve 76, which feeds the pressure of the compressor to the piston 66 of the intake valve 22 through the change-over or idle running valve 57 and contemporaneously connects the compressor to the discharge through the small orifice 74.

In this way the compressor is set completely at idle running mode (intake valve closed) and contemporaneously the internal pressure is discharged, reducing the power absorbed to a minimum value corresponding to what is necessary to keep the intake valve closed and, on the other hand, sufficient to ensure continued lubrication through the circulation of oil.

The above-mentioned idle-running or idle-running valve 57 is positioned along the channel that connects the servo valve 55 to the intake valve 22. As previously described, the idle-running valve comprises a ball element 71, which normally seals on the conical seat 73, closing the passage of the oil under pressure, coming from the servo valve 55 towards the discharge hole into the atmosphere 74.

When the compressed air reaches the idle-running valve 57 through the solenoid valve 76, it pushes the ball element 71 from the above-mentioned seat against a second seat 78 axially opposite opening contemporaneously the passage towards the piston 66 of the intake valve 22 in order to close it, and closing the discharge passage 89 towards the intake chamber, said discharge passage having been previously utilized by the oil coming from the servo valve to carry out the modulation of the delivery.

A pressure discharge valve 96 completes the control system for discharging the pressure after the stopping (shown in Fig. 7); this valve releases the compressed air inside the compressor, when it is still, in order to prepare it for a successive start.

The pressure discharge valve 96 is constituted of the combination of a rod 97, having a sealing ring 98 at one extremity, and a control piston 99 positioned at the extremity opposite the rod.

The sealing ring 98 seals against a conical seat, closing the passage for compressed air coming through the channel 100 from the inside of the compressor towards a discharge hole to the outside, provided with a silencer filter 102.

The side of the piston opposite the rod is in communication with the intake chamber 61 of the compressor, by means of the channel 103.

When the compressor stops, the compressed air goes back into the intake chamber by means of the compression cells, since there is no longer the sealing of the fins.

The said chamber is therefore put under pressure since, on the stopping of the compressor, the intake valve closes automatically as it has the characteristic of a non-return valve.

The piston of the discharge valve, which communicates with it, is pushed back, so that the rod, pushing the sealing ring away from its proper seat, opens the discharge for the air under pressure contained in the compressor.

When the compressor starts again, the combined forces of the pressure of air coming from the delivery and the light depression in the intake chamber, will provide for the return of the rod and the piston into their initial position, closing the air discharge.

From what has been said and shown, it is therefore evident that the invention is directed to a new structure of air compressor, which is characterized mainly by a particular conformation of the circuit for the separation of the oil from the air under pressure, which comprises means for a primary separation inside the oil chamber, capable of effecting an efficacious action of separation of the oil from the air, thanks to a triple action, which comes about mainly in a circuit inside the oil chamber of the compressor, capable also of collecting the foam that is liberated by the oil in the decompression phase, than in an additional separation chamber at the entrance to the final separation filter, and in the final separator itself, made more efficacious by its horizontal position.

Claims

1.-A rotary air compressor, of the type comprising an external body (10) defining an oil chamber (13), and an internal cylindrical body (11) defining a compression chamber (14) in which a radial fin rotor (15) rotates, the compression chamber (14) being connected on one side to an air intake port, and respectively to a compressed air exit port through an oil separation circuit, and control valve means for the regulation of the working conditions of the compressor; said oil separation circuit comprising a labyrinth path (38) in the upper part of the oil chamber (13) of the compressor, said labyrinth path (38) being defined by a succession of circular fins (40) and annular diaphragms (39) arranged alternately in planes orthogonal to the axis of the compressor, characterized by the fact that the first diaphragm (40) of the oil chamber (13), met by the air at the exit from the compression chamber (14), comprises an upper offset part (40a) coplanar with the first fin (39), said upper part (40) of the first diaphragm (40) extending downwards from the top, on both sides of the oil chamber (13), beyond the air exit port (37) from the compression chamber (14).

2. - A compressor as claimed in claim 1, characterized by the fact that the air exit port (37) from the compression chamber (14), is located in a higher position as compared with the internal edge of the first annular diaphragm (10) inside the oil chamber (13).

3. - A compressor as claimed in claims 1 and 2, characterized by the fact that the annular diaphragms (40) successive to the first one, defining the labyrinth path (38) for separation of the oil from the air, present venting holes (35) for the air in the highest part of the oil chamber (13).

4. - A compressor as claimed in claim 3, in which the oil chamber (13) is delimited by a cylindrical internal surface of the external body (10), characterized by the fact that the air venting holes (35) are tangent to the above-mentioned internal surface.

5. - A compressor as claimed in claim 1, in which the oil separation circuit (38) comprises a final separator filter (25), characterized by the fact that a secondary separation device is provided, said device comprising an auxiliary separation chamber (29) upstream from the final separation filter (25).

6. - A compressor as claimed in claim 5, characterized by the fact that the auxiliary separation chamber (29) is provided in the closure cover (29') of the casing (26) of the final separator filter (25).

7. - A compressor as claimed in the preceding claim, characterized by the fact that the auxiliary separation chamber (29) communicates with the inside of the oil chamber (13) of the compressor, through apertures (32) in a tubular fixing element (31) of the cover (29) and the housing of the filter, to the external body (10) of the compressor.

8. - A compressor as claimed in one or more of the preceding claims, characterized by the fact that the filter (27) of the final oil separation device (25) is arranged with its longitudinal axis in a substantially horizontal position.

9. - A compressor as claimed in claim 8, further characterized by the fact that an oil-drip collector element (46) is arranged longitudinally in the lower part of the oil separation filter (27).

10. - A compressor as claimed in the preceding claims, in which the final oil separation filter (27) is in communication with a compressed air exit port (33) through a minimum-pressure non-return valve (34), positioned in a housing, characterized by the fact that the said valve (34) comprises a sliding piston member (54) for supporting a disk like closing member (49) said closing member (49) being positioned at the upper extremity of the piston (54), in correspondence with a downwards oriented sealing seat (48) of the valve, formed in the upper part of said oil separator (25).

11. - A compressor as claimed in claim 1, in which the compression chamber (14) communicates with the outside through an intake valve (22), and in which the control means for the compressor comprises a delivery modulating servo valve (55), an idle running valve (57), and a pressure relief valve (56), characterized by the fact that the above-mentioned valves (55, 56, 57) are arranged in a single valve body 58 provided frontally to the body (10) of the compressor on the side opposite that of connection of the rotor (15) to the drive motor of the compressor.

12. - A compressor as claimed in claim 11, in which the intake chamber of the compressor communicates with the external ambient through a filter (23), characterized by the fact that the valve unit (55, 56, 57) of the control means of the compressor is located inside the cartridge of the above-mentioned filter (23).

13. - A compressor as claimed in claim 1, in which the control means of the compressor comprises a modulating valve (55) operatively connected to the control side of the intake valve (22) of the compressor, characterized by the fact that the modulating valve (55) is connected to the oil chamber (13) of the compressor and respectively to the control side of the intake valve (22), through an idle running valve (57) operated to close towards the modulating valve (55), by the pressure of air in the compressor.

14. - A compressor as claimed in claim 13, characterized by the fact that the idle running valve (57) comprises a three-way ball valve (71), having a

first sealing seat (78) in correspondence with the connection channel (80) with the modulating valve (55), a second sealing seat (73), opposite the preceding one, in correspondence with a discharge channel (74) towards the atmosphere, respectively in the connection with a source (28) of air under pressure of the compressor, and a lateral connection channel (69) with the control side of the intake valve (22), said ball valve (71) being normally closed towards the second valve seat (73) mentioned above.

15. - A compressor as claimed in the preceding claim, characterized by the fact that the connection channel (75) of the idle running valve (57) with the source of air (28) of the compressor, comprises a solenoid valve (76) controlled by a pressure switch (77) adjusted for a pressure value slightly lower than the maximum delivery pressure of the compressor.

16. - A compressor as claimed in claim 1, characterized by the fact that the stator-rotor unit (11, 15) is removable through an end opening of the oil chamber (13), which is opposite to the drive motor of the compressor.

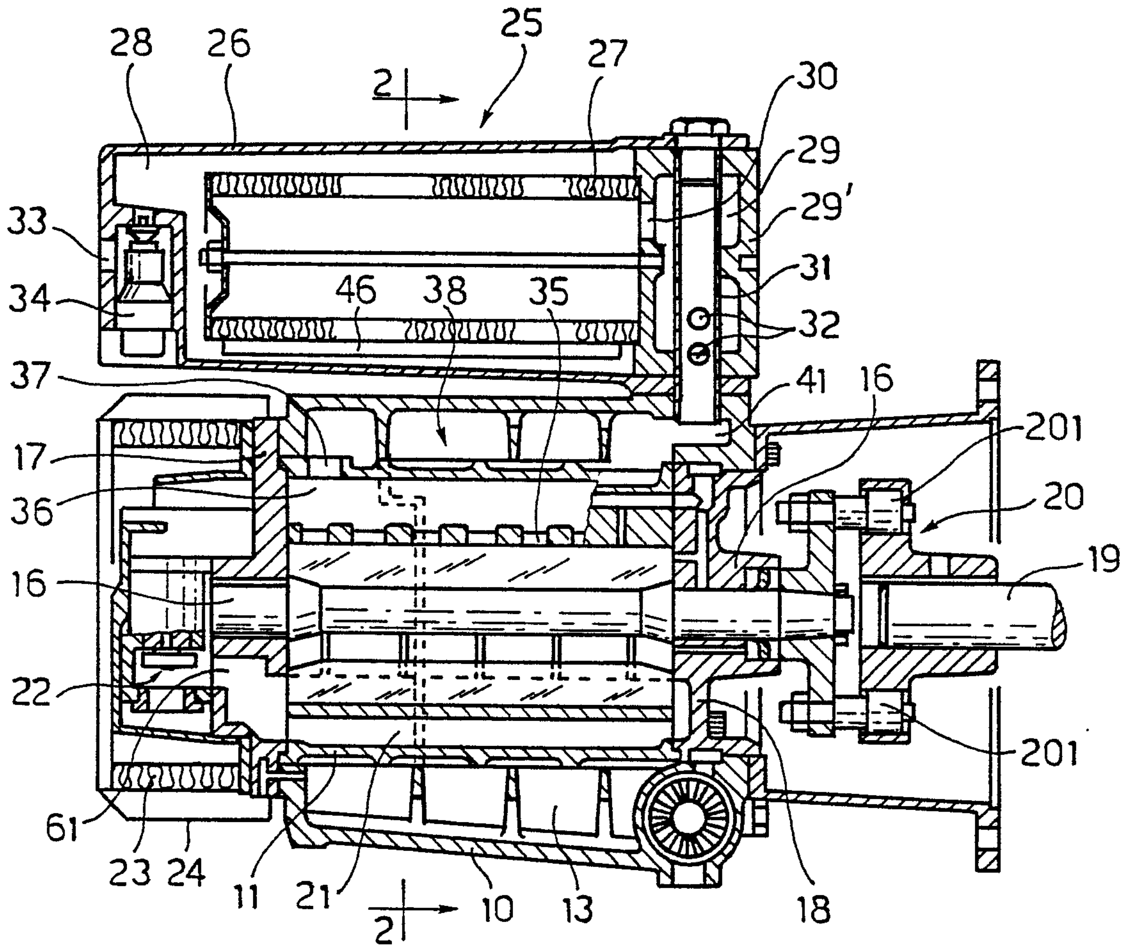
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Fig. 1

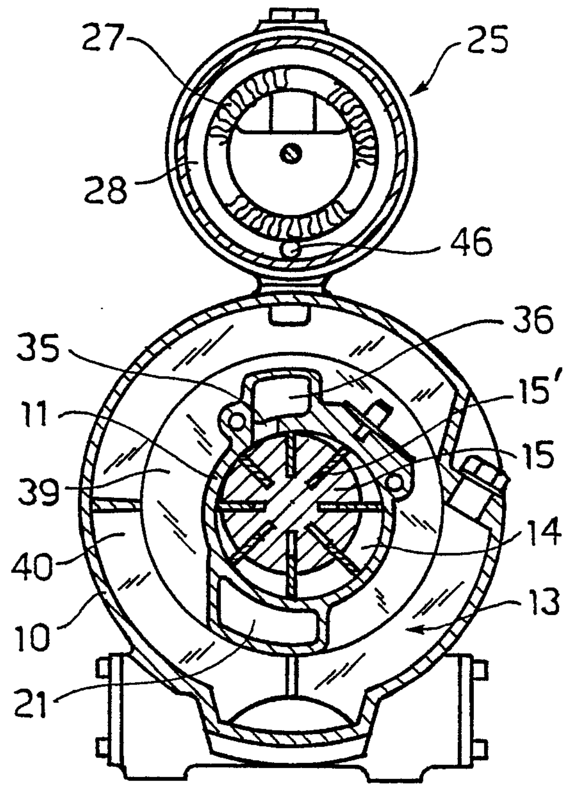
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Fig. 2

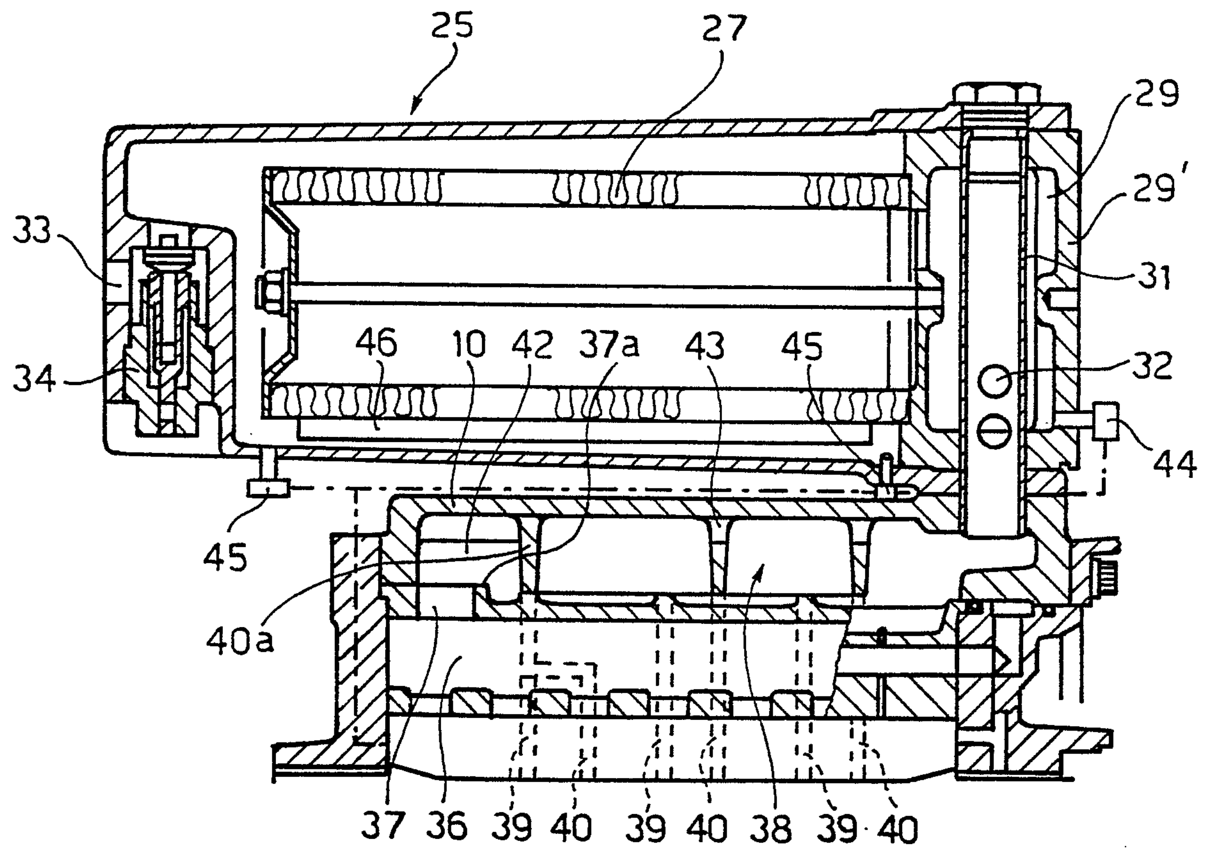
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Fig. 3

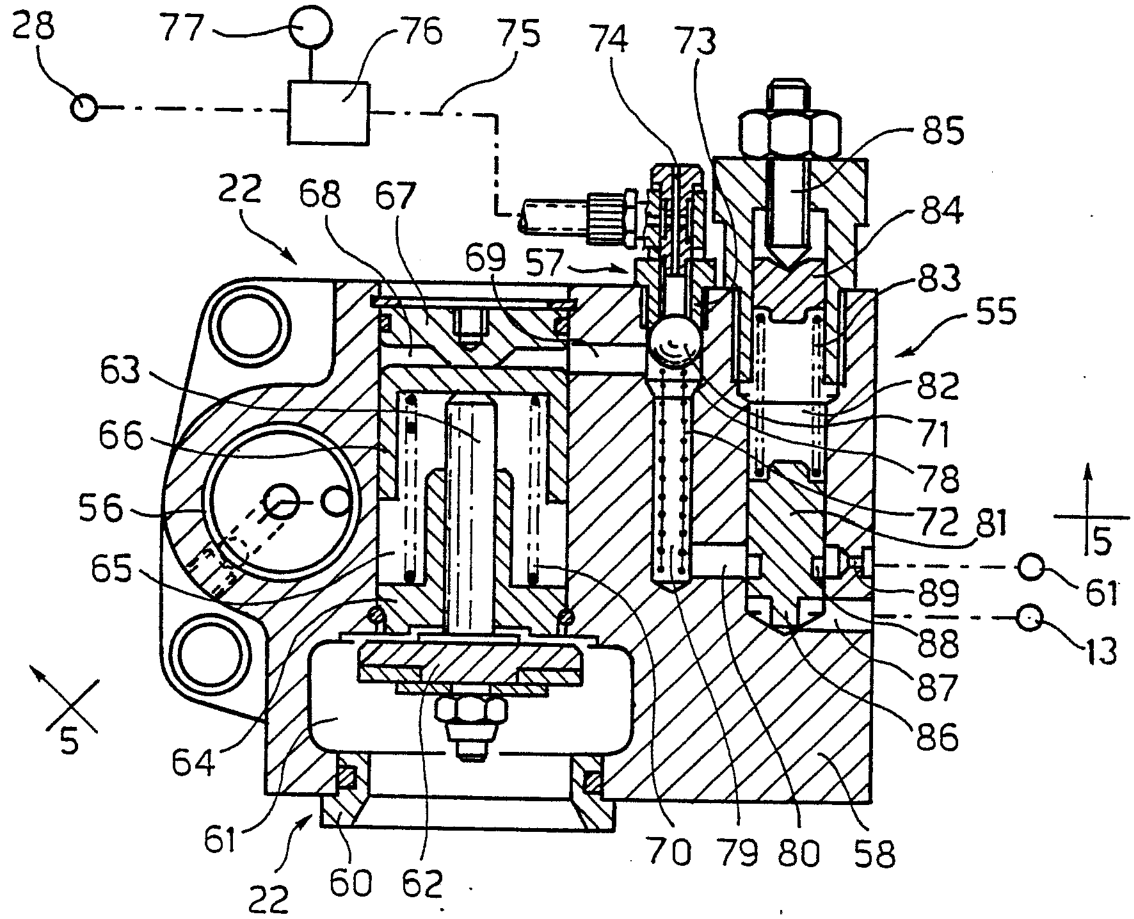
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Fig. 4

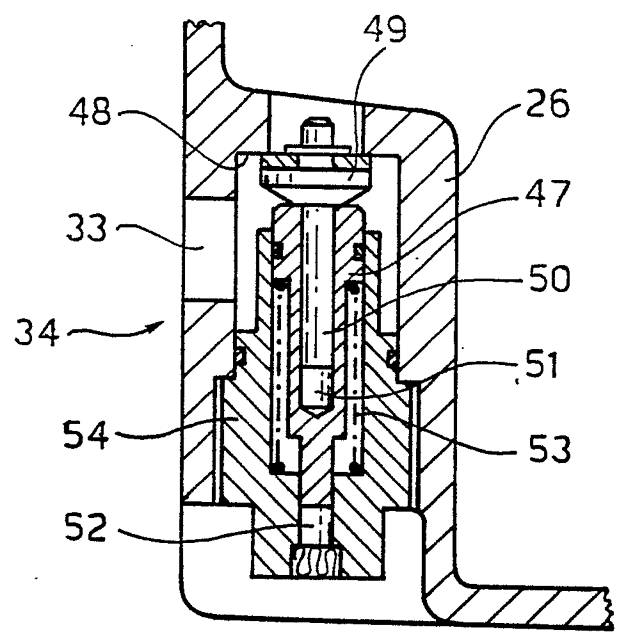
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Fig. 6

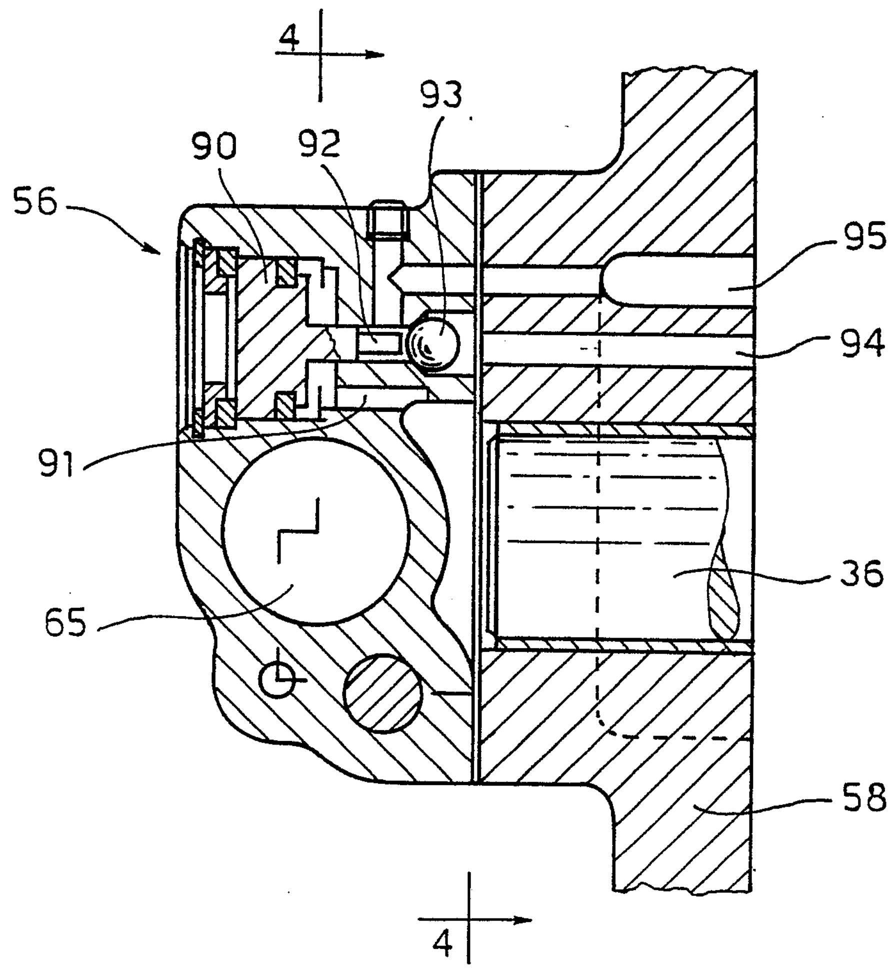

Fig. 5

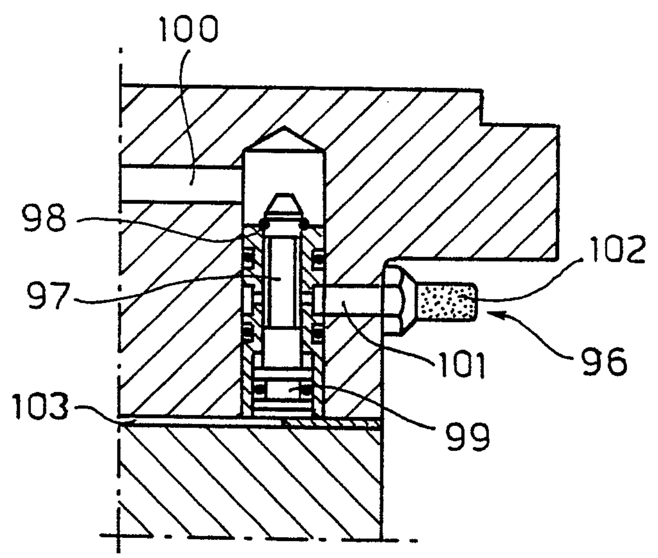

Fig. 7