

OUTLET VALVE FOR A ROLLING PISTON ROTARY COMPRESSOR

Generally this invention refers to an outlet valve for a rolling piston notary compressor and more specifically to a new construction for housing the outlet valve to be used in a compressor of this type, which is usually employed in small refrigerating equipments.

A rolling piston rotary compressor usually has direct suction and outlet towards the inside of the case, that is they operate with inner high pressure within the case (high-side compressors).

In this type of compressor, the high pressure gas contained inside the case becomes an excellent means to carry noise, thus allowing that pulses and turbulences from the discharge of compressed gas within the compressor assembly into the interior of the case are transmitted through the high pressure gas to the case walls, which vibrate and cause noise. From the abovementioned description, it will be seen that it is very important to avoid or reduce the generation of turbulence in the outlet flow of a "high-side" type compressor. A favourable place for turbulence formation is just the discharge hole outlet where the high speed discharge gas flow collides with the walls of the recess which houses the valve at the outer face of the respective end wall of the compressor assembly cylinder. The formation of turbulence is also due to the boundary layer separation at the valve seat outlet (as hereinafter described).

The turbulence caused at the area circumscribing the outlet valve seat mainly produces high frequency noises. Most of the known rotary compressors have the discharge valve housing recess machined generally at right angles on the outer face of the end cylinder wall, which is usually defined by one of the bearings of the compressor crankshaft, such as it is shown in Figures 1, 2 and 3. That shape of the prior art is very favourable to turbulence formation in the discharge flow right at the discharge port outlet.

The outlet valve in question is applied to a rotary compressor wherein the rolling piston is assembled within a cylinder defined by a cylinder block and two opposed end walls, one of which is provided with a gas discharge port, the outlet end of

which defines an annular valve seat placed in an oblong recess formed in said end wall a blade outlet valve being mounted in said recess. According to this invention, the area of said oblong recess circumscribing the valve seat has its bottom wall merging with the lateral circumscribing wall of the oblong recess and/or with peripheral wall of the valve seat through respective curved surfaces.

The area of joint between the recess bottom and the peripheral edge of the valve seat and/or the side wall of the recess circumscribing the valve seat being rounded off, the gas discharge flow becomes smoother, thereby avoiding turbulence formation right after the valve outlet and, therefore, high frequency noise formation.

Such gas flow smoothness can further be increased since the bottom wall of said recess circumscribing area will be given a concave shape merging at least with one of the parts defined by the side circumscribing wall of the oblong recess and by the valve seat peripheral edge.

In a particular embodiment of this invention, the circumscribing side wall of the oblong recess keeps a radial spacing to the peripheral edge of the valve seat not smaller than $\frac{3}{4}$ diameter of said peripheral edge of the valve seat, such spacing being enough to cause the gas flow from the discharge port to reach the circumscribing side wall of the oblong recess at a substantially reduced speed.

Said circumscribing side wall of the oblong recess can further have, in relation to the peripheral edge of the valve seat, a contour substantially increasing in elliptical shape from the points of said circumscribing side wall which are placed nearly on the extensions of the diameter of the valve seat transverse to the longitudinal axis of the valve blade towards the point of said side wall which is placed on the extension of the blade longitudinal axis. Such reduction in the bending of the circumscribing side wall at the area corresponding to the opening side of the valve blade, besides smoothing the gas flow, substantially reduces the loss of load in the gas flow being discharged into the cylinder.

This invention will hereinafter be described with reference to the annexed drawings, in which:

Figure 1 shows a partial longitudinal section view of a rolling piston rotary compressor of the type in which this invention is used,

Figure 2 shows a partial plan view of the end wall of the cylinder, in the direction of the arrow X of Figure 1, illustrating the oblong recess shape for housing the outlet valve of the prior art;

Figure 3 shows a cross section view which is magnified and taken along line III-III of Figure 2 and showing the valve blade and the opening backstop thereof;

Figure 4 shows a plan view similar to that of Figure 2, but showing the oblong recess contour which is made up according to this invention;

Figure 5 shows a magnified cross section view taken along line V-V of Figure 4 and further showing its relative position of the blade and backstop;

Figure 6 shows a longitudinal section view taken alone line VI-VI of Figure 4;

Figure 7 is a longitudinal section view similar to that of Figure 6, but showing the relative position of the blade and backstop;

Figures 8 and 9 show respectively a plan view and a longitudinal section view of a second configuration for the oblong recess for housing the outlet valve;

Figures 10 and 11 show, respectively, a plan view and a longitudinal section view of a third configuration for the oblong recess for housing the outlet valve, and

Figure 12 is a graph comparing the acoustic spectrum of compressor noise for the housing recess according to the prior art and according to this invention.

According to Figure 1, the compressor in question comprises a case 1 to which is attached a section coupling 2 and a discharge coupling 3 and housing a cylinder block 4 within which a rolling piston 5 is placed, the latter being assembled on a crankshaft 6 which is driven by an electrical motor made up of stator 7 and rotor

8. The crankshaft 6 is supported by a main bearing 10 and by a secondary bearing 20, each of which incorporates a plate or flange 10a and 21 which is attached to one of the end axial faces of the cylinder block 4, so as to define the cylinder walls within which the rolling piston 5 is moved.

In the shown example, a discharge damping chamber 13 is provided at the outer face of the secondary bearing 20 to receive compressed gas from within the cylinder, with the plate 21 of the secondary bearing 20 provided with an axial and eccentric discharge front 22 whose outlet end defines an annular valve seat 23 (Fig.2) within an oblong recess 24 which is formed in the outer axial face of the plate 21 on the secondary bearing 20 and sized to house a blade shaped valve 30, the opening position of which is defined by a backstop 31 (Fig.3) which is attached to the recess bottom 24 by a rivet 32.

It will be understood that the recess 24, the outlet valve 30 and the discharge port 22 need not be compulsorily associated to the secondary bearing 20, and they can be provided together with any member defining one of the end walls of the compressor assembly cylinder. Figure 3 shows an oblong recess 24 formed according to the present art, that is having the area of the bottom wall 25 which circumscribes the valve seat 23 forming sharp corners and substantially orthogonal to the side adjacent wall of the recess 24 and to the peripheral wall of the valve seat.

In Figure 4, 5, 6 and 7 a first configuration of this invention is shown wherein the area of the bottom wall 25 which circumscribes the valve seat 23 merges with the side circumscribing wall of the recess 24 through a curved surface 24a in a concave contour shape.

According to this first configuration the elimination of the sharp corners between the bottom wall 25 and the side circumscribing wall of the recess 24 allows the gas discharge flow condition to be substantially modified. The condition of the gas discharge flow is further improved by a curved surface 25a at the joint areas between the bottom wall 25 and the peripheral wall of the valve seat 23.

In the configuration illustrated in Figures 8 and 9 a further

alteration is introduced in addition to that provided for in the configuration of Figures 4, 5, 6 and 7.

This alteration is concerned with the radial spacing between the peripheral edge of the valve seat 23 and the circumscribing side wall of the recess 24. In the configurations of Figures 4, 5, 6, 7, 10 and 11 said radial spacing is approximately constant and not smaller than $3/4$ diameter of the peripheral edge of the valve seat 23.

In the configuration of Figures 8 and 9, said radial spacing increases from the sides of the valve seat towards the area of the side wall of the recess 24 which lies along the longitudinal axis of the valve blade 30. In a more specific way, the radial, spacing increases from the points of the side wall of the recess which are located on opposite sides of the valve seat in relation to the longitudinal axis of the blade 30, towards the point of the side wall which is beyond the end of the blade. With such a constructive arrangement, that side of the valve wall has a configuration much more adequate to the gas flow, therefore avoiding turbulence formation as well as minimizing load losses.

Said variable spacing characteristic can be used together with one or both fillets 24a and 25a and also with the characteristic illustrated in Figures 10 and 11, wherein the bottom wall 25c has a basically concave shape.

The graph illustrated in Figure 12 shows a substantial reduction in the noise level to be expected, especially at high frequencies, for the new constructive solution in relation to that for the prior art.



CLAIMS:

1. A rolling piston rotary compressor, comprising a rolling piston being assembled within a cylinder which is defined by a cylinder block and two opposed end walls, one of which is provided with a gas discharge port, the outlet end of which defines an annular valve seat provided in an oblong recess formed in said end wall, the compressor further comprising a blade outlet valve mounted in said recess, characterized in that the area of said oblong recess (24) circumscribing the valve seat (23) has its bottom wall (25, 25c) merging with the circumscribing side wall of the oblong recess (24) and/or with the peripheral wall of the valve seat (23) through respective curved surfaces (24a, 25a), and in that the side wall of the oblong recess (24) circumscribing the valve seat (23) keeps a radial spacing to the peripheral edge of the valve seat (23) not less than $3/4$ the diameter of said peripheral edge of the valve seat (23).
 2. A rolling piston rotary compressor, according to claim 1, characterized in that the bottom wall (25c) of the oblong recess (24) circumscribing the valve seat (23) is in concave shape.
 3. A rolling piston rotary compressor according to claim 1 or claim 2, characterized in that said radial spacing increases from the opposed side areas of the valve seat (23) towards the side wall area of the oblong recess (24) provided on the blade longitudinal axis (30).
 4. A rolling piston rotary compressor according to claim 3, characterized in that said radial spacing increases along a substantially elliptical contour.
 5. A rolling piston rotary compressor according to any of claims 1 to 4, the rolling piston being assembled on a crankshaft which is supported by main and secondary bearings, characterized in that the oblong recess (24) is provided on the side axial face of one of said bearings.
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