

DESCRIPTION

CENTRIFUGAL COMPRESSOR

Technical Field

[0001]

The present invention relates to centrifugal compressors, and in particular, to a centrifugal compressor that compresses low-temperature gas (for example, ethylene gas at -60°C or lower).

Background Art

[0002]

An example of a known centrifugal compressor is disclosed in Patent Document 1.

Patent Document 1: Japanese Unexamined Patent Application, Publication No. 2001-3893.

Disclosure of Invention

[0003]

When low-temperature gas (for example, ethylene gas at -60°C or lower) is compressed using the centrifugal compressor disclosed in the above-mentioned Patent Document 1, thermal contraction may occur at a casing (housing), particularly at one end of the casing (at an end having an intake port), and the clearance between the rotating shaft and the radial

bearing may be decreased (the clearance cannot be kept at an appropriate value (a predetermined value)) due to the thermal contraction, thus causing seizing up of radial bearing at the location (portion) in question.

[0004]

The present invention is made in consideration of the above-described circumstances, and it is an object of thereof to provide a centrifugal compressor in which, when low-temperature gas (for example, ethylene gas at -60°C or lower) is compressed, thermal contraction of a housing, in particular, thermal contraction at one end of the housing (an end having an intake port) can be absorbed, so that a decrease in the clearance between the rotating shaft and the bearing can be prevented (the clearance can be maintained at an appropriate value (a predetermined value)), thereby preventing seizing up of radial bearing at the location (portion) in question.

[0005]

The present invention adopts the following solutions to solve the above-described problems.

A centrifugal compressor that supports a rotating shaft having a multi-stage impeller through bearings and that is provided with a casing having an intake port, at one end of the rotating shaft in the longitudinal direction, for taking in working fluid; wherein at least one groove extending along

the length of the rotating shaft is provided in an area positioned at one end of the housing and at the outside in the radial direction of the bearings.

[0006]

With this centrifugal compressor, when low-temperature working fluid (for example, ethylene gas at -60°C or lower) is compressed, the thermal contraction of the casing, in particular, the thermal contraction at one end (an end having the intake port) of the casing, is absorbed by the groove. That is, the thermal contraction of the casing due to the intake of low-temperature working fluid is absorbed by the groove.

This can prevent a decrease in the clearance between the rotating shaft and the bearing (can maintain the clearance at an appropriate value (a predetermined value)), thereby preventing seizing up of radial bearing at the location (portion) in question.

[0007]

It is preferable that the above-described centrifugal compressor be configured such that the bottom of the groove is formed in a rounded shape.

The bottom of the groove is subjected to a concentrated stress due to the thermal contraction of the casing. However, since the bottom of the groove is formed in a rounded shape (an R shape), the stress concentrated on the bottom of the

groove can be uniformly dispersed in different directions, thereby preventing the occurrence of cracks.

[0008]

The present invention offers the advantage that, when low-temperature gas (for example, ethylene gas at -60°C or lower) is compressed, the thermal contraction of the housing, in particular, the thermal contraction at one end (an end having the intake port) of the housing, is absorbed so that a decrease in the clearance between the rotating shaft and the bearing can be prevented (the clearance can be maintained at an appropriate value (a predetermined value)), thereby preventing seizing up of radial bearing at the location (portion) in question.

Brief Description of Drawings

[0009]

[FIG. 1] Fig. 1 is a sectional view showing an embodiment of a centrifugal compressor according to the present invention, showing the overall configuration of the centrifugal compressor.

[FIG. 2] Fig. 2 is a sectional view taken from arrow II-II in Fig. 1.

[FIG. 3] Fig. 3 is a front view as viewed along arrow A in Fig. 1.

[FIG. 4] Fig. 4 is a cross-sectional view taken from

arrow IV-IV in Fig. 2.

[FIG. 5] Fig. 5 is an enlarged perspective view of a relevant part of the centrifugal compressor shown in Fig. 1.

[FIG. 6] Fig. 6 is a diagram showing an embodiment of the centrifugal compressor according to the present invention, showing an enlarged perspective view of a relevant part of the centrifugal compressor.

Best Mode for Carrying Out the Invention

[0010]

An embodiment of a centrifugal compressor according to the present invention will be described with reference to Figs. 1 to 5.

Fig. 1 is a sectional view showing the overall configuration of the centrifugal compressor according to this embodiment; Fig. 2 is a sectional view taken from arrow II-II in Fig. 1; Fig. 3 is a front view as viewed along arrow A in Fig. 1; Fig. 4 is a cross-sectional view taken from arrow IV-IV in Fig. 2; and Fig. 5 is an enlarged perspective view of a relevant part of the centrifugal compressor according to this embodiment.

[0011]

As shown in Fig. 1, a centrifugal compressor 10 is provided with a multi-stage impeller 12 (in this embodiment, three stages) fixed to a shaft (rotating shaft) 11; a casing

(housing) 14 that forms a diffuser 13 around the periphery of the impeller 12; and journal bearings (bearings) 15 that forms a shaft seal between the casing 14 and the shaft 11.

The centrifugal compressor 10 according to this embodiment is configured such that the shaft 11 is of a horizontal shaft type which is disposed horizontally, and the casing 14 is of a horizontally divided type which is divided horizontally.

[0012]

The centrifugal compressor 10 compresses gas (working fluid: for example, low temperature (-60°C or lower) ethylene gas) g drawn through an intake port 16 and then discharges it. That is, the gas g that is drawn through the intake port 16 is given a centrifugal force due to the rotation of the impeller 12 to increase in speed and pressure and is fed to the diffuser 13, where it is compressed in accordance with changes in the channel area of the diffuser 13. The gas g is further compressed while passing through each stage of the impeller 12 and is discharged through an outlet port 17.

[0013]

The impeller 12 is a disc to which a large number of blades is attached, forming an impeller channel 18 between the blades. The gas g that has entered the impeller channel 18 from the center is blown by the rotation of the impeller 12 to increase in speed and pressure and exits from the

circumferential side into the diffuser 13.

[0014]

The diffuser 13 is an apparatus that reduces the speed of the gas g that passes through the channel thereof to increase the pressure thereof by changing the cross-sectional area of the channel and forms a channel to feed the gas g flowing out of the impeller channel 18 into the inlet of the downstream impeller channel 18. As shown in Figs. 1 and 2, since the impeller 12 is provided continuously along the axis, the diffuser 13 is formed so as to extend radially outward from an outlet 19 of the impeller channel 18, bend at the outermost periphery, then return radially inward, and communicate with an inlet 20 of the impeller channel 18.

[0015]

The shaft 11 that rotationally supports the impeller 12 is mounted to the casing 14, with both ends supported by gas seals 21. One end (the left end in Figs. 1 and 2) of the shaft 11 is also supported by a thrust bearing 22.

On the other hand, as shown in Fig. 1, the casing 14 is provided with an upper housing 14a and a lower housing 14b.

[0016]

As shown in Figs. 2 to 5, the lower housing 14b of the centrifugal compressor 10 according to this embodiment has slits (grooves) 23. The slits 23 are provided at the outside in the radial direction of the journal bearing (bearing) 15

located at one end of the shaft 11 and one in each of the right and left parts of the lower housing 14b, that is, two in total.

[0017]

Assuming that the shaft diameter of the shaft 11 is 140 mm and the outside diameter of a housing 26 is 300 mm, each slit 23 is formed to have a length (the length along the axis of the shaft 11) $L1 = 140$ mm, a width (the horizontal length) $L2 = 40$ mm, and a depth (the vertical length) $L3 = 170$ mm.

[0018]

Reference numeral 24 in Figs. 1, 2, and 5 denotes a lubricant discharge channel, and reference numeral 25 in Figs. 1 and 2 denotes a thrust collar. When the depth $L3 = 170$ mm, the angle formed by the line connecting the end (the lower end) of the slit 23 in the vertical direction and the central axis (rotation axis) C of the shaft 11 and the upper surface of the lower housing 14b is about 25° . The end (bottom) of the slit 23 in the vertical direction is formed in an R shape.

[0019]

The centrifugal compressor 10 according to this embodiment is configured such that, for example, when low-temperature gas (for example, ethylene gas at -60°C or lower) is compressed, the thermal contraction of the lower housing 14b, in particular, the thermal contraction at one end (an end having the intake port 16) of the lower housing 14b, is

absorbed by the slits 23. That is, the thermal contraction of the lower housing 14b due to the intake of low-temperature gas is absorbed by the slits 23.

This can prevent a decrease in the clearance between the shaft 11 and the journal bearing (bearing) 15 (can maintain the clearance at an appropriate value (a predetermined value)), thereby preventing seizing up of radial bearing at the location (portion) in question.

[0020]

The ends of the slits 23 in the vertical direction are subjected to a concentrated stress due to the thermal contraction of the lower housing 14b. However, since the ends of the slits 23 in the vertical direction are formed in an R shape, the stress concentrated at the ends of the slits 23 in the vertical direction can be dispersed uniformly in different directions, thereby preventing the occurrence of cracks. In the event that (if) cracks occur at the ends of the slits 23 in the vertical direction, the cracks extend vertically downward, thus causing no interference with (having no influence on) the operation of the centrifugal compressor 10.

[0021]

Furthermore, as shown in Fig. 5, the lubricant discharge channel 24 is formed to communicate only with the upper part of one end of the slit 23. That is, the lubricant discharge channel 24 is formed so that the locus of the bottom face of

the lubricant discharge channel 24 draw a semicircle from one end to the other end thereof.

This can minimize machining of the lower housing 14b for forming the lubricant discharge channel 24 and can ensure sufficient rigidity of the lower housing 14b.

[0022]

The present invention is not limited to that of the above-described embodiment and may be in the form shown in Fig. 6. In this embodiment, a lubricant discharge channel 24a is formed so as to communicate with the whole of one end of the slit 23. That is, the lubricant discharge channel 24a is formed such that the locus of the bottom face thereof extends by a predetermined distance from both ends in a direction approaching each other along the horizontal direction and then draws an arc downward.

Thus, when low-temperature gas (for example, ethylene gas at -60°C or lower) g is compressed, the thermal contraction of the lower housing 14b, in particular, the thermal contraction at one end (an end having the intake port 16) of the lower housing 14b, can be absorbed more than in the above-described embodiment. That is, the thermal contraction of the lower housing 14b due to the intake of low-temperature gas is absorbed more than in the above-described embodiment.

This can further prevent a decrease in the clearance between the shaft 11 and the journal bearing (bearing) 15 (can

maintain the clearance at an appropriate value (a predetermined value)), thereby more reliably preventing burn-in at the location (portion) in question.

It is needless to say that the form shown in Fig. 6 can ensure sufficient rigidity of the lower housing 14b.

CLAIMS

1. A centrifugal compressor that supports a rotating shaft having a multi-stage impeller through bearings and is provided with a housing having an intake port, at one end of the rotating shaft in the longitudinal direction, for taking in working fluid;

wherein at least one groove extending in a vertical direction and along the length of the rotating shaft is provided in an area positioned at one end of the housing, at the outside in the radial direction of the bearings, and in an area spaced from the bearings.

2. The centrifugal compressor according to Claim 1, wherein the bottom of the groove is formed in a rounded shape.