

VALVE MOUNTING ARRANGEMENT FOR A REFRIGERATION COMPRESSOR

Field of the Invention

The present invention refers to an arrangement for
5 mounting a valve, which is not of the single piece
type, in a refrigeration compressor, such as that used
in small refrigeration systems.

Background of the Invention

The energetic efficiency of the refrigeration
10 compressors is mostly attributed to the good
performance of their valves in the control of the gas
flow.

In the reciprocating refrigeration compressors, the
compression of the refrigerant gas is achieved by
15 movement of the piston, which is driven by a driving
means, such as a mechanism of the connecting rod -
crankshaft type, or by a linear motor. The piston
reciprocates inside the compression chamber and, at
the moment it begins to return from the upper dead
20 point to the lower dead point, in its suction stroke,
it draws the refrigerant gas from the suction line of
the refrigeration system to which the compressor is
coupled (that is, coming from the evaporator of the
refrigeration system). Subsequently, when said piston
25 returns from the lower dead point, in its compression
stroke, it compresses the refrigerant gas which, under
high pressure (of condensation), flows through the
discharge system and returns to the refrigeration
system to which the compressor is coupled.

30 Reciprocating refrigeration compressors use one way
valves to control the gas flow during operation
thereof. The valve systems contained in the head are
responsible for regulating the flowrate and optimizing
the dynamics of the gas flow during the suction and
35 discharge of refrigerant gas in relation to the

compression cylinder. A suction valve controls the gas flow coming from the suction line connected to the low pressure side of the refrigeration system and which is drawn into the interior of the compression cylinder, while a discharge valve controls the already compressed gas flow to be directed to the high pressure side of the refrigeration system.

The suction valve is designed to be responsible not only for regulating the gas flow during the suction, but also in order that its opening and closing pendular movement be synchronized with the displacement of the piston. Actually, for a better performance in the compression cycle, it is desired to anticipate the opening of the suction valve (in relation to the arrival of the piston at the upper dead point), in order to increase the volumetric efficiency.

The suction and discharge valves generally comprise one or more passage orifices and vanes that are fixed by one of the ends thereof, so that, when a pressure differential is established through the valve, the vane moves, allowing the passage of gas in the required preferential direction.

There are countless embodiments of suction valve systems adopted in reciprocating compressors, regarding the project of the obturator, of the valve seat, of the gas passage orifice and also the way the valve is attached.

In the construction in which the suction valve is of the single-piece type, made of a laminar plate to be mounted to the valve plate, the suction valve is usually dimensioned to have its lateral movement restricted by head screws (figure 1), which attach the single-piece suction valve to both the valve plate and the head. This construction minimizes possible lateral

and transverse movements which may alter the positioning of the suction valve when mounted to the valve plate. In spite of this advantage, said construction presents a high cost due to the raw material that is consumed in the production of said suction valve. Furthermore, such construction requires additional machining operations of the faces of the blank valve plate.

In a known prior art arrangement for mounting a single-piece suction valve, the latter is substituted by a valve that is not constructed in a single-piece, or valve element, which is lodged in a recess produced in the valve plate (figure 2), the fixation of said valve element to the valve plate being achieved by mechanically interlocking said parts, generally by riveting or spot welding.

Nevertheless, although not presenting the constructive deficiencies of the single-piece suction valve, said solution has the disadvantage of requiring an additional process for mounting the valve plate assembly, which is required to guarantee the correct positioning of the valve element in the recess.

Objects of the Invention

Thus, it is an object of the present invention to provide a valve mounting arrangement for a refrigeration compressor, which allows providing and maintaining, in a simple and reliable manner, the positioning of a valve element on the valve plate.

Another object of the present invention is to provide an arrangement as cited above, which reduces the process steps of mounting the valve element on the valve plate.

An additional object is to provide an arrangement as cited above, which has a reduced cost.

Summary of the Invention

These and other objects are achieved through a valve mounting arrangement for a compressor of the type that presents a cylinder defining, in its interior, a compression chamber having an end closed by a valve plate provided with at least one suction orifice and at least one discharge orifice, each being selectively closed by a respective valve element having a mounting end portion attached to an adjacent face of the valve plate; a bending median portion; and a sealing end portion operatively associated with the respective orifice on the valve plate, said mounting arrangement comprising: a receiving recess provided on the valve plate to lodge the mounting end portion of the valve element; a first retaining means to be seated and secured against said adjacent face of the valve plate, so as to retain the mounting end portion of the valve element in the interior of the receiving recess; and at least one of the parts of: at least one orientation projection, carried by at least one of the parts of receiving recess of the valve plate and mounting end portion of the valve element and to be fitted into a respective orientation recess provided in the other of said parts; and a second retaining means provided between the receiving recess and the mounting end portion of the valve element, so as to avoid the latter from moving outwardly from the receiving recess of the valve plate, before mounting the first retaining means.

The objects of the present invention are further achieved with a valve mounting arrangement for a refrigeration compressor of the type described above and which comprises: a receiving recess provided on the valve plate to lodge the mounting end portion of the valve element, said receiving recess presenting a contour similar to and surrounding the contour of said

mounting end portion, so that the latter is tightly disposed in said receiving recess; a first retaining means to be seated and secured against said adjacent face of the valve plate, so as to retain the mounting end portion of the valve element in the interior of the receiving recess; and at least one of the parts of: at least one orientation projection carried by at least one of the parts of receiving recess of the valve plate and mounting end portion of the valve element and to be fitted into a respective orientation recess provided in the other of said parts; and a second retaining means provided between the receiving recess and the mounting end portion of the valve element, so as to avoid the latter from moving outwardly from the receiving recess of the valve plate, before mounting the first retaining means.

Brief Description of the Drawings

The invention will be described below with reference to the enclosed drawings, given by way of example of one embodiment of the invention and in which:

Figures 1 and 1a schematically and respectively represent a plan view of a valve plate, when observed from the side of the compression cylinder and illustrating a suction orifice and a single-piece suction valve, said valve plate and suction valve being constructed according to the prior art;

Figure 2 schematically represents a perspective view of a valve plate and valve element constructed according to another prior art embodiment;

Figures 3 and 3a schematically and respectively represent an exploded perspective view of a valve plate, when observed from the side of the compression cylinder and illustrating a suction orifice, a discharge orifice and a valve element, and a suction valve not of the single-piece type, said valve plate

and valve element being constructed according to the present invention;

Figure 4 schematically represents an enlarged sectional view of the region in which the valve plate is mounted between a top cylinder portion and a head, for the valve plate - valve element construction illustrated in figure 3, the mounting end portion of said valve element being seated on the valve plate; and

Figure 5 represents an enlarged view of the region in which the end portion is mounted in the receiving recess of the valve plate.

Detailed Description of the Invention

The present invention will be described in relation to a refrigeration compressor comprising, in the interior of a casing (not illustrated), a motor-compressor assembly including a cylinder 1 that lodges a piston 2 reciprocating within a compression chamber 3 defined in the interior of said cylinder 1 between a top portion of said piston 2 and a valve plate 4 seated onto an end portion of the cylinder 1, said prior art valve plate 4 being described below.

The compressor further carries an electric motor (not illustrated) that drives said piston 2 in suction and compression strokes of a refrigerant gas of a refrigeration system to which the compressor is coupled, said refrigerant gas being admitted in the interior of the compression chamber 3, from a suction line of the refrigeration system to which the compressor is coupled.

The prior art valve plate 4 illustrated in figures 1, 1a and 2 is provided with at least one suction orifice 5 and with at least one discharge orifice 6, each being selectively closed by a respective suction valve 7 and a discharge valve (not illustrated) carried by

the valve plate 4.

In the prior art construction illustrated in figures 1 and 1a, the suction valve 7 is of the type that comprises a flexible vane 7a, stamped in a support
5 blade 7b made of a material having adequate characteristics to the operation of the flexible vane 7a during the opening and closing of the suction orifice 5 and which is attached between a valve plate 4 and a cylinder cover 8, by appropriate means (not
10 illustrated). The support blade 7b is provided with holes 7c, which receive fixation means (not illustrated) for retaining said support blade 7b between the cylinder cover 8 and the valve plate 4. The cylinder cover 8 is attached to the valve plate 4,
15 so as to separate the high and low pressures sides and internally define at least one suction chamber (not illustrated) maintained in selective fluid communication with the compression chamber 3 through the suction orifice 5.

20 In the prior art construction illustrated in figure 2, the suction valve 7 is in form of a valve element welded to a recess 4a produced on the valve plate 4, with a contour similar and external to the contour of the suction valve 7 mounted in said recess 4a.

25 These prior art constructions present the deficiencies already mentioned above.

As mentioned above and illustrated in the enclosed drawings, the invention refers to a valve mounting arrangement for a refrigeration compressor of the
30 above-mentioned type and which comprises at least one valve element 10 having a mounting end portion 11 attached to an adjacent face of a valve plate 20 of the present invention and described below; a bending median portion 12; and a sealing end portion 13,
35 operatively associated with the respective orifice on

the valve plate 20 and which in the illustrated construction is a suction orifice 21, and the valve element 10 is a suction valve.

In the construction of the illustrated valve element
5 10, the bending median portion 12 comprises a median opening 14 aligned with a discharge orifice 22 defined on the valve plate 20 and imparts to the valve element 10, in both its bending median portion 12 and sealing end portion 13, a U-shape with the legs united by the
10 mounting end portion 11.

According to the invention, the valve element 10 presents a determined geometry defined in such a way as to result in a vane with an optimum ratio between stiffness and maximum bending stress, as described
15 ahead.

The valve element 10 of the present invention is defined in a sheet made of flexible material with a reduced thickness comprising an outer edge 15, defining the external contour of said valve element
20 10, for example, substantially U-shaped, and an inner edge 16 defining the contour of the median opening 14. According to the present invention, the valve plate 20 is provided with at least one suction orifice 21 and at least one discharge orifice 22, said valve plate 20
25 being further provided with a receiving recess 23 for lodging the mounting end portion 11 of the valve element 10, said receiving recess 23 presenting a contour similar to and surrounding the contour of said mounting end portion 11, so that the latter is tightly
30 disposed in said receiving recess 23, avoiding lateral movements of said mounting end portion 11 in the interior of the receiving recess 23. With this construction, the mounting end portion 11 is retained, by interference, in the interior of the receiving
35 recess 23, against lateral displacements in a seating

plane of said parts of mounting end portion 11 and receiving recess 23.

The valve plate 20 of the present invention is obtained, for example, by sintering. However, the
5 present invention also foresees the production by stamping or machining, the latter being the most expensive.

In a particular form of the present invention, as illustrated in the enclosed figures, the receiving
10 recess 23 presents a contour corresponding to that of the respective valve element 10 along the whole periphery thereof, said contour of the receiving recess 23 maintaining a minimum clearance from the adjacent contour of the valve element 10, in the parts
15 of bending median portion 12 and sealing end portion 13 of said valve element 10, so as not to interfere with the closing and opening operations of these portions of the valve element 10.

The valve mounting arrangement of the present
20 invention further comprises at least one orientation recess 30 provided in at least one of the parts of receiving recess 23 of the valve plate 20 and mounting end portion 11 of the valve element 10, and at least one orientation projection 40, carried by at least one
25 of the parts of receiving recess 23 of the valve plate 10 and mounting end portion 11 of the valve element 10, and to be fitted in the orientation recess 30 provided in the other part, in order to avoid relative displacements between the valve element 10 and the
30 valve plate 20 in the seating plane of said parts.

Within the concept presented herein, it is possible to make different constructions of orientation recess and orientation projection, such as, respectively, grooves or
35 through holes and saliences or pins projecting from

the part where they are provided. Other solutions are also possible, in which there is the provision of at least one projection and one recess in each of the parts of receiving recess 23 of the valve plate 20 and mounting end portion 11 of the valve element 10.

In the illustrated constructions, the valve element 10 comprises two orientation recesses 30 in the form of holes 17, for example through holes, which are symmetrically provided in the longitudinal axis of the valve element 10, each being fitted in a respective orientation projection 40 defined in the receiving recess 23 of the valve plate 20, in the form of a pin 24 incorporated in a single piece to the valve plate 20, projecting from the bottom face of the receiving recess 23.

Independent of the constructive form of each orientation projection 40, this must have a height calculated to be at maximum equal to that of the face of the valve plate 20, in which is defined the receiving recess 23 carrying said orientation projection 40, in order not to interfere with the mounting of the valve plate 10 between the cylinder and the cylinder cover 8.

In the present invention, the fixation of the parts being mounted is achieved by a first retaining means being seated and secured against the face of the valve plate 20 carrying the valve elements 10, in order to retain the mounting end portion 11 of said valve elements 10 in the interior of the receiving recess 23 and by the orientation projection 40 being fitted in the respective orientation recess 30.

In the case the valve element 10 defines a discharge valve, said first retaining means is defined by the cylinder cover 8, which is seated and secured onto the valve plate 20, attaching the latter to the cylinder

block through adequate means. In some constructions, this mounting arrangement further presents at least one sealing gasket 9 between the parts of cylinder cover 8 and valve plate 20 and between the latter and
5 the cylinder 1.

In the case the valve element 10 defines a suction valve, said first retaining means is defined by a top portion of the cylinder 1. In this case, it is also necessary to provide the present mounting arrangement
10 with a second retaining means provided between the receiving recess 23 and the mounting end portion 11 of the valve element 10, so as to avoid the latter from moving outwardly from the receiving recess 23 of the valve plate 10, before mounting the first retaining
15 means.

In a way of carrying out the present invention, the second retaining means 50 is a liquid presenting enough surface tension to maintain the mounting end portion 11 of the valve element 10 retained in the
20 respective receiving recess 21 of the valve plate 20 upon mounting the valve. Said liquid can be, for example, a viscous liquid, such as oil, and more particularly, a lubricant oil of the type used in refrigeration compressors.

25 In another constructive form of the present invention, the second retaining means 50 is an adhesive that maintains the mounting end portion 11 of the valve element 10 retained in the respective receiving recess 23.

30 According to the present invention, the second retaining means 50 is provided to operate for retaining the valve element 10 into the receiving recess 23 against orthogonal displacements that permit the valve element 10 to come out from the receiving
35 recess 23, at least temporarily, upon mounting said

parts to the cylinder 1.

In order to facilitate the correct mounting of the valve element 10 to the valve plate 20, said valve element 10 comprises an eccentric indexing means 18
5 provided in its mounting end portion 11, particularly adjacent to an edge of said mounting end portion 11.

The fixation of the valve in the housing is achieved through the joint action of at least two of the following three factors: the actuation of the
10 orientation projections 40 in the orientation recesses 30, positioning the valve element 10 on the valve plate 20 and restricting the lateral and longitudinal movements of said valve element 10 in relation to the receiving recess 23; the profile of the mounting end
15 portion 11 of the valve element 10 and the corresponding profile of the adjacent contour of the receiving recess 23, said profiles helping to restrict the lateral and longitudinal movements of said valve element 10; and the application of the second
20 retaining means 50, in the form of an oil or adhesive, which is dosed and applied to the region of the mounting end portion 11, for example, close to the orientation projections 40, adhering the valve element 10 inside the receiving recess 23 and hindering said
25 valve element 10 from moving away from said receiving recess 23.

According to the concept of the invention disclosed herein, the present mounting arrangement guarantees the fixation of the valve element 10 to the receiving
30 recess 23, at least until mounting the first retaining means, by action of at least two of the parts of: orientation projection 40 and respective orientation recess 30; second retaining means 50 and receiving recess 23, presenting a contour similar to and
35 surrounding the contour of the mounting end portion

11, so that to place the latter in said receiving recess 23.

In the construction in which the receiving recess 23 does not have a contour similar to and surrounding the contour of the mounting end portion 11, so that the latter is tightly disposed in said receiving recess 23, the fixation of the valve element 10 to the receiving recess 23 is guaranteed, at least until the first retaining means is mounted, by action of each orientation projection 40 and respective orientation recess 30, and also of the second retaining means 50.

In the condition in which the receiving recess 23 presents a contour similar to and surrounding the contour of the mounting end portion 11, so that the latter is tightly disposed in said receiving recess 23, the fixation of the valve element 10 to the receiving recess 23, at least until mounting the first retaining means, is guaranteed with the provision of one or both of the parts of orientation projection 40 and respective orientation recess 30, and also of the second retaining means 50.

The mounting arrangement of the present invention with a valve element 10 housed in a receiving recess 23 defined in the valve plate 20 results in a cost reduction as compared to the known prior art mounting arrangements, since it consumes less quantity of raw material for producing the valve element 10 and dispenses additional machining operations of the faces of the blank valve plate 20. Moreover, the mounting arrangement of the present invention simplifies the process of defining the receiving recess 23 in the valve plate 20, which is achieved during the sintering thereof, as well as the process for affixing the valve element 10 in the receiving recess 23, and eliminates the need of a fixation step, by welding the valve

element 10, when this is a suction valve, to the valve plate 10. The provision of an eccentric indexing means 18 in the valve element 10 allows the latter to be correctly mounted to the valve plate 20, considering
5 the lamination and pre-tension of the valve.

While only one possible embodiment for the mounting arrangement of the invention has been illustrated herein, it should be understood that this is exemplary, not intended to limit the inventive scope
10 defined in the claims accompanying the present specification.

CLAIMS

1. A valve mounting arrangement for a refrigeration compressor of the type that presents a cylinder (1) defining, in its interior, a compression chamber (3) having an end closed by a valve plate (4, 20) provided with at least one suction orifice (5, 21) and at least one discharge orifice (6, 22), each being selectively closed by a respective valve element (10) having a mounting end portion (11) attached to an adjacent face of the valve plate (4, 20); a bending median portion (12); and a sealing end portion (14) operatively associated with the respective orifice on the valve plate (4, 20), characterized in that it comprises: a receiving recess (23) provided on the valve plate (20) to house the mounting end portion (11) of the valve element (10); a first retaining means (8, 9) to be seated and secured against said adjacent face of the valve plate (20), in order to retain the mounting end portion (11) of the valve element in the interior of the receiving recess (23); and at least one of the parts of: at least one orientation projection (40) carried by at least one of the parts of receiving recess (23) of the valve plate (20) and mounting end portion (11) of the valve element (10) and to be fitted into a respective orientation recess (30) provided in the other of said parts; and a second retaining means (50) provided between the receiving recess (23) and the mounting end portion (11) of the valve element (10), so as to avoid the latter from moving outwardly from the receiving recess (23) before mounting the first retaining means.

2. A valve mounting arrangement for a refrigeration compressor of the type that presents a cylinder (1) defining, in its interior, a compression chamber (3) having an end closed by a valve plate (4, 20) provided

with a suction orifice (5, 21) and a discharge orifice (6, 22), each being selectively closed by a respective valve element (10) having a mounting end portion (11) attached to an adjacent face of the valve plate (4, 20); a bending median portion (12); and a sealing end portion (14) operatively associated with the respective orifice on the valve plate (4, 20), characterized in that it comprises: a receiving recess (23) provided on the valve plate (20) to house the mounting end portion (11) of the valve element (10), said receiving recess (23) presenting a contour similar to and surrounding the contour of said mounting end portion (11), so that the latter is tightly disposed in said receiving recess (23); a first retaining means (8, 9) to be seated and secured against said adjacent face of the valve plate (20), so as to retain the mounting end portion (11) of the valve element (10) inside thereceiving recess (23); and at least one of the parts of: at least one orientation projection (40) carried by at least one of the parts of receiving recess (23) of the valve plate (20) and mounting end portion (11) of the valve element (10) and to be fitted in a respective orientation recess (30) provided in the other of said parts; and a second retaining means (50) provided between the receiving recess (23) and the mounting end portion (11) of the valve element (10), so as to avoid the latter from moving outwardly from the receiving recess (23) of the valve plate (20), before mounting the first retaining means.

3. The arrangement, as set forth in claim 1, characterized in that the receiving recess (23) presents a contour similar to and surrounding the contour of said mounting end portion (11), so that the latter is tightly disposed in said receiving recess

(23).

4. The arrangement, as set forth in any one of the claims 2 or 3, characterized in that the mounting end portion (11) is retained against lateral displacements
5 in said seating plane, by interference, in the receiving recess (23) of the valve plate (20).

5. The arrangement, as set forth in any one of the claims 1 or 2, characterized in that the receiving recess (23) presents a contour coinciding with that of
10 the respective valve element (10), said contour maintaining a minimum clearance from the adjacent contour of the valve element (10) of the parts of bending median portion (12) and sealing end portion (13).

15 6. The arrangement, as set forth in any one of the claims 1 or 2, characterized in that the orientation projection (30) is defined by at least one pin (24) projecting from the receiving recess (23) and fitted into a respective orientation recess (40) provided in
20 the mounting end portion (11) of the valve element (10).

7. The arrangement, as set forth in claim 6, characterized in that the valve element (10) is provided with at least one through hole (17) to
25 receive an orientation projection (30) provided in the receiving recess (23) of the valve plate (20).

8. The arrangement, as set forth in any one of the claims 1 or 2, characterized in that the second retaining means (50) is a liquid presenting a surface
30 tension sufficient to maintain the mounting end portion (11) of the valve element (10) retained in the respective receiving recess (23) of the valve plate (20), upon mounting the valve.

9. The arrangement, as set forth in claim 8,
35 characterized in that the second retaining means (50)

is a viscous liquid.

10. The arrangement, as set forth in claim 9, characterized in that the viscous liquid is an oil.

11. The arrangement, as set forth in claim 10,
5 characterized in that the oil is a lubricant oil.

12. The arrangement, as set forth in any one of the claims 1 or 2, characterized in that the second retaining means (50) is an adhesive that maintains the mounting end portion (11) of the valve element (10)
10 retained in the respective receiving recess (23) of the valve plate (20), upon mounting the valve.

13. The arrangement, as set forth in any one of the claims 1 or 2, characterized in that the valve element (10) comprises an eccentric indexing means (18)
15 provided in its mounting end portion (11).

14. The arrangement, as set forth in any one of the claims 1 or 2, characterized in that the eccentric indexing means (18) is provided adjacent to an edge of the mounting end portion (11).

20 15. The arrangement, as set forth in any one of the claims 1 or 2, characterized in that the valve element (10) is a suction valve, the first retaining means (8, 9) comprising a top portion of the cylinder (1) and a cylinder cover (8) seated against the valve plate
25 (10).