

"DISCHARGE VALVE ARRANGEMENT FOR A HERMETIC COMPRESSOR"

Field of the Invention

The present invention refers to a discharge valve arrangement for a hermetic compressor to be used in
5 refrigeration systems, for example, in household refrigeration systems, such as refrigerators, freezers, water fountains, etc., or even in electronic equipment using compact compressors with reduced dimensions.

The present invention is particularly applied to a
10 hermetic compressor comprising a cylinder block defining a compression cylinder with an end closed by a valve plate provided with suction and discharge orifices contained within the inner contour of the axial projection of the compression cylinder. At least one
15 suction orifice occupies an annular sector and is closed by a suction valve comprising a flexible suction vane that presents a mounting end portion, to be affixed to the valve plate, a bending median portion and a sealing end portion that is operatively associated with the
20 suction orifice.

Background of the Invention

The energetic efficiency of the small hermetic refrigeration compressors is mostly attributed to the good performance of the suction and discharge systems
25 (which include suction and discharge orifices, respective suction and discharge valves, and the attenuating filter) of said compressors, particularly to the performance of the valves of said system in controlling the gas flow. Part of the energy losses in
30 these compressors is caused by the load loss in the suction and discharge system thereof. Thus, solutions intended to reduce such losses actuate directly in the increase of the compressor efficiency.

The usually carried out optimizations consist in
35 reducing the losses by increasing the gas passage areas, as well as reducing the rigidity of the valves. One of

the main restrictions imposed to the gas is found in the suction and discharge orifices.

A known solution usually applied to commercial refrigeration and air conditioning uses more than one
5 orifice for gas admission or exhaustion. By using multiple orifices, the gas passage area can be increased without the collateral effects regarding increase of rigidity and eventual instabilities in the valve system. Within this concept, it is also possible to improve the
10 multiple orifices so that they can actuate in applications with a more efficient modulation of the refrigeration capacity than that obtained with only one orifice. Generally, the known compressor applications that use multiple discharge orifices are those directed
15 to the field of commercial refrigeration with high mass flow, such as the automotive or air conditioning industries, which usually employ large diameter pistons. In residential applications, the constructions with multiple orifices are rarely employed, mainly due to the
20 considerable increase of dead volume, which is more harmful to the capacity and efficiency in these applications. Moreover, in the residential applications, the piston diameters are smaller and therefore less space is for positioning the valve system.

25 In order to facilitate the productive process, the suction and discharge orifices usually present a circular cross section and are constructed in a valve plate generally made of steel.

In most cases and mainly when the hermetic compressor
30 has a small size, the geometrical shape of the suction valve and of the suction and discharge orifices, as well as the need of separating the already compressed gas from the gas that is at suction pressure (such requirement being mainly fulfilled by the cylinder
35 cover), forces the discharge orifice to be positioned eccentrically in relation to the axis of the center of the compression cylinder, being very close to the wall

of said cylinder, so that the suction orifice may be also contained within the axial projection of the inner contour of the compression cylinder, maintaining a certain minimum spacing in relation to the discharge
5 orifice.

The co-pending solutions disclosed in documents US2004/0228742 (EP1301711) and US2006/0096647 of the same applicant overcome the deficiencies regarding the positioning of a discharge orifice concentric to the
10 axis of the center of the compression cylinder. Such solutions, however, still present the inconveniences of low performance caused by load loss in the discharge system, mainly in applications with low condensation pressures, in applications for refrigeration with low
15 mass flow, and in certain solutions that use refrigerant fluid R600a.

Summary of the Invention

Thus, it is an object of the present invention to provide a discharge valve arrangement for a hermetic
20 compressor to be used in refrigeration systems designed to operate, for example, in residential applications, particularly with low mass flow, and which allows minimizing the load loss, improving the performance of the compressor, independently of the type of refrigerant
25 fluid used.

It is another object of the present invention to provide an arrangement, as cited above and which can be applied particularly to the constructions in which the piston presents a diameter of reduced dimensions, providing a
30 positioning of the discharge system that minimizes the pressure differentials existing in the known prior art constructions, reducing energy dissipation and load loss during compression, without impairing the effective gas flow area in the suction orifice, neither the minimum
35 spacing of the suction orifice in relation to the discharge orifice.

It is a particular object to present an arrangement,

such as cited above regarding the constructions of a suction system of the type described in documents US2004/0228742 (EP1301711) and US2006/0096647, in which the suction orifice is provided internal to an axial
5 projection of the inner contour of the compression cylinder and external to the contour of the discharge orifice, in order to maintain a certain minimum spacing from the latter.

These and other objects are attained through a discharge
10 valve arrangement for a hermetic compressor to be used in refrigeration systems and comprising: a cylinder block defining a compression cylinder; a valve plate closing an end of the compression cylinder and provided with suction and discharge orifices contained within the
15 inner contour of the axial projection of the compression cylinder, at least one suction orifice occupying an annular sector—external to the axial projection, and a discharge orifice closed by a discharge valve comprising a flexible discharge vane, said suction orifice being
20 closed by a suction valve comprising a flexible suction vane presenting: a mounting end portion to be affixed to the valve plate; a bending median portion; and a sealing end portion operatively associated with the suction orifice. According to the present invention, the valve
25 plate is provided with a plurality of discharge orifices that are distributed in at least one of the regions defined externally and internally to the contour of the flexible suction vane, each discharge orifice provided internally to the contour of the flexible suction vane
30 being axially aligned with a respective through opening provided in the bending median portion of the flexible suction vane.

According to a particular form of the present invention, the bending median portion of the flexible suction vane
35 is provided with a through opening. There is provided a central discharge orifice aligned with the axis of the compression cylinder and having its axial projection

internal to said through opening, and at least another discharge orifice having its axial projection disposed in the interior of the axial projection of the compression cylinder, in order to present the same flow restriction condition applied to the central orifice during the discharge operation of the compressor. In a variant of this constructive aspect of the present invention, the bending median portion of the flexible suction vane can be provided with a single discharge orifice having its axial projection contained in the interior of said through opening.

According to another aspect of the present invention, the bending median portion of the flexible suction vane is provided with a through opening, any discharge orifice, whose axial projection is internal to the contour of the flexible suction vane, having its axial projection contained in the interior of said through opening.

According to a further aspect of the present invention, the flexible suction vane comprises a plurality of through openings, each containing, therewithin, the axial projection of a respective discharge orifice. In a variant of this constructive aspect, the present solution further presents at least another discharge orifice external to the contour of the suction vane.

According to still another aspect of the present invention, there are provided a plurality of flexible discharge vane portions, each presenting a respective sealing end selectively closing at least one discharge orifice, and a respective mounting end to be affixed to the valve plate, the mounting ends of the flexible discharge vanes being defined in a single common piece, from which project the sealing ends of said flexible discharge vanes.

Still according to another aspect of the present invention, the flexible suction vane comprises a plurality of through openings, each containing,

therewithin, the axial projection of a respective discharge orifice provided in the valve plate.

For residential applications with low condensation temperature and operating with refrigerant fluid R600a, the invention described herein and provided with multiple discharge orifices present benefits, since the reduction of the load losses in the discharge system compensates for the harmful effect of the dead volume. Moreover, the compressors working with a refrigerant fluid R600a use pistons with larger diameters than those operating with a refrigerant fluid R134a, generating an adequate space for housing the multiple orifices.

Brief Description of the Drawings

The invention will be described below, with reference to the enclosed drawings, in which:

Figure 1 represents, schematically, a plan view of a valve plate when observed from the side of the compression cylinder, illustrating a flexible suction vane and the suction and discharge orifices constructed according to the prior art;

Figure 2 represents, schematically and as illustrated in figure 1, a plan view of a valve plate presenting an arrangement of suction and discharge orifices of the present invention, in which the axial projection of one of the discharge orifices is disposed internally to a through opening provided in the flexible suction vane and the axial projection of another discharge orifice is disposed externally to the contour of the flexible suction vane;

Figure 3 represents, schematically and as illustrated in figure 2, a plan view of a valve plate presenting an arrangement of suction and discharge orifices of the present invention, in which the axial projection of one of the discharge orifices is disposed internally to a through opening provided in the flexible suction vane and the axial projection of other two discharge orifices is disposed externally to the contour of the flexible

suction vane, symmetrically to the orifice whose projection is internal to the through opening, said discharge orifices presenting the same cross section;

Figure 4 represents, schematically and as illustrated in
5 figure 3, a plan view of a valve plate presenting an arrangement of suction and discharge orifices of the present invention, in which the discharge orifices have a distinct cross section;

Figure 5 represents, schematically, a second arrangement
10 of suction and discharge orifices of the present invention, in which the axial projection of each discharge orifice is disposed internally to a respective through opening provided in the flexible suction vane;

Figure 6 represents, schematically, a third arrangement
15 of suction and discharge orifices of the present invention, in which the axial projection of each discharge orifice is disposed externally to the contour of the flexible suction vane;

Figure 7 represents, schematically, a constructive
20 variant for the third arrangement of suction and discharge orifices illustrated in figure 6 and in which the axial projection of each discharge orifice is disposed externally to the contour of the flexible suction vane, said discharge orifices presenting the
25 same cross section;

Figure 8 represents, schematically, another constructive variant for the third arrangement of suction and discharge orifices illustrated in figure 6, in which the discharge orifices present distinct cross sections;

Figure 9 represents, schematically, a perspective view
30 of a valve plate, when observed from the opposite side of the compression cylinder and illustrating a constructive form of discharge valve carrying flexible discharge vanes, each associated with a respective
35 discharge orifice; and

Figure 10 represents, schematically, a perspective view of the valve plate illustrated in figure 9, when

observed from the opposite side of the compression cylinder and deprived of the valve system.

Description of the Illustrated Embodiments

The present invention will be described for a hermetic
5 compressor of refrigeration systems, to be applied, for
example, in household refrigeration systems and
comprising, in the interior of a non-illustrated casing,
a motor-compressor assembly (not illustrated) including
a cylinder block defining a compression cylinder 1
10 inside which is housed a reciprocating piston 2, which
draws and compresses the refrigerant gas when driven by
an electric motor of the motor-compressor assembly. In
these constructions, the compression cylinder 1 and the
reciprocating piston 2 have a reduced diameter, which
15 restricts the space to provide and arrange the suction
and discharge valves.

The compression cylinder 1 has an end closed by a valve
plate 10 affixed to the cylinder block and provided with
suction orifices 11 and discharge orifices 12. In the
20 interior of the compression cylinder 1, between the top
of the reciprocating piston 2 and the valve plate 10, it
is defined a compression chamber (not illustrated),
which is maintained in selective fluid communication
with the suction and discharge sides (not illustrated)
25 of the refrigeration compressor, through the selective
opening and closing of the suction orifices 11 and
discharge orifices, by respective suction valves 20 and
discharge valves 30. The suction valves 20 and the
discharge valves 30 are constructed in the form of a
30 flexible vane, as described ahead.

According to the prior art construction illustrated in
figure 1, the valve plate 10 presents a discharge
orifice 12 internal to an axial projection 40 of the
inner contour of the compression cylinder 1, and a
35 suction orifice 11 provided internal to said axial
projection 40 and external to the contour of the
discharge orifice 12, so as to maintain, from the

latter, a certain minimum radial spacing, which is calculated to form a wall thickness that is able to adequately press a sealing joint (not illustrated), in order to avoid undue escape of gas from the high pressure side towards the low pressure side. Although not illustrated, it should be understood that any one of the suction and discharge orifices 11, 12 may have a respective axial projection that is central or substantially central to the axial projection 40 of the compression cylinder 1.

The suction orifice 11 is disposed so as to be external to the axial projection of any discharge orifice 12.

In the prior art construction illustrated in figure 1, the discharge orifice 12 is circular and coaxial to the inner contour of the compression cylinder 1 and the suction orifice 11 is in the form of an annular sector, substantially concentric to at least one of the inner contours of the compression cylinder 1 and of the discharge orifice 12. This construction is disclosed in patent EP1301711.

For the constructions being described, the valve plate 10 secures, on its face turned to the interior of the compression cylinder 1, a suction valve 20, in the form of a flexible suction vane 21, presenting: a mounting end portion 22, to be affixed to the valve plate 10; a bending median portion 23; and a sealing end portion 24 operatively associated with the suction orifice 11 and which is displaceable, by elastic deformation, between a closed valve position, blocking the suction orifice 11, and an open valve position, releasing said suction orifice 11, said flexible suction vane 21 having at least its sealing end portion 24 and bending median portion 23 situated within the axial projection 40 of the inner contour of the compression cylinder 1.

In the prior art construction illustrated in figure 1, the flexible suction vane 21 presents, in its bending median portion 23, a through opening 25, inside which

lies the axial projection of the contour of a central discharge orifice 12 concentric to the axis of the compression cylinder 1.

The importance of centralizing the discharge orifice 12
5 lies in the fact that the compressed gas discharge process occurs while the piston is very close to the upper dead point of the mechanism. In this case, the centralization of the discharge orifice 12 reduces the pressure differentials along the compression cylinder 1,
10 during the period in which the compressed gas is discharged through the discharge valve 30. The reduction of said pressure differentials results, directly, in less energy dissipation during the compression process, thereby providing more energetic efficiency to the
15 compressor.

However, it should be understood that, while in some described and illustrated constructions the central discharge orifice 12 is provided concentric to the axis of the compression cylinder 1, such disposition is not
20 mandatory, as said discharge orifice 12 can be provided offset from the alignment in relation to the axis.

According to the present invention, the valve plate 10 is provided with a plurality of discharge orifices 12 distributed in at least one of the regions defined
25 externally and internally to the contour of the flexible suction vane 21, each discharge orifice 12 provided internally to the contour of the flexible suction vane 21 being axially aligned with a respective through opening 25 provided in the bending median portion 23 of
30 the flexible suction vane 21.

The arrangement of the present invention further comprises a discharge valve 30 formed by a plurality of flexible discharge vanes 31, each operatively associated with at least one discharge orifice 12 and presenting a
35 respective mounting end 32, to be affixed to the valve plate 10, a bending median region 33 and a respective sealing end 34 which selectively closes at least one

discharge orifice 12.

In a first way of carrying out the present invention, regarding the discharge valve 30 illustrated in figure 9, the mounting ends 32 of the flexible discharge vanes 31 are defined in a single common piece, from which project the bending median region 33 and the sealing end 34 of each said flexible discharge vane 31.

In another construction (not illustrated), the discharge valve presents a flexible discharge vane 31 provided with a mounting end 32, a bending medium region 33, and a sealing end 34 which closes the discharge orifices 12 disposed aligned to each other and orthogonal to the axis of the flexible discharge vane 31. In another way of carrying out the present invention, also not illustrated, each flexible discharge vane 31 may define a discharge valve which is independent from the other discharge valves, each flexible discharge vane 31 being affixed to the valve plate 10 by the respective mounting end 32.

For any of these constructions, the sealing end 34 of each flexible discharge vane 31 may selectively close one or more discharge orifices 12.

In a way of carrying out the present invention, in which the bending median portion 23 of the flexible suction vane 21 is provided with a single through opening 25, at least part of the axial projections of the discharge orifices 12 may be contained in the interior of said through opening 25. In a constructive variant of the present invention, any discharge orifice 12, whose axial projection is internal to the contour of the flexible suction vane 21, has its axial projection contained in the interior of said through opening 25.

In the construction illustrated in figure 2, the arrangement of the present invention comprises a single discharge orifice 12 having its axial projection contained in the interior of the through opening 25, said arrangement further comprising at least another

discharge orifice 12 having its respective axial projection eccentric and external to the outer contour of the bending portion 23 of the flexible suction vane 21.

5 In this construction, the discharge orifice 12 with the axial projection internal to said through opening 25 is, for example, provided centralized and/or aligned with the axis of the compression cylinder 1.

Regarding the dimensioning of the discharge orifices 12,
10 these may be defined to present the same or a similar flow restriction condition during the discharge operation of the compressor. However, it should be understood that the flow restriction condition among the discharge orifices 12 may be independent for each
15 discharge orifice.

In the construction of figures 3 and 4, it is illustrated a single discharge orifice 12 having its axial projection contained in the interior of the through opening 25 and, external to the latter, other
20 two discharge orifices 12, each having its respective axial projection eccentric and external to the outer contour of the bending portion 23 of the flexible suction vane 21, said other two discharge orifices being particularly disposed symmetrically to the axis of the
25 compression cylinder 1 and orthogonally to the axis of the flexible suction vane 21. For this constructive variant, other discharge orifices 12, provided in the valve plate 10, will be external to the contour of the flexible suction vane 21.

30 In a way of carrying out this constructive option, not mandatory, the discharge orifices 12 are disposed in the valve plate 10, so that each discharge orifice 12 is subject to the same flow restriction applied by the flexible discharge vane 31, during its opening
35 operation.

In the constructive options illustrated herein, said other two discharge orifices 12 are disposed in an

alignment containing the central discharge orifice 12, said alignment being orthogonal to the axis of the flexible discharge vane 31, said two other discharge orifices 12 being symmetric in relation to said axis.

- 5 In particular, the central discharge orifice 12 and the other two discharge orifices 12 present the same cross-sectional area, although this construction is not always mandatory.

10 It should be understood that, although the illustrated constructions present the discharge orifices 12 with circular contour, other constructions presenting elliptical contour or other preferred form are possible, within the concept presented herein. Each discharge orifice 12 may be optimized in an independent form in
15 relation to the others, this optimization being defined by the independent dimensioning of each discharge orifice 12, calculated as a function of the flow restriction condition that said discharge orifice 12 should present.

- 20 The discharge orifices 12 may be disposed in alignments orthogonal or parallel to the axis of the flexible suction vane 21, inside or outside the through opening 25 in the latter, said alignments including or not a central discharge orifice 12 concentric to the axis of
25 the compression cylinder 1.

The discharge orifices 12 of the present invention may be equally shaped and dimensioned so as to maintain from each other, for example, at minimum a similar flow restriction condition, upon movement of the respective
30 flexible discharge vane 31. The possible variations of distribution of the discharge orifices 12 are defined, for each project, as a function of the intended result. In a constructive option, all the discharge orifices 12 present, at minimum, a similar flow restriction
35 condition, during the compressor discharge operation, or present flow restriction conditions independently calculated for each discharge orifice 12.

In the construction illustrated in figure 9, the discharge orifices 12 are selectively closed by a discharge valve 30 comprising three flexible discharge vanes 31, each having the respective sealing end 34
5 operatively associated with a respective discharge orifice 12, said flexible discharge vanes 31 having the mounting ends 32 joined to each other in a single piece that is affixed in the valve plate 10.

In another form of distribution (not illustrated), the
10 discharge orifices 12 can be concentrically distributed around a central discharge orifice 12 and spaced therefrom so as to maintain the same flow restriction condition applied to the central discharge orifice 12, during the discharge operation of the compressor.

15 In the constructions provided with a central discharge orifice 12, in order to maintain the same flow restriction condition during the discharge operation of the compressor, the discharge orifices 12 present variations in at least one of the characteristics of
20 cross-sectional area and distance in relation to the central discharge orifice 12.

In the constructions without a central discharge orifice 12, in order to maintain the same flow restriction condition during the discharge operation of the
25 compressor, the discharge orifices 12 present variations in at least one of the characteristics of cross-sectional area and diameter in relation to the movement of a corresponding portion of discharge valve 30.

In another way of carrying out the present invention,
30 illustrated in figure 5, the flexible suction vane 21 comprises a plurality of through openings 25, each containing, in its interior, the axial projection of a respective discharge orifice 12. In this construction, and as already described for the construction
35 illustrated in figures 2 to 4, a discharge orifice 12 can be provided, for example, centralized and particularly aligned with the axis of the compression

cylinder 1, at least another discharge orifice 21 having its axial projection internal to the contour of the flexible suction vane 21. In the construction illustrated in figure 5, the flexible suction vane 21 is provided with three through openings 25, each aligned with the axial projection of a respective discharge orifice 12, said through openings 25 being aligned to each other and orthogonally to the axis of the flexible suction vane 21. As already previously described, the discharge orifices 12 can be dimensioned and positioned to each other, and in relation to the flexible suction vane 21, so that each discharge orifice 12 is subject to the same flow restriction applied by the flexible discharge vane 31, during its opening operation, although this arrangement is not mandatory.

In the embodiment illustrated in figure 5, one of the through openings 25 is provided aligned with the axis of the flexible suction vane 21. In this construction illustrated in figure 5, all the other discharge orifices 12 present the same cross-sectional area, although this conformation is not mandatory, as described for the embodiments illustrated in figures 2 to 4.

It should be understood that this construction also allows the provision of at least another discharge orifice 12 having its axial projection external to the contour of the flexible suction vane 21, it being possible to arrange said discharge orifices 12 so that all of them are subject to the same flow restriction applied by the flexible discharge vane 31, during the opening operation thereof.

In these constructions, the discharge orifices 12 are disposed in an alignment which contains the central discharge orifice 12 and which is orthogonal to the axis of the flexible discharge vane 31, the discharge orifices 12, other than the central one, being symmetrically arranged in relation to said axis and said

central discharge orifice 12.

Also in this construction, the discharge valve 30 can be of the type which comprises a respective flexible discharge vane 31 for each discharge orifice 12, and
5 each flexible discharge vane 31 can also be operatively associated with a plurality of discharge orifices 12 aligned with the axis of the flexible discharge vane 31. In the construction illustrated in figures 6-8, the arrangement of the present invention comprises only
10 discharge orifices 12 having their axial projections positioned externally to the contour of the flexible suction vane 21, one of said discharge orifices 12 being, for example, centralized and the other discharge orifices 12 being disposed so as to be subject to the
15 same flow restriction condition applied by the flexible discharge vane 31, during its opening operation. In particular, the other discharge orifices 12 are disposed in an alignment which contains the central discharge orifice 12 and which is orthogonal to the axis of the
20 flexible discharge vane 31, said discharge orifices 12 being symmetric in relation to said axis. For this construction, the central discharge orifice 12 and the other discharge orifices 12 present the same cross-sectional area.

25 Figures 9 and 10 illustrate a constructive form of the valve plate 10, in which the discharge orifices 12 are provided in a body portion of the valve plate 10 which is lowered from a front face of the latter, in opposition to that face turned to the compression
30 cylinder 1, said recess being calculated to house the flexible discharge vanes 31 mounted to said valve plate 10.

The arrangement of the present invention, for a construction using a suction valve as described, allows
35 the provision of multiple discharge orifices in hermetic compressors of household refrigeration systems, leading to more efficiency and reduction of dead volume in said

refrigeration compressor, by facilitating the gas flow from inside the compression cylinder 1 to the multiple discharge orifices 12. Even though the discharge orifice 12 internal to the through opening 25 is not exactly centralized in relation to the axis of the compression cylinder 1, the possibility of providing multiple discharge orifices 12 for a construction of suction valve 20 of the type described herein already results in a significant improvement in the discharge efficiency, further allowing multiple discharge orifices 12 to be provided in different alignments and with different cross-sections for hermetic refrigeration compressors.

It should be understood that the known concept of incorporating an axial protrusion on the top face of the piston, in order to cooperate with the discharge orifice 12 during the final compression stroke of the piston, aiming to reduce the dead volume in the compression chamber, can be equally applied in the present invention, by simply incorporating, to the top face of the reciprocating piston 2, the protrusions adequately positioned to cooperate with the respective discharge orifices 12. The physical positioning of the protrusions should naturally follow the relative positioning of the discharge orifices 12 in the valve plate 10, whilst the conformation of the protrusions and respective discharge orifices 12 may follow only one pattern among the known patterns, or present different conformation patterns for matching a frusto-conical profile with a cylindrical orifice and vice-versa, depending on the positioning of the protrusion in the contour of the compression chamber, aiming at reducing the dead volume, without impairing the discharge flow of the refrigerant gas compressed in the interior of the compression chamber.

The provision of multiple discharge orifices 12 presenting a reduced diameter in relation to the diameter of a single discharge orifice 12, such as that of the prior art, better optimizes the discharge valve

30 in relation to the use of a single discharge orifice 12.

The use of multiple discharge orifices 12 also permits using smaller thicknesses for the discharge valve 30 (since smaller discharge orifices 12 impose smaller stresses to the valve), resulting in more freedom to optimize the rigidity and natural frequency of the flexible discharge vane 31 of the discharge valve 30. Besides, since the discharge orifices 12 present reduced dimensions in relation to the single discharge orifice 12 of the prior art, the forces required to open the discharge valve 30 are smaller, softening said opening. Moreover, the presence of multiple discharge orifices 12 enables the use of a smaller maximum opening of the discharge valve 30, since multiple discharge orifices 12 increase the gas flow area, which is proportional to the diameter of the discharge orifice 12 versus opening height of the discharge valve 30. The higher the number of discharge orifices 12, the smaller the maximum opening of the discharge valve 30 necessary for a good gas flow, since the total gas flow area is proportional to the product of the number of discharge orifices 12 multiplied by the diameter thereof.

Accordingly, by associating the requirement of a smaller force for opening the discharge valve 30 (due to the smaller diameters of the discharge orifices 12) with the need of a smaller opening for the latter (as a function of the higher number of discharge orifices 12), the energy with which the discharge valve 30 will seat against the recess provided in the body portion of the valve plate 10 and which actuates as an end stroke stop (not illustrated) will be reduced, bringing benefits, such as noise reduction and mainly reliability, since the impact forces are reduced.

While only one exemplary embodiment for the present invention has been illustrated herein, it should be understood that alterations can be made in the form and

disposition of the constitutive elements, without departing from the constructive concept defined in the claims that accompany the present specification.

CLAIMS

1. A discharge valve arrangement for a hermetic compressor to be used in refrigeration systems and comprising: a cylinder block defining a compression cylinder (1); a valve plate (10) closing an end of the
5 compression cylinder (1) and provided with suction orifices (11) and discharge orifices (12) contained within the inner contour of the axial projection (40) of the compression cylinder (1), at least one suction
10 orifice (11) occupying an annular sector external to the axial projection of a discharge orifice (12) closed by a discharge valve (30) comprising a flexible discharge vane (31), said suction orifice (11) being closed by a suction valve (20) comprising a flexible suction vane
15 (21) presenting: a mounting end portion (22) to be affixed to the valve plate (10); a bending median portion (23); and a sealing end portion (24) operatively associated with the suction orifice (11), characterized in that the valve plate (10) is provided with a
20 plurality of discharge orifices (12) distributed in at least one of the regions defined externally and internally to the contour of the flexible suction vane (21), each discharge orifice (12) provided internally to the contour of the flexible suction vane (21) being
25 axially aligned with a respective through opening (25) provided in the bending median portion (23) of the flexible suction vane (21).

2. The arrangement, as set forth in claim 1, characterized in that the bending median portion (23) of
30 the flexible suction vane (21) is provided with a through opening (25), any discharge orifice (12), whose axial projection is internal to the contour of the flexible suction vane (21), having its axial projection contained in the interior of said through opening (25).

35 3. The arrangement, as set forth in claim 2, characterized in that it comprises a central discharge orifice (12) having its axial projection internal to

said through opening (25).

4. The arrangement, as set forth in claim 3, characterized in that the central discharge orifice (12) is aligned with the axis of the compression cylinder (1).

5. The arrangement, as set forth in any of claims 2, 3 and 4, characterized in that it comprises a single discharge orifice (12) having its axial projection contained in the interior of said through opening (25).

6. The arrangement, as set forth in claim 5, characterized in that it comprises at least another discharge orifice (12) having its axial projection external to the contour of the flexible suction vane (21).

7. The arrangement, as set forth in claim 2, characterized in that at least part of the discharge orifices (12) are disposed so as to be subject to the same flow restriction applied by the flexible discharge vane (31) during its opening operation.

8. The arrangement, as set forth in any of claims 3, 4 and 5, characterized in that it comprises at least other two discharge orifices (12) having their axial projections external to the contour of the flexible suction vane (21) and being disposed in an alignment containing a central discharge orifice (12) and which is orthogonal to the axis of the flexible discharge vane (31), said two discharge orifices (12) being symmetrical in relation to the axis of the compression cylinder (1).

9. The arrangement, as set forth in claim 1, characterized in that at least part of the discharge orifices (12) of the plurality of discharge orifices (12) present the same cross-sectional area.

10. The arrangement, as set forth in claim 1, characterized in that the discharge orifices (12) of the plurality of discharge orifices (12) present distinct cross-sections.

11. The arrangement, as set forth in claim 1,

characterized in that the flexible suction vane (21) comprises a plurality of through openings (25), each containing, in its interior, the axial projection of a respective discharge orifice (12).

5 12. The arrangement, as set forth in claim 11, characterized in that it comprises a central discharge orifice (12).

13. The arrangement, as set forth in claim 12, characterized in that the central discharge orifice (12)
10 is aligned with the axis of the compression cylinder (1).

14. The arrangement, as set forth in any of claims 11, 12 and 13, characterized in that the discharge orifices (12) having their axial projections internal to the
15 contour of the flexible suction vane (21) are disposed orthogonally to the axis of the flexible discharge vane (31), said discharge orifices (12) being symmetrical in relation to the axis of the compression cylinder (1).

15. The arrangement, as set forth in claim 14,
20 characterized in that at least part of the discharge orifices (12) are disposed so as to be subject to the same flow restriction applied by the flexible discharge vane (31) during its opening operation.

16. The arrangement, as set forth in claim 11,
25 characterized in that at least part of the discharge orifices (12) of the plurality of discharge orifices (12) present the same cross-sectional area.

17. The arrangement, as set forth in claim 11, characterized in that the discharge orifices (12) of the
30 plurality of discharge orifices (12) present distinct cross-sections.

18. The arrangement, as set forth in any of claims 11-17, characterized in that it comprises at least another discharge orifice (21) having its axial projection
35 external to the contour of the flexible suction vane (21).

19. The arrangement, as set forth in claim 18,

characterized in that the other external discharge orifice (12) is disposed so as to be subject to the same flow restriction applied by the flexible discharge vane (31) to the other discharge orifices (12) during its opening operation.

20. The arrangement, as set forth in any of claims 11-17, characterized in that it comprises at least other two discharge orifices (12) having their axial projections external to the contour of the flexible suction vane (21).

21. The arrangement, as set forth in claim 20, characterized in that the other two discharge orifices (12) are disposed so that all the discharge orifices (12) are subject to the same flow restriction applied by the flexible discharge vane (31) during its opening operation.

22. The arrangement, as set forth in any of claims 20 and 21, characterized in that said other two discharge orifices (12) are disposed in an alignment which contains the central discharge orifice (12) and which is orthogonal to the axis of the flexible discharge vane (31), said two discharge orifices (12) being symmetrical in relation to said axis.

23. The arrangement, as set forth in claim 22, characterized in that at least part of the discharge orifices (12) of the plurality of discharge orifices (12) present the same cross-sectional area.

24. The arrangement, as set forth in claim 22, characterized in that the discharge orifices (12) of the plurality of discharge orifices (12) present distinct cross-sections.

25. The arrangement, as set forth in claim 1, characterized in that it comprises only discharge orifices (12) having their axial projections positioned externally to the contour of the flexible suction vane (21).

26. The arrangement, as set forth in claim 25,

characterized in that one of said discharge orifices (12) is centralized and aligned with the axis of the compression cylinder (1).

27. The arrangement, as set forth in claim 26,
5 characterized in that at least part of the discharge orifices (12) are disposed so as to be subject to the same flow restriction applied by the flexible discharge vane (31), during its opening operation.

28. The arrangement, as set forth in claim 27,
10 characterized in that at least part of the discharge orifices (12) are disposed in an alignment containing a central discharge orifice (12) and which is orthogonal to the axis of the flexible discharge vane (31), said discharge orifices (12) being symmetrical in relation to
15 said axis.

29. The arrangement, as set forth in claim 28,
characterized in that some of the discharge orifices (12) present the same cross-sectional area.

30. The arrangement, as set forth in claim 29,
20 characterized in that all the discharge orifices (12) present distinct cross-sections.