"ACOUSTIC MUFFLER FOR A REFRIGERATION COMPRESSOR"

Field of the Invention

The present invention refers, in a general way, to a construction of an acoustic muffler for a hermetic refrigeration compressor, of the type which retains particulate material contained in the gas flow admitted in the suction of the compressor.

Background of the Invention

Hermetic compressors of refrigeration systems usually have their suction provided with an acoustic muffler (acoustic filter or suction muffler) located in the interior of the shell and which conducts the gas from the suction line to the suction valve.

Such component has several functions that are important to the adequate operation of the compressor, such as: gas conduction, acoustic dampening and, in some cases, thermal insulation of the gas that is drawn to the interior of the cylinder.

Suction acoustic mufflers are generally constructed to create a trajectory for the refrigerant gas flow that is admitted in a compression chamber of the refrigeration compressor, from a suction line of a refrigeration system to which the compressor is coupled, so that the displacement of said refrigerant gas flow generates minimum noise.

Frequently, the hermetic compressors utilized in refrigeration systems suffer damages in their internal components due to the entry of solid particles therewithin. Such particles are originated in the refrigeration circuit and arise as a function of inefficient cleaning or by contamination during the several phases of manufacturing the components and of assembling the refrigeration systems. These particles penetrate in the compressors carried by the refrigerant gas flow. Hard solid particles, such as chips from machining processes, can provoke damages to the suction valve to the point of breaking it, making the

compressor inoperative. Even flexible solid particles, such as cloth fibers, can adhere to the surface of the suction valve or discharge valve, impairing the complete closing thereof, reducing the efficiency of the compressor.

With the objective of preventing the problems mentioned above or even other problems which can be caused by the presence of solid contaminants in the refrigeration circuit and mainly in the interior of the compressor, some manufacturers use a flat impurity filter in metallic material, which is mounted upstream of the suction valve considering the pumping flow of the refrigerant gas, such as presented, for example, in documents US6715582 and US4911619. The impurity filter is obtained from a mesh of intertwined wires (wire mesh), which is cut to form a flat geometric figure. Figure 1 shows an example of a known construction of flat impurity filter. Its function is to retain solid particles, preventing them from reaching the suction valve. Figure 2 shows the application of said known prior art impurity filter in distinct positions in the suction muffler.

A characteristic inherent to the utilization of the filters manufactured from wire meshes is the load loss caused to the refrigerant gas flow. This load loss occurs due to the resistance suffered by the gas flow as a function of the significant reduction of the passage area through the impurity filter, besides the aerodynamic friction existing between the refrigerant gas and the metallic wires of the mesh.

The characteristics described above significantly affect the project of the suction system components in compressors, mainly when it is necessary to apply an impurity filter in very narrow regions, such as in one of the gas inlet or outlet ducts of the suction muffler, as shown in the illustrated example, or also in passages defined therewithin for communication

between its inner chambers, in case the suction muffler presents two or more inner chambers. The reduced passage area, which is inherent to the impurity filter, requires the provision of antechambers in narrow regions, to make feasible the application of a larger impurity filter, providing the required passage for the refrigerant gas flow. This requirement results in more complex projects and greater difficulty to manufacture the component parts of a respective impurity filter. When a suction muffler is directly applied in one of the gas inlet or outlet ducts, or in a passage between volumes thereof, in case said suction muffler presents two or more volumes, the alternative to avoid the restriction to the gas flow being suctioned is to increase the diameter or the passage area, respectively. This alternative, however, provokes degradation of the acoustic performance of the suction muffler, since a larger diameter of any of the gas inlet or outlet ducts, or a larger area in a passage between the volumes of the suction muffler results in less restriction to the acoustic energy originated by the compression operation of the refrigerant gas and which follows a path that is opposite to the flow of said refrigerant gas.

Objects of the Invention

It is an object of the present invention to provide an acoustic muffler which overcomes the deficiencies cited above in relation to an efficient retention of impurities contained in the refrigerant gas flow through the suction muffler, without prejudice to the efficiency of said muffler as an acoustic filter.

A more specific object of the present invention is to provide a muffler as cited above, which does not require modifications in the constructive aspects of said suction muffler.

Another object of the present invention is to provide a muffler of the type cited above and which is easy to

obtain and has a low cost.

Disclosure of the Invention

The objects above are accomplished through the provision of an acoustic muffler for a refrigeration compressor, comprising a hollow body defining at least one muffler chamber which carries a gas inlet duct having an inlet opening external to the muffler chamber and an outlet opening in the interior of the muffler chamber, and a gas outlet duct presenting an inlet opening in the interior of the muffler chamber and an outlet opening external to said muffler chamber, at least one of the parts defined by the hollow body, by the gas inlet duct and by the gas outlet duct defining a gas passage provided with at least one impurity filter in the form of a mesh and which presents a mesh surface larger than that defined by the contour of the cross section of said gas passage and projecting to at least one of the sides of said cross-section.

Brief Description of the Drawings

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

Figures 1 and 1a schematically represent a front view and a lateral view, respectively, of an impurity filter construction for an acoustic muffler, constructed according to the prior art;

Figure 2 schematically represents a partial view of the refrigerant gas inlet region in a refrigeration compressor, particularly illustrating the suction muffler with the arrangement of impurity filters, which are constructed according to the prior art and as illustrated in figures 1 and 1a, and also indicating the direction of the refrigerant gas flow admitted in the compression chamber;

Figures 3 and 3a schematically represent a front view and a lateral view, respectively, of an impurity filter construction for an acoustic muffler, constructed according to the present invention;

Figure 4 schematically represents a partial view of the refrigerant gas inlet region in a refrigeration compressor, particularly illustrating the suction muffler with the arrangement of impurity filters constructed according to the present invention and as illustrated in figures 3 and 3a, and also illustrating the regions in which said impurity filter is affixed to the acoustic muffler; and

Figure 5 schematically represents a front view of the gas inlet duct of the acoustic muffler carrying the impurity filter of the present invention, as illustrated in figure 4.

Description of the Illustrated Embodiments

According to the illustrations, the present invention provides an acoustic muffler to be mounted in the interior of a hermetic shell 1 of a refrigeration compressor comprising a motor-compressor including a cylinder 2, which houses a piston 3 that reciprocates inside a compression chamber 4 defined within said cylinder 2 between a top portion of said piston 3 and a valve plate 5 seated on an end portion of the cylinder 2. The compressor also carries an electric motor (not illustrated) that drives said piston 3 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 4, from a suction line of the refrigeration system to which the compressor is coupled and which comprises a suction inlet tube 6 disposed through the shell 1 and opened to the interior of the suction muffler. The valve plate 5 defines a suction orifice 5a and a discharge orifice (not illustrated) and carries a respective suction valve 5b and a discharge valve, also not illustrated.

The acoustic muffler comprises: a hollow body 10 defining at least one muffler chamber 11; a gas inlet duct 20 having an inlet opening 21 external to the

muffler chamber 11; and an outlet opening 22, in the interior of the muffler chamber 11 and a gas outlet duct 30, presenting an inlet opening 31 inside the muffler chamber 11 and an outlet opening 32 outside said muffler chamber 11. The acoustic muffler receives the refrigerant gas arriving from the suction inlet tube 6, through the inlet opening 21 of the gas inlet duct 20 of said suction muffler, and directs said refrigerant gas to the interior of the compression chamber 4, through the outlet opening 32 of the gas outlet duct 30 of said suction muffler. In the illustrated constructions, the outlet opening 32 of the gas outlet duct 30 directs the refrigerant gas directly to the interior of said compression chamber 4.

The prior art acoustic mufflers present one, two or more impurity filters arranged in gas passages through the interior of said acoustic muffler, from the inlet to the outlet thereof. In the prior art acoustic muffler illustrated in figure 2, it presents a first flat impurity filter 7, provided in a gas passage P defined in the gas inlet duct 20, adjacent to its inlet opening 21, and a second impurity filter 8, provided in a gas passage P defined adjacent to the outlet opening 32 of the gas outlet duct 30 of the hollow body 10 of said acoustic muffler. Such impurity filter arrangements in the acoustic muffler present the deficiencies mentioned above.

The present invention establishes a solution to overcome the difficulties related to the utilization of a flat impurity filter, of the type used in the prior art constructions, but which also uses a wire mesh.

According to the present invention, at least one of the parts defined by the hollow body 10, by the gas inlet duct 20 and by the gas outlet duct 30 defines a gas passage P in which is provided an impurity filter 40, constructed according to the present invention and which has the form of a mesh presenting a mesh surface

41, substantially larger than that defined by the contour of the cross section of the gas passage P and projecting to at least one of the sides of a plane containing said cross-section of the gas passage P.

The present invention utilizes a concept of a volumetric and metallic impurity filter 40, which has its mesh surface 41 shaped to present a three-dimensional geometric form which can vary according to the contour conditions of the place where the impurity filter 40 will be installed.

Although the construction illustrated in figures 3, 3a, 4 and 5 presents an impurity filter 40 with a semi-spherical geometry applied in any of the gas inlet duct 20 and of gas outlet duct 30 of the hollow body 10 of the acoustic muffler, it should be understood that the concept presented herein also foresees other spatial geometric forms, whether regular, such as spheres, semi-spheres, cubes, parallelepipeds, pyramids, cylinders, cones, pyramid or cone trunks, or any other form, which characterizes three-dimensional figures. Said impurity filters can be provided in any part of the acoustic muffler, along the path followed by the refrigerant gas inside said acoustic muffler, upstream the suction valve.

According to the present invention, the mesh surface 41 of the impurity filter 40 presents a tubular shape having an end 42 with a contour coinciding with that of the cross-section of the gas passage P, and an opposite closed end 43 which, in the illustrated construction, is defined by a mesh portion in the form of a substantially spherical cap. Nevertheless, it should be understood that the opposite end 43 can have any shape, such as rectilinear and disposed parallel or inclined in relation to the plane containing the cross-section of the gas passage P.

The end 42 of the mesh surface 41 defines a peripheral edge for mounting the impurity filter 40 to the gas

passage P in which it is provided, and from which projects, for example, towards the passage of the refrigerant gas flow, the remainder of said mesh surface 41, in order to occupy a certain volume of the part to which said impurity filter 40 projects.

According to the present invention, at least one of the inlet and outlet openings 21, 22, 31, 32 of each of the gas inlet duct 20 and gas outlet duct 30 carries at least one respective impurity filter 40 constructed according to the present invention. However, it should be understood that other solutions for positioning the impurity filters in the gas passages P of the acoustic muffler are possible, in which some of said gas passages P carry an impurity filter of conventional construction and/or an impurity filter 40 constructed according to the present invention.

In the illustrated construction, the gas inlet duct 20 comprises an impurity filter 40 provided adjacent to the inlet opening 21, for example, in the outer edge portion thereof, whilst the gas outlet duct 30 comprises an impurity filter 40 provided adjacent to the respective outlet opening 32. Nevertheless, it should be understood that other constructions are possible, such as the provision of more than one impurity filter 40 in one or in both the gas inlet duct 20 and the gas outlet duct 30. It should further be understood that the acoustic muffler can carry only one impurity filter 40, for example, in the gas inlet 31 of the gas outlet duct 30.

Although not illustrated, the present invention can be also applied to gas discharge acoustic mufflers.

The construction of the impurity filter 40 of the present invention has as an advantage the gain of the passage area for the refrigerant gas, without requiring to increase the filtering orifices of the wire mesh utilized in the manufacture of said impurity filter 40, or to increase the dimensions of the region where said

impurity filter 40 is mounted in the acoustic muffler, to compensate for load loss effects. The surface area of the impurity filter 40 of the present invention is significantly larger than the surface area of the known prior art flat impurity filters, permitting to compensate for load loss effects caused by the reduction of the passage area in the impurity filters with a planar surface.

The impurity filter 40 is affixed to the gas passage P in which it is provided, through a fixation means 50 which, according to a way of carrying out of the present invention, is in the form of a deformed peripheral portion of the gas passage P, in the region of the end 42 of the impurity filter 40 in which the latter is affixed. According to the illustrated constructive form, the gas passage P, which receives and affixes the impurity filter 40, is provided with axial or radial projections, which are deformed, for example, by heating, after the impurity filter 40 is placed and affixed in the respective gas passage P.

According to the present invention, the fixation means 50 comprises at least one retaining projection 51, provided in one of the parts of gas inlet duct 20 and gas outlet duct 30, and to be seated on an adjacent portion of the end 42 of the impurity filter 40, said retaining projection 51 being plastically deformed at the end 42 of the impurity filter 40, for example, by thermal deformation.

In the illustrated solution, the gas inlet opening 21 of the gas inlet duct 20 and/or the gas inlet 31 of the gas outlet duct 30 is provided with a plurality of retaining projections 51, to the seated, by thermal deformation, on an adjacent portion of the end 42 of the impurity filter 40. It should be understood that, although the present invention foresees the fixation, by bending a plurality of retaining projections 51, said fixation can be obtained from a single projection,

peripherally surrounding the contour of the edge of the respective part of the gas inlet 21 of the gas inlet duct 20 and of the gas inlet 31 of the gas inlet duct 30.

According to the illustrations, the gas inlet 21 of the gas inlet duct 20 presents a peripheral flange 21a, surrounding the peripheral edge of said gas inlet 21, against which is seated the end 42 of an impurity filter 40 constructed according to the present invention, before receiving the deformation of a retaining projection 51 of said gas inlet duct 20.

In this construction, after positioning the impurity filter 40 in the respective gas passage P, portions of the peripheral contour of said gas passage P in the region of the acoustic muffler are shaped so as to overlap an adjacent portion of the end 42 of the impurity filter 40. In a preferred way of carrying out the present invention, the deformation is carried out upstream the gas passage P.

In the constructions in which two or more impurity filters are provided in the same gas passage P, for example, a flat impurity filter constructed according to the prior art and an impurity filter constructed according to the present invention, the deformation of a portion of the contour of said gas passage P should secure an adjacent end portion of the contour of each said impurity filter mounted in the gas passage P, affixing said filters to each other and against the adjacent wall portion of the acoustic muffler where the gas passage P is defined.

While a construction of acoustic muffler presenting an impurity filter 40 in the gas inlet duct 20 and in the outlet gas duct 30 has been illustrated, it should be understood that said acoustic muffler can present only one impurity filter 40, for example, in the gas inlet 31 of the gas outlet duct 30.

While the present invention has been described and

illustrated for an acoustic muffler having its hollow body 10 internally defining only one muffler chamber 11, it should be understood that, in the case of an acoustic muffler having two or more muffler chambers, the dividing wall thereof presenting a gas passage P can secure an impurity filter constructed according to the prior art or to the present invention.

CLAIMS

1. An acoustic muffler for a refrigeration compressor, comprising a hollow body (10) defining at least one muffler chamber (11) which carries a gas inlet duct (20) having an inlet opening (21) external to the muffler chamber (11) and an outlet opening (22) in the interior of the muffler chamber (11), and a gas outlet duct (30) presenting an inlet opening (31) in the interior of the muffler chamber (11) and an outlet opening (32) external to said muffler chamber (11), at least one of the parts defined by the hollow body (10), by the gas inlet duct (20) and by the gas outlet duct (30) defining a gas passage (P) provided with an impurity filter (7, 8, 40) in the form of a mesh, characterized in that at least one impurity filter (40) presents a mesh surface (41) larger than that defined by the contour of the cross-section of said gas passage (P) and projecting to at least one of the sides of said cross-section.

2. An acoustic muffler, as set forth in claim 1, characterized in that the mesh surface (41) of the impurity filter (40) projects to one of the sides of the cross-section of the gas passage (P), towards the refrigerant gas flow.

3. An acoustic muffler, as set forth in claim 2, characterized in that the mesh surface (41) of the impurity filter (40) presents a tubular shape having an end (42) with a contour coinciding with that of the cross-section of the gas passage (P), and a closed opposite end (43).

4. An acoustic muffler, as set forth in claim 3, characterized in that the opposite end (43) of the impurity filter (40) is defined by a mesh portion in the form of a substantially spherical cap.

5. An acoustic muffler, as set forth in claim 1, characterized in that the gas inlet duct (20) comprises at least one impurity filter (40) provided adjacent to the inlet opening (21) of said gas inlet duct (20).

6. An acoustic muffler, as set forth in claim 1, characterized in that the gas outlet duct (30) comprises at least one impurity filter (40) provided adjacent to the inlet opening (31) of said gas outlet duct (30).

7. An acoustic muffler, as set forth in claim 1, characterized in that the mesh surface (41) is made of metallic material.

8. An acoustic muffler, as set forth in claim 1, characterized in that it comprises a fixation means (50) securing at least one impurity filter (7, 8 and 40) in the respective gas passage (P).

9. An acoustic muffler, as set forth in claim 8, characterized in that the fixation means (50) comprises at least one retaining projection (51) provided in one of the parts of gas inlet duct (20) and gas outlet duct (30), to be seated on an adjacent portion of the end (42) of the impurity filter (40).

10. An acoustic muffler, as set forth in claim 9, characterized in that the retaining projection (51) is plastically deformable at the end (42) of the impurity filter (40).

11. An acoustic muffler, as set forth in claim 10, characterized in that the retaining projection (51) is thermically deformable.