

CLAMP FOR TUBULAR CONNECTIONS IN SMALL REFRIGERATION SYSTEMS

Field of the Invention

The present invention refers to a clamp for a tubular connection of a tubular connecting element, in an elastically deformable material, to be attached around a tubular element that conducts a working fluid, suitable for small refrigeration systems of the type which comprises a compressor operatively associated with a refrigeration circuit containing at least one working fluid, said refrigeration system comprising at least one said tubular connecting element and one said tubular element, said clamp comprising two semi-annular portions having, each one, a first end and a second end, said first ends being coupled to each other, in a single piece, by a coupling portion and the second end of one of said semi-annular portions being provided with a locking means to be engaged in a lock receiving means provided in the second end of the other semi-annular portion, the coupling portion between the two first ends being made so as to allow said two semi-annular portions to be displaced between an open position, with the second ends spaced from each other, allowing to place the clamp around the tubular connecting element already mounted around the tubular element, and a closed position, in which the locking means are retained in the lock receiving means, and in which the tubular connecting element is pressed against the tubular element.

Background of the Invention

The refrigeration systems essentially comprise a compressor, a condenser and an evaporator, connected to each other through tubular connections, which contain a working fluid that is defined by a refrigerant fluid pumped by the compressor, to promote heat exchange with an ambient usually associated with the evaporator of the refrigeration system.

Among the characteristics responsible for improving the performance of the refrigeration compressors are the increase of the amount of refrigerant fluid, in gas form, drawn during suction, and the reduction of the power
5 necessary to compress this gas, requiring the gas to be under as low temperature as possible (greater specific mass). One of the ways for attaining this object is to use a direct suction system.

In some known compressor constructions for a
10 refrigeration system, the gas suction occurs by direct suction, from an inlet suction tube 1a mounted in the casing 1 of the compressor, to the interior of a suction chamber, usually comprising a suction acoustic muffler 2 disposed in the interior of said casing 1. The suction
15 chamber further comprises a suction orifice generally defined in a valve plate and, in some constructions, an additional suction chamber, defined in a head mounted against the valve plate, both not illustrated. In other known compressor constructions for a refrigeration
20 system, the gas suction occurs by direct suction, but with a suction acoustic muffler 2 mounted outside the casing 1 of the compressor.

In the constructions presenting the suction acoustic muffler 2 inside the casing 1 of the compressor, the
25 tubular connection that defines a suction line of the refrigeration system is maintained in fluid communication with said suction acoustic muffler 2 through a flexible tubular connecting element 3 that provides a hermetic connection between the gas inlet region in the interior
30 of the casing 1 of the compressor, through the inlet suction tube 1a and the suction chamber, accommodating the movements resulting from the relative vibration between said suction chamber and the wall of the casing 1 of the compressor, directing the cold gas of the suction
35 directly to the interior of the suction chamber, minimizing heat exchanges of this cold gas with the gas present in the interior of the casing 1.

The tubular connecting element 3 establishes a passageway for the refrigerant fluid in gas form, being attached, by one of its ends, to the outer part of a gas inlet duct of the suction chamber, usually mounted in the interior of the casing 1 of the compressor (figure 1) and having an opposite end seated and pressed against an adjacent inner wall portion of the casing 1, said opposite end surrounding concentrically the inlet suction tube 1a.

During the start of the compressor or during the normal operation thereof, the pressure inside the tubular connecting element 3 is lower than the pressure outside it, due to the suction effected by the movement of a piston 4, reciprocating inside a cylinder 5 of the compressor, and whose movement draws the refrigerant fluid, in gas form, to the interior of a compression chamber 5a defined inside said cylinder 5, in which is mounted the piston 4. This pressure reduction causes a contraction in the tubular connecting element 3 pulling the whole mechanical assembly of the compressor that is connected to the suction chamber against the wall of the casing 1 of the compressor. The inertia of the mechanical assembly generates a force which tends to oppose to this movement, causing the release of the tubular connecting element 3 from the suction chamber.

In a known solution, the tubular connecting element 3 is constructed in a flexible material with low thermal conductivity which can be retained to the suction acoustic muffler 2 and in sliding contact with the casing 1 of the compressor, as it occurs in the solution described in document US4793775. However, this construction presents the disadvantage, in some conditions, mainly at the start of the compressor, of conducting the tubular connecting element 3 to detach from its mounting condition to the acoustic muffler 2.

In order to guarantee the fixation of the tubular connecting element 3, by its connecting end, to the suction chamber or, more specifically, to the acoustic

muffler, it is necessary to install a clamp 6, which externally and radially presses the tubular connecting element 3 against the outer surface of a tubular element 7 of the acoustic muffler 2. This clamp 6 of known construction is manufactured in steel, which generates potential problems related to the safety of the compressor, due to the possibility of this component falling inside the casing 1, causing the risk of a short circuit between the electrically powered parts and the casing 1. Besides, this known construction presents disadvantages as to the mounting of the metallic clamp 6 around the tubular connecting element 3, mainly in situations in which there is not enough space for using tools or automatic mounting devices to be applied to elements that will definitively lock the clamp in the mounted condition.

Another disadvantage of this construction refers to the manufacturing costs of said clamp 6, which by the fact of being metallic, requires cutting and mechanical shaping steps to be manufactured, as well as surface and heat treatments, which also raise the cost of its production. Although there are known different clamp solutions in non-conductive material, they present a mounting position in which the second ends (provided with the locking means and the lock receiving means respectively) present a construction usually not strong enough for preventing breaks in the fixation region between the locking means. Said known clamp solutions (DE-A-3708225; DE-U-202006006746; US-A-5474268; DE-B-102004023867; and WO-A-03/001069) do not have provisions for defining a stabilized closed condition for the clamp.

Objects of the Invention

It is an object of the present invention to provide a clamp for tubular connections in small refrigeration systems which allows attaching a tubular connecting element to a tubular element of the refrigeration system, in a reliable way, preventing involuntary releases.

Another object of the present invention is to provide a clamp such as cited above and which does not compromise the operational reliability of the compressor.

It is a further object of the present invention to
5 provide a clamp of the type presented above, which is of easy construction and reduced cost.

It is also a specific object of the present invention to provide a clamp as cited above, which promotes the tight and reliable connection of a tubular connecting element
10 of an acoustic muffler of the compressor to a tubular element of said acoustic muffler.

Summary of the Invention

These and other objects of the present invention are attained with the provision of a clamp for a tubular
15 connection of a tubular connecting element, in an elastically deformable material, to be attached around a tubular element that conducts a working fluid, suitable for small refrigeration systems of the type which comprises a compressor operatively associated with a
20 refrigeration circuit containing at least one working fluid, said refrigeration system comprising at least one said tubular element, said clamp comprising two semi-annular portions, each having a first end and a second end, said first ends being coupled to each other in a
25 single piece, by a coupling portion and the second end of one of said semi-annular portions being provided with a locking means to be engaged in a lock receiving means provided in the second end of the other semi-annular
30 portion, the coupling between the two first ends being made so as to allow the two semi-annular portions to be displaced between an open position, with the second ends spaced from each other, allowing to place the clamp around the tubular connecting element already mounted around the tubular element, and a closed position, in
35 which the locking means are retained in the lock receiving means, and in which the tubular connecting element is pressed against the tubular element, wherein

each second end comprises a projecting portion presenting a width and a thickness calculated so as to reinforce the locking region of the clamp, to prevent breaks in the fixation region between the locking means and the lock receiving means, and radially extending outwardly from the contour of the respective semi-annular portion, the coupling portion is elastically deformable and has a contour to constantly force the semi-annular portions to approximate in order to conduct the clamp to its closed position in which each projecting portion has a respective confronting face seated against the confronting face of the other projecting portion. Advantageous embodiments of the invention are described in the independent claims.

15 Brief Description of the Drawings

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

20 Figure 1 represents, schematically and in a lateral view, part of a compressor casing where is provided an inlet suction tube communicating a suction line portion of a refrigeration system with the interior of a prior art acoustic muffler;

25 Figure 2 represents, schematically and in a partial longitudinal section, an acoustic muffler having a tubular connecting element attached to its tubular element through a clamp constructed according to the present invention;

30 Figure 3 represents, schematically and in an enlarged view, the region where the clamp is mounted to the tubular connecting element of figure 2;

Figure 4 represents, schematically and in a longitudinal

section, according to line IV-IV in figure 3, the clamp of the present invention mounted to the tubular connecting element and tubular element of the acoustic muffler;

- 5 Figure 5 schematically represents a front view of the clamp of the present invention in its open position;
Figure 6 schematically represents a front view of the clamp of the present invention in its closed position;
Figure 7 schematically represents a perspective view of
10 the clamp of the present invention in its open position and as illustrated in figure 5; and
Figure 8 schematically represents a perspective view of the clamp of the present invention in its closed position and as illustrated in figure 6.

15 Description of the Illustrated Embodiment

Although the concept described herein is applied to any tubular connections in small refrigeration systems of the type which comprises a compressor operatively associated with a refrigeration circuit containing at
20 least one working fluid FT, the description below will use, as an example, the tubular connections of an acoustic muffler in a refrigeration compressor. It should be understood that this does not imply any restriction to the applicability of the present
25 invention. The same can be said in relation to the embodiment presented in the drawings; what is intended to protect is the principle and not the specific application or constructive form.

According to the present invention, the refrigeration
30 system comprises at least one tubular connecting element 10, made of an elastically deformable material, to be attached around a tubular element 20 that conducts a working fluid FT, such as, for example, a refrigerant fluid, through a clamp 30 which comprises two semi-
35 annular portions 31, each having a first end 32 and a second end 33, said first ends 32 being coupled to one another and the second end 33 of one of said semi-annular

portions 31 being provided with a locking means 40 to be engaged to a lock receiving means 50 provided in the second end 33 of the other semi-annular portion 31, the coupling between the two first ends 32 being made so as to permit said two semi-annular portions 31 to be displaced between an open position, with the second ends 33 spaced from each other to allow placing the clamp 30 around the tubular connecting element 10 already mounted around the tubular element 20 and a closed position, in which the second ends 32 are seated against each other, with the locking means 40 retained in the lock receiving means 50, and in which the tubular connecting element 10 is pressed against the tubular element 20.

It should be understood that the clamp 30 of the present invention can be also applied for attaching tubular connections conducting working fluid FT other than the refrigerant fluid, but which are also present in the refrigeration system, particularly in the interior of the compressor.

According to a way of carrying out the present invention, in order to obtain the closed position of the clamp 30, the locking means 40 is elastically deformed to fit in the lock receiving means 50 upon the mutual seating of the second ends 33 of the semi-annular portions 31, said locking means 40 being, for example, definitively retained in the lock receiving means 50 in said closed position of the two semi-annular portions 31 (figures 6 and 8).

According to a way of carrying out of the present invention, the locking means 40 comprises at least one tooth 41 to be engaged in the lock receiving means 50, which comprises, for example, a projection 51 having a ramp portion 51c against which the tooth 41 of the locking means is actuating, during the operation for obtaining the closed condition of the present clamp.

In a way of carrying out of the present invention, not illustrated, the locking means comprises a projection,

for example, in the form of a tooth, to be introduced through a window of the lock receiving means, engaging to an adjacent edge thereof.

In the illustrated constructive form, the locking means
5 40 and the lock receiving means 50 further present a respective window 42, 52, to facilitate the introduction and the coupling of the parts of tooth 41 and projection 51, respectively of the locking means 40 and of the lock receiving means 50.

10 In a way of carrying out the present invention, the two first ends 32 of the two semi-annular portions 31 of the clamp 30 are coupled to each other, in a single piece, by a coupling portion 34 that is elastically deformable to permit the relative angular movement of the two semi-
15 annular portions 31 between their open and closed positions.

The clamp 30 of the present invention comprises an outer surface made of polymeric material, which guarantees its low electrical conductivity. In a particular form of the
20 present invention, the clamp 30 is provided in polymeric material, being produced by injection in plastic material.

The coupling portion 34 is defined, for example, by an arched projection uniting the first ends 32 of the semi-
25 annular portions 31, whose contour allows said coupling portion 34 to constantly force the semi-annular portions 31 to their closed position. In the illustrated constructive form, the coupling portion 34 is defined by an arched radial projection 34a.

30 According to the illustrations, the two semi-annular portions 31 define a circular contour to the clamp 30, said two semi-annular portions 31 being, for example, symmetrical in relation to a diametral axis of the clamp 30, for example, an axis passing through the coupling
35 portion 34.

The mounting of the clamp of the present invention to the tubular connections will be described considering the

tubular connections for an acoustic muffler 2 of the type utilized in the suction line of a refrigeration compressor, as illustrated in the enclosed drawings.

According to the drawings illustrated in figures 2-4, the clamp 30 of the present invention is conducted, in its open position, to surround a usually flexible tubular connecting element 10 provided around a usually more rigid tubular element and which defines an inlet nozzle of the acoustic muffler 2, which, in the illustrated example, is a suction acoustic muffler. For this mounting arrangement, the first and second ends 32, 33 of each semi-annular portion 31 are conducted to a mutual spacing, until each said semi-annular portion 31 is seated against an adjacent outer surface portion of the tubular connecting element 10, in the fixation region thereof around the tubular element 20. For a better fixation of the clamp 30 to said tubular connections, the inner diameter defined by the semi-annular portions 31, in the closed position of said clamp 30, must be at most equal to the outer diameter of the tubular connecting element 20 around which said clamp 30 is mounted, so that, in the closed position, said clamp 30 exerts a radial compression of said tubular connecting element 10 against the tubular element 20.

After mounting the clamp around the tubular connecting element 10, the coupling portion 34 forces the semi-annular portions 31 to approximate, in order to conduct the clamp 30 to its closed position. In this condition, the locking means 40 is coupled to the lock receiving means 50, for example, by fitting the tooth 41 of said locking means 40 into the projection 51 of the lock receiving means 50, forcing the first ends 32 of the semi-annular portions 31 to a mutual seating.

In the illustrated construction, each second end 33 comprises a projecting portion 33a radially extending outwardly from the contour of the respective semi-annular portion 31 and presenting, in a free end, a respective

lateral flange 33b. In the closed position of the clamp 30 of the present invention, the projecting portion 33a of each semi-annular portion 31 has a respective confronting face seated against the confronting face of the other projecting portion 33a. Each projecting portion 33a presents a width and a thickness calculated so as to reinforce the locking region of the clamp, preventing breaks in the fixation region between the locking means 40 and the lock receiving means 50. In the illustrated construction, each projecting portion 33a presents a width superior to the width of a corresponding semi-annular portion 31, for example, by a value between 1.5 and 2 times the width of said semi-annular portion 31. The projection 51 of the lock receiving means 50 comprises a base 51a, orthogonally projecting from the confronting face of the respective projecting portion 33a towards the projecting portion 33a of the other semi-annular portion carrying the locking means 40, said base 51a having an upper face disposed substantially parallel to an adjacent upper edge 42a of the window 42 defined in the other projecting portion 33a carrying the locking means 40, in order to remain seated against this upper edge 42a, in the closed position of the present clamp. The projection 51 comprises a tongue 51b, angularly projecting from the base 51a, so as to have a ramp face facing the tooth 41 of the locking means 40, an end of said tongue 51b spaced from an adjacent lower edge 52a of the window 52 being provided in the respective semi-annular portion 31, to allow introducing the tooth 41 of the locking means 40, upon the mounting the clamp of the present invention, around a tubular connecting element. In the illustrated construction, each of the parts of tooth 41 and projection 51, respectively of the locking means 40 and of the lock receiving means 50 presents a respective ramp portion, said ramp portions mutually actuating when the clamp is conducted to the closed position, provoking the elastic deformation of said

parts, until both are mutually engaged.

The clamp 30 of the present invention has, as advantages, the elimination of risks with short circuit, in case the clamp 30 falls in the interior of the casing 1 of the compressor, since its material is a bad electricity conductor, providing more safety to the user, in case said clamp 30 presents a defect and detaches from its mounting position.

Another advantage of the present solution refers to the easy handling and application of the present clamp 30, not only by the fact of said clamp being obtained in a flexible material, such as polymeric material, which has more flexibility in relation to the steel of the usual constructions, but also regarding the construction of the coupling portion of said clamp 30. This flexibility allows the clamp 30 to be handled and applied more easily in situations in which there is no much space to use tools or automatic mounting devices.

A further advantage refers to the reduced cost for obtaining the clamp 30 of the present invention, since the manufacture of said clamp 30 is made in a single step, by injection, without requiring shaping or welding processes, with or without the use of heat, or applications through a thermo-shrinkable process.

25

CLAIMS

1. A clamp for a tubular connection of a tubular
connecting element (10), in an elastically deformable
5 material, to be attached around a tubular element (20)
that conducts a working fluid (FT), suitable for small
refrigeration systems of the type which comprises a
compressor operatively associated with a refrigeration
circuit containing at least one working fluid (FT), said
10 refrigeration system comprising at least one said tubular
connecting element (10) and one said tubular element (20)
said clamp comprising two semi-annular portions (31)
having, each one, a first end (32) and a second end (33),
said first ends (32) being coupled to each other, in a
15 single piece, by a coupling portion (34) and the second
end (33) of one of said semi-annular portions (31) being
provided with a locking means (40) to be engaged in a
lock receiving means (50) provided in the second end (33)
of the other semi-annular portion (31), the coupling
20 portion (34) between the two first ends (32) being made
so as to allow said two semi-annular portions (31) to be
displaced between an open position, with the second ends
(33) spaced from each other, allowing to place the clamp
(30) around the tubular connecting element (10) already
25 mounted around the tubular element (20), and a closed
position, in which the locking means (40) are retained in
the lock receiving means (50), and in which the tubular
connecting element (10) is pressed against the tubular
element (20), wherein each second end (33) comprises a
30 projecting portion (33a) presenting a width and a
thickness calculated so as to reinforce the locking
region of the clamp, to prevent breaks in the fixation
region between the locking means (40) and the lock
receiving means (50), and radially extending outwardly
35 from the contour of the respective semi-annular portion
(31), the coupling portion (34) is elastically deformable
and has a contour to constantly force the semi-annular

portions (31) to approximate in order to conduct the clamp (30) to its closed position in which each projecting portion (33a) has a respective confronting face seated against the confronting face of the other projecting portion (33a).

2. Clamp, as set forth in claim 1, characterized in that the coupling portion (34) is defined by an arched projection of the first ends (32) of the semi-annular portions (31).

3. Clamp, as set forth in claim 2, characterized in that the coupling portion (34) is defined by an outer radial projection.

4. Clamp, as set forth in claim 1, characterized in that the locking means (40) is elastically deformed, upon the mutual seating of said second ends (33), to be attached in the lock receiving means (50).

5. Clamp, as set forth in claim 4, characterized in that the locking means (40) is definitively retained in the lock receiving means (50), in the closed position of the two semi-annular portions (31).

6. Clamp, as set forth in claim 4, characterized in that the locking means (40) comprises a tooth (41) to be engaged in a projection (51) of the lock receiving means (50).

7. Clamp, as set forth in claim 1, characterized in that the two semi-annular portions (31) define a circular contour when in the closed position.

8. Clamp, as set forth in claim 7, characterized in that the two semi-annular portions (31) are symmetrical in relation to a diametral axis of the clamp (30).

9. Clamp, as set forth in claim 1, characterized in that it comprises an outer surface in an electrical non-conductive material.

10. Clamp, as set forth in claim 9, characterized in that it is formed, in a single piece, of polymeric material.