

A SUCTION ARRANGEMENT FOR A RECIPROCATING HERMETIC
COMPRESSOR

Field of the Invention

5 The present invention refers to a suction arrangement for a reciprocating hermetic compressor of the type having low pressure within its hermetic shell.

Background of the Invention

Reciprocating hermetic compressors are generally
10 provided with suction acoustic dampening systems (acoustic filters), which are disposed inside the shell with the function to attenuate the noise generated during the suction of the refrigerant fluid. Such components, however, cause losses both in the
15 refrigerating capacity and in the efficiency of the compressor, resulting from gas overheating and flow restriction. The manufacture of said filters from plastic materials have meant a significant advance regarding their optimization, although a considerable
20 amount of the compressor losses is still due to this component.

In reciprocating compressors, the movement of the piston and the use of suction and discharge valves, which open only during a fraction of the total cycle,
25 produce a pulsing gas flow both in the suction and in the discharge lines. Such flow is one of the causes of noise, which may be transmitted to the environment in two forms: by the excitement of the resonance frequencies of the inner cavity of the compressor, or
30 of other component of the mechanical assembly, or by the excitement of the resonance frequencies of the piping of the refrigerant system, i.e., evaporator, condenser and connecting tubes of these components of the compressor refrigerating system. In the first case,
35 the noise is transmitted to the shell, which irradiates

it to the external environment.

In order to attenuate the noise generated by the pulsing flow, acoustic dampening systems (acoustic filters) have been used. These systems may be
5 classified as dissipative and reactive systems. The dissipative dampening systems absorb sound energy, but create an undesirable pressure loss. On the other hand, the reactive mufflers tend to reflect part of the sound energy, thereby reducing pressure loss. The dissipative
10 mufflers are more used in discharge dampening systems, where the pulsation is high. The reactive systems are preferred for the suction, since they present less pressure loss. Said pressure loss in the acoustic filters is one of the causes that reduce the efficiency
15 of the compressors, mainly in the suction case, which is more sensible to the pressure loss effects.

Other cause that reduces the efficiency of the compressors, when usual acoustic mufflers are employed, is the overheating of the suctioned gas. During the
20 time interval between the entrance of the gas into the compressor and its admission to the compressor cylinder, the gas temperature is increased, due to heat transfer from the several hot sources existing inside the compressor. The temperature increase causes an
25 increase in the specific volume and consequently a reduction in the refrigerant mass flow. Since the refrigerating capacity of the compressor is directly proportional to the mass flow, reducing said flow results in efficiency loss.

30 Reducing these negative effects has been achieved with the evolution in the acoustic filter designs.

In prior constructions, the gas coming from the suction line and discharged into the shell passes through the main hot sources inside the compressor, before reaching
35 the filter and being drawn towards the cylinder inside

(indirect suction). This gas circulation should promote the cooling of the motor. Because of this and because the filters were usually metallic, the efficiency of the compressor was impaired due to gas overheating.

- 5 The requirements for more efficient compressors have led to the development of acoustic dampening systems with more efficient conceptions. The gas, rather than passing through all heated parts inside the compressor, is drawn directly to the inside of the suction filter
10 (U.S. 1,591,239, U.S. 4,242,056). Other technique uses, in the suction piping inside the compressor, nozzles or flared tubes (U.S. 4,486,153), which allow the flow to be directed between the inlet tube and the suction filter. Moreover, such filters began to be manufactured
15 with plastic materials, which have adequate thermal insulating properties. These improvements brought about considerable increases in the efficiency of the refrigerating hermetic compressors. Nevertheless, overheating and load loss due to the use of the suction
20 filter still represent significant amounts in the efficiency losses of the compressors.

In the known reciprocating hermetic compressors of the art, the gas coming from the evaporator enters into the shell and then passes through the suction filter,
25 wherefrom it is drawn to the inside of the cylinder defined in the cylinder block, where it is compressed up to a pressure sufficient to open the discharge valve. Upon being discharged, said gas passes through the discharge valve and discharge filter, leaving the
30 compressor inside and leading towards the condenser of the refrigerating system. In this type of compressor, the discharge filter is always hermetic, i.e., the gas is not released into the shell inside, whereas the suction filter is in fluid communication with said
35 shell inside.

Disclosure of the Invention

Thus, it is an object of the present invention to provide a reciprocating hermetic compressor with a suction arrangement which presents, besides less
5 suction gas heating, a reduction of pressure loss associated with the suction filter.

This and other objectives are achieved through a suction arrangement for a reciprocating hermetic compressor of the type including a hermetic shell
10 comprising a suction inlet tube for admitting gas into the shell; a suction orifice, which is provided at the head of a cylinder disposed inside the shell and which is in fluid communication with the suction inlet tube, said arrangement comprising a suction means having a
15 first end hermetically coupled to the suction inlet tube and a second end hermetically coupled to the suction orifice, in order to conduct low pressure gas from the suction inlet tube directly to the suction orifice, providing thermal and acoustic insulation to
20 the gas flow being drawn; and at least one pressure equalizing means, providing a predetermined fluid communication of the gas being drawn between the suction inlet tube and suction orifice into the shell, said pressure equalizing means maintaining
25 substantially unaltered the thermal and acoustic insulating characteristics of the suction means.

Brief Description of the Drawings

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

30 Fig. 1 shows, schematically and in a vertical longitudinal sectional view, a reciprocating hermetic compressor of the type used in refrigerating systems and constructed according to the prior art;

Fig. 2 shows, schematically, a reciprocating hermetic
35 compressor, associated with a refrigerating system

according to the prior art;

Fig. 3 shows, schematically and in a partial view, a reciprocating hermetic compressor, associated with a refrigerating system according to one constructive form of the present invention;

Fig. 4 shows, schematically and in a partial view, a reciprocating hermetic compressor, associated with a refrigerating system according to another constructive form of the present invention;

Fig. 5 shows, schematically and in an enlarged view, a construction of the suction means mounted to both the suction inlet tube and suction chamber inlet of the compressor shell, and a pressure equalizing means mounted to the assembly; and

Fig. 6 shows, schematically and in a frontal view, a constructive form for the suction means of the present invention;

Best Mode of Carrying Out the Invention

According to the illustrations, a refrigerating system of the type used in refrigerating appliances usually comprise, connected by adequate piping, a condenser 10, which receives high pressure gas at the high pressure side of a hermetic compressor 20 of the reciprocating type and which sends high pressure gas to a capillar tube 30, where the refrigerant fluid is expanded, communicating with an evaporator 40 which sends low pressure gas to a low pressure side of the hermetic compressor 20.

According to figure 1 as shown, the hermetic compressor 20 comprises a shell 21, inside which is suspended through springs a motor-compressor unit including a cylinder block, in which a cylinder 22 lodges a piston 23 that reciprocates within said cylinder 22, drawing and compressing the refrigerant gas when driven by the electric motor. Said cylinder 22 has an open end, which

is closed by a valve plate 24 affixed to said cylinder block and provided with suction and discharge orifices. Said cylinder block further carries a head which is mounted onto said valve plate 24 and which defines
5 internally therewith a suction chamber 25 and a discharge chamber 26, which are maintained in selective fluid communication with cylinder 22, through the respective suction and discharge orifices 24a, 24b. Said selective communication is defined by opening and
10 closing said suction and discharge orifices 24a, 24b by the respective suction and discharge valves 25a, 26a.

By suction chamber it is meant only the volume of the cylinder head upstream the suction valve 25a.

The communication between the high pressure side of the
15 hermetic compressor 20 and the condenser 10 occurs through a discharge tube 27 having an end, which is opened to an orifice provided on the surface of shell 21, communicating said discharge chamber 26 with condenser 10, and an opposite end, which is opened to
20 the discharge chamber 26.

Shell 21 further carries a suction inlet tube 28, mounted to an admission orifice which is provided at shell 21 and opened to the inside of the latter, communicating with a suction piping located externally
25 to shell 21 and coupled to the evaporator 40. In this construction, the gas coming from shell 21 is admitted inside a suction acoustic filter 50 mounted in front of the suction chamber 25, in order to dampen the noise of the gas being drawn into cylinder 22 during the opening
30 of the suction valve. This construction has the deficiencies discussed above.

According to the present invention, as illustrated in figures 3 and 6, between the evaporator 40 and the inside of suction chamber 25 of the hermetic compressor
35 20, there is mounted, interconnecting said parts, a

suction means 60, which is provided within shell 21 and which comprises, at least on a portion of its length, a suction duct, in flexible material for instance, having a first end 61 coupled to the suction inlet tube 28 and
5 a second end 62 coupled to a gas inlet portion of the suction chamber 25, said suction duct 60 being hermetically affixed to both suction inlet tube 28 and suction chamber 25, so as to conduct low pressure gas from the evaporator 40 directly to said suction chamber
10 25, providing thermal and acoustic insulation of the gas being drawn in relation to the internal environment of the compressor. In another constructive option of the present invention, the second end 62 of the suction duct 60 communicates the gas being drawn directly to
15 cylinder 22, for example with said second end 62 being hermetically and directly coupled to the suction orifice 24a.

According to the present invention, the hermetic compressor 20 no longer has the suction acoustic filter
20 50 within shell 21. In a constructive option as illustrated in figure 4, the suction acoustic filter 50 is mounted upstream the suction inlet tube 28. Mounting the filter externally to shell 21 allows filters with higher volume and tubes with larger diameters to be
25 used, while still providing the same acoustic dampening effect with less pressure loss. Since the refrigerating capacity is proportional to the suction pressure, the less said loss, the higher will be the compressor efficiency. This filter arrangement prevents the gas,
30 while passing through the inside of said filter, from being unduly heated as it occurs in the prior art construction.

According to the present invention, the suction duct 60 is designed so as to be preferably produced as a
35 continuous tubular duct, which is constructed, in order

to avoid interruption of the gas flow being drawn, in an adequate material which causes minimum noise and vibration transmission to shell 21 and which further avoids gas overheating during the admission thereof. In order to have these qualities, the suction duct 60 is obtained with a construction that offers high resistance to heat transmission, such as for example the constructions using a material with low conductivity characteristic (poor thermal conductors), which also have good acoustic dampening characteristics.

The requirement of suction piping flexibility is due to the relative movement existing between the mechanical assembly and the shell 21, since the mounting of said parts is made through flexible springs. The flexibility will prevent said piping from being broken during transportation or even during normal operation of the compressor.

The suction duct 60 is further dimensioned in order to minimize the noise generated by the pulsing flow resulting from the excitement of both the suction line piping and the evaporator 40, and in order to reduce loss of load of the gas flow coming from the suction inlet tube 28 and consequently to the suction chamber 25 or directly to the suction orifice 24a.

Due to the characteristics of the gas flow, smaller length and larger diameter of the suction duct 60 inside the compressor, there will be less pressure loss in relation to the pressure loss existing in the suction filter used in the prior art.

Using the suction duct 60 causes a reduction of the path made by the gas inside the shell, previously to being admitted into the cylinder. By reducing the path, the overheating effect of the gas being drawn is smaller, which increases the refrigerating capacity and

efficiency.

In a constructive option of the present invention for the suction means 60, as illustrated in figures 5 and 6, said means is in the form of a loop tube, which is
5 "U" shaped with rounded sides and internally provided with or incorporating (for example by material injection) at least one spring element 63 which constantly maintains said tube in a condition of structural stability, in order to prevent it from
10 collapsing when submitted to pressure differences, such as during the compressor operation.

According to the present invention, as illustrated in figures 4 and 5, between the suction inlet tube 28 and suction chamber 25, the suction arrangement of the
15 present invention further comprises a pressure equalizing means 70 which preferably provides a predetermined fluid communication between the inside of the suction chamber 25 and the inside of shell 21, said pressure equalizing means 70 being dimensioned so as to
20 promote jointly with the suction means 60 the acoustic energy absorption of the gas being drawn.

In the constructive option in which the second end 62 of the suction means 60 is directly coupled to the suction orifice 24a, the pressure equalizing means 70
25 is provided between the suction inlet tube 28 and said suction orifice 24a, in order to provide fluid communication of the gas being drawn with the inside of shell 21.

The pressure equalizing means 70 may be further
30 dimensioned and constructed in order to provide thermal insulation, as it occurs with the suction means 60.

In the preferred illustrated construction, the pressure equalizing means 70 is in the form of a rigid capillar tube, which has a small diameter and long length and
35 which comprises, between an inlet end, attached to and

opened into the suction chamber 25, and an outlet end to release the gas into the inside of shell 21, an acoustic dampening region 71, for instance in the form of a median helical portion occupying a substantial length portion of the pressure equalizing means 70, said length portion being defined so as to reduce the acoustic energy of the suction gas directed to the inside of shell 21. The pressure equalizing means 70 further allows to obtain a pressure inside said shell 21 substantially proximate to the suction pressure.

According to the present invention, the low pressure gas released inside shell 21 through the pressure equalizing means 70 causes a high gas flow restriction, so that the acoustic waves originated at the outlet of said pressure equalizing means have very low energy, which is insufficient to excite the resonances inside the cavity.

Though not illustrated, the suction arrangement of the present invention may have a plurality of pressure equalizing means coupled or incorporated to at least one of the parts defined by the suction duct 60 and suction chamber 25. Other constructive solutions of the present invention have a pressure equalizing means with a plurality of at least one of the parts defined by the inlet ends and outlet ends interconnected by one or more acoustic dampening regions 71.

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1. A suction arrangement for a reciprocating hermetic compressor of the type including a hermetic shell (21),
5 comprising a suction inlet tube (28) for admitting gas into the shell; a suction orifice (24a), which is provided at the head of a cylinder (22) disposed inside the shell (21) and which is in fluid communication with the suction inlet tube (28), characterized in that it
10 comprises a suction means (60) having a first end (61) hermetically coupled to the suction inlet tube (28) and a second end (62) hermetically coupled to the suction orifice (24a), in order to conduct low pressure gas from the suction inlet tube (28) directly to the
15 suction orifice (24a), providing thermal and acoustic insulation to the gas flow being drawn; and at least one pressure equalizing means (70), providing a predetermined fluid communication of the gas being drawn between the suction inlet tube (28) and suction
20 orifice (24a) into the shell (21), said pressure equalizing means (70) maintaining substantially unaltered the thermal and acoustic insulating characteristics of the suction means (60).
2. Arrangement, as in claim 1, characterized in that
25 the pressure equalizing means (70) is in the form of a capillary tube having, on a portion of its length, at least one acoustic dampening region (71), defined so as to reduce the acoustic energy in the suction gas directed towards the inside of shell (21).
- 30 3. Arrangement, as in claim 2, characterized in that the pressure equalizing means (70) comprises, between a gas inlet end and a gas outlet end opened to the inside of shell (21), a respective acoustic dampening region (71).
- 35 4. Arrangement, as in claim 3, characterized in that



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the pressure equalizing means (70) is a capillary element in a rigid material, with the gas inlet end coupled to the suction chamber (25) and the gas outlet end opened towards the inside of shell (21).

5 5. Arrangement, as in claim 4, characterized in that the acoustic dampening region (71) is defined by a helical portion of the length of the pressure equalizing means (70).

10 6. Arrangement, as in claim 1, characterized in that the suction means (60) is provided, at least on part of its extension, with a construction having high resistance to heat transmission.

15 7. Arrangement, as in claim 6, characterized in that the suction means (60) comprises, at least on part of its extension, a flexible duct.

8. Arrangement, as in claim 7, characterized in that the flexible duct is made of a material with low thermal conductivity.

20 9. Arrangement, as in claim 8, characterized in that the suction duct (60) is dimensioned to reduce the load loss of the gas flow arriving at the suction inlet tube (28).

25 10. Arrangement, as in claim 9, characterized in that the suction duct (60) is defined so that the gas flow being drawn is not interrupted between the suction inlet tube (28) and the suction orifice (24a).

30 11. Arrangement, as in claim 10, characterized in that the second end (62) of the suction means (60) is hermetically and directly coupled to the suction chamber (25).

35 12. Arrangement, as in claim 11, characterized in that the suction duct (60) is in the form of a "loop" tube, which is "U" shaped and has rounded sides, and which is internally provided with at least one spring element (63) which constantly maintains a condition of





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structural stability to said tube.

13. Arrangement, as in claim 1, characterized in that it comprises a suction acoustic filter (50) mounted upstream the suction inlet tube (28).

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