(54) Title: IMPROVED SUCTION MUFFLER FOR USE IN A HERMETICALLY SEALED COMPRESSOR OF A REFRIGERATION APPLIANCE

(57) Abstract: The present invention relates to a suction muffler (1) for use in a hermetically sealed compressor (2) of a refrigeration appliance. The suction muffler (1) comprises a shell (3), a cavity (4) inside the shell (3), an inlet port (5) for admitting the refrigerant into the cavity (4) and an outlet port (6) for discharging the refrigerant out of the cavity (4). In the suction muffler (1) of the present invention the cavity (4) is enclosed by an un-smooth surface (7) which has a plurality of raised portions (8) for acoustically damping the refrigerant which flows through the cavity (4).
Description

IMPROVED SUCTION MUFFLER FOR USE IN A HERMETICALLY SEALED COMPRESSOR OF A REFRIGERATION APPLIANCE

[0001] The present invention relates to a hermetically sealed compressor of a refrigeration appliance such as a domestic refrigerator. The present invention particularly relates to the suction muffler of the hermetically sealed compressor.

[0002] Hermetically sealed compressors which are used in domestic refrigerators are commonly known. A hermetically sealed compressor generally comprises a reciprocating mechanism which conveys the refrigerant from the evaporator side to the condenser side. During the refrigeration cycle, the flow of the refrigerant and the moving parts of the reciprocating mechanism generate vibrations and noise. To reduce the noise, the refrigerant is generally passed through a suction muffler which is disposed into the hermetically sealed compressor on an upstream side of the valve plate. The suction mufflers which are used in hermetically sealed compressors are commonly known. A suction muffler usually comprises a shell, at least one cavity inside the shell, an inlet port for admitting the refrigerant into the cavity and an outlet port for discharging the refrigerant out of the cavity. An effective operation of the suction muffler is crucial for the customer satisfaction. The installation place of the domestic refrigerator can easily become very noisy and jeopardize a customer's living comfort. Therefore, the noise produced by the flow of the refrigerant must be effectively damped to safeguard silent operation of the domestic refrigerator. In general, the reduction in the noise which can be attained by the suction muffler depends on its size and shape. However an increase in the size of the suction muffler is not desired in view of the production costs.

[0003] An objective of the present invention is to provide a suction muffler for use in a hermetically sealed compressor of a refrigeration appliance which overcomes the aforementioned drawbacks of the prior art in a cost effective way and which enables a low noise operation.

[0004] This objective has been achieved by the suction muffler as defined in
claim 1, the hermetically sealed compressor as defined in claim 14 and the refrigeration appliance as defined in claim 15. Further achievements have been attained by the subject-matters respectively defined in the dependent claims.

[0005] In the suction muffler of the present invention, the cavity is enclosed by an unsmooth surface which has a plurality of raised portions for acoustically damping the refrigerant which flows through the cavity.

[0006] With the present invention, the reduction in the noise level attained by the cavity has been further increased by virtue of the unsmooth surface in a similar way as in anechoic chambers. The raised portions increase the total surface area of the cavity. Thereby, the sound waves propagating in the refrigerant encounter an increased number of successive impingements on the unsmooth surface of the cavity and thus, attenuate stronger. With the suction muffler of the present invention, the noise generated by the flow of the refrigerant can be reduced to desired and bearable levels which comply with the standards without compromising the overall size of the compressor. Thereby, the refrigeration appliance can be prevented from causing any acoustic discomfort to the user. Thereby, the customer satisfaction can be increased.

[0007] In an embodiment, the unsmooth surface is immediately formed into the interior of the shell. Thereby, the noise reduction capability of the cavity inside the shell has been further improved.

[0008] In an alternative embodiment, the unsmooth surface is immediately formed into the interior of a separate inner covering instead of the shell. In this alternative embodiment, the suction muffler is retrofitted with the inner covering for improving the noise reduction of the cavity of the shell. The inner covering is also useful in acoustically decoupling the unsmooth surface from the shell. In this embodiment, the shell and the inner covering are manufactured from the same material or alternatively from different materials for example with different thermal properties and/or acoustic properties.

[0009] In another alternative embodiment, the unsmooth surface is immediately formed into the interior of a separate inner layer instead of the inner
covering and the shell. In this alternative embodiment, the inner layer is fixed onto the interior of the inner covering. And the suction muffler is retrofitted with the inner covering which has the inner layer fixed thereon. In this embodiment, the inner covering and the inner layer are manufactured from the same material or alternatively from different materials as mentioned above.

[0010] In another embodiment, the suction muffler is manufactured from thermal insulation materials and/or plastic materials.

[0011] In another embodiment, the raised portions are arranged in one or more than one two-dimensional arrays.

[0012] In another embodiment, the raised portion has a pyramidal shape. The raised portion alternatively has a wedge shape, a knobbed shape or the like.

[0013] Additional advantages of the suction muffler and the hermetically sealed compressor of the present invention will become apparent with the detailed description of the embodiments with reference to the accompanying drawings in which:

[0014] Figure 1 - is a schematic perspective view of a hermetically sealed compressor which has a suction muffler according to an embodiment of the present invention,

[0015] Figure 2 - is a schematic partial exploded perspective view of the suction muffler according to an embodiment of the present invention,

[0016] Figure 3 - is a schematic enlarged view of the detail A of Fig. 2,

[0017] Figure 4 - is another schematic partial exploded perspective view of the suction muffler according to an embodiment of the present invention,

[0018] Figure 5 - is another schematic partial exploded view of the suction muffler according to an embodiment of the present invention.

[0019] The reference signs appearing on the drawings relate to the following technical features.

1. Suction muffler
2. Compressor
3. Shell

[0020] 3a. Part
The suction muffler (1) is suitable for use in the hermetically sealed
compressor (2) of a refrigeration appliance, in particular a domestic refrigerator.

[0026] The suction muffler (1) comprises a shell (3), at least one cavity (4) inside the shell (3), an inlet port (5) for admitting the refrigerant into the cavity (4) and an outlet port (6) for discharging the refrigerant out of the cavity (4) (Fig. 1 to 5).

[0027] In the suction muffler (1) of the present invention, the cavity (4) is enclosed by an unsmooth surface (7). The unsmooth surface (7) has a plurality of raised portions (8) for acoustically damping the refrigerant which flows through the cavity (4).

[0028] The hermetically sealed compressor (2) of the present invention comprises the suction muffler (1).

[0029] The refrigeration appliance (not shown) of the present invention comprises the hermetically sealed compressor (2).

[0030] In an embodiment, the unsmooth surface (7) is defined by the interior of the shell (3). In this embodiment, the unsmooth surface (7) is immediately formed into the interior of the shell (3) during the manufacturing process.

[0031] In an alternative embodiment, the suction muffler (1) comprises an inner covering (9) which is installed into the shell (3). In this embodiment, the unsmooth surface (7) is defined by the interior of the inner covering (9) instead of the shell (3). In this embodiment, the unsmooth surface (7) is immediately formed into the interior of the inner covering (9) during the manufacturing process. And the inner covering (9) is subsequently assembled with the shell (3) (Fig. 1 to 5). Thereby, the suction muffler (1) can be easily retrofitted with the unsmooth surface (7) for improving the noise reduction. In addition, as the inner covering (9) is separately provided from the shell (3), the unsmooth surface (7) can be acoustically decoupled from the shell (3).

[0032] In another alternative embodiment, the suction muffler (1) comprises an inner covering (9) which is installed into the shell (3) and an inner layer (10) which is fixed onto the interior of the inner covering (9). In this embodiment, the unsmooth surface (7) is defined by the interior of the inner layer (10) instead of the inner covering (9) and the shell (3). In this
embodiment, the unsmooth surface (7) is immediately formed into the interior of the inner layer (10) during the manufacturing process. And the inner layer (10) is subsequently assembled with the inner covering (9) and the shell (3).

[0033] In a version of the preceding embodiment, the inner layer (10) is manufactured from a thermal insulation material.

[0034] In another version of the preceding embodiments, the inner covering (9) is manufactured from a thermal insulation material.

[0035] In another version of the preceding embodiments, the thermal insulation material comprises a heat-resistant durable resin.

[0036] In another version of the preceding embodiments, the inner covering (9) has three pieces, namely a top part (9a), a bottom part (9b) and a circumferential part (9c) which fit the interior of the shell (3).

[0037] In another version of the preceding embodiments, the shell (3) is manufactured from a heat-resistant durable plastic.

[0038] In another version of the preceding embodiments, the plurality of raised portions (8) are arranged in one or more than one two-dimensional arrays which enclose the cavity (4).

[0039] In another version of the preceding embodiments, each raised portion (8) has a pyramidal shape or a truncated pyramidal shape. In an alternative version of the preceding embodiments, the raised portion (8) has a wedged shape, a knobbed or the like.

[0040] In another version of the preceding embodiments, the shell (3) has two pieces, namely an upper part (3a) and a lower part (3b) which are releasably attachable to each other. The inlet port (5) is on the lower part (3a) and the outlet port (6) is on the upper part (3b).

[0041] In another version of the preceding embodiments, the inlet port (5) and the outlet port (6) are located on different sides of the shell (3) which do not oppose each other.

[0042] In another version of the preceding embodiments, the upper part (3a) of the shell (3) has one or more than one slots (11) and the lower part (3b) of the shell (3) has one or more than one claw (12) for snap fitting into the corresponding slot (11).
In the subsequent description, the operation of the hermetically sealed compressor (2) will be briefly explained by way of example. The compressor (2) is hermetically sealed by the upper casing (13) and the lower casing (14). The lower casing (14) serves as the lubricant sump (15). An oil pickup-tube (16) is partly immersed into the lubricant sump (15). The motor (17) has a stator (18) and a rotor (19). The crankshaft (20) is journalled to the main bearing (21) on the cylinder block (22) and fixed to the rotor (19). The piston (23) is reciprocatingly disposed into the cylinder bore (24) for compressing the refrigerant therein. The piston (23) is coupled via the connecting rod (25) and the pin (26) to the crankshaft (20). The cylinder bore (24) is covered by the cylinder head (27). As the piston (23) moves forwards, the compressed refrigerant enters the exhaust chamber (28) of the cylinder head (27) via the exhaust port (29) of the valve (30) which is arranged between the cylinder head (27) and the cylinder block (22). As the piston (23) moves rearwards, the refrigerant is sucked from the suction muffler (1) and through the intake port (31) of the valve plate (30) into the cylinder bore (24). The noise is mainly generated in the vicinity of the intake port (31) and the exhaust port (29) of the valve plate (30) under the influence of the reciprocating movement of the piston (23). The suction muffler (1) attenuates the acoustic waves generated inside the refrigerant which flows through the cavity (4).

In another version of the preceding embodiments, the suction muffler (1) is mounted to the cylinder head (27) at a location upstream of the valve plate (30).

In another version of the preceding embodiments, the refrigeration appliance is provided as a domestic refrigerator.

With the suction muffler (1) of the present invention, the noise level of the hermetically sealed compressor (2) can be reduced to desired levels in a cost effective way. With the present invention, a refrigeration appliance has been provided which has a low noise emission. Thereby, the customer satisfaction can be increased.
Claims

1. A suction muffler (1) for use in a hermetically sealed compressor (2) of a refrigeration appliance, the suction muffler (1) comprising a shell (3), a cavity (4) inside the shell (3), an inlet port (5) for admitting the refrigerant into the cavity (4) and an outlet port (6) for discharging the refrigerant out of the cavity (4), the suction muffler (1) being characterized in that the cavity (4) is enclosed by an unsmooth surface (7) which has a plurality of raised portions (8) for acoustically damping the refrigerant which flows through the cavity (4).

2. The suction muffler (1) according to claim 1, characterized in that the unsmooth surface (7) is defined by the interior of the shell (3).

3. The suction muffler (1) according to claim 1, characterized in that an inner covering (9) which is installed into the shell (3), wherein the unsmooth surface (7) is defined by the interior of the inner covering (9).

4. The suction muffler (1) according to claim 1, characterized in that an inner covering (9) which is installed into the shell (3) and an inner layer (10) which is fixed onto the interior of the inner covering (9), wherein the unsmooth surface (7) is defined by the interior of the inner layer (10).

5. The suction muffler (1) according to claim 4, characterized in that the inner layer (10) is made from a thermal insulation material.

6. The suction muffler (1) according to any one of claims 3 to 5, characterized in that the inner covering (9) is made from a thermal insulation material.

7. The suction muffler (1) according to claim 5 or 6, characterized in that the thermal insulation material comprising a heat-resistant durable resin.

8. The suction muffler (1) according to any one of claims 3 to 7, characterized in that the inner covering (9) has a top part (9a), a bottom part (9b) and a circumferential part (9c) which fit the interior of the shell (3).

9. The suction muffler (1) according to any one of claims 1 to 8, characterized in that the shell (3) is made from heat-resistant durable plastic.

10. The suction muffler (1) according to any one of claims 1 to 9, characterized in that the plurality of raised portions (8) are arranged into a two-dimensional array.

11. The suction muffler (1) according to any one of claims 1 to 10, characterized in
that each raised portion (8) has a pyramidal shape.

12. The suction muffler (1) according to any one of claims 1 to 11, characterized in that the shell (3) has an upper part (3a) and a lower part (3b) which are releasably attachable to each other and wherein the inlet port (5) is on the lower part (3a) and the outlet port (6) is on the upper part (3b).

13. The suction muffler (1) according to claim 12, characterized in that the upper part (3a) has one or more than one slots (11) and the lower part (3b) has one or more than one claw (12) for snap fitting into the corresponding slot (11).

14. A hermetically sealed compressor (2), characterized in that the suction muffler (1) as defined in any one of claims 1 to 13.

15. A refrigeration appliance, in particular a domestic refrigerator, characterized in that the hermetically sealed compressor (2) as defined in claim 14.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

INV. F04B39/00 F04C29/06 F04D29/66
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC.

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F04B F04C F04D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of Box C.

See patent family annex.

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Date of the actual completion of the international search

7 July 2015

Date of mailing of the international search report

16/07/2015

Authorized officer

Jurado Orenes, A
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