

HERMETIC COMPRESSOR AND STATOR INSULATOR

TECHNICAL FIELD

- 5 The present disclosure relates to hermetic compressors and particular, it relates to the arrangement of snubbers for suspension springs in a hermetic compressor.

BACKGROUND

- 10 Reduction of vibration of hermetic compressors and the ease of assembly have long been a concern for domestic appliance manufacturers, particularly in compressors for refrigeration appliances.

Many of the appliances utilize reciprocating compressors. The hermetic compressor
15 comprises a motor having a crankshaft coupled to a connecting rod. The connecting rod is coupled to a piston which is housed inside the cylinder head. The connecting rod, the piston and the cylinder head together form the pump assembly of the hermetic compressor. The pump assembly and the motor form the compressor assembly. During operation, the crankshaft of the motor rotates at a predetermined
20 speed. This rotary motion is translated into a linear reciprocating motion via the connecting rod coupled to piston. Noise is generated by the rotating motion of motor and also from vibration of the reciprocating connecting rod and piston of the pump assembly.

- 25 Damping of vibrations from the hermetic compressor is presently achieved by mounting the entire compressor assembly on suspension springs inside the hermetic compressor. The suspension springs are further augmented by snubbers which help maintain the integrity and shape of the suspension springs and also prevent the suspension springs from being displaced from their intended positions.

30 The snubbers are typically used in pairs for each suspension spring. An upper snubber is attached to the compressor assembly and a corresponding lower snubber attached to the lower portion of the hermetic shell. The upper snubber is substantially aligned with the lower snubber and allows the upper snubber to be

fitted into one end of the suspension spring and the lower snubber to be fitted into the opposing end of the same suspension spring.

5 In some hermetic compressors, the upper snubbers are protrusions formed on the front and rear support leg that are coupled to the stator. Due to the desire to reduce compressor parts and to simplify assembly process, in a recent development, bolt heads screwed at the peripheral of the stator also act as upper snubbers coupled to the suspension spring. However, the location of the upper snubber is restricted by the location of the bolt head.

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SUMMARY OF THE INVENTION

15 In aspects of the present disclosure, one or more snubbers are provided on a stator insulator within a hermetic compressor. This provides flexibility in the positioning of the snubbers and therefore the positioning of the suspension springs. Further, since the snubbers are provided on the stator insulator, the number of parts of the hermetic compressor may be reduced.

20 According to a first aspect of the present disclosure a hermetic compressor comprises an electromotive element and a compressing element. In operation, the electromotive element drives the compressing element. The electromotive element comprises a stator core and a lower insulator. The compressing element is arranged above the electromotive element in a container housing and the stator supports the compressing element. A plurality of suspension springs support the stator above the
25 base of the container. The lower insulator of the stator comprises at least one snubber configured to engage one of the suspension springs.

30 In embodiments of the present invention the lower insulator of the stator comprises at least one snubber configured to engage with a suspension spring that support the stator and therefore the compressing element that is located above the stator. The suspension springs act to damp vibrations from the reciprocation of the compressing element. By providing a snubber or a plurality of snubbers on the insulator, the range of possible locations of the snubbers is increased without a requirement for

additional parts of the hermetic compressor since the snubbers may be integrated into the lower insulator of the stator.

5 In some embodiments, the snubber or snubbers on the insulator are arranged within a periphery defined by the stator core. The snubbers may overlap with coil windings on bobbins formed at least in part by the insulator. In some embodiments the snubbers may be provided on deformable arms which allow the coil windings to be wound around the bobbins before the snubber is positioned by bending the deformable arm. The snubbers may be configured to mechanically engage with the
10 bobbins with a clip or locking mechanism to hold the snubbers in place.

In some embodiments, the snubber or the snubbers on the insulator are arranged outside a periphery defined by the stator core. This positioning allows the snubbers to be placed relatively far from the central axis of the stator.

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The snubbers may comprise a protrusion configured to engage with the suspension springs by fitting within the end of the suspension springs. Alternatively, the snubbers may comprise a cup shaped portion configured to receive the end of the suspension springs.

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According to a second aspect of the present disclosure, a stator insulator portion configured to receive a stator core comprises at least one snubber configured to engage with a suspension spring.

25 The stator insulator portion may be substantially annular in cross section and the snubber may be provided on a deformable arm that extends from the insulator portion in a radial direction.

The stator insulator portion may comprise at least one bobbin portion configured to
30 form at least part of a bobbin for receiving a coil winding. The deformable arm may allow the snubber to be moved into a position overlapping the bobbin. The snubber may be configured to engage with the bobbin in the position overlapping the bobbin.

BRIEF DESCRIPTION OF THE DRAWINGS

In the following, embodiments of the present invention will be described as non-limiting examples with reference to the accompanying drawings in which:

5 Figure 1 shows a cut-away view of a hermetic compressor;

Figure 2 shows a view of the compressing element and electromotive element of a hermetic compressor;

10 Figure 3A is a side view of the compressing element and electromotive element of a hermetic compressor according to an embodiment of the present invention;

Figure 3B is a view from below of the compressing element and electromotive element shown in Figure 2A;

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Figure 4A shows a perspective view of the compressing element and electromotive element of a hermetic compressor according to an embodiment of the present invention;

20 Figure 4B is a side view of the compressing element and electromotive element shown in Figure 4A;

Figure 5 shows a cross section through a snubber formed from a lower stator insulator according to an embodiment of the present invention;

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Figure 6A shows a snubber formed from a lower stator insulator according to an embodiment of the present invention; and

Figure 6B shows a cut-away view of the snubber shown in Figure 6A.

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DETAILED DESCRIPTION

Figure 1 shows a cut-away view of a hermetic compressor. The hermetic compressor 100 comprises an airtight container which is formed from a top airtight container portion 101 and a bottom airtight container portion 102. The hermetic compressor 100 comprises a compressing element 103 which is driven by an electromotive element 104. The compressing element 103 comprises a cylinder block 105, a piston 106, a crankshaft 107 and a connecting rod 108. The electromotive element 104 comprises a stator 109 which comprises a stator core 110 and a plurality of stator coil windings 111. A rotor 112 is located within the stator 109. As shown in Figure 1, the compressing element 103 is arranged above the electromotive element 104. The electromotive element 104 supports the compressing element 103. The electromotive element 104 is supported above the base of the bottom airtight container portion 102 by a plurality of suspension springs 113.

In use, an electric current is supplied to the coil windings 111 of the stator 109. This results in a varying magnetic field produced by the stator coil windings 111 and the stator core 109. This magnetic field causes the rotor 112 to rotate within the stator 109. The rotation of the rotor 112 cause the crankshaft 107 to rotate. The rotation of the crankshaft 107 causes the piston 106 to reciprocate within a cylinder in the cylinder block 105. This reciprocation compresses a refrigerant as part of a refrigeration cycle.

The reciprocation of the piston 106 in the cylinder causes vibrations and noise. These vibrations are damped by the suspension springs 113 and snubbers located at the top and bottom of the suspension springs.

Figure 2 shows a view of the compressing element and electromotive element of a hermetic compressor. In the example shown in Figure 2, the compressing element 203 comprises a cylinder block 205. The electromotive element 204 comprises a stator which is formed from a stator core 210 formed from a ferromagnetic material. A stator insulator 214 is arranged within the stator core 210. The stator insulator 214 forms bobbins around which stator coil windings 211 are wound. A rotor 212 is located within the stator.

As shown in Figure 2, the compressing element 203 is coupled to the electromotive element 204 by four bolts 215. The bolts 215 attach the cylinder block 205 to the stator core 210. The bolts 215 form snubbers on which suspension springs 213 are mounted. An advantage of such an arrangement is that the number of parts for the hermetic compressor are reduced since the bolts 215 also perform the function of upper snubbers on which the suspension springs 213 are mounted. A disadvantage of such an arrangement is that the position of the bolts 215 and therefore the snubbers are fixed by the location of the stator core 210 and the locations where the compressing element 203 meets the electromotive element 204.

Figure 3A is a side view of the compressing element and electromotive element of a hermetic compressor according to an embodiment of the present invention. Figure 3B is a view from below of the compressing element and electromotive element shown in Figure 3A.

In the embodiment shown in Figures 3A and 3B, the stator 310 comprises an upper stator insulator 311 and a lower stator insulator 312. A stator core (not shown in Figures 3A and 3B) is arranged between the upper stator insulator 311 and the lower stator insulator 312. The lower stator insulator 312 comprises a plurality of snubbers 313 which in this embodiment comprise protrusions 314 which fit inside suspension springs to support the compressing element and the electromotive element and damp vibrations.

As shown in Figure 3B, the lower stator insulator 312 is substantially annular in cross-section. The lower stator insulator 312 defines a circular inner cavity in which the rotor 316 is located. A plurality of bobbins 315 are defined by the lower stator insulator 315. The bobbins 315 have a central axis in the radial direction. Stator coils (not shown in Figure 3B) are wound around the bobbins. In the embodiment shown in Figures 3A and 3B, the snubbers 313 extend outside the periphery of the annular shape of the lower stator insulator 312. In this embodiment, the snubbers 313 are arranged at symmetrical positions relative to the central axis of the rotor 316.

Figure 4A shows a perspective view of the compressing element and electromotive element of a hermetic compressor according to an embodiment of the present

invention. Figure 4B is a side view of the compressing element and electromotive element shown in Figure 4A.

In the embodiment shown in Figures 4A and 4B, the compressing element 403 has an asymmetric center of gravity with respect to the central axis of the stator 410 of the electromotive element 404. As shown in Figure 4A, the main body of the cylinder block 405 is located on the left-hand side of the hermetic compressor. Therefore, the center of gravity of the compressing element 403 is also located on the left-hand side of the central axis of the electromotive element 404. This arrangement reduces the amount of material required for the compressing element, and in particular, the cylinder block 405. However, the translation of the center of gravity of the compressing element 403 away from the central axis of the stator 410 must be compensated for in the locations of the suspension springs.

In this embodiment, two different types of snubber are provided to engage the suspension springs. A first type of snubber 415 is formed from the head of a bolt which attaches the cylinder block 405 to the stator core 413. A second type of snubber 420 is formed from the lower stator insulator 412. Figure 4A shows the second type of snubber 420 in a position in which it extends radially from the lower stator insulator 420. As shown in Figure 4A, the second type of snubber 420 is attached to the body of the lower stator insulator 412 by a deformable arm 421. A tab 422 extends from the second type of snubber 422.

As shown in Figure 4A, the stator 410 is formed from the upper stator insulator 411, the stator core 413 and the lower stator insulator 412. The upper stator insulator 411 and the lower stator insulator 412 form bobbins 416 around which stator coil windings 417 are wound.

Figure 4B is a side view of the compressing element and electromotive element shown in Figure 4A when the deformable arm 421 has been bent so that the second type of snubber 420 is located beneath the stator core 413. As shown in Figure 4B, the deformable arm 421 comprises a cut-away portion 423 which has a reduced thickness allowing the deformable arm 421 to be bent so that the snubber 420 mounted on the end of the deformable arm 421 faces downwards. The tab 422

attached to the second type of snubber 420 engages with a clip 425 located on one of the bobbins 416. This engagement holds the second type of snubber 420 in place.

5 The arrangement of the second type of snubber 420 described allows the second type of snubber 420 to overlap with the coil windings 417. This means that the suspension springs mounted on the second type of snubber 420 can be closer to the central axis of the stator core 413 than the first type of snubber 415 formed from the bolt heads of bolts which attach the cylinder block 405 to the stator core 413. In the arrangement shown in Figure 4A this allows the positions of the suspension springs
10 414 to be altered to compensate for the offset of the center of gravity of the compressing element 403.

The provision of the second type of snubber 420 on deformable arms 421 allows the coil windings 417 to be wound around the bobbins 416 before the second type of
15 snubber 420 is moved into place by bending the deformable arms 421. This facilitates manufacture of the hermetic compressor with a minimal number of parts.

Figure 5 shows a cross section through a snubber formed from a lower stator insulator according to an embodiment of the present invention. As shown in Figure 5,
20 the lower stator insulator 512 is located below the stator core 513. The lower stator insulator 512 forms the lower part of a bobbin 516 around which coil windings 517 are wound. The deformable arm 521 extends radially outwards from the lower stator insulator 512. The deformable arm 521 bends back on itself in a C-shape. The curvature of the deformable arm 521 is highest at the cut-away portion 523 where
25 the thickness of the deformable arm 521 is reduced. The snubber 520 attached to the deformable arm 521 comprises a protrusion which faces downwards. The opposite face of the snubber 520 rests against the bobbin 516. The tab 522 extends from the snubber 520 and a hook portion 526 engages with a slot 525 in the bobbin 516. This locking mechanism holds the snubber 520 in place.

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As described above, one or more of the snubbers may be formed from the lower stator insulator. This provides for an increased design freedom in the location of the snubbers and therefore the suspension springs. For example, as shown in Figures 3A and 3b, the snubbers may be arranged outside the periphery of the stator core.

This allows for the suspension springs to be placed at an increased distance from the central axis of the stator core and the rotor. As described above in relation to Figures 4A, 4B and 5, the snubbers may be arranged to overlap with the coil windings of the stator. This arrangement allows the suspension springs to be located
5 closer to the central axis of the stator core and the rotor.

In the embodiments described above, the snubbers are formed as protrusions. Embodiments are also envisaged in which some or all of the snubbers are formed with a cup shaped profile which is configured to receive one end of the suspension
10 springs.

Figure 6A shows a snubber formed from a lower stator insulator according to an embodiment of the present invention. As shown in Figure 6A, the snubber 620 is formed from the lower stator insulator 612. In this embodiment, the snubber 620 has
15 a cup shaped profile and the suspension spring 614 fits inside the snubber 620. As shown in Figure 6A, at the bottom end of the suspension spring 614, a lower snubber 630 fits inside the suspension spring 614. The lower snubber 630 is located on the bottom of the lower airtight container portion of the hermetic compressor. An advantage of the arrangement shown in Figure 6A is that since the upper snubber
20 formed from the lower stator insulator 612 fits over the suspension spring 614 while the lower snubber 630 fits inside the suspension spring 614 the suspension spring can be reduced in length without the risk that the snubbers will impact upon one another.

25 Figure 6B shows a cut-away view of the snubber shown in Figure 6A. As shown in Figure 6B, the snubber 620 formed from the lower stator insulator 612 has a hollow cup-shaped interior. The top surface may comprise a circular groove to receive the suspension spring 614.

30 The stator insulators in the embodiments described above may be formed from materials such as PBT (Polybutylene terephthalate) or LCP (Liquid-crystal polymer). However it will be appreciated that the insulator materials are not limited to these materials.

Whilst the foregoing description has described exemplary embodiments, it will be understood by those skilled in the art that many variations of the embodiments can be made within the scope and spirit of the present invention.

CLAIMS

1. A hermetic compressor comprising an electromotive element and a compressing element housed in a container, the electromotive element being configured to drive the compressing element and comprising a stator comprising a stator core and a lower insulator, wherein the compressing element is arranged within the container above the electromotive element such that the stator supports the compressing element, the hermetic compressor further comprising a plurality of suspension springs configured to support the stator above a base of the container, wherein the lower insulator comprises at least one snubber configured to engage one of the suspension springs.
2. A hermetic compressor according to claim 1, wherein the stator core defines a periphery of the stator and the at least one snubber is arranged inside the periphery of the stator.
3. A hermetic compressor according to claim 2, wherein the stator comprises a plurality of coil windings each wound around a respective bobbin, the respective bobbins being formed at least in part by the lower insulator, wherein the at least one snubber is arranged below one of the coil windings.
4. A hermetic compressor according to claim 3, wherein the at least one snubber is coupled to the lower insulator by a deformable arm.
5. A hermetic compressor according to claim 4, wherein the at least one snubber is configured to mechanically engage with one of the bobbins.
6. A hermetic compressor according to claim 1, wherein the stator core defines a periphery of the stator and the at least one snubber is arranged outside the periphery of the stator.
7. A hermetic compressor according to any preceding claim wherein the at least one snubber comprises a protrusion configured to engage with one of the suspension springs.

8. A hermetic compressor according to any one of claims 1 to 6, wherein the at least one snubber comprises a cup-shaped portion configured to receive an end of one of the suspension springs.

9. A stator insulator portion configured to receive a stator core, the stator insulator portion comprising at least one snubber configured to engage with a suspension spring and thereby support the stator core.

10. A stator insulator portion according to claim 9, the stator insulator portion being substantially annular in cross-section and having a deformable arm extending in a radial direction, the deformable arm coupling the at least one snubber to the stator insulator portion.

11. A stator insulator portion according to claim 10, further comprising at least one bobbin portion configured to form at least part of a bobbin for receiving a coil winding, the deformable arm being configured to allow the at least one snubber to be moved to a position overlapping the bobbin.

12. A stator insulator portion according to claim 11, the at least one snubber being arranged to engage with the bobbin in the position overlapping the bobbin.