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(71) Applicant: **ARCELIK ANONIM SIRKETI** [TR/TR];
Sutluce Karaagac Caddesi No: 2/6 Beyoglu, 34445 ISTAN-
BUL (TR).

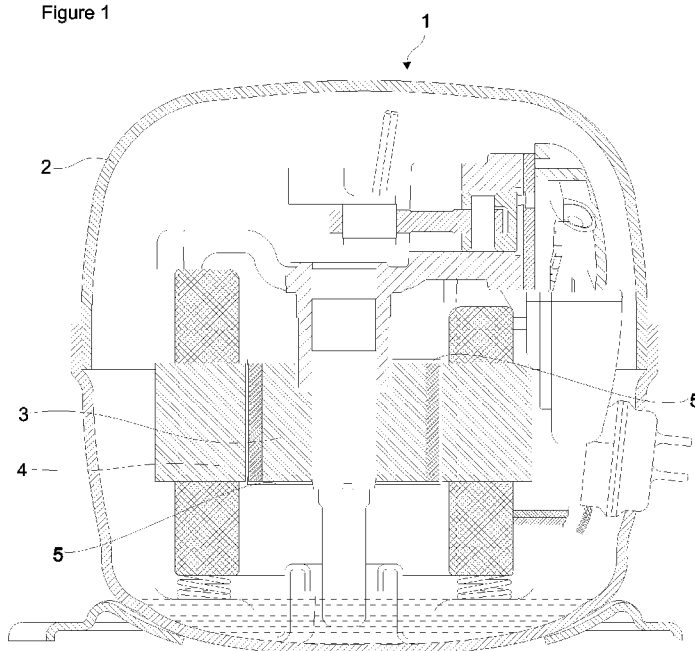
(72) Inventors: **KORKMAZ, Cansin**; E5 Ankara Asfalti Uzeri,
Tuzla, 34950 ISTANBUL (TR). **GUNDUZ, Cihan**; E5
Ankara Asfalti Uzeri, Tuzla, 34950 ISTANBUL (TR).

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(54) Title: A HERMETIC COMPRESSOR WITH A COUNTERWEIGHT

Figure 1



(57) Abstract: The present invention relates to a hermetic compressor (1) comprising: a housing (2), a rotor (3) and a stator (4) inside the housing (2) and wherein the stator (4) is placed around the rotor (3) so as to be concentric with the rotor (3) around a rotation axis (I), a rotor cover (5) placed onto a planar surface of the rotor (3), a recess (6) on the rotor cover (5) having a first wall (7) and a second wall (8) wherein the first wall (7) is closer to the rotation axis (I) and a counterweight (9) placed inside the recess (6).

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Description**A HERMETIC COMPRESSOR WITH A COUNTERWEIGHT**

- [0001] The present invention relates to a hermetic compressor, in particular to a hermetic compressor having a counterweight.
- [0002] A cooling appliance typically utilizes a hermetic compressor to cyclically convey the refrigerant from an evaporator to a condenser. The hermetic compressor is formed by a housing, hermetically isolating the operational parts such as the rotor and the stator of the hermetic compressor from the outer environment. During the operation of the hermetic compressor, the rotor and a shaft passing through the rotor rotates. During the rotation of the rotor and the shaft, relatively high centrifugal forces are generated which, in turn, act on the rotor especially when the refrigerant is being compressed. The hermetic compressor is configured to rotate the rotor and the shaft according to the cooling needs of the cooling appliance meaning that the higher cooling needs require the higher number of revolutions per minute. The rotation causes the rotor and the shaft to vibrate which, in turn, increases the energy consumption of the hermetic compressor. Another problem is the noise level caused by the vibrations of the rotor and the shaft. Therefore, it is vital to minimize the vibrations so as to decrease the energy consumption and the noise level of the hermetic compressor.
- [0003] A prior art publication in the technical field of the present invention may be referred to as US5476369A among others, the document disclosing a compressor having a lower axial ring placed onto the rotor wherein the lower axial ring comprises a counterweight.
- [0004] An objective of the present invention is to eliminate the vibrations and the noise resulting during the operation of the hermetic compressor in an economic and easily reproducible manner.
- [0005] The objective has been achieved by the counterweight according to the present invention as defined in the independent claim 1. Further achievements have been attained by the subject matters respectively defined in the dependent claims.
- [0006] The hermetic compressor of the present invention comprises a housing,

hermetically separating the interior volume of the hermetic compressor from the outer environment. The housing houses a rotor and a stator wherein the stator is placed around the rotor so as to be concentric with the rotor. The concentricity of the rotor and the stator lies along a rotation axis. As the hermetic compressor is energized, the rotor, along with a shaft passing through the rotor, starts to rotate around the rotation axis. The rotor is in the shape of a cylinder having two flat surfaces. A rotor cover is placed on to each of the flat surfaces of the rotor. Each rotor cover comprises a recess. The recess has a first wall and a second wall wherein the first wall is closer to the rotational axis. A counterweight is placed inside the recess in a sliding manner. Once the hermetic compressor is energized, the rotor starts to rotate around the rotation axis and as a result the counterweight starts to slide toward the second wall. The biasing means is placed to be in between the counterweight and one of the said side walls and configured to bias the counterweight toward the first wall. As the revolution per minute of the rotor increases, the centrifugal force increases, forcing the counterweight toward the second wall. The biasing means is configured to bias the position of the counterweight toward the first wall. As a result, the exact position of the counterweight can be adjusted inside the recess by use of the biasing means which, in turn, helps the vibrations caused by the rotation of the rotor and the shaft to be damped. This helps reduce friction between the rotor, the shaft and the stator therefore reducing energy consumption of the hermetic compressor. Another advantageous effect of damping the vibration is that the overall noise level of the hermetic compressor and that of the cooling appliance is reduced.

[0007] In another embodiment of the invention, the recess is formed on to each of the rotor cover wherein the rotor covers are placed on to the flat surfaces of the rotor. The position of the recesses on the respective rotor covers is configured to be symmetrical with respect to the rotation axis. In other words, each of the rotor cover has one recess and the position of the recesses are diagonal with respect to the rotation axis. This embodiment helps to further increase the damping effect of the counterweight and the

biasing means which, in turn, helps reducing vibrations thereby reducing the noise level and the energy consumption of the hermetic compressor.

[0008] In another embodiment of the invention, the biasing means extends in between the counterweight and the first wall. During initial position the hermetic compressor is at rest and the rotor remains inactive and the counterweight is in initial position. As the rotor starts to rotate, the counterweight slides toward the second wall. The biasing means applies a restoring force to the counterweight, retracting the counterweight toward the initial position. Attaching the biasing means in between the first wall and the counterweight helps to bias the counterweight toward the initial condition in an easy and reproducible way, meanwhile decreasing the noise level and the energy consumption of the hermetic compressor.

[0009] In another embodiment of the invention, the biasing means is a helical spring. The helical springs are easy and cheap to produce and the spring constant of the biasing means remains almost constant as the revolution per minute of the rotor increases. The restoring force of the biasing means increases linearly with the change of distance in between the counterweight and the first wall making the helical springs highly suitable for damping the vibrations of the hermetic compressor.

[0010] In another embodiment of the invention, the biasing means extends in between the counterweight and the second wall. As the rotor starts to rotate, the counterweight slides toward the second wall. The biasing means is compressed between the counterweight and the second wall. The biasing means applies a restoring force to the counterweight, pushing the counterweight toward the first wall. Therefore, the position of the counterweight is adjusted according to the revolution per minute of the rotor, which helps to damp the vibration and reduce the noise caused by the vibration.

[0011]

[0012] In another embodiment of the invention, the biasing means is a leaf spring. The leaf spring is placed in between the counterweight and the second wall. Upon rotation of the rotor, the spring is compressed, therefore creating a restoring force opposing against the centrifugal force formed as

a result of the rotation of the rotor.

- [0013] In another embodiment of the invention, plurality of biasing means are placed in between the counterweight and the first wall and the second wall. In one embodiment, plurality of biasing means which are helical springs are placed in between the counterweight and the first wall and the second wall improving damping of the vibrations. In another embodiment, the biasing means, which is a leaf spring, and the biasing means, which is a helical spring is placed in between the counterweight and the second wall and the first wall respectively. It is possible to use any combination of the biasing means thereof. Use of the plurality of the biasing means is especially advantageous to damp the vibrations of the hermetic compressor at high revolution per minute. The high revolution per minute being higher than 2000 revolution per minute.
- [0014] In the hermetic compressor of the present invention, the vibrations caused by a wide range of revolution per minute values can be eliminated via the use of the counterweight and the biasing means placed inside the recess. By this means, the noise level and the energy consumption of the hermetic compressor is improved.
- [0015] The drawings are not meant to delimit the scope of protection as identified in the claims nor should they be referred to alone in an effort to interpret the scope identified in the claims without recourse to the technical disclosure in the description of the present invention.
- [0016] Figure 1 – is a cross sectional side view of the hermetic compressor
- [0017] Figure 2 – is a cross-sectional side view of the rotor and the rotor cover
- [0018] Figure 3 – is an enlarged view of dashed A-A lines in Figure 2
- [0019] Figure 4 – is an exploded view of the rotor and the rotor cover
- [0020] Figure 5 – is an upper view of the rotor cover
- [0021] The following numerals are assigned to different parts demonstrated in the drawings and referred to in the present detailed description of the invention:
1. Hermetic Compressor
 2. Housing
 3. Rotor

4. Stator
5. Rotor cover
6. Recess
7. First wall
8. Second wall
9. Counterweight
10. Biasing means

[0022] The present invention relates to a hermetic compressor (1) comprising; a housing (2), a rotor (3) and a stator (4) inside the housing (2) and wherein the stator (4) is placed around the rotor (3) so as to be concentric with the rotor (3) around a rotation axis (I), a rotor cover (5) placed onto a planar surface of the rotor (3), a recess (6) on the rotor cover (5) having a first wall (7) and a second wall (8) wherein the first wall is closer to the rotation axis (I) and a counterweight (9) placed inside the recess (6).

[0023] The present invention relates to a hermetic compressor (1) comprising; a biasing means (10) inside the recess (6) biasing the counterweight (9) into a predetermined position and wherein the counterweight (9) is configured to slidably move inside the recess (6) upon rotation of the rotor (3). The hermetic compressor (1) comprises various rotating parts, such as the stator (4) which is placed co-centric and around the rotor (3). The central axis of the rotor (3) and the stator (4) is a cylindrical shaped channel through which a shaft passes through. As the hermetic compressor (1) is energized, the rotor (3) starts to rotate around and inside the stator (4). Similarly the shaft rotates and as the shaft rotates, the oil stored at the bottom of the housing (2) climbs up the shaft and oils the moving parts. As a result, the parts are prevented from wearing out. The rotor (3) is cylindrically shaped and the ends of the rotor (3) is covered by the pair of the rotor covers (5). The rotor (3), rotates around the rotation axis (I) and this rotation axis (I) lies along the central axis of the stator (4). The shaft is also configured to rotate around the rotation axis (I). The recess (6) is formed on to the rotor cover (5) and comprises the first wall (7) and the second wall (8) wherein the first wall (7) is closer to the rotation axis (I). The counterweight (9) is placed inside the recess (6) and is free to move in

a slidable manner between the first wall (7) and the second wall (8). As the hermetic compressor (1) is energized and the rotor (3) starts to rotate, the counterweight (9) is forced to slide toward the second wall (8) due to centrifugal force. The biasing means (10) is placed inside the recess (6) and is configured to be in between the counterweight (9) and one of the said walls (7,8). The biasing means (10) biases the counterweight (9) to the counterweight's (9) initial position, the initial position being the position during which the hermetic compressor (1) is not energized and thus the rotor (3) does not rotate. As the rotor (3) starts to rotate, the centrifugal force forces the counterweight (9) to slide toward the second wall (8) and the biasing means (10) forms a restoring force to the movement of the counterweight (9). The revolution per minute of the hermetic compressor (1) varies according to the cooling needs of the cooling appliance wherein the hermetic compressor (1) is utilized. As the revolution per minute of the rotor (3) increases, the centrifugal force applied to the counterweight (9) increases and as a result, the restoring force acting against the counterweight (9) applied by the biasing means (10) increases. By this means, the exact location of the counterweight (9) depending on various revolution per minute values can be adjusted, damping the vibrations caused by the rotation of the rotor (3). The damping effect of the biasing means helps to keep noise level of the hermetic compressor (1) at a minimum level. The vibrations also cause the hermetic compressor (1) to use more energy. As a result, use of the biasing means (10) minimizes the noise level and the energy consumption of the hermetic compressor (1). (Figure – 1)

[0024] In another embodiment of the hermetic compressor (1), the recess (6) is formed onto each one of the rotor covers (5) and wherein the recesses (6) are configured to be symmetrical with respect to the rotation axis (I). The pair of rotor covers (5) cover the rotor (3) from both ends. The recesses (6) are formed on both of the rotor covers (5) into which the counterweights (9) are placed. The location of the recesses (6) is configured to be symmetrical with respect to the rotation axis (I) meaning that their location is diagonal. By use of the recesses on both of the rotor covers (5) further

minimizes the noise level and the energy consumption of the hermetic compressor (1). (Figure – 2)

[0025] In another embodiment of the hermetic compressor (1), the biasing means (10) extends in between the first wall (7) and the counterweight (9). The biasing means (10) is placed so as to extend in between the first wall (7) and the counterweight (9). Therefore, as the rotor (3) starts to rotate, the centrifugal force forces the counterweight (9) to move toward the second wall (8) whereas the biasing means (10) biases the counterweight (9) toward the first wall (7). As the revolution per minute of the rotor (3) increases the restoring force exerted by the biasing means (10) to the counterweight (9) increases. As a result, the vibrations caused by the rotation of the rotor (3) is minimized, decreasing the noise level and the energy consumption of the hermetic compressor (1).

[0026] In another embodiment of the hermetic compressor (1), the biasing means (10) is a helical spring. The biasing means (10) is in the form of a helical spring and extends in between the first wall (7) and the counterweight (9). An advantage of using a helical springs as the biasing means (10) is that they are cheap and easy to produce. As the revolution per minute of the rotor (3) increases the centrifugal force affecting the counterweight (9) increases. As a result the restoring force exerted by the biasing means (10) to the counterweight (9) increases proportional to the centrifugal force applied on to the counterweight (9). (Figure – 3 and 4)

[0027] In another embodiment of the hermetic compressor (1), the biasing means (10) extends in between the second wall (8) and the counterweight (9). The biasing means (10) is placed so as to extend in between the second wall (8) and the counterweight (9). Therefore, as the rotor (3) starts to rotate, the centrifugal force forces the counterweight (9) to move toward the second wall (8) whereas the biasing means (10) biases the counterweight (9) away from and toward the second wall (8) and the first wall (7) respectively. As the revolution per minute of the rotor (3) increases the biasing means (10) applies more restoring force. As a result, the vibrations caused by the rotation of the rotor (3) is minimized, decreasing the noise level and the energy consumption of the hermetic compressor

(1).

[0028] In another embodiment of the hermetic compressor (1), the biasing means (10) is a leaf spring. The biasing means (10) is in the form of a leaf spring and extends in between the second wall (8) and the counterweight (9). The leaf springs in the shape of a "V" are cheap and easy to produce and also to assemble in between the counterweight (9) and the second wall (8). As the revolution per minute of the rotor (3) increases the centrifugal force affecting the counterweight (9) increases. As a result the restoring force applied by the biasing means (10) to the counterweight (9) increases proportional to the centrifugal force applied on to the counterweight (9). (Figure – 5)

[0029] In another embodiment, the hermetic compressor (1) comprises an arc shaped recess (6), and a corresponding arch shaped counterweight (9), the straight edges of the said arcs being perpendicular to the rotation axis (I) of the rotor (3). The imaginary lines extending along the edges of the arcs intersect the rotation axis (I) with 90 degree. The counterweight (9) and the biasing means (10) work with the centrifugal force principal. Because of that, the effect of the counterweight (9) is proportional to the position of the counterweight's (9) center of gravity. In order to fully utilize the weight of the counterweight (9), it is essential to use the recess (6) with concave geometries such as arc shapes therefore increasing the performance of the counterweight (9).

[0030] In the hermetic compressor (1) of the present invention, the vibrations are dampened by use the counterweight (9) and the biasing means (10) inside the recess (6) formed on to the rotor cover (5), minimizing the noise level and the energy consumption of the hermetic compressor (1).

Claims

1. A hermetic compressor (1) comprising;
a housing (2), a rotor (3) and a stator (4) inside the housing (2) and wherein the stator (4) is placed around the rotor (3) so as to be concentric with the rotor (3) around a rotation axis (I),
a rotor cover (5) placed onto a planar surface of the rotor (3),
a recess (6) on the rotor cover (5) having a first wall (7) and a second wall (8) wherein the first wall (7) is closer to the rotation axis (I),
a counterweight (9) placed inside the recess (6),
characterized by
a biasing means (10) inside the recess (6) biasing the counterweight (9) into a predetermined position and wherein the counterweight (9) is configured to slidably move inside the recess (6) upon rotation of the rotor (3).
2. A hermetic compressor (1) according to claim 1, **characterized in that** the recess (6) is formed onto each one of the rotor covers (5) and wherein the recesses (6) are configured to be symmetrical with respect to the rotation axis (I).
3. A hermetic compressor (1) according to any one of the preceding claims, **characterized in that** the biasing means (10) extends in between the first wall (7) and the counterweight (9).
4. A hermetic compressor (1) according to any one of the preceding claims, **characterized in that** the biasing means (10) is a helical spring.
5. A hermetic compressor (1) according to claim 1 and 2, **characterized in that** the biasing means (10) extends in between the second wall (8) and the counterweight (9).
6. A hermetic compressor (1) according to claim 5, **characterized in that** the biasing means (10) is a leaf spring.
7. A hermetic compressor (1) according to any one of the preceding claims, **characterized by** an arc shaped recess (6), and by a corresponding arch shaped counterweight (9), the straight edges of the said arcs being perpendicular to the rotation axis (I) of the rotor (3).

Figure 1

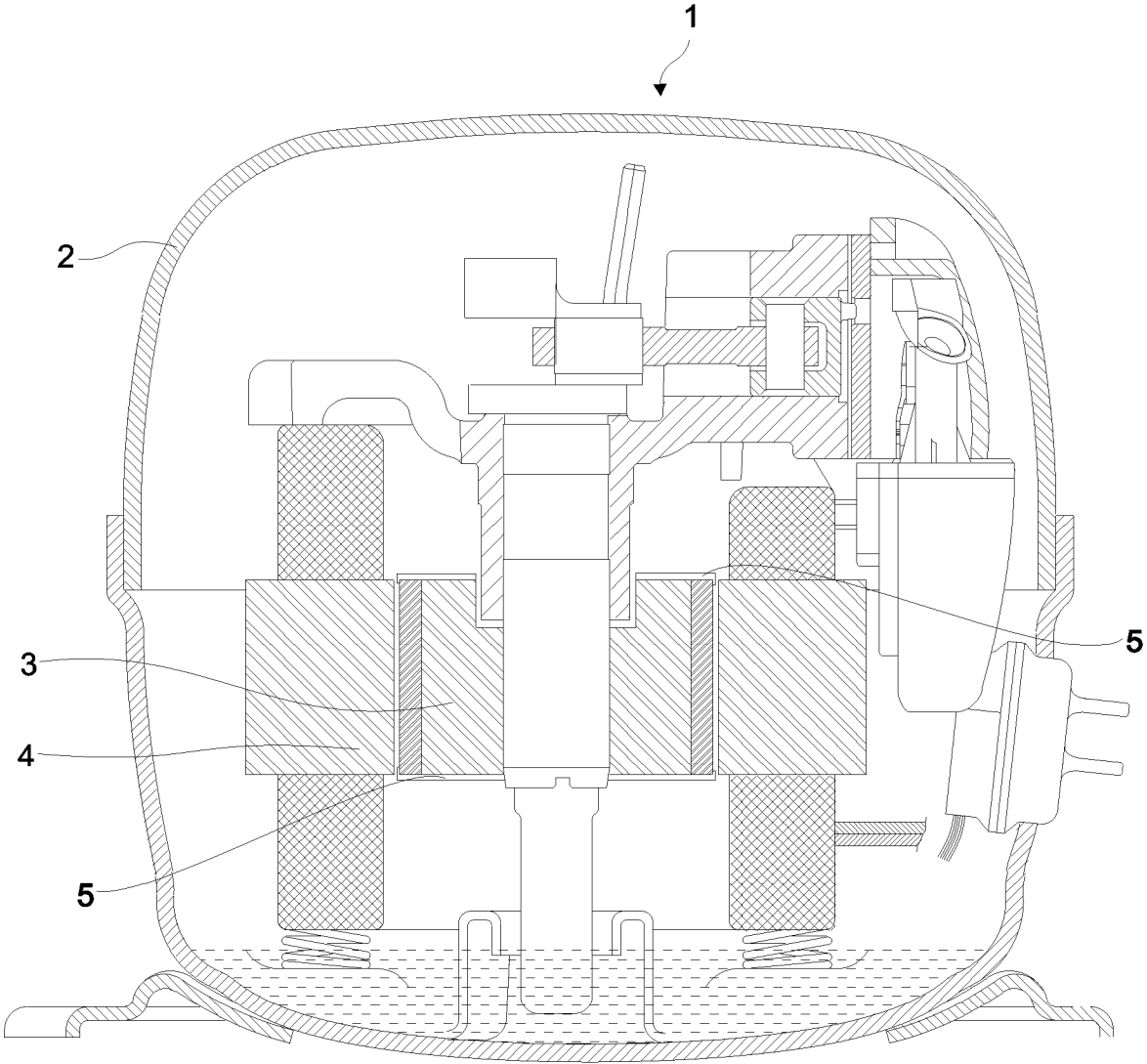


Figure 2

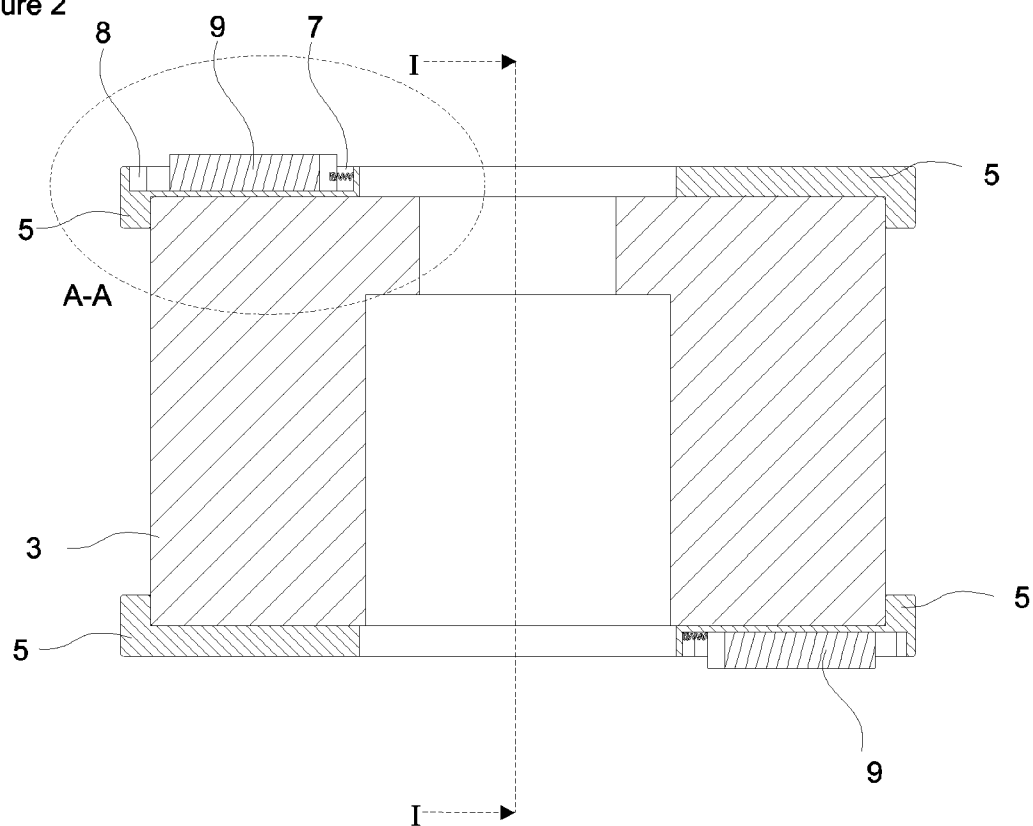
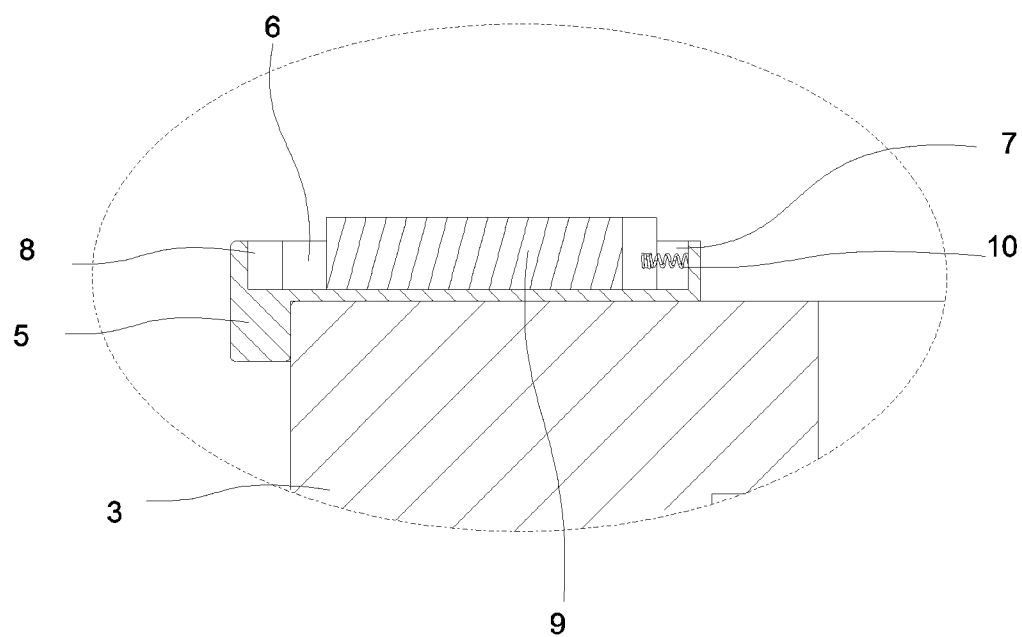


Figure 3



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Figure 4

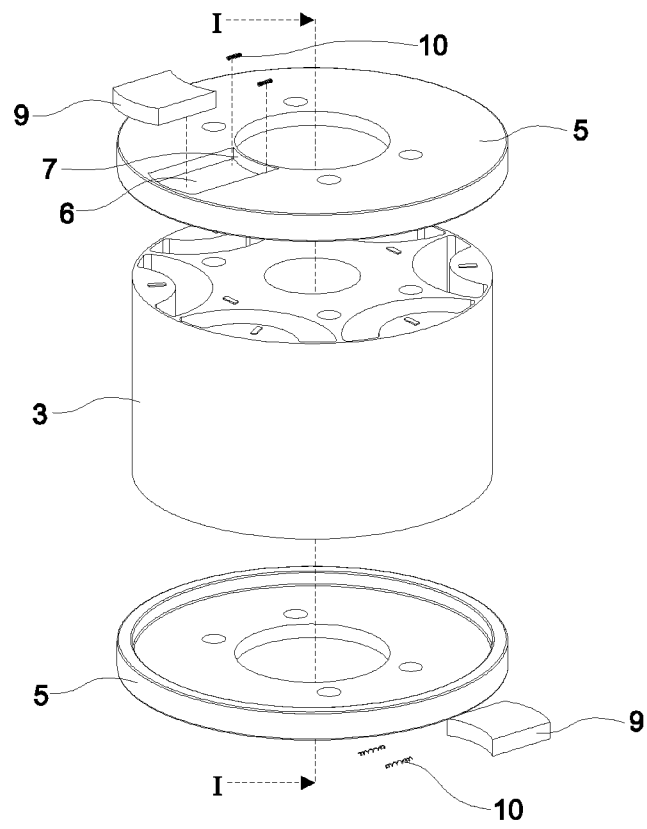
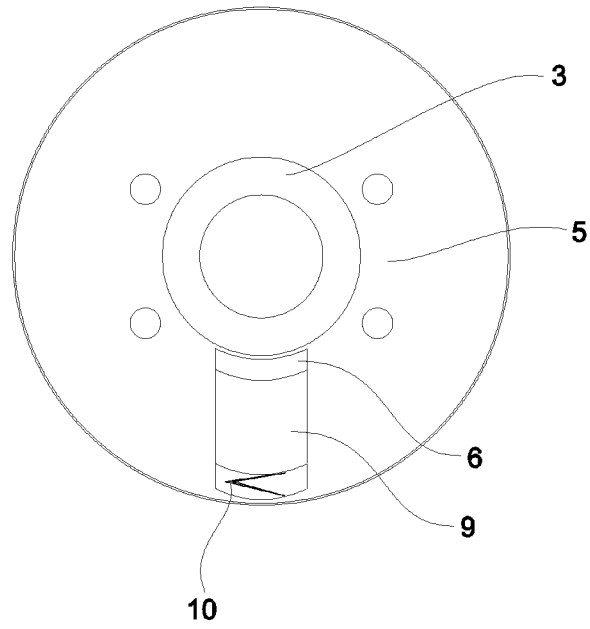


Figure 5



INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
INV. F04C18/02 F04C23/00 F04C29/00
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)
F04C

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

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 106 337 812 A (ZHUHAI GREE REFRIGERATION TECHNOLOGY CT ENERGY SAVING & ENVIRONMENTAL) 18 January 2017 (2017-01-18) abstract figures paragraph [0006] -----	1-6
Y	US 5 476 369 A (FOWLKES JEFFREY C [US] ET AL) 19 December 1995 (1995-12-19) figures -----	1-7
Y	KR 200 391 204 Y1 (LG ELECTRONICS CO., LTD [KR]) 29 July 2005 (2005-07-29) figures paragraph [0010] ----- -/-	1-7



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Date of the actual completion of the international search

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Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Durante, Andrea

INTERNATIONAL SEARCH REPORT

International application No

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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