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(54) A COMPRESSOR COMPRISING A VIBRATION DAMPING MEMBER

(57) A compressor (1) comprises: a casing (2); a body (3) which is disposed in the casing (2); a rotor which is disposed on the body (3) and a stator (4) which is disposed around the rotor so as to be concentric with the rotor; at least one connection member (5) which is disposed on the stator (4) and which enables the stator (4) to be placed into the casing (2); at least one spring (7) which is disposed on the connection member (5); and a vibration damping member (6) which is made of a flexible material and which is fitted over the spring (7) such that a gap remains between the spring (7) and the vibration damping member (6) at at least one region thereof.

Figure 3

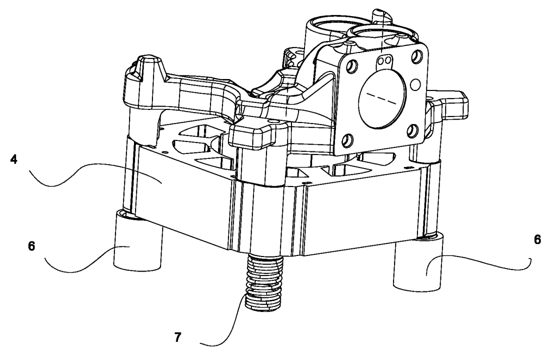
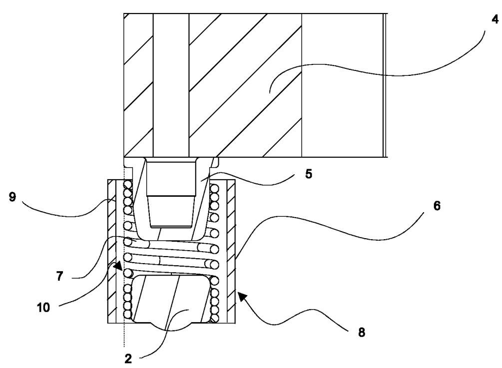


Figure 4



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Description

[0001] The present invention relates to a hermetic compressor wherein vibration damping is improved, especially at low speeds, when the spring has high oscillations to reduce transient and steady-state vibrations.

[0002] In hermetic compressors, the electric motor, which is composed of a stator and a rotor and is used for driving the crankshaft-piston rod, the cylinder-piston mechanism and others mechanisms are disposed on a body in a leak-proof casing. In hermetic compressors used in cooling devices, the movement of the piston that compresses the refrigerant fluid is provided by an electric motor. The rotor of the electric motor is connected to the crankshaft and the crankshaft transmits the movement to the pistons by means of a rod. The compression chamber into which the pistons moves forwards and backwards is disposed on a cylinder block. The cylinder block is fixed on the stator of the electric motor. When the compressor is operated, the electric motor is energized and the rotor starts to rotate. A vibration occurs on the stator due to the magnetic field. Moreover, another vibration occurs due to the movement of the rotor depending on the rotational speed of the rotor. The forward-backward movement of the pistons also create a similar vibration. The vibrations generated due to the electric motor and the movement of the pistons are transmitted to the body of the compressor and create a noise that can be heard from the outside. Vibration is undesirable since hermetic compressors are used especially in household appliances such as refrigerators. The inevitable noise caused by vibration should be minimized in terms of user satisfaction. The vibration and noise caused by the operation of the electric motor, mechanical forces and the refrigerant gas force are tried to be reduced by keeping the electric motor on a plane with a plurality of springs fixed to the electric motor (lamination parts of the stator) and the other end to the casing.

[0003] During the duty cycle of the compressor, a powerful start-up trigger is used to overcome engine jolt and dry friction conditions. Therefore, said harmful vibrations at the start are unavoidable because the compressors have to pass through low frequencies that coincide with the resonant frequencies of the system until they reach stable operation at high frequencies. Therefore, despite low speeds (rpm), high displacements are observed initially, while steady-state vibrations attenuate at high frequencies away from the system's resonant frequency.

[0004] When the compressor operates at high speeds, the displacement caused by the oscillation of the spring due to the vibration-induced oscillating effect on the body is low. Since the operating speed of the compressor is high, the vibration intervals of the spring are very frequent, and the displacement caused by the swinging of the spring to the right and left is less. However, in the opposite case, since the vibration intervals of the spring are less frequent at low speeds, the displacement caused by the swinging movements of the spring due to vibration is high. Therefore, it is possible to control the vibration in the compressor more effectively by limiting the swing of the spring, which occurs especially at low speeds.

[0005] In the Korean Patent Document No. KR20180119415A, a compressor is disclosed, wherein magnetic parts are used to adjust the stiffness of transmission members and vibrations are reduced.

[0006] In the Patent Application No. WO2015/127998, a compressor is disclosed, comprising a vibration damping mechanism wherein a single large spring is used instead of four small springs.

[0007] In the state of the art Chinese Utility Model Document No. CN210483991U, a compressor is disclosed, comprising a vibration damping member which is disposed under the spring and on the lower foot connected to the casing.

[0008] The aim of the present invention is the realization of a compressor wherein the displacements caused by the swinging of the spring in the temporary start-up, the temporary shutdown and the steady-state during the operation of the compressor are reduced.

[0009] The compressor of the present invention comprises a casing; a body which is disposed in the casing and which supports the compressor components such as cylinder, piston, engine and cylinder head, etc, and a rotor and a stator concentric with the rotor around the rotor which together form the motor. The stator is placed in the casing with at least one connecting member from a lower surface. In order to overcome the vibration problem, at least one spring is fitted over said at least one connecting member. The stator is connected to the casing by fitting the spring over a second connection member on the casing such as pin, etc.

[0010] The compressor of the present invention comprises a vibration damping member which is used to damp the vibrations that occur in the body during the operation of the compressor, which is disposed on the spring and which is manufactured from a flexible material to prevent the high swinging movement of the spring, which occurs especially at low speeds. The vibration damping member is in the form of a sleeve fitted over the spring so as to almost completely surround the spring.

[0011] A gap remains in at least one region between the vibration damping member and the spring. Said gap can be equal in every region where the spring is surrounded, or can be in different sizes, narrowing and/or expanding at intervals.

[0012] In an embodiment of the present invention, the gap between the spring and the vibration damping member is between 0.1 mm and 1 mm, preferably between 0.1 mm and 0.5 mm.

[0013] By producing the vibration damping member from any flexible material such as thermoplastic elastomer, extra noise and unwanted situations are prevented when the spring and vibration damping member come into contact with each other. The vibration damping member manufactured from a rigid material creates more noise and vibration effect upon coming into contact with the spring.

[0014] In an embodiment of the present invention, the vibration damping member is a cylindrical tube suitable for placing the spring therein. In this form, when the vibration damping member surrounds the spring, the spring and the inner wall of the vibration damping member are close to each other, but there is a gap therebetween at least in one region. Thus, the oscillation and displacement movements of the spring are restricted by the vibration damping member, thus damping the vibration and preventing the generation of noise.

[0015] In an embodiment of the present invention, the vibration damping member almost completely surrounds the spring so as to almost come into contact with the spring in the region where the connection member in the housing connected to the spring is located, and so as to leave a gap between the spring and the vibration damping member at the region of the spring on the connection piece which provides the connection of the spring with the stator. In this embodiment, the inner wall forming the cylindrical body of the vibration damping member has a fragmented structure. The wall which is composed of at least two pieces with at least one intermediate step can be arranged to surround the spring with gaps of different sizes. Thus, some parts of the spring are surrounded by a wider gap, while other parts are surrounded by a narrower gap. This allows vibration damping to occur more effectively in situations where the vibration of the spring is not the same in all regions.

[0016] Surrounding the spring with different gaps at different parts thereof can be achieved by having different wall thicknesses between the inner wall and outer wall of the vibration damping member or by gradual transitions between the inner wall and the outer wall thereof.

[0017] In an embodiment of the present invention, the vibration damping member comprises an S-shaped inner wall with an irregular waveform. Thus, irregular gaps are formed between the spring and the vibration damping member.

[0018] By means of the present invention, a compressor is realized wherein vibrations and noise caused by the operation of the electric motor and moving components are damped and user satisfaction is increased.

[0019] The model embodiments related to the compressor realized in order to attain the aim of the present invention are shown in the attached figures, where:

Figure 1- is the perspective view of the compressor in an embodiment of the present invention.

Figure 2- is the view of the compressor in an embodiment of the present invention, displaying inner components such as body, cylinder head and stator.

Figure 3- is the view of an embodiment displaying the connection of the spring, the vibration damping member and the stator in the compressor of the present invention.

Figure 4- is the view of an embodiment wherein the gap between the vibration damping member and the spring is equal at both sides of the spring in the compressor of the present invention.

Figure 5- is the view of an embodiment wherein the gap between the vibration damping member and the spring is conical in the compressor of the present invention.

Figure 6- is the view of an embodiment wherein the gap between the vibration damping member and the spring is in a varying form with two steps in the compressor of the present invention.

Figure 7- is the view of an embodiment wherein the gap between the vibration damping member and the spring is in a varying form with more than two steps in the compressor of the present invention.

Figure 8- is the view of an embodiment wherein the gap between the vibration damping member and the spring is irregular in the compressor of the present invention.

[0020] The elements illustrated in the figures are numbered as follows:

1. Compressor
2. Casing
3. Body
4. Stator
5. Connection member
6. Vibration damping member
7. Spring
8. Cylindrical body
9. Inner wall
10. Gap
11. First wall
12. Second wall
13. Step

[0021] The compressor (1) comprises a casing (2); a body (3) which is disposed in the casing (2); a rotor which is disposed on the body (3) and a stator (4) which is disposed around the rotor so as to be concentric with the rotor; at least one connection member (5) which is disposed on the stator (4) and which enables the stator (4) to be placed into the casing (2); and at least one spring (7) which is disposed on the connection member (5).

[0022] The compressor (1) of the present invention comprises a vibration damping member (6) which is manufactured from a flexible material and which is fitted over the spring (7) so as to almost completely surround the spring (7) such that a gap remains between the spring (7) and the vibration damping member (6) at at least one region thereof.

[0023] The vibration damping member (6) in the compressor (1) of the present invention is fitted over the spring (7) so as to almost completely surround the spring which is disposed between the stator (4) and the casing (2). Thus, the vibration damping member (6) acts as a limiting member for the spring (7), especially at low operating speeds and when there are high oscillations on the spring (7), and reduces the vibration and noise thanks to a gap (10) between the spring (7) and the vibration damping member (6). The vibration damping member (6) is manufactured from a flexible material. Thus, the generation of extra vibration and noise when the spring (7) oscillates in the gap (10) during shaking and comes into contact with the vibration damping member (6) is prevented.

[0024] In an embodiment of the present invention, the compressor (1) comprises the vibration damping member (6) having an inner wall (9) and a hollow cylindrical body (8) so as to allow the placement of the spring (7) therein.

[0025] In an embodiment of the present invention, the compressor (1) comprises a gap (10) from 0.1 mm to 1 mm, which is equal at all regions between the inner wall (8) of the vibration damping member (6) and the spring (7). Thus, the displacement of the spring (7) due to the oscillation occurring in each region is equally damped.

[0026] In an embodiment of the present invention, the compressor (1) comprises the vibration damping member (6) comprising the inner wall (9) having at least one first wall (11) which surrounds at least a part of the spring (7), at least one step (13) in connection with the first wall (11) and the first wall (11) and at least one second wall (12) which is connected to the first wall (11) by means of the step (13) and which surrounds another part of the spring (7) such that a gap (10) different than the gap (10) between the first wall (11) and the spring (7) remains therebetween. In this embodiment, a gap (10) structure with at least one step in the form of a ladder is formed between the inner wall (9) and the spring (7). This structure provides the damping of oscillation movements of different frequencies occurring at different regions of the spring (7).

[0027] In an embodiment of the present invention, the compressor (1) comprises the vibration damping member (6) having a conical inner wall (9) so as to expand from the lower part of the spring (7), which is placed in the casing (2), towards the connection member (5) and to form a conical gap (10) between the spring (7) and the vibration damping member (6).

[0028] In an embodiment of the present invention, the compressor (1) comprises the vibration damping member (6) having an inner wall (9) with a wavy (S-shaped) structure to form a wavy gap (10) between the spring (7) and the vibration damping member (6).

[0029] In an embodiment of the present invention, the compressor (1) comprises the vibration damping member (6) manufactured from any flexible material such as thermoplastic polyurethane (TPU), thermoplastic elastomer (TPE), elastic PVC and/or polyolefin plastomer. Said thermoplastic material can be chosen from any material with a stiffness value between 0.2 and 2 N/mm, resistant to refrigerant oil and temperature.

[0030] The stiffness value of the material can be measured by any force testing device that works with the method that includes the following steps:

- A force is applied on the sample material by means of a linear trigger,

- The force applied from the bottom of the sample is measured with a dynamometer,

- In the meantime, the movement of the linear trigger is measured with the help of a laser sensor (it can also be a different displacement sensor),

- According to the measured data, the displacement (mm) versus force (N) graph is obtained,

- A linear correction curve with the equation y= mx+b is applied to the graph and the "m" value calculated according to the obtained data gives a value in "N/mm" which is the stiffness value.

[0031] A cooling device, for example a domestic refrigerator, comprises a compressor (1) of the present invention.

[0032] By means of the present invention, a compressor (1) with improved vibration damping and a cooling device comprising said compressor (1) are realized.

Claims

1. A compressor (1) **comprising** a casing (2); a body (3) which is disposed in the casing (2); a rotor which is disposed on the body (3) and a stator (4) which is disposed around the rotor so as to be concentric with the rotor; at least one connection member (5) which is disposed on the stator (4) and which enables the stator (4) to be placed into the casing (2); and at least one spring (7) which is disposed on the connection member (5), **characterized by** a vibration damping member (6) which is manufactured from a flexible material and which is fitted over the spring (7) so as to almost completely surround the spring (7) such that a gap remains between the spring (7) and the vibration damping member (6) at at least one region thereof.

2. A compressor (1) as in Claim 1, **characterized by**

the vibration damping member (6) having an inner wall (9) and a hollow cylindrical body (8) so as to allow the placement of the spring (7) therein

3. A compressor (1) as in Claim 1 or 2, **characterized by** a gap (10) from 0.1 mm to 1 mm, which is equal at all regions between the inner wall (8) of the vibration damping member (6) and the spring (7).

4. A compressor (1) as in Claim 1 or 2, **characterized by** the vibration damping member (6) comprising the inner wall (9) having at least one first wall (11) which surrounds at least a part of the spring (7), at least one step (13) in connection with the first wall (11) and the first wall (11) and at least one second wall (12) which is connected to the first wall (11) by means of the step (13) and which surrounds another part of the spring (7) such that a gap (10) different than the gap (10) between the first wall (11) and the spring (7) remains therebetween.

5. A compressor (1) as in any one of the Claims 1 to 3, **characterized by** the vibration damping member (6) having a conical inner wall (9) so as to expand from the lower part of the spring (7), which is placed in the casing (2), towards the connection member (5) and to form a conical gap (10) between the spring (7) and the vibration damping member (6).

6. A compressor (1) as in any one of the Claims 1 to 3, **characterized by** the vibration damping member (6) having an inner wall (9) with a wavy (S-shaped) structure to form a wavy gap (10) between the spring (7) and the vibration damping member (6).

7. A compressor (1) as in any one of the Claims 1 to 6, **characterized by** the vibration damping member (6) manufactured from any flexible material such as thermoplastic polyurethane (TPU), thermoplastic elastomer (TPE), elastic PVC and/or polyolefin plastomer.

8. A cooling device comprising a compressor (1) as in any one of the Claims 1 to 7.

Figure 1

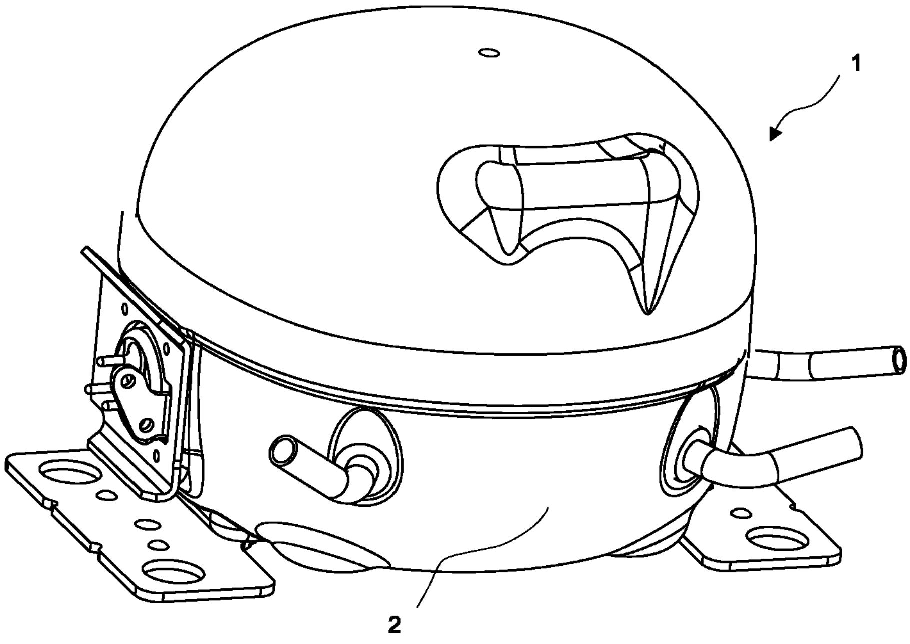


Figure 2

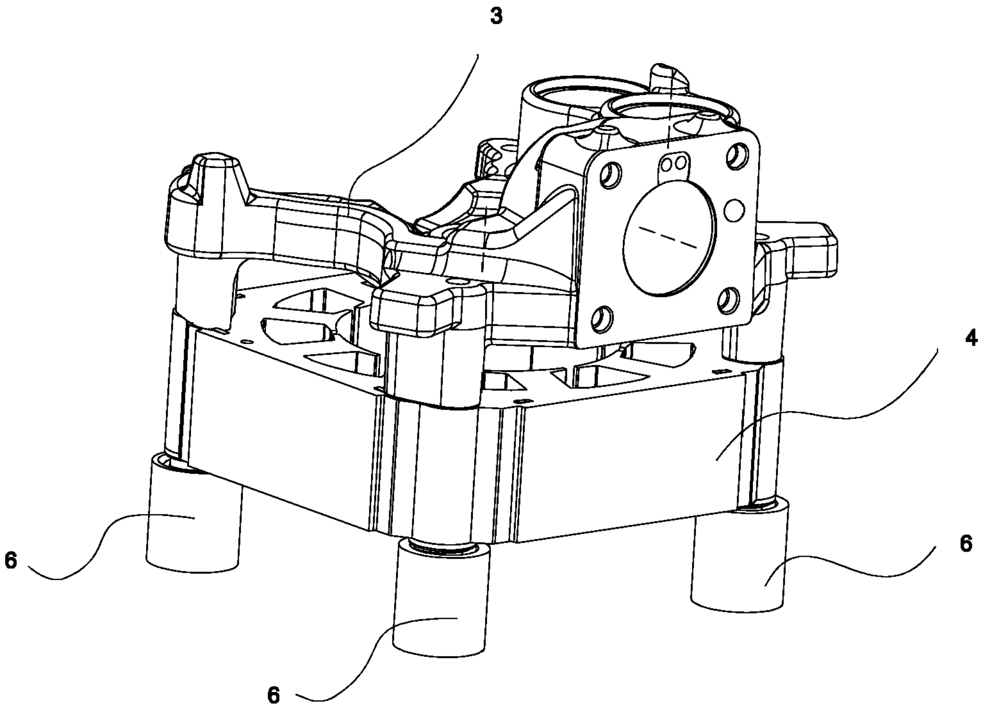


Figure 3

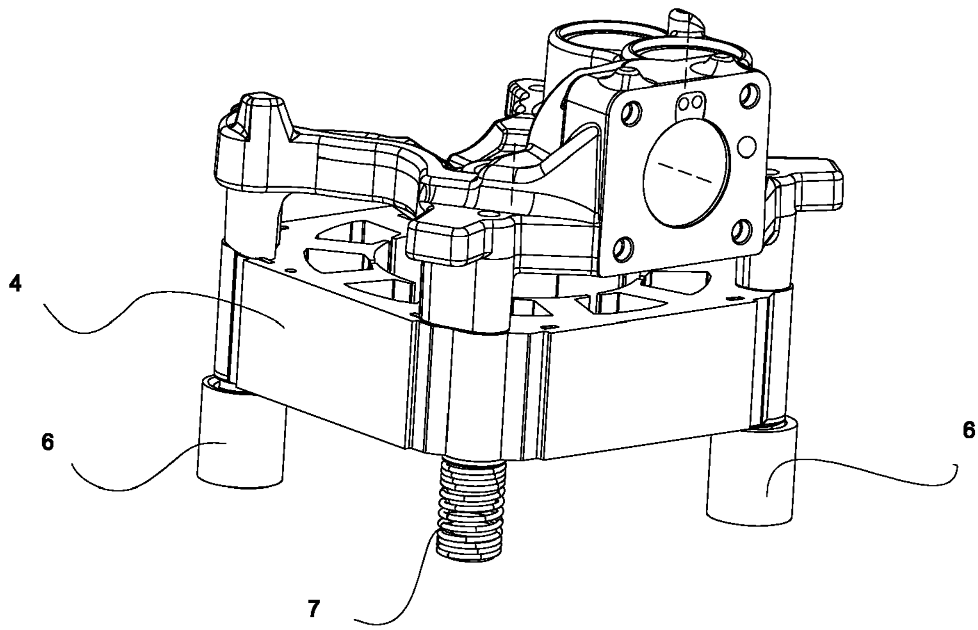


Figure 4

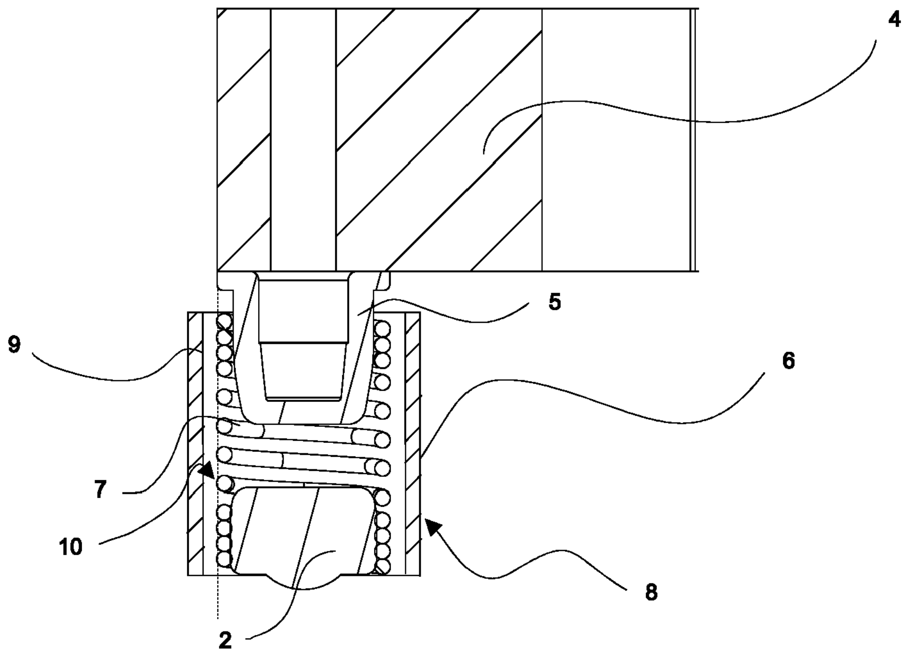


Figure 5

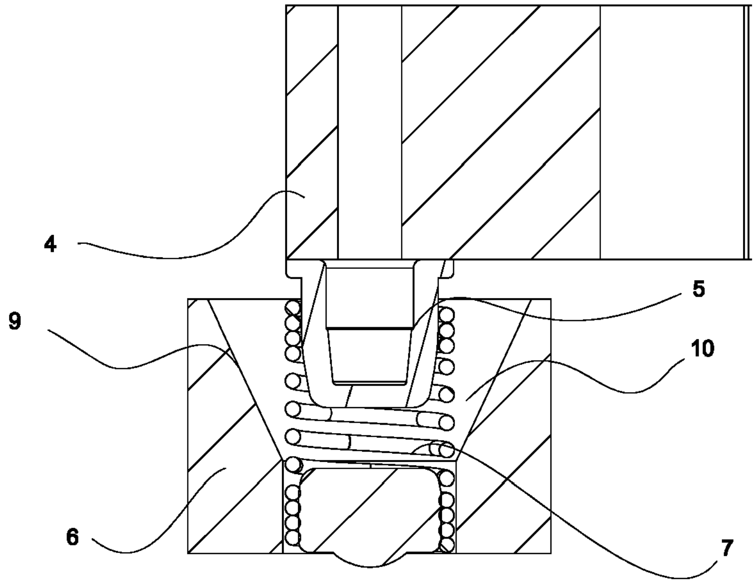


Figure 6

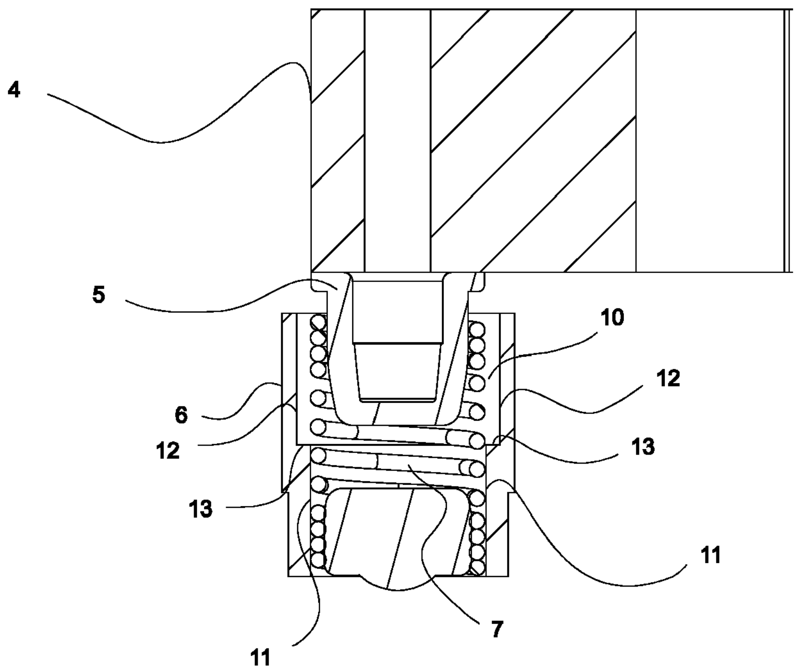


Figure 7

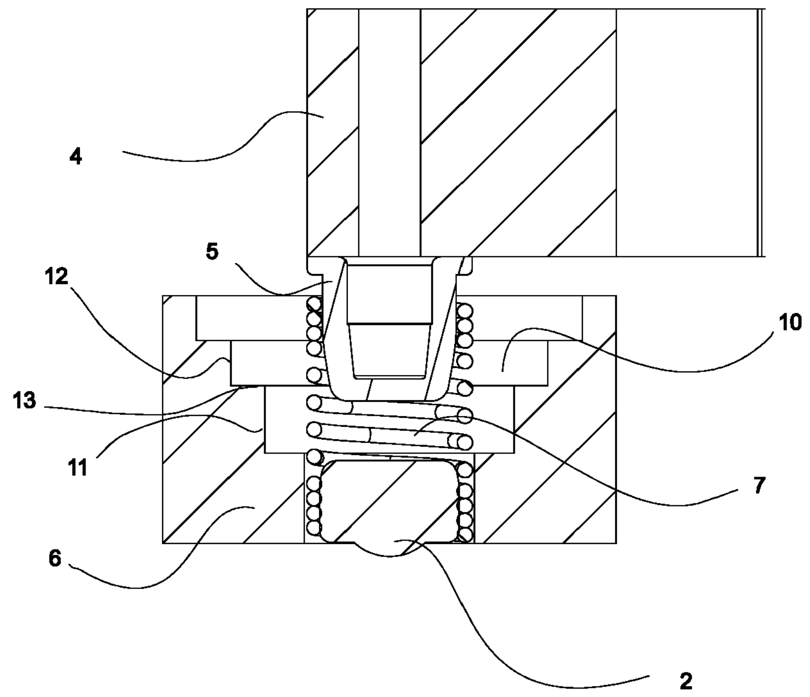
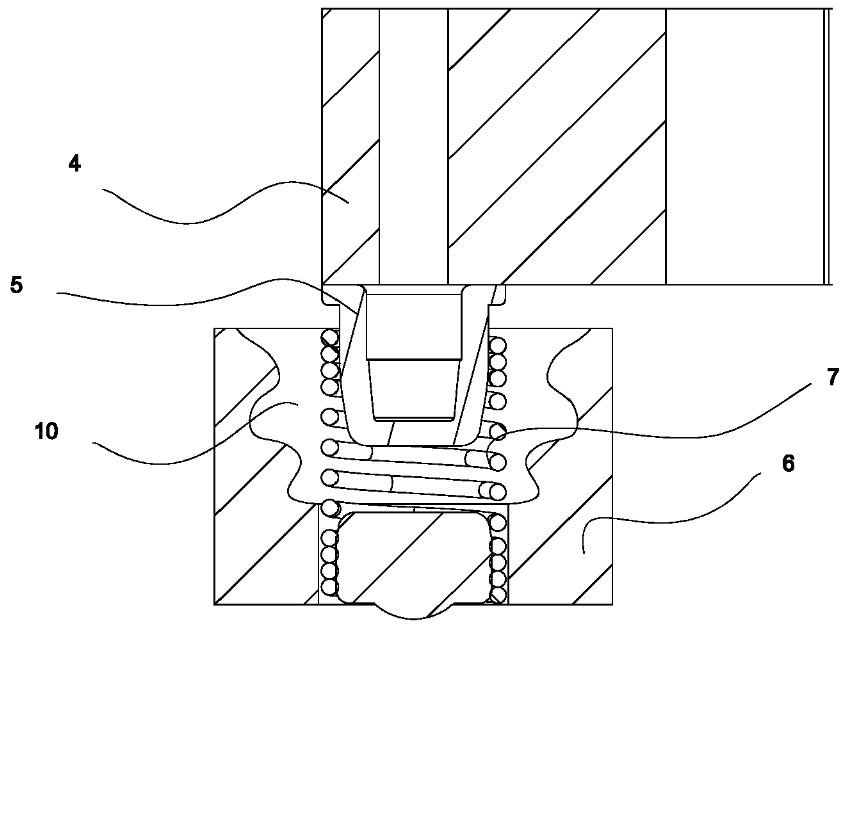


Figure 8



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EUROPEAN SEARCH REPORT

Application Number
EP 22 20 4781

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TECHNICAL FIELDS SEARCHED (IPC)

F04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	8 March 2023	Olona Laglera, C

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