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(54) A HERMETIC COMPRESSOR HAVING A RESTRAINER

(57) The present invention relates to a hermetic compressor (1) comprising; a housing (2), a cylinder (3) inside the housing (2) and that enables the refrigerant to be sucked and pumped; a piston (4) that is operated in the cylinder (3); a body that supports the cylinder (3) and the piston (4); a cylinder head (5) that enables the refrigerant sucked and pumped by the movement of the piston (4) into the cylinder (3) to be guided; an exhaust chamber (6) that is disposed in the cylinder head (5) wherein the refrigerant fluid pumped during the compression movement of the piston (4) is accumulated; a valve table (7) placed between the cylinder (3) and the cylinder head (5); an exhaust port (8) arranged on the valve table (7) that enables the refrigerant to pass from the cylinder (3) to the exhaust chamber (6) during the compression movement of the piston (4);
an exhaust valve (9) disposed on the valve table (7) that opens and closes the exhaust port (8);
a restrainer (10) fixed onto the valve table (7) that extends into the exhaust chamber (6) and that restrains the movement of the exhaust valve (9), wherein the exhaust valve (9) and the restrainer (10) are produced from a ferromagnetic material.

EP 3 974 650 A1

Description

[0001] The present invention relates to a hermetic compressor, in particular to a hermetic compressor having a magnetic and a non contact restrainer.

[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, piston makes reciprocating movement pumping and sucking the refrigerant. As the piston pumps the refrigerant to the exhaust chamber, the refrigerant passes through the valve plate by means of the exhaust valve that is configured to open to allow the refrigerant reach to the exhaust chamber. In some cases, the exhaust valve adheres to the restrainer and cannot return to its initial position as required. It is any objective of the present invention to overcome the adhesion of the exhaust valve to the restrainer.

[0003] A prior art publication in the technical field of the present invention may be referred to as EP1797324B1 among others, the document disclosing a hermetic compressor of which the thermodynamic efficiency is improved, comprising a valve table that facilitates the flow of the circulating fluid by enabling it to be discharged in a short time.

[0004] A prior art publication in the technical field of the present invention may be referred to as WO2017194492A1 among others, the document disclosing a hermetic compressor having a closed volume that provides attenuation of the noise generated.

[0005] A prior art publication in the technical field of the present invention may be referred to as WO2017194516A1 among others, the document disclosing a hermetic compressor wherein the need for using an elastomer gasket prone to deformation between the connection tube and the valve table to provide sealing is eliminated

[0006] An objective of the present invention is to eliminate the adhesion caused by the refrigerant between the restrainer and the exhaust valve.

[0007] Another objective of the present invention is to improve response time of the exhaust valve. Meaning that the exhaust valve opens and allows the refrigerant to be transferred to the exhaust chamber.

[0008] The method realized to achieve the aim of the present invention and disclosed in the first claim and the dependent claims comprises a hermetic compressor. 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. The hermetic compressor further comprises a cylinder that is used for refrigerant to be sucked and pumped. Said movement is provided by means of a piston that is inside the cylinder. The hermetic compressor further comprises a body wherein the body supports the piston and the cylinder. A cylinder head is provided so as to guide the refrigerant to be sucked and pumped into the cylinder. The hermetic compressor further comprises an exhaust chamber which is disposed on the cylinder head wherein the refrigerant is accumulated during the pump movement of the piston. A valve plate is placed in between the cylinder and the cylinder head and an exhaust port is arranged on the valve plate. The exhaust port is configured to enable the refrigerant to pass from the cylinder to the exhaust chamber during the compression movement of the piston. An exhaust valve is provided on the valve table wherein the exhaust valve is configured to open the exhaust port upon compression movement of the piston thereby releasing a certain amount of refrigerant into the exhaust chamber. The movement of the exhaust valve is limited by means of a restrainer placed on the valve table. The restrainer is configured to extend at least partially into the exhaust chamber. The restrainer and the exhaust valve is produced from a ferromagnetic material. The hermetic compressor of the present invention further comprises a seal placed in between the exhaust valve and the restrainer so as to electrically insulate the said parts from each other. The hermetic compressor of the present invention further comprises a circuit that is used to provide an electrical current to the restrainer, inducing ferromagnetism on the restrainer. Only the restrainer is electrified which helps create a permanent magnet from the restrainer. This creates a magnetic attraction between the restrainer and the exhaust valve, thereby creating an attraction between the restrainer and the exhaust valve. This magnetic attraction helps the exhaust valve overcome the adhesion created due to the lubricant in between the exhaust valve and the valve plate. As a result of this, operational efficiency of the hermetic compressor is improved.

[0009] In another embodiment of the invention, the circuit is configured to provide a varying current to the restrainer which helps overcome lower operation efficiency caused by the adhesion of the exhaust valve after a long time of use. The lubricant used for lubrication of the operational parts of the hermetic compressor may tend to get denser after a long time of period, mainly due to particles accumulating. The circuit is configured to provide a higher current to the restrainer, thereby eliminating the negative effects of the lubricant in the long run. Additionally, the circuit can provide a varying current as a response to the cooling needs of the appliance wherein the hermetic compressor operates.

[0010] In another embodiment of the invention, the hermetic compressor comprises a fastening means that is used to fix the restrainer and the exhaust valve onto the valve plate. The fastening means is produced from a dielectric material; therefore, it does not conduct the current from the exhaust valve to the valve plate.

[0011] In another embodiment of the invention, the fastening means is a rivet.

[0012] In another embodiment of the invention, the circuit comprises an electric motor, an electrical switch, a data logger, a laser encoder and a crank eccentric trunnion.

[0013] An advantageous effect provided by means of the present invention is that the restrainer is polarized which in turn creates a magnetic field between the restrainer and the exhaust valve, thereby eliminating the possibility of adhesion between the exhaust valve and the restrainer.

[0014] An advantageous effect provided by means of the present invention is that the current provided by means of the circuit can be varied according to the position of the crank eccentric trunnion and therefore that of the exhaust valve which in turn increases responsiveness of the exhaust valve. This helps eliminate the adhesion between the exhaust valve and the valve plate. Also this helps increase the energy efficiency of the hermetic compressor.

[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.

Figure 1 - is a cross sectional side view of the hermetic compressor

Figure 2 - is an isolated view of the valve table

Figure 3 - is a cross sectional view of the valve table along dashed A-A lines in Figure-2

Figure 4 - is an enlarged view of the dashed B-B lines in Figure-3

Figure 5 - is a schematic of the circuit

[0016] 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. Cylinder
4. Piston
5. Cylinder head
6. Exhaust chamber
7. Valve table
8. Exhaust port
9. Exhaust valve
10. Restrainer
11. Seal
12. Circuit
13. Fastening means
14. Electric motor
15. Electrical switch
16. Data logger
17. Laser encoder
18. Crank eccentric trunnion

[0017] The present invention relates to a hermetic compressor (1) comprising; a housing (2), a cylinder (3) inside the housing (2) and that enables the refrigerant to be sucked and pumped; a piston (4) that is operated in the cylinder (3); a body that supports the cylinder (3) and the piston (4); a cylinder head (5) that enables the refrigerant sucked and pumped by the movement of the piston (4) into the cylinder (3) to be guided; an exhaust chamber (6) that is disposed in the cylinder head (5) wherein the refrigerant fluid pumped during the compression movement of the piston (4) is accumulated; a valve table (7) placed between the cylinder (3) and the cylinder head (5);

[0018] an exhaust port (8) arranged on the valve table (7) that enables the refrigerant to pass from the cylinder (3) to the exhaust chamber (6) during the compression movement of the piston (4); an exhaust valve (9) disposed on the valve table (7) that opens and closes the exhaust port (8); a restrainer (10) fixed onto the valve table (7) that extends into the exhaust chamber (6) and that restrains the movement of the exhaust valve (9), wherein the exhaust valve (9) and the restrainer (10) are produced from a ferromagnetic material.

[0019] The present invention further comprises; a seal (11) produced from a dielectric material and placed between the exhaust valve (9) and the restrainer (10) such that the seal (11) is configured to electrically insulate the restrainer (10) and the exhaust valve (9) from each other and a circuit (12) configured to provide electrical current to the restrainer (11), inducing ferromagnetism. The seal (11) can be produced in two different methods. In the first method, the seal (11) is produced from a plate that is a dielectric material and is placed between the restrainer (10) and the exhaust valve (9). In another method, the seal (11) is produced as a coating and is used to coat one of the surfaces of the restrainer (10) or the exhaust valve (9) facing each other. In either case, the seal (11) is configured to electrically insulate the restrainer (10) and the exhaust valve (9) from each other. As a result, the electricity cannot pass from the restrainer (10) to the exhaust valve (9). In addition to this, the circuit (12) is configured to provide electricity to the restrainer (10). As a result of which, the restrainer (10) is electrified and creates a magnetic field. Due to the magnetic field, the restrainer (10) magnetically influences the exhaust valve (9) which in turn will also be polarized. The sign of the polarizations of the exhaust valve (9) and that of the restrainer (10) are opposite, therefore creating a magnetic attraction between the two. By means of this, the exhaust valve (9) is opened efficiently, eliminating the possibility of the exhaust valve (9) being adhered to the valve table (7) because of the lubricant oil.

[0020] The present invention relates to a hermetic compressor (1) wherein the circuit (12) is configured to provide varying current wherein the variation depends on the angle between the valve table (7) and the exhaust valve (9). The angle of opening of the exhaust valve (9) with respect to the valve table (7) is predetermined by the manufacturer. The angle can change between a max-

imum angle and zero angle. The time interval wherein the exhaust valve (9) remains open is calculated and entered into the control card of the hermetic compressor (1). Therefore, the control unit knows the angle of the opening at a certain time interval. The control unit is in communication with the circuit (12) and is configured to vary the current. As a result of which, a better and a more efficient hermetic compressor (1) control is achieved.

[0021] The present invention relates to a hermetic compressor (1) further comprising a fastening means (13) produced from a dielectric material via which the restrainer (10) and the exhaust valve (9) are fixed onto the valve table (7). The fastening means (13) is used to attach the restrainer (10) and the exhaust valve (9) onto the valve table (7). By means of providing a fastening means (13) that is produced from a dielectric material, electrical inductivity between the restrainer (10) and the exhaust valve (9) is achieved.

[0022] The present invention relates to a hermetic compressor (1) wherein the fastening means (13) is a rivet. The rivets are an economical solution to fasten items onto other items.

[0023] The present invention relates to a hermetic compressor (1) wherein the circuit (12) comprises an electric motor (14), an electrical switch (15), a data logger (16), a laser encoder (17) and a crank eccentric trunnion (18). The electrical motor (14) produces the electrical current that is used to polarize the restrainer (10). The electrical switch turns on and off the circuit (12). The data logger saves and reformates the data provided by means of the laser encoder (17). The laser encoder (17) is the device that detects displacements of the crank eccentric trunnion (18) with laser and sends this signal to the data logger (16) which in turn processes the data. The laser encoder (17) detects displacements of the crank eccentric trunnion (18) and therefore the movement of the exhaust valve (9) is measured with accuracy. During the movement of the crank eccentric trunnion (18), the laser encoder (17) detects the position of the crank eccentric trunnion (18) and therefore that of the exhaust valve (9).

[0024] In the hermetic compressor (1) of the present invention, the magnetic attraction originating from the polarization of the restrainer (10) by the circuit (12) is used for counter act the negative effects of lubricants adhesive effect between the valve table (7) and the exhaust valve (9).

Claims

1. A hermetic compressor (1) comprising;

a housing (2), a cylinder (3) inside the housing (2) and that enables the refrigerant to be sucked and pumped;
a piston (4) that is operated in the cylinder (3);
a body that supports the cylinder (3) and the piston (4);
a cylinder head (5) that enables the refrigerant sucked and pumped by the movement of the piston (4) into the cylinder (3) to be guided;
an exhaust chamber (6) that is disposed in the cylinder head (5) wherein the refrigerant fluid pumped during the compression movement of the piston (4) is accumulated;
a valve table (7) placed between the cylinder (3) and the cylinder head (5);
an exhaust port (8) arranged on the valve table (7) that enables the refrigerant to pass from the cylinder (3) to the exhaust chamber (6) during the compression movement of the piston (4);
an exhaust valve (9) disposed on the valve table (7) that opens and closes the exhaust port (8);
a restrainer (10) fixed onto the valve table (7) that extends into the exhaust chamber (6) and that restrains the movement of the exhaust valve (9), wherein the exhaust valve (9) and the restrainer (10) are produced from a ferromagnetic material;
characterized by
a seal (11) produced from a dielectric material and placed between the exhaust valve (9) and the restrainer (10) such that the seal (11) is configured to electrically insulate the restrainer (10) and the exhaust valve (9) from each other and by a circuit (12) configured to provide electrical current to the restrainer (11), inducing ferromagnetism.

2. A hermetic compressor (1) according to claim 1, **characterized in that** the circuit (12) is configured to provide varying current wherein the variation depends on the angle between the valve table (7) and the exhaust valve (9).

3. A hermetic compressor (1) according to any preceding claim, **characterized by** a fastening means (13) produced from a dielectric material via which the restrainer (10) and the exhaust valve (10) are fixed onto the valve table (7).

4. A hermetic compressor (1) according to claim 3, **characterized in that** the fastening means (13) is a rivet.

5. A hermetic compressor (1) according any preceding claim, **characterized in that** the circuit (12) comprises an electric motor (14), an electrical switch (15), a data logger (16), a laser encoder (17) and a crank eccentric trunnion (18).

Figure 1

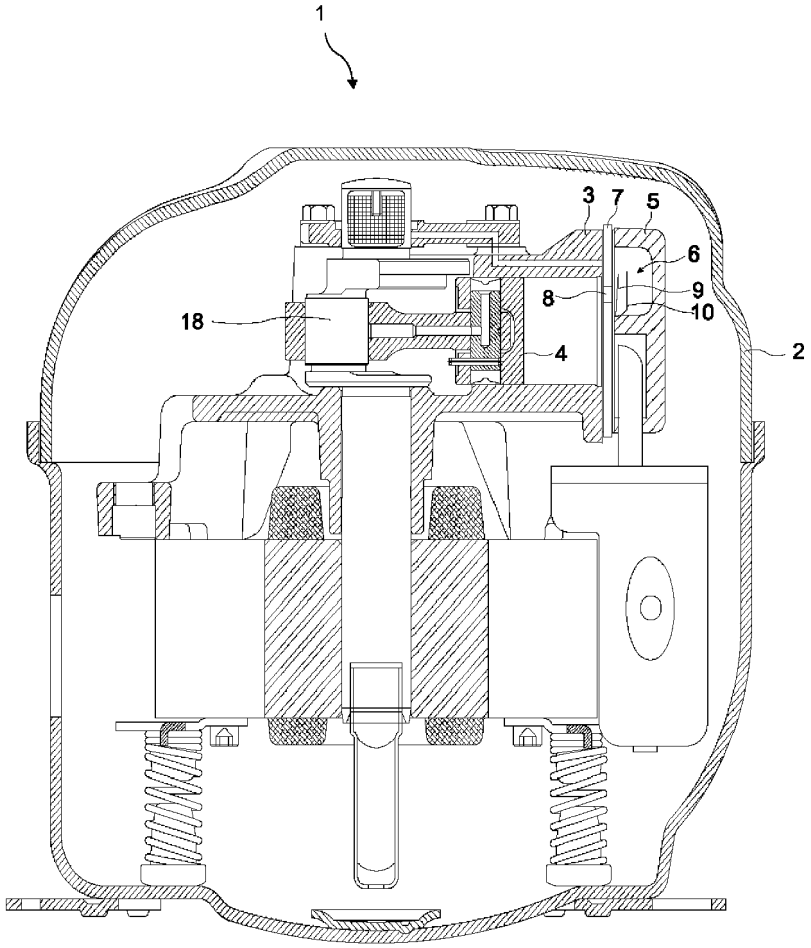


Figure 2

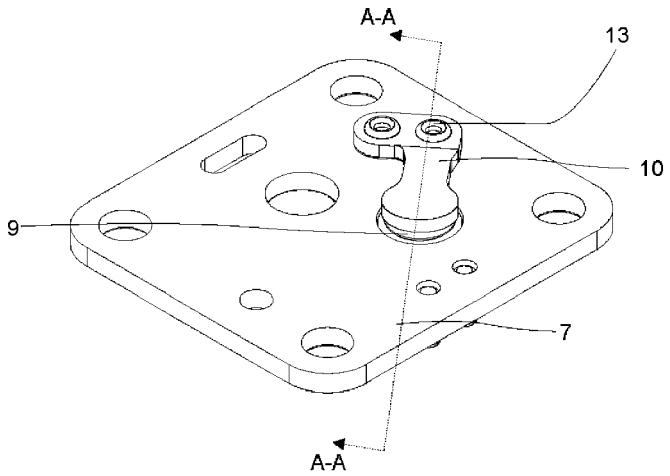


Figure 3

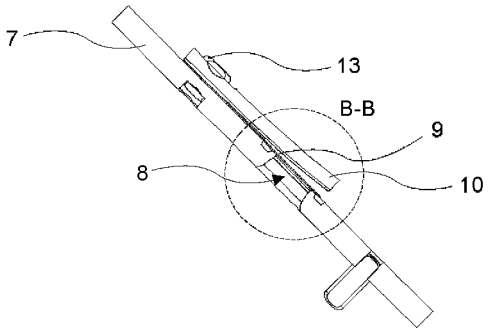


Figure 4

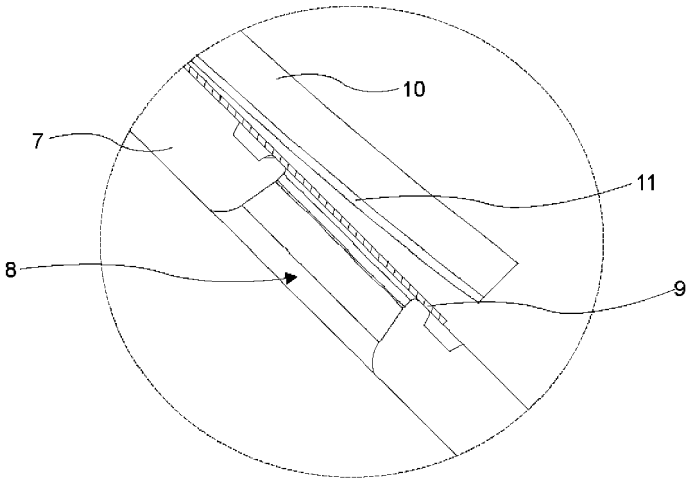
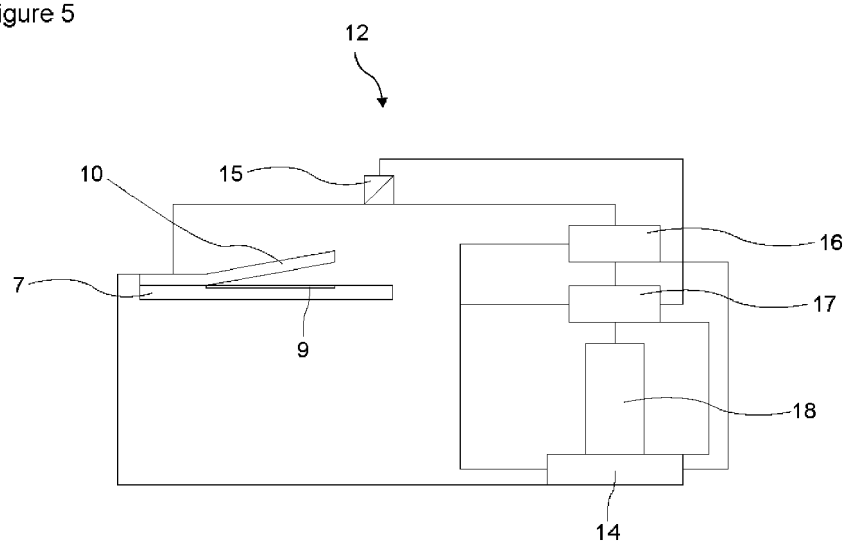


Figure 5



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EUROPEAN SEARCH REPORT

Application Number
EP 21 18 7573

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	JP 2000 097163 A (TOYODA AUTOMATIC LOOM WORKS [JP]) 4 April 2000 (2000-04-04)	1,3,4	INV. F04B7/00
A	* figure 6 * * paragraph [0025] - paragraph [0027] * * paragraph [0035] - paragraph [0037] * -----	2,5	F04B27/08 F04B27/10 F04B39/10 F04B53/10
Y	JP S53 69005 U (TOYODA KK [JP]) 9 June 1978 (1978-06-09)	1,3,4	
A	* figure 1 * * Magnetic coil circuit (6) generating an attraction force on the valve reed (3); paragraph [0002] * -----	2,5	
A	JP S53 96203 U (TOYODA KK [JP]) 4 August 1978 (1978-08-04) * figure 2 * * Rubber seal element (6); paragraph [0002] * -----	1-5	
A	KR 2008 0033745 A (SAMSUNG KWANGJU ELECTRONICS CO. [KR]) 17 April 2008 (2008-04-17) * figures 1, 3, 6 * * paragraph [0040] - paragraph [0046] * * paragraph [0050] - paragraph [0055] * -----	1-5	TECHNICAL FIELDS SEARCHED (IPC) F04B
A	EP 2 798 214 A1 (WHIRLPOOL SA [BR]) 5 November 2014 (2014-11-05) * figure 1 * * paragraph [0021] - paragraph [0024] * * paragraph [0034] - paragraph [0039] * -----	1-5	

1 The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	28 January 2022	Gnüchtel, Frank

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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L : document cited for other reasons
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& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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- EP 1797324 B1 **[0003]**
- WO 2017194492 A1 **[0004]**
- WO 2017194516 A1 **[0005]**