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(54) **A COMPRESSOR HAVING IMPROVED LUBRICATION MEANS**

(57) The present invention relates to a compressor (1) of a cooling appliance, the compressor (1) comprising a crankshaft (2) and a cylinder block (3) which has a main bearing (4) for supporting the crankshaft (2) and a casing (5) which has a lower section (6) for collecting lubricant, the crankshaft (2) comprising a vertically extending shaft (7) which includes an integral bearing section (8) that is adapted for being guided into the main bearing (4), the shaft (7) comprising an integral lower tip section (9) that is adapted for being directly immersed into the lubricant inside the lower section (6), wherein shaft (7) comprises an integral crank (10) adapted for converting rotational movement in reciprocating movement and an axially upwardly continuous lubricant channel (11) that is formed so as to extend along and within the shaft (7) and adapted for conveying the lubricant from the lower tip section (9) towards the surface of the crank (10) via an outlet that is provided on the crank (10) upon rotation of the shaft (7).

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Description

[0001] The present invention relates to a compressor, in particular to a compressor having improved lubrication means.

[0002] Hermetically sealed reciprocating compressor are commonly used in a wide range of applications such as cooling appliances and air conditioning appliances. In such compressors, the lubrication of moving parts and parts guiding said moving parts such as crankshaft, cylinder block and main bearing is performed by the lubricating oil collected inside the compressor especially in the lower section of the compressor casing. The lubricant is transferred towards the upper portions of the compressor by means of centrifugal forces and the channel provided inside the crankshaft. As the compressor starts to operate, the lubricant is carried along the channel and towards the crank. The lubricant is then ejected, preferably upwards, by means of an extension pipe or other means. The lubricant is ejected, collides with the upper section of the casing of the compressor after which the lubricant starts to drip on moving parts and parts guiding said moving parts therefore lubricating the said parts. The lubrication in compressors is vital as the moving parts tends to wear out in the absence of proper lubrication which in time leads to decrease in energy efficiency of the compressor. Another problem with compressors is that the compressor requires more lubrication in higher operating speeds meaning that the rpm (revolutions per minute). A problem faced with compressors working at high rpm values is that the lubricant is ejected from the crankshaft or other lubricating means provided on the crankshaft at a high speed. The lubricant collides the upper section of the casing at a high speed therefore increasing the operational noise level of the compressor. Another problem faced with compressors operating at high rpm values is that the lubricant, after hitting the upper section of the casing, scatters inside the casing and reaches the suction muffler. The lubricant enters the suction muffler and mixes with the coolant which in turn decreases the energy efficiency of the compressor.

[0003] A prior art publication in the technical field of the present invention may be referred to as EP3250826A1 among others, the document disclosing a crankshaft for a hermetic compressor wherein the crankshaft comprises means for transferring and distributing lubricant towards the moving parts and parts guiding said moving parts.

[0004] An objective of the present invention is to provide a lubricating device which provides improved lubrication performance, reducing the noise generated by the compressor and ensuring that no lubricant enters the suction muffler and therefore to the cooling cycle of the appliance wherein the compressor is utilized.

[0005] The method realized to achieve the aim of the present invention and disclosed in the first claim and the dependent claims comprises a compressor suitable to be used in a cooling appliance. The compressor comprises a cylinder block and a main bearing. The main bearing supports a crankshaft. The compressor comprises a casing hermetically sealing the operational parts of the compressor wherein the casing comprises a lower section and an upper section. The lower section and the upper section are connected to each other, hermetically sealing the compressor. The crankshaft comprises a shaft vertically extending wherein the shaft comprises a bearing section. The bearing section is guided inside the main bearing. The shaft further comprises a tip section on a lower surface of the shaft. The tip section is immersed inside in the lubricant collected inside the lower section. The shaft comprises an integral crank on an upper part of the shaft. The crank converts the rotational movement in reciprocating movement. A channel is provided inside the shaft and transmits the lubricant from the tip section towards the crank upon rotation of the shaft. As the compressor starts to operate, the shaft starts to rotate conveying the lubricant inside the lower section via the channel and towards the crank. The crank is provided with an outlet by means of which the lubricant that was conveyed is transferred towards the surface of the crank. As the rpm of the compressor increases, more lubricant is transferred towards the crank and to other moving parts of the compressor thereby reducing energy loses caused by the friction between the moving parts. The compressor further comprises a lubricating device. The lubricating is device is hollow and is placed onto the crank via an inlet pipe. The inlet pipe provides the lubricant to enter inside the lubricating device. A hole is provided on the surface of the lubricating device. By means of the hole, the lubricant that was conveyed inside the lubricating device is transferred to the moving parts of the compressor and the parts guiding the said moving parts. As the rpm of the compressor increases more lubricant will be conveyed via the channel towards the lubricating device. The hole is provided on the lubricating device so as to transfer the lubricant at least partly laterally. By means of the lubricating device and the hole provided on said device, the lubrication of the moving parts of the compressor and the parts guiding the said moving parts is achieved meanwhile hindering the lubricant to hit upper section of the casing. This helps decrease the noise level of the compressor. Another advantageous effect provided by means of this invention is that the lubricant is prevented from reaching the suction muffler, minimizing the possibility of the lubricant getting into the coolant cycle which in turn minimizes energy efficiency losses.

[0006] In an embodiment of the invention, the lubricating device comprises a lower surface. The lower surface accommodates the inlet pipe. The lubricating device further comprises an upper surface and a side surface interconnecting the upper surface and the lower surface. The hole is located on the side surface.

[0007] In an embodiment of the invention, lubricating device is in cylindrical shape and forms a planar and almost continuous surface with the crank. The crank recip-

rocates and the flush surface the crank forms with the surface of the lubricating device eliminates the possibility of the lubricating device colliding with other parts of the compressor.

[0008] In an embodiment of the invention, the lubricating device is at least partially in spherical shape. It is to be understood that the vertical projection of the lubricating device should not be extending beyond the vertical projection of the crank.

[0009] In an embodiment of the invention, the lubricating device comprises plurality of holes on side surface at different heights. As the compressor starts to operate at higher rpm values, more and more lubricant will be conveyed towards the lubricating device. Higher rpm values require higher lubrication and by means of plurality of holes the moving parts of the compressor and the parts guiding the said moving parts are lubricated in an efficient manner. Another advantage of using plurality of holes is that the lubricant is divided among the holes, decreasing the speed of lubricant as it exits the lubricating device. By this means, the operational noise level of the compressor is decreased.

[0010] In an embodiment of the invention, the hole forms an internal wall of the side surface of the lubricating device. The internal wall of the holes is inclined wherein the cross sectional area of the hole narrows towards the exterior of the lubricating device. By means of this, the lubricant reaches farther as the lubricant exits the lubricating device even during lower rpm values.

[0011] In an embodiment of the invention, the upper part of the internal wall in inclined, directing the lubricant downwards and onto the moving parts of the compressor.

[0012] In the compressor of the present invention, lubrication of the moving parts of the compressor such as crankshaft, main bearing, shaft and crank is lubricated properly thanks to the hole provided on the crank meanwhile eliminating the possibility of the lubricant from reaching the suction muffler.

[0013] Another advantageous effect provided by the hole being located on the side surface is that the lubricating oil is prevented to hit the upper section of the casing thereby minimizing the noise level of the compressor.

[0014] 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 crosssectional view of the compressor

Figure 2 - is a side view of the crankshaft

Figure 3 - is a side view of the crankshaft

Figure 4 - is an isolated view of the lubricating device

Figure 5 - is an isolated view of the lubricating device

Figure 6 - is a crosssectional view of the lubricating device along the dashed lines infigure 5

[0015] The following numerals are assigned to different parts demonstrated in the drawings and referred to in the present detailed description of the invention:

1. Compressor
2. Crankshaft
3. Cylinder block
4. Main bearing
5. Casing
6. Lower section
7. Shaft
8. Bearing section
9. Tip section
10. Crank
11. Channel
12. Lubricating device
13. Inlet pipe
14. Hole
15. Lower surface
16. Upper surface
17. Side surface
18. Internal wall

[0016] The present invention relates to a compressor (1) of a cooling appliance, the compressor (1) comprising a crankshaft (2) and a cylinder block (3) which has a main bearing (4) for supporting the crankshaft (2) and a casing (5) which has a lower section (6) for collecting lubricant, the crankshaft (2) comprising a vertically extending shaft (7) which includes an integral bearing section (8) that is adapted for being guided into the main bearing (4), the shaft (7) comprising an integral lower tip section (9) that is adapted for being directly immersed into the lubricant inside the lower section (6), wherein shaft (7) comprises an integral crank (10) adapted for converting rotational movement in reciprocating movement and an axially upwardly continuous lubricant channel (11) that is formed so as to extend along and within the shaft (7) and adapted for conveying the lubricant from the lower tip section (9) towards the surface of the crank (10) via an outlet that is provided on the crank (10) upon rotation of the shaft (7).

[0017] The present invention relates to a compressor (1) further comprising a lubricating device (12) that is hollow wherein the lubricating device (12) is placed onto the crank (10) via an inlet pipe (13) and wherein the inlet pipe (13) is inserted inside the outlet and adapted for conveying the lubricant inside the lubricating device (12) and a hole (14) on a surface of the lubricating device (12). Once the compressor (1) starts running, the lubricant accumulated inside the lower casing (6) is conveyed via the channel (11) towards the outlet of the crank (10). The outlet is in fluid communication with the inlet pipe (13) of the lubricating device (12). The lubricating device is hollow, and the conveyed lubricant enters the hollow inner volume of the lubricating device (12). As the crank

(10) along with the rotational movement reciprocates, the lubricant is ejected via the hole (14) provided on the lubricating device (12). By means of this, the rotating and reciprocating parts of the compressor (1) are lubricated efficiently. Meanwhile by means of the hole, range of the jet of the lubricant is controlled. As a result of this, lubricant is prevented from colliding with the upper section, minimizing the noise level of the compressor (1). Another advantageous effect provided by means of the lubricating device (12) is that the position of the hole (14) on the lubricating device (12) is adjusted so as to keep the jet of the lubricant away from the suction muffler. By means of this, the lubricant is prevented from getting into the cooling cycle, increasing energy efficiency of the compressor (1).

[0018] In another embodiment, the lubricating device (12) comprises a lower surface (15) an upper surface (16) and a side surface (17) interconnecting the lower surface (15) and the upper surface (16) wherein the hole (14) is on the side surface (17). By providing the hole (14) on the side surface (17), the lubricant is ejected from the lubricating device (12) laterally which in turn helps to lubricate the moving parts of the compressor (1). This helps decrease the noise of the compressor (1) resulting from collision of the lubricant and the lower section (7) and/or the upper section.

[0019] In another embodiment, the side surface (17) is cylindrical and forms a planar and almost continuous surface with the crank (10). By means of the lubricating device (12) having a cylindrical shape, the lubricating device (12) is prevented colliding with parts of the compressor (1) during reciprocating movement.

[0020] In another embodiment, the lubricating device (12) is at least partially in spherical shape.

[0021] In another embodiment, the side surface (17) comprises plurality of holes (14) at different heights. Depending on the operating speed, in other words rpm, of the compressor (1), lubricant is conveyed towards the lubricating device (12) via the channel (11). As the rpm increases, the lubricating device (12) is filled with lubricant. Plurality of holes (14) provides multiple orifices for the lubricant to emerge and lubricate the moving parts of the compressor (1). The height difference between the holes (14) provides the lubricant to reach different areas of the compressor (1). Additionally, plurality of holes (14) has the advantage to dispose of the lubricant faster which will lead to increased noise level at high rpm values.

[0022] In another embodiment, the hole (14) is formed by an internal wall (18) on the side surface (15) wherein the internal wall (18) is inclined, narrowing the hole (14) towards the exterior of the lubricating device (12). By means of the holes (14), narrowing towards the exterior of the lubricating device (12), the range of the jet of lubricant is increased, effectively lubricating the moving parts of the compressor (1) in lower rpm values.

[0023] In another embodiment, the upper part of the internal wall (18) is inclined. By means of this, the direction of the jet of lubricant is directed downwards, eliminating the possibility of the lubricant reaching the suction muffler. Energy efficiency of the compressor (1) decreases if the lubricant gets into the cooling cycle along with coolant.

[0024] In the compressor (1) of the present invention, the lubricating oil is prevented to hit the upper section as it exits the crank (10) therefore minimizing operational noise of the compressor (1).

[0025] Another advantageous effect of the present invention is that the lubricating oil is prevented to reach suction muffler by means of holes (14) that limit the horizontal distance travelled by the lubricating oil.

[0026] Another advantageous effect of the present invention is that the holes (14) that are drilled onto the side surface (17) at different height helps to reduce noise level and limit the horizontal distance travelled by the lubricating oil at varying capacities the compressor (1) operates.

Claims

1. A compressor (1) of a cooling appliance, the compressor (1) comprising a crankshaft (2) and a cylinder block (3) which has a main bearing (4) for supporting the crankshaft (2) and a casing (5) which has a lower section (6) for collecting lubricant, the crankshaft (2) comprising a vertically extending shaft (7) which includes an integral bearing section (8) that is adapted for being guided into the main bearing (4), the shaft (7) comprising an integral lower tip section (9) that is adapted for being directly immersed into the lubricant inside the lower section (6), wherein shaft (7) comprises an integral crank (10) adapted for converting rotational movement in reciprocating movement and an axially upwardly continuous lubricant channel (11) that is formed so as to extend along and within the shaft (7) and adapted for conveying the lubricant from the lower tip section (9) towards the surface of the crank (10) via an outlet that is provided on the crank (10) upon rotation of the shaft (7), **characterized by**
a lubricating device (12) that is hollow wherein the lubricating device (12) is placed onto the crank (10) via an inlet pipe (13) and wherein the inlet pipe (13) is inserted inside the outlet and adapted for conveying the lubricant inside the lubricating device (12) and a hole (14) on a surface of the lubricating device (12).

2. The compressor (1) according to claim 1, **characterized in that** the lubricating device (12) comprises a lower surface (15) an upper surface (16) and a side surface (17) interconnecting the lower surface (15) and the upper surface (16) wherein the hole (14) is on the side surface (17).

3. The compressor (1) according to claim 2, **characterized in that** the side surface (17) is cylindrical and

forms a planar and almost continuous surface with the crank (10).

4. The compressor (1) according to claims 1 to 2, **characterized in that** the lubricating device (12) is at least partially in spherical shape.

5. The compressor (1) according to claims 2 to 4, **characterized in that** the side surface (17) comprises plurality of holes (14) at different heights.

6. The compressor (1) according to claims 2 to 5, **characterized in that** the hole (14) is formed by an internal wall (18) on the side surface (15) wherein the internal wall (18) is inclined, narrowing the hole (14) towards the exterior of the lubricating device (12).

7. The compressor (1) according to claim 6, **characterized in that** the upper part of the internal wall (18) is inclined.

Figure 1

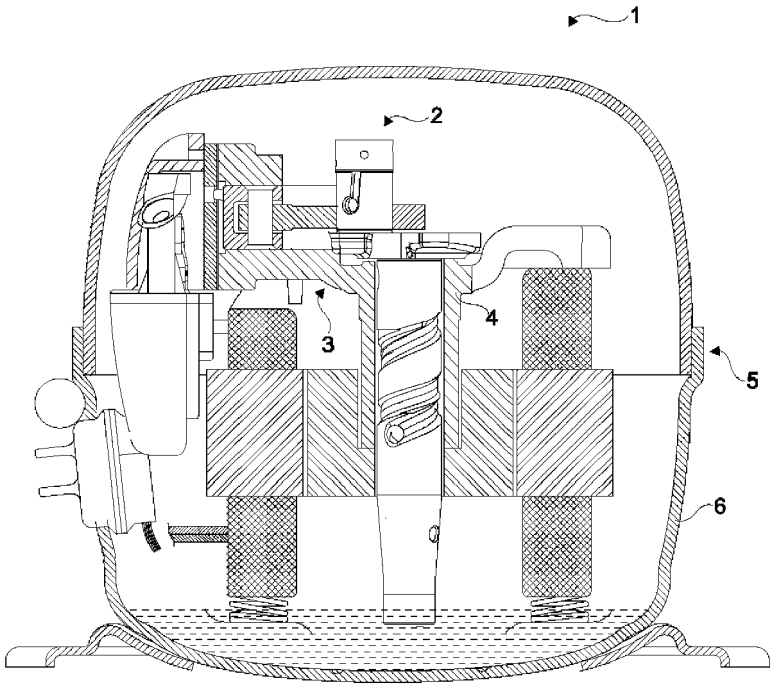


Figure 2

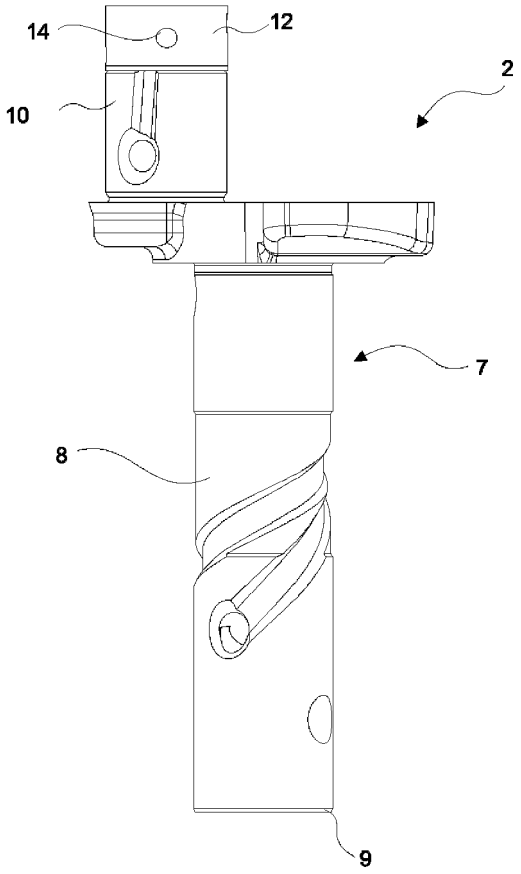


Figure 3

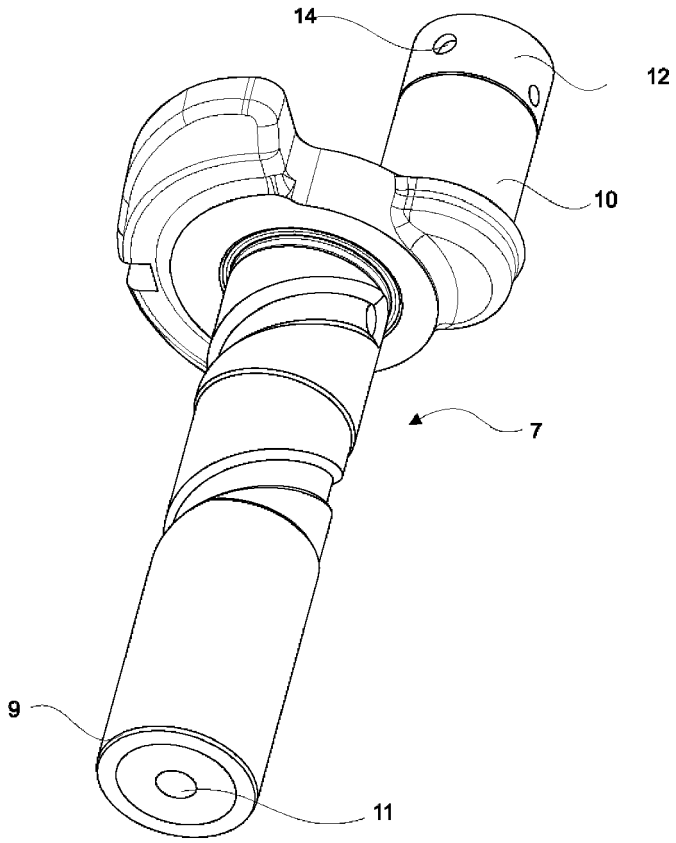


Figure 4

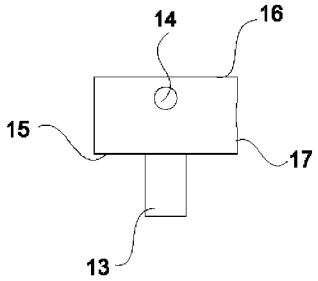


Figure 5

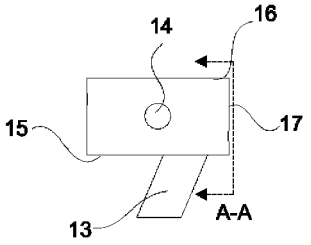
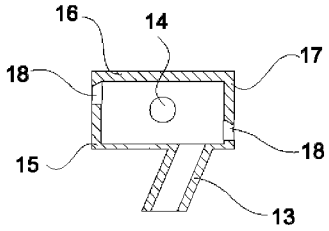


Figure 6



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EUROPEAN SEARCH REPORT

Application Number
EP 20 19 3619

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	EP 3 250 826 A1 (ARÇELIK ANONIM SIRKETI [TR]) 6 December 2017 (2017-12-06) * claims 1-14; figures 1-3 *	1-7	INV. F04B39/00 F04B39/02
A	WO 2016/155806 A1 (ARCELIK AS [TR]) 6 October 2016 (2016-10-06) * claims 1-11; figures 2-4 *	1-7	
A	US 5 088 579 A (KIM KI M [KR] ET AL) 18 February 1992 (1992-02-18) * claims 1-19; figures 1-7 *	1-7	
			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	9 October 2020	Fistas, Nikolaos

CATEGORY OF CITED DOCUMENTS

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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09-10-2020

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 3250826 A1	06-12-2017	EP 3250826 A1	06-12-2017
		WO 2016119869 A1	04-08-2016
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US 5088579 A	18-02-1992	NONE	

EPO FORM P0459

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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Patent documents cited in the description

- EP 3250826 A1 **[0003]**