

Title: "REFRIGERATION COMPRESSOR WITH INTERNAL COOLING SYSTEM".

The present invention refers to hermetic refrigeration compressors, with reciprocal movement, which have means for collecting oil which is expelled by the drive shaft by way of the cam, in the upper part of the compressor shell. This accumulated oil is used to cool certain specific parts of the compressor block so as to increase the efficiency thereof. Thereafter, the oil returns to the bottom of the compressor.

Description of the State of the Art

Attempts to improve the performance of refrigeration compressors are increasingly common, the main purpose being to reduce their energy consumption. It is known that a large part of the losses of compressors are due to the overheating of gas in the path from the entry of the compressor up to the entry of the compression cylinder. Another factor that reduces the performance of compressors is the inefficiency of gas compression, due to the high working temperature of the cylinder.

Accordingly, with the aim of increasing the efficiency of the compressors, ideas and solutions have been developed viewing the reduction of the temperature of the cylinder. Different approaches with this objective can be found in the patent documents described ahead.

For example, patent document WO 2007/068072, uses the concept of isolation of cylinder heating sources. According to this document, a spacing duct is built on a valve plate and open to the interior of the discharge chamber, maintaining the cylinder cover of the compressor spaced from the valve plate and defining an annular plenum around said spacing duct. Accordingly, the heat transmission from the cylinder cover to the valve plate is reduced, ultimately reducing the heating of the cylinder in the compression chamber region, increasing the efficiency of the compressor.

Document WO 2007/014443 proposes another solution to increase the efficiency of compressors, which uses heat tubes to remove the heat from the hot parts in contact with the cylinder. This document proposes a hermetic compressor with a heat dissipation system, in which a thermal

energy transfer duct is mounted to the cylinder block, the duct having a heat absorbing end, whereas its other heat releasing end is disposed away from the cylinder block in order to absorb heat generated with the cooling fluid compression inside the cylinder and dissipate it to a region away from the cylinder, thus reducing the temperature of the cylinder, and also increasing the efficiency of the compressor.

Another possible alternative to reduce the temperature of the cylinder is the best use of lubricating oil of the compressor as cooling means. Currently, the main function of the oil is to lubricate the mechanism of the compressor, in order to guarantee the reliability and durability of its parts.

Based on the use of oil with cylinder cooling objectives, we can cite patent US4,569,639, in which the inventors proposed the use of an outlet extension of the shaft and a deflector in the cylinder head, with the objective of directing the flow of oil leaving the shaft extension towards the cylinder head, causing cooling of the cylinder. This extension of the cylinder has an orifice through which the oil is slung horizontally towards the deflector of the cylinder head, whereas this extension is turned. The deflector also has an orifice at a height approximately equal to the height at which the oil is slung, making this oil run over the cylinder head to cool it. Additionally, this invention allows a reduction of the oil, to prevent it from boiling and losing its essential properties.

The inventors indicate that the objective of the invention is to reduce the temperature of the cylinder, to provide greater reliability of the compressor, because a cooler cylinder would reduce the risks of excessive heating of the oil that is found in the inner region of this component, thus avoiding possible problems of carbonization of this oil, which could generate residues which would damage the compressor.

Objectives of the Invention

An objective of the invention is to provide an increase in the efficiency of hermetic refrigeration compressors, maximizing the flow of oil around the compressor cylinder and at the same time reducing the working temperature of the cylinder.

Another objective of the invention is to reduce overheating of the compression gas, further contributing to boost the efficiency of the compressor.

Brief Description of the Invention

The objectives of the invention are achieved by means of a refrigeration compressor with inner cooling system, comprising compressor shell, inside of which are disposed a compression cylinder having a cylinder body and a cylinder head, a piston that performs an alternating movement inside the cylinder, an oil accumulation region in the lower part of the compressor shell, piston drive means that drive the alternating movement of the piston inside the cylinder, oil pumping means from the oil accumulation region over the piston drive means, the piston drive means comprises a rotary shaft oriented substantially vertically, which has an upper end mounted to a piston drive cam, through which the oil pumped over the piston drive means is expelled, the compressor shell comprises an oil sump located in its internal upper portion, the oil sump having an oil drain directed on the surface of the cylinder; the oil sump extending along the entire inner circumference of the compressor shell.

Preferably, the oil sump extends around the entire inner circumference of the shell, and the oil drain from the oil sump is intended for spilling oil over the cylinder body.

The compressor shell may comprise a cover, and the oil sump is formed in the region of this cover, and can be formed integrally with the cover, or integrally with the compressor shell, or as an additional part which is coupled to a part of the compressor shell. The oil sump can be formed by stamping during the production process of a part of the compressor shell.

The piston drive means comprise a rotary shaft oriented substantially vertically, which has an upper end mounted to a piston drive cam, which expels the oil pumped over the piston drive means. The oil sump preferably comprises an oil collection region, in which at least a portion of the oil is collected that is expelled by the piston drive means, and the oil collection region has a geometry that allows the run-off of the oil collected to drain from the oil sump.

Summarized Description of the Drawings

The present invention shall now be described in further details

based on a sample embodiment represented in the drawings, wherein the figures show:

figure 1 – is a cross-sectional view of a refrigeration compressor of the state of the art, without the inner cooling system of the present invention; and

figure 2 – is a cross-sectional view of a refrigeration compressor according to a present invention, with the inner cooling system.

Detailed Description of the Drawings

Figure 1 depicts a compressor of the state of the art merely for comparison purposes with the present invention. This compressor of the hermetic refrigeration compressor type, with reciprocal movement does not have the internal cooling system of the present invention. This compressor is disposed inside the shell 1. The compressor comprises a cylinder that has a cylinder body 3 and a cylinder head 2, and a piston that performs an alternating movement inside the cylinder. In the lower portion of the compressor shell, an oil accumulating region 5 is formed in the shape of a well. The oil accumulating in this accumulation region originally has the purpose of lubricating the compressor parts, reducing the attrition between them and increasing the durability of the compressor.

This refrigeration compressor of the state of the art also has piston drive means, which are responsible for driving the alternating movement of the piston inside the cylinder, compressing the compression fluid. The drive means normally comprise a rotor and a stator, which drive the rotational movement of a rotary shaft 4. This rotary shaft is oriented substantially vertically in relation to the compressor shell, and is disposed in such a way that its lower end 13 is immersed in the oil well, while its opposite upper end is mounted to a cam 7 which drives the piston movement.

Therefore, when the compressor is switched on and the rotary shaft 4 turns inside the compressor, an oil pump pumps the oil upwards that is accumulated in the oil accumulation region 5, towards the drive means, and particularly around the rotary shaft 4, such that a portion of the oil 14 is ultimately slung to the upper part of the shaft, by means of the also rotational

cam 7. As shown by the arrows in figure 1, this portion of oil is aimed upwards, towards the upper face of the compressor shell 1, or on the inner surface of the cover of the compressor 6, and also sideways, towards the inner walls of the upper region of the compressor shell. Another portion of oil
5 expelled over the cam around the area formed between the compressor block and the upper face of the shell falls again and runs over the compressor block as a whole.

Thus, a large part of the oil 14 that is slung towards the upper face of the compressor shell 1 ultimately runs towards the ends of this upper
10 face or cover 6, and then runs downwards over the side walls of the shell, falling again onto the oil accumulation region 5, where it exchanges heat with the compressor shell 1. There is an optimization of concentration of the oil expelled over the cylinder, to cool this part of the compressor specifically.

However, experimental analyses indicate that there is a
15 considerable difference of temperature between the oil present in the oil accumulation region 5 at the bottom of the compressor (also called carter) and the compression cylinder, and the oil is considerably cooler than the compression cylinder. Accordingly, there is potential to reduce the temperature of the cylinder, if it is possible to maximize the flow of oil around
20 it, withdrawing heat from its surface. A cooler cylinder generates an improvement in efficiency of the compression process, and also a decrease in the overheating of the gas during suction and this reflects directly in an increase in the efficiency of the compressor. In light of this, the present invention proposes to maximize the flow of oil on the cylinder in order to cool
25 it.

Figure 2 illustrates a compressor according to the present invention, which is provided with the internal cooling system. This compressor has the same parts described for the compressor of the state of the art, namely the shell 1 inside of which the compressor is disposed, the
30 cylinder which has a cylinder body 3 and a cylinder head 2, and a piston 12 that performs an alternating movement inside the cylinder. The oil accumulation region 5 is also formed by the lower portion of the compressor

shell 1.

The refrigeration compressor according to the invention also has piston drive means, which drive the alternating movement of the piston inside the cylinder, and which comprise, for example, a motor and a stator which drive a rotary shaft 4 oriented substantially vertically in relation to the compressor shell. The lower end of the shaft 13 is immersed in the oil well, whereas its opposite upper end is mounted to a cam 7 which drives the piston movement. This compressor also has a pumping system which pumps the oil upwards that is accumulated in the oil accumulation region 5, towards the piston drive means, and particularly around the rotary shaft 4, when the compressor is switched on, such that a portion of the oil is expelled upwards, towards the upper face inside the compressor shell 1, or on the cover of the compressor 6, and also sideways, over the inner walls of the upper region of the compressor shell, as shown by the arrows illustrated in figure 2. Another portion of oil expelled by the cam around the area formed between the compressor block and the upper face of the shell falls again and runs over the compressor block as a whole.

The compressor illustrated in figure 2 also comprises an oil sump 8 located in the upper portion inside the compressor shell. This oil sump 8 has an oil collection region 11 and an oil drain 9, which is directed to spill oil on the surface of the cylinder. Hence, the oil accumulated on the sump 8, and having a temperature considerably lower than the temperature of the cylinder, is drained so as to run on the surface of the cylinder, preferably on the surface of its body 3, so as to cool it. After this run-off, the oil returns to the oil accumulation region 5 in the lower part of the compressor shell, where again it exchanges heat with the shell 1.

Accordingly, there is a considerable increase in the flow of oil over the cylinder, thus maximizing the cooling capacity of the cylinder by means of this portion of lubricating oil, which, normally according to the state of the art, would run directly to the oil accumulation region 5 at the bottom of the shell.

The oil sump preferably extends around the entire inner

circumference of the compressor shell, and can be, for example, a circumferential wing that extends from the inner wall of the compressor shell towards the center, and has an edge 10 extending vertically upwards from its inner end. The area formed on the circumferential wing and limited by the edge 10 forms the oil collection region 11. Therefore, the oil 14 that was expelled from the cam 7 on the upper face of the compressor shell 1, will drop or run down over the oil sump 8, accumulating in the oil collection region 11, and prevented from leaking out of the sump 8 by the vertical edge 10. A portion of the oil 14 expelled by the cam around the area formed between the compressor block and the upper face of the shell can also be collected by the oil sump 8.

As shown in figure 2, the oil drain 9 is built, for example, in the shape of a wing inclined downwards from an end of the oil sump 8, in a position above the compression cylinder, such that the drain 9 is directed to spill oil onto the surface of the cylinder, and preferably onto the surface of the cylinder body. Alternatively, the drain can also be built in the form of a hole on the surface of the oil sump 8 or on its edge, or in any other form that is capable of draining the oil accumulated in the oil sump 8 over the surface of the cylinder of the compressor. The oil collection region 11 is preferably shaped with geometry such that it allows or facilitates the run-off of the oil collected for draining 9 the oil sump, for example, with a horizontal circumferential wing which can be slightly inclined downwards towards the drain region 9.

In an embodiment of the invention, as illustrated in figure 2, the compressor shell preferably comprises a cover 6 in its upper part. Thus, the oil sump 8 can be formed directly in the region of this cover 6, being mounted thereon in the form of an additional part, or formed integrally and jointly to the cover 6 in the form of a single part.

Alternatively, the oil sump 8 can be formed as an additional part mounted directly on the compressor shell 1 in its upper region, or fixed to any other part of this shell, for example being fixed to its inner side walls. In another embodiment of the invention, the oil sump 8 is formed integrally and

jointly with the compressor shell.

When the oil sump 8 is built integrally and jointly with any part of the shell 1 of the compressor, be it with the cover 6 or other part of the shell body, this sump can be formed by means of additional steps in the process of stamping of these parts, during the production process thereof.

Additionally, in another alternative embodiment of the invention not illustrated in the drawings, the compressor may also comprise an oil-cooling device disposed in the upper oil sump 8. This device should be able to cool the oil accumulated in the sump, before this oil falls onto the cylinder, thus boosting the temperature reductions of this cylinder. This cooling device can be in the form of a heat exchanger, a heat tube or any other means of cooling oil.

Having described an example of a preferred embodiment, it should be understood that the scope of the present invention encompasses other potential variations, being limited solely by the content of the claims appended hereto, other possible equivalents being included therein.

CLAIMS

1. Refrigeration compressor with inner cooling system, comprising compressor shell (1), inside of which are disposed
a compression cylinder having a cylinder body (3) and a cylinder head (2),
a piston (12) that performs an alternating movement inside the cylinder,
an oil accumulation region (5) in the lower part of the compressor shell (1),
piston drive means that drive the alternating movement of the piston inside the cylinder,
oil pumping means from the oil accumulation region (5) over the piston drive means,
wherein the piston drive means comprises a rotary shaft (4) oriented substantially vertically, which has an upper end mounted to a piston drive cam (7), through which the oil pumped over the piston drive means is expelled
characterized wherein
the compressor shell (1) comprises an oil sump (8) located in its internal upper portion, the oil sump having an oil drain (9) directed on the surface of the cylinder; the oil sump (8) extending along the entire inner circumference of the compressor shell (1).
2. Refrigeration compressor with inner cooling system according to claim 1, characterized wherein the oil drain (9) of the oil sump is directed to spill oil onto the cylinder body (3).
3. Refrigeration compressor with inner cooling system according to any of claims 1 or 2, characterized wherein the compressor shell (1) comprises a cover (6), and the oil sump (8) is formed in the region of this cover.

4. Refrigeration compressor with inner cooling system according to claim 3, characterized wherein the oil sump is formed integrally with the cover (6).

5. Refrigeration compressor with inner cooling system according to any of claims 1 to 3, characterized wherein the oil sump (8) is formed integrally with the compressor shell (1).

6. Refrigeration compressor with inner cooling system according to any of claims 1 to 5, characterized wherein the oil sump is formed by stamping during the production process of a part of the compressor shell (1).

7. Refrigeration compressor with inner cooling system according to any of claims 1 to 3, characterized wherein the oil sump is built as an additional part which is coupled to a part of the compressor shell (1).

8. Refrigeration compressor with inner cooling system according to any of claims 1 to 7, characterized wherein the oil sump comprises an oil collection region (11), in which at least a portion of the oil is collected which is expelled by the piston drive means.

9. Refrigeration compressor with inner cooling system according to claim 8, characterized wherein the oil collection region (11) has a geometry that allows the run-off of the oil collected for draining (9) the oil sump (8).

10. Refrigeration compressor with inner cooling system according to any of claims 1 to 9, characterized by also comprising an oil cooling device disposed in the oil sump (8).