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(72) Inventors:  
• **MANKE, Adilson Luiz**  
**89221-103 Joinville (BR)**  
• **SANTIAGO, Rodrigo Antônio**  
**89212-050 Joinville (BR)**  
• **TADA, Maurício Pereira**  
**89218-180 Joinville (BR)**

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(74) Representative: **Soldatini, Andrea et al**  
**Società Italiana Brevetti S.p.A.**  
**Corso dei Tintori, 25**  
**50122 Firenze (IT)**

(71) Applicant: **Whirlpool S.A.**  
**04578-000 São Paulo - SP (BR)**

(54) **CONSTRUCTIVE ARRANGEMENT INTRODUCED IN A RECIPROCATING COMPRESSOR INCLUDING A LUBRICANT OIL PUMP**

(57) The present invention related to the technological field of reciprocating compressors and, particularly, constructive details of lubricating oil pumps of reciprocating compressors.

Problem to be solved: Nowadays, the industrial process of the rotating shaft assembling of the compressor in its rotor deforms the channels in which the lubricating oil is pumped from the bottom of the reciprocating compressor housing to the moving elements that integrate the compression functional unity of the reciprocating compressor. This deformation is mainly because of the mechanical interference between the bodies.

Resolution of the problem: It is revealed a constructive arrangement introduced on reciprocating compressor including helical pump of lubricating oil where the rotating shaft comprises at least one lower region and at least one intermediate region. On the lower region of the rotating shaft, the lubricating oil is pumped by an internal channel of the rotating shaft and on the intermediate region of the rotating shaft, the lubricating oil is temporary stored and transferred, for the rotating shaft bearing region. The cooperating region between the retaining pin and the rotating shaft is limited by the lower region. Additionally, the lower region of the rotating shaft still comprises, on its external side, a contouring recess. These two features prevents that the cooperating region of the lower channel of the lubricant oil conduction suffers any type of deformation by assembling the rotating shaft on the electrical engine rotor.

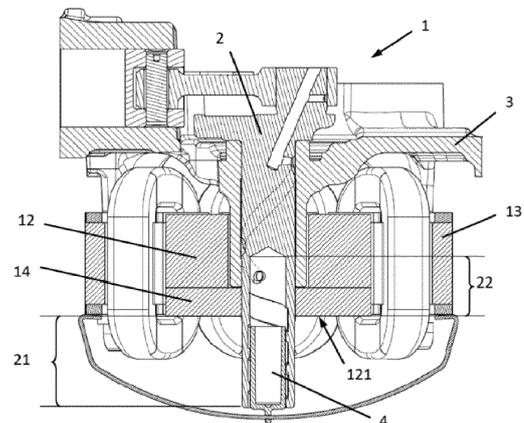


FIG. 1

## Description

### Field of the Invention

**[0001]** The current invention refers to a new constructive arrangement introduced in a reciprocating compressor including helical pump of lubricating oil, which is defined by interaction between the compressor rotating shaft (also known as the crankshaft) and the retaining pin, being the last stationary. On this context, it should be highlighted that said helical pump of lubricating oil is about the arrangement responsible for conducting or pumping lubricating oil stored on the bottom of the reciprocating compressor housing for the moving elements that are part of the compression functional unity of the reciprocating compressor.

### Background of the Invention

**[0002]** As it is known by experts on the matter, reciprocating compressor (normally hermetic) foresee the use of lubricating oil to reduce friction and wear between the moving components and, specially, the moving components that integrates the compression functional unity of the reciprocating compressor, as, for example, the rod, the piston, the shaft, among others. Generally, the lubricating oil is stored on the internal lower portion of the hermetic housing, being this region called crankcase.

**[0003]** On this scenario, it is mandatory that the lubricating oil stored on the bottom of the reciprocating compressor housing is conducted to the moving elements that integrate the compression functional unity of the reciprocating compressor. Thus, it is common to use the movement of the own rotating shaft of the compressor (which is coupled to the electrical engine rotor of the compressor) to conduct or pump this lubricating oil to the regions where the same is necessary.

**[0004]** Traditionally, conducting lubricating oil is made by a lubricating oil pump, which is defined by the interaction with the compressor rotating shaft. In general, the current state of the art comprises concepts of centrifugal pump and helical rotating pump of lubricating oil.

**[0005]** Briefly, the centrifugal pumps are defined by the interaction of stamped tips or pipes and holes integrated to the compressor rotating shaft, being that its functioning requires, normally the operation in frequencies above 50 Hz. Generally, the high rotation of the compressor shaft generated a centrifugal effect capable of conduct vertically the lubricating oil stored on the bottom of the reciprocating compressor housing for the moving elements that integrate the compression functional unity of the reciprocating compressor. The general details of this type of concept are broadly known by technicians on the art.

**[0006]** Also briefly, the helical pumps are defined by interaction with the compressor rotating shaft, being the functioning requiring, mandatory, the existence of a stationary pin housed on the lower end of said compressor rotating shaft. Generally, said stationary pin enables the

dragging of lubricating oil by the viscous tension principle generated on the helical channel existing between it and the internal surface of the rotating shaft, which makes possible the conduction of the stored lubricating on the bottom of the housing for the moving elements that integrates the compression functional unity of the reciprocating compressor even with the compressor operating in lower frequencies, around 20 Hz. The general details of this type of concept also are broadly known by technicians on the art.

**[0007]** There are known numerous patent documents, each one with its technical particularity, that describe reciprocating compressors including lubricating oil pump, being it helical or centrifugal.

**[0008]** Documents WO2012062852, WO2012062848, WO2012062860, JP60119389 describes (each one involving a technical particularity), for example, a general concept of reciprocating compressor including a helical pump of lubricating oil where it is foreseen the existence of a helical channel defined by the cooperation between the shaft internal surface and the external surface of a pin. Said helical channel is defined by grooves disposed on the pin external surface. This conceptual solution, while capable of pumping lubricating oil from the bottom of the compressor housing, until the moving components that integrates the compression functional unity, is totally dependent from said pin whose external surface comprises helical grooves.

**[0009]** Document WO9629516, in turn, describes a general concept of reciprocating compressor including a rotating pump of lubricating oil where is foreseen the existence of a helical channel defined by a helical groove, which extends for all the vertical length, and defined by cooperation between the shaft internal surface and the external surface of a pin. On this specific solution, it is necessary the maintenance of an elevated radial slot for avoiding the early blocking or wearing of the external surfaces of the pin and internal of the shaft, due to deformation on the shaft internal diameter caused by the assembling interference of the rotor on the shaft.

**[0010]** Documents JP2009150249, JP62147081, KR20000046855, KR100858657, CN202756204, CN102720660 describes (each one englobing a particular technic), for example, a main concept of reciprocating compressor including a centrifugal pump of lubricating oil where is foreseen the existence of a helical channel defined by a helical groove machined on the internal wall of the own shaft, which extends until the intermediate region of the shaft (normally until the high of the first lubricating radial hole on the shaft body). It might be highlighted that, according to this conceptual solution, it is not foreseen the existence of any additional component that cooperates with said shaft. This conceptual solution, while capable of pumping the lubricating oil from the bottom of the compressor housing until the moving components that integrates the compression functional unity without the need of additional components, presents low efficiency of the pumping process, normally inadequate

for variable speed compressors.

**[0011]** However, and independently of the type of lubricating oil pump (helical or centrifugal), it is possible to note that in all existing solutions the oil pump is housed inside the rotating shaft, being one portion of the same in coinciding region with the coupling region to the rotor of the compressor electrical engine, which normally results in assembling deformation (due to mechanical interference between the bodies) that can reduce the pumping efficiency, or still, the life time of the own compressor due to the eventual lack of lubricating oil on the moving elements that integrate the compression functional unity of the reciprocating compressor.

**[0012]** It is based on this context that arises the present invention.

#### Objectives of the Invention

**[0013]** Thus, it is one of the objectives of the present invention to reveal one new constructive arrangement introduced in reciprocating compressor including helical pump of lubricating oil that makes possible the lubricating oil pumping from the bottom of the compressor housing until the moving components that integrates the compression functional unity, being said shaft free of deformations in all the diametric slot region between pin and the tubular region of the compressor rotating shaft.

**[0014]** Furthermore, it is one of the objectives of the invention in question that the constructive arrangement introduced in reciprocating compressor including helical pump of lubricating oil makes possible the optimization of mechanical and dimensional features.

#### Summary of the Invention

**[0015]** All the objectives of the invention in question are reached by means of the constructive arrangement introduced in reciprocating compressor including helical pump of lubricating oil.

**[0016]** For that, said compressor comprises at least one electrical engine formed by at least one rotor and at least one stator, at least one rotating shaft functionally coupled to the electrical engine rotor, at least one compressor block capable of housing, at least partially, the rotating shaft and at least one retaining pin cooperating with the rotating shaft.

**[0017]** According with the invention in question, the rotating shaft comprises at least one lower region and at least one intermediate region.

**[0018]** Said lower region comprises the extension of the rotating shaft defined between its own lower end and all its own extension that is disposed out and below the lower side of the coupling region of the electrical engine rotor, being that the cooperating region between the retaining pin and the rotating shaft limits to the lower region.

**[0019]** The intermediate region comprises the extension of the rotating shaft hollow region disposed from and above the lower side of the coupling region of the rotor

shaft, in region non-cooperating with the retaining pin.

**[0020]** Particularly, the lower region of the rotating shaft further comprises, on its external side, a contouring recess.

#### Brief Description of the Drawings

**[0021]** The preferred embodiment of the present invention will be detailed based on the figures listed below, in which:

Figure 1 illustrates, schematically, the reciprocating compressor including the interaction between the rotating shaft, the block, the stationary pin, the fixing clamp and the electrical engine, according to the constructive arrangement in question;

Figure 2 illustrates, schematically, just the rotating shaft of compressor, according to the constructive arrangement in question.

#### Detailed Description of the Invention

**[0022]** Preliminarily, it remains to clarify that the reciprocating compressor 1 comprises, inside its hermetic housing (not illustrated), one electrical engine formed by a rotor 12 and a stator 13.

**[0023]** On the preferred embodiment of the present invention, as illustrated on figure 1, the rotating shaft 2 is functionally attached to the rotor 12 of the electrical engine by means of a coupling structure 14, and partially disposed inside the compressor block 3.

**[0024]** As detailed illustrated on figures 1 and 2, the rotating shaft 2 comprises a fundamentally cylindrical body that can be better analyzed segmented. This is, said rotating shaft 2 can be better studied if imaginatively divided in a lower region 21 and an intermediate region 22. This subdivisions have the reference to the interference region of said rotor 12 of electrical engine (including the coupling structure 14) and the hollow region of said rotating shaft 2 that extends above the interference region with the coupling structure 14 (including).

**[0025]** Thus, said lower region 21 is about the extension of rotating shaft 2 defined between its own lower end and all its own extension that is disposed out and below the lower side 121 of the coupling structure 14 of rotor 12 of electrical engine.

**[0026]** The intermediate region 22 is about the extension of the hollow region 21 of the rotating shaft 2 that extends above the lower side 121 of the coupling structure 14 of the rotor 12, in which there is no cooperation or functional interaction with the retaining pin 4.

**[0027]** According to the preferred embodiment of the invention in question, the lower region 21 is cylindrically hollow and cooperates with a retaining pin 4, which is inserted inside the hollow cylinder existing on the lower region 21 of the rotating shaft 2.

**[0028]** The cooperation between the lower region 21 and the retaining pin 4 defines, as it should be in helical

pumps, a lower channel of lubricating oil conduction. On the preferred embodiment illustrated on figures 1 and 2, the lower channel for conducting the lubricating oil is formed between the flat external wall of the retaining pin 4 and a helical groove 211 existing on the internal side of the lower region 21 of the rotating shaft 2. Alternatively (not illustrated), the lower channel for conducting lubricant oil could be formed between an eventual flat internal wall of the lower region 21 of the rotating shaft 2 and an eventual helical groove existing on the external side of the retaining pin 4. Still alternatively, (not illustrated), the lower channel for conducting the lubricating oil could be formed, interchangeably, between flat segments and grooved of the internal wall of the lower region 21 of the rotating shaft 2 and grooved and flat segments of the external side of the retaining pin 4, or vice versa.

**[0029]** Independently of the embodiment of the lower channel for conducting the lubricating oil, the great merit of the invention in question consists on the fact that limits the overlay region of the retaining pin 4 to the lower region 21 of the rotating shaft 2 (this is, all the extension of said rotating shaft 2 that is disposed out and below the lower side 121 of the coupling structure 14 of the rotor 12 of the electrical engine, this region free of deformations, allowing the assembling slots to be significantly reduced, increasing the efficiency of pumping of this helical pump. The lower region 21 of the rotating shaft 2 still comprises, on its external side, a contouring recess 212.

**[0030]** This way, the fact that the lower region 21 of the rotating shaft 2 comprises, on its external side, a contouring recess 212 for all its longitudinal extension makes possible the optimization of rotating shaft assembling 2 on the rotor 12 of the electrical engine, thus, this diametric reduction of the lower region 21 of the rotating shaft 2 avoids the occurrence of eventual plastic and/or elastic deformations of this part of the shaft, not damaging during assembling, at least one dimensional point of view, the lower region cooperation 21 of the rotating shaft 2 with the retaining pin 4 and, consequently, not imparting the efficiency or reciprocating the final diametric slot of the overlay region with the lower channel for conducting lubricating oil.

**[0031]** Also according to the preferred embodiment of the invention in question, the intermediate region 22 comprises a hollow space 221 from and above the lower side 121 of the coupling structure 14 of the shaft to the rotor. Such hollow space 221, as occurs in centrifugal pumps, is destined to temporary storage and transference of the lubricating oil to the bearing region of the rotating shaft, which is preliminarily pumped by the lower channel of conduction of lubricating oil existing on the lower region 21 of the rotating shaft 2.

**[0032]** The transference of the lubricating oil of the intermediate region 22 of the rotating shaft 2 for the bearing region of the shaft on the compressor block 3 is made by one or more passing radials holes 213 and/or 214.

**[0033]** This way, and due to the existence of the contouring recess 212 existing on the external side of the

lower region 21 of the rotating shaft 2, the lower channel for conducting the lubricating oil do not suffer any type of deformation during the rotating shaft assembling 2 of the rotor 12 of the electrical engine 12. This allows the diametric slots between the internal side of the lower region 21 of the rotating shaft 2 and the external side of the retaining pin 4 be smaller (tighter and typically lower than 0,150 mm), what ends optimizing the lubricating oil pump performance as a whole.

**[0034]** Despite the descriptions and drawings presented and discussed on this document emphasizes the preferred configuration of the invention, it remains evident that the scope of the present invention encompasses other possible embodiments obvious and/or equivalents based on the presented claims.

## Claims

1. Constructive arrangement introduced in reciprocating compressor including helical pump of lubricant oil, said compressor comprising:

- at least one electrical engine formed by at least one rotor (12) and at least one stator (13);
- at least one rotating shaft (2) functionally coupled to the rotor (12) of the electrical engine;
- at least one compressor block (3) capable of housing, at least partially the rotating shaft (2);
- at least one retaining pin (4) cooperating with the rotating shaft (2);
- the rotating shaft (2) comprises at least one lower region (21) and at least one intermediate region (22);
- said constructive arrangement introduced on reciprocating compressor including helical pump of lubricating oil being specially **characterized by**:
- said lower region (21) comprising the extension of the rotating shaft (2) defined between its own lower end and all its own extension that is disposed outside and below the lower face (121) of the coupling structure (14) of the rotor (12) of the electrical engine;
- the cooperating region between the retaining pin (4) and the rotating shaft (2) limits to the lower region (21); and
- said intermediate region (22) comprising the extension of the rotating shaft hollow region (2) disposed from and above the lower side (121) of the coupling structure (14) of the shaft to the rotor, in non-cooperating region with the retaining pin (4).

2. Constructive arrangement introduced in reciprocating compressor including helical pump of lubricant oil, according to claim 1, **characterized by** the lower region (21) of the rotating shaft (2) further compris-

ing, on its external side, a contouring recess.

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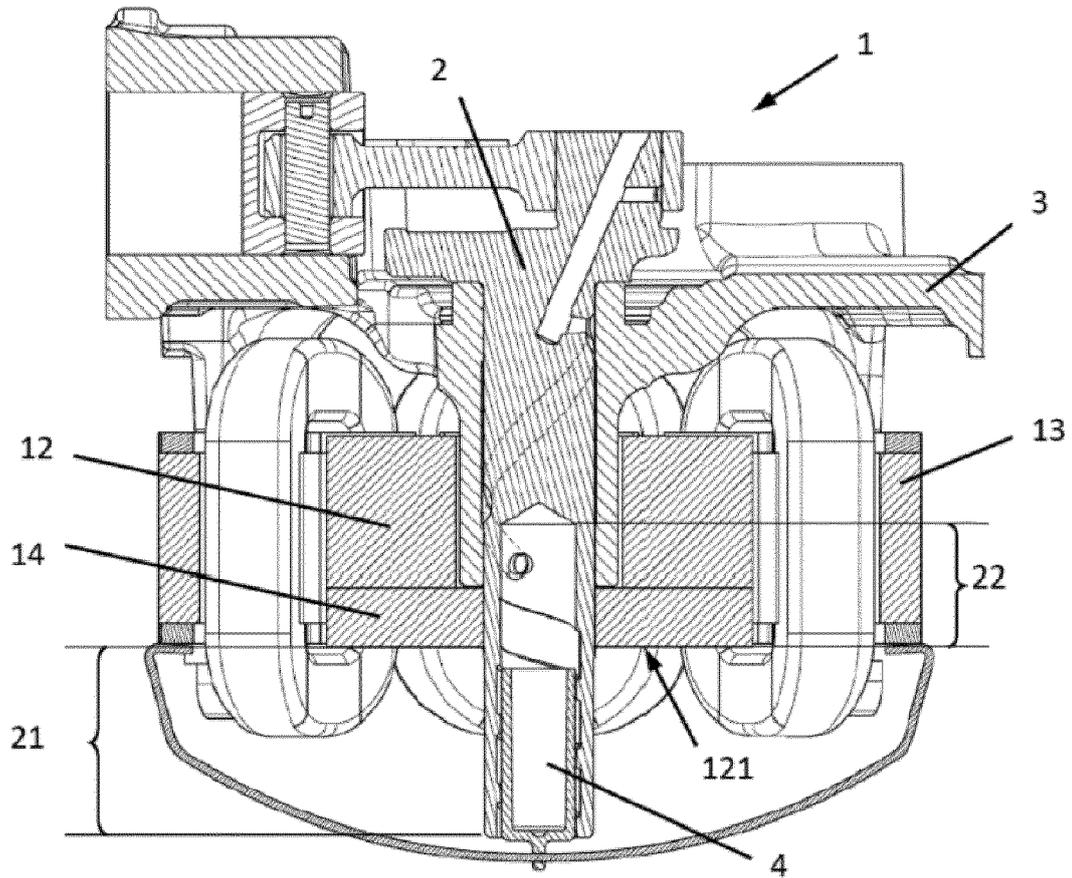


FIG. 1

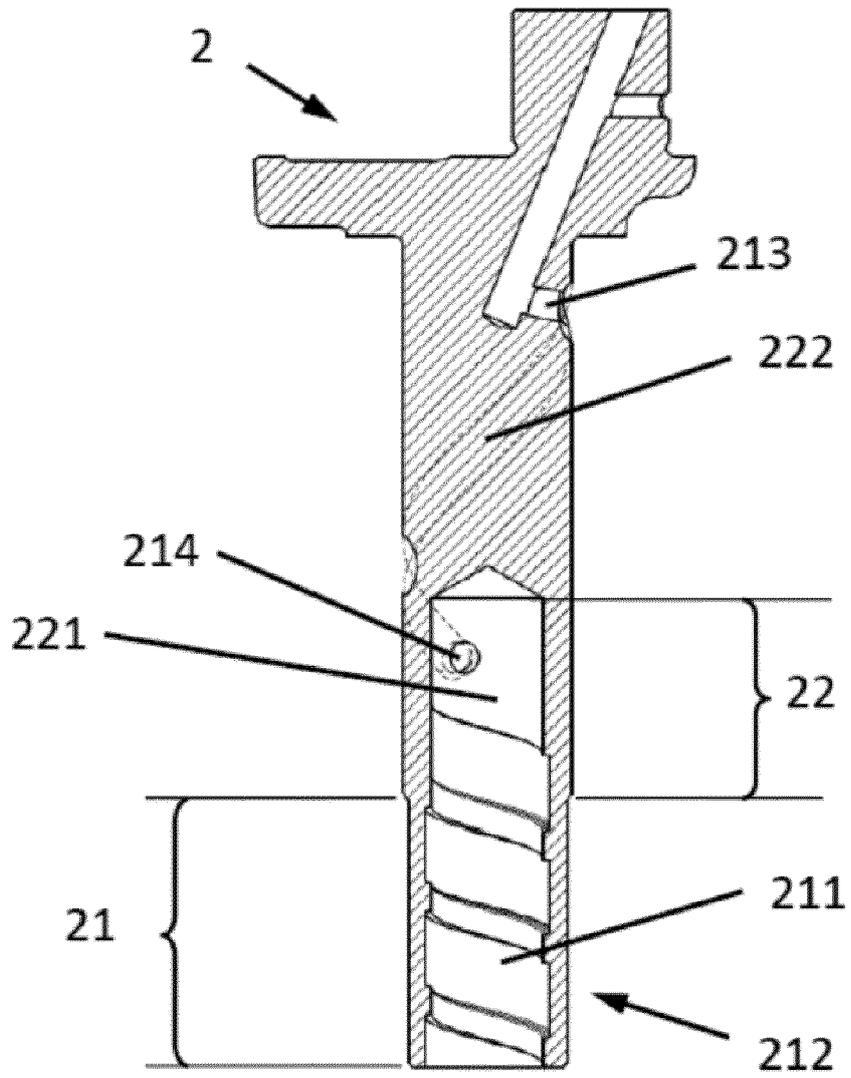


FIG. 2



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