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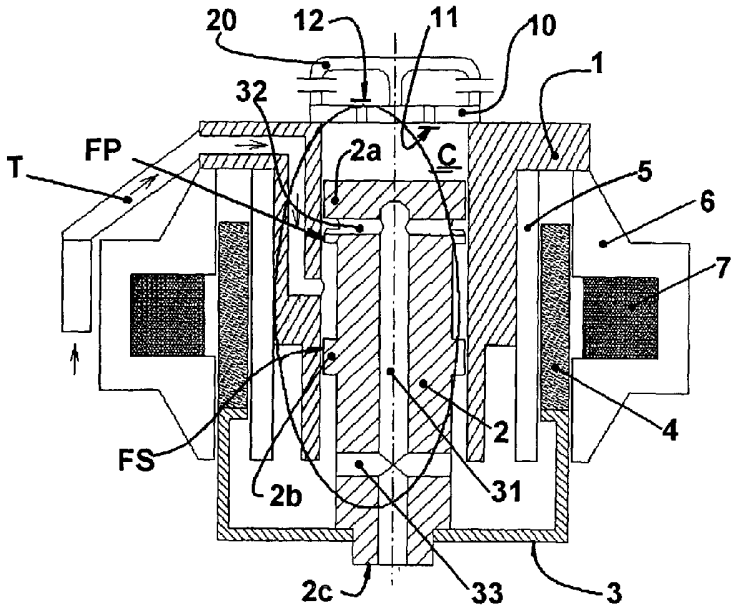
(54) Title: PISTON FOR A HERMETIC COMPRESSOR



(57) Abstract: A piston mounting arrangement for a hermetic compressor driven by a linear motor of the type comprising, inside a shell: a cylinder (1), within which is defined a compression chamber (C); a piston (2) reciprocating inside the cylinder (1) and presenting a main bearing (2a) for gas compression, a secondary bearing (2b) for oil retention, and a circumferential recess (R) between the two bearings, which maintain with the internal wall of the cylinder (1) a main radial gap (FP) and a secondary radial gap (FS), respectively, the piston (2) being provided, in the interior thereof and along its extension, with a passage (30) defining a fluid communication means between the main radial gap (FP) and the interior of the shell.

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PISTON FOR A HERMETIC COMPRESSOR

Field of the Invention

The present invention refers to a construction for the reciprocating piston of a hermetic compressor of the type driven by a linear motor and used in refrigeration systems.

Background of the Invention

In a reciprocating compressor driven by a linear motor, the gas suction and gas compression operations are performed by the reciprocating axial movements of the piston inside a cylinder, which is closed by a cylinder head and mounted within a hermetic shell, in the cylinder head being positioned the suction and discharge valves that control the admission and discharge of the gas in relation to the cylinder. The piston is driven by an actuating means that supports magnetic components driven by a linear motor affixed to the shell of the compressor.

In some constructions, the piston is mounted against a resonant spring means in the form of a spring assembly affixed to the hermetic shell of the compressor, which springs operate to guide the axial displacement of the piston and make the whole assembly act resonantly in a predetermined frequency, allowing the linear motor to be adequately dimensioned to continuously supply power to the compressor upon operation of the latter.

The piston is mounted against the spring assembly, which is rigidly mounted against the cylinder, and the piston, the actuator, the magnetic component, and the spring assembly form together the resonant assembly of the compressor.

In this embodiment (illustrated in figure 1), the oil coming from the oil reservoir is pumped by a pumping system, which can be of the inertial type, or any

other mechanism, said lubricating oil being inserted in a recess of the piston located between a main bearing and a secondary bearing, so that these bearings can be adequately lubricated during the operation of the compressor.

This construction presents some disadvantages, such as allowing the gas to leak through the gap existing between the main bearing and the cylinder during the compression stroke, the gas mixing with the oil existing in the recess located between both bearings, causing said oil to lose its lubricity properties, increasing the friction, the wear, and the energy consumption of the compressor.

Depending on the amount of gas leaking through the gap between the main bearing and the cylinder, the pressure may rise in the recess existing in the piston, causing failure in the operation of the oil pump, regardless the type thereof, reducing or even avoiding sufficient oil to flow to lubricate the bearings, causing the same effects above, or even the gripping of the piston.

Objects of the Invention

Thus, it is an object of the present invention to provide a constructive arrangement for the reciprocating piston of a hermetic compressor driven by a linear motor, which minimizes the mixture of the gas that leaks through the gap between the main bearing and the cylinder during compression, maintaining the lubricity of the oil and the operation of the oil pump.

A further object of the present invention is to provide the arrangement mentioned above, with a reduced cost and which dispenses the use of additional parts for mounting the linear motor.

Summary of the Invention

These and other objects are achieved through a piston mounting arrangement for a hermetic compressor driven by a linear motor of the type that comprises, inside a shell: a linear motor; a cylinder, within which is defined a compression chamber; a piston reciprocating inside the cylinder and presenting a main bearing for gas compression, a secondary bearing for oil retention, and a circumferential recess between the two bearings, which maintain with the internal wall of the cylinder a main radial gap and a secondary radial gap, respectively; and an actuating means operatively coupling the piston to the linear motor.

According to the present invention, the piston is provided in the interior thereof and along its extension, with a passage defining a fluid communication means between the main radial gap and the interior of the shell.

Brief Description of the Drawings

The invention will be described below, with reference to the enclosed drawings, in which:

Figure 1 is a schematic longitudinal diametrical sectional view of a hermetic compressor of the type driven by a linear motor and presenting a prior art construction of the piston reciprocating inside the cylinder;

Figure 2 is a schematic enlarged view of a portion of the cylinder and piston indicated in figure 1;

Figure 3 is a schematic longitudinal diametrical sectional view, such as that in figure 1, for the piston construction of the present invention;

Figure 4 is a schematic enlarged view of a portion of the cylinder and piston indicated in figure 3; and

Figure 5 is a schematic diametrical cross-sectional view of the main bearing of the piston, illustrating the gas inlet ends of the passage provided in the

piston, according to the present invention.

Description of the Illustrated Embodiment

The present invention will be described in relation to a reciprocating compressor driven by a linear motor of the type used in refrigeration systems and comprising, inside a hermetic shell (not illustrated), a motor-compressor assembly including a non-resonant assembly formed by a linear motor and a cylinder 1, and a resonant assembly formed by a piston 2 reciprocating inside the cylinder 1, and an actuating means 3, external to the cylinder 1 and which carries a magnet 4 that is axially impelled upon energization of the linear motor, said actuating means 3 operatively coupling the piston 2 to the linear motor.

According to the illustrations of figures 1 and 2, the piston 2 comprises a main bearing 2a for gas compression, and a secondary bearing 2b for oil retention, both bearings respectively maintaining with the internal wall of the cylinder 1, a main radial gap FP and a secondary radial gap FS, said main and secondary bearings being axially spaced from each other. The piston 2 is further provided with a circumferential recess R defined between the main bearing 2a and the secondary bearing 2b and which receives lubricant oil from an oil reservoir (not illustrated).

As illustrated in the enclosed figures, the linear motor is mounted around the cylinder 1 and the piston 2, and comprises an internal lamination stack 5 and an external lamination stack 6 with a coil 7 therein.

According to the illustrations, the cylinder 1 has an end closed by a valve plate 10, provided with a suction valve 11 and with a discharge valve 12, allowing the selective fluid communication to occur between a compression chamber C, defined between the

top of piston 2 and the valve plate 10, and the respective internal portions of a cylinder head 20 that are respectively maintained in fluid communication with the low and high pressure sides of the refrigeration system to which the compressor is generally coupled.

In the construction shown in figure 1, the oil coming from an oil reservoir defined inside the compressor shell is conducted, by means of a pumping system (not illustrated) of the inertial type, or any other mechanism, to the movable parts of the compressor with relative movement, such as between the piston 2 and the cylinder 1. In this case, the lubricating oil is conducted to the circumferential recess R through a tube T, to allow for the lubrication of the main bearing 2a and the secondary bearing 2b of the piston 2 during the compressor operation.

This construction presents the disadvantages discussed above, which has been overcome with the piston mounting arrangement of the present invention.

According to the present invention, the piston 2 defines in the interior thereof and along its extension, a passage 30 defining a fluid communication means between the main radial gap FP and the interior of the shell and comprising at least one longitudinal channel 31, having an inlet end 31a opened to the internal end of at least one inlet radial channel 32, whose external end 32a is opened to the inside of said main radial gap FP, and an outlet end 31b opened to the shell.

According to the illustrations, the main bearing 2a is provided with a circumferential recess 40, to which inside opens the external end 32a of each inlet radial channel 32.

In a constructive option of the present invention, the

passage 30 comprises a single longitudinal channel 31 coaxial to the axis of the piston 2, and opened to the lateral surface of the piston 2, between the secondary bearing 2b and an end 2c of the piston 2, adjacent to the actuating means 3. In a constructive variation of this solution, the longitudinal channel 31 presents at least one outlet end 31b opened to said end 2c of piston 2.

In the solution illustrated in figure 3, the longitudinal channel 31 presents an outlet end 31b opened to the end 2c of piston 2, and it is also medianly opened to the internal end of at least one outlet radial channel 33, having an external end 33a opened to the lateral surface of the piston between the secondary bearing 2b and the end 2c of the piston 2.

With the arrangement of the present invention, the gas leaking from the radial gap FP between the main bearing 2a of the piston and the internal wall of the cylinder 1 during the compression stroke of the compressor operation, is directed to pass through the net formed by the radial channels and the longitudinal channel and conducted to the interior of the shell of the compressor, which is at a suction pressure.

This construction minimizes the leakage of the gas to the circumferential recess R during the compression stroke, allowing for a better lubrication of the piston and the cylinder, thus increasing the efficiency of the operation and the reliability of the compressor. Furthermore, a better lubrication reduces the noise levels during the compressor operation.

CLAIMS

1. A piston mounting arrangement for a hermetic compressor driven by a linear motor, comprising inside a shell: a linear motor; a cylinder (1), within which is defined a compression chamber (C); a piston (2) reciprocating inside the cylinder (1) and presenting a main bearing (2a) for gas compression, a secondary bearing (2b) for oil retention, and a circumferential recess (R) between the two bearings, which maintain with the internal wall of the cylinder (1) a main radial gap (FP) and a secondary radial gap (FS), respectively, and an actuating means (3) operatively coupling the piston (2) to the linear motor, characterized in that the piston (2) is provided, in the interior thereof and along its extension, with a passage (30) defining a fluid communication means between the main radial gap (FP) and the interior of the shell.

2. The piston mounting arrangement according to claim 1, characterized in that the passage (30) comprises at least one longitudinal channel (31) having an inlet end (31a) opened to the internal end of at least one inlet radial channel (32), whose external end (32a) is opened to the inside of said main radial gap (FP), and an outlet end (31b) opened to the shell.

3. The piston arrangement according to claim 2, characterized in that the main bearing (2a) is provided with a circumferential recess (40) to which interior is opened the external end (32a) of each inlet radial channel (32).

4. The piston mounting arrangement according to claim 2, characterized in that the outlet end (31b) of the longitudinal channel (31) is axially opened to the inside of the shell.

5. The piston mounting arrangement according to claim

4, characterized in that the longitudinal channel (31) is also medianly opened to the internal end of at least one outlet radial channel (33) having an external end (33a) opened to the lateral surface of the piston (2), between the secondary bearing (2b) thereof and an end of said piston (2) adjacent to the actuating means (3).

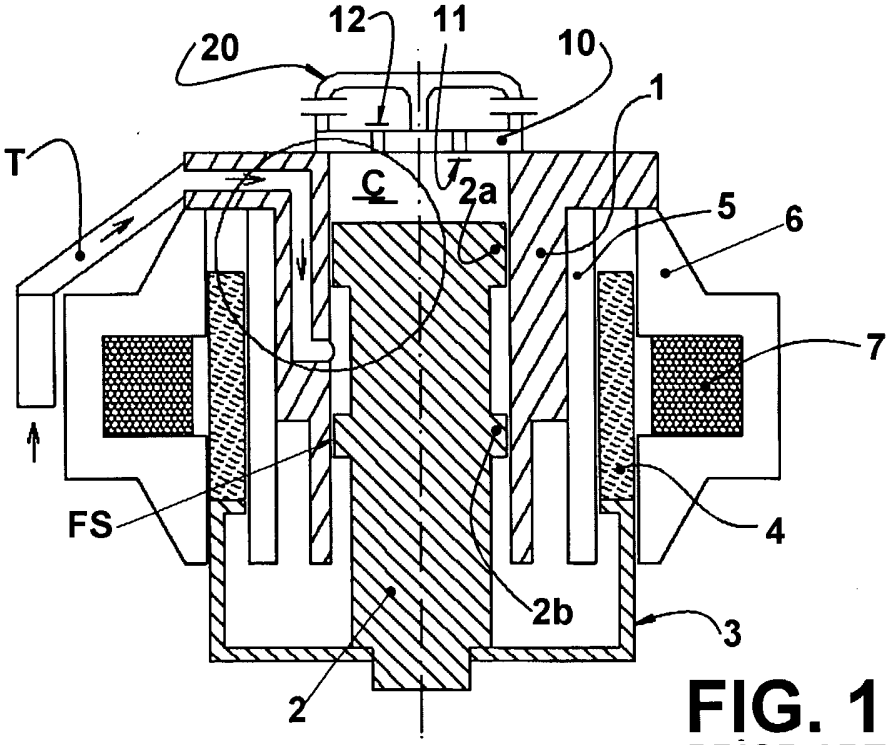

FIG. 1
PRIOR ART

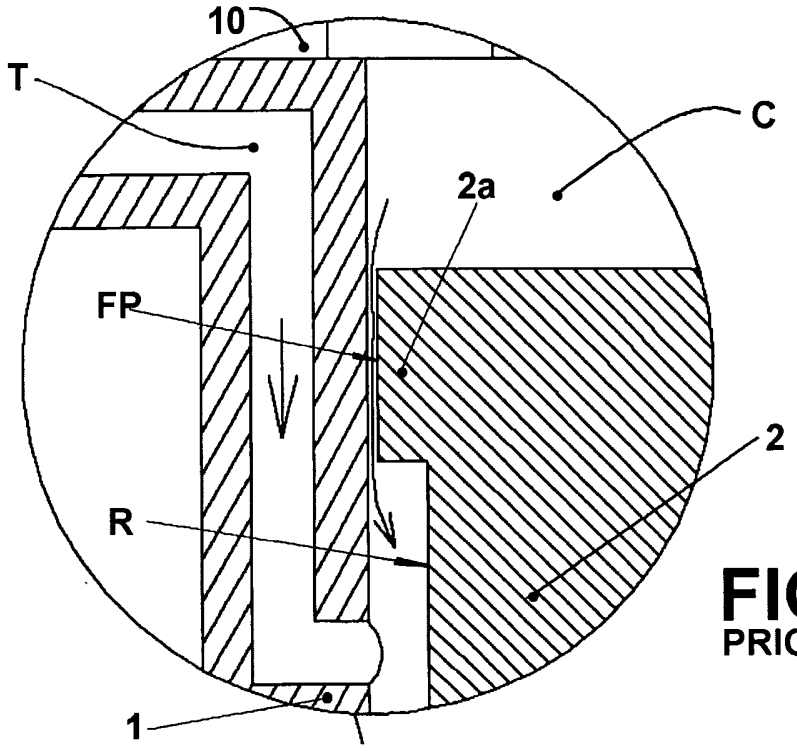

FIG. 2
PRIOR ART

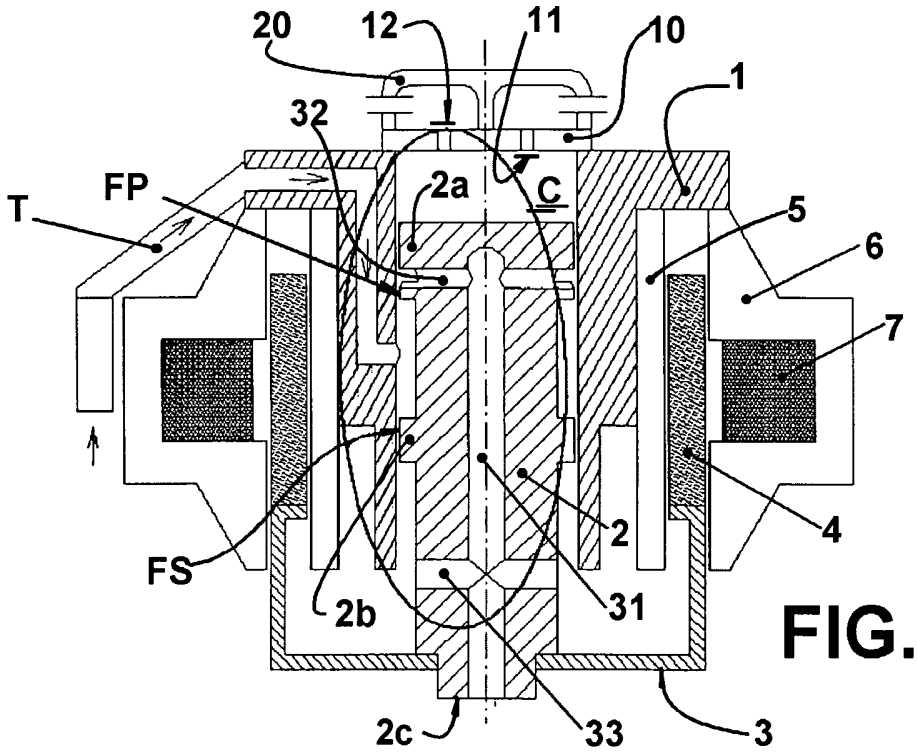
20
12
11
10
1
32
T
FP
2a
C
5
6
7
4
2
31
2b
FS
2c
33
3

FIG. 3

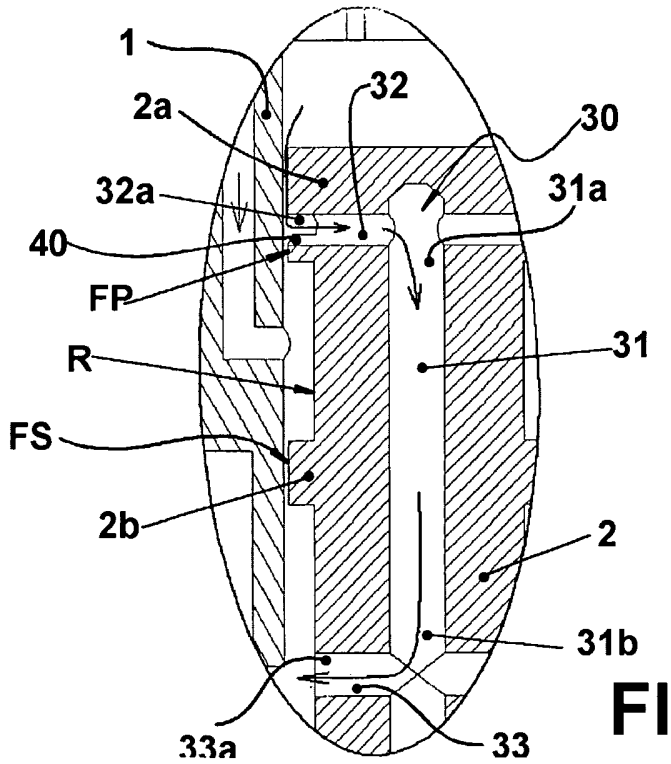
1
32
2a
30
32a
31a
40
FP
31
R
FS
2b
2
31b
33a
33

FIG. 4

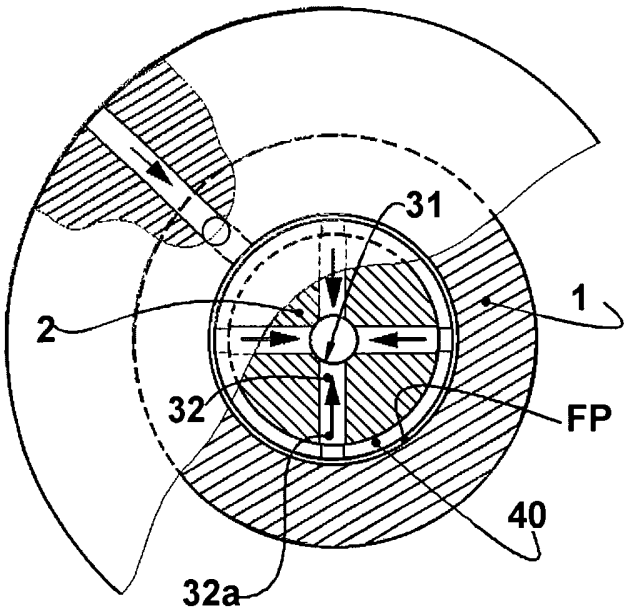

FIG. 5

INTERNATIONAL SEARCH REPORT

Inter onal Application No
PCT/BR 03/00086

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 F04B39/00 F04B39/02 F04B35/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 F04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 461 806 A (BARTHALON MAURICE) 19 August 1969 (1969-08-19) column 14, line 20 -column 15, line 9; figure 19 -----	1,2,4

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

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Date of the actual completion of the international search	Date of mailing of the international search report
8 October 2003	14/10/2003

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Ingelbrecht, P

INTERNATIONAL SEARCH REPORT

Information on patent family members

Int. ...nal Application No
PCT/BR 03/00086

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