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(54) **HERMETIC COMPRESSOR**

(57) The present invention refers to a hermetic compressor and, more specifically, a hermetic compressor comprising a centrifugal pump (1) to provide oil for the moving parts of said compressor. In the compressor of

the present invention, the vertical shaft (7) extends axially from the rotor to form a free end (8) in its inferior portion, and said free end (8) is sized to be received in a corresponding end (12) of the centrifugal pump (1).

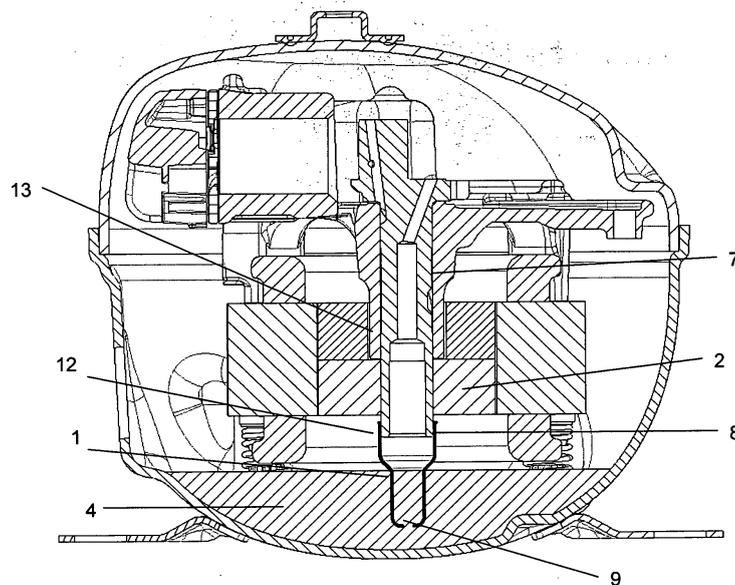


FIG. 3

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Description

Field of the Invention

[0001] The present invention refers to a hermetic compressor and, more specifically, to a hermetic compressor comprising a centrifugal pump to provide oil for the moving parts of said compressor.

Background of the Invention

[0002] A compressor has the function of elevating the pressure of a certain volume of fluid to a pressure that is required to carry out a determined work. The Refrigeration Industry commonly utilizes hermetic compressors comprising, in general, a sealed shell which defines, in its interior, an oil reservoir and an oil pump device that is responsible for leading the oil of the reservoir to the moving parts of the compressor.

[0003] The Refrigeration Industry worries about the performance of the refrigeration compressors. In fact, several studies were carried out in order to improve such performance, wherein the latest generation of compressors utilizes variable speed drives. Upon varying the operational speed of the compressor, the capability of refrigerating can be set to the demand of the system, promoting a great benefit in energy consumption.

[0004] A difficulty that results from the reduction of operational rotation is the pumping of the oil. Pumps normally used in those compressors are based on the centrifugal effect to lead the oil towards the parts to be lubricated. Those pumps are widely used due to its low cost and high reliability. Other alternatives with different principles can make the pumping in low rotation speeds possible, but the cost and the reliability are not competitive.

[0005] The prior art oil pumps comprise an oil intake tube having an oil input. The intake stage depends on the centrifugal effect, wherein the pump rotation speed forces the oil that goes into the orifice against the walls of the tube, promoting the increase in pressure, and, consequently, its elevation.

[0006] Thus, the pumping energy, that is necessary for lubricating, is obtained from the rotation and from the diameter of the pump. As a lower rotation is defined for the compressor to achieve a better performance of the same, which is applied to the refrigeration system, such rotation tends to be as low as possible, wherein the oil pump is the main limiting factor to decrease the rotation.

[0007] Three main factors affect the efficiency of the pump: the diameter of the oil input orifice, the upsetting height (i.e. height between the suction point of the pump and the highest elevation point of the oil) and the radius or diameter of the pump.

[0008] With reference to the first factor, the diameter of the input orifice of the pump creates a pressure equalization region, rendering such region inactive. The increase in pressure, which is resulted from the centrifugation, only occurs in regions having a higher diameter

than the one of the input orifice. Thus, an input orifice having a very big diameter will prejudice the performance of the pump in low rotation speeds.

[0009] Regarding the second factor, it shall be noted that the higher the upsetting height, the greater the energy necessary for pumping, since the oil shall be elevated up to the input orifice of the first bearing of the compressor. Subsequently, the propeller of the shaft will do the remaining pumping work.

[0010] With respect to the third factor, it shall be noted that the radius or diameter of the pump in the oil output region (i.e., in the region of the input orifice of the first bearing of the compressor) is fundamental to the efficiency of the pump. This is due to the fact that the path followed by the oil through the shaft interior up to such output orifice shall consider the parabolic form acquired by the oil from its centrifugation, wherein no protuberance can intercept such parabola (if an interception occurs, the flux of oil will be simply interrupted).

[0011] In view of the foregoing, the design of the pump has an important role in the performance of the compressor, further considering the need of a pump that is suitable for a compressor operating at a reduced rotation.

Objectives of the Invention

[0012] Thus, one of the objectives of the invention is the provision of an efficient oil pump for being utilized with a hermetic compressor having a variable speed driver.

[0013] Another objective of the present invention is the provision of an oil pump designed to efficiently actuate in a compressor operating at a reduced rotation.

Summary of the Invention

[0014] The present invention achieves the above-mentioned objectives by means of a hermetic compressor comprising a shell which involves the component parts of a compressor, an oil reservoir in the inferior part of the shell, a cylinder block that incorporates a bearing to support a vertical shaft on which a rotor is assembled, and a centrifugal pump that leads the oil to the moving parts of the compressor, wherein said vertical shaft extends axially from the rotor to form a free end in its inferior portion, the free end being sized to be received in a corresponding end of the centrifugal pump, and at least one portion of the inner sidewall of the end of the pump and at least one portion of the outer sidewall portion of the shaft assuming a juxtaposed condition after the reception.

[0015] In order to avoid the unnecessary use of raw material, the free end of the vertical shaft extends axially, and only enough, to enable the attachment of the end of the pump, wherein, in a preferred embodiment, the free end of such vertical shaft extends up to a maximum of 6 mm.

[0016] Furthermore, in said preferred embodiment of

the present invention, the free end presents a machined portion having a reduced external diameter in order to facilitate the assembly of the end of the pump.

[0017] The assembly between the free end of the shaft and the corresponding end of the pump is preferably effected by interference fit, but alternative means, such as binding, would be equally used.

Concise Description of the Drawings

[0018] The figures show:

Figure 1 - Figure 1 illustrates a cut view of a conventional hermetic compressor comprising a pumping solution that is already known in the prior art;

Figure 2 - Figure 2 illustrates a cut view of a conventional hermetic compressor comprising another pumping solution that is already known in the prior art;

Figure 3 - Figure 3 illustrates a cut view of a hermetic compressor comprising the pumping solution provided by the present application;

Figure 4 - Figure 4 illustrates a detailed cut view of the oil pump of the present invention, which is assembled on the compressor shaft.

Detailed Description of the Invention

[0019] The present invention will be described below, in a detailed manner, with basis on the examples of execution that are represented by the drawings. Although the detailed description utilizes, as an example, an alternative compressor for refrigeration, it shall be understood that the principles of the present invention can be applied to any type, size or configuration of hermetic compressor.

[0020] Figures 1 and 2 illustrate compressors comprising pumping solutions that are already in the prior art.

[0021] In the solution illustrated in figure 1, the oil pump (1) is inserted in the rotor of the engine (2). The pump (1) has an end (3) plunged in the oil (4) disposed in a reservoir of the shell (5) and another end (6) inserted in the rotor (2). This configuration creates a free pathway for the oil, but restricts the region that is available for attaching the shaft (7) and the pump. In fact, as shown in such figure, the shaft (7) is continuous up to the superior end (6) of the pump.

[0022] In the solution illustrated in figure 2, the pump (1) is inserted in the shaft (7), wherein said shaft (7) extends up to the end of the rotor (2). This configuration improves the region that is available for attaching the shaft (7), but the diameter of the oil passage is affected to enable the insertion of the pump in the shaft.

[0023] The solution adopted by the present invention is illustrated in figures 3 and 4. As can be noted upon reading the detailed description of such figures, the present invention discloses a pumping solution capable of guaranteeing a suitable diameter for passing the oil, an optimization of the upsetting height, and a simplified

assembly means for the oil pump.

[0024] Thus, in the compressor of the present invention which is illustrated in figure 3, the shaft (7) extends slightly from the rotor (2), leaving a free end (8) to enable the assembly of the centrifugal pump (1).

[0025] It shall be emphasized that the free end (8) has only a necessary extension for enabling the assembly of the pump (1). This is due to the need of non-extending too far the shaft (8), what would result in an unnecessary use of the material, elevating, therefore, the final cost of the compressor. Thus, in a preferred embodiment of the present invention, the extension of the free end is limited to 6 mm.

[0026] As better illustrated in figure 4, one end of the pump (1) is plunged in the oil (4), wherein such end further comprises an input orifice (9) in its more extreme portion. The other end (12) of the pump (1) is sized to be connected with the free end (8) of the shaft (7), wherein the outer side wall of the shaft and the inner side wall of the pump are arranged in a juxtaposed condition after fitting.

[0027] In the preferred embodiment of the present invention, one part of the free end of the shaft (7) is machined to reduce its external diameter, wherein such machined part is reserved for receiving the end of the pump to be assembled.

[0028] Additionally, in the preferred embodiment of the present invention, the assembly of the pump (1) on the free end (8) of the shaft (7) is carried out by interference fit, not being necessary the use of binders or adhesives.

[0029] However, it shall be noted that other forms of fitting and assembling could be utilized. Thus, in an alternative embodiment of the present invention, the assembly of the pump (1) on the free end (8) of the shaft (7) is carried out by means of binding.

[0030] During the rotation of the pump (1), the centrifugal power causes the elevation of oil in the inner side wall of both pump and shaft in a parabolic configuration, as shown by number (10) in figure 4. The pumping energy shall be sufficient so as the upsetting height reaches the output orifice where the first bearing is disposed, as shown by number (11) in such figure. The correct sizing of the parabolic column up to a height H depends on guaranteeing a sufficient radius R.

[0031] In the present invention, the assembly of the pump (1) in an external position in relation to both shaft and rotor guarantees a suitable upsetting height, wherein the input orifice is naturally disposed closer to the shaft.

[0032] In fact, as the assembly of the pump (1) does not take any internal extension of the shaft (7) in relation to the rotor, all interference region of the shaft is available, and the inferior end of the bearing (13) can be brought very close to the oil (see figure 3), in such a way that the orifice (11) can be arranged in a upsetting height H that is easily reached even at low rotation.

[0033] Furthermore, as previously mentioned, once the pump (1) is externally assembled in relation to the shaft, it can be guaranteed a suitable radius R for enabling the parabolic pathway of the oil up to this reduced

upsetting height.

[0034] The configuration for assembling the pump of the present invention achieves, by means of a simple and economic construction, a pumping solution that is efficient at providing a compressor operating at low rotation. 5

[0035] It shall be understood that the description provided with basis on the above-mentioned figures only refers to feasible embodiments for the hermetic cylinder of the present invention. The scope of the object of the present invention is defined in the appended claims. 10

Claims 15

1. A hermetic compressor comprising a shell (5) which involves the component parts of the compressor, an oil reservoir (4) in the inferior part of the shell, a block cylinder incorporating a bearing to support a vertical shaft (7) on which a rotor (2) is assembled, and a centrifugal pump (1) that leads the oil to the moving parts of the compressor, **CHARACTERIZED in that** said vertical shaft extends axially from the rotor (2) to form a free end (8) in its inferior portion, said free end being sized to be received in a corresponding end (12) of the centrifugal pump (1), and at least one portion of the inner sidewall of the end of the pump and at least one portion of the outer sidewall portion of the shaft assuming a juxtaposed condition after the reception. 20 25 30
2. A hermetic compressor, in accordance with claim 1, **CHARACTERIZED in that** the free end (8) of the vertical shaft (7) extends axially, and only enough, to enable the attachment of the end of the pump. 35
3. A hermetic compressor, in accordance with claim 2, **CHARACTERIZED in that** the free end (8) of the vertical shaft (7) extends up to a maximum of 6 mm. 40
4. A hermetic compressor, in accordance with one of the preceding claims 1 to 3, **CHARACTERIZED in that** the free end (8) presents a machined portion having a reduced external diameter. 45
5. A hermetic compressor, in accordance with one of the preceding claims 1 to 4, **CHARACTERIZED in that** the assembly between the free end (8) of the shaft and the corresponding end (12) of the pump (1) is carried out by interference fit. 50
6. A hermetic compressor, in accordance with one of the preceding claims 1 to 4, **CHARACTERIZED in that** the assembly between the free end (8) of the shaft and the corresponding end (12) of the pump (1) is carried out by binding. 55

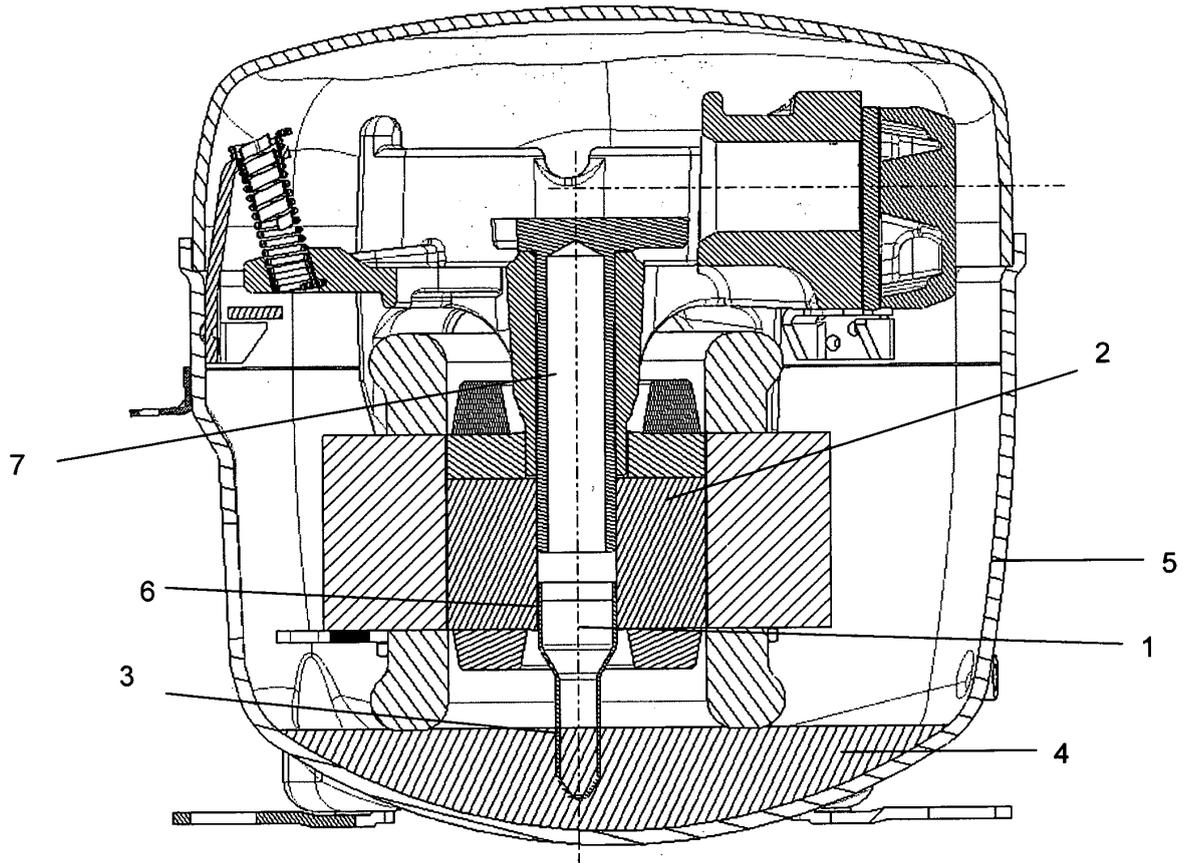


FIG. 1

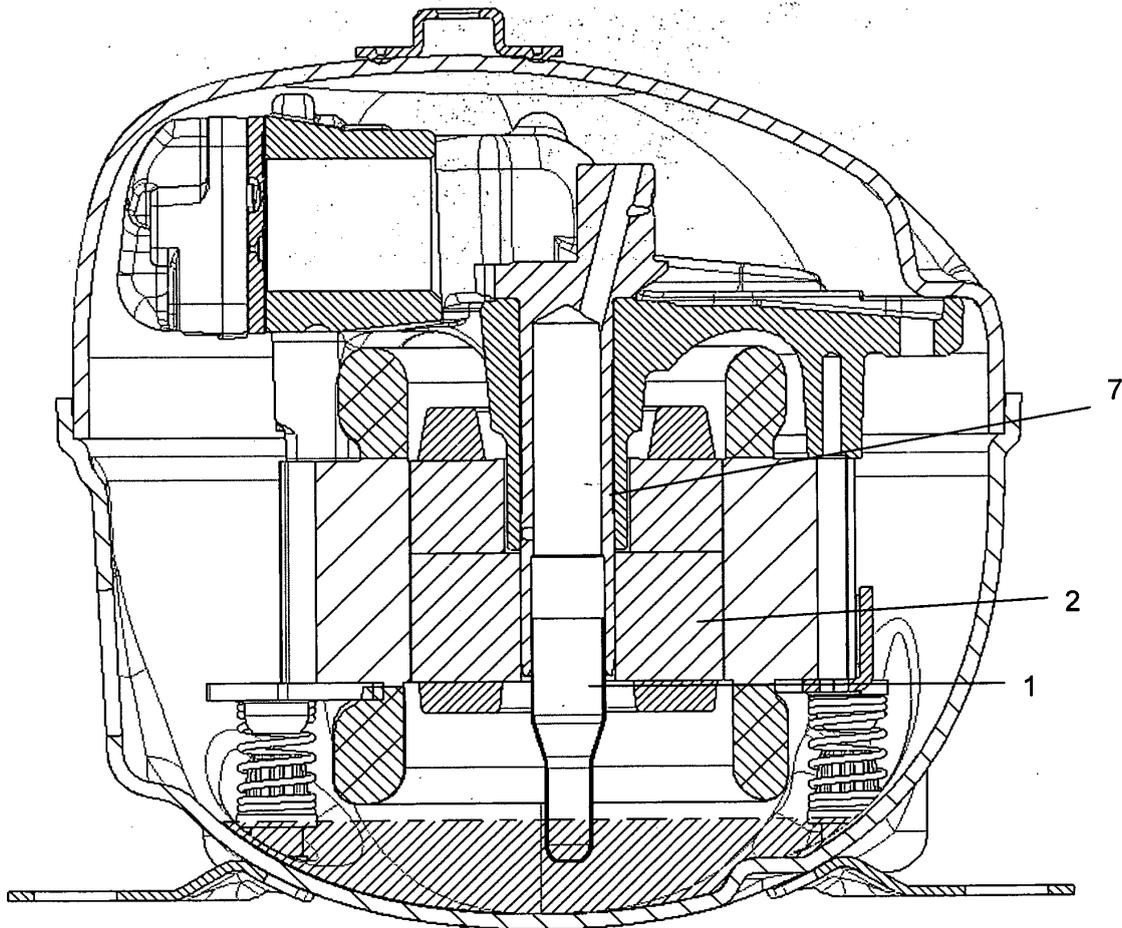


FIG. 2

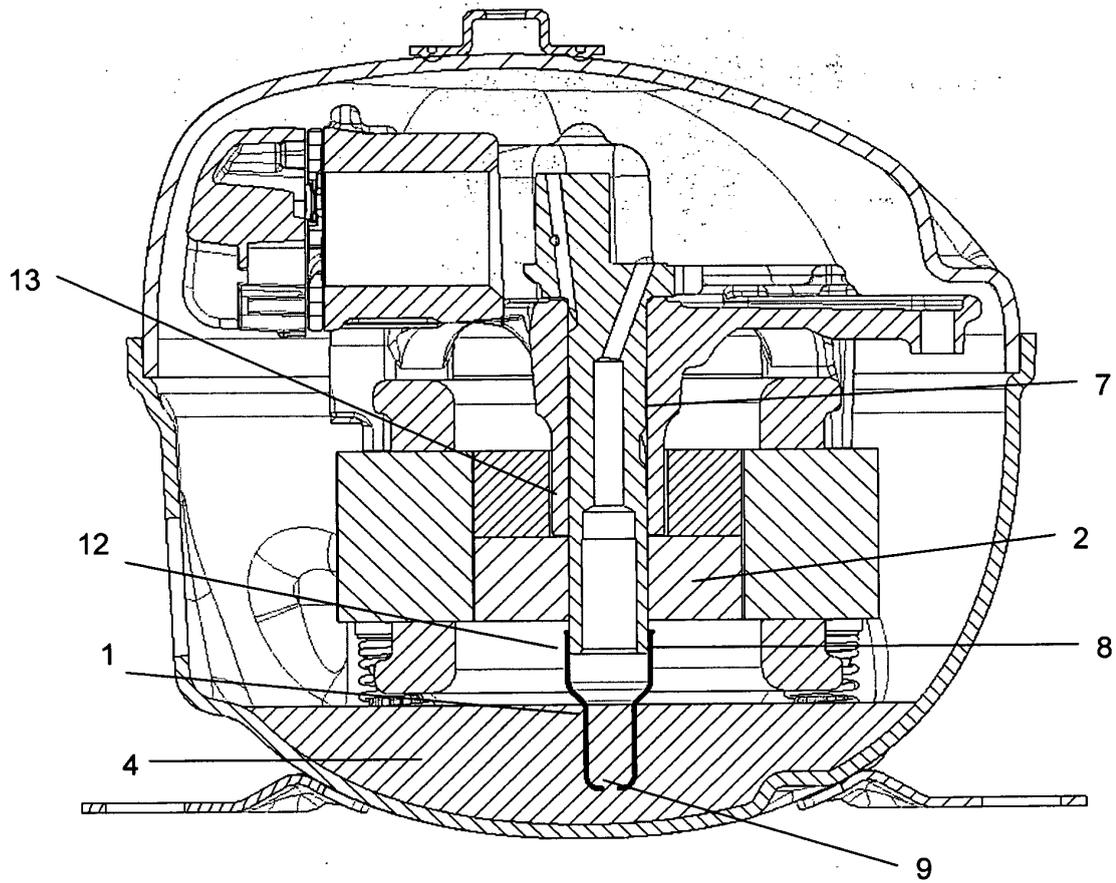


FIG. 3

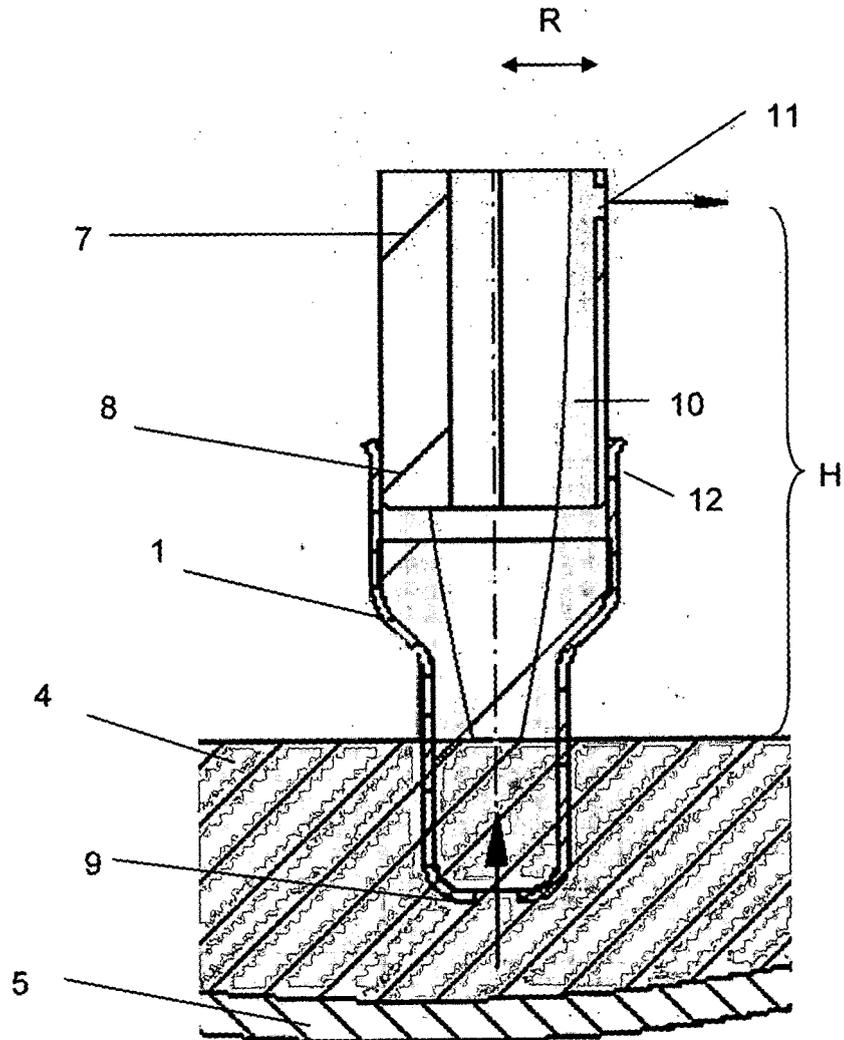


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER INV. F04B39/02 ADD.		
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) F04B F04D F04C		
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		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.		
* Special categories of cited documents :		
"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention	
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Date of the actual completion of the international search	Date of mailing of the international search report	
16 November 2010	08/12/2010	
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Homan, Peter	

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Information on patent family members

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