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(54) RECIPROCATING COMPRESSOR CYLINDER COVER

(57) The present invention refers to a reciprocating compressor cylinder cover and, more particularly, to a cylinder cover provided with at least one discharge chamber comprising a compact construction concept, able to guarantee an application in reciprocating compressors of different capacities, with hermetic housings provided with different internal volumes.

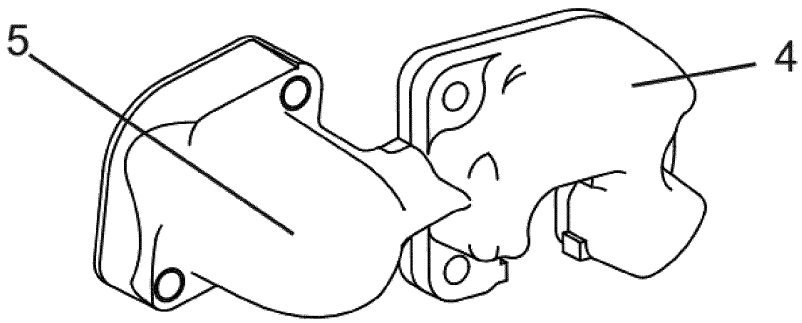

FIG. 1

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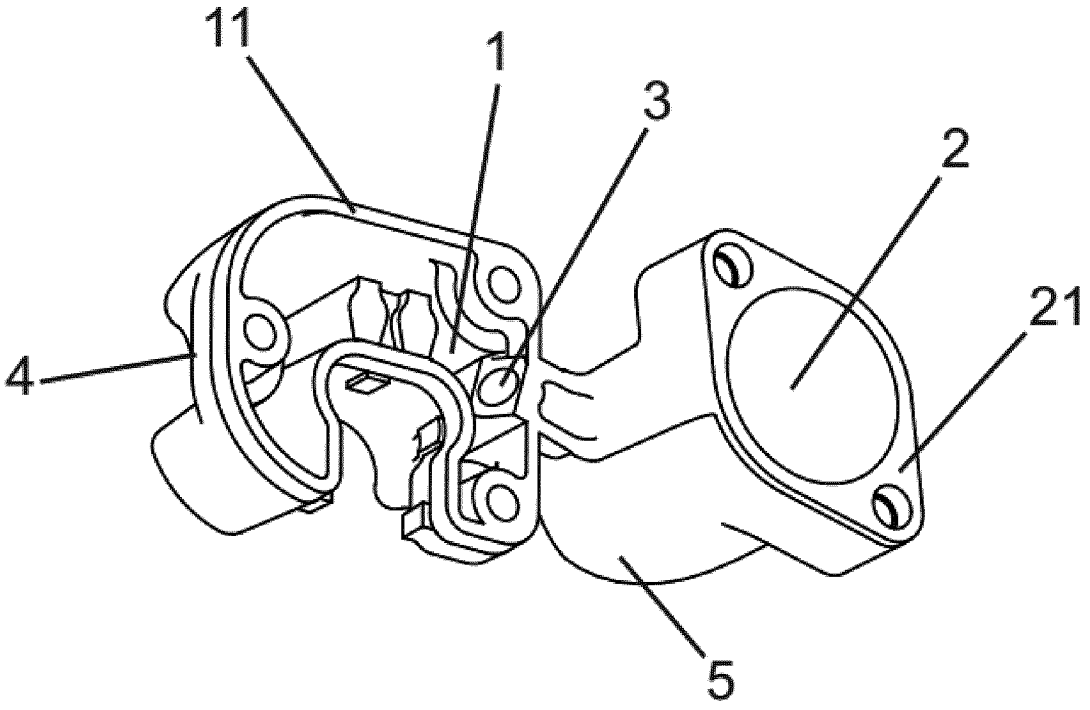

FIG. 2

Description

Field of the invention

[0001] The present invention refers to a reciprocating compressor cylinder cover and, more particularly, to a cylinder cover provided with at least one discharge chamber.

Background of the invention

[0002] As is known to those skilled in the art, reciprocating compressors comprise a compression mechanism fundamentally integrated by a compression cylinder and a movable piston, which performs alternative movements within said compression cylinder. Evidently, one end of the compression cylinder also receives a set of valves, which control the inflow (suction) and outlet (discharge) flows of the refrigerant gas from inside the compression cylinder. This set of valves is attached to the end of the compression cylinder by a component commonly known as the cylinder cover.

[0003] In certain embodiments, the cylinder covers also include, in addition to the necessary fastening means, a chamber involving a discharge valve. This chamber influences thermodynamic performance and also acts to attenuate pressure transients from the compression process.

[0004] In the vast majority of embodiments of reciprocating compressors, the cylinder cover consists of a discharge chamber, therefore, it is necessary to provide other expansion chambers arranged along the discharge inside the reciprocating compressor.

[0005] On the other hand, the current state of the art further comprises embodiments in which a cylinder cover comprises more than one discharge muffling chamber.

[0006] Patent document US5328338 describes, for example, a reciprocating compressor that - among other technical features - comprises a cylinder cover integrated by three chambers fluidly connected to each other in order to define three expansion chambers in the discharge sequentially arranged. From a constructive point of view, said cylinder cover consists of the union between a stamped metal plate and a smooth metal plate, and said stamped metal plate includes multiple ribs that, closed by the smooth metal plate, form the expansion chambers of discharge and the respective ducts that establish fluid communications between the chambers. Of course, sealing means (sealing gasket, for example) are also provided between the metal plates. It is observed, however, that the metal plates extend in a vertical direction and, therefore, this type of construction is not suitable for compact reciprocating compressors, after all, they do not have a large vertical space inside their airtight housings.

[0007] Patent document US9587634, for example, describes a reciprocating compressor of which cylinder cover comprises a circular region, suitable for the interface with the free end of the compression cylinder, and two large radial projections. Said circular region comprises two chambers, each of which is fluidly connected to one of the radial projections. Each of the aforementioned radial projections also receives an additional closing body. Thus, the set formed by the cylinder cover and additional closing bodies ends up defining a suction expansion chamber integrated to the cylinder cover and a discharge expansion chamber integrated to the cylinder cover, being that both the expansion chamber of suction and discharge expansion chamber each comprise two sequentially arranged volumes. As can be seen, the closing interfaces of the openings defined in the circular region of the cylinder cover are defined in a vertical plane while the closing interfaces of the radial projections are defined in horizontal planes. This divergence between the closing planes (which concern the difference between the opening planes of the muffling chambers) is notoriously responsible for a great manufacturing complexity, after all, the cylinder cover described in patent document US9587634 can only be made by an injection process that employs a complex injection mold integrated by moving parts.

[0008] Thus, based on the known state of the art, it is noted that cylinder covers comprising more than one expansion chamber either have dimensions not suitable for reciprocating compressors of different capacities (US5328338) or comprise constructions that require exaggeratedly complex manufacturing processes (US9587634), which limit the use of metal alloys, thereby impairing the compressor noise due to the low rigidity of the assembly and increasing the cost due to the need to use additional components to guarantee the closing of the chambers. It is based on this scenario that the present invention arises.

Objectives of the invention

[0009] Thus, it is the fundamental objective of the invention to disclose a reciprocating compressor cylinder cover which comprising at least one discharge chamber fluidly connected to each other, can be made of metallic material and by means of a simplistic and not excessively expensive manufacturing process.

[0010] It is also one of the objectives of the invention at issue that the reciprocating compressor cylinder cover presented herein comprises a compact construction concept, able to guarantee that an application in reciprocating compressors of different capacities, with hermetic housings provided with different internal volumes.

[0011] It is also one of the objectives of the invention at issue that the reciprocating compressor cylinder cover now presented has adequate rigidity to avoid resonance in the excitation frequencies of a reciprocating compressor and allows the fixation for closing through simple and inexpensive parts, such as screws and hydraulic joints.

[0012] It is also one of the objectives of the invention at issue that the cylinder cover now disclosed allows the second chamber to be subdivided into additional cham-

bers keeping the assembly compact.

Summary of the invention

[0013] All the aforementioned objectives are fully achieved by means of the reciprocating compressor cylinder cover, which comprises at least one first expansion chamber and at least one second expansion chamber fluidly connected to each other by means of at least one communication duct, the first expansion chamber being defined, at least partially, in the closing region of the compression cylinder, and the second expansion chamber being defined, at least partially, in the perpendicular projection extended from the closing region facing the same face as the compression cylinder region.

[0014] According to the invention at issue, the first expansion chamber comprises a closing interface with the valve plate disposed on the end of the compression cylinder and the second expansion chamber comprises a closing interface with the counter parts of the discharge system, with the attachment interface of the first expansion chamber and the attachment interface of the second expansion chamber facing the same face of the component.

Brief description of the drawings

[0015] The present invention is detailed based on the figures listed below, wherein:

Figure 1 shows, in front perspective, the reciprocating compressor cylinder cover according to the invention at issue;

Figure 2 illustrates, in posterior perspective, the reciprocating compressor cylinder cover according to the invention at issue;

Figure 3 shows the reciprocating compressor cylinder cover according to the invention at issue, seen from the back;

Figure 4 shows the reciprocating compressor cylinder cover according to the invention at issue, seen from the front; and

Figure 5 illustrates the section A-A taken from figure 4.

Figure 6 illustrates the exhaust chamber subdivided into two chambers interconnected by at least one communication duct.

Figure 7 illustrates the exhaust chamber and the cylinder cover, in section, subdivided into two chambers interconnected by at least one communication duct.

Detailed Description of the Invention

[0016] In accordance with the core objectives of the invention at issue, a reciprocating compressor cylinder cover is disclosed which comprises at least a first expansion chamber 1 and at least a second expansion chamber 2 fluidly connected to each other by means of at least one communication duct 3.

[0017] According to the invention at issue, a single first expansion chamber 1 and a single expansion chamber 2 are preferably provided, both of which are fluidly connected to each other via communication duct 3. Also, according to the invention at issue, both expansion chambers 1 and 2 as well as the communication duct 3 are made of an integral metallic body, with a tightness between the parts that allows the adjustment of the component stiffness.

[0018] Preferably, but not limited to, expansion chambers 1 and 2 comprise discharge expansion chambers, their shapes and geometries being defined according to specific projects and not necessarily related to the objectives and core of the invention at issue.

[0019] As shown in figures 1, 2, 3 and 4, the first expansion chamber 1 is defined in region 4 of the compression cylinder (not shown), and the second expansion chamber 2 is defined, at least partially, in region 5 extended from region 4. It is to be noted that, as seen in the figures, region 4 defines a closure region and region 5 defines a perpendicular projection.

[0020] As with the compressor cylinder cover described in patent document US9587634, the first expansion chamber 1 is opened and comprises a closing interface 11 with the valve plate (not shown) arranged on the end of the compression cylinder (not shown). Thus, in order to be considered an expansion chamber itself, the first expansion chamber 1 must be attached to the valve (not shown) arranged on the end of the compression cylinder (not shown).

[0021] As also with the compressor cylinder cover described in patent document US9587634, the second expansion chamber 2 comprises a closing interface 21 with a closing structure (not shown). Thus, in order to be considered an expansion chamber itself, the second expansion chamber 2 needs to be attached to the closing structure (not shown).

[0022] In any case, and unlike the compressor cylinder cover described in patent document US9587634, the attachment interface 11 of the first expansion chamber 1 and the closing interface 21 of the second expansion chamber 2 are facing the same face.

[0023] This feature of the closing interface 11 of the first expansion chamber 1 and the closing interface 21 of the second expansion chamber 2 facing the same face is extremely innovative, and ends up: a) allowing the manufacture of the reciprocating cylinder cover through the manufacturing process of injection with simple and low cost tooling; b) allow the design of compact compressors; c) allow the adjustment of flexibility between the chambers, reducing the resonances in the compressor's excitation frequencies; d) allow the fixation of counterparts of the discharge system using conventional methods of fixation in reciprocating compressors (screw and hydraulic joints); e) allow the second chamber to be subdivided into additional chambers keeping the set compact.

[0024] Finally, in a preferred embodiment, the cylinder cover of the present invention is capable of comprising an exhaust chamber that is preferably subdivided into two or more chambers interconnected by at least one communication duct.

[0025] It is important to note that the description above has the sole purpose of describing, in an exemplary manner, the particular embodiment of the utility model at issue. Therefore, it is clear that modifications, variations and constructive combinations of the elements that perform the same function in substantially the same way to achieve the same results, remain within the scope of protection defined by the attached claims.

Claims

1. Reciprocating compressor cylinder cover, comprising:

   at least a first expansion chamber (1) and at least a second expansion chamber (2) fluidly connected to each other by means of at least one communication duct (3);
   the first expansion chamber (1) being defined, at least partially, by the region (4) of the cover and the counter-parts of the compression cylinder;
   the second expansion chamber (2) being defined, at least partially, by the region (5) of the cover and the counter-parts of the discharge system;
   the reciprocating compressor cylinder cover being **characterized in that:**

   the first expansion chamber (1) comprises a closing interface (11) with the valve plate arranged at the end of the compression cylinder and the second expansion chamber (2) comprises a closing interface (21) with counter-parts of the discharge system; and
   the closing interface (11) of the first expansion chamber (1) and the closing interface (21) of the second expansion chamber (2) are facing the same face, and
   the regions (4) and (5) of the cylinder cover comprise at least one restriction between them, said restriction being designed to reduce resonances in the excitation frequencies of the reciprocating compressor.

2. Reciprocating compressor cylinder cover, according to claim 1, **characterized in that** an exhaust chamber is subdivided into two or more chambers interconnected by at least one communication duct.

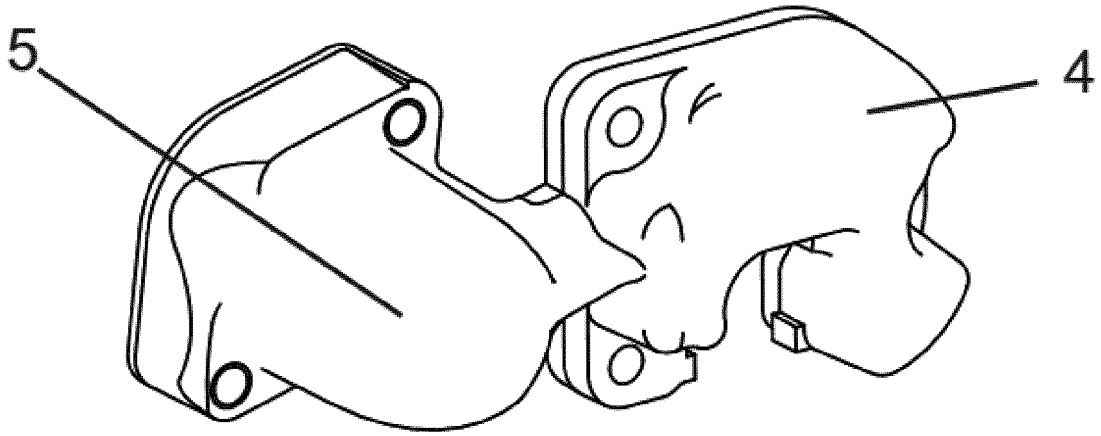

FIG. 1

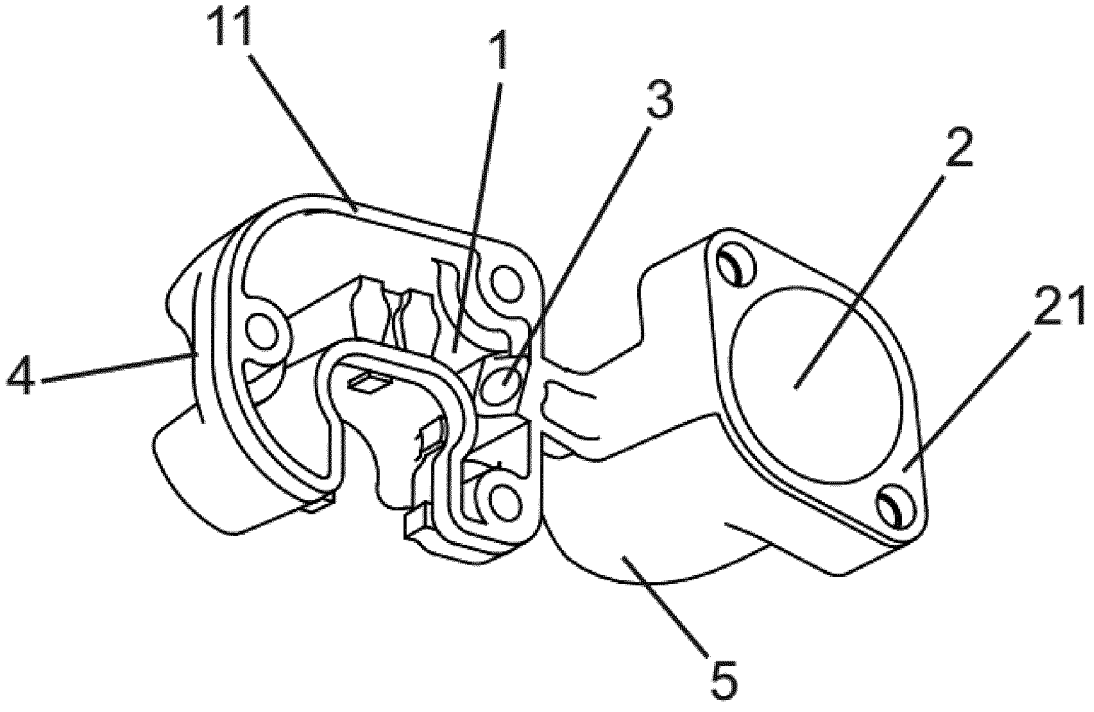

FIG. 2

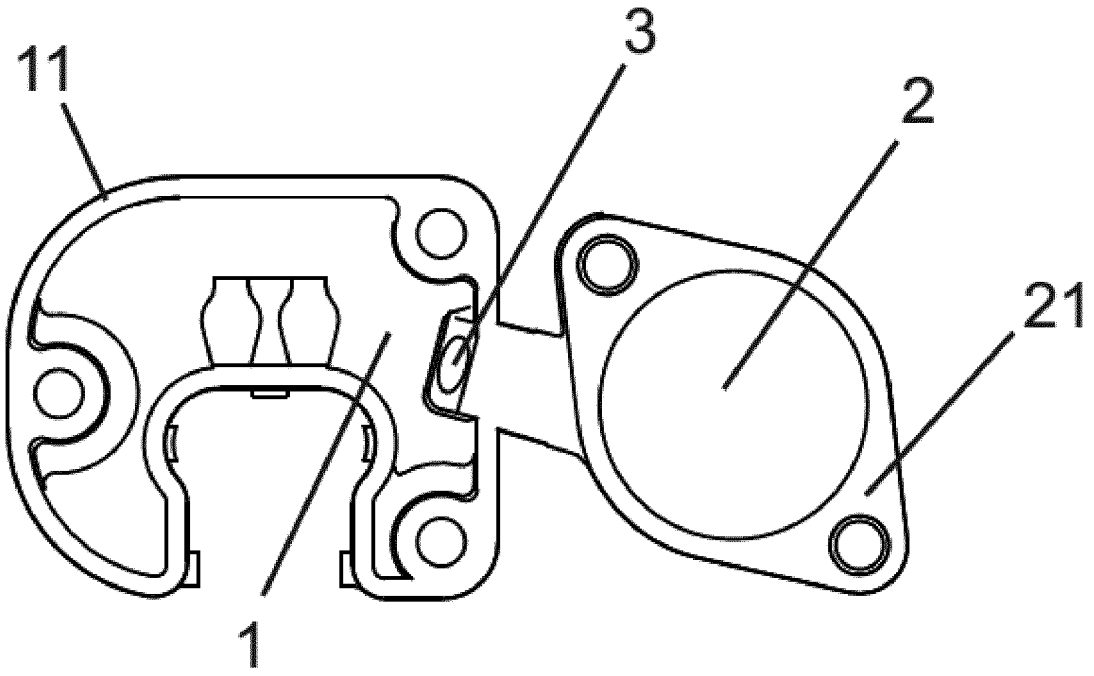

FIG. 3

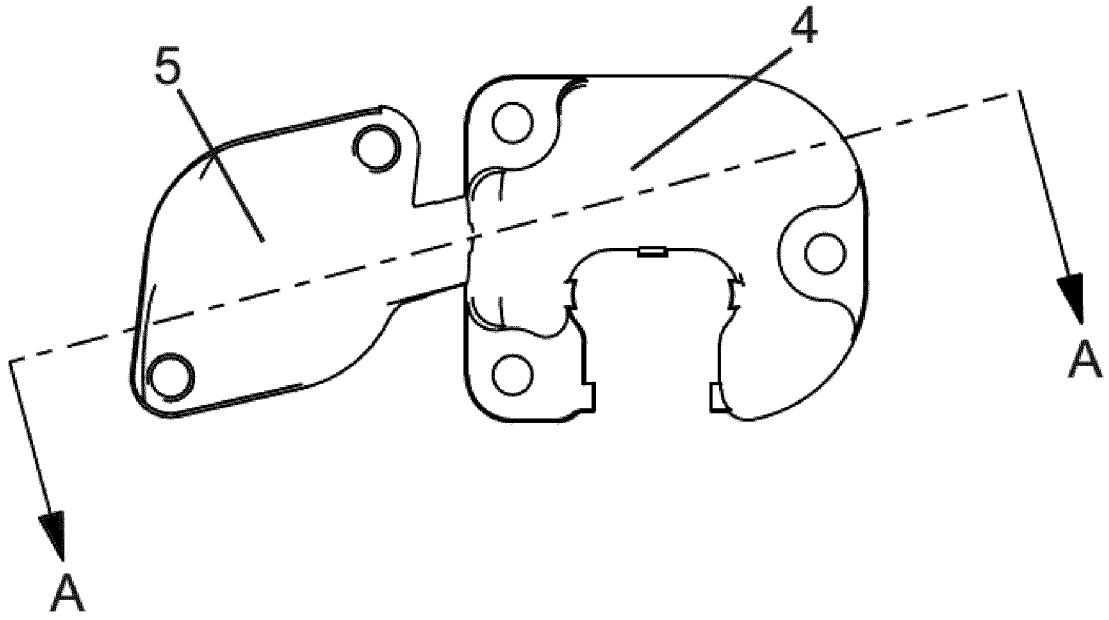

FIG. 4

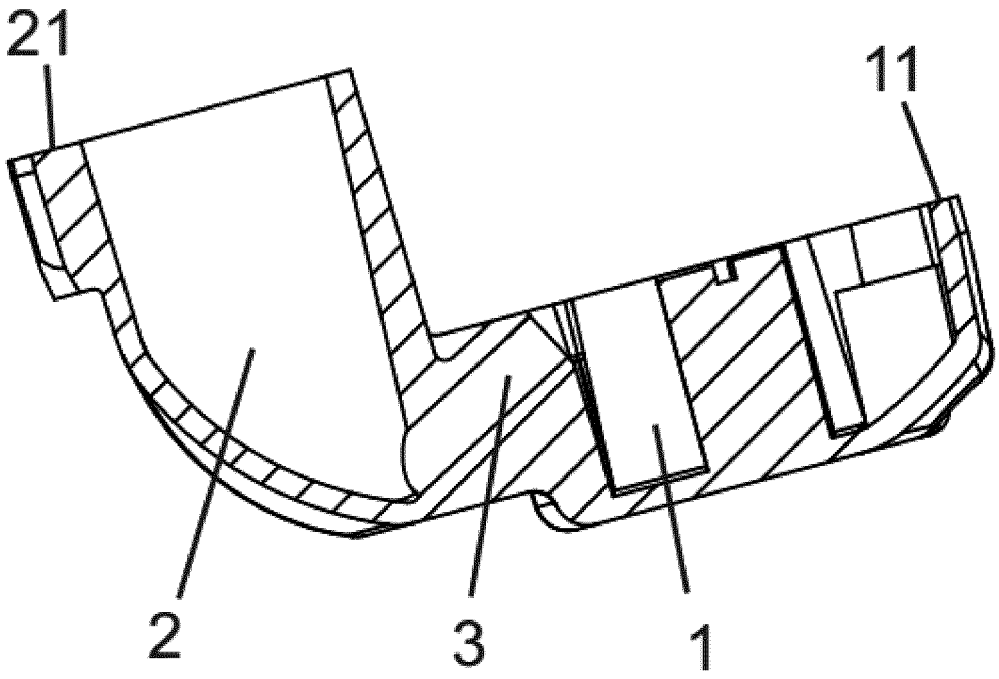

FIG. 5

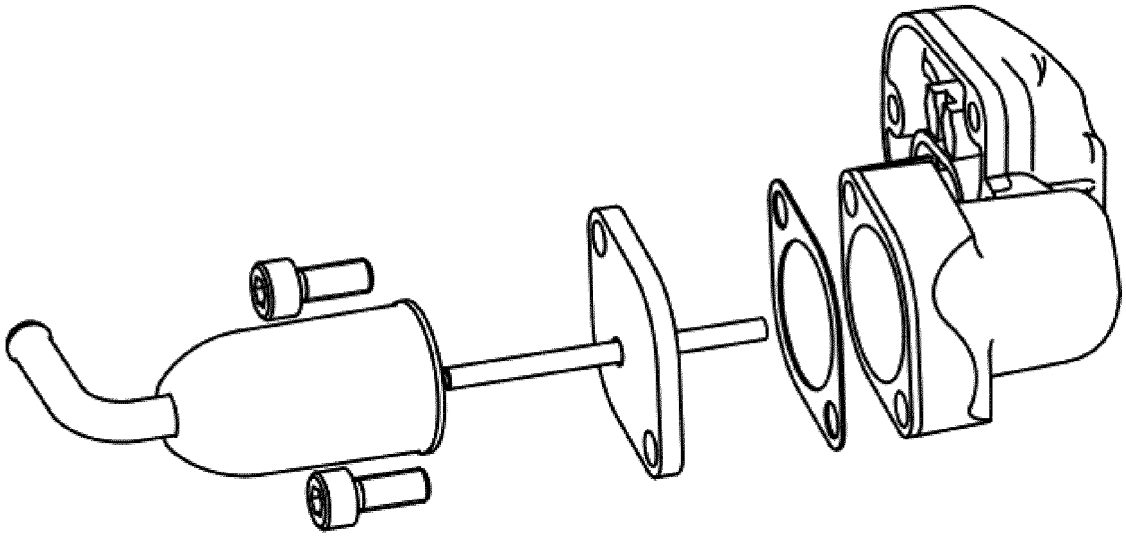

FIG. 6

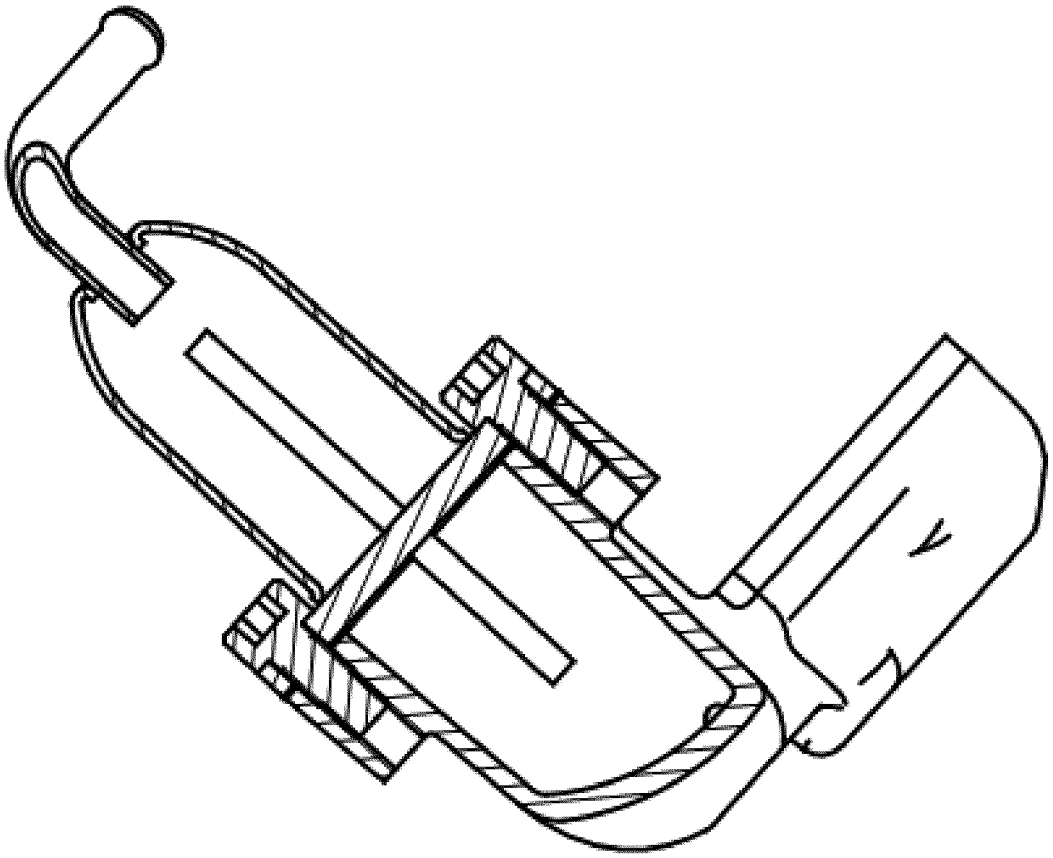

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/BR2020/050572

A. CLASSIFICATION OF SUBJECT MATTER
INV. F04B39/00 F04B39/12 F04B39/14
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

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 practicable, 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.
A	US 5 328 338 A (HIRANO YUTAKA [JP] ET AL) 12 July 1994 (1994-07-12) cited in the application column 12, lines 10-41; figures 16,17	1,2
A	US 9 587 634 B2 (LG ELECTRONICS INC [KR]) 7 March 2017 (2017-03-07) cited in the application the whole document	1,2
A	US 2017/260974 A1 (HORBATIUK BORYS WICKTOR DAGOSTIM [BR] ET AL) 14 September 2017 (2017-09-14) the whole document	1,2

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

☒ See patent family annex.

* Special categories of cited documents :

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 February 2021	26/02/2021

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, Fax: (+31-70) 340-3016	Olona Laglera, C

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/BR2020/050572

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5328338 A	12-07-1994	NONE	
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REFERENCES CITED IN THE DESCRIPTION

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- US 5328338 A **[0006] [0008]**
- US 9587634 B **[0007] [0008] [0020] [0021] [0022]**