(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 536 962 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
11.09.2019 Bulletin 2019/37

(51) Int Cl.:
***F04C 25/02** (2006.01)* ***F04C 29/12** (2006.01)*
***F04C 18/344** (2006.01)*

(21) Application number: **18382144.6**

(22) Date of filing: **07.03.2018**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(71) Applicant: **Entecnia Consulting, S.L.U.**
31014 Pamplona - Navarra (ES)

(72) Inventors:
- **SANZ LARRAURI, Francisco Javier**
  31014 Navarra - PAMPLONA (ES)
- **VILLANUEVA MADOZ, María**
  31014 Navarra - PAMPLONA (ES)
- **TROBAJO SANMARTIN, Jorge**
  31014 Navarra - PAMPLONA (ES)
- **MAISTERRA MILLO, Ana**
  31014 Navarra - PAMPLONA (ES)

(74) Representative: **Balder IP Law, S.L.**
Paseo de la Castellana 93
5ª planta
28046 Madrid (ES)

(54) ROTARY-VANE VACUUM PUMP AND OUTLET ASSEMBLY THEREOF

(57) A vacuum pump, based on a rotor with at least one vane housed in a pump chamber, which prevents fluid extraction flow from being blocked by means of an assembly of multiple outlets. Said outlet assembly comprises at least a first outlet conduct (100) with a first inner aperture (110) and a first outer aperture (120), and at least a second outlet conduct (200) with a second inner aperture (210) and a second outer aperture (220). The first inner aperture (110) and the second inner aperture (210) extract a fluid from an internal cavity (300) of the vacuum pump, whereas the first outer aperture (120) and the second outer aperture (220) expel the extracted fluid into an outside area (400) the vacuum pump. By disposing the first inner aperture (110) and the second inner aperture (210) at different heights, any accumulated particle which could block the extraction flow tends to gather around the first outlet conduct (100). Therefore, even in case said first outlet conduct (100) is partially o fully blocked, the second outlet conduct (200) can carry on with the extraction.

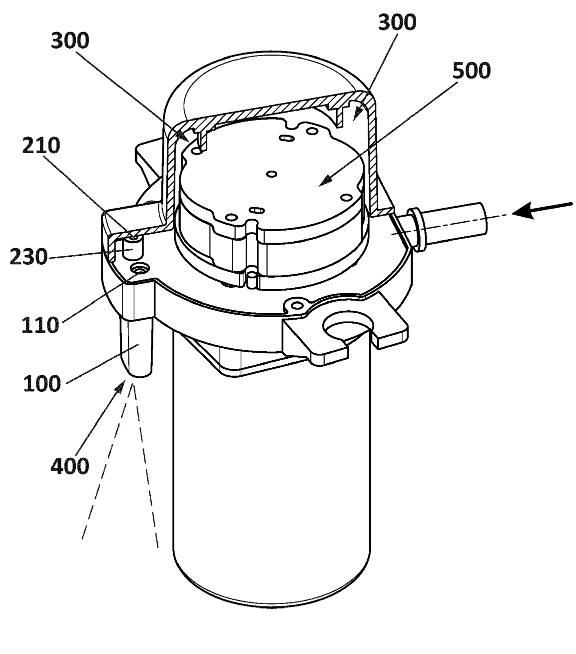

FIG. 1

EP 3 536 962 A1

Description

FIELD OF THE INVENTION

[0001] The present invention has its application within the vacuum pump sector, and especially, in the industrial area engaged in providing rotary-vane pumps where a rotor creates subspaces when moved within a pump chamber.

BACKGROUND OF THE INVENTION

[0002] Rotary-vane vacuum pumps are typically based in a pump chamber where a rotor with one or more slots is housed. A vane is partially or fully introduced into each slot of the rotor. Since the inner volume of the pump chamber is greater than the volume occupied by the rotor and the vanes, a centrifugal force applied to the rotor results in the generation of subspaces. That is, the pump chamber is designed to enable the vanes to go in and out of the rotor alternatively, creating cavities of a variable volume.

[0003] A fluid inlet located in a wall of the pump chamber wall is connected to an external device whose pressure needs to be lowered, feeding the pump chamber with a compressible fluid, such as air or any other gas. As the position of the fluid inlet is fixed, but the vanes move during pump operation, the inlet point periodically feed different cavities or subspaces. A fluid outlet, also located in a pump chamber wall, extracts the fluid from the chamber as the pressure in the cavity is greater than the pressure outside the vacuum pump. Note that the vacuum pump may comprise any number of additional chambers and/or conducts acting as intermediate stages between the pump chamber and the outside.

[0004] For example, US-3,468,260-A presents an early approach to the rotary-vane concept. In this case, the rotor comprises four radially positioned vanes, each vane further comprising a U-shaped notch for pressure balancing. Rotation of the vanes, whose transverse edges are sandwiched between complementing camming surfaces, generates a cyclical volume decrease. A single inlet port is provided at the point of maximum volume, whereas a single outlet port is provided at the point of minimum volume.

[0005] US-6,296,460-B1 and US-6,688,862-B2 present more recent examples of pump chamber architectures. In the first case, instead of relying on fully-rigid elements, each of the four radially positioned vanes comprises a resilient diaphragm, sealed to the pump cavity. A rotating compression plate with a plurality of rollers cyclically deforms the diaphragms, increasing fluid flow between the inlet and outlet of each cavity. In the second case, the pump chamber housing the rotor is surrounded at an external pressure chamber with a piston under hydraulic pressure, and on the opposite end by a seated spring. This assembly enables relative displacements between the vacuum pump elements in response to pressure differentials, hence regulating the resulting output flow.

[0006] Regardless of the particular implementation of the pump chamber, the rotor, and any auxiliary chamber connected thereto, the extracted fluid always needs to be expelled outside the vacuum pump. This fluid expulsion may be performed directly to the atmosphere (or any other kind of free-space medium), or towards another device, for further conduction or treatment of the expelled fluid. In both cases, this final fluid expulsion outside the vacuum pump is particularly sensible to blockages caused by particles generated both inside and outside the pump, which may result in reduced performance or internal damage.

[0007] Firstly, since the expelled fluid is compressed prior to chamber release, condensation phenomena may occur. The presence of humidity and/or the thermal conditions may also result in fully or partially outlet blockage. For example, humidity condensation may result in the creation of a water-like layer in the bottom surface of the last chamber before the final fluid expulsion. A temperature decrease could freeze said layer, further obstructing fluid passage. Similar undesired situations could appear with liquids carried by the fluid due to contamination (such as oil or grease), external dirt, internal component wear, or any other internal or external source of blocking particles.

[0008] Therefore, there is still the need in the state of the art of an outlet arrangement for rotary-vane vacuum pumps that maintains fluid extraction in the presence of any kind of particle threatening to block the vacuum outlet, regardless of whether said particles are generated inside or outside the pump. This would further prevent performance reduction and internal damage, and would increase the device lifespan.

SUMMARY OF THE INVENTION

[0009] The invention provides a solution for this problem by means of an outlet assembly according to claim 1. Preferred embodiments of the invention are defined in dependent claims.

[0010] The current invention solves all the aforementioned problems by disclosing an outlet assembly for a rotary-vane vacuum pump, with an auxiliary outlet conduct which continues extracting a fluid from the vacuum pump to an outside area, even if a main outlet conduct becomes blocked during operation of the device. Note that said outside area may either be a free-space region surrounding the vacuum pump, or any additional system or device which further conducts or processes the extracted fluid.

[0011] In a first aspect of the invention, an outlet assembly is disclosed, which extracts a fluid from an internal cavity of a rotary-vane vacuum pump and expels said extracted fluid outside the vacuum pump through at least a first outlet conduct and a second outlet conduct. The internal cavity is preferably either a pump chamber housing a rotor with at least one vane, or an intermediate chamber connected to said pump chamber through at least an intermediate outlet conduct. The at least first outlet conduct is connected to the internal cavity through a first inner aperture and to the outside area through a first outer aperture, whereas the second outlet conduct is connected to the internal cavity through a second inner aperture and to the outside area through a second outer aperture. In order to prevent any residual particle accumulated in the internal cavity from simultaneously blocking both outlet conducts, the second inner aperture is disposed at a a greater height than the first inner aperture.

[0012] Note that the term "height" refers to an orientation defined by design as an optimal orientation for the operation of the vacuum pump, usually with the rotor axis in a vertical direction but a user may decide to operate the pump in a different orientation, hence varying the particular height difference between the first inner aperture and the second inner aperture. For example two outlet conduits with their inner apertures at the same height, measured along a direction parallel to the rotor axis, when using the pump in a non-vertical orientation (the axis of the rotor non vertical) will have the inner aperture of the conducts at different heights. Thus the height is not related to the length of the outlet conducts or to the length of the part of the conducts that opens to the intermediate cavity but to the fact that the inner apertures of the conducts are not at the same height related to a possibility of particles of entering or blocking the inner apertures. Preferably the height is defined along an axis perpendicular to a wall of the internal cavity crossed by the first outlet conduct. Alternatively, the height can be defined along an axis perpendicular to the first and/or second outer aperture, preferably arranged as to provide a vertical flow of the fluid when extracted from the vacuum pump. The height can also be defined in a vertical direction along a wall where the two outlets conducts open to the outside of the pump, for example as in a vertical wall (parallel to the axis of rotation of the rotor) of the pump chamber.

[0013] The height difference between the second inner aperture and the first inner aperture is preferably greater than 1 mm. The diameters of the second inner aperture and the first inner aperture are preferably greater than 1 mm.

[0014] Preferably, the wall of the internal cavity crossed by the first outlet conduct is a bottom wall of said internal cavity, whereas the second outlet conduct may preferably cross the internal cavity either through the same bottom wall, through a lateral wall or through a top wall. Nevertheless, other alternative arrangements may be applied, such as both the first and second outlet conducts being disposed on the same lateral wall, both on a top wall, or one on a lateral wall and one on a top wall, always maintaining the aforementioned height difference between their inner outputs. Again, note that the terms "bottom", "top" and "lateral" refer to an orientation defined by design as an optimal orientation for the operation of the vacuum pump, which does not necessarily need to be the final orientation applied by the user.

[0015] Several preferred alternatives are disclosed in order to implement the height difference between the first inner aperture and the second aperture:

- A hollow protrusion, which is part of the second outlet conduct itself, extending said second outlet conduct beyond the wall crossed by the second outlet conduct and into the internal cavity. The second inner aperture is located in said hollow protrusion, preferably either at one of its extreme, perpendicularly disposed to a main axis of the second outlet conduct; or in a lateral of said hollow protrusion, disposed in parallel to said main axis in a periscope-like arrangement. Note that the term "main axis", refers to the direction in which a conduct crosses the wall of the internal cavity, without restricting any ulterior bend, or modification in shape or direction of said conduct.
- An attachable wall, attached to an extreme of the second outlet conduct. That is, a piece of the same or a different material which is attached at an extreme of the second outlet conduct, further extending said second outlet conduct into the internal cavity, while preserving flow of the fluid. As in the previous case, the second inner aperture may be located in said attachable wall, preferably either at one of its extreme, perpendicularly disposed to a main axis of the second outlet conduct; or in a lateral said hollow protrusion, disposed in parallel to said main axis in a periscope-like arrangement.
- Gathering means in the surrounding area of the first outlet conduct, that is, a geometrical disposition which tends to accumulate a substance that may block the flow of the fluid. In a preferred example, said gathering means comprise an undercut region, an inclined wall or a frusto-conical shaped wall in a surface of the internal cavity crossed by the first outlet conduct.

Note that more than one of the aforementioned alternatives may be combined within a single embodiment of the outlet assembly of the invention.

[0016] The first inner aperture and/or the second inner aperture are preferably circular-shaped, being the first inner aperture larger or equal to the second inner aperture, as to increase fluid flow through the first outlet conduct in the absence of any blockage. Nevertheless, other shapes or size arrangements may be applied in particular embodiments of the invention.

[0017] In some embodiments the first outlet conduct and the second outlet conduct have a variable cross section. In an embodiment the first outlet conduct and/or the second outlet conduct are preferably cone-shaped, that is, the first outer aperture is preferably larger than the first inner aperture and the second outer aperture is larger than the second inner aperture.

[0018] Note that although the outlet assembly preferably comprises only two outlet conducts, with the previously-described characteristics and dispositions, alternative embodiments of the invention may comprise a greater number of conducts, as long as two of them preserve the aforementioned relations. That is, other particular embodiments of the invention may comprise more than one conduct protruding into the internal cavity, with equal or varying height, as long as at least one conduct presents a lower height. Likewise, other particular embodiments of the invention may comprise more than one conduct with their apertures at the same or lower height than the wall of the internal cavity, as long as the outlet arrangement also comprises a conduct with a greater height.

[0019] In a second aspect of the present invention, a rotary-vane vacuum pump is disclosed, comprising:

- A pump chamber.
- A rotor with one or more vanes, housed within the pump chamber. When said rotor moves, subspaces are created between the vane (or vanes) of the rotor and the pump chamber walls.
- Preferably, one or more intermediate chambers, connected to both the pump chamber and the outside area. The intermediate chamber is preferably cylindrical and is typically connected to the pump chamber by means of at least an intermediate outlet conduct, preferably comprising labyrinth-like arrangement to reduce fluid pressure.
- An outlet assembly according to any preferred option and/or embodiment of the first aspect of the invention, that is, an outlet assembly comprising at least two outlet conducts with their inner apertures at different heights within an internal cavity of the vacuum pump. Said internal cavity may either be the intermediate chamber, or the pump chamber.

[0020] In the particular case of the outlet assembly being directly connected to the pump chamber, and in order to prevent protrusions or attachable walls from hindering the rotor movement, the height difference between the outlet conducts is preferably implemented by means of an undercut region in the wall of said pump chamber, by a different position in the lateral wall of the pump chamber one by placing one outlet on a lateral wall and another on a top wall.

[0021] The rotary-vane vacuum pump and the outlet assembly of the invention therefore provide uninterrupted fluid extraction, even when other particles are accumulated within the pump, such as dirt, frozen vapor, or any other substance that may threaten to block the flow of fluid. Additional advantages and features of the invention will become apparent from the detailed description that follows and will be particularly pointed out in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] For the purpose of aiding the understanding of the characteristics of the invention, according to a preferred practical embodiment thereof and in order to complement this description, the following figures are attached as an integral part thereof, having an illustrative and non-limiting character:

Figure 1 shows a perspective view of a pump with an outlet assembly according to one embodiment of the invention. The cover has been partially removed for clarity.

Figure 2 shows a perspective view of a pump with an outlet assembly according to another embodiment of the invention. A part of the cover and a part of the pump chamber have been removed for clarity.

Figure 3 illustrates a sectional view of a first preferred embodiment of the outlet assembly of the invention, comprising parallel conducts in a same cavity wall, with a hollow protrusion and an undercut region.

Figure 4 shows a second preferred embodiment of the outlet assembly of the invention, also comprising parallel conducts in a same cavity wall, but with a lateral inner aperture in the hollow protrusion.

Figure 5 illustrates a third preferred embodiment of the outlet assembly of the invention, also comprising parallel conducts in a same cavity wall, with an attachable wall for enhanced inner aperture height.

Figure 6 depicts a fourth preferred embodiment of the outlet assembly of the invention, also comprising parallel conducts in a same cavity wall, with a lateral inner aperture in the attachable wall.

Figure 7 shows a fifth preferred embodiment of the outlet assembly of the invention, comprising perpendicular conducts in different cavity walls.

Figure 8 illustrates a sixth preferred embodiment of the outlet assembly of the invention, comprising parallel conducts in a lateral cavity wall.

Figure 9 depicts a seventh preferred embodiment of the outlet assembly of the invention, comprising perpendicular conducts in different cavity walls, and with a conduct bend after one of the inner apertures.

Figure 10 shows a sectional view of where one of the conducts extends such that the inner aperture is very close to a wall of the internal cavity.

Figure 11 shows an embodiment comprising frustoconical shaped gathering means.

Figure 12 shows an embodiment with gathering means comprising an inclined wall.

DETAILED DESCRIPTION OF THE INVENTION

[0023] Note that in this text, the term "comprises" and its derivations (such as "comprising", etc.) should not be understood in an excluding sense, that is, these terms should not be interpreted as excluding the possibility that what is described and defined may include further elements, steps, etc.

[0024] In the context of the present invention, the term "approximately" and terms of its family (such as "approximate", etc.) should be understood as indicating values very near to those which accompany the aforementioned term. That is to say, a deviation within reasonable limits from an exact value should be accepted, because a skilled person in the art will understand that such a deviation from the values indicated is inevitable due to measurement inaccuracies, etc. The same applies to the terms "about" and "around" and "substantially".

[0025] Figures 1 and present a first preferred embodiment of the rotary-vane vacuum pump and of the outlet assembly of the invention. A first outlet conduct (100) and a second outlet conduct (200) communicate an internal cavity (300) and an outside area (400), enabling a fluid, such as air or another gas, to be extracted from said internal cavity (300). The flow of fluid is initially generated by a movement of a rotor inside a pump chamber (500). Said pump chamber (500) communicates with the internal cavity (300) through any number of conducts and/or auxiliary chambers. In another embodiments the internal cavity can be the pump chamber (500). The rotor generating the flow of fluid comprises at least one slot and at least one vane, although its particular geometry and configuration may be implemented according to any technology known in the state of art, independently of the outlet assembly configuration.

[0026] The first outlet conduct (100) comprises a first inner aperture (110) at an interface between said first outlet conduct (100) and the internal cavity (300), and a first outer aperture (120) at an interface between said first outlet conduct (100) and the outside area (400). Likewise, the second outlet conduct (200) comprises a second inner aperture (210) at an interface between said second outlet conduct (200) and the internal cavity (300), and a second outer aperture (220) at an interface between said second outlet conduct (200) and the outside area (400).

[0027] Note that, although in all the exemplary embodiments of the invention, the first inner aperture (110), the first outer aperture (120), the second inner aperture (210) and the second outer aperture (220) are all represented with circular shapes and constant size, particular embodiments of the invention may comprises apertures with different shapes and sizes. In particular, the first inner aperture (110) is preferably larger than the second inner aperture (210) to increase fluid flow through the first outlet conduct (100) in the absence of blockages. Furthermore, although the first outlet conduct (100) and the second outlet conduct (200) are represented as straight cylindrical conducts, particular embodiments of the invention may comprise any kind of bends, width variations, bifurcations, etc. In particular, in some embodiments the first outlet conduct (100) and the second outlet conduct (200) may comprise a variable cross section, such as, for example, partially conical shapes, that is, the first inner aperture (110) may be smaller than the first outer aperture (120), and the second inner aperture (210) may be smaller than the second outer aperture (220), being the width of the conducts increased along its path according to any linear or non-linear variation.

[0028] Figure 3 shows in greater detail the interface region between the first embodiment of the outlet assembly and the internal cavity (300). In order to implement a greater height at the second inner aperture (210) than at the first inner aperture (110), the second outlet conduct (200) comprises a cylindrical hollow protrusion (230) at the upper end of the conduct. That is, the second outlet conduct (200) itself protrudes from a wall of the internal cavity (300), displacing the second inner aperture (210) away from said wall and into a more central region of the internal cavity (300).

[0029] Furthermore, the first outlet conduct (100) comprises gathering means in the surroundings of the first inner aperture (110). In an embodiment, said gathering means comprise an undercut region (130) in a bottom surface of the internal cavity (300), although any alternative geometrical or material modification that favors the accumulation of substances threatening to block the outlet assembly may be implemented in other particular embodiments. In another embodiment the gathering means can comprise an inclined wall (140), wherein the first inner aperture (110) is placed in a lower position than the second inner (210) aperture as shown in figure 11. In another embodiment the gathering means comprise a conical wall (150), for example a frusto-conical shaped wall, wherein the first inner aperture (110) is placed in the lower small base of the frustum and the second inner aperture (210) is placed in the lateral wall, as shown in figure 12.

[0030] By the combined action of the hollow protrusion (230) of the second outlet conduct (200) and the undercut region (130) of the first outlet conduct (100), any internal or external fluids or particles threatening to hinder regular operation of the vacuum pump, will tend to accumulate in the bottom area of the internal cavity (300), and more specifically, in the gathering means around the first outlet conduct (100). Therefore, even if said first outlet conduct (100) becomes partially or fully blocked, the second inner aperture (210) will be safe from pollution due to its increased height.

[0031] Figure 3 is a sectional view of the same first embodiment, where the increased width of the first outlet conduct (100) compared to the second outlet conduct (200) can be appreciated. As a consequence, in the absence of blockages, the first outlet conduct (100) acts as a primary outlet, with a greater fluid flow than the second conduct (200). Note that although in this example the first outlet conduct (100) is parallel to the second outlet conduct (200) during all their length, being the first outer aperture (120) and the second outer aperture (220) located in the same area, alternative embodiments of the invention may comprise separate paths and separate fluid expulsion regions for each conduct. Likewise, although in this example the first outlet conduct (100) and the second outlet conduct (200) are inscribed within a same monolithic piece, which also serves as part of the bottom wall of the internal cavity (300), embodiments of the invention may comprise separate pieces for each conduct.

[0032] Figure 4 presents an alternative embodiment for the interface between the second outlet conduct (200) and the internal cavity (300). In this case, instead of disposing the second inner aperture (210) at one extreme of the hollow protrusion (230), as in the previous example, said second inner aperture (210) is disposed in a lateral wall of the hollow protrusion (230), achieving a periscope-like configuration that further prevents any blocking particle from being introduced into the second outlet conduct (200). That is, in this case, the second inner aperture (210) is perpendicular to an intersection of the second outlet conduct (200) and the wall of the internal cavity (300) crossed by said second outlet conduct (200); as opposed to a parallel disposition of the previous example. Note, nevertheless, that different angles between the second inner aperture (210) and said intersection may be implemented in alternative embodiments of the invention. Also note that this configuration, as well as any other configuration described herein is compatible with any other optional feature, such as an undercut region (130), varying conduct shapes or widths, etc.

[0033] Figure 5 illustrates an alternative approach for increased height of the second inner aperture (210). Instead of a hollow protrusion (230), the second outlet conduct (200) comprises an attachable wall (240). That is, although the shape and functionality of the attachable wall (240) may be similar to those of the hollow protrusion (230), the attachable wall (240) is not part of the conduct itself, but an external piece attached to an end of said conduct. Depending on the particular implementation of the invention, said attachable wall (240) may be fabricated in a same or in a different material as the second outlet conduct (200). Also note that, although in this example both the first outlet conduct (100) and the second outlet conduct (200) finalize at the same level of the internal cavity (300) wall, the attachable wall (240) may be combined with a hollow protrusion (230), combining both height increments. Likewise, both the first outlet conduct (100) and the second outlet conduct (200) may comprise attachable walls (240), as long as the resulting height of the second inner aperture (210) is greater than the height of the first inner aperture (110).

[0034] Figure 6 illustrates an alternative disposition of the attachable wall (240), where instead of disposing the second inner aperture (210) at one extreme of the attachable wall (240), said second inner aperture (210) is disposed in a lateral of the attachable wall (240), again achieving a periscope-like configuration. That is, in this case, the second inner aperture (210) is perpendicular to an intersection of the second outlet conduct (200) and the wall of the internal cavity (300) crossed by said second outlet conduct (200); as opposed to the parallel disposition of the previous example.

[0035] Figure 7 shows an alternative disposition where the first outlet conduct (100) is located in a first wall of the internal cavity (300), typically a bottom wall, whereas the second outlet conduct (200) is located in a second wall of the internal cavity (300), typically a lateral wall. The first inner aperture (110) and the second inner aperture (210) are hence disposed perpendicularly, the latter having an increased height without the need of including hollow protrusions (230) or attachable walls (240) -although said elements could be combined with this disposition in particular embodiments of the invention-.

[0036] Figure 8 presents another alternative disposition where both the first outlet conduct (100) and the second outlet conduct (200) are located in the same lateral wall of the internal cavity (300). The first inner aperture (110) and the second inner aperture (210) are hence disposed in parallel, the latter having an increased height, and hence being more protected from possible blockages.

[0037] Figure 9 illustrates the fact that either the first outlet conduct (100), the second outlet conduct (200) or both may comprise any number of bends along their path. In this particular instance, a disposition where the first outlet conduct (100) and the second outlet conduct (200) are located in perpendicular walls of the internal cavity (300) is presented. Nevertheless, any other disposition of the outlet assembly may also comprise any number of bends or shape modifications along the path of the conducts.

[0038] Another embodiment is shown in figure 10, wherein that second outlet conduct (200) protrudes from a wall of the internal cavity (300) and extends close to a top wall (310) of the internal cavity (300), such that the gap between the second inner aperture (210) and the top wall (310) is so small that prevents any particle for entering or blocking the conduct (200).

Claims

1. Outlet assembly of a rotary-vane vacuum pump which comprises a rotor with at least one vane housed in a pump chamber (500), the outlet assembly comprising:

   - at least a first outlet conduct (100) comprising a first inner aperture (110) adapted to extract a fluid from an internal cavity (300), and a first outer aperture (120) adapted to expel the extracted fluid into an outside area (400) of the vacuum pump;

characterized in that the outlet assembly further comprises:

- at least a second outlet conduct (200) comprising a second inner aperture (210) also adapted to extract the fluid from the internal cavity (300) of the vacuum pump, and a second outer aperture (220) also adapted to expel the extracted fluid into an outside area (400) of the vacuum pump; being the second inner aperture (210) disposed at a greater height than the first inner aperture (110).

2. Outlet assembly according to claim 1 **characterized in that** the second outlet conduct (200) comprises a hollow protrusion (230), being the second inner aperture (210) disposed at said hollow protrusion (230).

3. Outlet assembly according to claim 1 **characterized in that** the second outlet conduct (200) comprises an attachable wall (240), being the second inner aperture (210) disposed at said attachable wall (240).

4. Outlet assembly according to any of the previous claims **characterized in that** the first outlet conduct (100) further comprises gathering means, in the surrounding area of the first outlet conduct, adapted to gather a blocking substance accumulated at the internal cavity (300) of the vacuum pump.

5. Outlet assembly according to claim 4 **characterized in that** the gathering means comprise an undercut region (130), an inclined wall (140) or a frusto-conical shaped wall (150) in a surface of the internal cavity (300) crossed by the first outlet conduct (100).

6. Outlet assembly according to any of the previous claims **characterized in that** the second inner aperture (210) is perpendicular to an intersection between the second outlet conduct (200) and a wall of the internal cavity (300) crossed by said second outlet conduct (200).

7. Outlet assembly according to any of claims 1 to 5 **characterized in that** the second inner aperture (210) is parallel to an intersection between the second outlet conduct (200) and a wall of the internal cavity (300) crossed by said second outlet conduct (200).

8. Outlet assembly according to any of the previous claims **characterized in that** the first outlet conduct (100) and the second outlet conduct (200) are disposed intersecting a same wall of the internal cavity (300).

9. Outlet assembly according to any of claims 1 to 7 **characterized in that** the first outlet conduct (100) and the second outlet conduct (200) are disposed intersecting two different walls of the internal cavity (300).

10. Outlet assembly according to any of the previous claims **characterized in that** the first inner aperture (110) and the second inner aperture (210) are circular-shaped.

11. Outlet assembly according to any of the previous claims **characterized in that** the first outlet conduct (100) and the second outlet conduct (200) have a variable cross section, .

12. Outlet assembly according to any of the previous claims **characterized in that** the first inner aperture (110) is larger than the second inner aperture (210).

13. Rotary-vane vacuum pump comprising:

- a pump chamber (500),;
- a rotor housed in the pump chamber (500), the rotor comprising at least one vane, and being subspaces generated between the at least one vane and the chamber wall by a movement of the rotor;

characterized in that the vacuum pump further comprises an outlet assembly according to any of claims 1 to 12.

14. Rotary-vane vacuum pump according to claim 13 **characterized in that** the internal cavity (300) from where the first inner aperture (110) and the second inner aperture (210) are adapted to extract the fluid is an intermediate chamber connected to the pump chamber through at least an intermediate outlet.

15. Rotary-vane vacuum pump according to claim 13 **characterized in that** the internal cavity (300) from where the first inner aperture (110) and the second inner aperture (210) are adapted to extract the fluid is the pump chamber (500).

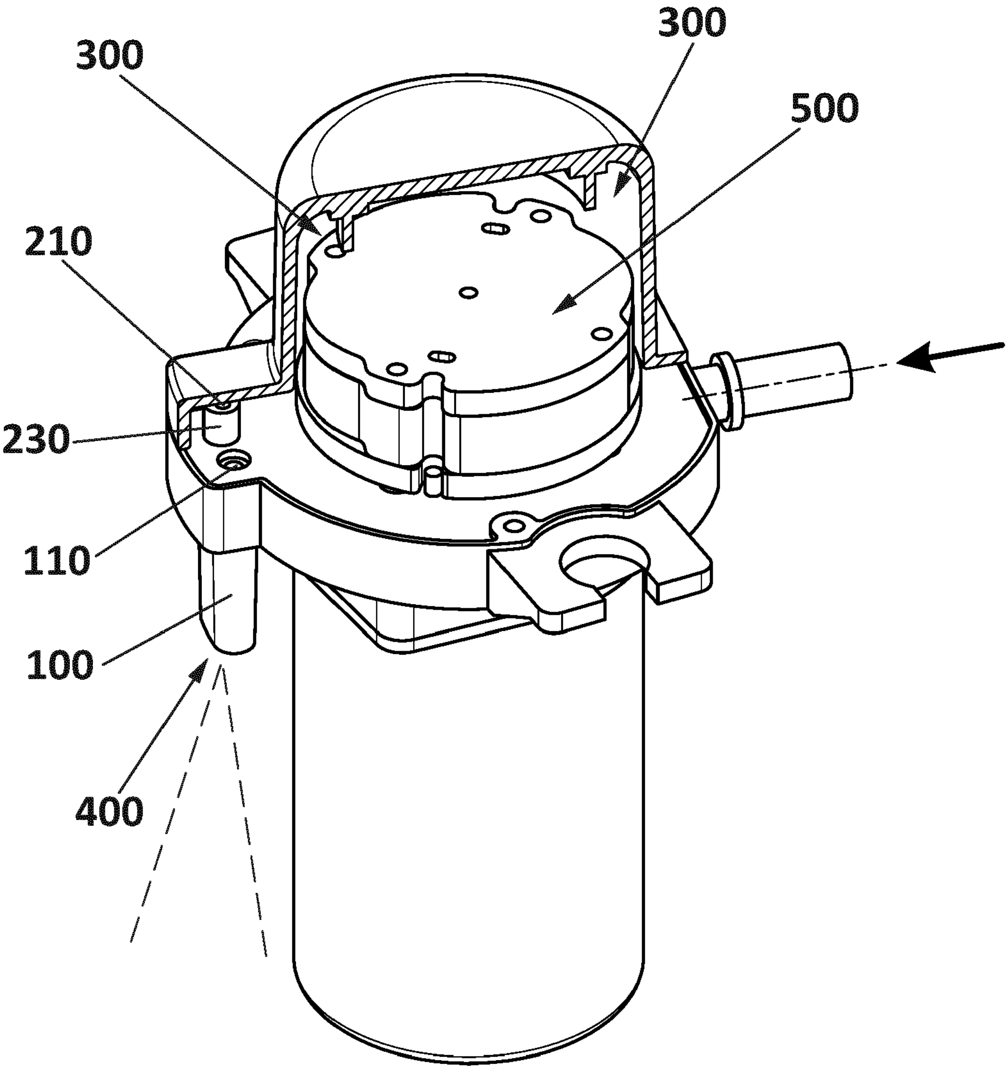

FIG. 1

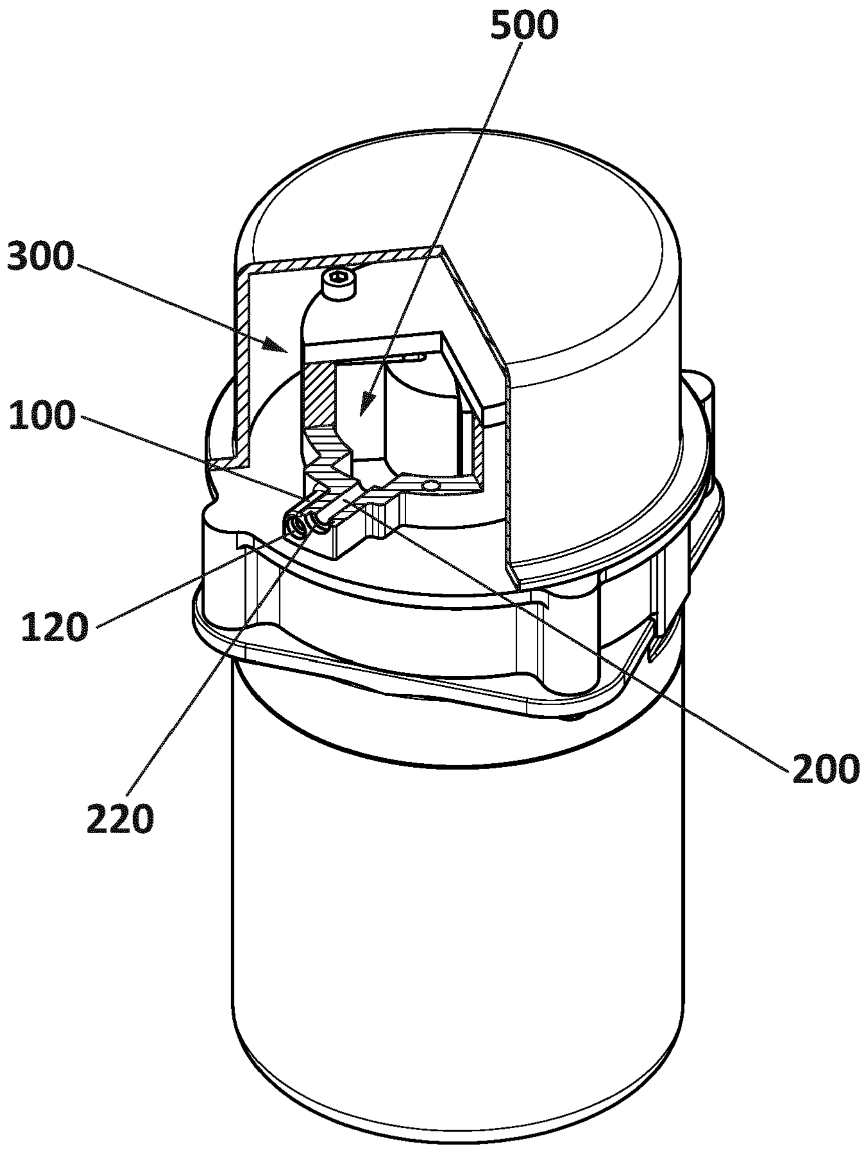

FIG. 2

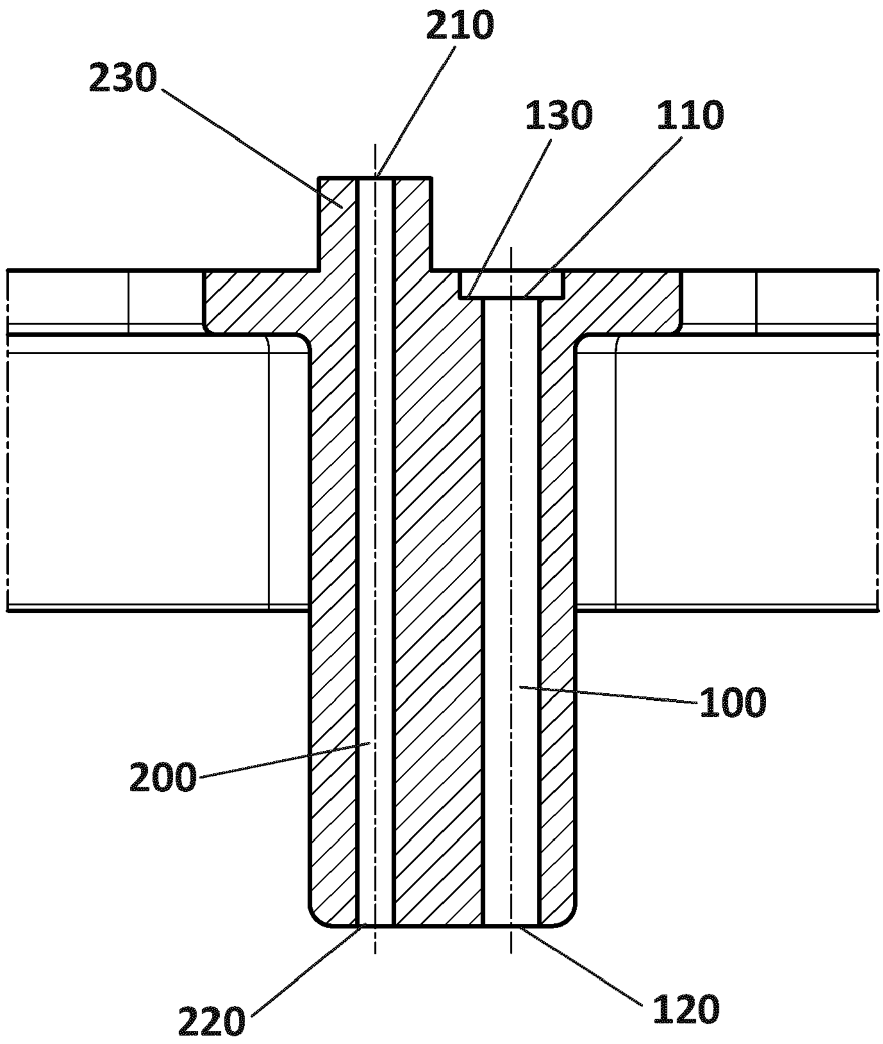

FIG. 3

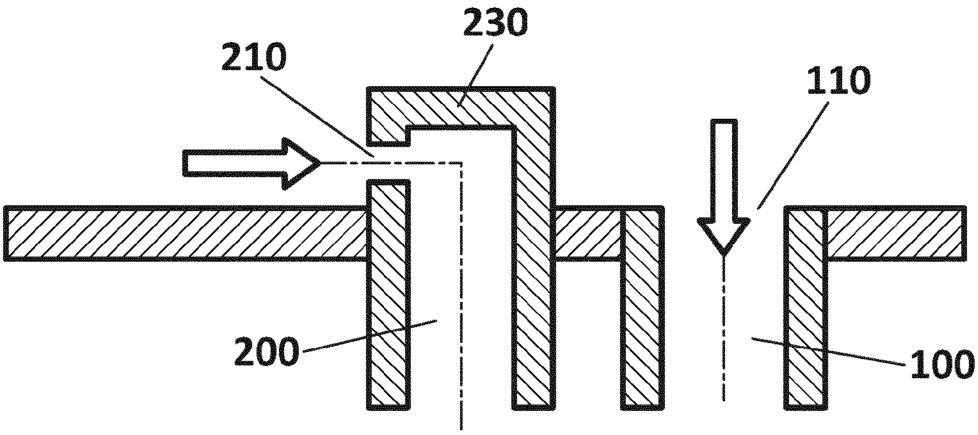

FIG. 4

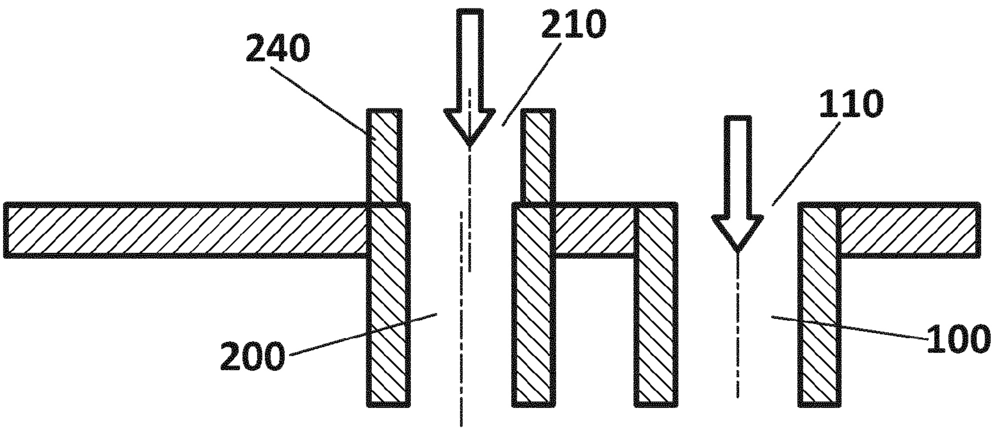

FIG. 5

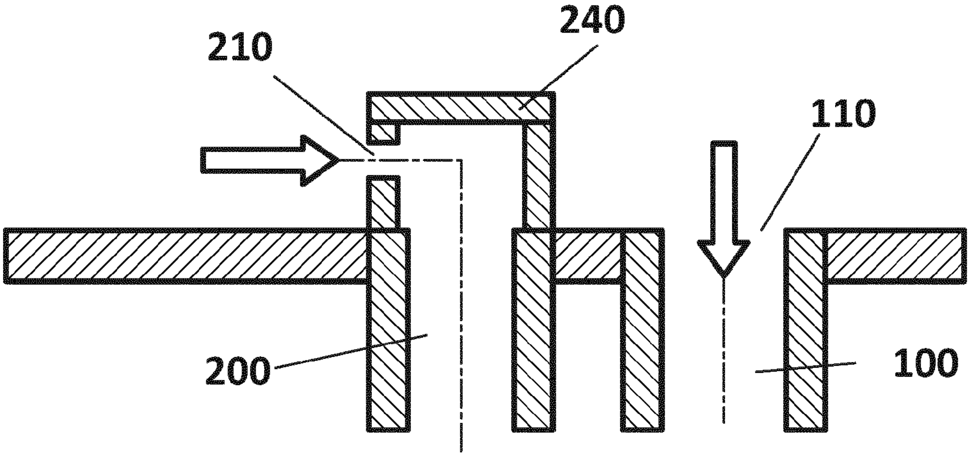

FIG. 6

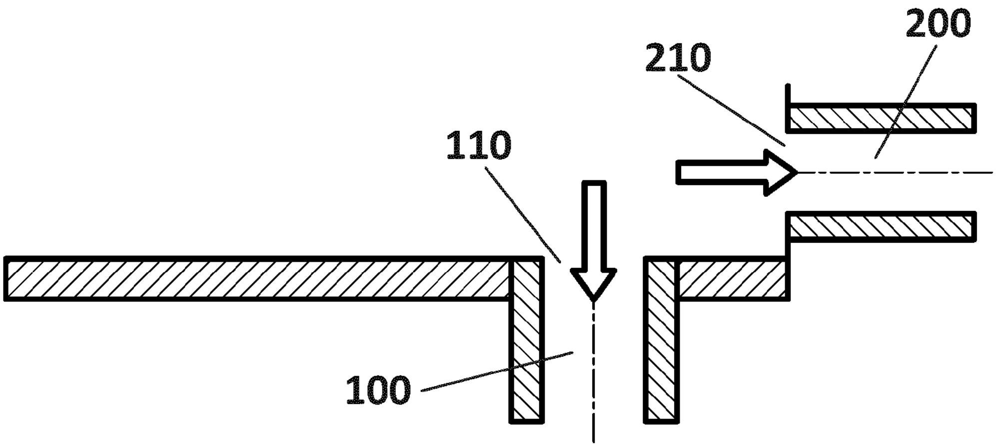

FIG. 7

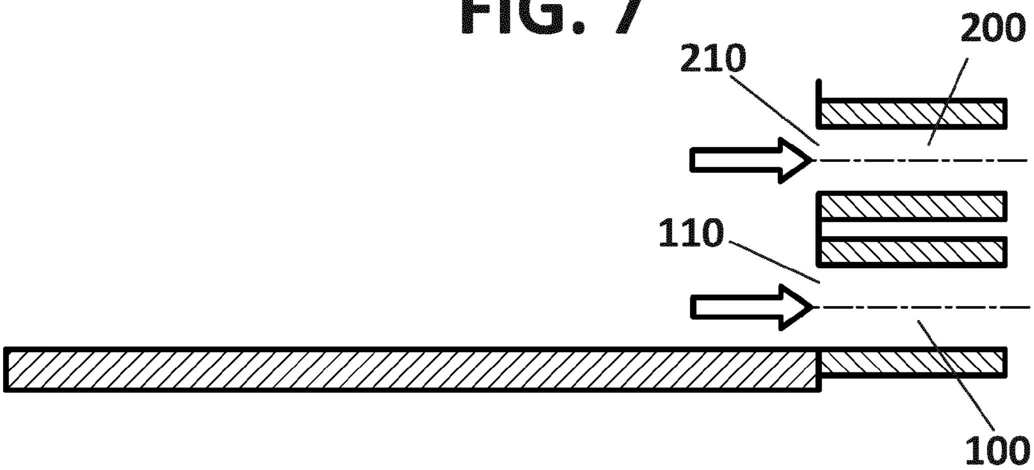

FIG. 8

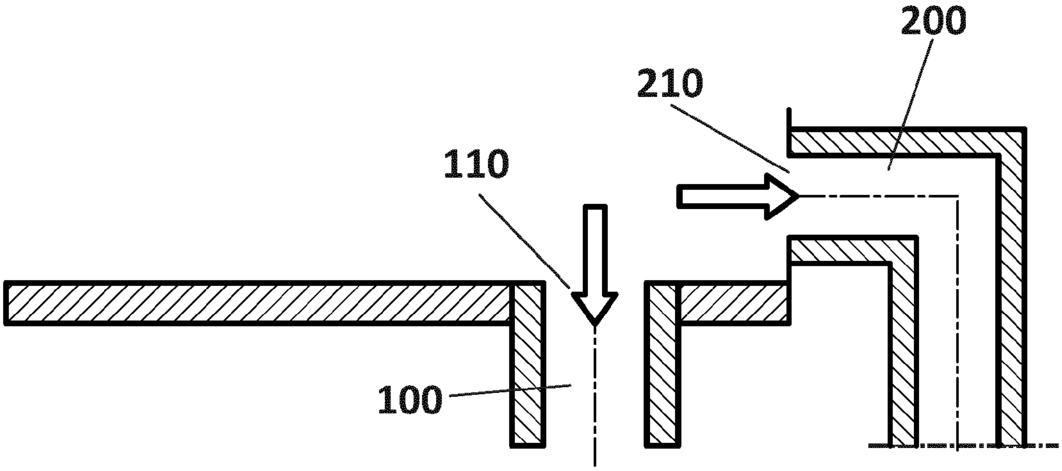

FIG. 9

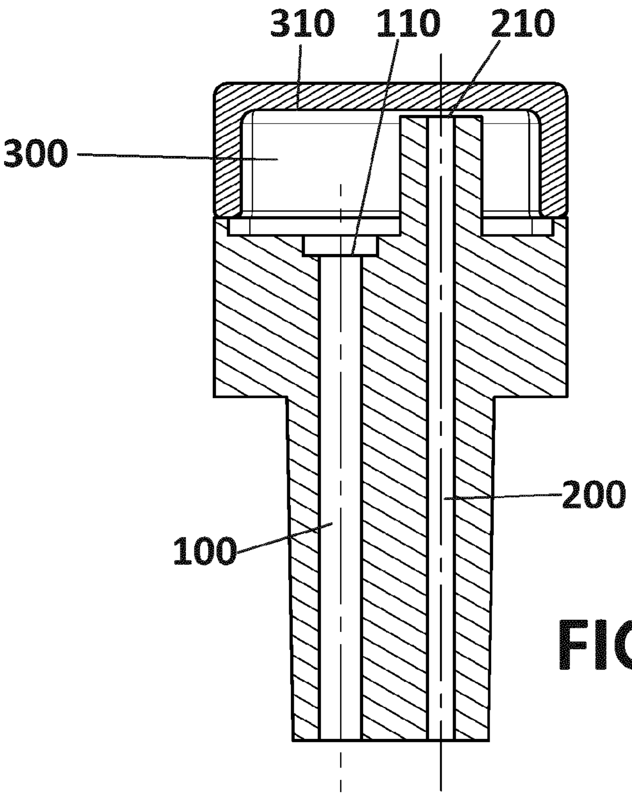

FIG. 10

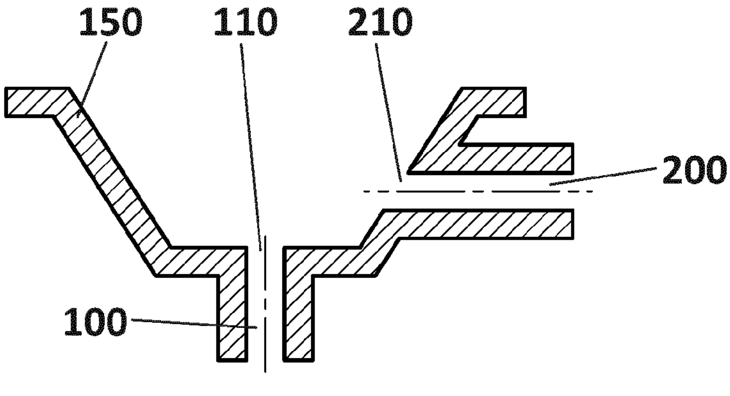

FIG. 11

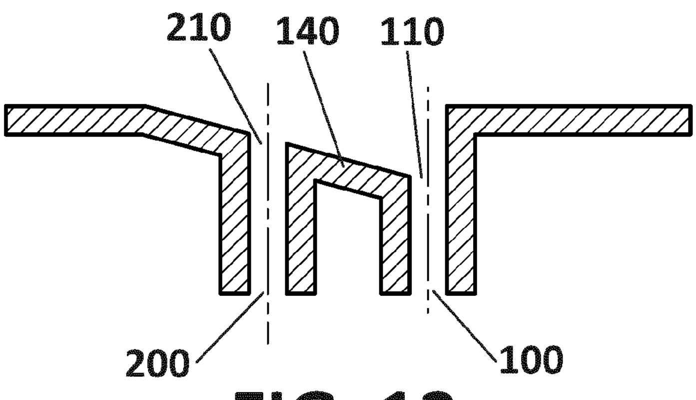

FIG. 12

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 18 38 2144

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	DE 10 2015 118111 A1 (HELLA KGAA HUECK & CO [DE]) 27 April 2017 (2017-04-27) * paragraph [0021] - paragraph [0027]; claim 1; figures 1,4,5 * -----	1-15	INV. F04C25/02 F04C29/12 F04C18/344
A	DE 10 2015 120304 A1 (HELLA KGAA HUECK & CO [DE]) 24 May 2017 (2017-05-24) * abstract; claim 1; figure 2 * -----	1-15	

TECHNICAL FIELDS SEARCHED (IPC)
F04C

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	10 September 2018	Descoubes, Pierre

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 18 38 2144

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

10-09-2018

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 102015118111 A1	27-04-2017	CN 108137029 A	08-06-2018
		DE 102015118111 A1	27-04-2017
		US 2018238311 A1	23-08-2018
		WO 2017067819 A1	27-04-2017
DE 102015120304 A1	24-05-2017	CN 108291544 A	17-07-2018
		DE 102015120304 A1	24-05-2017
		WO 2017089156 A1	01-06-2017

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 3468260 A **[0004]**
- US 6296460 B1 **[0005]**
- US 6688862 B2 **[0005]**