

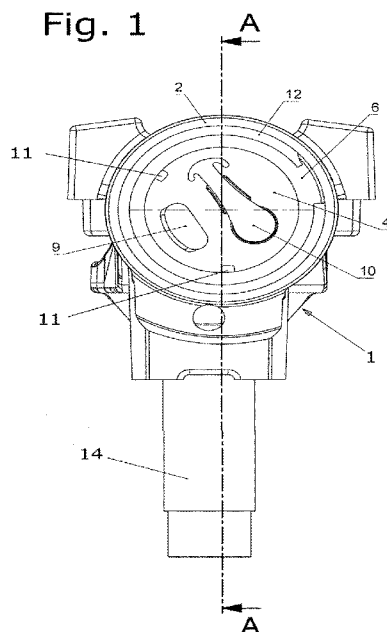


- (51) International Patent Classification:
F04B 39/12 (2006.01) *F04B 53/10* (2006.01)
- (21) International Application Number:
PCT/EP2024/065985
- (22) International Filing Date:
10 June 2024 (10.06.2024)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
A 50454/2023 09 June 2023 (09.06.2023) AT
- (71) Applicant: **NIDEC GLOBAL APPLIANCE AUSTRIA GMBH** [AT/AT]; JAHNSTRASSE 30, 8280 FÜRSTENFELD, STEIERMARK (AT).
- (72) Inventors: **KOHL, Michaela**; JAHNSTRASSE 30, 8280 FÜRSTENFELD, STEIERMARK (AT). **BRABEK, Walter**; JAHNSTRASSE 30, 8280 FÜRSTENFELD, STEIERMARK (AT). **ZIPP, Gunther**; JAHNSTRASSE 30, 8280 FÜRSTENFELD, STEIERMARK (AT).
- (74) Agent: **MODIANO, Gabriella Diana**; Modiano & Partners (DE), Steinsdorfstrasse, 14, 80538 Muenchen (DE).

- (81) Designated States (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CV, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IQ, IR, IS, IT, JM, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, MG, MK, MN, MU, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.
- (84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, CV, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SC, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, ME, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:
— with international search report (Art. 21(3))

(54) Title: REFRIGERANT COMPRESSOR



(57) Abstract: Refrigerant compressor with a compressor housing in which a refrigerant compression unit (1) is arranged, the compression unit having a refrigerant-compressing piston-cylinder unit, the cylinder housing (2) of which is closed by means of a valve plate (4), said valve plate is inserted into a receiving recess (3) of the cylinder housing and a pressing element (6) presses the valve plate relative to the cylinder housing in the direction of the cylinder, an insert (12) having a shoulder (7) is provided which is firmly connected to the cylinder housing, and the pressing element is arranged and pressed in the axial direction between the valve plate and the shoulder, wherein the pressing element has at least one positioning element (11) which engages with a corresponding positioning element of a channel component (18, 19).



"REFRIGERANT COMPRESSOR"

[0001] The invention relates to a refrigerant compressor with a compressor housing in which a refrigerant-compressing compression unit is arranged. The compression unit comprises a piston-cylinder unit that compresses the refrigerant, and the cylinder housing is closed by a valve plate.

[0002] EP 1 864 021 A1 discloses a design as described above with a valve plate that is fixed to the cylinder housing by means of a clamping element. The clamping element encircles the valve plate and is connected to the outside of the cylinder housing at the height of the cylinder in the axial direction by engaging in a recess in the cylinder housing. This necessitates a complex construction of the clamping element, particularly because the clamping element is also designed to clampingly attach a suction channel and a pressure channel to the valve plate.

[0003] A similar arrangement is disclosed in EP 1 888 918 A1. The clamping element has areas that encircle the valve housing laterally, resulting in a separately manufactured form.

[0004] Document US 3,021,995 relates to compressors and particularly to compressors in which the motor and compressor are enclosed in a hermetically sealed casing. However, the crankcase of such document is complex and presents a large number of components such as cylinder liner, suction valve cage, discharge valve cage, ring valve plate, Belleville Spring, and snap ring. In opposition, the present invention discloses a simpler crankcase with a recess for valve plate, a recess for disc spring, and a notch.

[0005] The object of the invention is to provide a stable and easily manufacturable and constructible design. Another object of the invention is to ensure a secure and reliable sealing of the valve plate against the cylinder.

[0006] This object is achieved according to the invention in that the valve plate is inserted into a receiving recess of the cylinder housing, and a pressing element presses the valve plate against the cylinder housing in the direction of the cylinder, a shoulder is provided that is firmly connected to the cylinder housing away from the cylinder in the axial direction, and the pressing element is arranged and pre-tensioned in the axial direction between the valve plate and the shoulder.

[0007] The arrangement of the pressing element in the axial direction between the valve plate and the shoulder achieves a simple construction in which the individual components can be stacked one after another on the cylinder housing. At the same time, the pressing element does not need to be specially adapted in shape, but standard components can be used, and the valve plate can still be pressed sufficiently firmly onto the cylinder housing. The cylinder housing no longer needs to have recesses at the height of the cylinder, as the shoulder is arranged in the axial direction above the cylinder. This results in a particularly simple yet stable design. The pressing element no longer needs to have arms or other connecting elements to connect to the cylinder housing but can rest directly against the shoulder.

[0008] By pre-tensioning in the direction of the cylinder, it is meant that the pressing element presses the

valve plate axially in the direction of the cylinder. This ensures a tight closure of the cylinder housing.

[0009] By "in the axial direction," it is meant the axial direction of the receiving recess. This is usually also coaxial with the cylinder, in which case the axial direction corresponds to the axis of the cylinder.

[00010] By "firmly connected in the axial direction away from the cylinder," it is meant that the shoulder is not movable relative to the cylinder housing in the axial direction at least away from the cylinder. "Firmly connected" thus means immovably connected at least in the direction away from the cylinder.

[00011] Preferably, the shoulder is not movable relative to the cylinder housing in the axial direction, meaning it is not movable in the axial direction towards the cylinder either. This can be achieved, for example, by inserting the element forming the shoulder into a radial recess of the cylinder housing that is matched to the shape of the element.

[00012] The shoulder can be formed by one or more elements that are separable from the cylinder housing. It can also be provided that the at least one element forming the shoulder is made in one piece with the cylinder housing, i.e., part of the cylinder housing. The element forming the shoulder and/or the shoulder itself is preferably arranged in the receiving recess. The shoulder thus supports itself on the inside of the cylinder housing.

[00013] If the shoulder is formed by an insert, the insert is preferably inserted into the receiving recess and

connected to the cylinder housing in the receiving recess. It thus supports itself on the inside.

[00014] Unless explicitly defined otherwise, terms such as axial or radial refer to the axis of the receiving recess.

[00015] Preferably, at least one sealing element is arranged between the cylinder housing and the valve plate.

[00016] It is preferably provided that the pressing element and preferably also the element forming the shoulder are arranged in the receiving recess.

[00017] It may be provided that the receiving recess has at least one notch, preferably a radial notch, into which the element forming the shoulder is inserted. The notch can be, for example, a groove.

[00018] Preferably, the compressor housing is hermetically sealed.

[00019] Preferably, the pressing element is elastic in the axial direction and is particularly preferably made of micro-alloyed steel or spring steel. This enables a simple and cost-effective design that can still effectively pre-tension the valve plate.

[00020] In a preferred embodiment, it is provided that the pressing element has at least one disc spring and is preferably formed by at least one disc spring. A disc spring is a preferably ring-shaped or disc-shaped element that acts as a mechanical spring in the axial direction. Preferably, it has the shape of a usually flat truncated cone. It can also be provided that the pressing element comprises several disc springs, which can be arranged at least partially in parallel-i.e., in the same direction-or in series-i.e., in

opposite directions. It is particularly advantageous if the pressing element has only one disc spring or is formed by only one disc spring. This is a particularly simple, cost-effective, and easy-to-assemble construction that usually provides sufficient pre-tensioning.

[00021] Furthermore, it is advantageous if the pressing element abuts the valve plate on the side facing the cylinder and the shoulder on the side facing away from the cylinder in the axial direction. Through direct contact, a compact design is achieved, in which the pre-tensioning can be directly transmitted between the elements.

[00022] It is preferably provided that the shoulder is formed by an insert, preferably ring-shaped or ring-segment-shaped, which is inserted into a preferably radial notch of the cylinder housing and is preferably made of spring steel. Unlike the prior art, where the clamping element has encircling areas, here the insert, which is fixed in the valve housing, is divided into two separate components by the pressing element. This allows for simpler assembly and the use of standard components. The notch can, for example, be a groove. The notch is preferably arranged in the receiving recess. Such an insert can be easily placed on the disc spring after its arrangement and brought into the intended position relative to the cylinder housing through compression. This ensures that the insert is loaded in the axial direction by the pressing element, where the insert is positively connected to the cylinder housing. To remove the insert from its fixed connection with the cylinder housing, a radial or tangential force must be applied to the insert. Thus, a particularly secure design is achieved.

[00023] In this context, it is particularly advantageous if the shoulder is formed by an internal retaining ring. This further reduces the number of specialized parts and allows for the use of standard components.

[00024] To set the exact rotational position of the valve plate easily during installation, it can be provided that the shape of the valve plate and the receiving recess are matched so that the valve plate fits into the receiving recess only in one rotational position along the axis of the receiving recess. This prevents the incorrect rotational position from being mistakenly set during assembly, which is particularly problematic if the valve plate has openings or other elements that interact with adjacent parts.

[00025] The valve plate can also fit into the receiving position when reversed, i.e., when it is inserted such that the surface originally facing the cylinder now faces away from the cylinder.

[00026] To ensure sufficient sealing, it can be provided that the pressing element presses the valve plate against the cylinder housing with a force of at least 1500 N, preferably at least 2000 N, and particularly preferably at least 2500 N in the direction of the cylinder.

[00027] It is particularly advantageous if the pressing element has at least one positioning element that engages with a corresponding positioning element of a channel component. Such positioning elements assist in assembling the channel components in the correct position with the cylinder housing. Thus, the pressing element only needs to be brought into the correct position relative to the cylinder

housing once, and the subsequent arrangement of one or more channel components is then easily possible, as they are indicated and/or determined by the positioning elements.

[00028] Positioning elements can include, for example, tongues for engaging in corresponding recesses or holders. Correspondingly, the positioning elements can also include appropriate recesses or holders.

[00029] Preferably, it is provided that the rotational position of the pressing element relative to the cylinder housing is fixed, and particularly preferably that the rotational position is determined by the element forming the shoulder. This determination can be achieved, for example, by matching the shape of the pressing element with the shape of the cylinder housing, and/or through a force fit via the shoulder.

[00030] It is preferably provided that the valve plate has at least one pressure opening and at least one suction opening. This is particularly useful as the valve plate is easy to process. Preferably, the pressure opening has a pressure valve and/or the suction opening has a suction valve. Through this suction valve, coolant can be drawn into the interior of the cylinder, where it is compressed by the piston and expelled through the pressure valve from the interior of the cylinder into a pressure channel.

[00031] In this context, it is particularly advantageous if it is provided that a pressure channel connects to the pressure opening outside the cylinder and a suction channel connects to the suction opening outside the cylinder, and preferably the pressure channel is formed by a first channel component and/or the suction channel is

formed by a second channel component. It may be provided that the first and second channel components have connecting elements for connecting to each other. This allows the channel components to be connected to each other and then connected to the cylinder housing together in one step.

[00032] To ensure particularly easy assembly, it may be provided that the pressing element has at least one first positioning element that engages with a corresponding positioning element of the first channel component, and at least one second positioning element that engages with a corresponding positioning element of the second channel component. It may also be provided that the pressing element has at least one first positioning element that engages with a corresponding positioning element of the first channel component and another channel component is rotatably connected to the first channel component about the cylinder axis. This allows the rotational position of both channel components relative to the cylinder housing to be adjusted.

[00033] Furthermore, it is advantageous if at least one channel component is attached to the cylinder housing with at least one, preferably Y-shaped, clamp, wherein the clamp is connected to the cylinder housing via at least one locking element. Preferably, the cylinder housing has at least one undercut into which the locking element can engage. This undercut can be formed, for example, by a groove on the cylinder housing.

[00034] Subsequently, the invention will be described in more detail with reference to non-limiting embodiments in the figures. They show:

[00035] Fig. 1 is a top view of a compression unit of a refrigerant compressor according to the present invention in a first embodiment;

[00036] Fig. 2 is a partial sectional view of the compression unit along line A - A in Fig. 1;

[00037] Fig. 3 shows an enlarged section B from Fig. 2; Fig. 4 is an exploded view of the compression unit of Figs. 1 to 3. The embodiment shown in the figures discloses a compression unit 1 of a refrigerant compressor according to the present invention, which comprises a piston-cylinder unit with a cylinder housing 2. The cylinder 5 has a cylinder axis Z along which the cylinder 5 extends and along which the piston, not shown, performs its up and down movements. At the upper end of the cylinder 5 along the cylinder axis Z, a receiving recess 3 is provided, which has an axis coaxial with the cylinder axis Z. In this receiving recess 3, closing the cylinder 5 from the top, a valve plate 4 is inserted. The receiving recess 3 has a substantially cylindrical shape. The receiving recess 3 has a radial shoulder on which the valve plate 4 rests in the direction of the cylinder 5. This prevents further movement of the valve plate 4 towards the cylinder 5 and is advantageous for other embodiments as well. Preferably, as shown in the figures, at least one sealing element 13 in the form of a sealing ring is arranged between the radial shoulder and the valve plate 4. On the side of the valve plate 4 facing away from the cylinder 5 in the axial direction, a pressing element 6 is arranged, which is designed as a disc spring and is arranged in another recess 3a. It has a flat ring shape, which is chamfered and thus conical. The disc spring

rests with an inner edge 6a on the valve plate 5 and with an outer edge 6b on a shoulder 7 of the insert 12. For better visibility, the components lying axially above the shoulder 7 are not shown in Fig. 1. The insert 12, designed as an internal locking ring, has a ring segment shape. It is inserted into a radially executed notch 8, which is designed as a groove and prevents the movement of the internal locking ring in the axial direction away from the cylinder 5. Movement in the axial direction towards the cylinder 5 is only possible to a limited extent, but is in any case limited by the preload.

[00038] The internal locking ring can be inserted into the notch 8 by compressing and thereby bringing its two circumferential ends closer together. The pressing element 6 is arranged in the axial direction between the valve plate 4 and the shoulder 7 and is elastically deformed by them in the axial direction. Thus, the pressing element 6 presses the valve plate 4 with approximately 2,000 N in the axial direction into the receiving recess 3. A significant advantage of this construction is that the axial force is distributed very evenly in the circumferential direction, ensuring reliable sealing. The valve plate 4 has a pressure opening 9 and a suction opening 10, which can be closed by a suction valve or pressure valve, not shown here. The pressing element 6 has two positioning elements 11 in the form of radially inward-directed tongues. They are arranged on the inner diameter of the pressing element 6 and serve to engage with channel components 18, 19. In this embodiment, a channel component 18 has two corresponding positioning elements in the form of notches into which the tongues

engage. The first and second channel components 18, 19 are connected to each other via a plug connection. A bearing housing 14 serves to accommodate the crankshaft bearings, not shown. At the same time, the suction unit 18 and the pressure unit 19 are pressed onto the valve plate 4 and secured by a clamp 20, which is also supported on the outer groove 17 of the cylinder housing 2 by means of three locking elements 22. Fig. 4 shows the structure of the compression unit 1 in detail in an exploded view. In particular, it can be seen that the clamp 20 presses the first channel component 18, designed as a suction unit, and the second channel component 19, designed as a pressure unit, together with the positioning unit 21 for positioning relative to the cylinder housing 2, onto the cylinder housing 2 and the valve plate 4 lying thereon. Due to the independent attachment and preloading of the valve plate 4 via the disc spring serving as the pressing element 6, the holding forces applied by the clamp 20 can be adjusted to the connection between the valve plate 4 and the suction unit 18 and the pressure unit 19.

[00039] The forces exerted by the clamp 20 are typically significantly lower than the force applied by the compression spring. As visible in Fig. 4, the receiving recess 3 features a radial recess 23, positioned at the level of the valve plate 4. Within this recess, a radial extension of the valve plate 4 is inserted, which in Fig. 4 is obscured by the compression spring and thus not visible. The engagement of this extension into the radial recess 23 ensures that the valve plate 4 can only be positioned in a specific rotational orientation relative to the cylinder housing 2.

CLAIMS

1. Refrigerant compressor with a compressor housing in which a refrigerant-compressing compression unit (1) is arranged, the compression unit (1) having a refrigerant-compressing piston-cylinder unit, the cylinder housing (2) of which is closed by means of a valve plate (4), said valve plate (4) is inserted into a receiving recess (3) of the cylinder housing (2) and a pressing element (6) presses the valve plate (4) relative to the cylinder housing (2) in the direction of the cylinder (5), that a shoulder (7) is provided which is firmly connected to the cylinder housing (2) in the axial direction away from the cylinder (5), and that the pressing element (6) is arranged and pressed in the axial direction between the valve plate (4) and the shoulder (7), **characterized in that** the pressing element (6) has at least one positioning element (11) which engages with a corresponding positioning element of a channel component.

2. Refrigerant compressor, according to claim 1, **characterized in that** the pressing element (6) has at least one disc spring and is preferably formed by at least one disc spring.

3. Refrigerant compressor, according to claim 1 or 2, **characterized in that** the pressing element (6) rests in the axial direction on the side facing the cylinder (5) on the valve plate (4) and on the side facing away from the cylinder (5) on the shoulder (7).

4. Refrigerant compressor, according to one of claims 1 to 3, **characterized in that** the shoulder (7) is formed by a preferably annular or ring-segment-shaped insert (12)

which is inserted into a notch (8) of the cylinder housing (2).

5. Refrigerant compressor, according to one of claims 1 to 4, **characterized in that** the shoulder (7) is formed by an internal locking ring.

6. Refrigerant compressor, according to one of claims 1 to 5, **characterized in that** the shape of the valve plate (4) and the receiving recess (3) are coordinated with one another, so that the valve plate (4) only fits into the receiving recess in a rotational position along the axis of the receiving recess (3).

7. Refrigerant compressor, according to one of claims 1 to 6, **characterized in that** the pressing element (6) presses the valve plate (4) relative to the cylinder housing (2) with a force of at least 1500 N, preferably at least 2000 N and particularly preferably at least 2500 N in the direction of the cylinder (5).

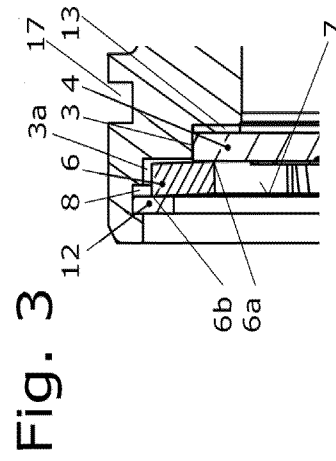
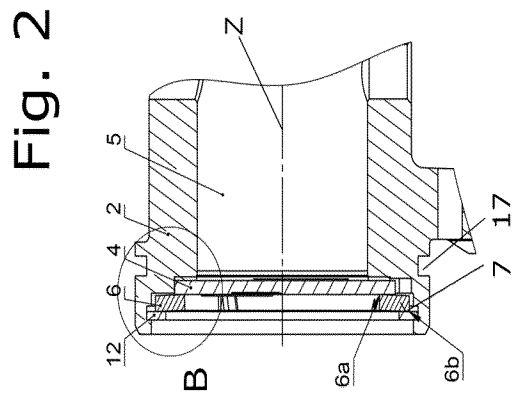
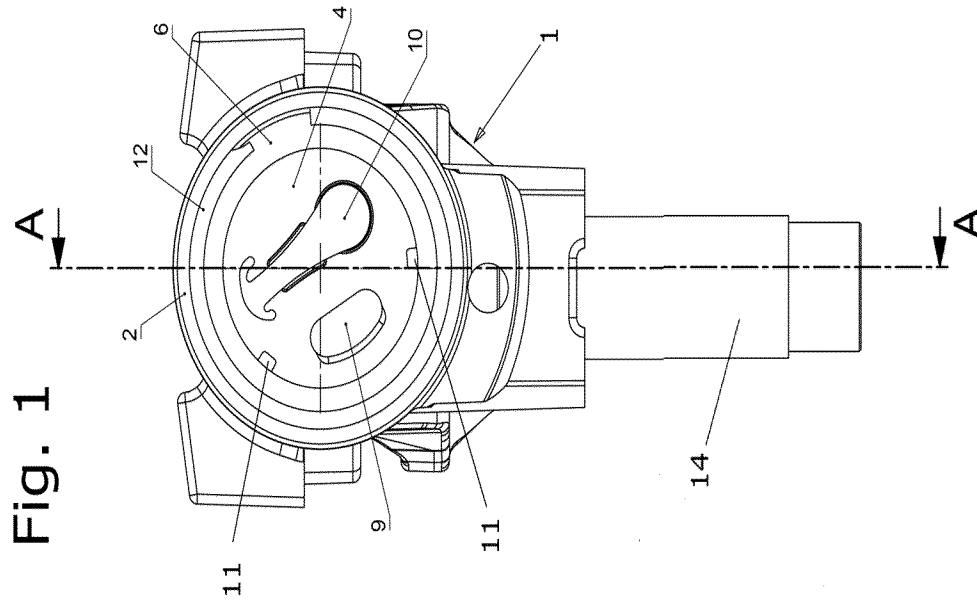
8. Refrigerant compressor, according to one of claims 1 to 7, **characterized in that** the valve plate (4) has at least one pressure opening (9) and at least one suction opening (10).

9. Refrigerant compressor, according to claim 8, **characterized in that** a pressure channel is connected to the pressure opening (9) outside the cylinder (5) and a suction channel is connected to the suction opening (10) outside the cylinder (5) and that the pressure channel is preferably formed by a first channel component and/or the suction channel is formed by a second channel component.

10. Refrigerant compressor, according to claim 9, **characterized in that** the pressing element (6) has at least

one first positioning element which engages with a corresponding positioning element of the first channel component and has at least one second positioning element which engages with a corresponding positioning element of the second channel component.

11. Refrigerant compressor, according to one of claims 8 to 10, **characterized in that** at least one channel component is fastened to the cylinder housing with at least one, preferably Y-shaped, clamp, the clamp being connected to the cylinder housing (2) via at least one locking element.



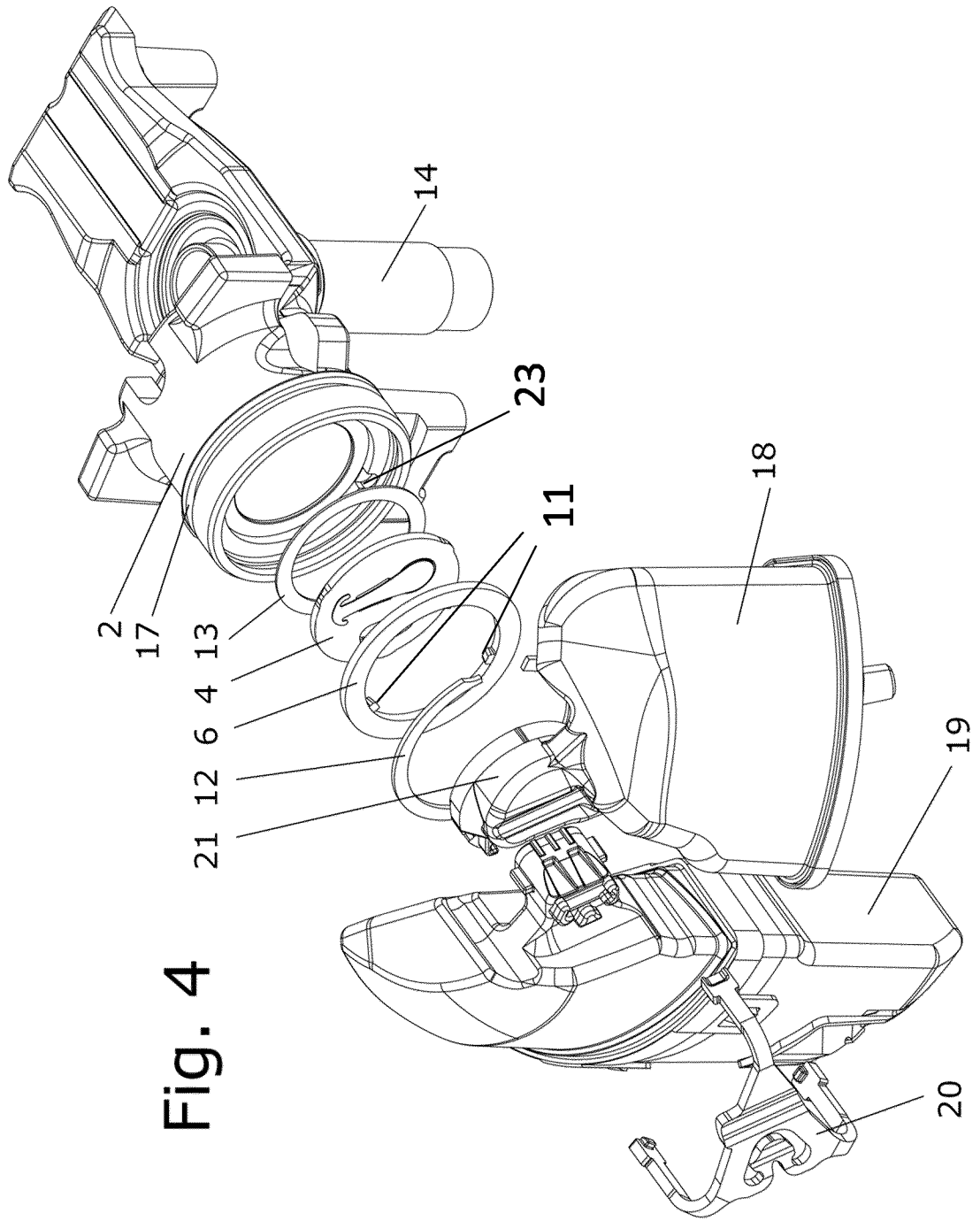


Fig. 4

INTERNATIONAL SEARCH REPORT

International application No PCT/EP2024/065985
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A. CLASSIFICATION OF SUBJECT MATTER
 INV. **F04B39/12** **F04B53/10**
 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.
X	US 3 021 995 A (NEUBAUER EMIL T) 20 February 1962 (1962-02-20) cited in the application column 1, line 55 - column 2, line 2; figure 1 -----	1 - 11
A	EP 4 170 162 A1 (SECOP GMBH [DE]) 26 April 2023 (2023-04-26) paragraphs [0038] - [0043]; figure 2 -----	1
A	US 9 605 666 B2 (SEAGAR NEVILLE DAVID [NZ]; MCGILL IAN CAMPBELL [NZ] ET AL.) 28 March 2017 (2017-03-28) claim 1; figure 5 -----	1

Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents :

<p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier application or patent but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p>	<p>"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</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&" document member of the same patent family</p>
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Date of the actual completion of the international search 4 July 2024	Date of mailing of the international search report 15/07/2024
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2024/065985

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