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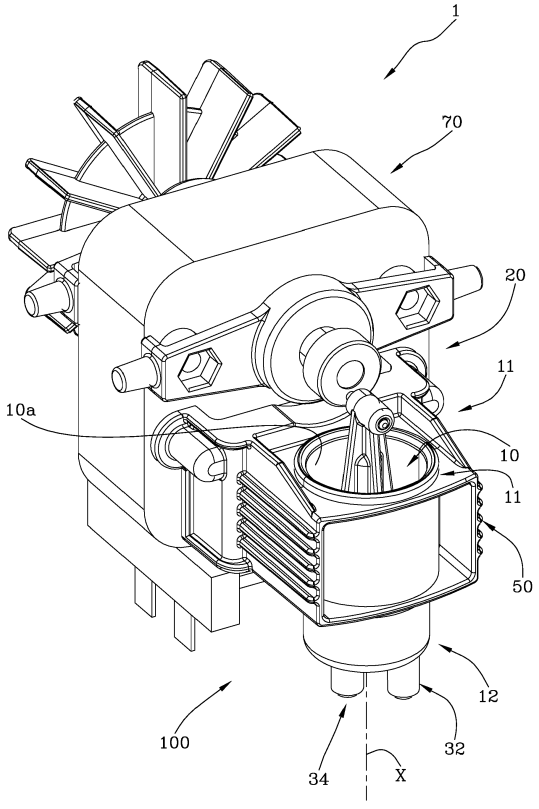
(54) Compression device for a fluid

(57) Described is a fluid compression device, comprising at least a compression chamber extending longitudinally between a first end and a second end, a bottom wall operatively associated with the compression chamber and having at least one delivery opening for putting into fluid communication the compression chamber with a delivery duct, compression means such as to interact with the compression chamber and/or the bottom wall in order to compress the fluid inside the compression chamber, at least one diaphragm valve operatively associated with the compression means for allowing at least the delivery of the compressed fluid from the compression chamber using the delivery duct. The device is characterised in that at least one diaphragm valve is positioned in an inner portion of the compression chamber in such a way as to interact with the compression means in an operating configuration for use of the compression device.

Fig.1



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Description

[0001] This invention relates to a fluid compression device.

[0002] More specifically, this invention relates to a compression device for a compressible fluid, preferably a gaseous fluid like atmospheric air or another similar gas.

[0003] According to the preferred embodiment of the invention, the device relates to an atmospheric air compressor for making an aerosol.

[0004] The compression device according to this invention is aimed particularly at making aerosols for medical use.

[0005] It is known that an aerosol is a particular mixture in which a substance (solid or liquid) is in a finely dispersed state. In the medical field, a suspension of the aerosol type is used mainly for curing problems of a respiratory nature. It consists of an apparatus comprising a compression device which allows the aerial administration of medicines for the cure or prevention of diseases related to the respiratory system. The efficiency of the aerosol apparatus is due to the fact that the medicine is reduced to very small particles which, escaping from the force of gravity, are able to more easily access all areas of the respiratory system of a patient.

[0006] In the prior art, for example shown by the contents of patents US3540470, US1619481, US6227825 and US4532685, the technology relative to fluid compression devices in particular for an aerosol apparatus, comprises an electric motor connected to a kinematic mechanism of the crank-connecting rod type in turn connected to a sealed piston. The sealed piston sliding inside a compression chamber makes it possible to create the flow of compressed air which is sent from the compression chamber, for example using a flexible hose, to the dispenser equipped with a specific bottle to create the aerosol. More specifically, the flow of compressed air is created by means of an elastic diaphragm which allows, alternatively, the suction and the discharge of a volume of air.

[0007] The elastic diaphragm is a diaphragm made of plastic material, known in the prior art, with two flexible notched tabs, one for the introduction and one for the discharge of the air to and from the compression chamber. The notched tabs of the diaphragm valve are associated with respective holes positioned in a lower part of the compression chamber and designed one for the suction and one for the delivery of the compressed air. In the prior art, the compression device of the apparatus for aerosols comprises, in addition to the electrical part, two main elements: a first element which constitutes the central body in which the compression chamber is formed and a second element forming the head of the compression chamber, connected outside the first element at an end of the chamber. The head of the compression chamber generally has at least the delivery duct of the compressed air; in other prior art solutions there may also be the duct for suction of air into the chamber.

[0008] In other words, the part of the compression device designed for the compression comprises two separate elements which are operatively associated during a condition of use of the apparatus for aerosols.

[0009] Fluid compression devices are known in the prior art in particular for an apparatus for aerosols where the central body and the head of the compression chamber are assembled to each other by contact surfaces and centring edges. Generally speaking, the clamping is achieved by prior art fixing means of the threaded type such as screws, nut and stud or other threaded means which allow an effective mechanical and pneumatic seal of the assembly.

[0010] More specifically, for favouring the pneumatic seal between chamber and head of chamber the prior art interposes the diaphragm valve between the two elements, or, rather, a part of it which is not designed for cyclic deformation during the pumping and compression cycle but is designed to act as gasket. Generally speaking, the diaphragm valves are produced by punching or cutting from a semi-finished plastic element with predetermined strength and elasticity properties.

[0011] The shape of the diaphragm valve comprises an excessive amount of material along the perimeter edge for it to be packed between the first element and the second element of the compression device of the apparatus for aerosols. In this way, the above-mentioned seal is created, leaving two functions to the diaphragm valve: the alternating management of suction and delivery of the compressed air to and from the compression chamber and the pneumatic sealing of the compression chamber isolating it from the outside environment, even though is made physically with the assembly of two or more elements.

[0012] According to the prior art, the compression devices for an apparatus for aerosols as described above and, more specifically, the compression chamber assembly, are subject to some drawbacks which limit the use in terms of efficiency, reliability and management and maintenance costs.

[0013] It is known that the compression device for aerosols has limitations due mainly to the mechanical architecture and the solutions adopted with regard to the pneumatic system.

[0014] Moreover, the device comprises a plurality of pieces and parts which must be made individually by mechanical processing or by die forming and which must then be assembled. Moreover, in the prior art, as well as the high number of pieces of the compression device there is also a loss of compressed air from various points of the compression chamber and chamber head assembly due to the difficulty of assembly and the possibility, which is not insignificant, of a non-compliant assembly of the various parts.

[0015] The aim of this invention is to provide a compression device for aerosols which is reliable over time and which guarantees the same flow rate of compressed

air even after various hours of operation without a loss in performance.

[0016] The aim of this invention is also to provide a compression device for aerosols which allows a greater ease of assembly, especially with the presence of a smaller number of elements and parts to be assembled compared with the prior art.

[0017] Moreover, another aim of this invention is to provide a compression device for aerosols which has a simple, robust and rational structure in terms of dimensions and operating spaces of the compressor, if necessary with a possibility of increasing the flow rate capacity and/or pressure thanks to a modular type design concept of the compression system.

[0018] The invention according to this invention relates to a compression device for aerosols which can be assembled more simply and faster than the prior art, above all with a smaller number of structural elements and parts compared with the traditional compression device for aerosols, thus allowing a significant advantage in terms of costs for the large scale production of the compression device.

[0019] These and other aims are substantially achieved by a compression device for aerosols as described in one or more of the appended claims.

[0020] Further features and advantages of the present invention are more apparent from the detailed description of a preferred, but non-exclusive, embodiment of a compression device for aerosols according to this invention.

[0021] The description is provided below with reference to the accompanying drawings, which are also non-limiting and provided by way of example only, in which:

- Figure 1 is a schematic perspective view of the compression device for aerosols according to this invention;
Figure 2 is an exploded schematic perspective view of the compression device for aerosols of Figure 1;
Figure 3 is a schematic cross section view of the compression device of Figure 1;
Figure 4 is a schematic perspective view of a component of the compression device of Figure 1;
Figure 4A is a schematic cross section view of the component of Figure 4;
- Figure 5 is a schematic perspective view partly in cross section of a further embodiment of the compression device of Figure 1.

[0022] The accompanying drawings show in its entirety a fluid compression device in the preferred, non-limiting embodiment according to the inventive concept of this invention.

[0023] The compression device in the accompanying drawings is labelled in its entirety with the numeral 1.

[0024] With reference to Figure 1 in particular, the compression device 1 has a compression chamber 10 positioned in such a way as to extend between a first end 11 and a second end 12.

[0025] Preferably, the compression chamber 10 extends along an axis "X". Still more preferably, the axis X is positioned in a vertical position with reference to the normal use of the compression device.

[0026] Preferably, the compression chamber 10 has a transversal cross-section (therefore perpendicular to the axis of extension "X") circular in shape. The compression device 1 also comprises a bottom wall 30, better illustrated in Figure 5, and operatively associated with the compression chamber 10. The bottom wall 30 is such that it interacts with the compression means 20 of the device 1. In other words, the bottom wall 30 completes and closes the space inside the compression chamber 10 and in which the fluid introduced is compressed.

[0027] The compression device 1 comprises compression means 20 such as to interact at least with the compression chamber 10 and/or with the bottom wall 30 to compress the fluid inside the compression chamber 10. Preferably, the bottom wall 30 is such as to have at least one delivery opening 31 for putting into fluid communication the compression chamber 10 with a delivery duct 32.

[0028] Preferably, the bottom wall 30 also has a suction opening 33, for example positioned adjacent to the delivery opening 31, for putting into fluid communication a suction duct 34 with the compression chamber 10.

[0029] According to a possible embodiment, of which the accompanying drawings constitute a non-limiting example, the bottom wall 30 comprises a flat portion 35, as shown schematically in Figure 5 where some parts are missing, including a part of the flat portion 35, in order to show certain details which would otherwise be hidden.

[0030] The compression device 1 also comprises a diaphragm valve 40 (illustrated in Figures 2 and 3) operatively associated with the compression means 20.

[0031] Preferably, the diaphragm valve 40 is made by punching from a sheet of rubber, if necessary strengthened with a thin nylon link embedded in the rubber, or by hot injection moulding or by means of other techniques which are not described in detail below.

[0032] The diaphragm valve 40 is equipped with a predetermined degree of flexibility and elasticity preferably determined on the basis of the dimensions of the compression chamber 10 and the maximum compression pressure reached by the device 1.

[0033] Preferably, the diaphragm valve 40 has a main lying plane "P" which in an operating configuration for using the device 1 is positioned perpendicularly to the axis of extension "X" of the compression chamber 10.

[0034] According to a possible embodiment, of which the accompanying drawings constitute a non-limiting example, the diaphragm valve 40 has a perimetric edge 43 shaped having the greater dimensions (relative to the plane "X") approximately equal to the diameter of the compression chamber 10. Preferably, the diaphragm valve 40 is configured in such a way as to allow at least the delivery of the compressed fluid from the compression chamber 10 by means of the delivery duct 32.

[0035] According to the preferred embodiment, the diaphragm valve 40 is configured in such a way as to also allow the introduction of fluid into the compression chamber 10, that is to say, which allows the suction of the fluid, for example from the outside 100, using the suction duct 34.

[0036] The suction duct 34 and the delivery duct 32 can have a diameter of the same size or different.

[0037] The diaphragm valve 40 comprises at least one notched tab 41. The tab 41 has, for example, at least a semi-circular shape or preferably equal to at least ¾ of a full circumference with a predetermined diameter, for example a diameter approximately equal to the diameter of the delivery duct 32. In other words, the tab 41 comprises a portion 41 a for connecting with the rest of the diaphragm valve 40, formed without interruptions with the diaphragm valve.

[0038] The tab 41 is flexible in such a way as to bend beyond the lying plane "P" of the diaphragm valve 40 during a step of delivering a compressed fluid in an operating configuration for use of the device 1. In other words, the tab 41 bends about the connecting portion 41 a relative to the lying plane "P" of the diaphragm valve 40.

[0039] If the diaphragm valve 40 is configured in such a way as to also allow the introduction of fluid, the diaphragm valve 40 may comprise a further notched tab 42. The further tab 42 has, for example, at least a semi-circular shape or preferably equal to at least % of a full circumference with a predetermined diameter, for example a diameter approximately equal to the diameter of the suction duct 34. In other words, the further tab 42 comprises a portion 42a for connecting with the rest of the diaphragm valve 40, formed without interruptions with the diaphragm valve.

[0040] The further tab 42 is flexible in such a way as to bend beyond the lying plane "P" of the diaphragm valve 40 during a step of sucking a compressed fluid from the outside 100 in an operating configuration for use of the device 1. In other words, the further tab 42 bends about the connecting portion 42a relative to the lying plane "P" of the diaphragm valve 40.

[0041] The further tab 42, if present, is preferably made in the proximity of the tab 41. In an operating configuration for use of the device 1, the further tab 42 is positioned in such a way as to bend in an opposite direction to the direction along which the tab 41 bends.

[0042] Advantageously, the diaphragm valve 40 is positioned in an inner portion of the compression chamber 10 in such a way as to interact with the compression means 20 in an operating configuration for use of the compression device 1. In other words, the diaphragm valve 40 is not interposed between the two elements, that is to say, the compression chamber and the head of the chamber of the device, according to the prior art, rather, the diaphragm valve 40 is located in a position adjacent to the bottom wall 30 inside the compression chamber 10.

[0043] Preferably, the diaphragm valve 40 is abutted at least partly on the bottom wall 30 of the device 1 in an operating configuration for use of the device 1. In this position, the diaphragm valve 40 is such that it interacts with the compression means 20.

[0044] Advantageously, the compression device 1 comprises a main body 50 having the compression chamber 10 and the bottom wall 30 made in a single continuous piece. In other words, the main body 50 of the device 1 is an element made of the same material and in which the compression chamber 10 and the bottom wall 30 are made in a single piece. Preferably, the main body 50 of the device 1 is made of a metallic material, for example a lightweight alloy, or a high performance plastic material (for example charged with fibre), and shaped by mechanical machining and/or moulding or die casting.

[0045] Advantageously, the flat portion 35 of the bottom wall 30 is designed to at least partly abut with the diaphragm valve 40 in an operating configuration for use of the device 1.

[0046] Preferably, the diaphragm valve 40 is positioned in such a way as to have the notched tab 41 positioned at the delivery opening 31 of the bottom wall 30 and the further notched tab 42, if present, positioned at the suction opening 33 of the bottom wall 30.

[0047] For this reason, in an operating condition for use of the device 1 which comprises the delivery of compressed air towards the delivery duct 32 the tab 41 is such as to bend towards the bottom wall 30 in the direction of the delivery opening 31. In an operating configuration for use of the device 1, at the delivery opening 31 the bottom wall 30 may have an inclined seat 35a in such a way as to house the bent tab 41 and at the same time provide a stop surface.

[0048] Vice versa, in an operating condition for use of the device 1 which comprises the suction of air from the outside 100 through the suction duct 34, the further tab 42 is such as to bend in an opposite direction to the tab 41, that is, in a direction opposite to the position of the suction opening 33. In other words, the further tab 42 during the step of sucking air into the compression chamber 10 is such as to bend towards the space of the compression chamber 10 in the direction of the compression means 20 (as also shown in Figure 3).

[0049] Preferably, the diaphragm valve 40 along the perimeter edge 43 has a pair of slotted seats 44 (shown in Figure 2) diametrically opposite each other and which are functionally described below.

[0050] According to a possible embodiment, of which the accompanying drawings constitute a non-limiting example, the device 1 comprises contact means 60 designed for at least partly constraining the diaphragm valve 40 and for allowing it to reversibly deform in an operating configuration for use of the compression device 1. More specifically, the contact means 60 are such that they fix in an abutted position the diaphragm valve 40 on the bottom wall 30 of the device 1 using a relative portion with a corresponding flat portion 35 of the bottom wall 30.

[0051] According to the preferred embodiment of this invention, the contact means 60 comprise a shaped element 61 designed to be fixed to a portion of the bottom wall 30.

[0052] In a different embodiment not illustrated and fully covered in the inventive concept of the invention, the contact means 60 comprise a shaped element 61 designed to be fixed to an inner portion of the compression chamber 10, in other words, in an intermediate position along the extension of the compression chamber 10 not adjacent to the bottom wall 30.

[0053] For this reason, in an operating configuration for use of the compression device 1, the shaped element 61 is located in a position at least partly abutting the diaphragm valve 40 whilst the diaphragm valve 40 is positioned in a position abutting the flat portion 35 of the bottom wall 30. In other words, the arrangement of the above-mentioned elements in an operating configuration of the device 1 comprises a packing, starting from the space of the compression chamber 10, of the shaped element 61 against the diaphragm valve 40 in turn against the flat portion 35 of the bottom wall 30.

[0054] Preferably, the shaped element 61 has a main plane of extension "G" defining a first side 61 a operatively facing the compression means 20 and a second side 61 b, opposite to the first side 61 a, comprising a flat surface 61 c designed to operatively abut at least partly the diaphragm valve 40 (see Figures 4 and 4A). According to the preferred configuration of the invention and considering a position of normal use of the device 1, the shaped element 61 has the first side 61 a facing upwards and second side 61 b facing downwards. Preferably, in an operating condition for use of the device 1, the shaped element 61 e centred relative to the axis of extension "X" of the compression chamber 10 and, in the case of a compression chamber with a circular cross section, has a shape in plan which is substantially circular having the same diameter as the compression chamber 10.

[0055] Preferably, the shaped element 61 has at least one passage 62 such as to place in fluid communication the first side 61 a with the second side 61 b. Preferably, the passage 62 is positioned at the delivery opening 31 of the bottom wall 30 and is designed to interact with the tab 41 of the diaphragm valve 40 in an operating configuration for use of the device 1.

[0056] Preferably, the shaped element 61 has a further passage 63 such as to place in fluid communication the first side 61 a with the second side 61 b. More specifically, the further passage 63 is positioned at the suction opening 33 of the bottom wall 30, if present, and is designed to interact with the further tab 42, if present, of the diaphragm valve 40 in a configuration for use of the device 1.

[0057] According to a possible embodiment, of which the accompanying drawings constitute a non-limiting example, in an operating configuration for use of the device 1, the passage 63, at the suction opening 33, has an inclined rib 63a located along the diameter of the passage 63, in such a way as to house the further bent tab 42 and at the same time provide a surface stop. Preferably, the device 1 comprises fixing means, not illustrated in the accompanying drawings, for the shaped element 60 and/or for the diaphragm valve 40.

[0058] In other words, the fixing means in a possible embodiment are such as to affect only the diaphragm valve 40 to ensure the packing of the flat portion 35 of the bottom wall 30. In a different embodiment, the fixing means are such as to affect the diaphragm valve 40 using a device (for example, threaded means) and the contact means using a device which is different and separate from the previous one (for example, a snap-on system). Preferably, the fixing means are of the threaded type, for example screws or an assembly of nut and threaded stud or threaded pin.

[0059] In the preferred but non-exclusive embodiment of this invention, the fixing means are such as to affect the contact means 60, in particular the shaped element 61 and the diaphragm valve 40 using a single fixing device.

[0060] According to a possible embodiment, of which the accompanying drawings constitute a non-limiting example, the fixing means comprise a pair of projections 64 of the shaped element 64 positioned for example on the second side 61 b of the shaped element 61, as illustrated in Figure 4.

[0061] The pair of projections 64 have, respectively, a through hole 64a for the passage of screws, centring pins or similar elements (not illustrated).

[0062] With reference to Figure 5, the pair of projections 64 are designed to be operatively associated with respective receiving portions 36 of the bottom wall 30 of the compression chamber 10 in an operating configuration for use of the device 1.

[0063] For reasons of representation of the main body 50 cross sectioned, only a receiving portion 36 of the bottom wall 30 of the device 1 is visible (Figure 5).

[0064] According to the preferred operating condition, the arrangement of the diaphragm valve 40 interposed between the shaped element 61 and the flat portion 35 of the bottom wall 30 is made by the pair of projections 64 with the slotted seats 44 of the diaphragm valve 40 and simultaneously the projections 64 are housed at the bottom of the respective receiving portions 36. The final fixing of the above-mentioned elements is made using screws or other threaded means screwed in the through holes 64a of the pair of projections 64 and respective threaded holes made in the receiving portions 36 of the bottom wall 30.

[0065] In order to correctly position the shaped element 61 and prevent the reversal of the gaps 62, 63 relative to the corresponding openings 31, 33, at least one projection 64 may have a contact element 64c such as a small pocket or seat which prevents assembly in the case of incorrect positioning of the shaped element on the bottom wall 30. This solution is shown for example in Figure 4 with details of the shaped element 61 that sees the contact element 64c with a respective seat 36a on at

least one receiving portion 36, as shown in Figure 5.

[0066] This is purely by way of an example and should not be construed as limiting the scope of the inventive concept of this invention and the scope of protection sought with this application.

[0067] According to the preferred embodiment, the compression means 20 comprise a connecting rod-crank unit having a sealed piston 21 (Figures 2 and 3) fixed to the foot of a connecting rod and operatively associated with walls 10a of the compression chamber 10.

[0068] The piston 21 may comprise a gasket having the function of pneumatic and lubrication seal during the sliding on the walls 10a of the compression chamber 10.

[0069] Preferably, the connecting rod-crank unit is driven by an electric motor 70 as illustrated in Figures 1 and 3.

[0070] In a different embodiment included the inventive concept of the invention, not illustrated in the accompanying drawings, the compression means 20 comprise a flexible diaphragm mounted on the bottom wall 30 in such a way as to cover the diaphragm valve 40. In that case, the compression chamber 10 is formed between the flexible diaphragm and the diaphragm valve 40. In detail, the movement of the flexible diaphragm generates a compression or a suction inside the compression chamber 10. In that case, the compression chamber 10 need no longer have walls 10a surrounding the compression chamber 10.

[0071] Alternatively, if the compression chamber 10 has the walls 10a surrounding the compression chamber, the flexible diaphragm may be connected to the walls 10a (preferably to the outer edge of the walls 10a) in such a way as to define, by its movement, a compression and a suction of air inside the chamber compression 10.

[0072] In each of these two cases, the compression means 20 comprise a rod which operates on the flexible diaphragm for moving at least a part towards or away from the diaphragm valve in such a way as to form the compression or the suction. The stem can be moved according to a crank lever system wherein the rod is formed by the crank of the system which acts on the diaphragm valve.

[0073] In a variant of this movement, the compression means 20 comprise an electromagnetic device operatively associated with the stem in order to actuate it with alternating rectilinear motion using a variable electromagnetic field in an operating configuration for use of the compression device 1.

[0074] Advantageously, the device 1 according to this invention provides a single main body, without joints or snap-on fitting or successive gluing operations in such a way that the compression efficiency is better than that of a prior art compressor.

[0075] Advantageously, the making and assembly of a compression device according to this invention is faster and more simple and therefore lends itself to mass production in large numbers.

[0076] In addition, the positioning of the diaphragm valve inside the compression chamber allows any air leaks which occur at the diaphragm valve to be kept inside so as to improve the compression performance.

[0077] The insertion of the diaphragm valve inside the compression chamber allows greater reliability and reduced risks of pollution of the fluid (at the infeed and/or outfeed of the compressor) since the main body is a single part sealed and completely isolated from the outside. In this way, advantageously, the perimeter portion of the diaphragm valve is not exposed to outside agents such as moisture, solvents, grease or UV rays which could deteriorate the diaphragm in an irreversible manner.

Claims

1. A fluid compression device (1), comprising:

- at least one compression chamber (10) extending longitudinally between a first end (11) and a second end (12);
- a bottom wall (30) operatively associated with the compression chamber (10) and having at least one delivery opening (31) for putting into fluid communication the compression chamber (10) with a delivery duct (32);
- compression means (20) such as to interact with the compression chamber (10) and/or the bottom wall (30) for compressing the fluid inside the compression chamber (10);
- at least one diaphragm valve (40) operatively associated with the compression means (20) for allowing at least the delivery of the fluid compressed by the compression chamber (10) by means of the delivery duct (32); the diaphragm valve (40) being configured to allow the flow of fluid into the compression chamber (10) by suction;

characterised in that the at least one diaphragm valve (40) is positioned in an inner portion of the compression chamber (10) in a position adjacent to the bottom wall (30) in such a way as to interact with the compression means (20) in an operating configuration for use of the compression device (1) for compressing the fluid; the device (1) comprising a main body (50) comprising the compression chamber (10) and the bottom wall (30) made in a single continuous piece on the main body (50).

2. The device (1) according to claim 1, comprising contact means (60) configured for at least partly constraining the diaphragm valve (40) and for allowing a reversible deformation in an operating configuration for use of the compression device (1).

3. The device (1) according to claim 2, wherein the contact means (60) comprise a shaped element (61) designed for being fixed to a portion (35) of the bottom

wall (30) and/or in an inner portion of the compression chamber (10), the shaped element (61) being positioned at least partly abutting the diaphragm valve (40).

4. The device (1) according to claim 3, wherein the shaped element (61) has a main plane of extension ("G") defining a first side (61 a) operatively facing the compression means (20) and a second side (61 b) opposite to the first (61 a) comprising a flat surface (61 c) designed to operatively abut at least partly the diaphragm valve (40).

5. The device (1) according to claim 4, wherein the shaped element (61) has at least one passage (62) such as to place in fluid communication the first side (61 a) with the second side (61 b), the passage (62) being positioned at the delivery opening (31) of the bottom wall (30) and designed to interact with a notched tab (41) of the diaphragm valve (40) in an operating configuration for use of the device (1).

6. The device (1) according to claim 4, wherein the shaped element (61) has a further passage (63) such as to place in fluid communication the first side (61 a) with the second side (61 b), the further passage (63) being located at a suction opening (33) of the bottom wall (30) and designed to interact with an additional notched tab (42) of the diaphragm valve (40) in a configuration for use of the device (1).

7. The device (1) according to any one of claims 3 to 6, wherein the diaphragm valve (40) has a main lying plane ("P") positioned parallel to the flat surface (61 c) of the shaped element (61) in an operating configuration for use of the device (1), the diaphragm valve (40) having a perimeter edge (43) shaped equal to a transversal section of the compression chamber (10).

8. The device (1) according to any one of claims 3 to 7, comprising fixing means for the shaped element (61) and/or for the diaphragm valve (40) operatively associated with a portion (35) of the bottom wall (30).

9. The device (1) according to claim 8, wherein the fixing means comprise a pair of projections (64) positioned on the second side (61 b) of the shaped element (61), the projections (64) having, respectively, a through hole (64a) and being operatively associated with respective receiving portions (36) of the bottom wall (30) in an operating configuration for use of the device (1).

10. The device (1) according to claim 9, wherein the pair of projections (64) positioned on the second side (61 b) of the shaped element (61) are such as to engage in respective slotted seats (44) of the diaphragm valve (40) in an operating configuration for use of the device (1).

11. The device (1) according to claim 1, comprising fixing means such as to fix at least the diaphragm valve (40) in an inner portion of the compression chamber (10).

12. The device (1) according to any one of the preceding claims, wherein the bottom wall (30) comprises a flat portion (35) designed to at least partly abut the diaphragm valve (40) in an operating configuration for use of the device (1).

13. The device (1) according to any one of the preceding claims, wherein the compression means (20) comprise a connecting rod-crank unit comprising a sealed piston (21) fixed to the foot of the connecting rod, the sealed piston (21) being operatively associated with walls (10a) of the compression chamber (10).

14. The device (1) according to any of the preceding claims, wherein the compression means (20) comprise a flexible diaphragm mounted on the bottom wall (30) in such a way as to cover the diaphragm valve (40); the compression chamber (10) being formed between the flexible diaphragm and the diaphragm valve (40) in such a way that the movement of the flexible diaphragm generates a compression or a suction inside the compression chamber (10).

Fig.1

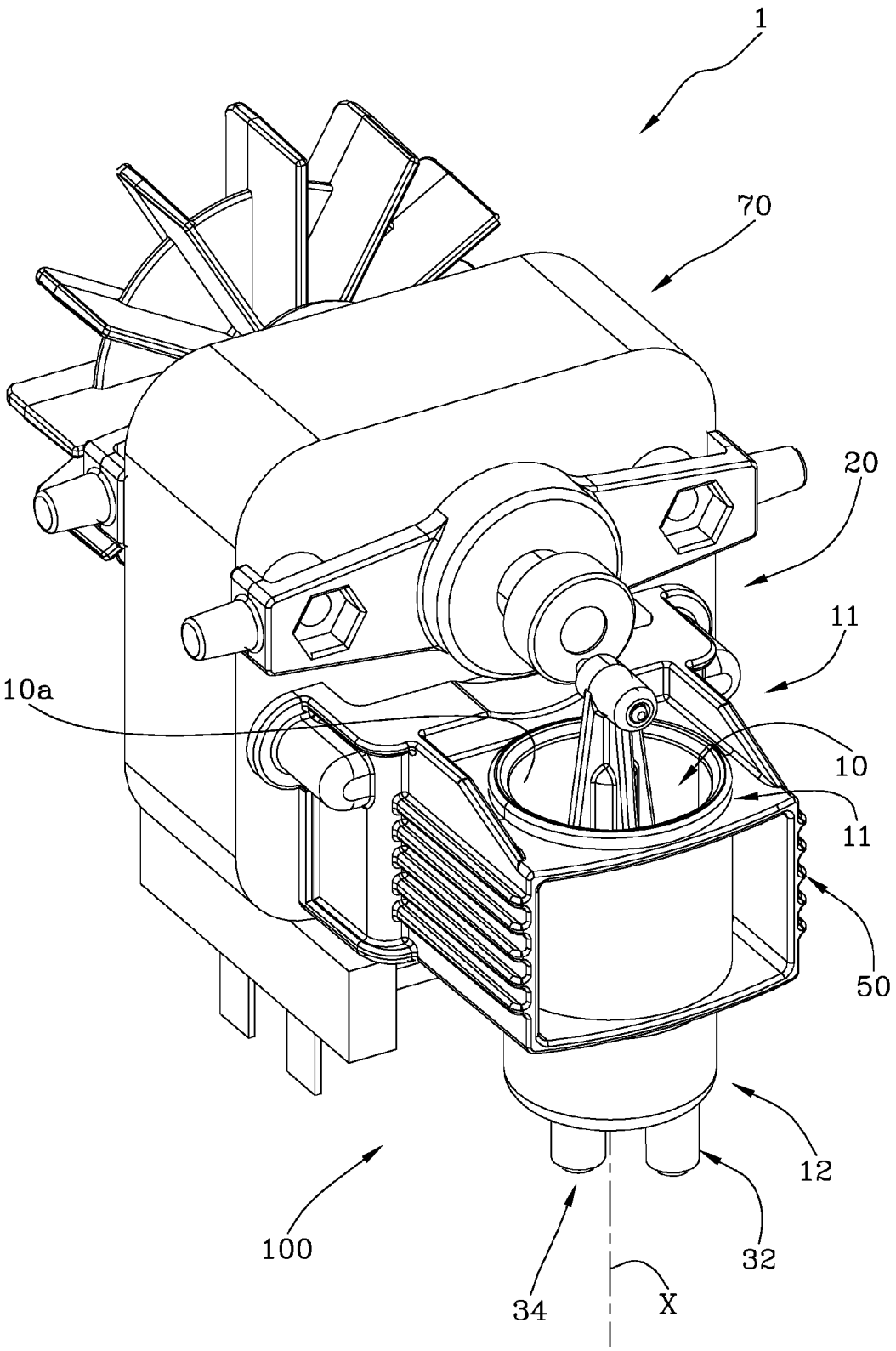

Fig.2

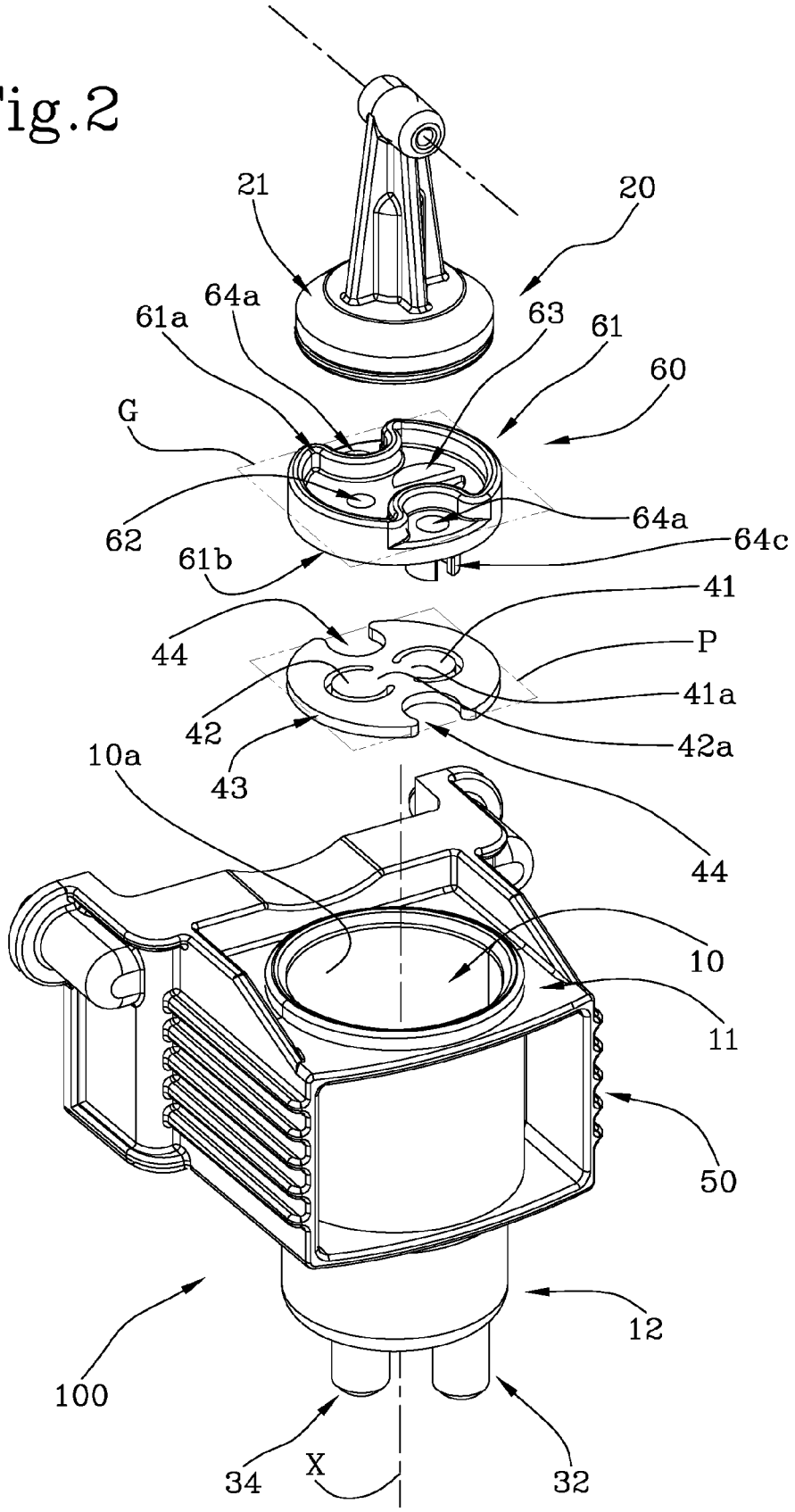
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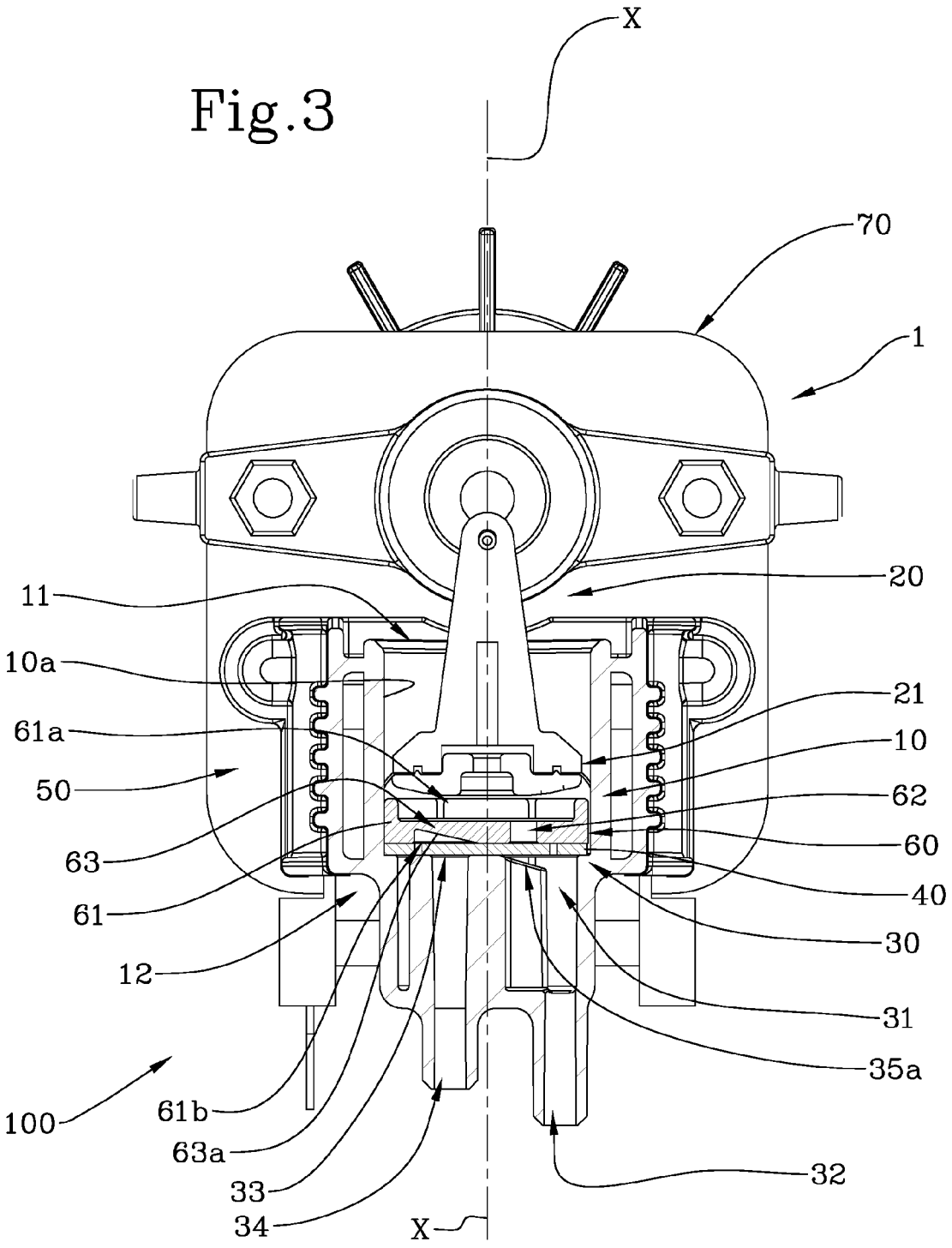
Fig.3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X

Fig.4

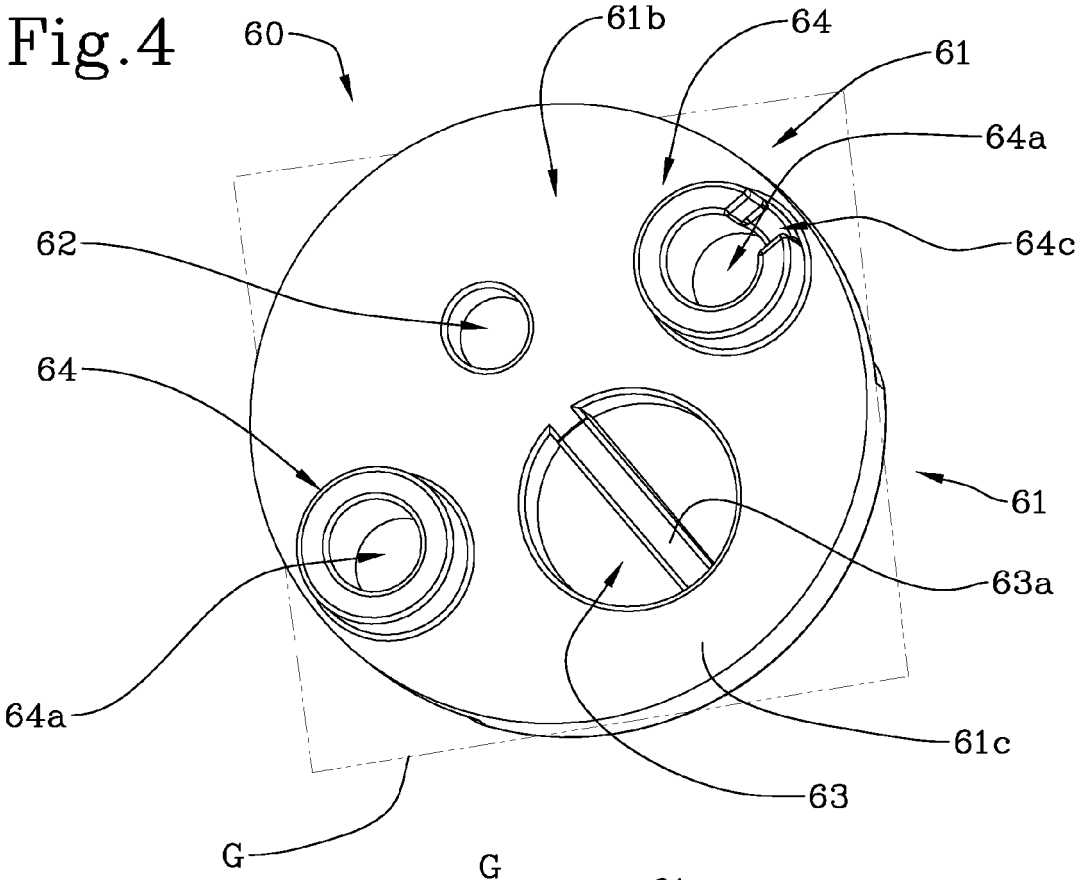

60
61b
64
61
64a
64c
62
64
61
63a
64a
61c
63
G

Fig.4A

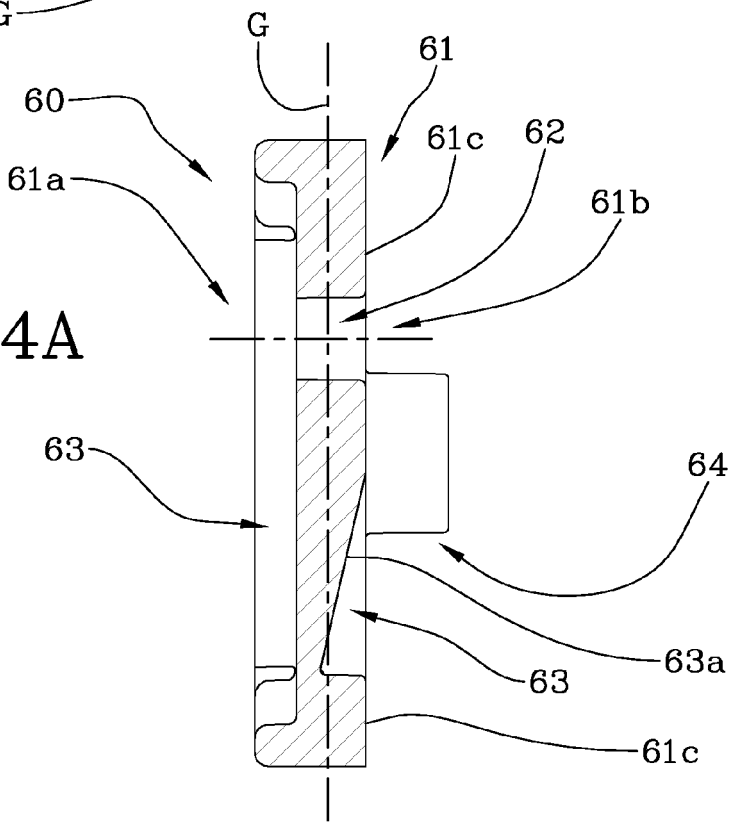
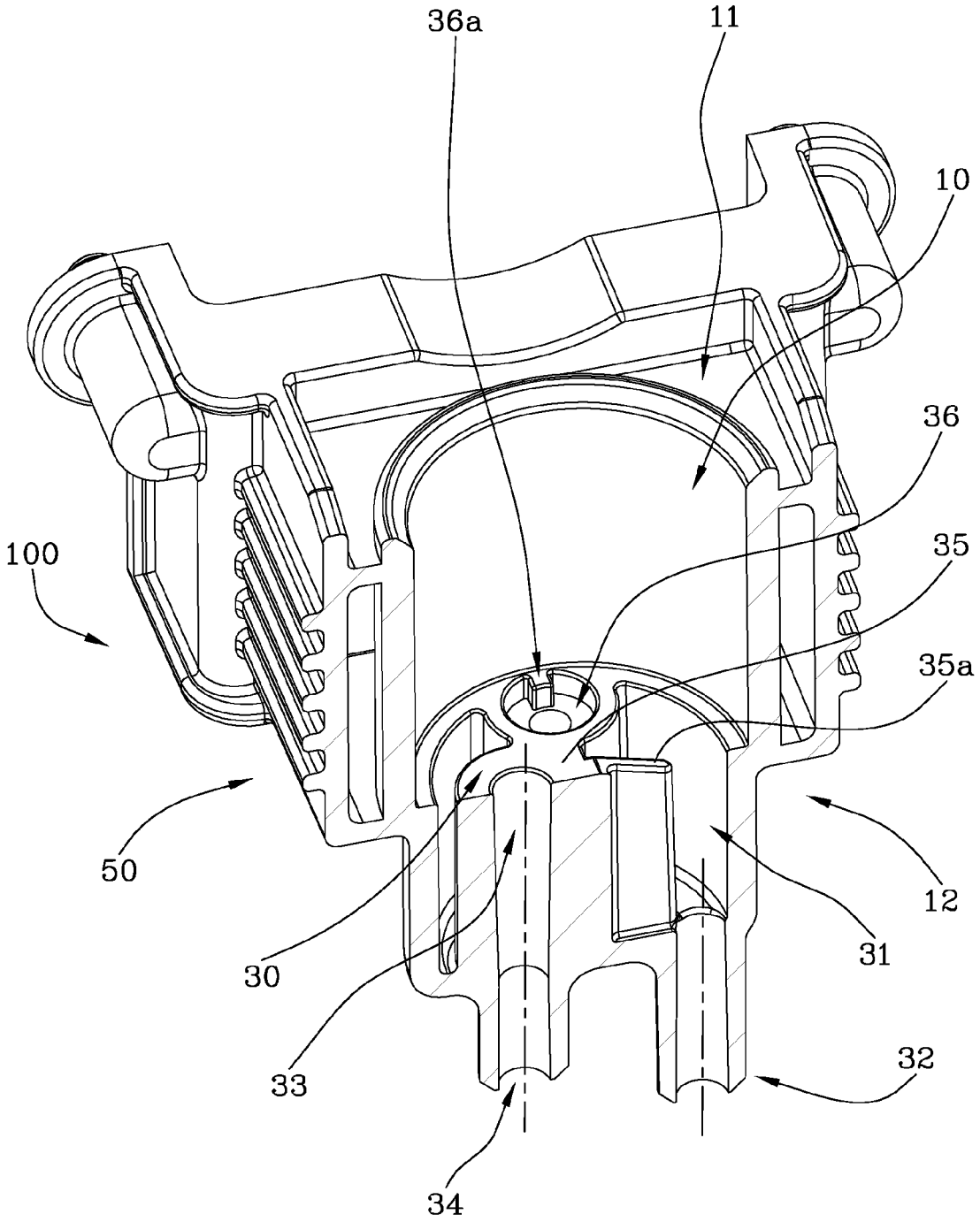

G
61
60
61c
62
61a
61b
63
64
63a
63
61c

Fig.5



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EUROPEAN SEARCH REPORT

Application Number
EP 15 15 0441

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	23 June 2015	Richmond, Robin

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