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(54) Method and arrangement for attaching a filter to a respiratory apparatus

Verfahren und Einrichtung zur Befestigung eines filtermittels an eine Atemschutzgerät

Procédé et agencement pour fixer un moyen de filtration à un appareil respiratoire

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EP-A- 0 394 139 DE-C- 748 953
FR-A- 2 537 695

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Description

[0001] The invention relates generally to joints between parts in respiratory apparatuses intended for removing detrimental substances from respiratory air. The invention relates in particular to the attachment of a filter to the blower part of the respiratory apparatus.

[0002] A modern respiratory apparatus 100 usually has, in accordance with Figure 1, a face mask 101 intended for being secured over the wearer's face by means of straps and a blower part 102 inside which there is a blower (not shown separately in the figure) which sucks air through a filter or filters 103 and blows the air via a hose 104 to the face mask 101. The filters 103 are in general disposable. It is possible to link to a respiratory apparatus filters having different filtering properties according to the environment in which the wearer of the respiratory apparatus will be. Common filter types include, for example, particle filters and smoke gas filters.

[0003] Figure 2 depicts a cross section of a prior art method for attaching a filter 103 to the blower part 102. The filter has a threaded boss 201 the outer surface of which has a male thread 202 according to the DIN 3182 standard. The blower part 102 has a recess 203 the inner surface of which has a corresponding female thread 204. At the bottom of the recess 203 there is a step 205 against which there is placed a ring-like rubber seal 206. When the filter 103 is attached to the blower part 102 by screwing its threaded boss 201 into the recess 203, the rim 207 of the outer end of the threaded boss will press against the rubber seal 206 and will seal the joint between the filter and the blower part.

[0004] One of the disadvantages of the prior art arrangement is that the filter always has to be screwed all the way to the bottom of the thread in order for the joint to be tight. If the filter has not been screwed into place properly, the joint between the filter and the blower part will leak, which may be fatal for the wearer. On the other hand, the DIN 3182 standard prescribes that the length of the threaded boss of the filter must be such that, when the filter is screwed into place, some of the thread remains visible, in which case the thread tends to collect dirt and dust. If the apparatus is used in an environment in which the dirt and dust contain detrimental substances, the dirt and dust accumulated in the thread may in time be hazardous.

[0005] Prior art publications that disclose features of attaching a filter to a respiratory apparatus are for example EP 065 754, EP 090 083, EP 394 139, DE 748 953, and FR 2 537 695.

[0006] One object of the present invention is to provide a method and arrangement for attaching the filter so that the tightness of the joint is not dependent on whether or not the filter has been screwed all the way home. It is also an object of the invention to provide for the filter an attachment arrangement which is economical in terms of manufacturing techniques. It is a further object of the invention to provide an arrangement which reduces the

accumulation of dirt and dust in the thread of the filter.

[0007] The objects of the invention are achieved by forming a sealing zone on the inner surface of the filter attachment boss.

[0008] The arrangement according to the invention is characterized by the features recited in the characterising part of the independent claim directed to an arrangement.

[0009] The invention also relates to a method which is characterized by the features recited in the characterising part of the independent claim directed to a method.

[0010] According to the invention, it is possible to form a cylindrical portion in that part of the respiratory apparatus to which the filter is attached, and when the filter is being attached this portion pushes inside the threaded boss of the filter. That filter part which, according to prior art, is threaded, is referred to below generally as an attachment boss. Between the outer surface of the cylindrical portion and the inner surface of the attachment boss of the filter it is possible to form a sealing zone by placing between the surfaces, for example, an O-ring of an elastic material, known per se. The closer the sealing zone thus formed is to the outer end of the cylindrical portion, the less the tightness of the arrangement is sensitive to whether or not the filter has been screwed properly in place. The invention does not exclude the possibility of the attachment arrangement also having a prior art seal: double sealing will further improve the safety in use of the product.

[0011] The invention is highly applicable to a modular blower part which has a separate blower module to which it is possible to connect, according to need, suction duct modules of different shapes and sizes, to which modules it is further possible to connect a suitable number of filters. According to one preferred embodiment, a filter is connected by the arrangement according to the invention directly to a cylindrical portion in the blower module. The suction duct module may in this case be a simple support part which does not have an actual suction duct but which merely supports the joint between the filter and the blower module.

[0012] The invention is described below in greater detail with reference to preferred embodiments presented by way of example and to the accompanying figures, wherein

- Figure 1 depicts a prior art respiratory apparatus,
- Figure 2 depicts a prior art arrangement for attaching the filter,
- Figure 3a depicts the principle of the invention,
- Figure 3b depicts a modification of the principle of Figure 3a,
- Figure 4 depicts the principle according to Figure 3b applied to one modular blower part,
- Figure 5 depicts the principle according to Figure 3a applied to another modular blower part, and
- Figure 6 depicts one modification of the invention.

[0013] Above, in connection with the description of pri-

or art, reference was made to Figures 1 and 2, and thus below, in the description of the invention, reference will be made primarily to Figures 3a - 6. In the figures, the same reference numerals are used for parts which correspond one to another.

[0014] Figure 3a shows as a partial cross-section a filter 301 and another part 302 of the respiratory apparatus, which part may be, for example the suction duct module of a modular blower part. The filter has an attachment boss 303, the outer surface of which has, in this embodiment of the invention, a male thread 304 defined by the DIN 3182 standard, in itself in accordance with prior art. The wall of the recess in part 302 has a corresponding female thread 305. Part 302 also has a cylindrical portion 306, which is coaxial with thread 305, in which case, when the filter 301 has been screwed into place, the cylindrical portion 306 extends inside the attachment boss 303 of the filter. Encircling the outer surface of the cylindrical portion 306 there is a groove 307 in which there is placed a sealing ring, in itself in accordance with prior art, for example an O-ring 308, made of an elastic material. The depth of the groove 307 is smaller than the thickness of the O-ring 308, and thus, when the O-ring 308 is in the groove 307, its outer surface projects somewhat from the outer surface of the cylindrical portion. The outer diameter of the cylindrical portion 306 is to such an extent smaller than the inner diameter of the attachment boss 303 of the filter that the cylindrical portion fits well inside the attachment boss; however, the thickness of the O-ring is great enough to cause the inner surface of the attachment boss of the filter to press tightly against the O-ring, whereby a tight joint is formed between the inner surface of the attachment boss 303 and the outer surface of the cylindrical portion 306.

[0015] Figure 3a shows that the tightness of the joint between the filter 301 and the part 302 is not too sensitive to whether or not the filter has been screwed properly in place. If the inner surface of the attachment boss 303 of the filter has substantially the shape of a straight circular cylinder, the filter can be unscrewed (the filter moving upwards relative to the position in the figure) until the outer end of the attachment boss 303 is at the level of the O-ring 308 without the tightness of the joint suffering therefrom. The closer the groove 307 is to the outer end (in the figure, the upwardly pointing end) of the cylindrical portion 306, the further the filter can be unscrewed without the joint beginning to leak.

[0016] Figure 3b shows as a partial cross-section another embodiment of the invention, which is otherwise similar to the embodiment of Figure 3a, but in which there is additionally used a sealing ring 320 in itself in accordance with prior art. The inner end (in the figure, the lower end) of the female thread 305 comprised by part 302 has a flat surface 321 against which the sealing ring 320 is placed. When the filter 301 is screwed fully into place, the outermost end of its attachment boss will press against the sealing ring 320 in the same manner as in prior art arrangements. Since, however, in the arrange-

ment depicted in Figure 3b there is also a sealing zone according to the invention between the outer surface of the cylindrical portion 306 and the inner surface of the attachment boss 303, a very high safety in use is achieved through this arrangement: when the filter has been screwed properly in place, the joint between it and part 302 has two sealing zones, and even if the filter were accidentally slightly unscrewed, there would still remain one sealing zone.

[0017] Figure 4 shows as a partial cross-section a modular blower part 400, which is made up of a blower module 401, a suction duct module 402, and filters 403 and 404. The suction duct module 402 is attached to the blower module 401 by the blower module being pushed partly inside the cylindrical connection portion 405 in the suction duct module and by a band 406 being tightened around the connection portion 405 and the blower module portion inside it. The connection portion 405, the band 406 and the outer surface of the blower module 401 may have a hole for the hose leading to the face mask of the respiratory apparatus; for the sake of clarity, the hose and the hole are not shown in the figure. On the other hand, it is also possible to form an attachment point for the hose at a point in the blower module which will not come inside the connection portion 405, in which case the connection portion 405 and the band 406 need not have a hole for it. When the blower module 401 and the suction duct module 402 have been attached to each other, the cylindrical portion 407 in the blower module has been pushed inside the suction duct 408 in the suction duct module. Between the outer surface of the cylindrical portion 407 and the inner surface of the suction duct 408 there is formed a joint the tightness of which can, when so desired, be improved by placing in the groove 409 encircling the outer surface of the cylindrical portion 407 an O-ring 410 made of an elastic material.

[0018] The suction duct module 402 has attachment sites for two filters 403 and 404. The filter 403 and the seals used for attaching it are shown detached, and the filter 404 and the seals used for attaching it are shown attached. The structure of the attachment sites is similar to that in Figure 3b, i.e. each attachment site has a female thread into which the male thread of the attachment boss of the filter fits, and a cylindrical portion which will extend inside the attachment boss of the filter when the filter is screwed in place, an O-ring 411, 412 having been placed in the groove encircling the outer surface of the cylindrical portion. The joints between the suction duct module 402 and the filters 403 and 404 are sealed by the O-ring 411, 412 and additionally - when the filters are properly screwed in place - by the prior-art sealing ring 413, 414.

[0019] Figure 5 shows as a partial cross-section the attachment of a filter 403, in the manner according to the invention, directly to the blower module 401. The attachment boss 303 of the filter 403 is simply pushed over the cylindrical portion 407 in the blower module 401, whereupon the O-ring 410 placed in the groove 409 encircling the outer surface of the cylindrical portion 407 will seal

the joint between the filter and the blower module. The purpose of the cylindrical portion 407 is to direct air to the impeller or corresponding pumping means which is in the blower module and which, rotated by an electric motor, pumps the air to the face mask of the respiratory apparatus. The combination between the blower module and the filter, wherein the attachment boss 303 of the filter is pushed over the cylindrical portion 407, would not in itself require any other parts. For the firmness of the joint it is, however, preferable that the arrangement additionally includes a support part 501, which has a female thread 502 fitting the male thread of the attachment boss of the filter, and which can be attached to the blower module 401 by an arrangement based on a tightening band 406, similar to that described above in connection with Figure 4 with reference to the attachment of the suction duct module 402 to the blower part 401. It is clear that it would also be possible to add to the arrangement according to Figure 5 a prior art seal, for example by forming at the inner end (in the figure, the left end) of the cylindrical portion of the blower module 401 a flat surface against which the prior art sealing ring would be placed.

[0020] Since in the arrangement according to the invention the sealing is not produced at the outermost end of the attachment boss of the filter, and since the tightness of the joint between the filter and the rest of the respiratory apparatus is not dependent on the axial movement of the attachment boss of the filter (movement in the orientation of the central axis of the attachment thread), that part (most preferably the suction duct module or the support part according to Figure 5) of the respiratory apparatus which has a female thread for the attachment of the filter can be shaped in a manner deviating from prior art. Above there was mentioned the prior art DIN 3182 standard, according to which some of the thread of the attachment boss must remain visible even when the filter has been screwed properly into place. In the arrangement according to the invention this need not be so; the filter can be screwed in so far that the entire attachment boss disappears into the recess in the wall of which there is the female thread.

[0021] Of the last-mentioned principle there can be presented a modification according to Figure 6, in which a separate annular sealing portion 602 is formed in the support part 601 (or some other corresponding part to which the filter is screwed). When the filter 403 has been screwed fully in place, the sealing portion 602 will press against that surface 603 of the filter which faces that respiratory apparatus part to which the filter is attached. An arrangement such as this effectively prevents the accumulation of dirt and dust in the area of the attachment boss of the filter. Figure 6 also shows how a prior art sealing ring 320 is added to an arrangement in which the filter is directly connected to the blower module.

[0022] The frame material of filters is most commonly injection-molded polypropylene. In a modular blower unit the frame material of the blower module is most commonly fiberglass-reinforced injection-molded polypropyl-

ene. The suction duct module may be of some more resilient material, such as polyurethane, which has been shaped, for example, by casting. Advantages derived from the selection of the materials are described, for example, in the same applicant's Finnish patent application number 972931. However, the DIN 3182 standard requires that the thread by which the filter is attached to some other part of the respiratory apparatus meets, among others, certain rigidity requirements. For this reason, during manufacture it has been necessary to connect to a suction duct module prepared from a soft material, such as polyurethane, an insert comprising the threads, which insert is made, for example, of injection-molded polypropylene. According to the present invention, the sealing in the attachment of the filter is not dependent on the rigidity of the thread, and thus the use of inserts can, at least in part, be forgone. For example, in the arrangement shown in Figure 5, the support part 501 may in its entirety be made of polyurethane. Plastic parts manufactured entirely of the same material are advantageous in terms of both the manufacturing techniques and recyclability.

[0023] The invention can be modified in various ways without deviating from the protective scope of the patent claims presented below. For example, the invention does not presuppose that the inner surface of the attachment boss of the filter have the shape of a straight circular cylinder; it may be slightly conical so that the inner diameter of the attachment boss is at its maximum at the outermost end of the attachment boss and decreases towards the inner end of the attachment boss. By this there is achieved the advantage that it is easier to guide the filter into its place. On the other hand, at the same time some of the advantageous features of the invention will be lost, since an attachment boss having a conical inner surface becomes sealed against an O-ring on the surface of the cylindrical portion, coming inside it, in the best possible manner only when the filter has been screwed properly in place. Also in the suction duct module or the blower module the cylindrical portion which, when the filter is being attached, pushes inside the attachment boss of the filter may have a shape other than cylindrical; the invention presupposes only that a sufficiently large proportion of it fits inside the attachment boss of the filter so that the sealing zone can be formed. The said cylindrical portion is called cylindrical only so that it would have a certain consistent and unambiguous name. Also, the invention does not presuppose that the outer surface of the attachment boss of the filter have a thread according to the DIN 3182 standard, or that the outer surface of the attachment boss have any thread, but since filter manufacturing lines are typically equipped to form a thread on the outer surface of the attachment boss of a filter, it is advantageous in terms of manufacturing techniques that the arrangement according to the invention allows the presence of a thread similar to that in prior art arrangements.

Claims

1. An arrangement for attaching a filter (301, 403, 404) to a respiratory apparatus, the arrangement comprising a respiratory apparatus and a filter, in which arrangement the filter comprises an attachment boss (303) having a threaded outer surface and a smooth inner surface, **characterized in that** the arrangement comprises:
 - in that part (302, 402, 401) of the respiratory apparatus to which the filter is to be attached a smooth cylindrical portion (306, 407) having an outer diameter smaller than the inner diameter of the attachment boss,
 - means (308, 411, 412, 410) for forming a sealing zone between the outer surface of the said cylindrical portion and the inner surface of the said attachment boss,- on the outer surface of the attachment boss of the filter a male thread (304) and
 - in that part of the respiratory apparatus to which the filter is to be attached a female thread (305) which is concentric with the said cylindrical portion (306) and into which the said male thread fits mechanically.
2. An arrangement according to Claim 1, **characterized in that**
 - that part of the respiratory apparatus to which the filter is to be attached comprises a blower module and a support part (501, 602) that comprises said female thread (502) into which the said male thread fits mechanically.
3. An arrangement according to Claim 2, **characterized in that** it additionally comprises means for attaching the blower module (401) and the support part (501, 601) to each other in a position in which the said female thread (502) and the said cylindrical portion (407) are located concentrically relative to each other.
4. An arrangement according to Claim 1 or 2, **characterized in that** the said male thread is a thread according to the DIN 3182 standard, such that the length of the threaded boss of the filter must be such that, when the filter is screwed in place, some of the thread remains visible.
5. A method for attaching a filter to a respiratory apparatus, **characterized in that** in the method there is formed a sealing zone (308, 411, 412, 410) between the smooth outer surface of a cylindrical portion (306, 407) in that part (302, 401, 402) of the respiratory apparatus to which the filter is attached and the smooth inner surface of an attachment boss (303)

in the filter, said smooth outer surface of said cylindrical portion (306, 407) having an outer diameter smaller than the inner diameter of the attachment boss, and that the attachment between the filter (403) and that part of the respiratory apparatus to which the filter is attached is additionally supported by screwing a male thread (304) on the outer surface of the said attachment boss into a female thread (305) mechanically mating with it.

Patentansprüche

1. Anordnung zum Anbringen eines Filters (301, 403, 404) an einem Atemgerät, wobei die Anordnung ein Atemgerät und ein Filter enthält und in dieser Anordnung das Filter einen Anbringungsansatz (303) enthält, der eine Gewindeaußenoberfläche und eine glatte Innenoberfläche hat, **dadurch gekennzeichnet, dass** die Anordnung enthält:
 - in dem Teil (302, 402, 401) des Atemgerätes, an dem das Filter angebracht werden soll, einen glatten Zylinderabschnitt (306, 407), dessen Außendurchmesser kleiner ist als der Innendurchmesser des Anbringungsansatzes,
 - Einrichtungen (308, 411, 412, 410) zum Ausbilden einer Dichtungszone zwischen der Außenoberfläche des Zylinderabschnittes und der Innenoberfläche des Anbringungsansatzes,
 - auf der Außenoberfläche des Anbringungsansatzes des Filters ein Außengewinde (304) und
 - in dem Teil des Atemgerätes, an dem das Filter anzubringen ist, ein Innengewinde (305) das mit dem zylindrischen Abschnitt (306) konzentrisch ist und in den das Außengewinde mechanisch passt.
2. Anordnung nach Anspruch 1, **dadurch gekennzeichnet, dass**
 - der Teil des Atemgerätes, an dem das Filter anzubringen ist, ein Ausblasmodul und einen Halteteil (501, 602) enthält, der das Innengewinde (502) enthält, in das das Außengewinde mechanisch passt.
3. Anordnung nach Anspruch 2, **dadurch gekennzeichnet, dass** sie zusätzlich Einrichtungen zum Anbringen des Ausblasmoduls (401) und des Halteteils (501, 601) aneinander in einer Position enthält, in der das Innengewinde (502) und der zylindrische Abschnitt (407) relativ zueinander konzentrisch angeordnet sind.
4. Anordnung nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** das Außengewinde ein Gewinde gemäß dem Standard DIN 3182 ist, so dass die

Länge des Gewindeansatzes des Filters derart beschaffen sein muss, dass, wenn das Filter an Ort und Stelle geschraubt ist, ein Teil der Gewindegänge sichtbar bleibt.

5. Verfahren zum Anbringen eines Filters an einem Atemgerät, **dadurch gekennzeichnet, dass** bei dem Verfahren eine Dichtungszone (308, 411, 412, 410) zwischen der glatten Außenoberfläche eines zylindrischen Abschnittes (306, 407) in dem Teil (302, 401, 402) des Atemgerätes, an dem das Filter angebracht wird, und der glatten Innenoberfläche eines Anbringungsansatzes (303) in dem Filter ausgebildet wird, wobei die glatte Außenoberfläche des zylindrischen Abschnittes (306, 407) einen Außendurchmesser hat, der geringer ist als der Innendurchmesser des Anbringungsansatzes, und dass die Anbringung zwischen dem Filter (403) und dem Teil des Atemgerätes, an dem das Filter angebracht wird, zusätzlich **dadurch** gehalten wird, dass ein Außengewinde (304) auf der Außenoberfläche des Anbringungsansatzes in ein Innengewinde (305) geschraubt wird, das mechanisch zu diesem passt.

Revendications

1. Agencement pour fixer un filtre (301, 403, 404) à un appareil respiratoire, l'agencement comprenant un appareil respiratoire et un filtre, dans lequel l'agencement du filtre comprend un bossage de fixation (303) ayant une surface extérieure filetée et une surface intérieure lisse, **caractérisé en ce que** l'agencement comprend :

dans la partie (302, 402, 401) de l'appareil respiratoire à laquelle le filtre doit être fixé, une partie cylindrique lisse (306, 407) ayant un diamètre extérieur plus petit que le diamètre intérieur du bossage de fixation, un moyen (308, 411, 412, 410) pour former une zone d'étanchéité entre la surface extérieure de ladite partie cylindrique et la surface intérieure dudit bossage de fixation, sur la surface extérieure du bossage de fixation du filtre, un filetage mâle (304) et dans la partie de l'appareil respiratoire à laquelle le filtre doit être fixé, un taraudage femelle (305) concentrique avec ladite partie cylindrique (306) et dans lequel ledit filetage mâle s'ajuste mécaniquement.

2. Agencement selon la revendication 1, **caractérisé en ce que**

la partie de l'appareil respiratoire à laquelle le filtre doit être fixé comprend un module de soufflage et une partie support (501, 602) comprenant ledit taraudage femelle (502) dans lequel ledit filetage mâle

s'ajuste mécaniquement.

3. Agencement selon la revendication 2, **caractérisé en ce qu'il** comprend de plus un moyen pour fixer l'un à l'autre le module de soufflage (401) et la partie support (501, 601), dans une position dans laquelle ledit taraudage femelle (502) et ladite partie cylindrique (407) sont disposés de manière concentrique l'un par rapport à l'autre.
4. Agencement selon la revendication 1 ou 2, **caractérisé en ce que** ledit filetage mâle est un filetage conforme à la norme DIN 3182, tel que la longueur du bossage fileté du filtre doit être telle que lorsque le filtre est vissé en place, une partie du filetage reste visible.
5. Procédé de fixation d'un filtre à un appareil respiratoire, **caractérisé en ce que** dans le procédé, est formée une zone d'étanchéité (308, 411, 412, 410) entre la surface extérieure lisse d'une partie cylindrique (306, 407) dans la partie (302, 401, 402) de l'appareil respiratoire à laquelle le filtre est fixé et la surface intérieure lisse d'un bossage de fixation (303) dans le filtre, ladite surface extérieure lisse de ladite partie cylindrique (306, 407) ayant un diamètre extérieur plus petit que le diamètre intérieur du bossage de fixation et **en ce que** la fixation entre le filtre (403) et la partie de l'appareil respiratoire à laquelle le filtre est fixé est supportée de plus par vissage d'un filetage mâle (304) sur la surface extérieure dudit bossage de fixation dans un taraudage femelle (305) couplé mécaniquement avec celui-ci.

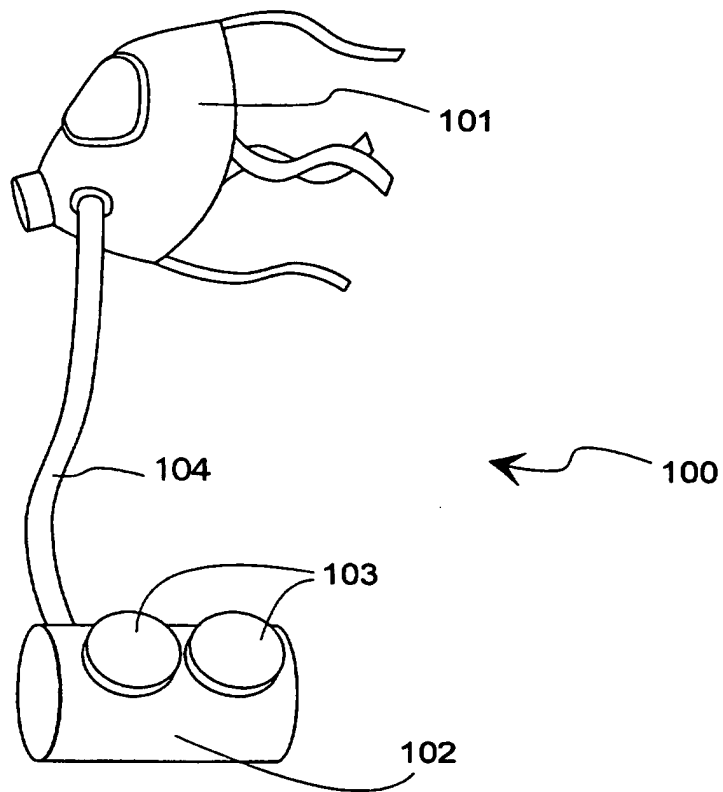


Fig. 1
PRIOR ART

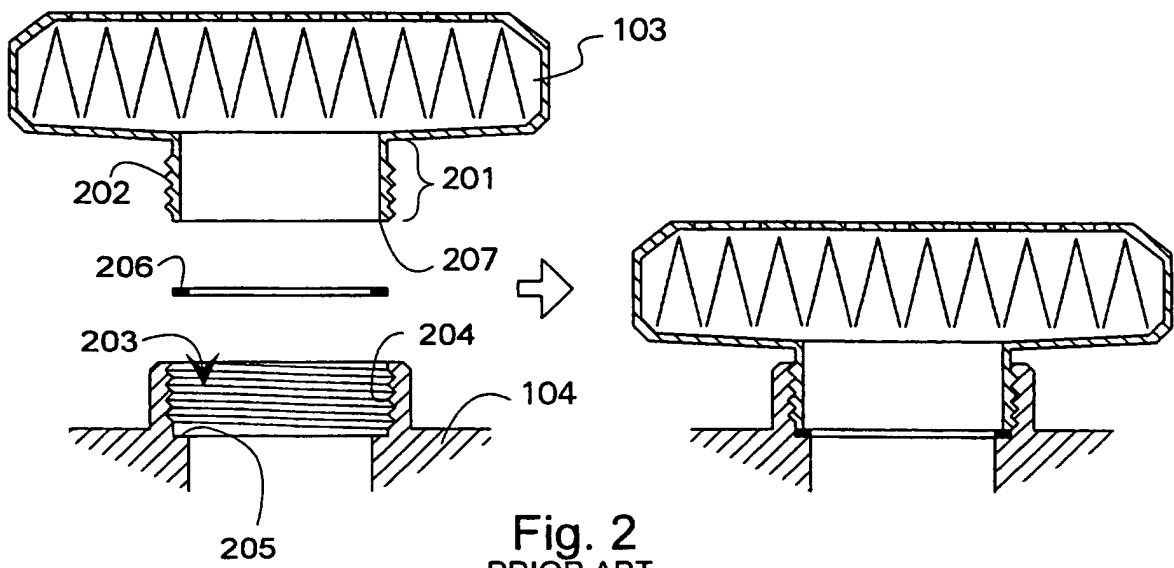


Fig. 2
PRIOR ART

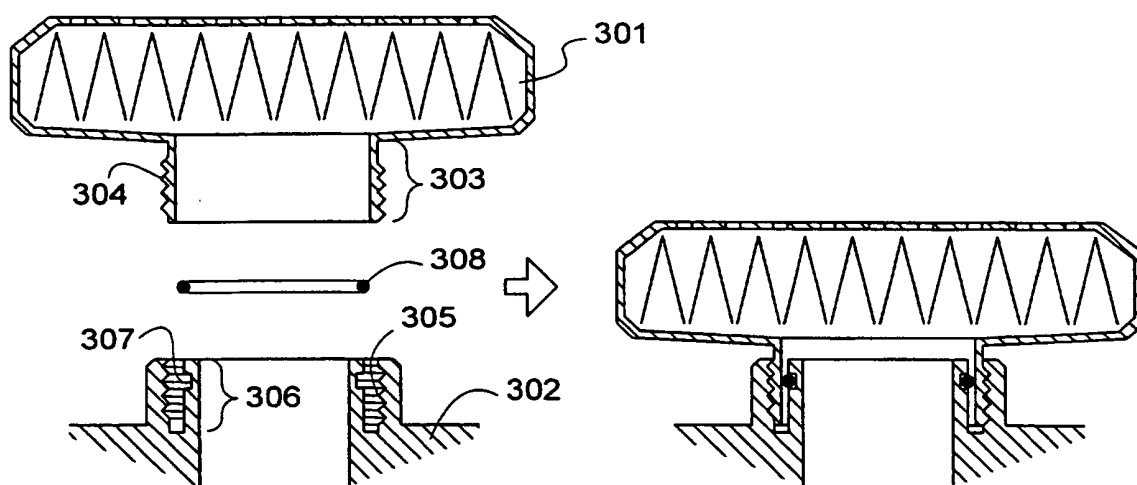


Fig. 3a

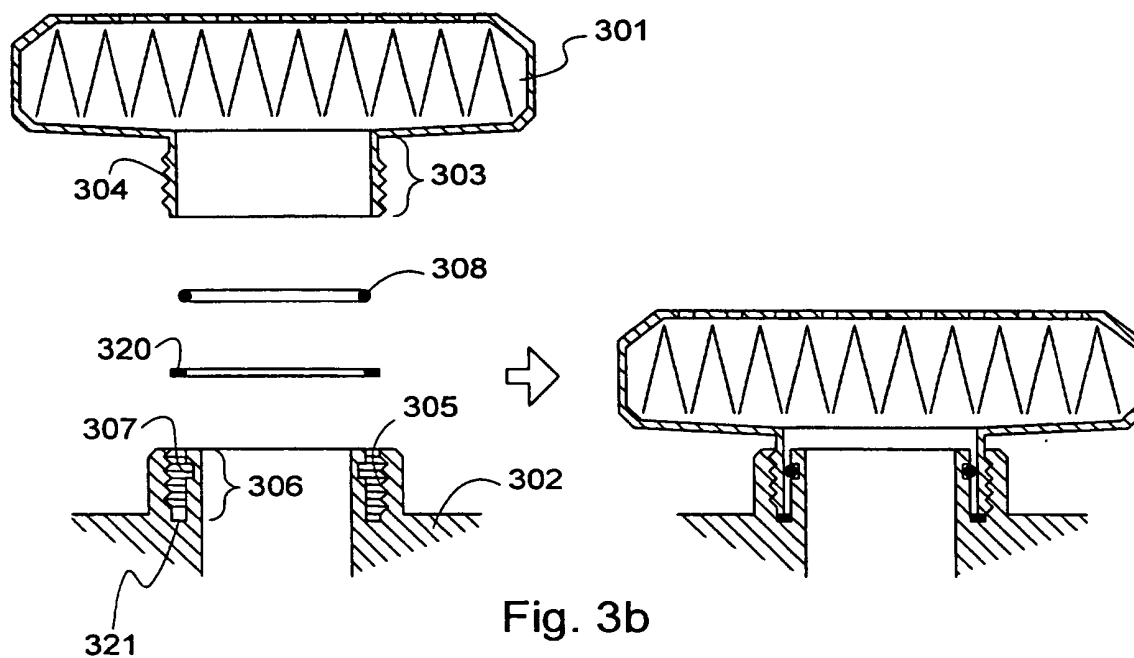


Fig. 3b

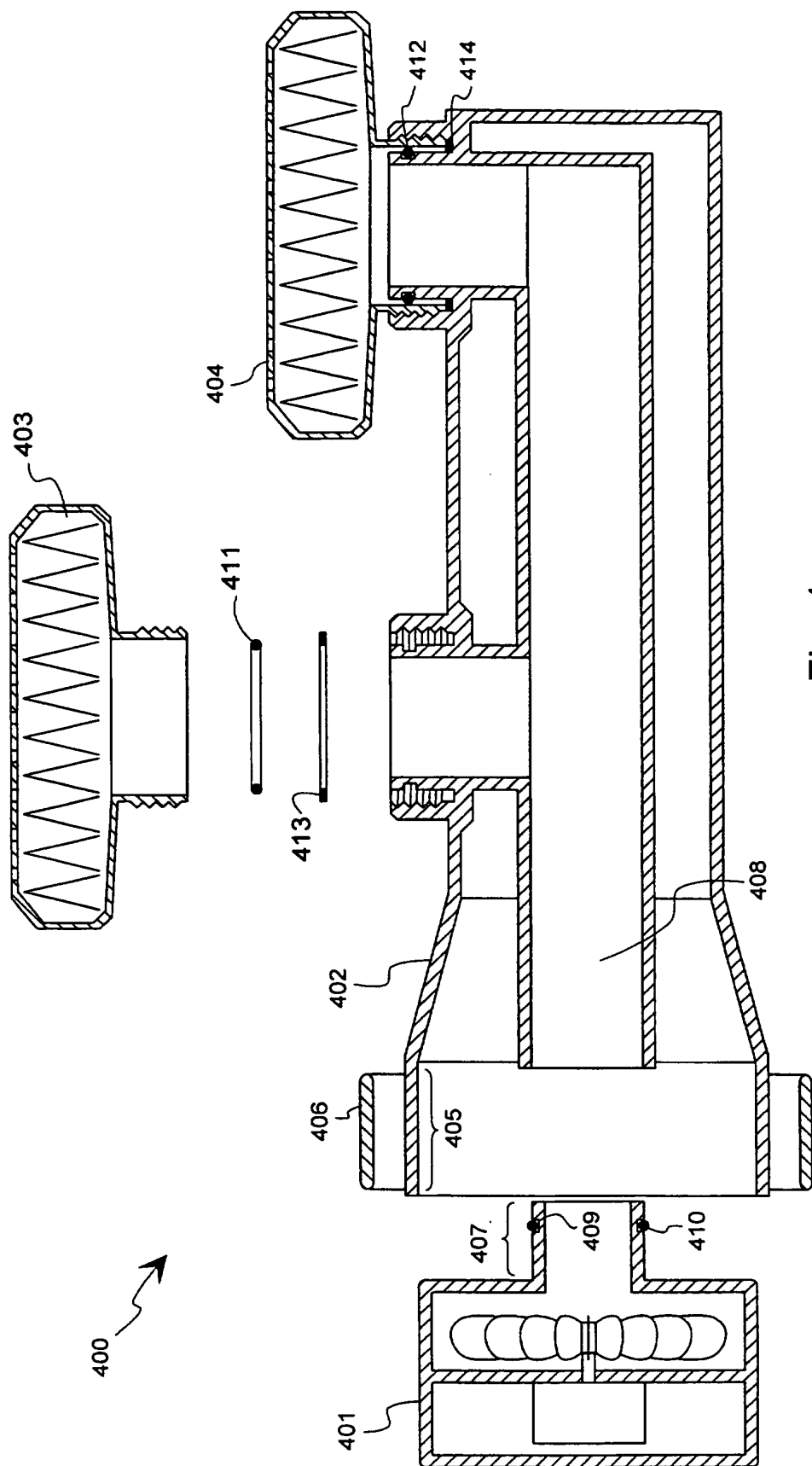


Fig. 4

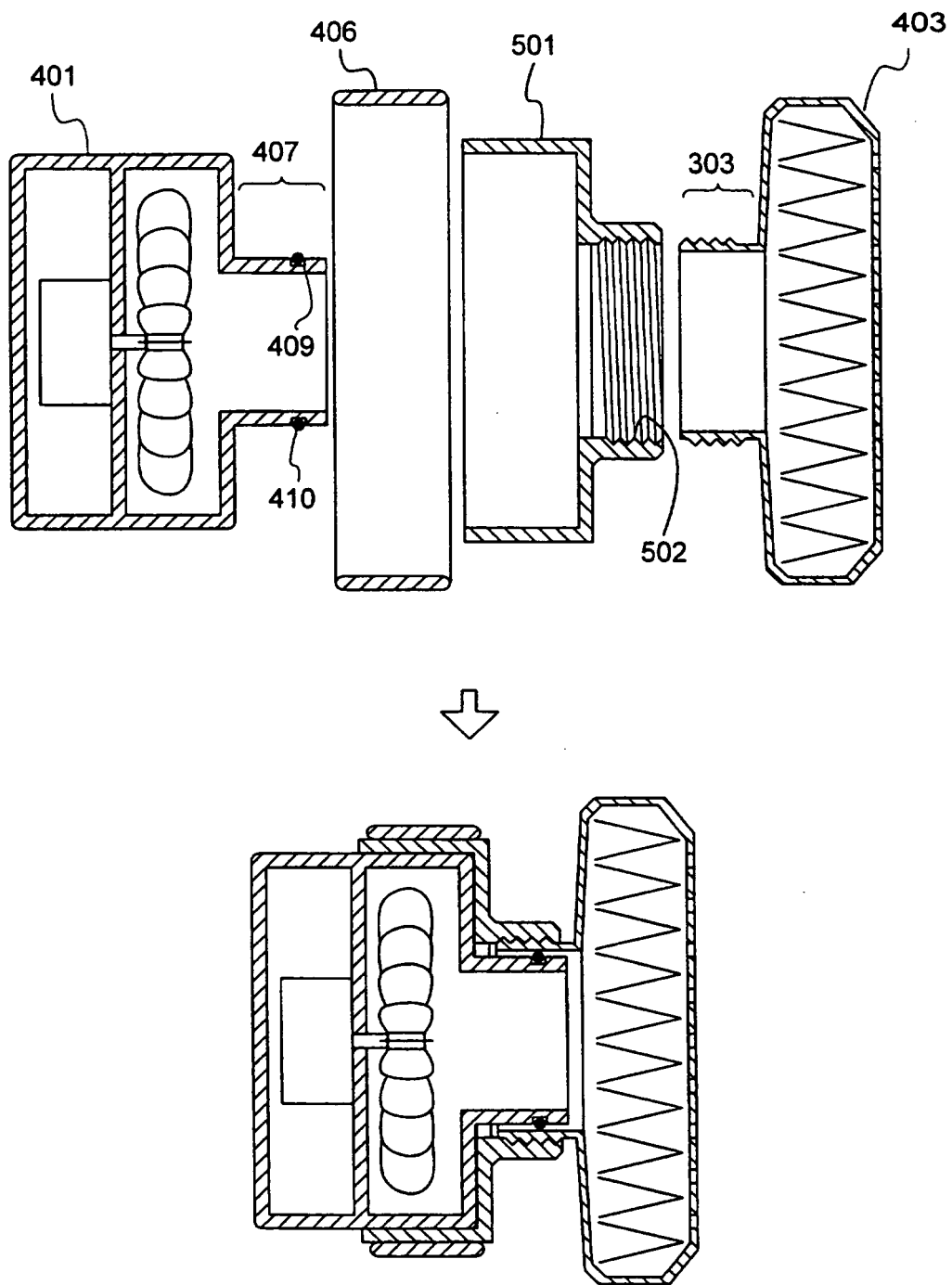


Fig. 5

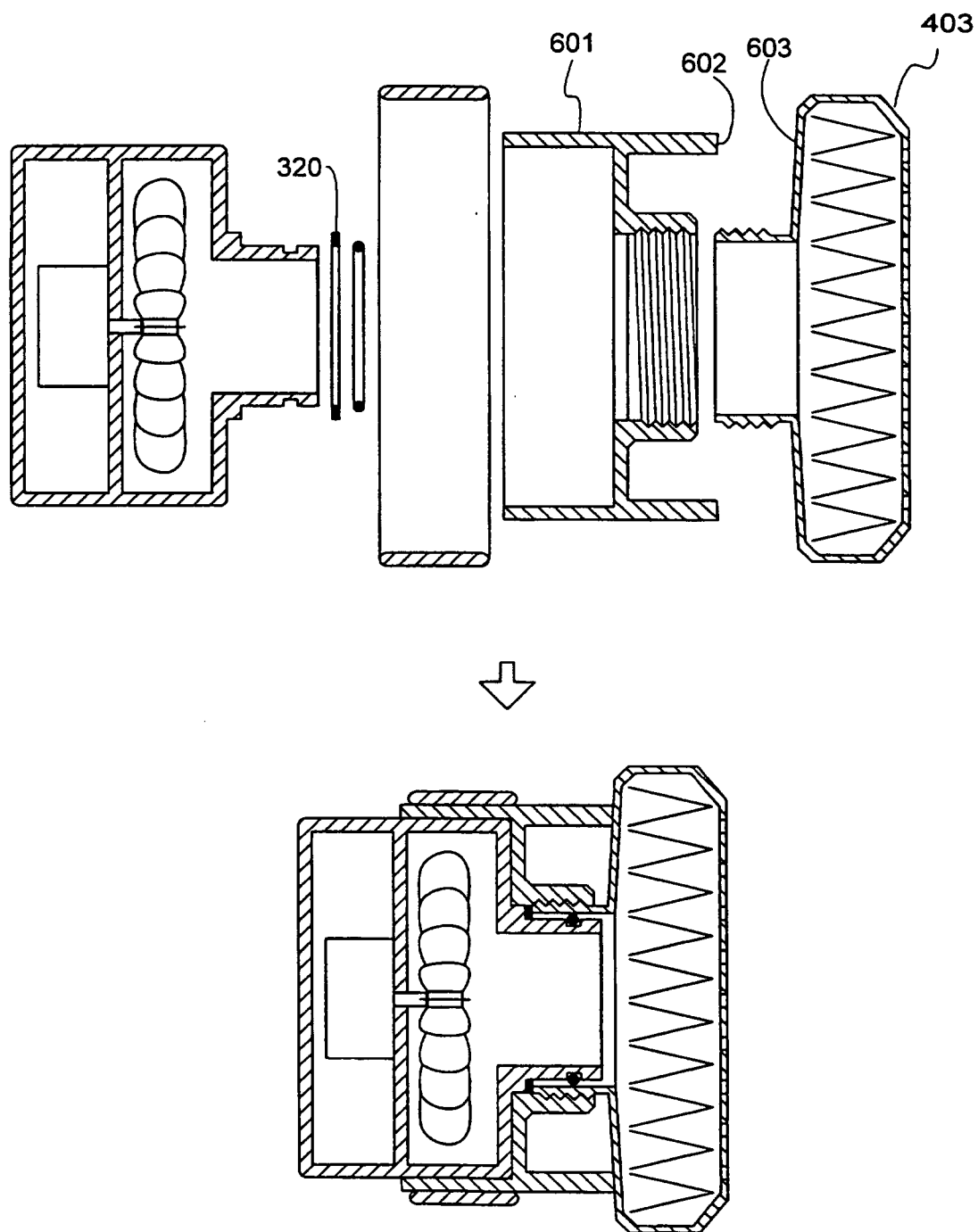


Fig. 6

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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- EP 090083 A **[0005]**
- EP 394139 A **[0005]**
- DE 748953 **[0005]**
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- FI 972931 **[0022]**