



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
14.06.2017 Bulletin 2017/24

(51) Int Cl.:
A62B 7/02 (2006.01) **A62B 9/00 (2006.01)**
A62B 17/00 (2006.01) **A62B 17/04 (2006.01)**

(21) Application number: **16203303.9**

(22) Date of filing: **09.12.2016**

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

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(30) Priority: **10.12.2015 GB 201521747**

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(54) **AIR SUPPLY INLET ASSEMBLY**

(57) An air supply inlet assembly (100) for a protective garment, wherein the assembly comprises a chamber through which an air supply is arranged to pass towards an inner part of the suit, the chamber including a first conical portion (12) which is at least in part conical, and air arranged to pass through a sub-chamber (24) de-

fined internally of and at least in part by the first conical portion, exiting the sub-chamber via an outlet of the sub-chamber, wherein the first conical portion, serving in use, to at least in part attenuate the sound of inflowing air.

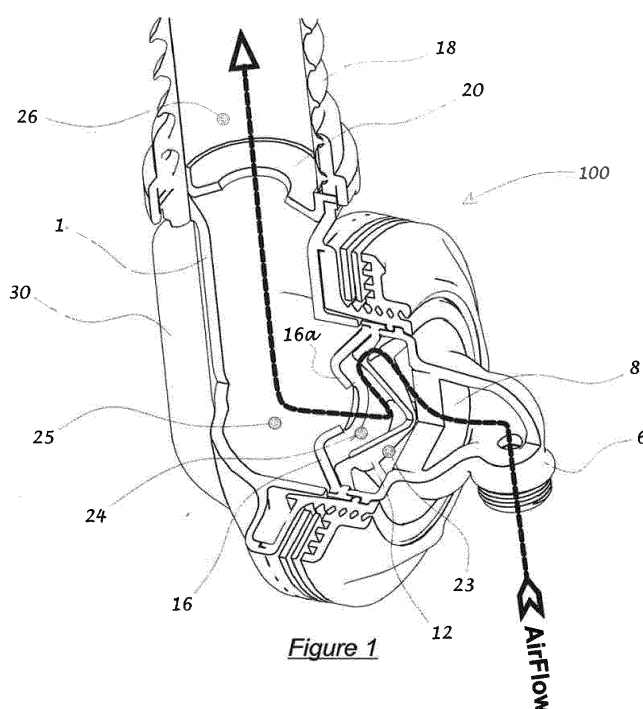


Figure 1

Description

Technical Field

[0001] The present invention relates to air supply inlets, in particular, although not exclusively, for protective garments. By "protective garments" we include, for example, hoods, blouses, full suits and half suits.

Background

[0002] In the field of chemical and biological hazard protection, personal protective equipment is known in the form of protective suits or garments. These are items of protective clothing fabricated from specific materials which are used to protect against harmful agents in a particular environment. Selecting the correct protective clothing is important to minimise the risk to the individuals working in a chemically or biologically hazardous environment. Such protective garments fully or partially encapsulate the wearer whilst typically providing a large transparent panel to allow vision for the user. Such protective garments are sometimes referred to as HAZMAT suits (Hazardous Material) suits and the material used for fabrication of these suits typically comprises an impermeable whole body garment. The suits are often used with self-contained breathing apparatus to ensure a supply of safe breathable air to the wearer. The air supply may be provided by way of a vessel or container of compressed air which the wearer would carry on his person externally of the protective suit. Typically, the head region of such protective suits is oversized relative to the spatial envelope of a wearer's head. Whilst this provides a less constrained and intrusive space for the user, the sound of the flow of air into the suit can be amplified in the head space. This can result in high noise levels which on one part may be unpleasant for the wearer and for another part may be detrimental to a wearer's auditory wellbeing as well as impairing communication for the wearer.

[0003] We have devised an improved air supply inlet assembly, which in one embodiment advantageously reduces the sound levels experienced by a wearer of a protective suit, resulting from the flow of incoming air.

Summary

[0004] According to the first aspect of the invention there is provided an air supply inlet for a protective garment, wherein the air supply inlet assembly comprises a chamber through which an air supply passes towards an inner part of the suit, the chamber may include a first conical portion which is at least in part conical, the first conical portion presents to the incoming air and is directed towards the incoming air supply, and air arranged to pass through a sub-chamber defined internally at least in part by the first conical portion, exiting the sub-chamber via an exit of the sub-chamber.

[0005] More generally, the first conical portion and the

second conical portion may be considered as defining a sound attenuation sub-chamber within the chamber of the air inlet assembly, the sound attenuation sub-chamber comprising an air inlet and an air outlet, and said inlet and outlet being offset from each other, with respect to an air flow path through the sub-chamber when viewed in the direction of air entering the sub-chamber, and preferably a central longitudinal axis of the sound attenuation sub-chamber, the inlet and the outlet are generally at different radial positions, such as radially inner (substantially central) position and a radially outer portion (and vice versa). The sound attenuation sub-chamber preferably comprises one or more internal wall surfaces which define the sub-chamber space.

[0006] The assembly may comprise one or more features as described in the detailed description and/or as shown in the drawings.

Brief Description of the Drawings

[0007] Various aspects of the invention will now be described by way of example only, with reference to the following drawings in which:

Figure 1 is a rear perspective part-sectional view of an air inlet assembly,

Figure 2 is a perspective view of a dual-cone sub-assembly and of a transitional cone component of the air supply inlet of Figure 1,

Figure 3 is an exploded perspective view of the dual cone sub-assembly, and

Figure 4 is a perspective exploded dual-cone sub-assembly view of the air supply inlet.

Detailed Description

[0008] With reference to the figures, there is shown an air inlet assembly 100, which may also be referred to as a pass-thru device. The air inlet assembly 100 is arranged for use with a protective suit, as worn by a user in an environment where there is a human health hazard such as a chemical or bio-hazard incident, for example. Such suits are made of a non-porous material, such as fabric, to protect a wearer of the suit from harmful substances in the environment. The air inlet assembly 100 is arranged to be secured to such protective suits so as to allow a breathable air supply to be provided to the wearer. As will be explained in more detail below, the air inlet assembly 100 advantageously reduces noise levels due to the airflow entering in to the protective suit, and so safeguards the user's aural comfort and wellbeing whilst wearing the suit.

[0009] The air inlet assembly 100 comprises an inlet portion and an outlet portion. The inlet portion comprises a spigot-type structure 6, and the outlet portion 1 com-

prises a hose attachment 22 which comprises a tubular collar (and an associated clip nut 21). The hose attachment 22 is arranged to receive and secure a length of hose 18, and wherein the hose 18 carries the air supply to the uppermost, head region of the suit. In use, a clean compressed air supply is connected to the inlet 6, which is conveniently provided with a threaded portion 27 to facilitate connection of a clean air supply conduit thereto, and the air fed into the inlet assembly passes through towards the outlet 1 and upwardly in the hose 18.

[0010] In the inlet 6 there is provided an insert 7 (which is used if airflow is required to be limited) which comprises a through-hole to allow air to pass therethrough. The inlet 6 is arranged at substantially 90° in order to direct the air into a chamber of the assembly 100. It will be appreciated that the inlet 6 is arranged to be swivelled to a required orientation, and the O-ring 9 maintaining an airtight seal. Within the chamber of the assembly 100 there is provided a disc component 8, which is made of a porous material. The porous disc 8 serves to provide both air flow control as well as noise control. Having passed through the porous disc 8 the air then progresses towards what may be termed a dual cone arrangement.

[0011] The dual cone arrangement comprises a first cone component 12 and a second cone component 16. Between the porous disc 8 and the first cone component 12, there is defined a sub-chamber 23. The first cone component comprises an apex portion directed towards the porous disc 8 and is orientated accordingly. The first cone component 12 provided at its periphery with a series of through-holes, and may be termed a webbed cone. Accordingly, the first cone 12 comprises a centrally located solid conical portion, and circumferentially distributed apertures. The apertures allow air to pass into a sub-chamber 24 which is defined by and located between the first cone component and the second cone component. Aside from the through-holes provided in the first cone component, the first cone component 12 is substantially non-porous. An outer surface of the first cone component 12 together with an inner surface of the first cone component 12 are provided with a fabric comprising matted fibres, and in particular a felt like material. The felt-like material advantageously provides noise attenuation. The coverings are shown in Figure 3 with reference numerals 13 and 11, and are provided on both sides of the central cone 12.

[0012] Referring now to the second cone component 16, this comprises an essentially (hollow) frusto-conical feature which is substantially oppositely orientated relative to the first cone component. The second cone component 16, broadly, comprises a cone which has been truncated by way of the provision of a central through-hole 16b. The through-hole is arranged to allow air to pass freely therethrough. The through-hole 16b is of substantially circular shape. An inner surface of the second cone component 16 is provided with a covering of a felt-like textile, in order to enhance sound attenuation properties. This covering is shown by reference numeral 15

in Figure 3. It should be noted that within the sub-chamber 24 there may be provided a foam pad 14 for the purpose of noise control (as best seen in Figures 3 and 4). A further foam pad may be provided adjacent to the through-hole 16b but external of the sub-chamber 24, namely within that void in the inlet assembly 100 which leads to the outlet 1.

[0013] Further in relation to second cone component 16, this may be described as having a "reversed" configuration. In other words, an outer portion progresses from being concave to convex, as best seen in Figure 1. As is evident, an inclined annular wall 16a defines the central aperture 16b of the second cone component. The purpose of this configuration, ie changing from convex to concave, is to alter the airflow direction.

[0014] There will now be described further features of the inlet assembly 100. The means of attachment of the inlet assembly 100 to the protective suit comprises a locking nut 5 which is of substantially annular shape, the inner portion of which is provided with a threaded portion 5a which engages with a counterpart thread portion provided on a boss or protuberance 2. In use, the locking nut 5 can be manually screwed towards and away from an annular land or shoulder 2a. Typically, a circular hole would be provided in the protective suit. When securing the assembly 100 to the protective suit the boss 2 is inserted through the hole in the suit from within the suit so as to protrude through the hole and externally of the suit. This would result in a portion of the mouth of the hole provided in the suit being located on the land 2a. On manually screwing down the locking nut 5 the portion of suit material clamped between the locking nut 5 and the land 2a and thereby securing and sealing the inlet assembly 100 in position to the protective suit. Located intermediate of the nut 5 and the land 2a there are provided a rubber washer 3 and a slip washer 4.

[0015] With reference to Figure 1, the rearward portion of the inlet assembly 100 is provided with a belt loop attachment 30. The belt loop attachment 30 defines a space through which the belt (which may be inside or outside the suit) of a wearer of the protective suit may be passed and to thereby keep the inlet assembly close to the wearer's body. In particular this avoids the risk of any part of the externally located part or component of the inlet assembly 100 becoming caught on an external item such as exterior hazards and then the inlet 100 becoming detached. The belt loop attachment 30 also provides ergonomic comfort to the wearer.

[0016] In use, the airflow entering the chamber 23 through the disc 8 comes directly into contact with the first medium covering 11 on cone component 12 and is channelled towards its outer perimeter. When the airflow leaves the convex side of the cone 12 it is forced to come into contact with the medium 15 on the cone component 16. The circumferential through holes in the cone 12 in conjunction with its position on the cone 16 channel the airflow between each covering medium limiting the amount of noise passing through from chamber 23 to

chamber 24. Connecting ribs 12a of the first cone component have been designed for strength to maintain the cone function between filter disc 8 and the cone component 16. The "reverse" cone component 16 channels the airflow to the cover medium 13 on the concave side of cone component 12. The airflow will then bounce away from cone component 12 and exit through the centre hole of cone component 16 into the chamber 25. The dual cone arrangement advantageously focusses airflow exiting the same towards a central region of the foam pad 17, which provides a steady noise reduction as the airflow rate increases.

[0017] The transition between sub-chamber 25 downstream of the double cone arrangement and sub-chamber 26 inside of the tube also plays a role in sound attenuation enhancement. When the airflow reaches the chamber 25, it has been filtered and is ready to be delivered to the user's hood but needs also to travel through the flexible hose 18 which could create noise. A transitional cone 20 is provided with its concave shape directed towards the tube 18, focusses the airflow towards the centre 26 of the hose where noise cannot travel quickly. The added cover medium 19 on the underside of the cone 20 concave face further filters noise coming from the chamber 25.

[0018] The cones' relative orientation has been chosen to ensure minimal airflow restriction while channelling it through each chamber. Maintaining efficient airflow not only ensures noise control but also advantageously allows the system to use a minimal inlet pressure to achieve a Manufacturer's Minimum Design Flow (MMDF).

[0019] The covering mediums 11, 13, 15 and 19 used on all three cone components comprise a soft brush material which has inconsistent physical properties (disruptive) unlike a solid. Sound waves will travel quickly through solids which means that the medium's function is sound attenuation by refraction/dispersion within the sub-chamber.

[0020] The "dual cone arrangement" and "transitional cone" advantageously provide sound reflection limitation using a sequence of events from source to observer. These events/limiter functions may be summarised as:

- Acoustic absorption through deadening material (cover medium)
- Focus of airflow by cone design
- Trapping sound by filtering noise through four sub-chambers 23, 24, 25 and 26, with the air inlet assembly 100 being considered as comprising an overall chamber divided into those multiple sub-chambers.

Claims

1. An air supply inlet assembly for a protective garment, wherein the assembly comprises a chamber through which an air supply is arranged to pass towards an

inner part of the suit, the chamber including a first conical portion which is at least in part conical, and air arranged to pass through a sub-chamber defined internally of and at least in part by the first conical portion, exiting the sub-chamber via an outlet of the sub-chamber, wherein the first conical portion, serving in use, to at least in part attenuate the sound of inflowing air.

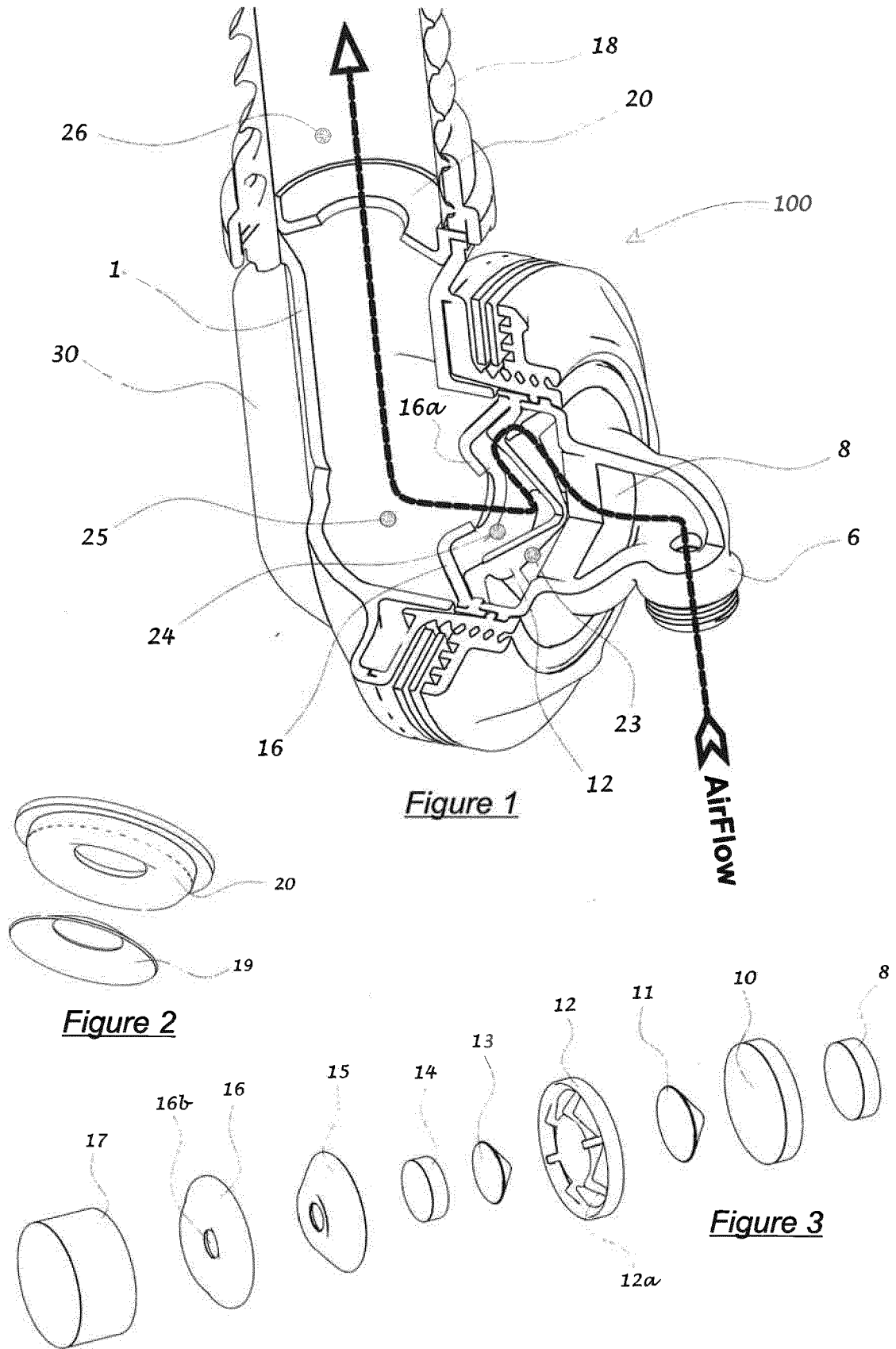
2. An air supply inlet assembly as claimed in claim 1 in which an internal surface of the first conical portion is substantially conical, wherein the internal surface at least in part defines the space of the sub-chamber.
3. An air supply inlet assembly as claimed in claim 1 or claim 2 in which an external surface of the first conical portion is substantially conical.
4. An air inlet assembly as claimed in claim 3 in which the first conical portion is directed towards the incoming air supply.
5. An air inlet assembly as claimed in any preceding claim in which the first conical portion is arranged to be upstream of the incoming air supply, and wherein an external surface of the first conical portion arranged to present to the incoming air supply.
6. An air supply inlet as claimed in any preceding claim in which the first conical portion comprises an apex region, and wherein the apex region is directed towards the direction of incoming air.
7. An air inlet assembly as claimed in any preceding claim comprising a second conical portion, which is at least in part conical, arranged in a substantially opposite orientation to the first conical portion.
8. An air supply inlet assembly as claimed in Claim 7 in which the second conical portion is provided with a through-hole to allow passage of air through to exit the sub-chamber.
9. An air supply inlet assembly as claimed in Claim 8 in which the through-hole is provided at an apex or substantially centralised region of the second conical portion.
10. An air supply inlet as claimed in any preceding claim in which the second conical portion comprises a fibrous textile or material on an outer surface.
11. An air supply inlet claimed in either claim 6 or claim 7 in which the fibrous textile or material comprises felt.
12. An air supply inlet as claimed in any preceding claim in which the second cone portion comprises a con-

cave portion and a convex portion, wherein the convex portion is directed with the sub-chamber.

13. An air supply inlet assembly as claimed in claim 12 in which an aperture is provided in the convex portion. 5
14. An air supply inlet as claimed in any preceding claim in which at least one of the first conical portion and the second conical portion is substantially non-porous. 10
15. An air supply inlet assembly as claimed in any preceding claim in which one or more regions of the chamber comprise a portion of sound attenuating foam. 15
16. An air supply inlet assembly as claimed in any preceding claim which comprises an inlet aperture, and the inlet aperture is provided as a part of a spigot-like formation. 20
17. An air supply inlet assembly as claimed in any preceding claim which comprises an air inlet aperture and a portion of porous material, wherein the portion of porous material is located intermediate of the air inlet aperture and the first and second cone portions, relative to the flow of air. 25
18. An air supply inlet assembly as claimed in any preceding claim which comprises an attachment for securing the air supply inlet to a protective suit. 30
19. An air supply inlet assembly as claimed in claim 18 in which the attachment comprises a protuberance, an outer surface of the protuberance provided with a threaded portion, and further comprising a lock ring which is arranged to threadably engage with the threaded portion of the protuberance, and in use a region between a land which surrounds the protuberance, and the lock ring, arranged to receive a portion of a protective suit and to clamp the portion of the protective suit between the lock ring and the land. 35
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20. An air supply inlet assembly as claimed in Claim 19 in which the lock ring arranged to be rotatable on the protuberance so as to translate the lock ring towards or away from the land. 45
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21. An air supply inlet assembly as claimed in any preceding claim in which an outlet air supply inlet comprises a connector arranged for securing a tube or hose. 55
22. An air supply inlet assembly as claimed in any preceding claim which comprises an airflow focussing portion, located downstream of the sub-chamber, ar-

ranged to direct airflow substantially centrally of a conduit.

23. An air supply inlet assembly as claimed in claim 22 in which the airflow focussing portion comprises an at least in part conical portion, which is provided with an aperture.
24. An air supply inlet assembly as claimed in any preceding claim which includes one or more foam material portions substantially filling one or more cross-sectional air flow regions or pathways of the assembly.
25. An air supply inlet assembly as claimed in claim 24 in which the one or more foam material portions have sound absorbing characteristics.
26. An air supply inlet assembly as claimed in any preceding claim in which the first conical portion comprises a fibrous textile or material is provided on an outer surface and/or inner surface thereof.



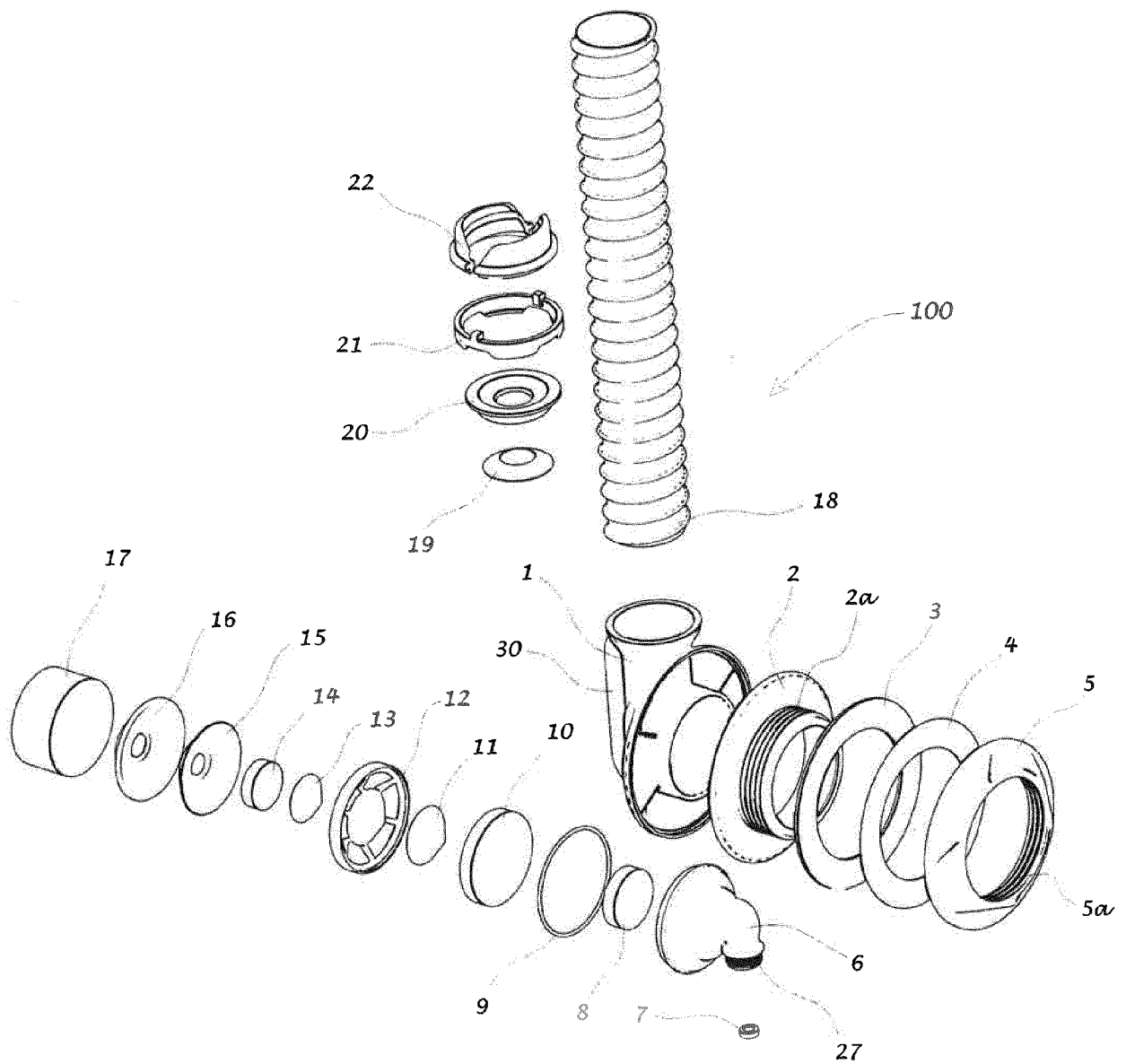


Figure 4



EUROPEAN SEARCH REPORT

Application Number
EP 16 20 3303

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Place of search The Hague		Date of completion of the search 12 April 2017	Examiner Zupancic, Gregor
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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