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(54) Title: ADAPTOR FOR CONNECTING A FILTER CARTRIDGE TO A RESPIRATOR MASK

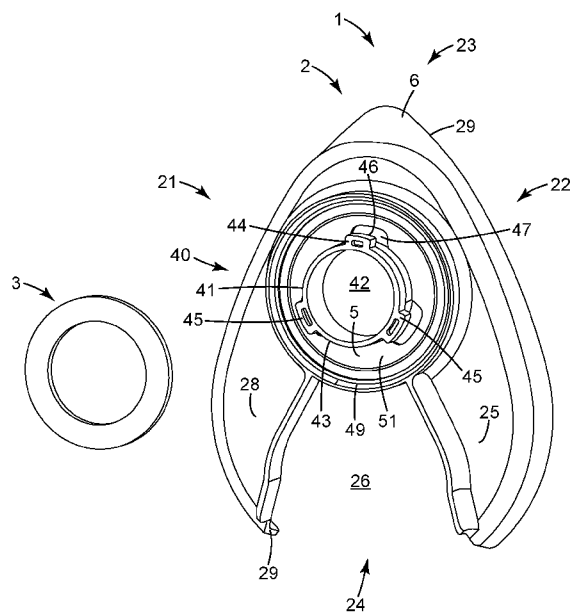


Fig. 6

(57) Abstract: An adaptor that facilitates connecting a filter cartridge with a twist fitting on a rear side thereof to a respirator mask body with a snap fitting on a front side thereof. The adaptor includes an integral, molded plastic main body with a snap-fit feature on the rear side and a twist-fit feature on the front side.



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ADAPTOR FOR CONNECTING A FILTER CARTRIDGE TO A RESPIRATOR MASK**Background**

Respiratory protection equipment is often used to protect wearers from breathing airborne
5 contaminants such as suspended particulates, odorous fumes, organic vapors, and the like. A common
personal respiratory protection device is known as a "respirator", which may be furnished to the user in either
a half-face or full-face configuration. Incoming air is commonly passed through one or more filter cartridges
to be filtered. Such respirators often use a single-cartridge configuration in which a filter cartridge is e.g.
laterally centrally located at the front of the mask; or, a dual-cartridge configuration in which a filter cartridge
10 is e.g. located on each front-side portion of the mask body (e.g. near the cheek area of a wearer of the
respirator). The filter cartridges are fluidically connectable to, and removable from, the mask body.
Complementary fittings may be are provided on the mask body and on the cartridge to facilitate this.

Summary

In broad summary, herein is disclosed an adaptor that facilitates connecting a filter cartridge with
15 a twist fitting on a rear side thereof, to a respirator mask body with a snap fitting on a front side thereof.
The adaptor comprises an integral, molded plastic main body with a snap-fit feature on the rear side and a
twist-fit-attachment feature on the front side. These and other aspects of the invention will be apparent
from the detailed description below. In no event, however, should this broad summary be construed to
limit the claimable subject matter, whether such subject matter is presented in claims in the application as
20 initially filed or in claims that are amended or otherwise presented in prosecution.

Brief Description of the Drawings

Fig. 1 is a front/side perspective view of a prior art respirator and filter cartridge, both with snap
fittings.

25 Fig. 2 is rear plan view of a prior art filter cartridge with a bayonet fitting.

Fig. 3 is a front/side perspective exploded view of an assembly comprising a respirator with a
snap fitting, a filter cartridge with a bayonet fitting, and an exemplary adaptor as disclosed herein.

Fig. 4 is a rear perspective view of the exemplary adaptor of Fig. 3.

Fig. 5 is a rear/side cross-sectional view of the exemplary adaptor of Fig. 4.

30 Fig. 6 is a front perspective exploded view of the exemplary adaptor of Fig. 3.

Like reference numbers in the various figures indicate like elements. Unless otherwise indicated,
all figures and drawings in this document are not to scale and are chosen for the purpose of illustrating
different embodiments of the invention. In particular the dimensions of the various components are
depicted in illustrative terms only, and no relationship between the dimensions of the various components
35 should be inferred from the drawings, unless so indicated.

As used herein as a modifier to a property or attribute, the term "generally", unless otherwise
specifically defined, means that the property or attribute would be readily recognizable by a person of

ordinary skill but without requiring absolute precision or a perfect match (e.g., within +/- 20 % for quantifiable properties). The term “substantially”, unless otherwise specifically defined, means to a high degree of approximation (e.g., within +/- 10% for quantifiable properties) but again without requiring absolute precision or a perfect match. Terms such as same, equal, uniform, constant, strictly, and the like, are understood to be within the usual tolerances or measuring error applicable to the particular
5 circumstance rather than requiring absolute precision or a perfect match.

Detailed Description

Glossary

As used herein, terms such as “forward” and “front” denote a direction generally away from a
10 wearer’s face and terms such as “rearward” and “rear” denote a direction generally toward a wearer’s face. (All descriptions of the herein-disclosed adaptor and a respirator with which it is used, are with reference to the respirator being fitted in position on a user’s face, unless otherwise noted). Terms such as radially “inward” and “inner” denote a direction away from the perimeter of an item (e.g. an adaptor, a respirator mask body, a cartridge, or a fitting), generally toward a central location (e.g., a geometric
15 center) of the item. Terms such as radially “outward” and “outer” denote a direction that is away from such a geometric center, e.g. toward and/or past the perimeter of the item. Terms such as “upper”, “lower”, “above”, “below”, and “vertical”, have their customary meaning. By “lateral” is meant a side-to-side direction that is generally perpendicular to the vertical axis of an adaptor and a respirator mask body (and thus to the sagittal plane of the wearer). By “axial” is meant a direction along which a fitting of one
20 item (e.g. a filter cartridge) is moved to be engaged to a fitting of another item (e.g., a respirator mask body or an adaptor). For convenience of illustration, a front-rear axis (f-r), a vertical axis (v), and a lateral axis (l) have been labeled in Fig. 1. In the depiction of Fig. 1, the axial direction will coincide with the front-rear direction (f-r).

A “snap-fit” (sometimes called a “snap-on” or “push-on”) attachment system is a system for
25 joining two items together, the two items comprising complementary fittings that are configured so that the items can be joined together by pressing the fittings together axially. A snap-fit system does not require any rotational movement of the items (thus of the fittings) relative to each other to perform the attachment.

A “twist-fit” (sometimes called a “twist-on”) system is a system for joining two items together,
30 the two items comprising complementary fittings that are configured so that the items can be joined together by a process that includes a step of rotating one of the devices through a rotational arc of at least about 25 degrees.

A “bayonet” attachment system is a particular type of “twist-fit” system for joining two items
35 together, the two items comprising complementary fittings that are configured so that the items can be joined together by pressing the fittings together axially and rotating one of the devices through a

rotational arc that is at least about 25 degrees. At least one of the fittings will comprise a central post with multiple radially-outward-protruding tabs (“bayonets”) as described in detail herein.

Respirators, e.g. a half-mask respirator 100 of the type shown in exemplary representation in Fig. 1, often comprise a mask body 120 to which at least one filter cartridge 130 can be attached. Mask body 120 is shaped to form an interior air space 123 around the nose and mouth of the wearer to separate this space from exterior air space 126 so that air that enters interior air space 123 from exterior air space 126 must pass through a filter cartridge 130. To enable filter cartridge(s) to be attached to the mask body, the mask body comprises one or more fittings, and each cartridge to be attached to the mask body comprises a complementary fitting. This allows the cartridge to be attached to the mask body so as to establish a fluidic connection between interior 223 of the cartridge and interior air space 123 of the mask body, while minimizing any chance of external (unfiltered) air leaking into the interior air space of the mask body.

In one common type of attachment system, a filter cartridge is snap-fitted to a mask body. As shown in exemplary manner in Fig. 1, a mask body 120 of a respirator 100 can comprise a snap fitting 110 and a filter cartridge 130 to be attached thereto can have a complementary snap fitting 131. (Often, one such fitting will be “male” fitting and the other will be a complementary “female” fitting.) Snap-fit attachment systems are described in detail in U.S. Patent No. 5579761 to Yuschak. As noted in the ‘761 patent, with many such systems a filter cartridge can be attached to a mask body by simply aligning the fitting of the cartridge with the fitting of the mask body and pressing the cartridge axially against the mask body, without necessitating any rotational movement of the filter cartridge and without requiring any kind of gasket or O-ring to obtain a hermetic fit between the filter cartridge and the mask body.

In another common type of attachment system, a filter cartridge is attached to a mask body by way of a “twist-fit” system. A twist-fit system is any in which two items comprise complementary fittings that are configured so that the items can be joined together by rotating one of the items relative to the other through a rotational arc of at least about 25 degrees. In some embodiments, a twist-fit system may use threaded fittings in which one item is rotated relative to the other through an arc of at least 360 degrees or more (i.e. through at least one full turn of the item). In other embodiments, a twist-fit system may use threaded fittings but may require less than a full turn, e.g. a rotation arc of from about 25 degrees to about 90, 180, or 270 degrees.

A particular type of twist-fit system is a bayonet-attachment system, as described e.g. in U.S. Patent Application Publication No. 2005/0145249 to Solyntjes. As noted in the Background of the ‘249 application, a bayonet system uses a quick rotational turn (for example 45 to 90 degrees) to attach a filter cartridge to a mask body. To facilitate this, such systems can use a set of radially-outwardly protruding tabs on one fitting (e.g. on a “male” fitting of the mask body) and a set of notches on the other fitting (e.g. on a “female” fitting of the filter cartridge). The filter cartridge is pressed axially against the mask body so that the tabs are received into the notches, after which the filter cartridge is rotated to perform the

attachment. Of course, the roles could be reversed, with the mask body bearing a female fitting with notches and the filter cartridge bearing a male fitting with tabs.

In some circumstances it may be desirable to attach a filter cartridge that has a twist fitting, e.g. a bayonet fitting, to a respirator mask body that has a snap fitting. To achieve this, the presently-disclosed adaptor is provided. In exemplary representation, Fig. 3 depicts an adaptor 1 that can be used to connect a filter cartridge 200 that has a twist fitting (in this particular embodiment, a bayonet fitting 210) on a rear side 222 thereof, to a mask body 120 of a respirator 100 that has a snap fitting 110 on a front side 121 thereof. Adaptor 1 comprises an integral, molded plastic main body 2 that comprises a front side 21, a rear side 22, an upper end 23, and a lower end 24 (as seen most easily in Figs. 4 and 6). Main body 2 may be made of any suitable thermoplastic or thermoset injection-molding resin, chosen from e.g. polyethylene, polypropylene, ethylene-propylene copolymers, polystyrene, polyamide, acrylonitrile-butadiene-styrene copolymers, polyvinyl chloride, polymethylmethacrylate, and copolymers and blends of any of these.

Rear side 22 of adaptor 1 comprises a snap-fit feature 10 that is attachable to a snap fitting 110 of a respirator mask body 120 so that the rear side 22 of the adaptor can be attached to the front side 121 of the respirator mask body 120. Front side 21 of adaptor 1 comprises a twist-fit feature (in this embodiment, a bayonet-attachment feature 40) to which is attachable a bayonet fitting 210 of a filter cartridge 200 so that the rear side 222 of the filter cartridge can be attached to the front side 21 of the adaptor 1. These arrangements can provide that when the adaptor is attached to the respirator mask body and the filter cartridge is attached to the adaptor, interior 223 of the filter cartridge is fluidly connected to the interior air space 123 of the respirator mask body by a fluid pathway that passes through the main body of the adaptor. Main body 2 of adaptor 1 comprises an annular panel 5 that defines a through-aperture 15. As discussed in detail later herein, annular panel 5 may provide a component of a snap-fit feature of rear side 22 of adaptor 1, and may also provide a component of a twist-fit (e.g. bayonet-attachment) feature of front side 21 of adaptor 1.

As shown in the rear view of adaptor 1 in Fig. 4, the snap-fit feature 10 of rear side 22 of main body 2 of exemplary adaptor 1 comprises a generally circular rim 12 that defines a generally circular, rear-facing opening 11. In specific embodiments rim 12 is a circumferentially continuous, uninterrupted circular rim. Rim 12 is forwardly undercut, by which is meant that the diameter of opening 11 defined by rim 12, varies along the front-rear axis of the adaptor so that the diameter decreases toward the rear of the adaptor. Rim 12 thus exhibits a radially-inwardly-projecting flange 13 at or near rearward end 16 of rim 12. (Flange 13 is most easily visible in the cross-sectional perspective view of Fig. 5.) Radially-inwardly-projecting flange 13 thus provides the point (along the front-rear direction of the adaptor, which corresponds to the axial direction of the snap-fit feature of the adaptor) of minimum diameter of rear-facing opening 11. The radial sides of rear-facing opening 11 are thus defined by rim 12. In at least some

embodiments, the forward end of rear-facing opening 11 is defined by annular rear surface 14 of annular panel 5 of adaptor 1 (rear surface 14 is most easily visible in Fig. 4).

Snap-fit feature 10 of adaptor 1 is configured to mate with snap fitting 110 of mask body 120 of respirator 100. In many cases, a snap fitting 110 of a respirator may comprise an axially-forwardly-projecting annular flange 112 with a radially-outwardly-protruding lip 113 located proximate a forward end 114 of flange 112 (as seen in Fig. 3). When adaptor 1 is pressed axially toward snap fitting 110 of respirator mask body 120, annular flange 112 of respirator mask body 120 can fit radially within rim 12 of snap-fit feature 10 of adaptor 1. To facilitate the insertion of annular flange 112 within rim 12, flange 112 may be designed (e.g. may be chosen to have a wall thickness, and/or may be made of material with a particular bending modulus) so that it is able to deform slightly radially inwardly to be able to pass through the narrowest-diameter portion of rim 12. When adaptor 1 has been moved sufficiently axially rearward toward mask body 120, radially-outwardly-protruding lip 113 of annular flange 112 of the mask body will be securely seated and retained in the space defined by the forwardly undercut rim 12 of the adaptor.

By such arrangements adaptor 1 may be securely attached to a respirator mask body 120 by a snap-fit connection. Although in some embodiments a resilient gasket (which term broadly encompasses any kind of compressible material such as an open or closed cell foam, a resilient solid material such as e.g. silicone rubber, or even a layer of pressure-sensitive adhesive) may be used in the snap-fit connection between the adaptor and the mask body, in some embodiments no resilient gasket of any kind is used in making the snap-fit connection. It will be appreciated that while in the depicted embodiment the adaptor comprises a female snap-fit feature so that it can be attached to a mask body that comprises a male snap fitting, in some embodiments the adaptor can comprise a male snap-fit feature so that it can be attached to a mask body that comprises a female snap fitting.

Now turning to Fig. 6, front side 21 of main body 2 of adaptor 1 comprises a twist-fit feature (in this embodiment, a bayonet-attachment feature) 40. In some embodiments, bayonet-attachment feature 40 comprises an annular post (i.e., a cylindrical tube) 41 that protrudes forwardly (and axially) from annular panel 5 of main body 2 of adaptor 1. Annular post 41 is hollow so as to define a through-aperture 42 extending completely therethrough along a front-rear axis of main body 2 of adaptor 1. A forward end 43 of annular post 41 comprises at least two non-symmetric tabs 44 and 45 that are circumferentially spaced apart around forward end 43 of annular post 41 and that each protrude radially outward from forward end 43 of annular post 41. By non-symmetric is meant that the tabs differ in at least one of their radial width and their circumferential length. In some embodiments one of the tabs (tab 44, as labeled in Fig. 6) exhibits a circumferential length that is shorter than that of another tab. In particular embodiments three non-symmetric tabs may be used (meaning that one of the tabs (e.g. tab 44) differs from the other two (e.g. tabs 45) in either radial width and/or circumferential length), and are circumferentially spaced apart around forward end 43 of annular post 41. In specific embodiments two of the tabs (e.g. tabs 45) exhibit

equal circumferential lengths and one of the tabs (e.g. tab 44) exhibits a circumferential length that is shorter than that of the other two tabs, as in the exemplary design of Fig. 6.

In some embodiments the at least two (e.g., three) non-symmetric tabs will each have a rearward end 46 that is spaced apart from a front surface 51 of annular panel 5 of bayonet-attachment feature 40. A space 47 will thus be defined between the rearward ends 46 of the tabs and front surface 51 of annular panel 5. (It will be noted that in Figs. 4 and 6, small (unnumbered) openings are present in annular panel 5, at locations directly rearward of the tabs. These openings are optional and may be provided e.g. to enhance the ease of demolding the adaptor from an injection-molding cavity.)

In some embodiments a twist-fit attachment feature, e.g. a bayonet-attachment feature, may utilize an annular resilient gasket 3 as shown in Fig. 6. A rear surface of gasket 3 may be abutted against annular front surface 51 of annular panel 5 of main body 2 of adaptor 1. Portions of gasket 3 may thus occupy space 47 between rearward ends 46 of the non-symmetric tabs and front surface 51 of annular panel 5. Gasket 3 is annular so that it radially (and circumferentially) surrounds a rearward end (shank) of annular post 41 near where post 41 joins annular panel 5 of adaptor 1. In at least some embodiments annular resilient gasket 3 is non-integral with main body 2 of adaptor 1. That is, gasket 3 may be a separately-made part from main body 2, and may be made of any kind of compressible material such as e.g. an open or closed-cell foam (e.g. polyurethane foam), a resilient solid material such as e.g. silicone rubber, a layer of pressure-sensitive adhesive, and so on. (The elasticity and resiliency of gasket 3 will allow it to be momentarily stretched to pass over the at least two tabs 44 and 45, in order to be placed in position on the shank of annular post 41 during the manufacture of adaptor 1.)

In the exemplary arrangements disclosed herein, a single item of the main body of the adaptor (annular panel 5), provides at least one component of the rear-side snap-fit feature 10 and also provides at least one component of the front-side bayonet-attachment feature 40. Specifically, annular panel 5 comprises an annular rear surface 14 that defines the forward end of circular, rear-facing opening 11 of snap-fit feature 10 (of the rear side of the adaptor). Also, annular panel 5 comprises an annular front surface 51 against which a rear surface of resilient gasket 3 of bayonet attachment feature 40 (of the front side of the adaptor) rests. And, of course, annular post 41 of bayonet attachment feature 40 of the front side of the adaptor, protrudes forwardly (extends integrally) from annular panel 5.

Also, in at least some embodiments the through-aperture 42 that extends through annular post 41 of bayonet-attachment feature 40 of adaptor 1 is coterminous with (that is, it is essentially the same shape and size as, and is aligned with) the aforementioned through-aperture 15 of annular panel 5 of adaptor 1. The two through-apertures 15 and 42 thus combine to provide a continuous fluid path that extends entirely through the front-rear thickness of the adaptor. (Since annular post 41 extends from annular panel 5, through-apertures 15 and 42 can be considered to be two axial lengths, in series, of one continuous fluid passageway.)

To attach adaptor 1 to a mask body of a respirator, adaptor 1 can be moved rearwardly (e.g., from a position similar to that shown in Fig. 3) toward the front side 121 of mask body 120, with snap-fit feature 10 of rear side 22 of adaptor 1 aligned with snap fitting 110 of front side 121 of mask body 120. The snap-fit feature 10 of the adaptor will thus move axially toward, and will contact, the snap fitting 110 of the mask body. When contact is made, forwardly-projecting flange 112 of snap fitting 110 of the mask body will be urged (deflected) slightly radially inward by rim 12 of the snap-fit feature of the adaptor along at least a portion of its circumferential extent. As filter cartridge 200 continues to be pressed towards mask body 120, forward end 114 of flange 112 (bearing radially-outward-protruding lip 113) of the mask body will move axially toward and past the radially-inwardly-projecting flange 13 of snap-fit feature 10 of the adaptor. Once forward end 114 and lip 113 of flange 112 are forwardly past flange 13, they will expand slightly radially outward and will then be seated securely in place. That is, in the attached state, flange 112 of snap fitting 110 of mask body 120 may have moved toward (and may have returned close to) to its pre-attached (undeflected) condition. However, flange 112 of the mask body snap fitting may still be under at least some radially-inward pressure from rim 12 of the adaptor snap-fit feature to help provide an essentially air-tight seal between these components. (Any contact between the forward end 114 of flange 112 of the mask body, and rear surface 14 of annular panel 5 of the adaptor, may also contribute to this seal.) Thus as noted, in at least some embodiments satisfactory leakage-free snap-fit attachment of the adaptor to the respirator mask body may be achieved without using any kind of resilient gasket.

In many embodiments, the adaptor may be permanently snap-fittedly attached to the mask body, meaning that it is not intended to be removed in ordinary use of respirator 100 and meaning that it cannot be manually removed by a user (e.g. without damaging or destroying either the mask body and/or the adaptor). In other embodiments the adaptor may be removably attached to the mask body.

With adaptor 1 snap-fittedly attached to the front side 121 of mask body 120 of respirator 100, a filter cartridge 200 bearing a twist fitting (e.g. a bayonet fitting) 210 on a rear side 222 thereof may then be attached to adaptor 1. To attach a filter cartridge 200 to adaptor 1, the filter cartridge and the adaptor are positioned so that bayonet attachment feature 40 of the adaptor is aligned with bayonet fitting 210 of the cartridge. Moreover, cartridge 200 is positioned (e.g. is rotated as needed) so that the aforementioned tabs 44 and 45 of annular post 41 of bayonet-attachment feature 40 of adaptor 1 are aligned with notches 213 and 214 that extend radially outward from central opening 211 of bayonet fitting 210 of the filter cartridge. If the tabs are asymmetric e.g. such that one of the tabs (e.g. tab 44 of Fig. 6) has a shorter circumferential length than the other two tabs (e.g. tabs 45 of Fig. 6), the cartridge is oriented so that tab 44 is aligned with a notch of the bayonet fitting of the cartridge (e.g. notch 213 of Fig. 2), that is sized so that it can only accommodate tab 44. This can ensure that a desired positioning (angular orientation) of the filter cartridge is achieved.

5 With the desired alignment achieved, the cartridge is then axially moved toward the adaptor so that annular post 41 of adaptor 1 passes into opening 211 of the filter cartridge bayonet fitting 210, and in particular so that tabs 44 and 45 of annular post 41 respectively pass into and through notches 213 and 214 of the cartridge bayonet fitting. Once the tabs have passed through the notches they enter a void
10 space located forwardly (toward the interior of the cartridge) of a rear wall of the cartridge housing. The cartridge can then be rotated (e.g., through an arc of from about 20 to about 90 degrees) so that the tabs are all now positioned axially forward of the wall of the cartridge housing (rather than being aligned with the notches). The cartridge housing wall prevents axially-rearward movement of the tabs and thus prevents the filter cartridge from being detached from the adaptor. (Circumferential stops 215 can be
15 provided in the cartridge fitting to limit the rotation of the cartridge to the desired amount.) The cartridge rotation thus displaces the tabs from being axially aligned with the notches thus holding the cartridge securely in place and not allowing the cartridge to be removed from the adaptor unless the cartridge is rotated back to where the tabs and notches are aligned. In some embodiments, when filter cartridge 200 is secured in place, forward end 43 of annular post 41 of the adaptor, may closely abut or contact struts 216
of the filter cartridge.

Although the above discussions have focused on an adaptor with a twist-fit feature that is a bayonet-attachment feature in particular, the disclosures herein are not limited to twist-fit features that are bayonet-attachment features. That is, rather than a front side feature of the adaptor comprising a bayonet-attachment feature (that comprises e.g. one or more tabs as described above), such a feature could be a
20 twist-fit feature that e.g. comprises threads that are complementary to threads of a filter cartridge that is desired to be attached to the adaptor. Such threads might be e.g. "fine" threads, e.g. requiring that a filter cartridge be rotated relative to the adaptor (or vice versa) through at least one full turn of 360 degrees. Or such threads might be e.g. "coarse" threads that require a turn of less than 360 degrees, or even less than 270, 180, or 90 degrees.

25 One difference between this type of twist-fit connection in general and a twist-fit bayonet connection in particular is that a threaded twist-fit connection may not necessarily require an initial axial push of the fittings toward each other prior to initiating the twisting motion. That is, such fittings may need only be brought close enough to each other to engage the threads before the rotation is commenced, whereas with a bayonet connection one fitting may need to be pushed axially (e.g., against the resistance
30 of a resilient gasket) sufficiently far forward for the tabs to be able to be rotated without being blocked, before rotation is commenced. Another difference is that with a bayonet-attachment system, the rotation step may not necessarily move the items axially an additional distance toward each other, while with a threaded twist-fit system the rotation may move the items an axially an additional distance toward each other. In various embodiments, a twist-fit threaded connection may or may not use a resilient gasket of
35 the general type described above.

It will be appreciated that snap-fit connections e.g. of the general type described in the
aforementioned '761 US Patent may not necessarily require any particular angular or rotational
configuration or alignment between two parts that are to be snap-fitted together. However, it will be
appreciated that in the present circumstance it may be advantageous that adaptor 1 is only able to be snap-
fitted to a mask body 120 of a respirator 100 when adaptor 1 is in a particular angular orientation. That is,
5 although the orientation of the filter cartridge relative to an adaptor to which it is attached may be dictated
by the twist fittings (e.g. by the tabs and notches of the above-described bayonet attachment system), this
may not be sufficient to dictate the orientation of the filter cartridge relative to the mask body to which
the adaptor is attached unless the orientation of the adaptor relative to the mask body is controlled.
10 Accordingly, in at least some embodiments the main body 2 of adaptor 1 is shaped so that the adaptor can
be attached to a mask body of a respirator only when the vertical axis of the adaptor is aligned with the
vertical axis of the respirator mask body. Fixing the orientation of the adaptor relative to the mask body in
this manner can provide that when the cartridge is attached to the adaptor the cartridge is not
unacceptably oriented (e.g., the cartridge does not extend upward so as to block the user's vision).

To achieve this, in some embodiments main body 2 of adaptor 1 may comprise an apron 25 (that
may e.g. exhibit a major plane that is at least generally parallel to a major plane of annular panel 5 of the
main body of the adaptor). Adaptor 1 may further comprise a perimeter skirt 29 that projects rearward
from at least a portion of a perimeter 20 of apron 25. Perimeter skirt 29 may be configured so that when
adaptor 1 is attached to front side 121 of respirator mask body 120, at least portions of perimeter skirt 29
20 of adaptor 1 may laterally outwardly abut portions of a perimeter 125 of front side 121 of the respirator
mask body. This can ensure that the adaptor can be attached to the front side of the respirator mask body
only when the vertical axis of the adaptor is aligned with the vertical axis of the respirator mask body.
And, it can ensure that once the adaptor is attached to the mask body it cannot rotate relative to the mask
body.

In some embodiments, a lower portion of apron 25 of main body 2 of adaptor 1 may define a
cutout 26 that is laterally centered on the vertical axis of the adaptor and that is downwardly offset along
the vertical axis of the adaptor from the snap-fit feature 10 (and also from the bayonet-attachment feature
40). Such a cutout may e.g. allow for unobstructed functioning of an exhalation valve 140 of mask body
120, as in the exemplary configuration of Fig. 3. In further embodiments, cutout 26 may be shaped so that
30 main body 2 of adaptor 1 exhibits a laterally symmetrical, generally V-shaped configuration with the
snap-fit feature of the adaptor being proximate the apex 6 of the V, and with the apron 25 of the main
body comprising first and second lateral wings that provide the arms of the V and that laterally bound the
cutout.

In view of the possible presence of a cutout 26 as described above, it is evident that the perimeter
35 20 (from which skirt 29 protrudes rearwardly) of adaptor 1 may be a partial perimeter. Moreover, it is
evident from Fig. 3 that the perimeter portions 125 of the mask body (which portions are outwardly

abutted by adaptor skirt 29) do not necessarily have to provide the extreme outermost edges of the mask body. In use of adaptor 1, some or much of rear surface 27 of apron 25 may closely abut, or contact, front surface 128 of mask body 120 of respirator 100. However, front surface 28 of apron 25 typically will not contact the rear surface 222 of filter cartridge 200.

5 Adaptor 1 can be used with any respirator that comprises a mask body with a snap fitting. One particular example of a respirator with a snap fitting is the product sold by 3M Company, St. Paul, MN, under the trade designation 3000 SERIES HALF-MASK RESPIRATOR. Such respirators often have a mask body that includes a portion bearing the at least one snap fitting, and that also comprises a soft, compliant portion 127 that may be molded or otherwise shaped so as to be able to conform to the contours
10 of a face. In some embodiments the respirator may be a “half-mask” type respirator as exemplified in Fig. 1. In other embodiments the respirator may be a full-face type respirator. (A half-face (half-mask) respirator fits over a person's nose and mouth, whereas a full-face respirator covers the eyes as well.) In some embodiments the respirator may be a “negative pressure” respirator that relies on the wearer's lungs as the means for drawing air through the respirator. In other embodiments the respirator may be a positive
15 pressure respirator that relies on forced air (e.g., from a pressure tank or blower that is carried by the person). Whatever the particular type of respirator, it may use a harness (not shown in any Figure) that includes e.g. one or more adjustable straps to secure the mask body to the wearer's head and minimizes any slippage or other undesired movement of the mask body.

 Mask body 120 can comprise any suitable exhalation valve or valves 140. An exhalation valve is
20 a unidirectional valve that allows only exiting air to pass therethrough. The outlet valve may be e.g. a button style valve, or it may be a cantilevered or flapper valve or the like (with a flapper valve being shown in Fig. 1). While exemplary embodiments have been depicted herein in which an adaptor comprises a female snap-fit feature and a respirator mask body comprises a male snap fitting, in other
25 embodiments the adaptor can comprise a male snap-fit feature and the mask body can comprise a female snap fitting.

 In embodiments of the general type shown in Fig. 3, adaptor 1 is used with a respirator that accepts a single cartridge that is attached at a location generally laterally centered somewhere on the vertical axis of the respirator. It is also possible to use adaptor 1 with a respirator that has two fittings so as to accept two cartridges (an example of such a respirator is found in U. S. Patent No. 7650884 to
30 Flanigan, noting that the ‘884 patent has bayonet fittings rather than snap fittings). In such designs, the cartridges are often attached at locations that are partway along the lateral side of the respirator (e.g., in the cheek areas of the wearer). In such embodiments, all characterizations herein of adaptor 1 still apply with that difference noted.

 Any suitable filter cartridge that comprises a twist fitting, e.g. a bayonet fitting, can be used with
35 adaptor 1. One particular example of a filter cartridge with a bayonet fitting is the product sold by 3M Company, St. Paul, MN, under the trade designation 6000 SERIES CARTRIDGES. Such filter cartridges

often comprise a housing 220 (comprised e.g. of two injected-molded housing pieces that are assembled together to form the housing) that defines an interior 223 within which filter media (e.g. a fibrous layer to filter particles, and/or a sorbent to filter gases or vapors) is contained. Such a cartridge may, for example, contain activated carbon to remove organic vapors from the air, a non-woven filter that has electrically-charged fibers to remove particulate material, or a combination of the two. One common type of filter cartridge, designed for removing organic vapors from the air, utilizes granulated charcoal particles as the media within the cartridge. Granulated charcoal, and other sorbent material, adsorb or absorb chemical contaminants (such as acids, bases, NO_x, etc.). The filter cartridge housing may be filled with granulated charcoal, activated carbon or other adsorbent material (or combinations of multiple adsorbent materials) and pressure is applied to compact the sorbent particles together to have as dense of a packing as possible.

A twist fitting (e.g. a bayonet fitting 210) of a filter cartridge 200 may be a separately made component that is attached to the housing 220 of a filter cartridge; however, in many embodiments it may be convenient that such a fitting is provided by features that are injection molded directly into the housing (e.g. into a rear housing piece) in the process of making the housing piece, as in the exemplary filter cartridge shown in Fig. 2. While exemplary embodiments have been depicted herein in which an adaptor comprises a male bayonet-attachment feature and a filter cartridge comprises a female bayonet fitting, in other embodiments the adaptor can comprise a female bayonet-attachment feature and the filter cartridge can comprise a male bayonet fitting. The same is true of twist-fit features in general.

The above discussions have referred to an adaptor being attached to a respirator mask body by manipulating the adaptor relative to the mask body, followed by a filter cartridge being attached to the adaptor by manipulating the filter cartridge relative to the adaptor. It will be understood that such steps can be performed in any order (e.g. the cartridge may be attached to the adaptor before the adaptor is attached to the mask body) and can involve movement of either or both items that are being attached. Furthermore, while the exemplary arrangements disclosed herein have recited a female snap-fit feature of an adaptor that is configured to snap fit to a male snap-fit feature of a respirator mask, and a male twist-fit feature of an adaptor that is configured to twist fit to a female twist-fit feature of a filter cartridge, either or both of these roles could be reversed if desired. It will be appreciated that an adaptor as disclosed herein serves the purpose of facilitating the attachment of a filter cartridge to a respirator mask while establishing a desired orientation of the cartridge relative to the mask. An adaptor as disclosed herein does not perform any filtering (whether of e.g. particles, gases or vapors, etc.) and so by definition is not a filter cartridge. The adaptor will of course support the weight of a filter cartridge that is attached thereto.

List of Exemplary Embodiments

Embodiment 1 is an adaptor that facilitates connecting a filter cartridge with a twist fitting on a rear side thereof to a respirator mask body with a snap fitting on a front side thereof, the adaptor comprising an integral, molded plastic main body comprising a front side and a rear side, an upper end and a lower end, and an annular panel defining a through-aperture therethrough; wherein the rear side of

the adaptor comprises a snap-fit feature that is attachable to a snap fitting of a respirator mask body so that the rear side of the adaptor can be attached to a front side of the respirator mask body; wherein the front side of the adaptor comprises a twist-fit feature to which is attachable a twist fitting of a filter cartridge so that a rear side of the filter cartridge can be attached to the front side of the adaptor; wherein
5 when the adaptor is attached to the respirator mask body and the filter cartridge is attached to the adaptor, an interior of the filter cartridge is fluidly connected to an interior air space of the respirator mask body by a fluid pathway that leads through the main body of the adaptor; and, wherein the main body of the adaptor is shaped so that the rear side of the adaptor can be attached to the front side of the respirator mask body only when a vertical axis of the adaptor is aligned with a vertical axis of the respirator mask
10 body.

Embodiment 2 is the adaptor of embodiment 1 wherein the twist-fit feature of the front side of the adaptor is a bayonet-attachment feature that is attachable to a bayonet fitting of the filter cartridge.

Embodiment 3 is the adaptor of any of embodiments 1-2 wherein the annular panel comprising the through-aperture therethrough, comprises an annular rear surface that defines a forward end of a rear-
15 facing opening of the snap-fit feature of the rear side of the adaptor; and, wherein the annular panel comprising the through-aperture therethrough, comprises an annular front surface against which a rear surface of a resilient gasket of the twist-fit feature of the front side of the adaptor is abutted. Embodiment 4 is the adaptor of any of embodiments 1-3 wherein the snap-fit feature of the rear side of the main body of the adaptor comprises a circumferentially continuous, uninterrupted rim that defines a circular, rear-
20 facing opening, the rim being forwardly undercut so as to exhibit a radially-inwardly-projecting flange at a rear end of the rim. Embodiment 5 is the adaptor of embodiment 4 wherein a forward end of the circular, rear-facing opening of the snap-fit feature of the rear side of the main body of the adaptor is defined by an annular rear surface of the annular panel of the main body of the adaptor.

Embodiment 6 is the adaptor of any of embodiments 1-5 wherein the main body of the adaptor
25 comprises an apron and comprises a perimeter skirt that projects rearward from at least a portion of a perimeter edge of the apron, and wherein the perimeter skirt is configured so that when the adaptor is attached to the front side of the respirator mask body, at least portions of the perimeter skirt of the adaptor laterally outwardly abut portions of a perimeter of the front side of the respirator mask body, so that the adaptor can be attached to the front side of the respirator mask body only when the vertical axis of the
30 adaptor is aligned with the vertical axis of the respirator mask body.

Embodiment 7 is the adaptor of embodiment 6 wherein a lower portion of the apron of the main body of the adaptor defines a cutout that is laterally centered on the vertical axis of the adaptor and that is downwardly offset along the vertical axis of the adaptor from the snap-fit feature. Embodiment 8 is the adaptor of embodiment 7 wherein the cutout is shaped so that the adaptor exhibits a laterally symmetrical,
35 generally V-shaped configuration with the snap-fit feature of the adaptor being proximate the apex of the

V, and with the apron of the main body comprising first and second lateral wings that provide the arms of the V and that laterally bound the cutout.

Embodiment 9 is the adaptor of any of embodiments 1-8 with the proviso that the rear side of the adaptor does not comprise any kind of resilient gasket or sealing material.

5 Embodiment 10 is the adaptor of any of embodiments 1 and 3-9 wherein the twist-fit feature of the front side of the adaptor comprises a threaded fitting to which is attachable the twist fitting of the rear side of the a filter cartridge

Embodiment 11 is the adaptor of any of embodiments 1 and 4-9 wherein the twist-fit feature of the front side of the adaptor is a bayonet-attachment feature that is attachable to a bayonet fitting of the filter cartridge, wherein the bayonet-attachment feature of the adaptor comprises an annular post that extends integrally forwardly from the annular panel of the main body of the adaptor, wherein the annular post comprises a through-aperture extending therethrough along a front-rear axis of the main body of the adaptor, and wherein a forward end of the annular post comprises at least two non-symmetric tabs that are circumferentially spaced apart around the forward end of the annular post and that each protrude radially outward from the forward end of the annular post.

Embodiment 12 is the adaptor of embodiment 11 wherein the at least two non-symmetric tabs each have a rearward end that is spaced apart from a front surface of the annular panel of the main body of the adaptor, and wherein one of the tabs exhibits a circumferential length that is shorter than that of another tab. Embodiment 13 is the adaptor of embodiment 12 wherein the forward end of the annular post comprises three non-symmetric tabs that are circumferentially spaced apart around the forward end of the annular post, and wherein two of the tabs exhibit equal circumferential lengths and one of the tabs exhibits a circumferential length that is shorter than that of the other two tabs. Embodiment 14 is the adaptor of any of embodiments 12-13 further comprising an annular resilient gasket whose rear surface is abutted against an annular front surface of the annular panel of the main body of the adaptor and portions of which gasket occupy a space between the rearward ends of the non-symmetric tabs and the front surface of the annular panel, which annular resilient gasket is non-integral with the main body of the adaptor and which radially outwardly surrounds a rearward shank of the annular post of the bayonet-attachment feature. Embodiment 15 is the adaptor of any of embodiments 11-14 wherein the through-aperture extending through the annular post of the bayonet-attachment fitting of the front side of the main body of the adaptor is coterminous with the through-aperture of the annular panel of the main body of the adaptor so that the two through-apertures combine to provide a continuous fluid path that extends entirely through the front-rear thickness of the adaptor.

Embodiment 16 is an assembly comprising: a respirator mask body with a snap fitting on a front side thereof; and, the adaptor of any of embodiments 1-15, with the rear side of the adaptor being attached to the front side of the respirator mask body by way of the snap-fit feature of the adaptor. Embodiment 17 is the assembly of embodiment 16 further comprising a filter cartridge with a twist fitting, wherein a rear

side of the filter cartridge is attached to the front side of the adaptor by way of the twist-fit feature of the adaptor. Embodiment 18 is the assembly of any of embodiments 16-17 wherein the twist-fit feature of the adaptor is a bayonet-attachment feature and wherein the twist fitting of the cartridge is a bayonet fitting.

Embodiment 19 is the method of adapting a respirator mask body with a snap fitting on a front side thereof to receive and be fluidly connected to a filter cartridge with a twist fitting on a rear side thereof, the method comprising: snap-fitting the rear side of the adaptor of any of embodiments 1-15 to the front side of the respirator mask body. Embodiment 20 is the method of embodiment 19 further comprising attaching a rear side of the filter cartridge with a twist fitting to the front side of the adaptor, by way of the twist-fit feature of the adaptor. Embodiment 21 is the method of any of embodiments 19-20 wherein the twist-fit feature of the adaptor is a bayonet-attachment feature and wherein the twist fitting of the cartridge is a bayonet fitting.

It will be apparent to those skilled in the art that the specific exemplary structures, features, details, configurations, etc., that are disclosed herein can be modified and/or combined in numerous embodiments. All such variations and combinations are contemplated by the inventor as being within the bounds of the conceived invention not merely those representative designs that were chosen to serve as exemplary illustrations. Thus, the scope of the present invention should not be limited to the specific illustrative structures described herein, but rather extends at least to the structures described by the language of the claims, and the equivalents of those structures. Any of the elements that are positively recited in this specification as alternatives may be explicitly included in the claims or excluded from the claims, in any combination as desired. Any of the elements or combinations of elements that are recited in this specification in open-ended language (e.g., comprise and derivatives thereof), are considered to additionally be recited in closed-ended language (e.g., consist and derivatives thereof) and in partially closed-ended language (e.g., consist essentially, and derivatives thereof). Various features disclosed herein have been characterized in terms of adjectives (e.g., attachable, connectable, removable) that signify the capability to have a particular action performed with the feature or performed on the feature. All uses of such adjectives herein, including in the claims, are to be interpreted as meaning that the feature is specifically adapted to perform the action or to have the action performed on it. By way of specific example, the phrase “a feature that is attachable to a fitting” is to be interpreted as “a feature that is adapted to be attached to a fitting”.

Although various theories and possible mechanisms may have been discussed herein, in no event should such discussions serve to limit the claimable subject matter. To the extent that there is any conflict or discrepancy between this specification as written and the disclosure in any document that is incorporated by reference herein but to which no priority is claimed, this specification as written will control.

What is claimed is:

1. An adaptor that facilitates connecting a filter cartridge with a twist fitting on a rear side thereof to a respirator mask body with a snap fitting on a front side thereof, the adaptor comprising an integral,
5 molded plastic main body comprising a front side and a rear side, an upper end and a lower end, and an annular panel defining a through-aperture therethrough;

wherein the rear side of the adaptor comprises a snap-fit feature that is attachable to a snap fitting of a respirator mask body so that the rear side of the adaptor can be attached to a front side of the respirator mask body;

10 wherein the front side of the adaptor comprises a twist-fit feature to which is attachable a twist fitting of a filter cartridge so that a rear side of the filter cartridge can be attached to the front side of the adaptor;

wherein when the adaptor is attached to the respirator mask body and the filter cartridge is attached to the adaptor, an interior of the filter cartridge is fluidly connected to an interior air space of the respirator mask body by a fluid pathway that leads through the main body of the adaptor;

15 and,

wherein the main body of the adaptor is shaped so that the rear side of the adaptor can be attached to the front side of the respirator mask body only when a vertical axis of the adaptor is aligned with a vertical axis of the respirator mask body.

20 2. The adaptor of claim 1 wherein the twist-fit feature of the front side of the adaptor is a bayonet-attachment feature that is attachable to a bayonet fitting of the filter cartridge.

25 3. The adaptor of claim 1 wherein the annular panel comprising the through-aperture therethrough, comprises an annular rear surface that defines a forward end of a rear-facing opening of the snap-fit feature of the rear side of the adaptor; and, wherein the annular panel comprising the through-aperture therethrough, comprises an annular front surface against which a rear surface of a resilient gasket of the twist-fit feature of the front side of the adaptor is abutted.

30 4. The adaptor of claim 1 wherein the snap-fit feature of the rear side of the main body of the adaptor comprises a circumferentially continuous, uninterrupted rim that defines a circular, rear-facing opening, the rim being forwardly undercut so as to exhibit a radially-inwardly-projecting flange at a rear end of the rim.

35 5. The adaptor of claim 4 wherein a forward end of the circular, rear-facing opening of the snap-fit feature of the rear side of the main body of the adaptor is defined by an annular rear surface of the annular panel of the main body of the adaptor.

6. The adaptor of claim 1 wherein the main body of the adaptor comprises an apron and comprises a perimeter skirt that projects rearward from at least a portion of a perimeter edge of the apron, and wherein the perimeter skirt is configured so that when the adaptor is attached to the front side of the respirator mask body, at least portions of the perimeter skirt of the adaptor laterally outwardly abut portions of a perimeter of the front side of the respirator mask body, so that the adaptor can be attached to the front side of the respirator mask body only when the vertical axis of the adaptor is aligned with the vertical axis of the respirator mask body.
7. The adaptor of claim 6 wherein a lower portion of the apron of the main body of the adaptor defines a cutout that is laterally centered on the vertical axis of the adaptor and that is downwardly offset along the vertical axis of the adaptor from the snap-fit feature.
8. The adaptor of claim 7 wherein the cutout is shaped so that the adaptor exhibits a laterally symmetrical, generally V-shaped configuration with the snap-fit feature of the adaptor being proximate the apex of the V, and with the apron of the main body comprising first and second lateral wings that provide the arms of the V and that laterally bound the cutout.
9. The adaptor of claim 1 with the proviso that the rear side of the adaptor does not comprise any kind of resilient gasket or sealing material.
10. The adaptor of claim 1 wherein the twist-fit feature of the front side of the adaptor comprises a threaded fitting to which is attachable the twist fitting of the rear side of the a filter cartridge
11. The adaptor of claim 1 wherein the twist-fit feature of the front side of the adaptor is a bayonet-attachment feature that is attachable to a bayonet fitting of the filter cartridge, wherein the bayonet-attachment feature of the adaptor comprises an annular post that extends integrally forwardly from the annular panel of the main body of the adaptor, wherein the annular post comprises a through-aperture extending therethrough along a front-rear axis of the main body of the adaptor, and wherein a forward end of the annular post comprises at least two non-symmetric tabs that are circumferentially spaced apart around the forward end of the annular post and that each protrude radially outward from the forward end of the annular post.
12. The adaptor of claim 11 wherein the at least two non-symmetric tabs each have a rearward end that is spaced apart from a front surface of the annular panel of the main body of the adaptor, and wherein one of the tabs exhibits a circumferential length that is shorter than that of another tab.

13. The adaptor of claim 12 wherein the forward end of the annular post comprises three non-symmetric tabs that are circumferentially spaced apart around the forward end of the annular post, and wherein two of the tabs exhibit equal circumferential lengths and one of the tabs exhibits a
5 circumferential length that is shorter than that of the other two tabs.

14. The adaptor of claim 12 further comprising an annular resilient gasket whose rear surface is abutted against an annular front surface of the annular panel of the main body of the adaptor and portions of which gasket occupy a space between the rearward ends of the non-symmetric tabs and the front
10 surface of the annular panel, which annular resilient gasket is non-integral with the main body of the adaptor and which radially outwardly surrounds a rearward shank of the annular post of the bayonet-attachment feature.

15. The adaptor of claim 11 wherein the through-aperture extending through the annular post of the
15 bayonet-attachment fitting of the front side of the main body of the adaptor is coterminous with the through-aperture of the annular panel of the main body of the adaptor so that the two through-apertures combine to provide a continuous fluid path that extends entirely through the front-rear thickness of the adaptor.

16. An assembly comprising:
a respirator mask body with a snap fitting on a front side thereof;
and,
the adaptor of claim 1, with the rear side of the adaptor being attached to the front side of the
20 respirator mask body by way of the snap-fit feature of the adaptor.

17. The assembly of claim 16 further comprising a filter cartridge with a twist fitting, wherein a rear
25 side of the filter cartridge is attached to the front side of the adaptor by way of the twist-fit feature of the adaptor.

18. The assembly of claim 17 wherein the twist-fit feature of the adaptor is a bayonet-attachment
30 feature and wherein the twist fitting of the cartridge is a bayonet fitting.

19. A method of adapting a respirator mask body with a snap fitting on a front side thereof to receive
and be fluidly connected to a filter cartridge with a twist fitting on a rear side thereof, the method
35 comprising:
snap-fitting the rear side of the adaptor of claim 1 to the front side of the respirator mask body.

20. The method of claim 19 further comprising attaching a rear side of the filter cartridge with a twist fitting to the front side of the adaptor, by way of the twist-fit feature of the adaptor.

5 21. The method of claim 19 wherein the twist-fit feature of the adaptor is a bayonet-attachment feature and wherein the twist fitting of the cartridge is a bayonet fitting.

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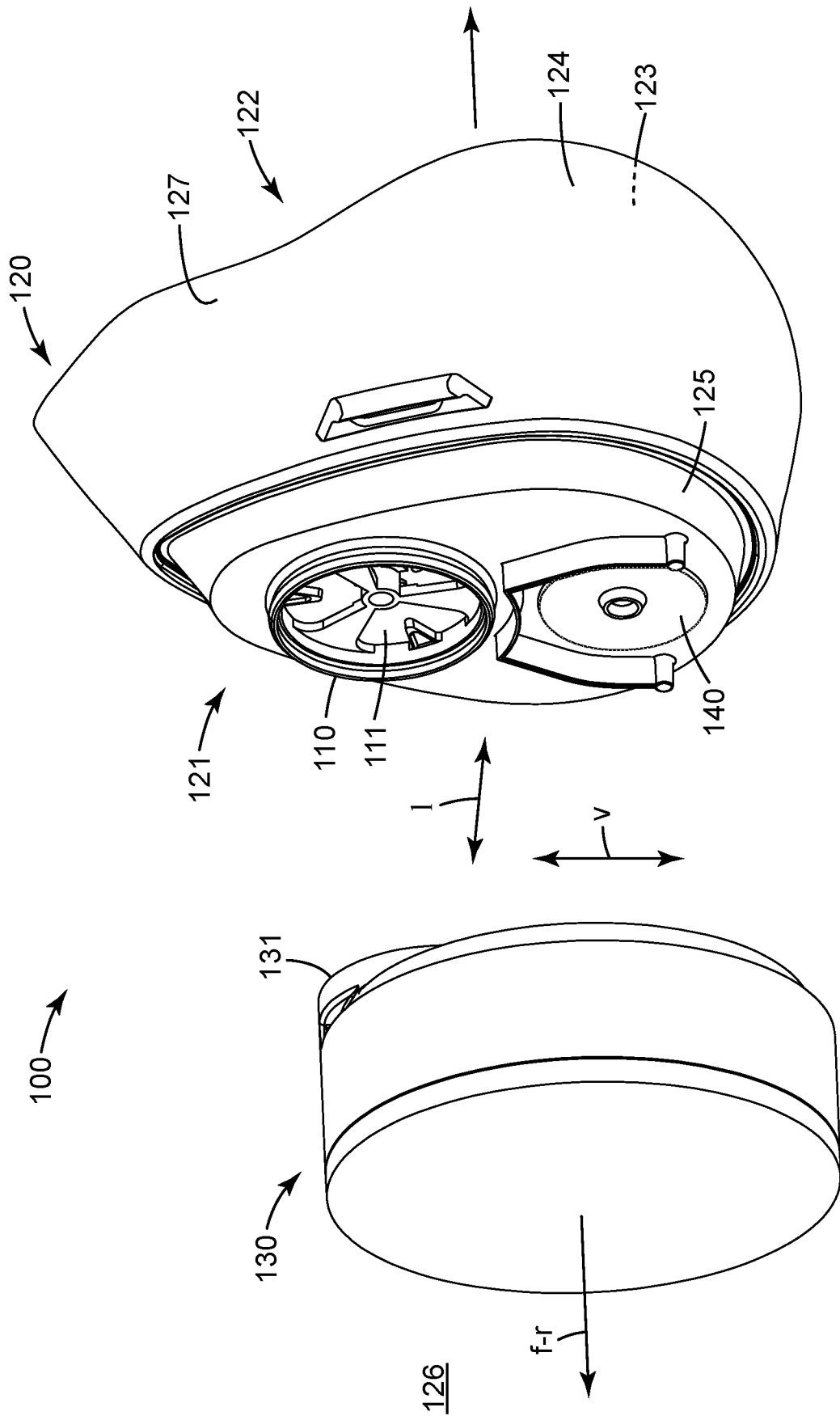


Fig. 1
PRIOR ART

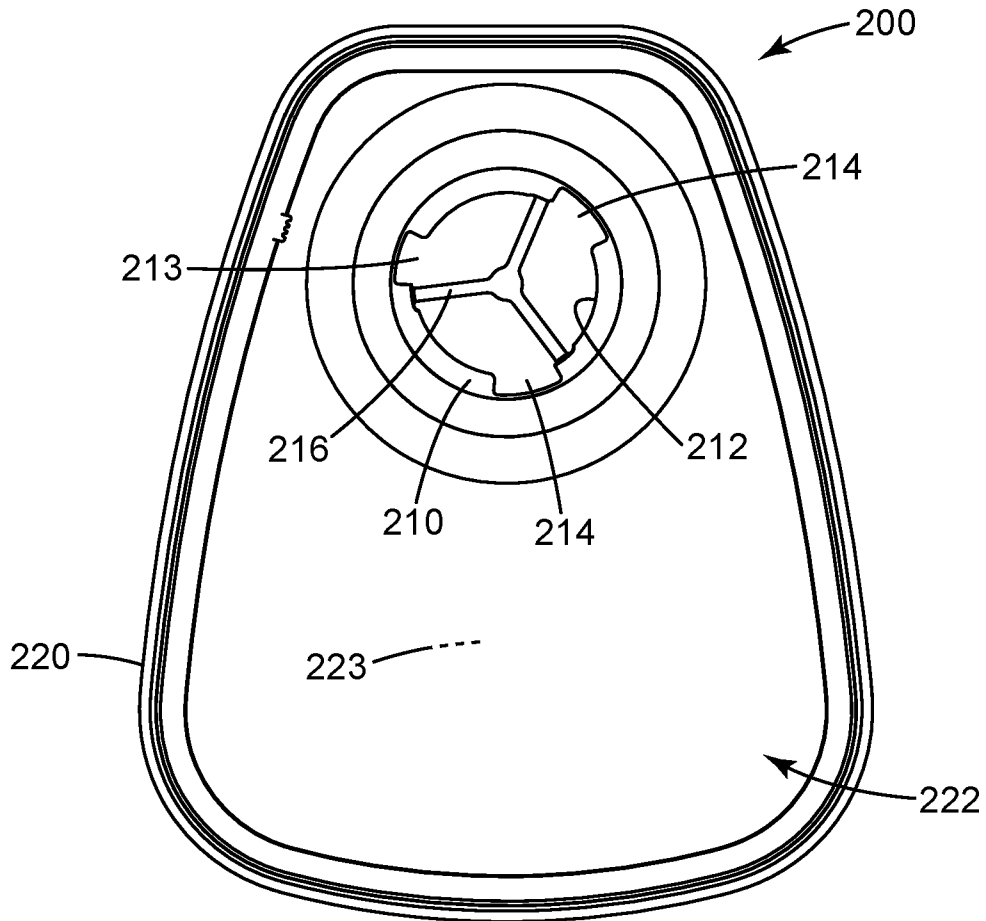


Fig. 2
PRIOR ART

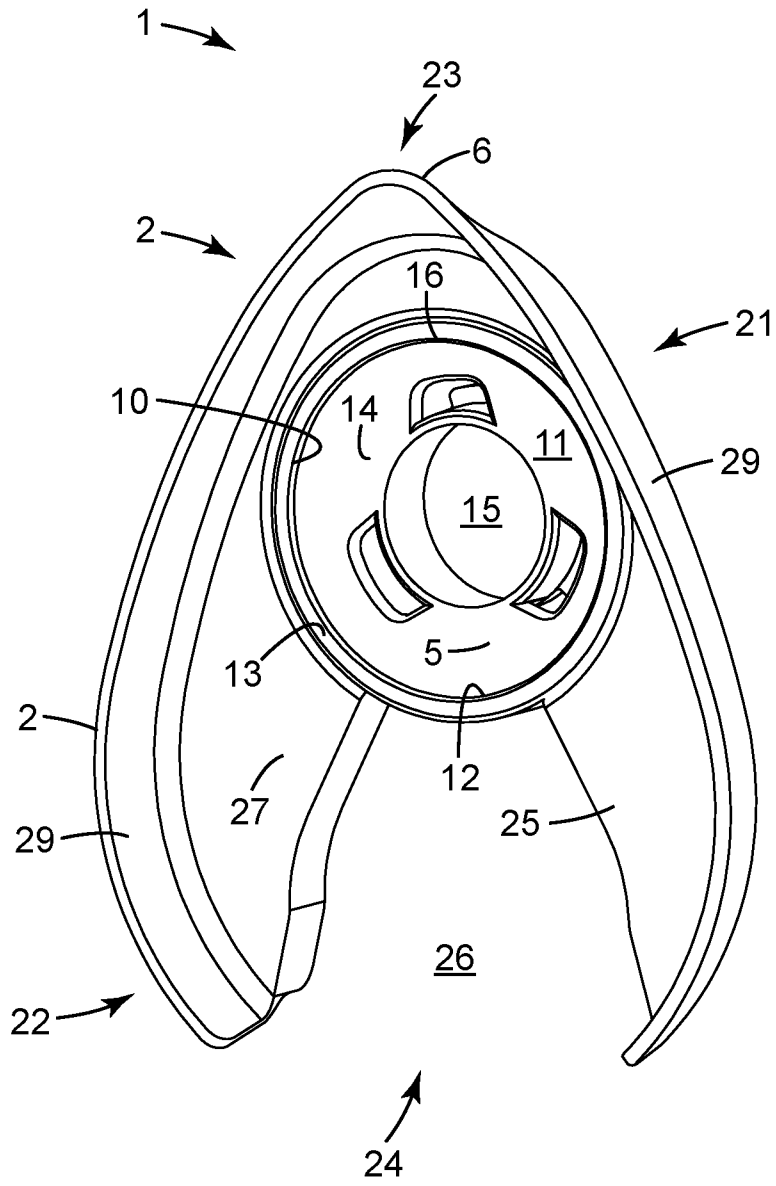


Fig. 4

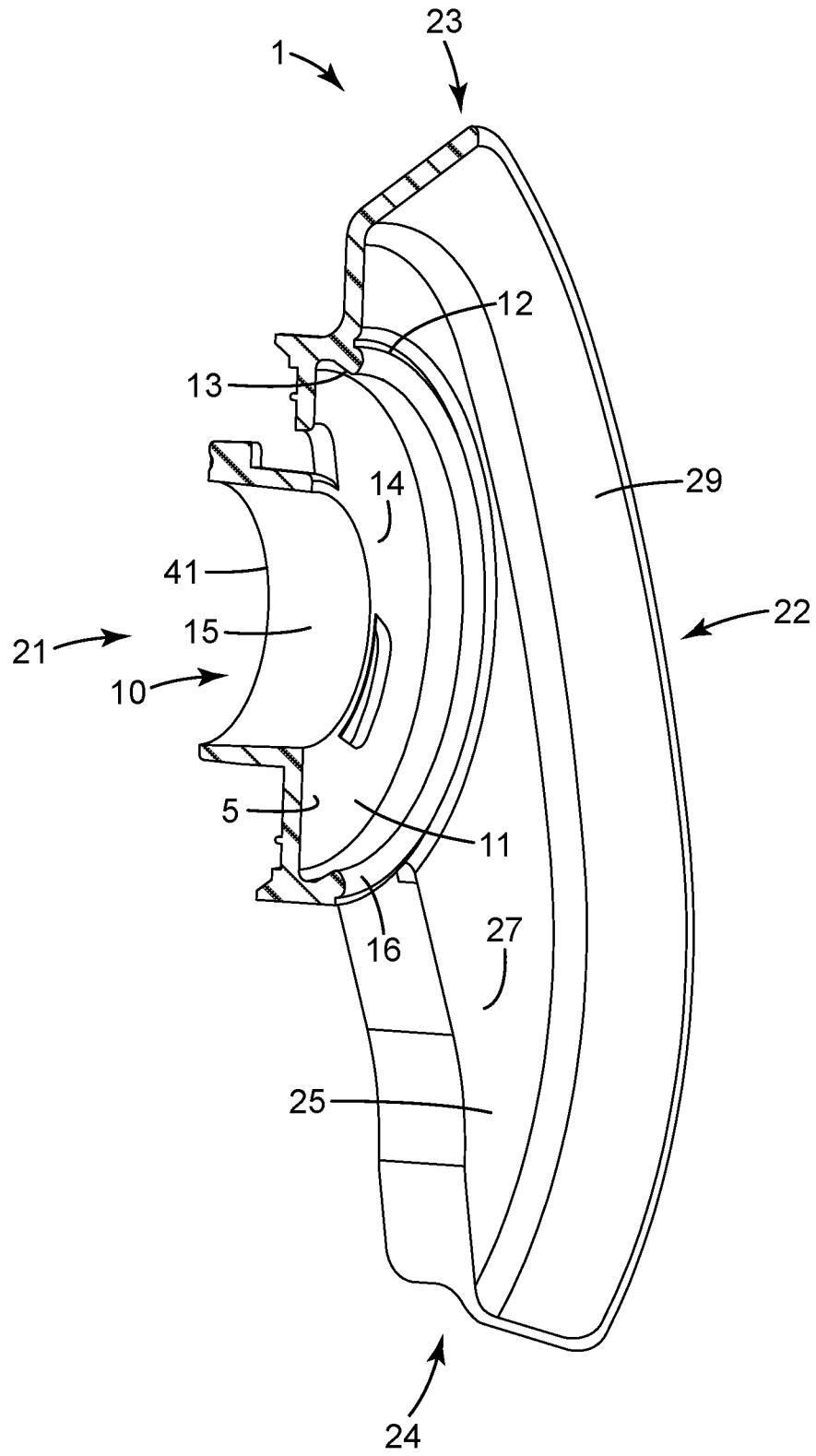


Fig. 5

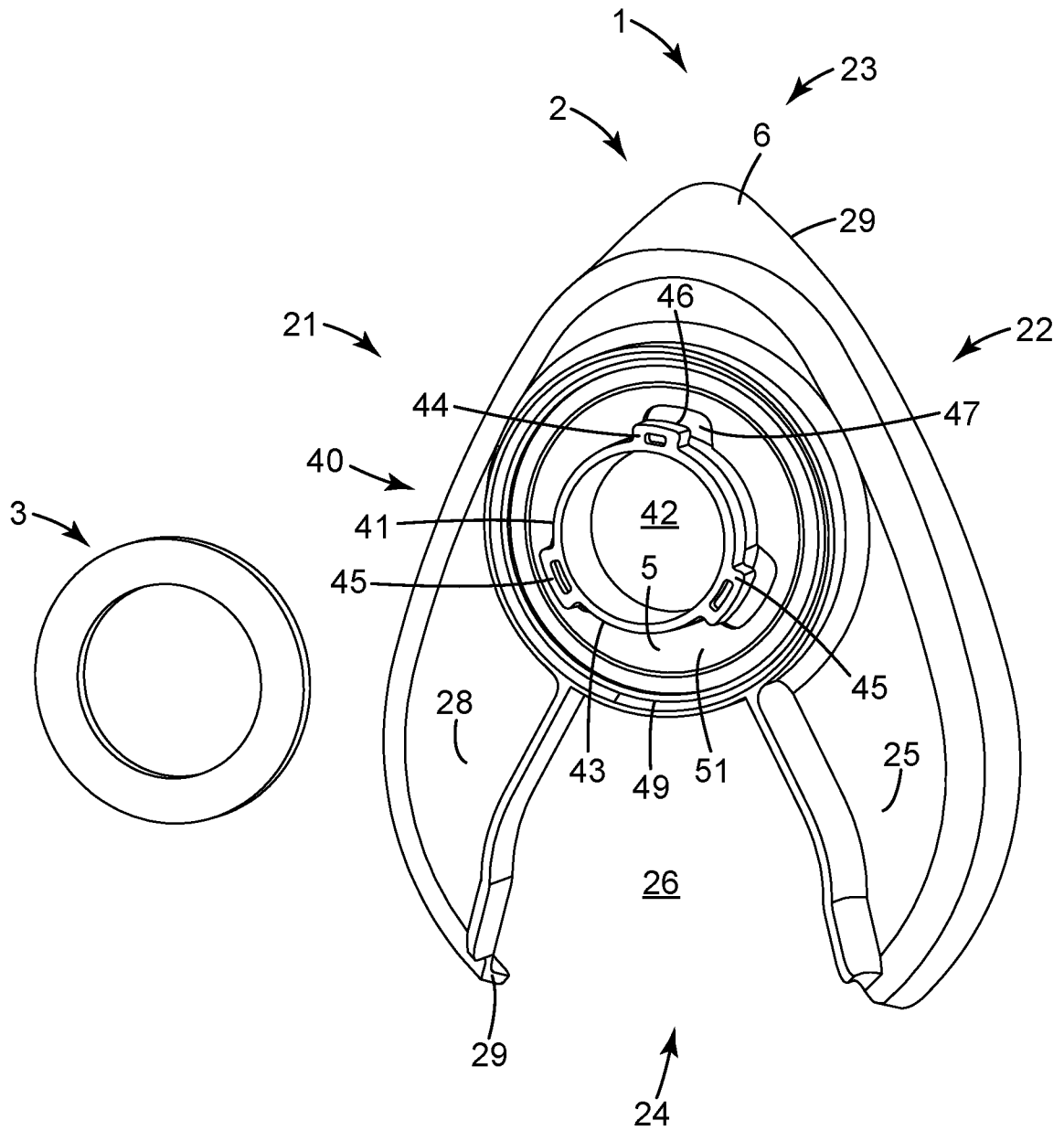


Fig. 6

A. CLASSIFICATION OF SUBJECT MATTER**A62B 19/00(2006.01)i, A62B 7/10(2006.01)i, A62B 23/02(2006.01)i, A62B 9/04(2006.01)i**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHEDMinimum documentation searched (classification system followed by classification symbols)
A62B 19/00; A62B 1/00; A62B 7/10; A62B 23/02; A62B 18/08; A62B 9/04Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility modelsElectronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: respirator, mask, filter, cartridge, adaptor, connect, snap, twist, bayonet**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2001-0029950 A1 (HAUBEIL) 18 October 2001 See paragraphs [28],[29] and claim 1.	1-21
A	US 7234462 B2 (PALAZZOTTO et al.) 26 June 2007 See column 6, line 36 - column 8, line 19 and figure 5.	1-21
A	EP 0342807 A2 (MINNESOTA MINING AND MANUFACTURING COMPANY) 23 November 1989 See claims 1-10 and figure 1.	1-21
A	US 05224473 A (BLOOMFIELD) 06 July 1993 See claims 1-13 and figures 1,2.	1-21
A	US 05592935 A (ELSTRAN et al.) 14 January 1997 See claims 1-26 and figure 3.	1-21

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"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)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"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

"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

"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

"&" document member of the same patent family

Date of the actual completion of the international search

17 August 2017 (17.08.2017)

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2017/031554

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2001-0029950 A1	18/10/2001	US 6539941 B2	01/04/2003
US 7234462 B2	26/06/2007	CA 2172719 A1	13/04/1995
		DE 69424299 T2	31/08/2000
		EP 0722352 A1	12/03/1997
		EP 0722352 B1	03/05/2000
		JP 09-503407 A	08/04/1997
		JP 3799413 B2	19/07/2006
		KR 10-0326132 B1	31/07/2002
		US 2002-0069871 A1	13/06/2002
		US 6382206 B1	07/05/2002
		WO 95-09676 A1	13/04/1995
EP 0342807 A2	23/11/1989	AR 244095 A1	29/10/1993
		AU 3313989 A	23/11/1989
		AU 617454 B2	28/11/1991
		BR 8902282 A	09/01/1990
		CA 1332716 C	25/10/1994
		DE 68923906 T2	18/04/1996
		DK 175092 B1	24/05/2004
		DK 238389 A	18/11/1989
		EP 0342807 A3	06/05/1992
		EP 0342807 B1	23/08/1995
		ES 2076208 T3	01/11/1995
		JP 02-019175 A	23/01/1990
		JP 2994402 B2	27/12/1999
		KR 10-1996-0005210 B1	23/04/1996
		MX 168560 B	31/05/1993
		US 4886058 A	12/12/1989
		ZA 8903011 A	28/12/1990
US 05224473 A	06/07/1993	US 5224474 A	06/07/1993
		WO 92-15369 A1	17/09/1992
US 05592935 A	14/01/1997	US 5720280 A	24/02/1998