(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 298 096 A2

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
23.03.2011 Bulletin 2011/12

(51) Int Cl.:
A41D 13/11 *(2006.01)*

(21) Application number: **10177484.2**

(22) Date of filing: **17.09.2010**

(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 SE SI SK SM TR
Designated Extension States:
BA ME RS

(30) Priority: **18.09.2009 US 562273**

(71) Applicant: **3M Innovative Properties Co.**
St. Paul, MN 55133-3427 (US)

(72) Inventors:
- **Eitzman, Philip Drake**
  St. Paul, MN 55133-3427 (US)
- **Duffy, Dean Roy**
  St. Paul, MN 55133-3427 (US)
- **Spoo, Scott Allen**
  St. Paul, MN 55133-3427 (US)

(74) Representative: **Vossius & Partner**
Siebertstrasse 4
81675 München (DE)

(54) **Filtering face respirator having grasping feature indicator**

(57) A filtering, face-piece respirator **10** that has a harness **14,** a mask body **12,** and first and second flanges **30a, 30b.** The mask body **12** comprises a filtering structure 16 and has a grasping feature such as first and second flanges **30a, 30b** disposed on first and second mask body sides. First and second indicia **32a, 32b** is placed on the first and second flanges **30a, 30b,** respectively. The provision of indicia on a grasping feature of a respirator mask body is beneficial for informing the wearer of where to grasp the mask body for donning, doffing, and adjustment.

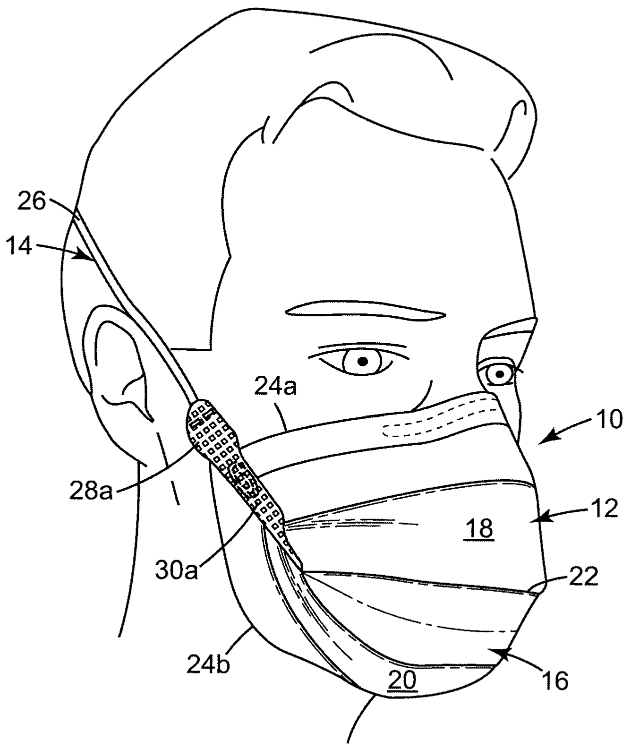

Fig. 1

EP 2 298 096 A2

Description

[0001] The present invention pertains to a respirator that has a grasping feature located on the mask body. The grasping feature includes an indicia that provides an indication of where the user should grasp the mask body for donning, or doffing, or adjusting.

BACKGROUND

[0002] Respirators are commonly worn over the breathing passages of a person for at least one of two common purposes: (1) to prevent impurities or contaminants from entering the wearer's breathing track; and (2) to protect other persons or things from being exposed to pathogens and other contaminants exhaled by the wearer. In the first situation, the respirator is worn in an environment where the air contains particles that are harmful to the wearer, for example, in an auto body shop. In the second situation, the respirator is worn in an environment where there is risk of contamination to other persons or things, for example, in an operating room or a clean room.

[0003] A variety of respirators have been designed to meet either (or both) of these purposes. Some respirators have been categorized as being "filtering face-pieces" because the mask body itself functions as the filtering mechanism. Unlike respirators that use rubber or elastomeric masks in conjunction with attachable filter cartridges (see, e.g., U.S. Patent RE39,493 to Yuschak et al. and U.S. Patent 4,098,270 to Dolby) or insert-molded filter elements (see, e.g., U.S. Patent 4,790,306 to Braun), filtering face-piece respirators are designed to have the filter media cover much of the whole mask body so that there is no need for installing or replacing a filter cartridge. Filtering face-piece respirators commonly come in one of two configurations: molded respirators and flat-fold respirators.

[0004] Molded filtering face piece respirators have regularly comprised non-woven webs of thermally-bonded fibers or open-work plastic meshes to furnish the mask body with its cup-shaped configuration. Molded respirators tend to maintain the same shape during both use and storage. Examples of patents that disclose molded, filtering, face-piece respirators include U.S. Patents 7,131,442 to Kronzer et al, 6,923,182, 6,041,782 to Angadjivand et al., 4,850,347 to Skov, 4,807,619 to Dyrud et al., 4,536,440 to Berg, and Des. 285,374 to Huber et al.

[0005] Flat-fold respirators - as their name implies - can be folded flat for shipping and storage and can be opened into a cup-shaped configuration for use. U.S. Patents 6,568,392 and 6,484,722 to Bostock et al., and 6,394,090 to Chen disclose examples of flat-fold respirators.

[0006] Before donning a respirator, it is critically important that the respirator wearer read and understand use instructions. A user's unfamiliarity with, for example, flat-fold respirators may cause incorrect handling and donning and doffing mistakes. Such misguided use may result in an improper and uncomfortable fit, which may lead to lack of protection and also may tarnish a user's perception of respirators.

[0007] Some filtering face-piece respirators have been provided with grasping features to assist the user in donning and doffing. U.S. Patents 6,948,499 and 6,945,249 to Griesbach, III et al. disclose an example of such a filtering face-piece respirator. While this respirator is provided with a grasping feature in the form of a "tab", the grasping feature does not include any type of indicia that would intuitively inform the user of where to grasp the mask during donning, doffing, and adjusting operations. Therefore, the grasping feature may not be readily apparent and accordingly may not be used by the wearer. As discussed below, the present invention, however, provides a user friendly way to quickly identify where to grasp the mask for fitment purposes.

SUMMARY OF THE INVENTION

[0008] The present invention provides a new filtering, face-piece respirator that comprises (a) a harness; and (b) a mask body that has a grasping feature located thereon, the grasping feature having an indicia for providing an indication for where to grasp the mask body for fitment.

[0009] The inventors discovered that the use of indicia on a grasping feature is beneficial for both achieving and maintaining a snug fit to the wearer's face. The grasping feature provides a solid surface onto which the wearer's fingers can easily grasp the mask body to properly position it during donning and subsequent adjustments and doffing. The indicia provides an indication to the wearer of where the grasping feature is located and how to grasp that feature during these fitment operations and accordingly facilitates wearer training.

[0010] Imagery, rather than text, has become an increasingly popular means for conveying information to users concerning the operation of various products. Many images have taken on universal recognition. The intention of the indicia in the present invention is to create an association in the mind of the user of the correct place on the respirator to hold the mask body when repositioning and doffing. The indicia may take the form of, for example, a fingerprint pattern. A fingerprint pattern can be integrated into an area of ultrasonically bonded material to be seen as a contrast, or image, between the welded and un-welded areas and also may be felt at the wearer's fingertips by varying mask thickness at those areas. An image, however, also could be printed onto the grasping feature to allow for a greater visual contrast from the rest of the mask. When the indicia is generally circular in shape, the effect could be achieved by cutting a crescent shape, or even a small hole, into the grasping feature, which hole or opening would have the additional function of allowing the mask to be hung on a nail or hook for easy storage away from contaminated surfaces, or even as a method for dispensing.

GLOSSARY

[0011] The terms set forth below will have the meanings as defined:

[0012] "bisect(s)" means to divide into two generally equal parts;

[0013] "comprises (or comprising)" means its definition as is standard in patent terminology, being an open-ended term that is generally synonymous with "includes", "having", or "containing". Although "comprises", "includes", "having", and "containing" and variations thereof are commonly-used, open-ended terms, this invention also may be suitably described using narrower terms such as "consists essentially of', which is a semi open-ended term in that it excludes only those things or elements that would have a deleterious effect on the performance of the inventive respirator in serving its intended function;

[0014] "clean air" means a volume of atmospheric ambient air that has been filtered to remove contaminants;

[0015] "contaminants" means particles (including dusts, mists, and fumes) and/or other substances that generally may not be considered to be particles (e.g., organic vapors, et cetera) but which may be suspended in air;

[0016] "crosswise dimension" is the dimension that extends laterally across the respirator from side-to-side when the respirator is viewed from the front;

[0017] "cup-shaped configuration" means any vessel-type shape that is capable of adequately covering the nose and mouth of a person;

[0018] "exterior gas space" means the ambient atmospheric gas space into which exhaled gas enters after passing through and beyond the mask body and/or exhalation valve;

[0019] "filtering face-piece" means that the mask body itself is designed to filter air that passes through it; there are no separately identifiable filter cartridges or insert-molded filter elements attached to or molded into the mask body to achieve this purpose;

[0020] "filter" or "filtration layer" means one or more layers of air-permeable material, which layer(s) is adapted for the primary purpose of removing contaminants (such as particles) from an air stream that passes through it;

[0021] "filter media" means an air-permeable structure that is designed to remove contaminants from air that passes through it;

[0022] "filtering structure" means a construction that includes a filter media or a filtration layer and optionally other layers;

[0023] "first side" means an area of the mask body that is located on one side of a plane that bisects the mask body normal to the cross-wise dimension;

[0024] "fitment" means any one or combination of donning, doffing, or the adjusting mask body position;

[0025] "flange" means a protruding part that has sufficient surface area to be grasped by a person;

[0026] "frontally" means extending away from the mask body perimeter when the mask body is in a folded condition;

[0027] "harness" means a structure or combination of parts that assists in supporting the mask body on a wearer's face;

[0028] "indicia" means an identifying mark(s), pattern (s), image(s), opening(s), texture(s) or combination thereof;

[0029] "integral" means being manufactured together at the same time; that is, being made together as one part and not two separately manufactured parts that are subsequently joined together;

[0030] "interior gas space" means the space between a mask body and a person's face;

[0031] "laterally" means extending away from a plane that bisects the mask body normal to the cross-wise dimension when the mask body is in a folded condition;

[0032] "line of demarcation" means a fold, seam, weld line, bond line, stitch line, hinge line, and/or any combination thereof;

[0033] "mask body" means an air-permeable structure that is designed to fit over the nose and mouth of a person and that helps define an interior gas space separated from an exterior gas space (including the seams and bonds that join layers and parts thereof together);

[0034] "nose clip" means a mechanical device (other than a nose foam), which device is adapted for use on a mask body to improve the seal at least around a wearer's nose;

[0035] "perimeter" means the outer edge of the mask body, which outer edge would be disposed generally proximate to a wearer's face when the respirator is being donned by a person;

[0036] "pleat" means a portion that is designed to be or is folded back upon itself;

[0037] "polymeric" and "plastic" each mean a material that mainly includes one or more polymers and that may contain other ingredients as well;

[0038] "plurality" means two or more;

[0039] "respirator" means an air filtration device that is worn by a person to provide the wearer with clean air to breathe;

[0040] "second side" means an area of the mask body that is located on one side of a plane that bisects the mask body normal to the cross-wise dimension (the second side being opposite the first side);

[0041] "snug fit" or "fit snugly" means that an essentially air-tight (or substantially leak-free) fit is provided (between the mask body and the wearer's face);

[0042] "tab" means a part that exhibits sufficient surface area for attachment of another component; and

[0043] "transversely extending" means extending generally in the crosswise dimension.

BRIEF DESCRIPTION OF THE DRAWINGS

[0044] FIG. 1 is a front perspective view of a filtering face-piece respirator **10,** in accordance with the present invention, being worn on a person's face;

[0045] FIG. 2 is a top view of the respirator **10** shown in FIG. 1;

[0046] FIG. 3 is an enlarged top view;

[0047] FIG. 4 is a cross-sectional view of the mask body **12** taken along lines 4-4 of FIG. 2; and

[0048] FIG. 5 is a cross-sectional view of the filtering structure **16** taken along lines 5-5 of FIG. 4.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0049] In practicing the present invention, a filtering face-piece respirator is provided that has a grasping feature disposed on the mask body. An indicia is placed on the grasping feature so that the user can readily learn that that feature is designed for being grasped by the user during fitment. The grasping feature may comprise first and second flanges that extend both laterally and frontally from the mask body when in an open configuration. The first and second flanges provide "handles" on each side of the mask body to allow the wearer to appropriately position the mask body during use. The wearer does not need to pinch the mask body to move the mask into a desired face-fitting position. The flanges thus provide a very handy means for accomplishing mask adjustment. The indicia acts to inform the user that the flanges are where the mask body should be grasped during donning, doffing, and adjusting.

[0050] FIG. 1 shows an example of a flat-fold filtering face-piece respirator **10** that may be used in accordance with the present invention to provide clean air for the wearer to breathe. As illustrated, the filtering face-piece respirator **10** includes a mask body **12** and a harness **14.** The mask body **12** has a filtering structure **16** through which inhaled air passes before entering the wearer's respiratory system. The filtering structure **16** removes contaminants from the ambient environment so that the wearer breathes clean air. The mask body **12** includes a top portion **18** and a bottom portion **20.** The top portion **18** and the bottom portion **20** are separated by a line of demarcation **22.** In this particular embodiment, the demarcation line **22** is a pleat that extends transversely across the central portion of the mask body. The mask body **12** also includes a perimeter that includes an upper segment **24a** and a lower segment **24b.** The harness **14** has a strap **26** that is stapled to a tab **28a.** As illustrated, the tab **28a** is an integral part of the flange **30a.**

[0051] FIG. 2 shows that the respirator **10** can have first and second flanges **30a** and **30b** located on opposing sides of the mask body **12.** The strap **26** is attached to each tab **28a, 28b** using, for example, a staple. The flanges **30a** and **30b** project both laterally and frontally from the mask body and as such provide a grasping feature for the user. Each flange projects laterally from the mask body in that it extends away from a plane **P** that bisects the mask body in the x directions. The flanges **30a** and **30b** also extend frontally from the mask body **12** in that they extend away from the perimeter **24a** towards the front edge **22** of the mask body **12** in the direction as noted by arrow y. Each flange typically occupies a surface area of about 1 to 15 square centimeters (cm^2), more typically about 2 to 12 cm^2, still more typically about 5 to 10 cm^2. Each flange also typically extends away from the mask body at least 2 millimeters (mm), more typically at least 5 mm, and still more typically at least 1 to 2 centimeters (cm). The flanges **30a, 30b** may be integrally or non-integrally disposed on the mask body and may comprise one or more or all of the various layers that comprise the mask body. That is, the flanges may be an extension of the material used to make the mask body, or they may be made from a separate material such as a rigid or semi-rigid plastic. The flanges **30a, 30b** each have an indicia **32a, 32b** located on one or more sides of the flanges. As shown, the indicia **32, 32** may be in the form of a fingerprint to inform the user of where the mask body can be grasped between by user's opposable digits, for example, the thumb and the index finger. The indicia could take on other shapes and forms, for example concentric circles, ovals, or rectangles. Alternatively, the indicia could include a hole in the flange so that the wearer can feel the contact between their opposable digits.

[0052] FIG. 3 shows an example of a hole **33** that may be provided within the indicia 32b. The indicia can be created from a weld pattern, a printed image, one or more openings, cut slit(s), perforations, tackiness, or a combination of such things. The indicia typically will occupy a surface area of about 1 to 6 square centimeters (cm^2), more typically about 2 to 4 cm^2. Although another item such as ink may be added to the surface of the mask body to create the indicia, the indicia typically is formed integrally and exclusively from the materials of the mask body itself, for example, as a weld pattern. The indicia may be a welded pattern that is noticeable on the opposing major surfaces of each flange - that is, the weld extends through the flange thickness. The layers that comprise the mask body accordingly may be welded together such that the weld pattern is noticeable from the top or bottom surface of the grasping feature. An integral flange can have additional welds or bonds **34** provided thereon to increase flange stiffness. Alternatively, an adhesive layer may be used between the layers to increase flange stiffness. Using a *Stiffness in Flexure Test* set forth below, the flanges may have a flexural modulus of at least 10 Mega Pascals (MPa), more typically at least 20 MPa when bent along a major surface of the flange. At the upper end, the flexural modulus is typically less than 100 MPa, more typically less than 60 MPa. These numbers (i.e., at both the low and high ends) are approximately twice as large when the test is performed along the edges of the sample. Flange stiffness may be measured using a modified ASTM D790 method "Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials," Method I "Three Point Bend Testing". Flexural Modulus can be calculated according to ASTM

D790 in the linear region of the stress-strain plot. Although the tabs **28a** and **28b** are illustrated in FIG. 2 as having a shared edge that is part of perimeter segment **24a,** the tabs, however may extend beyond the face-contacting periphery part of the mask body perimeter when the mask is placed upon a wearer's face as shown in FIG. 1. The face-contacting periphery generally resides within the bracketed area **35** and thus is not part of the tab perimeter. The mask body perimeter may have a series of bonds or welds **34**' to join the various layer of the mask body **12** together. Bond lines **36** also may be provided where the flanges **30a, 30b** meet the filtering structure **16.** The upper portion **18** may include at least one pleat line **38** that extends from the first side of the mark body to the second side of the mask body. Examples of other grasping features besides integral flanges may include the addition of other components attached to the mask body such as flaps, loops, and posts, and may include: plastic injection molded parts; die cut parts made of plastic, metal, and/or cellulosic materials; mechanical clip-on devices; adhesively attached devices made of plastic, metal, and/or cellulosic materials; and mechanically attached devices such as rivets that are deformed during the attachment process. U.S. Patent Application 12/338,084 entitled *Flat Fold Respirator Having Flanges Disposed On The Mask Body,* discloses an example of a filtering face-piece respirator that uses flanges as grasping features, suitable for use in the present invention.

[0053] FIG. 4 illustrates an example of a pleated configuration of a mask body **12** that may be used in connection with the present invention. As shown, the mask body **12** includes pleats **22** and **38,** already mentioned with reference to FIGs. 1 and 2. The upper portion or panel **18** of the mask body **12** also includes a pleat **40.** The lower portion or panel **20** of the mask body **12** includes pleats **42, 44, 46, 48, 50,** and **52.** The lower portion **20** of the mask body **12** may include more filter media surface area than the upper portion **18.** The mask body **12** also includes a perimeter web **54** that is secured to the mask body along its perimeter. A nose clip **56** may be disposed on the upper portion **18** of the mask body centrally, adjacent to the perimeter between the filtering structure **16** and the perimeter web **54.** The nose clip **56** may be made from a pliable metal or plastic that is capable of being manually adjusted by the wearer to fit the contour of the wearer's nose. The perimeter web **54** may be folded over the mask body at the perimeter **24a, 24b.** The perimeter web **54** also may be an extension of an inner cover web **58,** folded and secured around the edge of **24a** and **24b.** Alternatively, the perimeter web could be an extension of the outer cover web **60.** As shown, the upper portion **18** appears as a pleated panel when the mask body **12** is in a folded condition; similarly the lower portion **20** (FIG. 1) appears as a pleated panel when the mask is in its folded storage condition. More or less pleats than illustrated may be used in providing a flat-fold filtering face-piece respirator in accordance with the present invention.

[0054] FIG. 5 illustrates that the filtering structure **16** may include one or more layers such as the inner cover web **58,** the outer cover web **60,** and a filtration layer **62.** The inner and outer cover webs **58** and **60** may be provided to protect the filtration layer **62** and to preclude fibers from the filtration layer **62** from coming loose and entering the mask interior. During respirator use, air passes sequentially through layers **60, 62,** and **58** before entering the mask interior. The air that is disposed within the interior gas space of the mask may then be inhaled by the wearer. When a wearer exhales, the air passes in the opposite direction sequentially through layers **58, 62,** and **60.** Alternatively, an exhalation valve (not shown) may be provided on the mask body to allow exhaled air to be rapidly purged from the interior gas space to enter the exterior gas space, minimizing air passage through filtering structure **16.** Typically, the cover webs **58** and **60** are made from a selection of nonwoven materials that provide a comfortable feel, particularly on the side of the filtering structure that makes contact with the wearer's face. The construction of various filter layers and cover webs that may be used in conjunction with the support structure of the present invention are described below in more detail. To improve wearer fit and comfort, an elastomeric face seal can be secured to the perimeter of the filtering structure **16.** Such a face seal may extend radially inward from the perimeter to contact the wearer's face when the respirator is being donned. Examples of face seals are described in U.S. Patents 6,568,392 to Bostock et al., 5,617,849 to Springett et al., and 4,600,002 to Maryyanek et al., and in Canadian Patent 1,296,487 to Yard. The filtering structure also may have a structural netting or mesh juxtaposed against at least one or more of the layers **58, 60,** or **62,** typically against the outer surface of the outer cover web **60.** The use of such a mesh is described in U.S. Patent Application Serial No. 12/338,091 filed December 18, 2008, entitled *Expandable Face Mask with Reinforcing Netting.*

[0055] A filtering structure that is used in connection with the present invention may take on a variety of different shapes and configurations. Generally the shape and configuration of the filtering structure corresponds to the general shape of the mask body. Although a filtering structure has been illustrated with multiple layers that include a filtration layer and two cover webs, the filtering structure may simply comprise a filtration layer or a combination of filtration layers. For example, a pre-filter may be disposed upstream to a more refined and selective downstream filtration layer. Additionally, sorptive materials such as activated carbon may be disposed between the fibers and/or various layers that comprise the filtering structure. Further, separate particulate filtration layers may be used in conjunction with sorptive layers to provide filtration for both particulates and vapors. The filtering structure may include one or more stiffening layers that assist in providing a cup-shaped configuration. The filtering structure also could have one or more horizontal and/or vertical lines of demarcation that contribute to its structural integrity.

[0056] The filtering structure that is used in a mask body of the invention can be of a particle capture or gas and vapor type filter. The filtering structure also may be a barrier layer that prevents the transfer of liquid from one side of the filter layer to another to prevent, for instance, liquid aerosols or liquid splashes (e.g. blood) from penetrating the filter layer. Multiple layers of similar or dissimilar filter media may be used to construct the filtering structure of the invention as the application requires. Filters that may be beneficially employed in a layered mask body of the invention are generally low in pressure drop (for example, less than about 195 to 295 Pascals at a face velocity of 13.8 centimeters per second) to minimize the breathing work of the mask wearer. Filtration layers additionally can be flexible and can have sufficient shear strength so that they generally retain their structure under the expected use conditions. Examples of particle capture filters include one or more webs of fine inorganic fibers (such as fiberglass) or polymeric synthetic fibers. Synthetic fiber webs may include electret-charged polymeric microfibers that are produced from processes such as meltblowing. Polyolefin microfibers formed from polypropylene that has been electrically charged are particularly useful for particulate capture applications. An alternate filter layer may comprise a sorbent component for removing hazardous or odorous gases from the breathing air. Sorbents may include powders or granules that are bound in a filter layer by adhesives, binders, or fibrous structures - see U.S. Patents 6,334,671 to Springett et al. and 3,971,373 to Braun. A sorbent layer can be formed by coating a substrate, such as fibrous or reticulated foam, to form a thin coherent layer. Sorbent materials may include activated carbons that are chemically treated or not, porous alumna-silica catalyst substrates, and alumna particles. An example of a sorptive filtration structure that may be conformed into various configurations is described in U.S. Patent 6,391,429 to Senkus et al.

[0057] The filtration layer is typically chosen to achieve a desired filtering effect. The filtration layer generally will remove a high percentage of particles and/or or other contaminants from the gaseous stream that passes through it. For fibrous filter layers, the fibers selected depend upon the kind of substance to be filtered and, typically, are chosen so that they do not become bonded together during the molding operation. As indicated, the filtration layer may come in a variety of shapes and forms; it typically has a thickness of about 0.2 millimeters (mm) to 10 mm, more typically about 0.3 mm to 5 mm, and it could be a generally planar web or it could be corrugated to provide an expanded surface area - see, for example, U.S. Patents 5,804,295 and 5,656,368 to Braun et al. The filtration layer also may include multiple filtration layers joined together by an adhesive or any other means. Essentially any suitable material that is known (or later developed) for forming a filtering layer may be used as the filtering material. Webs of melt-blown fibers, such as those taught in Wente, Van A., Superfine Thermoplastic Fibers, 48 Indus. Engn. Chem., 1342 et seq. (1956), especially when in a persistent electrically charged (electret) form are especially useful (see, for example, U.S. Pat. No. 4,215,682 to Kubik et al.). These melt-blown fibers may be microfibers that have an effective fiber diameter less than about 20 micrometers (μm) (referred to as BMF for "blown microfiber"), typically about 1 to 12 μm. Effective fiber diameter may be determined according to Davies, C. N., *The Separation OfAirborne Dust Particles,* Institution Of Mechanical Engineers, London, Proceedings 1B, 1952. Particularly preferred are BMF webs that contain fibers formed from polypropylene, poly (4-methyl-1-pentene), and combinations thereof. Electrically charged fibrillated-film fibers as taught in van Turnhout, U.S. Patent Re. 31,285, also may be suitable, as well as rosin-wool fibrous webs and webs of glass fibers or solution-blown, or electrostatically sprayed fibers, especially in microfilm form. Electric charge can be imparted to the fibers by contacting the fibers with water as disclosed in U.S. Patents 6,824,718 to Eitzman et al., 6,783,574 to Angadjivand et al., 6,743,464 to Insley et al., 6,454,986 and 6,406,657 to Eitzman et al., and 6,375,886 and 5,496,507 to Angadjivand et al. Electric charge also may be imparted to the fibers by corona charging as disclosed in U.S. Patent 4,588,537 to Klasse et al. or by tribocharging as disclosed in U.S. Patent 4,798,850 to Brown. Also, additives can be included in the fibers to enhance the filtration performance of webs produced through the hydro-charging process (see U.S. Patent 5,908,598 to Rousseau et al.). Fluorine atoms, in particular, can be disposed at fiber surfaces in the filter layer to improve filtration performance in an oily mist environment - see U.S. Patents 6,398,847 B1, 6,397,458 B1, and 6,409,806 B1 to Jones et al. Typical basis weights for electret BMF filtration layers are about 10 to 100 grams per square meter. When electrically charged according to techniques described in, for example, the '507 Angadjivand et al. patent, and when including fluorine atoms as mentioned in the Jones et al. patents, the basis weight may be about 20 to 40 g/m^2 and about 10 to 30 g/m^2, respectively.

[0058] An inner cover web can be used to provide a smooth surface for contacting the wearer's face, and an outer cover web can be used to entrap loose fibers in the mask body or for aesthetic reasons. The cover web typically does not provide any substantial filtering benefits to the filtering structure, although it can act as a pre-filter when disposed on the exterior (or upstream to) the filtration layer. To obtain a suitable degree of comfort, an inner cover web typically has a comparatively low basis weight and is formed from comparatively fine fibers. More particularly, the cover web may be fashioned to have a basis weight of about 5 to 50g/m^2 (typically 10 to 30g/m^2), and the fibers used often have an average fiber diameter of about 5 to 24 micrometers, typically of about 7 to 18 micrometers, and more typically of about 8 to 12 micrometers. Suitable materials for the cover web may be blown microfiber (BMF) materials, particularly polyolefin BMF materials, for example polypropylene BMF materials (including polypropylene blends and also blends of polypropylene and polyethylene) and spun-bond fibers. Cover webs that are used in the invention preferably have very few fibers protruding from the web surface after processing and therefore have a smooth outer surface. Examples of cover webs that may be used in the present invention are disclosed, for example, in U.S. Patent 6,041,782 to Angadjivand, U.S. Patent 6,123,077 to Bostock et al., and WO 96/28216A to Bostock et al.

[0059] The strap(s) that are used in the harness may be made from a variety of materials, such as thermoset rubbers, thermoplastic elastomers, braided or knitted yarn/rubber combinations, inelastic braided components, and the like. The strap(s) may be made from an elastic material such as an elastic braided material. The strap preferably can be expanded to greater than twice its total length and be returned to its relaxed state. The strap also could possibly be increased to three or four times its relaxed state length and can be returned to its original condition without any damage thereto when the tensile forces are removed. The elastic limit thus is preferably not less than two, three, or four times the length of the strap when in its relaxed state. Typically, the strap (s) are about 20 to 30 cm long, about 3 to 10 mm wide, and about 0.9 to 1.5 mm thick. The strap(s) may extend from the first tab to the second tab as a continuous strap or the strap may have a plurality of parts, which can be joined together by further fasteners or buckles. For example, the strap may have first and second parts that are joined together by a fastener that can be quickly uncoupled by the wearer when removing the mask body from the face. An example of a strap that may be used in connection with the present invention is shown in U.S. Patent 6,332,465 to Xue et al. Examples of fastening or clasping mechanisms that may be used to joint one or more parts of the strap together are shown, for example, in the following U.S. Patents: 6,062,221 to Brostrom et al.; 5,237,986 to Seppala; and EP1,495,785A1 to Chien.

[0060] An exhalation valve also may be attached to the mask body to facilitate purging exhaled air from the interior gas space. The use of an exhalation valve may improve wearer comfort by rapidly removing the warm moist exhaled air from the mask interior. See, for example, U.S. Patents 7,188,622, 7,028,689, and 7,013,895 to Martin et al.; 7,428,903, 7,311,104, 7,117,868, 6,854,463, 6,843,248, and 5,325,892 to Japuntich et al. ; 6,883,518 to Mittelstadt et al.; and RE37,974 to Bowers. Essentially any exhalation valve that provides a suitable pressure drop and that can be properly secured to the mask body may be used in connection with the present invention to rapidly deliver exhaled air from the interior gas space to the exterior gas space.

[0061] A nose clip that is used in conjunction with the present invention may be essentially any additional part that assists in improving the fit over the wearer's nose. Because there are substantial changes in contour to the wearer's face in this region, a nose clip can better assist the mask body in achieving the appropriate fit in this location. The nose clip may comprise, for example, a pliable dead soft band of metal such as aluminum, which can be shaped to hold the mask in a desired fitting relationship over the nose of the wearer and where the nose meets the cheek. An example of a suitable nose clip is shown in U.S. Patent 5,558,089 and Des. 412,573 to Castiglione. Other nose clips are described in U.S. Patent Application 12/238,737 (filed September 26, 2008); U.S. Publications 2007-0044803A1 (filed August 25, 2005); and 2007-0068529A1 (filed September 27, 2005).

[0062] Although the present invention has been described with reference to a particular flat-fold mask, the invention may be used in conjunction with flat-fold masks that have other configurations - such as those shown in U.S. Patents 7,069,930 to Bostock et al. and 6,394,090 to Chen, or it may be used in conjunction with molded masks - see for example U.S. Patents 7,131,442 to Kronzer et al., 6,923,182 to Angadjivand et al, and 6,827,764 to Springett et al. The invention also may be used in connection with the molded masks cited above.

EXAMPLE

[0063] A respirator filtering structure was formed from three layers of nonwoven material and other respirator components. The mask was assembled in two main operations - preform making and mask finishing. The preform making stage included the steps of lamination and fixing of nonwoven fibrous webs, formation of pleat crease lines, and attachment of the nose clip. The mask finishing operation included folding of pleats along embossed crease lines, fusing the lateral mask edges with the claimed indicia feature, cutting the tab into its final form, and attaching the headband.

[0064] The body of the respirator was formed from three layers of nonwoven material: outer cover web (205 mm x 300 mm); a filter material (205 mm x 300 mm); and an inner cover web (238 mm x 300 mm). The outer and inner cover webs were a 34 grams per square meter (gsm) polypropylene spun-bonded nonwoven. The filter material used in the mask body was an electret-charged blown microfiber polypropylene web that had a basis weight of 59 gsm, a solidity of 6%, and an effective fiber diameter of 7.5 micrometers.

[0065] The respirator body was made by plying each of the layers, which was then ultrasonically welded together using a point-bonded pattern. Ultrasonic welding was accomplished using an ultrasonic welding unit, Model 2000, from Branson, Danbury, Connecticut, operated at a ram pressure of 483 kilo pascals (kPa) with a horn amplitude, frequency, and dwell time of 100%, 20 kilohertz (kHz) and 0.6 sec respectively. Operating against an anvil with flat-top square pegs, having individual face areas of 1.6 square millimeters arranged in a grid pattern with spacing of approximately one centimeter on center of the pegs, the flat-faced horn of the welder acted against the anvil at a contact pressure of approximately 6 MPa. With the layers of nonwoven fixed, crease lines that define pleat location were embossed on the fixed layers of nonwoven. Embossing of the crease lines was done using a die cutting machine, Hytronic Cutting Machine Model B, from USM Corporation, Haverhill, Massachusetts, at 15 tons of force and with a crease rule die. The die had nine bars with radius edges that traversed the length of the preform and when pressed into the preform created lines into the nonwoven layers. The embossed lines compressed the webs together at the point of contact but did not penetrate or significantly fuse the material.

[0066] As a final step in the preform making operation, the extending edges of the inner coverweb were wrapped around the edges of the preform and ultrasonically welded into place. Ultrasonic welding was carried out using an ultrasonic welding unit Model 2000X from Branson, Danbury, Connecticut, operated at a ram pressure of 448 kPa with a horn amplitude, frequency, and dwell time of 100%, 20 kHz, and 0.5 sec, respectively. Operating against an anvil with a contact surface area of 4.1 square centimeters, using the specified ram pressure and horn conditions, resulted in contact pressures of 8.5 MPa to bond the materials of the preform. The area of the anvil used to bond the perimeter edge of the preform was configured in flat-top square pegs, having individual face areas of 1.6 square millimeters that were arranged in a pattern 34' as shown in FIG. 2. The flat-faced horn of the welder acted against an anvil, fixing the perimeter web to the preform. Using this process, a nose clip was attached to the top of the preform and was encapsulated between the outer coverweb and the folded over edge of the inner coverweb. The nose clip was a malleable, plastically-deformable aluminum strip that had the shape shown in FIG. 2 and was 9 cm long by 0.5 cm wide by 1 mm thick.

[0067] In the mask finishing operation, pleats were folded along crease lines as shown in FIG. 4. Pleats located above the central fold of the mask, were folded such that the exterior folds faced downwards with the mask open; this was done to help prevent accumulation of gross matter in the mask folds when worn. With the preform properly pleated and folded around the center fold, the preform was ultrasonically welded to fuse the lateral edges of the mask **(28a** and **28b** in FIG. 2) and to create the bonded layers of the stiffening flange which includes the grasping indicia **(32a** and **32b** in FIG. 2). Ultrasonic welding was done using an ultrasonic welding unit Model 2000x also from Branson, operated at a ram pressure of 483 kPa with a horn amplitude, frequency, and dwell time of 100%, 20kHz, and .8 sec, respectively. The contact area of the anvil for bonding the flange material was configured with flat-top square pegs, having individual face areas of 1.04 square millimeters that were spaced 2.88 millimeters apart from their flat sides, and included the shape of the claimed indicia. The resultant bond pattern is indicated as 30a in FIG. 2. The anvil bars that formed the lateral edge bonds of the mask were 95.25 millimeters long and 9.525 millimeters wide, with the resulting bond pattern indicated as 36 in FIG. 2. The flat-faced horn of the welder acted against the anvil resulting in the formation of an indicia weld pattern shown in FIGS. 2 and 3) and created the bonded layers of the flanges. Angled bar elements of the anvil sealed the lateral edges of the mask and pin welding surfaces fused and stiffened the flange material. As a final step in the mask finishing operation, the stiffening flanges were cut to a desired shape, and a headband was stapled to the tabs. Flanges were 1.0 cm wide by 5.0 cm long with a 0.5 cm radius head located at the tab point of attachment of the headband. The headband was attached to the tabs radius head using a hand stapler from Stanley Bostitch, East Greenwich, Rhode Island, Model P6C-8 and staples No. STH5019 1/4 inch galvanized. Sections of the flange were cut from the mask and tested according to the method outlined in *Stiffness in Flexure Test.* The flange sections were tested in two orientations: along the flat plane of the sample and along the edge of the sample as it would be oriented along the length of the flange. When bent along the flat plane of the sample, the flexural modulus was 27 MPa. When tested along the edge of the sample, it was 66 MPa. The headband was 7.9 mm wide by 0.8 mm thick, Sample No. 125-1 from Providence Braid Co., Pawtucket, Rhode Island. The flanges were able to rotate on an axis parallel to the line of attachment to the mask body and provided a more rigid mask body when opened and donned. The indicia disposed on the flanges was readily visible as an indication of where to grasp the mask body.

[0068] This invention may take on various modifications and alterations without departing from its spirit and scope. Accordingly, this invention is not limited to the above-described but is to be controlled by the limitations set forth in the following claims and any equivalents thereof.

[0069] This invention also may be suitably practiced in the absence of any element not specifically disclosed herein.

[0070] All patents and patent applications cited above, including those in the Background section, are incorporated by reference into this document in total. To the extent there is a conflict or discrepancy between the disclosure in such incorporated document and the above specification, the above specification will control.

Claims

1. A filtering face-piece respirator that comprises:

(a) a harness;

(b) a mask body that has a grasping feature located thereon, the grasping feature having an indicia for providing an indication for where to grasp the mask body for fitment.

2. The filtering face-piece respirator of claim 1, wherein the grasping feature comprises a flange.

3. The filtering face-piece respirator of claim 2, wherein the grasping feature comprises first and second flanges located on opposing sides of the mask body.

4. The filtering face-piece respirator of claim 3, wherein the indicia comprises at least one cut-out portion on the first and second flanges, respectively.

5. The filtering face-piece respirator of claim 3, wherein the indicia comprises first and second weld lines on the first and second flanges, respectively.

6. The filtering face-piece respirator of claim 4, wherein the weld lines resemble a fingerprint.

7. The filtering face-piece respirator of claim 1, wherein the mask body comprises first and second flanges that are integral to the mask body.

8. The filtering face-piece respirator of claim 7, wherein the first and second flanges have first and second indicia noticeable on opposing major surfaces of each flange.

9. The filtering face-piece respirator of claim 8, wherein the indicia resembles a fingerprint.

10. The filtering face-piece respirator of claim 9, wherein the flanges each occupy a surface area of about 2 to 12 square centimeters.

11. A method of making a filtering face-piece respirator, which method comprises:

    (a) providing a mask body that has a grasping feature located thereon;
    (b) placing an indicia on the grasping feature to provide an indication to a respirator user of where to grasp the mask body for fitment purposes; and
    (c) securing a harness to the mask body.

12. The method of claim 11, wherein the grasping feature comprises first and second flanges located on opposing sides of the mask body.

13. The method of claim 12, wherein first and second indicia is placed on the first and second flanges, respectively.

14. The method of claim 13, wherein the first and second indicia comprise first and second weld patterns on the first and second flanges, respectively.

15. The method of claim 14, wherein the first and second weld each patterns resemble a fingerprint pattern, that occupies about 2 to 4 cm^2 in surface area.

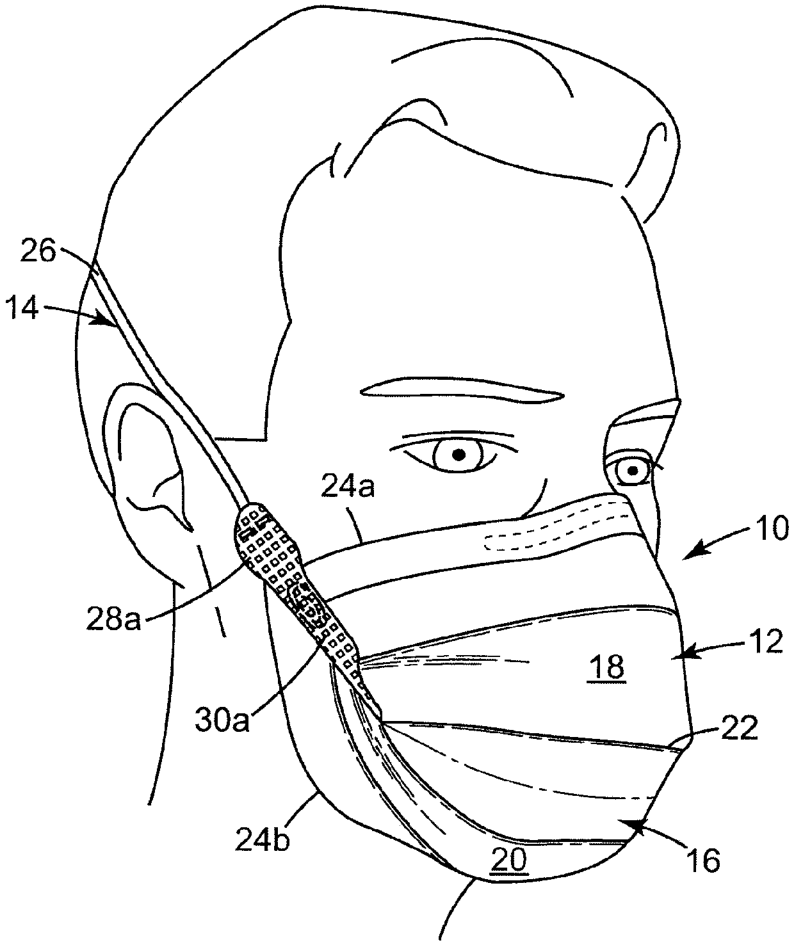
26
14
24a
10
28a
12
18
30a
22
24b
20
16

Fig. 1

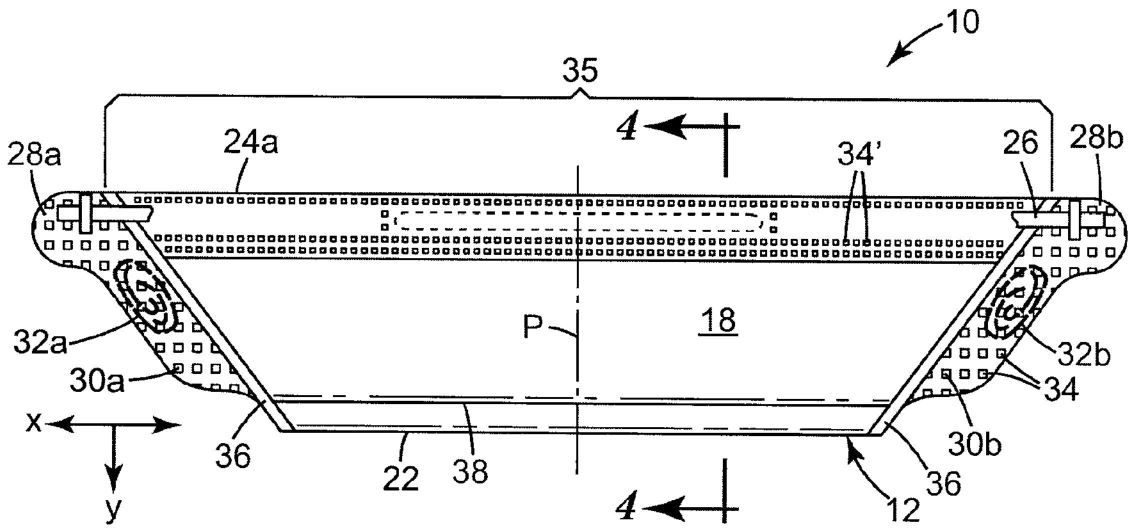
10
35
4
28a
24a
34'
26
28b
P
18
32a
32b
30a
34
x
36
22
38
12
36
30b
y
4

Fig. 2

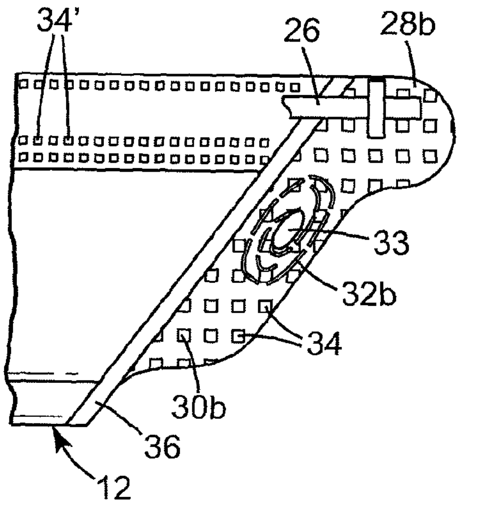

Fig. 3

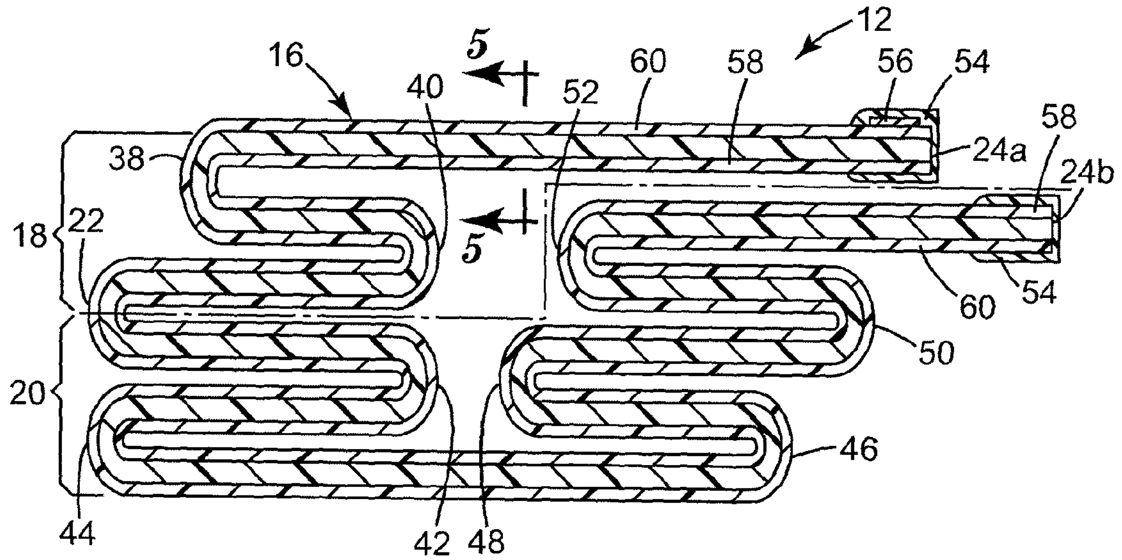

Fig. 4

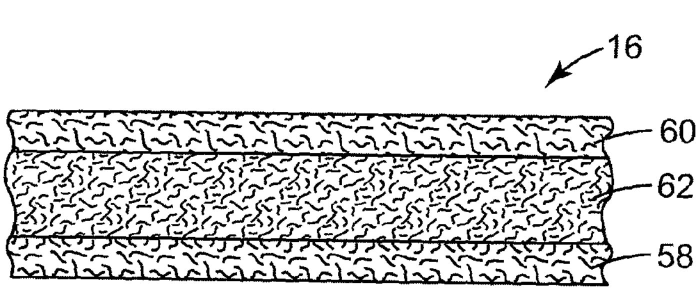

Fig. 5

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US RE39493 E, Yuschak **[0003]**
- US 4098270 A, Dolby **[0003]**
- US 4790306 A, Braun **[0003]**
- US 7131442 B, Kronzer **[0004] [0062]**
- US 6923182 B **[0004] [0062]**
- US 6041782 A, Angadjivand **[0004] [0058]**
- US 4850347 A, Skov **[0004]**
- US 4807619 A, Dyrud **[0004]**
- US 4536440 A, Berg, and Des **[0004]**
- US 285374 A, Huber **[0004]**
- US 6568392 B **[0005] [0054]**
- US 6484722 B, Bostock **[0005]**
- US 6394090 B, Chen **[0005] [0062]**
- US 6948499 B **[0007]**
- US 6945249 B, Griesbach, III **[0007]**
- US 338084 A **[0052]**
- US 5617849 A, Springett **[0054]**
- US 4600002 A, Maryyanek **[0054]**
- CN 1296487, Yard **[0054]**
- US 33809108 A **[0054]**
- US 6334671 B, Springett **[0056]**
- US 3971373 A, Braun **[0056]**
- US 6391429 B, Senkus **[0056]**
- US 5804295 A **[0057]**
- US 5656368 A, Braun **[0057]**
- US 4215682 A, Kubik **[0057]**
- US RE31285 E **[0057]**
- US 6824718 B, Eitzman **[0057]**
- US 6783574 B, Angadjivand **[0057]**
- US 6743464 B, Insley **[0057]**
- US 6454986 B **[0057]**
- US 6406657 B, Eitzman **[0057]**
- US 6375886 B **[0057]**
- US 5496507 A, Angadjivand **[0057]**
- US 4588537 A, Klasse **[0057]**
- US 4798850 A, Brown **[0057]**
- US 5908598 A, Rousseau **[0057]**
- US 6398847 B1 **[0057]**
- US 6397458 B1 **[0057]**
- US 6409806 B1, Jones **[0057]**
- US 6123077 A, Bostock **[0058]**
- WO 9628216 A, Bostock **[0058]**
- US 6332465 B, Xue **[0059]**
- US 6062221 A, Brostrom **[0059]**
- US 5237986 A, Seppala **[0059]**
- EP 1495785 A1, Chien **[0059]**
- US 7188622 B **[0060]**
- US 7028689 B **[0060]**
- US 7013895 B, Martin **[0060]**
- US 7428903 B **[0060]**
- US 7311104 B **[0060]**
- US 7117868 B **[0060]**
- US 6854463 B **[0060]**
- US 6843248 B **[0060]**
- US 5325892 A, Japuntich **[0060]**
- US 6883518 B, Mittelstadt **[0060]**
- US RE37974 E, Bowers **[0060]**
- US 5558089 A **[0061]**
- US 412573 A, Castiglione **[0061]**
- US 23873708 A **[0061]**
- US 20070044803 A1 **[0061]**
- US 20070068529 A1 **[0061]**
- US 7069930 B, Bostock **[0062]**
- US 6827764 B, Springett **[0062]**

Non-patent literature cited in the description

- **Wente, Van A.** Superfine Thermoplastic Fibers. *Indus. Engn. Chem.,* 1956, vol. 48, 1342 **[0057]**