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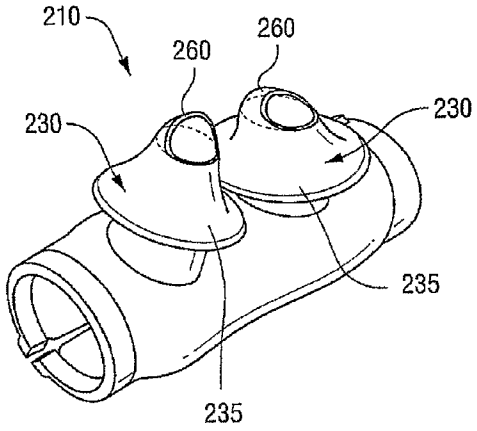

(57) Abstract: A nasal prong (230) for sealing with a nasal passage of a patient includes a head portion (235) structured to seal and/or sealingly communicate with the patient's nasal passage and a column or stalk structured to interconnect the head portion with a base. The head portion (235) is configured to direct gas in use away from the septum and/or posteriorly relative to the nasal passage.

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NASAL PRONGS FOR MASK SYSTEM

CROSS-REFERENCE TO APPLICATION

[0001] This application claims the benefit of U.S. Provisional Patent Application Nos. 60/835,442, filed August 4, 2006, and 60/852,649, filed October 19, 2006, each of which is incorporated herein by reference in its entirety.

FIELD OF THE INVENTION

[0002] The present invention relates to nasal prongs for a mask system for delivery of respiratory therapy to a patient. Examples of such therapies are Continuous Positive Airway Pressure (CPAP) treatment, Non-Invasive Positive Pressure Ventilation (NIPPV), and Variable Positive Airway Pressure (VPAP). The therapy is used for treatment of various respiratory conditions including Sleep Disordered Breathing (SDB) such as Obstructive Sleep Apnea (OSA).

BACKGROUND OF THE INVENTION

[0003] Nasal prongs (also referred to as nasal pillows, nozzles and cannulae) used in the treatment of SDB are designed for sealing inside and/or against respective nasal passages of the patient, such as against the outer, exposed surfaces of the nares. Air or other breathable gas is supplied by a blower and passed along a flexible conduit to the nasal prongs.

[0004] A common problem with known nasal prongs is patient comfort. For example, one common problem is irritation or discomfort of the inside of the patient's nostrils caused by air flow irritation (referred to as air jetting or jetting effect) when high velocity air, e.g., pressurized up to 14 cmH_2O or more, is passed through the nasal passages from the nasal prongs.

[0005] A known mask structured to minimize the sensation of air jetting is disclosed in U.S. Patent No. 5,724,965, for example.

[0006] There is a continuous need in the art to provide nasal prongs with a high level of comfort by reducing and/or eliminating air jetting.

SUMMARY OF THE INVENTION

[0007] One aspect of the present invention relates to nasal prongs that provide more comfort to the patient.

[0008] Another aspect of the present invention relates to nasal prongs that structured to reduce and/or eliminate air jetting.

[0009] Another aspect of the present invention relates to a nasal prong for sealing with a nasal passage of a patient. The nasal prong includes a head portion structured to seal and/or sealingly communicate with the patient's nasal passage and a column or stalk structured to interconnect the head portion with a base. The head portion is configured to direct gas in use generally away from or along the septum and/or posteriorly relative to the nasal passage.

[0010] Another aspect of the present invention relates to a nasal prong for sealing with a nasal passage of a patient. The nasal prong is structured to create conditions for turbulence or dispersion within the nasal passage.

[0011] Another aspect of the present invention relates to a nasal prong for sealing with a nasal passage of a patient. The nasal prong is structured to redirect air flow direction, diffuse air flow or create turbulence, and/or orient the prong orifice in order to reduce and/or eliminate air jetting effects.

[0012] Another aspect of the present invention relates to a nasal prong for sealing with a nasal passage of a patient. The nasal prong includes a head portion structured to seal and/or sealingly communicate with the patient's nasal passage and a column or stalk structured to interconnect the head portion with a base. The stalk is configured to direct air in a first direction and the head portion is configured to direct air in a second direction or vector that is angled with respect to the first direction.

[0013] Another aspect of the present invention relates to a nasal prong for sealing with a nasal passage of a patient. The nasal prong includes a head portion structured to seal and/or sealingly communicate with the patient's nasal passage and a column or stalk structured to interconnect the head portion with a base. The head portion is configured to provide sealing along a first plane and provide an exit orifice to direct gas along a vector or direction that is angled with respect to the first plane.

[0014] Another aspect of the present invention relates to a nasal prong for sealing with a nasal passage of a patient. The nasal prong includes a head portion structured to seal and/or sealingly communicate with the patient's nasal passage and a column or stalk structured to mount the head portion to a base. The head portion includes a hood, a rib, and/or a grate, each of which may include surface treatment.

[0015] Another aspect of the present invention relates to a nasal prong for sealing with a nasal passage of a patient. The nasal prong includes a head portion structured to seal and/or sealingly communicate with the patient's nasal passage and a column or stalk structured to mount the head portion to a base. The head portion includes an exit orifice that is offset from an axis of the stalk, has a triangular shape, and/or is angled with respect to a sealing plane.

[0016] Another aspect of the present invention relates to a nasal prong for sealing with a nasal passage of a patient. The nasal prong includes a head portion structured to seal and/or sealingly communicate with the patient's nasal passage and a column or stalk structured to mount the head portion to a base. The head portion has a dual-wall configuration including an inner wall and an outer wall that surrounds the inner wall. The inner wall and/or outer wall includes a hood, a rib, and/or a grate, each of which may include surface treatment.

[0017] Another aspect of the present invention relates to a nasal prong for sealing with a nasal passage of a patient. The nasal prong includes a head portion structured to seal and/or sealingly communicate with the patient's nasal passage and a column or stalk structured to mount the head portion to a base. The head portion has a dual-wall configuration including an inner wall and an outer wall that surrounds the inner wall. The inner wall includes one or more holes.

[0018] Another aspect of the present invention relates to a nasal prong for sealing with a nasal passage of a patient. The nasal prong includes a head portion structured to seal and/or sealingly communicate with the patient's nasal passage and a column or stalk structured to mount the head portion to a base. The head portion includes an anterior portion and a posterior portion. The anterior portion has a shape that is different than a shape of the posterior portion.

[0019] Another aspect of the present invention relates to a nasal prong for sealing with a nasal passage of a patient. The nasal prong includes a head portion structured to seal and/or sealingly communicate with the patient's nasal passage and a column or stalk structured to mount the head portion to a base. The head portion has a dual-wall configuration including an inner wall and an outer wall that surrounds the inner wall. An orifice of the inner wall and/or outer wall includes a series of contours or lobes.

[0020] Another aspect of the present invention relates to a mask system including a frame and a nasal prong assembly provided to the frame. The nasal prong assembly includes a base and a pair of nasal prongs provided to the base. A dispersion cartridge is adapted to extend through the base to create turbulence and/or disperse gas flow.

[0021] Another aspect of the present invention relates to a method for forming a dispersion cartridge adapted to create turbulence and/or disperse gas flow in a mask system. The method includes providing a flat piece of material that provides a plurality of openings or pores, rolling the material into cylindrical form, and inserting the cylinder into a frame, elbow, and/or end plug of the mask system to create turbulence and/or disperse gas flow.

[0022] Other aspects, features, and advantages of this invention will become apparent from the following detailed description when taken in conjunction with the accompanying drawings, which are a part of this disclosure and which illustrate, by way of example, principles of this invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] The accompanying drawings facilitate an understanding of the various embodiments of this invention. In such drawings:

[0024] Fig. 1 is a perspective view of a mask system including a nasal prong assembly as known in the art;

[0025] Figs. 2-1 to 2-5 illustrate the nasal prong assembly isolated from the mask system shown in Fig. 1 and showing reference planes through the nasal prong assembly, Figs. 2-3 to 2-5 also illustrating exemplary air flow ranges and angles according to an embodiment of the present invention;

[0026] Fig. 2-6 showing an exemplary human nose and an exemplary air flow direction according to an embodiment of the present invention; and

[0027] Figs. 3-1 to 3-3, 4-1 to 4-2, and 5-1 illustrate nasal prongs including hoods according to embodiments of the present invention;

[0028] Figs. 6-1, 7-1, and 8-1 illustrate nasal prongs including shifted orifices according to embodiments of the present invention;

[0029] Figs. 9-1, 9-2, and 10-1 illustrate nasal prongs including ribbing according to embodiments of the present invention;

[0030] Figs. 11-1 to 11-2 and 12-1 to 12-2 illustrate nasal prongs including triangular orifices according to embodiments of the present invention;

[0031] Figs. 13-1 to 13-2, 14-1, 15-1, 16-1 to 16-2, 17-1, and 18-1 to 18-2 illustrate nasal prongs including grates according to embodiments of the present invention;

[0032] Figs. 19-1, 20-1, 21-1, 22-1 to 22-2, 23-1, 23-2 to 23-3, 24-1, and 25-1 illustrate nasal prongs including dual walls according to embodiments of the present invention;

[0033] Figs. 26-1 to 26-2 illustrate a nasal prong including an angled orifice according to an embodiment of the present invention;

[0034] Figs. 27-1 to 27-2 illustrate a nasal prong including a concave anterior portion according to an embodiment of the present invention;

[0035] Figs. 28-1 to 28-3 illustrate various views of a disposable or re-useable dispersion cartridge for a nasal prong assembly according to an embodiment of the present invention; and

[0036] Fig. 28-4 illustrates a disposable or re-useable dispersion cartridge for a nasal prong assembly according to another embodiment of the present invention.

DETAILED DESCRIPTION OF ILLUSTRATED EMBODIMENTS

[0037] The following includes descriptions of several illustrated embodiments of the present invention, which may share common characteristics and features. It is to be understood that one or more features of any one embodiment may be combinable with one or more features of the other embodiments. In addition, each single feature or combination of features in any of the embodiments may constitute an additional embodiment.

[0038] Each illustrated embodiment includes features that may be used with the embodiments and/or components described in U.S. Non-Provisional Application Nos. 10/781,929, 10/546,305, and 11/101,657, and PCT Appln. Nos. PCT/AU2004/001832 and PCT/AU2006/000770, as would be apparent to those of ordinary skill in the art. U.S. Non-Provisional Application Nos. 10/781,929, 10/546,305, and 11/101,657 and PCT Appln. No. PCT/AU2006/000770 are each incorporated herein by reference in its entirety.

1. Known Nasal Prongs

[0039] Fig. 1 illustrates a mask system 5 including a nasal prong assembly 10 such as at that shown in the incorporated U.S. applications. As illustrated, the nasal prong assembly 10 includes a base 20 and a pair of nasal prongs 30 provided to the base 20. Each nasal prong 30 includes a head portion 35 adapted to seal and/or sealingly communicate with a respective patient nasal passage and a column or stalk 40 that interconnects the head portion 35 with the base 20. The nasal prong assembly 10 may be integrally formed in one-piece, e.g., by silicone in an injection molding process. The nasal prong assembly 10 is structured to be removably and replacably attached to a substantially rigid frame 50. One or more vent openings may be provided in the frame and/or base for CO_2 washout.

[0040] The known nasal prongs 30 are constructed and arranged to direct air into the patient's nasal passages in a predetermined flow direction or angle. Figs. 2-1 to 2-5 illustrate four planes (i.e., plane A, plane B, plane C, and plane D) through the nasal prong assembly 10. Planes A, B, and C pass through respective ones of the three axes of a selected prong 30, and plane D passes through a vertical axis of the base 20.

[0041] As illustrated, the nasal prongs 30 are mounted to the base 20 at an angle (e.g., plane B angled with respect to plane D as best shown in Fig. 2-4). In use, the prongs 30 "pinch" the nasal septum while directing air flow medially onto the septum (in the direction of plane B shown in Fig. 2-4) and superiorly into the nasal passage (in the direction of plane C shown in Fig. 2-5). The septum is the midline structure or wall inside the nose that divides the nose into left and right sides.

[0042] Such an air flow arrangement may be comfortable for a wide range of patients. For other patients, such an air flow arrangement may cause discomfort due to air jetting or directed flow onto the septum.

2. Nasal Prong Embodiments

[0043] The following embodiments describe alternative prong arrangements that are structured to improve comfort and fitting by reducing and/or eliminating the air jetting effect. Specifically, the following embodiments illustrate alternative prong arrangements structured to redirect air flow direction, diffuse air flow or create turbulence, and/or change the prong orifice in order to reduce and/or eliminate air jetting effects.

[0044] For example, a more comfortable prong may be structured to direct air flow superiorly rather than medially onto the septum (as viewed from the front). In an embodiment, air should be directed away from plane D and approach plane A to reduce the effect of air jetting and redirect the air away from close proximity tissue (i.e., the septum). Also, a more comfortable prong may be structured to direct air flow posteriorly into the nasal passage rather than superiorly straight up the nasal passage (as viewed from the side). In an embodiment, the orifice of the prong may be shifted more posteriorly and medially and directed superiorly.

[0045] Figs. 2-3 to 2-5 show exemplary air flow ranges (shaded regions) and angles according to an embodiment of the present invention. In an embodiment, d1 may be about 3°, d2 may be about 40°, d3 may be about 5°, d4 may be about 35°, and d5 may be about 90°. As noted above, the shaded regions are selected to direct air away from the septum and towards the back of the patient's head. Although specific dimensions and ranges are shown in Figs. 2-3 to 2-5, it is to be understood that these dimensions and ranges are merely exemplary and other dimensions and ranges are possible depending on application. For example, dimensions and ranges that vary from those provided +/- 10% may be suitable for particular applications.

[0046] Fig. 2-6 illustrates an exemplary human nose and an exemplary air flow direction according to an embodiment of the present invention. As illustrated, air flow is preferably directed more posteriorly (arrow indicated in solid lines), e.g., towards the back of the patient's head, rather than straight up the nasal passage as in the old configuration (arrow indicated in dashed lines) to protect sensitive areas of the anterior nose. That is, the air flow indicated in dashed lines in Fig. 2-6 provides a jetting effect in which air is a directed flow at sensitive areas of the anatomy, which may cause cooling and/or drying in these sensitive areas. Accordingly, an aspect of the invention relates to nasal prongs that provide less

directed flow and/or more turbulent flow. Turbulent flow provides flow with more energy so that it can travel around corners better. Also, an aspect of the invention relates to nasal prongs that provide increased dispersion, which may be done by turbulence. Dispersed air provides flow that is not directed at sensitive areas as much, e.g., air dispersed by creating small scale turbulence. Further, an aspect of the invention relates to nasal prongs that direct air away from sensitive areas of the patient's nose, e.g., such as air flow indicated in solid lines in Fig. 2-6.

[0047] In an alternative embodiment, the prongs may be configured to change (e.g., change continuously) air flow direction during therapy, e.g., to allow nasal mucosa to rest.

[0048] In yet another embodiment, the prongs may be configured to change air flow in concert with the nasal cycle, which is the normal cycle of congestion and decongestion of the nasal tissue to allow nasal mucosa to rest periodically. For example, independent flow in each nostril may be provided to address the nasal cycle. Such arrangements may increase the comfort of CPAP therapy.

[0049] Also, flow may be changed dependent on the patient's body position, e.g., side the patient is lying on. For example, the mask system may be configured to allow flow to be occluded in the inferior prong and open in the superior prong (if the patient is lying on his/her side), e.g., gravity flap, collapsible headgear tubing.

2.1 Hood to Direct Air

[0050] A hood may be provided to the head portion of the nasal prong to direct air flow. That is, the hood changes the air flow direction (with respect to the old configuration) to reduce and/or eliminate the air jetting effect, e.g., direct flow away from the septum.

[0051] In the illustrated embodiments, a hood is provided to an exterior portion of the prong. In alternative embodiments, a hood may be provided to an interior portion of the prong, e.g., at least partially within the head portion of the prong.

2.1.1 Anterior Hood

[0052] Figs. 3-1 to 3-3 illustrate a nasal prong assembly 210 according to an embodiment of the present invention. As illustrated, each prong 230 includes a hood 260, e.g., integrally formed with the head portion 235.

[0053] The hood 260 is provided to an anterior portion (i.e., front portion) of the head portion 235 along the perimeter of the prong orifice. The hood 260 is structured to change the air flow in two planes such that the hood 260 directs the air flow away from the septum and towards the back of the patient's head (e.g., see Fig. 2-6).

[0054] As shown in Fig. 3-2, the hood 260 directs the air superiorly (indicated in solid lines), e.g., straight up such that the air flow paths are generally parallel to one another, rather than towards the septum as in the old configuration (indicated in dashed lines). In addition, as shown in Fig. 3-3, the hood 260 directs the air posteriorly (indicated in solid lines), e.g., towards the rear, rather than straight up the nasal passage as in the old configuration (indicated in dashed lines). This arrangement avoids direct contact with sensitive areas of the anterior nose.

2.1.2 Medial Hoods

[0055] Figs. 4-1 to 4-2 illustrate a nasal prong assembly 310 according to another embodiment of the present invention. As illustrated, each prong 330 includes a hood 360, e.g., integrally formed with the head portion 335.

[0056] The hood 360 is provided to an medial portion (i.e., middle portion) of the head portion 335 along the perimeter of the prong orifice. In the example of Figs. 4-1 to 4-2, the hoods are provided on that portion of the prong closest to the other prong. The hood 360 is structured to change the air flow such that the hood 360 directs the air flow away from the septum.

[0057] As shown in Fig. 4-2, the hood 360 directs the air posteriorly (indicated in solid lines), e.g., straight up, rather than towards the septum as in the old configuration (indicated in dashed lines).

2.1.3 Large Hoods

[0058] Fig. 5-1 illustrates a nasal prong assembly 410 according to another embodiment of the present invention. As illustrated, each prong 430 includes a hood 460, e.g., integrally formed with the head portion 435.

[0059] The hood 460 is a larger version of the hood 360 shown in Fig. 4-1. The hood 460 is structured to change the air flow such that the hood 460 directs the air flow away from the septum. The hood 460 may also protect sensitive areas of the anterior nose.

2.2 Shifted Orifice to Direct Air

[0060] The placement of the prong orifice may be changed or shifted (with respect to the orifice in the old configuration) to direct air flow. That is, the shifted orifice changes the air flow direction (with respect to the old configuration) to reduce and/or eliminate the air jetting effect.

[0061] For example, the prong orifice may be shifted such that its axis is offset from the axis of the prong, e.g., shifted orifice provided along the perimeter of the old orifice. The orifice position may be customized to a specific patient, e.g., placement based on patient preference or comfort. Also, the shifted orifice may facilitate locating the prong into the patient's nose.

[0062] In alternative embodiments, the prong orifice may be positioned anywhere along the perimeter of old orifice to eliminate and/or reduce the jetting effect, e.g. ,depending on the geometry of the patient's nares.

2.2.1 Posteriorly Shifted Orifice

[0063] Fig. 6-1 illustrates a nasal prong assembly 510 according to another embodiment of the present invention. As illustrated, each prong 530 includes an orifice 545 that is shifted posteriorly towards the rear of the head portion 535 (with respect to the orifice in the old configuration shown in Fig. 1).

[0064] The posteriorly shifted orifice 545 is structured to shift the air flow more posteriorly as well as direct the air flow more posteriorly, e.g., towards the back of the patient's head rather than straight up the nasal passage as in the old configuration. This arrangement protects sensitive areas of the anterior nose.

2.2.2 Tiny Posterior Orifices

[0065] Fig. 7-1 illustrates a nasal prong assembly 610 according to another embodiment of the present invention. As illustrated, each prong 630 includes an orifice 645

that is shifted posteriorly towards the rear of the head portion 635 (with respect to the old orifice).

[0066] The posteriorly shifted orifice 645 is structured to shift the air flow more posteriorly as well as direct the air flow more posteriorly, e.g., towards the back of the patient's head rather than straight up the nasal passage as in the old configuration. In addition, the orifice 645 is relatively small to provide a relatively small concentrated jet of air directed posteriorly.

2.2.3 Medium Posterior Orifices

[0067] Fig. 8-1 illustrates a nasal prong assembly 710 according to another embodiment of the present invention. As illustrated, each prong 730 includes an orifice 745 that is shifted posteriorly towards the rear of the head portion 735 (with respect to the old orifice).

[0068] The posteriorly shifted orifice 745 is structured to shift the air flow more posteriorly as well as direct the air flow more posteriorly, e.g., towards the back of the patient's head rather than straight up the nasal passage as in the old configuration. The orifice 745 is medium sized (e.g., larger than the small orifice 645) to increase the available air flow and to provide a slightly more dispersed air flow.

2.3 Ribbing for Turbulence

[0069] Ribbing may be provided to the head portion of the nasal prong to create turbulence or a vortex. The ribbing creates turbulence in the air flow to reduce and/or eliminate the air jetting effect, e.g., air flow dispersed and not localized. That is, the ribbing disperses the air before it enters the patient's nasal cavity to reduce irritation.

[0070] Also, turbulence provides greater vapor or moisture exchange, which reduces dryness in the patient's nasal cavity. Specifically, turbulent flow may be more comfortable as dryness is reduced and humidity is increased because the humid air has more contact with the patient's nasal cavity rather than localized, directed flow.

[0071] In an alternative embodiment, turbulent flow may be created by a rotatable element within the nasal prong assembly, e.g., fan to create turbulence.

2.3.1 Helical Ribs

[0072] Fig. 9-1 illustrates a nasal prong assembly 810 according to another embodiment of the present invention. As illustrated, each prong 830 includes one or more ribs 865 that extend along an interior surface of the head portion 835, e.g., integrally formed with the head portion 835.

[0073] In the illustrated embodiment, each rib 865 has a helical shape that extends from the prong orifice to the rib or base of the head portion 835. However, the ribs may have other suitable shapes, and may have other suitable arrangements along the interior surface of the head portion 835, e.g., extend along a portion of the length of the head portion. As illustrated, 6 ribs 865 are provided to each prong 830. However, each prong 830 may have any suitable number of ribs, e.g., 1,2, 3, 4, or 5 ribs.

[0074] In use, the helical ribs 865 introduce swirl to the air flow, which increase the dispersion and turbulence of the air as it exits the prong orifice.

2.3.2 Concentric Ribs

[0075] Fig. 9-2 illustrates a nasal prong 930 according to another embodiment of the present invention. As illustrated, the prong 930 includes a plurality of ribs 965 that form concentric ribs or rings along an interior surface of the head portion 935, e.g., integrally formed with the head portion 935.

[0076] In the illustrated embodiment, each rib 965 has a generally circular, oval, and/or arcuate shape that extends around at least a portion of the interior perimeter of the head portion 935. For example, some ribs 965 may extend around the entire interior perimeter of the head portion 935, and other ribs 965 may extend around portions of the interior perimeter of the head portion 935 (e.g., multiple ribs spaced around perimeter). The ribs 965 may be parallel and/or angled with respect to plane A shown in Fig. 2-4 (Fig. 9-2 shows ribs 965 parallel with plane A).

[0077] As illustrated, 3 ribs 965 are provided to the prong 930. However, the prong 930 may have any suitable number of ribs, e.g., 4 or 5 ribs.

[0078] In use, the ribs 965 increase the dispersion and turbulence of the air as it exits the prong orifice.

2.3.3 Non-uniform Ribbing

[0079] Fig. 10-1 illustrates a nasal prong assembly 1010 according to another embodiment of the present invention. As illustrated, each prong 1030 includes a plurality of ribs 1065 provided to an interior surface of the head portion 1035, e.g., integrally formed with the head portion 1035.

[0080] In the illustrated embodiment, each rib 1065 has a random or non-uniform shape that extends along a portion of the interior surface of the head portion 1035. Any suitable number of ribs 1065 may be provided to each prong 1030, e.g., 3, 4, 5 or more ribs.

[0081] In use, the ribs 1065 increase the dispersion and turbulence of the air as it exits the prong orifice.

2.3.4 Roughened Interior Surface

[0082] In an alternative embodiment, each prong may include a head portion with a roughened or coarsened interior surface. In use, the roughened interior surface may increase the dispersion and turbulence of the air as it exits the prong orifice.

2.4 Triangular Orifice for Turbulence

[0083] The shape of the prong orifice may be changed to create turbulence. In the illustrated embodiments described below, the prong orifice is changed from a generally oval shape in the old configuration to a triangular shape, e.g., equilateral or other triangular shape. However, other shapes are possible, e.g., square, hexagonal.

[0084] The triangular orifice may assume different positions or orientations, e.g., change location of triangle's apex. The orientation may affect air flow direction, and may be selected based on patient preference or comfort, e.g., so air flow is not directed to sensitive regions of the patient's nose.

2.4.1 Triangle with Anterior Apex

[0085] Figs. 11-1 to 11-2 illustrate a nasal prong assembly 1110 according to another embodiment of the present invention. As illustrated, each prong 1130 includes an orifice 1145 with a triangular shape.

[0086] In the illustrated embodiment, the triangular orifice 1145 has an isosceles shape with the apex A oriented towards the anterior portion of the patient's nose (e.g., see Fig. 11-2). However, the triangular orifice 1145 may have other suitable shapes, e.g., equilateral or other triangular shape.

[0087] In use, the triangular orifice 1145 increases the dispersion and turbulence of the air as it exits the orifice and enters the patient's nasal passage. Specifically, the triangular orifice 1145 provides turbulent flow at its straight edges (slower air flow) and laminar flow at its vertices (faster air flow).

2.4.2 Triangle with Posterior Apex

[0088] Figs. 12-1 to 12-2 illustrate a nasal prong assembly 1210 according to another embodiment of the present invention. As illustrated, each prong 1230 includes an orifice 1245 with a triangular shape.

[0089] In the illustrated embodiment, the triangular orifice 1245 has an isosceles shape with the apex A oriented towards the posterior portion of the patient's nose (e.g., see Fig. 12-2). However, the triangular orifice 1245 may have other suitable shapes, e.g., equilateral or other triangular shape.

[0090] In use, the triangular orifice 1245 increases the dispersion and turbulence of the air as it exits the orifice and enters the patient's nasal passage. Specifically, the triangular orifice 1245 provides turbulent flow at its straight edges (slower air flow) and laminar flow at its vertices (faster air flow).

[0091] The orientation of the triangular orifice 1245 may be more preferable than that of the triangular orifice 1145 as the apex location provides flow that may avoid the septum.

2.5 Grate for Turbulence

[0092] A grate or grill may be provided to the nasal prong to create turbulence. The grate creates turbulence in the air flow to reduce and/or eliminate the air jetting effect, e.g., air flow dispersed and not localized. That is, the grate disperses the air before it enters the patient's nasal cavity to reduce irritation.

[0093] The grate may be provided at any suitable location along the nasal prong, e.g., at the base of the stalk, at the rim of nasal portion, etc. In addition, the grates of the grate may have any suitable shape and orientation.

[0094] The grate may be formed with a material similar to the prong, e.g., silicone. In alternative embodiments, the grate may be formed with Gortex or a textile membrane.

2.5.1 Grate Parallel to Minor Axis of Orifice

[0095] Figs. 13-1 to 13-2 illustrate a nasal prong assembly 1310 according to another embodiment of the present invention. As illustrated, each prong 1330 includes a grate 1370 along an interior portion of the prong 1330, e.g., integrally formed with the prong 1330.

[0096] In the illustrated embodiment, the grate 1370 is provided at the base of the stalk 1340 of the prong 1330. Also, the grate 1370 is oriented such that the grates 1372 of the grate 1370 extend generally parallel to the minor axis of the prong orifice 1345 (e.g., see Fig. 13-2). However, the grate 1370 may be provided at other suitable locations along the prong, and the grates 1372 may have other suitable shapes and orientations. In addition, the grate 1370 may have any suitable number of grates 1372, e.g., 3, 4, 5, or more grates.

[0097] In use, the grate 1370 increases the dispersion and turbulence of the air as it exits the prong orifice and enters the patient's nasal passage.

2.5.2 Grate Parallel to Major Axis of Orifice

[0098] Fig. 14-1 illustrates a nasal prong 1430 including a grate 1470 according to another embodiment of the present invention. The grate 1470 is substantially similar to the grate 1370 described above, e.g., grate 1470 is provided at the base of the stalk of the prong 1430. In contrast, the grate 1470 is oriented such that the grates 1472 of the grate 1470 extend generally parallel to the major axis of the prong orifice 1445. However, the grate 1470 may be provided at other suitable locations along the prong, and the grates 1472 may have other suitable shapes and orientations. In addition, the grate 1470 may have any suitable number of grates 1472, e.g., 3, 4, 5, or more grates.

[0099] In use, the grate 1470 increases the dispersion and turbulence of the air as it exits the prong orifice and enters the patient's nasal passage.

2.5.3 Circular Grate

[00100] Fig. 15-1 illustrates a nasal prong 1530 including a grate 1570 according to another embodiment of the present invention. As illustrated, the grates 1572 of the grate 1570 have a generally oval or circular configuration, e.g., grates 1572 are curved or arcuate and define one or more generally circular or oval openings through the grate.

[00101] The grate 1570 may be provided at the base of the stalk of the prong 1530, or at other suitable locations along the prong. Also, the grates 1572 may have other suitable shapes and orientations. In addition, the grate 1570 may have any suitable number of grates 1572, e.g., 3, 4, 5, or more grates.

[00102] In use, the grate 1570 increases the dispersion and turbulence of the air as it exits the prong orifice and enters the patient's nasal passage.

2.5.4 Grate at Rim of Prong

[00103] Figs. 16-1 to 16-2 illustrate a nasal prong assembly 1610 according to another embodiment of the present invention. As illustrated, each prong 1630 includes a grate 1670 along an interior portion of the prong 1630, e.g., integrally formed with the prong 1630.

[00104] In the illustrated embodiment, the grate 1670 is provided at the rim of the head portion 1635 of the prong 1630. Also, the grate 1670 is oriented such that the grates 1672 of the grate 1670 extend generally parallel to the minor axis of the prong orifice 1645 (e.g., see Fig. 16-2). However, the grate 1670 may be provided at other suitable locations along the prong, and the grates 1672 may have other suitable shapes and orientations. In addition, the grate 1670 may have any suitable number of grates 1672, e.g., 3, 4, 5, or more grates.

[00105] In use, the grate 1670 increases the dispersion and turbulence of the air as it exits the prong orifice and enters the patient's nasal passage.

2.5.5 Medial Hoods with Grates

[00106] Fig. 17-1 illustrates a nasal prong assembly 1710 according to another embodiment of the present invention. The nasal prong assembly 1710 is a hybrid or combination of the nasal prong assemblies shown in Figs. 4-1 to 4-2 and 13-1 to 13-2. Specifically, each prong 1730 includes a hood 1760 and a grate 1770, e.g., integrally formed with the prong 1730.

[00107] As illustrated, the hood 1760 is provided to an medial portion (i.e., middle portion) of the head portion 1735 and is structured to re-direct the air flow such that the hood 1760 directs or channels the air flow away from the septum.

[00108] The grate 1770 is provided at the base of the stalk 1740 of the prong 1730. Also, the grate 1770 is oriented such that the grates 1772 of the grate 1770 extend generally parallel to the minor axis of the prong orifice 1745. However, the grate 1770 may be provided at other suitable locations along the prong, and the grates 1772 may have other suitable shapes and orientations. In addition, the grate 1770 may have any suitable number of grates 1772, e.g., 3, 4, 5, or more grates.

[00109] In use, the hood 1760 directs the air posteriorly (e.g., straight up) away from the septum and the grate 1770 increases the dispersion and turbulence of the air as it exits the prong orifice and enters the patient's nasal passage. Thus, the air flow is both dispersed and channeled away from the septum.

2.5.6 Large Hoods with Grates

[00110] Fig. 18-1 to 18-2 illustrate a nasal prong assembly 1810 according to another embodiment of the present invention. The nasal prong assembly 1810 is a hybrid or combination of the nasal prong assemblies shown in Figs. 5-1 and 13-1 to 13-2. Specifically, each prong 1830 includes a relatively large hood 1860 and a grate 1870, e.g., integrally formed with the prong 1830.

[00111] As illustrated, the hood 1860 is provided to an medial portion (i.e., middle portion) of the head portion 1835 and is structured to change the air flow such that the hood 1860 directs the air flow away from the septum.

[00112] The grate 1870 is provided at the base of the stalk 1840 of the prong 1830. Also, the grate 1870 is oriented such that the grates 1872 of the grate 1870 extend generally parallel to the minor axis of the prong orifice 1845 (e.g., see Fig. 18-2). However, the grate 1870 may be provided at other suitable locations along the prong, and the grates 1872 may have other suitable shapes and orientations. In addition, the grate 1870 may have any suitable number of grates 1872, e.g., 3, 4, 5, or more grates.

[00113] In use, the hood 1860 directs the air posteriorly (e.g., straight up) away from the septum and the grate 1870 increases the dispersion and turbulence of the air as it exits the

prong orifice and enters the patient's nasal passage. Thus, the air flow is both dispersed and away from the septum. The hood 1860 may also protect sensitive areas of the anterior nose.

2.6 Dual Wall

[00114] The nasal prong may have a dual or double-wall head portion, i.e., a head portion including an inner wall (inner membrane) and an outer wall (outer membrane) that surrounds the inner wall. Such an arrangement may enhance the comfort and/or seal of the prong.

[00115] Embodiments of dual-wall nasal prongs are disclosed in PCT Appln. Nos. PCT/AU2004/001832 and PCT/AU2006/000770, each of which is incorporated herein by reference in its entirety. The illustrated embodiments described below include features that may be used with the embodiments and/or components described in these incorporated PCT applications.

2.6.1 Dual Wall Embodiment

[00116] Fig. 19-1 illustrates a nasal prong assembly 1910 according to another embodiment of the present invention. As illustrated, each prong 1930 includes dual or double-wall head portion 1935. Specifically, each head portion 1935 includes an inner wall 1934 (inner membrane) and an outer wall 1936 (outer membrane) that surrounds the inner wall 1934.

[00117] The outer wall 1936 is relatively thin, e.g., thickness in the range of 0.1 mm to 0.65 mm, and provides compliance and/or conformance with the patient's nose to enhance the seal of the prong 1930.

[00118] Further details of such dual-wall head portion are provided in PCT Appln. No. PCT/AU2006/000770, for example.

2.6.2 Smaller Dual Wall

[00119] The dual-wall nasal prong may be provided in different sizes. For example, Fig. 20-1 illustrates a nasal prong assembly 2010 including dual-wall nasal prongs 2030 which are a smaller version of the dual-wall nasal prongs 1930 shown in Fig. 19-1. Such a

smaller dual-wall nasal prong 2030 may provide a more comfortable fit and/or seal for some patients.

2.6.3 Dual Wall with Holes on Inner Wall

[00120] Fig. 21-1 illustrates a nasal prong assembly 2110 according to another embodiment of the present invention. As illustrated, each prong 2130 includes dual or double-wall head portion 2135. Specifically, each head portion 2135 includes an inner wall 2134 (inner membrane) and an outer wall 2136 (outer membrane) that surrounds the inner wall 2134.

[00121] In the illustrated embodiment, the inner wall 2134 includes a plurality of holes 2175. The holes 2175 may be provided along any suitable portion of the inner wall 2134. Also, the holes 2175 may be circular or may have any other suitable shapes, e.g., non-circular. In addition, the inner wall 2134 may have any suitable number of holes 2175, e.g., 3, 4, 5, or more holes.

[00122] In use, the holes 2175 disperse air as it passes through the prong 2130, e.g., to create turbulence.

2.6.4 Dual Wall with Grate

[00123] Figs. 22-1 to 22-2 illustrate a nasal prong assembly 2210 according to another embodiment of the present invention. As illustrated, each prong 2230 includes dual or double-wall head portion 2235. In addition, each prong 2230 includes a grate 2270.

[00124] In the illustrated embodiment, the grate 2270 is provided at the base of the stalk 2240 of the prong 2230. Also, the grate 2270 is oriented such that the grates 2272 of the grate 2270 extend generally parallel to the minor axis of the prong orifice 2245 (e.g., see Fig. 22-2). However, the grate 2270 may be provided at other suitable locations along the prong, and the grates 2272 may have other suitable shapes and orientations. In addition, the grate 2270 may have any suitable number of grates 2272, e.g., 3, 4, 5, or more grates.

[00125] In use, the dual-wall head portion 2235 increases comfort and/or seal and the grate 2270 increases the dispersion and turbulence of the air as it exits the prong orifice and enters the patient's nasal passage.

2.6.5 Dual Wall with Ribs

[00126] Fig. 23-1 illustrates a nasal prong assembly 2310 according to another embodiment of the present invention. As illustrated, each prong 2330 includes dual or double-wall head portion 2335. In addition, each prong 2330 includes a plurality of ribs 2365 that extend along an interior surface of the outer wall 2336.

[00127] In the illustrated embodiment, each rib 2365 has a helical shape that extends from the prong orifice to the rib or base of the head portion outer wall 2336. However, the ribs may have other suitable shapes, and may have other suitable arrangements along the outer wall 2336. As illustrated, 6 ribs 2365 are provided to each prong 2330. However, each prong 2330 may have any suitable number of ribs, e.g., 3, 4, or 5 ribs. Further, ribs may be provided to inner and/or outer surfaces of the inner wall 2334, e.g., in lieu of or in addition to the ribs on the outer wall 2336.

[00128] In use, the dual-wall head portion 2335 increases comfort and/or seal and the helical ribs 2365 introduce swirl to the air flow, which increase the dispersion and turbulence of the air as it exits the prong orifice and enters the patient's nasal passage.

[00129] Figs. 23-2 and 23-3 illustrate a nasal prong 2830 according to another embodiment of the present invention. As illustrated, the prong 2830 includes a dual or double-wall head portion 2835. In addition, the orifice of the inner wall 2834 includes a series of contours or lobes 2837, e.g., 9 contours or lobes, each having a suitable height H. However, the inner wall 2834 may include any suitable number of contours or lobes, e.g., 3, 4, 5, 6, or more contours or lobes. Further, a series of contours or lobes may be provided to the orifice of the outer wall 2836.

[00130] In the illustrated embodiment, the series of contours or lobes 2837 extend within the plane of the orifice. In an alternative embodiment, one or more of the contours or lobes may extend in a plane that is transverse to the plane of the orifice.

[00131] In use, the series of contours or lobes 2837 provides a "jet engine like" diffuser or non-oval-shaped orifice which increases the dispersion and turbulence of the air as it exits the orifice and enters the patient's nasal passage.

2.6.6 Dual Wall with Lower Inner Wall

[00132] Fig. 24-1 illustrates a nasal prong assembly 2410 according to another embodiment of the present invention. As illustrated, each prong 2430 includes dual or double-wall head portion 2435. Specifically, each head portion 2435 includes an inner wall 2434 (inner membrane) and an outer wall 2436 (outer membrane) that surrounds the inner wall 2134.

[00133] In the illustrated embodiment, the orifice of the inner wall 2434 is substantially lower than the orifice of the outer wall 2436 (e.g., compared to the dual-wall prong shown in Fig. 19-1). Such an arrangement may create more diffuse air entering the nasal passage without compromising a seal.

2.6.7 Dual Wall with Hood

[00134] In an alternative embodiment, the dual wall prong may include a hood such as that shown in Figs. 3-1 to 3-3 or 4-1 to 4-2. The hood may extend from the outer wall and/or the inner wall.

2.6.8 Dual Wall with Shifted Orifice

[00135] Fig. 25-1 illustrates a nasal prong 2530 according to another embodiment of the present invention. In the illustrated embodiment, the nasal prong 2530 is provided adjacent to a prong 30 of the old configuration for comparison purposes.

[00136] As illustrated, the prong 2530 includes dual or double-wall head portion 2535 with inner and outer walls 2534, 2536. In addition, the prong orifice 2545 is shifted more posteriorly and medially (with respect to the prong orifice of the old configuration), e.g., closer to the patient's lip. However, the prong orifice may be shifted to other suitable positions.

[00137] In use, the posteriorly shifted orifice 2545 is structured to shift the air flow more posteriorly and medially as well as direct the air flow more posteriorly and medially, e.g., direct air flow into the nasal passage as opposed to onto the nasal septum.

2.6.9 Dual Wall with Shifted Orifice, Hood, and Grate

[00138] In an alternative embodiment, the nasal prong 2530 of Fig. 25-1 may also include a hood (e.g., such as that shown in Figs. 3-1 to 3-3 or 4-1 to 4-2), and a grate (e.g., such as that shown in Fig. 13-1).

[00139] In use, the hood directs the air away from the septum and/or towards the back of the patient's head the grate increases the dispersion and turbulence of the air as it exits the prong orifice and enters the patient's nasal passage.

2.7 Thin Membrane

[00140] In alternative embodiment, a thin wall thickness, e.g., thickness in the range of 0.1 mm to 0.65 mm, may be provided to a nasal prong having a single wall configuration. Further details of such thin single wall nasal prong is provided in PCT Appln. No. PCT/AU2006/000770, for example.

[00141] In an embodiment, ribs (e.g., such as that shown in Figs. 9-1, 9-2, or 10-1) may be provided to the thin single wall nasal prong.

2.8 Orifice Cut at an Angle

[00142] The orifice of the nasal prong may be cut at an angle (with respect to the prong orifice of the old configuration) to direct air flow similar to a hood. That is, the angled orifice changes the air flow direction (with respect to the old configuration) to reduce and/or eliminate the air jetting effect, e.g., direct flow away from the septum.

2.8.1 45° Cut Orifice

[00143] Figs. 26-1 to 26-2 illustrate a nasal prong assembly 2610 according to another embodiment of the present invention. As illustrated, each prong 2630 includes a prong orifice 2645 that is cut at about a 45° angle (with respect to the prong orifice of the old configuration). However, the prong orifice 2645 may be cut at other suitable angles, e.g., angle may be dependent on the shape of the patient's nostrils.

[00144] The 45° cut prong orifice 2645 redirects air similar to a hood as described above, and maintains seal, integrity, and comfort. Specifically, as shown in Fig. 26-2, the 45° cut prong orifice 2645 is structured to direct the air superiorly (as indicated in solid lines),

e.g., straight up, rather than towards the septum as in the old configuration (as indicated in dashed lines).

2.8.2 Dual Wall with Shifted Orifice and 45° Cut Orifice

[00145] In an alternative embodiment, the nasal prong 2530 of Fig. 25-1 may also include a 45° cut prong orifice (e.g., such as that shown in Figs. 26-1 to 26-2).

[00146] In use, the 45° cut prong orifice 2645 directs the air superiorly away from the septum.

2.9 Concave Anterior Prong

[00147] Figs. 27-1 to 27-2 illustrate a nasal prong assembly 2710 according to another embodiment of the present invention. In the illustrated embodiment, the shape of an anterior portion of the prong 2730 is different than the shape of a posterior portion of the prong 2730.

[00148] Specifically, as best shown in Fig. 27-2, the anterior portion of the head portion 2735 has a concave shape or section 2780 (as viewed from the inside of the prong) and the posterior portion of the head portion 2735 has a convex shape or section 2785 (as viewed from the inside of the prong).

[00149] In use, the concave section 2780 of the head portion 2735 directs and disperses the air flow posteriorly, e.g., towards the back of the patient's head.

3. Dispersion Cartridge Provided to Nasal Prong Assembly

[00150] As shown in Figs. 28-1 to 28-3, a disposable or re-useable gas dispersion cartridge 3090 may be provided to a nasal prong assembly to increase turbulence and/or decrease the velocity in the gas or air flow. As illustrated, the dispersion cartridge 3090 includes a plurality of openings that creates turbulence and/or decreases the velocity in the air flow to reduce and/or eliminate the air jetting effect. That is, the dispersion cartridge 3090 disperses the air before it enters the nasal prongs and hence patient's nasal cavity to reduce irritation.

[00151] Also, the dispersion cartridge 3090 is structured to reduce the velocity of air traveling into the nasal passage to provide comfort to the patient (e.g., see sections 2.3 and

2.4.1), reduce noise generated due to air velocity in the mask system, and reduce noise transmitted into the mask system from the flow generator.

[00152] In the illustrated embodiment, the dispersion cartridge 3090 is a single part that may be provided, e.g., retrofit, to an existing nasal prong assembly (such as that shown in Fig. 1). As illustrated, the dispersion cartridge 3090 includes a mesh-like cylinder 3092 that provides a plurality of openings or pores 3094 therethrough. As shown in Fig. 28-1, one end of the mesh-like cylinder 3092 is provided to an end plug 3025, e.g., removably or non-removably attached to the end plug, that is adapted to be attached to one end of the frame 3050. Further details of such end plug are described in the above incorporated U.S. Patent Application No. 11,101,657.

[00153] When the end plug 3025 is assembled to the frame 3050 as shown in Fig. 28-2, the mesh-like cylinder 3092 extends through the proximal side frame member 3052 and towards the opposite side frame member 3052 of the frame 3050. Also, the distal end of the mesh-like cylinder 3092 extends towards the elbow 3027 attached to the opposite end of the frame 3050 and communicated with the air delivery tube. The distal end may engage with an interior surface of the opposite side frame member, e.g., an interference or friction fit. Similarly, the proximal end of the mesh-like cylinder 3092 may frictionally engage with an interior surface of the end plug 3025. When a nasal prong assembly 3010 (including a base 3020 and a pair of nasal prongs 3030) is attached to the frame 3050 as shown in Fig. 28-3, the mesh-like cylinder 3092 extends through the base 3020 and across the inlets to the nasal prongs 3030.

[00154] In use, gas enters through the elbow 3027 and is directed through the mesh-like cylinder 3092 to disperse or dissipate the gas before it enters the nasal prongs 3030 and hence the patient's nasal cavity to reduce irritation. The large surface area of the mesh-like cylinder 3092 prevents any additional impedance to the air delivery circuit.

[00155] The above-described arrangement facilitates assembly, removal, and/or replacement of the dispersion cartridge 3090. For example, the end plug 3025 may be easily removed from the frame 3050 to clean and/or replace the mesh-like cylinder 3092 attached thereto. It is noted that the mesh-like cylinder 3092 may be washed and reused, or the mesh-like cylinder 3092 may be made as a disposable item. Also, it should be appreciated that the positions of the end plug 3025 and elbow 3027 may be interchanged, according to preference.

[00156] In an alternative embodiment, the mesh-like cylinder 3092 may be attached to the elbow 3027 or opposite side frame member 3052 instead of the end plug 3025. In yet another embodiment, the mesh-like cylinder 3092 may be supported by the side frame members 3052 of the frame 3050, and sandwiched between the elbow 3027 and the end plug 3025 to secure the mesh-like cylinder 3092 in place.

[00157] In the illustrated embodiment, the mesh-like cylinder 3092 may be made of a metal or plastic mesh material. However, the mesh-like cylinder 3092 may be made of a fabric or textile material that is gas permeable, e.g., Gortex®. In an alternative embodiment, as shown in Fig. 28-4, a dispersion cartridge 3190 may include a thin-wall plastic or ceramic cylinder 3192 with a plurality of perforated holes 3194 therethrough. For example, the cylinder 3192 may include 1-600 holes or more, e.g., 1-30 rows each having 1-20 holes. In the example shown, the cylinder has 20-25 rows each having 15-20 holes. The holes could be patterned so as to avoid direct jetting into the nasal prongs.

[00158] In the illustrated embodiment, the dispersion cartridge 3092 has a cylindrical shape. However, the dispersion cartridge 3092 may have other suitable shapes to fit within the nasal prong assembly, e.g., flat or planar shape.

[00159] In another embodiment, a dispersion cartridge may comprise a flat piece of material, e.g., mesh-like material, which is rolled into cylindrical form and then inserted into the frame, elbow, and/or end plug.

[00160] The dispersion cartridge 3092 may provide additional uses. For example, the dispersion cartridge 3092 may also be used as a medicine/aromatic dispenser, moisture absorber, and/or humidifying element. For example, medicine may be provided within the dispersion cartridge and adapted to be dispersed as air passes through the dispersion cartridge. In addition, the cartridge may be provided with a filtering function. The filtering can occur as a result of the perforations and/or hole size, or the filtering can be provided by a separate component, such as a filter.

[00161] While the invention has been described in connection with what are presently considered to be the most practical and preferred embodiments, it is to be understood that the invention is not to be limited to the disclosed embodiments, but on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope

of the invention. Also, the various embodiments described above may be implemented in conjunction with other embodiments, e.g., aspects of one embodiment may be combined with aspects of another embodiment to realize yet other embodiments. Further, each independent feature or component of any given assembly may constitute an additional embodiment. In addition, while the invention has particular application to patients who suffer from OSA, it is to be appreciated that patients who suffer from other illnesses (e.g., congestive heart failure, diabetes, morbid obesity, stroke, barriatric surgery, etc.) can derive benefit from the above teachings. Moreover, the above teachings have applicability with patients and non-patients alike in non-medical applications.

WHAT IS CLAIMED IS:

1. A nasal prong for sealing with a nasal passage of a patient, comprising:

a head portion structured to seal and/or sealingly communicate with the patient's nasal passage; and

a column or stalk structured to interconnect the head portion with a base,

wherein the head portion is configured to direct gas in use generally away from or along the septum and/or posteriorly relative to the nasal passage.

2. The nasal prong according to claim 1, wherein the head portion is configured to direct gas in use generally parallel to the septum.

3. A nasal prong for sealing with a nasal passage of a patient, the nasal prong structured to create conditions for turbulence or dispersion within the nasal passage.

4. A nasal prong for sealing with a nasal passage of a patient, the nasal prong structured to redirect air flow direction, diffuse air flow or create turbulence, and/or orient the prong orifice in order to reduce and/or eliminate air jetting effects.

5. A nasal prong for sealing with a nasal passage of a patient, comprising:

a head portion structured to seal and/or sealingly communicate with the patient's nasal passage; and

a column or stalk structured to interconnect the head portion with a base,

wherein the stalk is configured to direct air in a first direction and the head portion is configured to direct air in a second direction or vector that is angled with respect to the first direction.

6. The nasal prong according to claim 5, wherein the head portion includes a hood, a rib, and/or a grate optionally with surface treatment.

7. A nasal prong for sealing with a nasal passage of a patient, comprising:

a head portion structured to seal and/or sealingly communicate with the patient's nasal passage; and

a column or stalk structured to interconnect the head portion with a base,

wherein the head portion is configured to provide sealing along a first plane and provide an exit orifice to direct gas along a vector or direction that is angled with respect to the first plane.

8. A nasal prong for sealing with a nasal passage of a patient, comprising:

a head portion structured to seal and/or sealingly communicate with the patient's nasal passage; and

a column or stalk structured to mount the head portion to a base,

wherein the head portion includes a hood, a rib, and/or a grate, each of which may include surface treatment.

9. The nasal prong according to claim 8, wherein the hood is structured to direct gas in use away from the septum and/or posteriorly relative to the nasal passage.

10. The nasal prong according to any one of claims 8-9, wherein the rib includes one or more ribs along an interior surface of the head portion to disperse air flow or create turbulence.

11. The nasal prong according to claim 10, wherein the rib has a helical shape.

12. The nasal prong according to claim 10, wherein the rib has a generally circular, oval, and/or arcuate shape that extends around at least a portion of the interior perimeter of the head portion.

13. The nasal prong according to claim 10, wherein the rib has a random or non-uniform shape.

14. The nasal prong according to any one of claims 8-13, wherein the grate is provided at a base of the stalk.

15. The nasal prong according to any one of claims 8-13, wherein the grate is provided at a rim of the head portion.

16. The nasal prong according to any one of claims 8-15, wherein the grate includes grates that extend generally parallel to a minor axis of an exit orifice.

17. The nasal prong according to any one of claims 8-15, wherein the grate includes grates that extend generally parallel to a major axis of an exit orifice.

18. The nasal prong according to any one of claims 8-15, wherein the grate includes grates that are curved or arcuate and define one or more circular or oval openings through the grate.

19. A nasal prong for sealing with a nasal passage of a patient, comprising:

a head portion structured to seal and/or sealingly communicate with the patient's nasal passage; and

a column or stalk structured to mount the head portion to a base,

wherein the head portion includes an exit orifice that is offset from an axis of the stalk, has a triangular shape, and/or is angled with respect to a sealing plane.

20. The nasal prong according to claim 19, wherein the orifice is shifted posteriorly to direct gas in use posteriorly relative to the nasal passage.

21. The nasal prong according to any one of claims 19-20, wherein the orifice has an isosceles triangular shape with the apex oriented towards an anterior portion of the patient's nose.

22. The nasal prong according to any one of claims 19-20, wherein the orifice has an isosceles triangular shape with the apex oriented towards a posterior portion of the patient's nose.

23. The nasal prong according to any one of claims 19-22, wherein the orifice is angled about 45° with respect to a sealing plane.

24. A nasal prong for sealing with a nasal passage of a patient, comprising:

a head portion structured to seal and/or sealingly communicate with the patient's nasal passage, the head portion having a dual-wall configuration including an inner wall and an outer wall that surrounds the inner wall; and

a column or stalk structured to mount the head portion to a base,

wherein the inner wall and/or outer wall includes a hood, a rib, and/or a grate, each of which may include surface treatment.

25. A nasal prong for sealing with a nasal passage of a patient, comprising:

a head portion structured to seal and/or sealingly communicate with the patient's nasal passage, the head portion having a dual-wall configuration including an inner wall and an outer wall that surrounds the inner wall; and

a column or stalk structured to mount the head portion to a base,

wherein the inner wall includes one or more holes.

26. A nasal prong for sealing with a nasal passage of a patient, comprising:

a head portion structured to seal and/or sealingly communicate with the patient's nasal passage; and

a column or stalk structured to mount the head portion to a base,

wherein the head portion includes an anterior portion and a posterior portion, the anterior portion having a shape that is different than a shape of the posterior portion.

27. The nasal prong according to claim 26, wherein the anterior portion has a concave shape and the posterior portion has a convex shape as viewed from an interior of the head portion.

28. A nasal prong for sealing with a nasal passage of a patient, comprising:

a head portion structured to seal and/or sealingly communicate with the patient's nasal passage, the head portion having a dual-wall configuration including an inner wall and an outer wall that surrounds the inner wall; and

a column or stalk structured to mount the head portion to a base,

wherein an orifice of the inner wall and/or outer wall includes a series of contours or lobes.

29. The nasal prong according to claim 28, wherein the orifice of the inner wall includes the series of contours or lobes.

30. The nasal prong according to any one of claims 28-29, wherein the series of contours or lobes includes 5-15 contours or lobes.

31. The nasal prong according to any one of claims 28-30, wherein the series of contours or lobes extend within a plane of the orifice.

32. A mask system comprising:

a frame;

a nasal prong assembly provided to the frame, the nasal prong assembly including a base and a pair of nasal prongs provided to the base; and

a dispersion cartridge adapted to extend through the base to create turbulence and/or disperse gas flow.

33. A mask system according to claim 32, wherein the cartridge includes a mesh-like cylinder that provides a plurality of openings or pores therethrough.

34. A mask system according to claim 33, wherein the mesh-like cylinder is made of metal or plastic mesh material.

35. A mask system according to claim 33, wherein the mesh-like cylinder is made of fabric or textile material.

36. A mask system according to claim 32, wherein the cartridge includes a thin-wall plastic or ceramic cylinder with a plurality of perforated holes therethrough.

37. A mask system according to claim 36, wherein the cylinder includes 1-600 holes or more.

38. A mask system according to claim 37, wherein the cylinder includes 1-30 rows each having 1-20 holes.

39. A mask system according to claim 38, wherein the cylinder includes 20-25 rows each having 15-20 holes.

40. A mask system according to any one of claims 32-39, wherein one end the cartridge is provided to an end plug that is attached to one end of the frame.

41. A mask system according to claim 40, wherein the cartridge extends through a proximal side frame member of the frame and towards an opposite side frame member of the frame when the end plug is attached to the frame.

42. A mask system according to any one of claims 40-41, wherein the cartridge includes a distal end that extends towards an elbow attached to an opposite end of the frame.

43. A mask system according to claim 42, wherein the distal end engages the elbow and/or a side frame member of the frame.

44. A mask system according to any one of claims 42-43, wherein the elbow is adapted to direct gas into the cartridge which is adapted to create turbulence and/or disperse gas flow before it enters the nasal prongs in use.

45. A mask system according to any one of claims 32-44, wherein the cartridge is disposable or re-useable.

46. A method for forming a dispersion cartridge adapted to create turbulence and/or disperse gas flow in a mask system, the method comprising:

providing a flat piece of material that provides a plurality of openings or pores;

rolling the material into cylindrical form; and

inserting the cylinder into a frame, elbow, and/or end plug of the mask system to create turbulence and/or disperse gas flow.

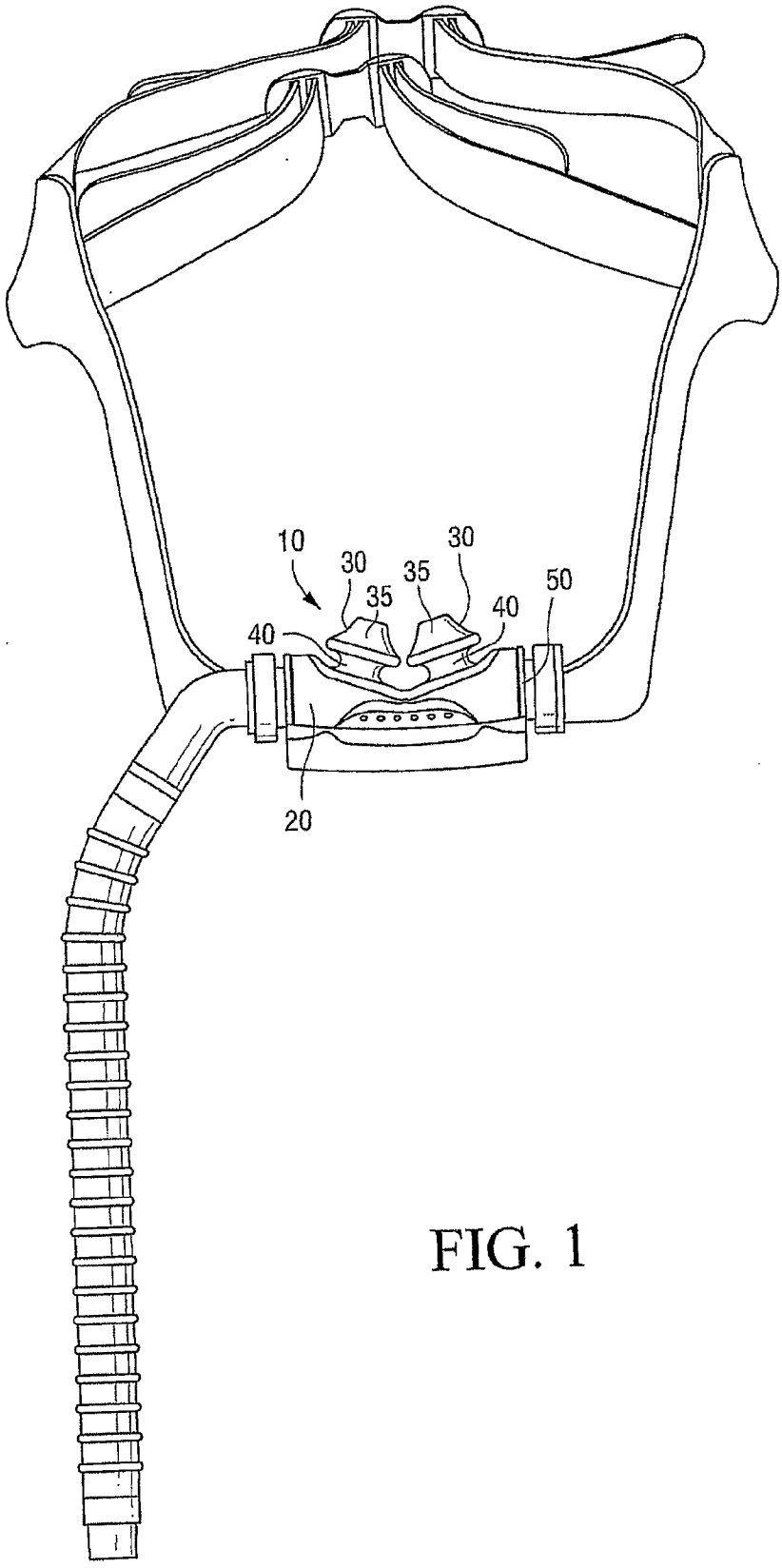

FIG. 1

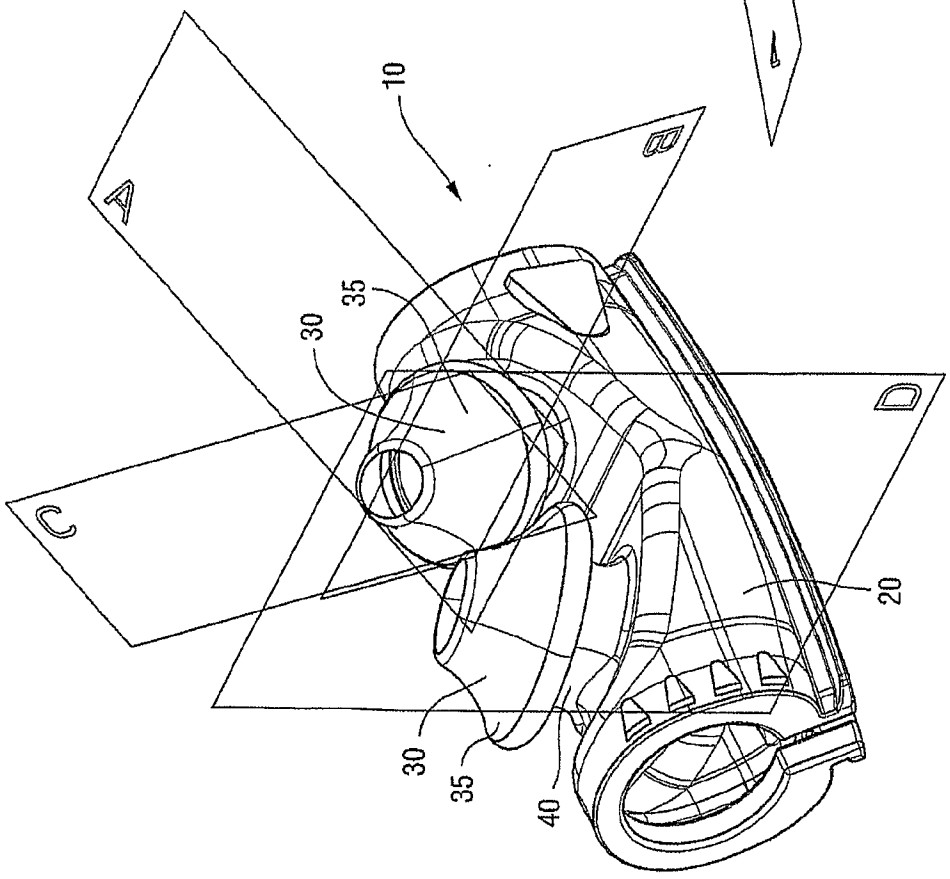

FIG. 2-1

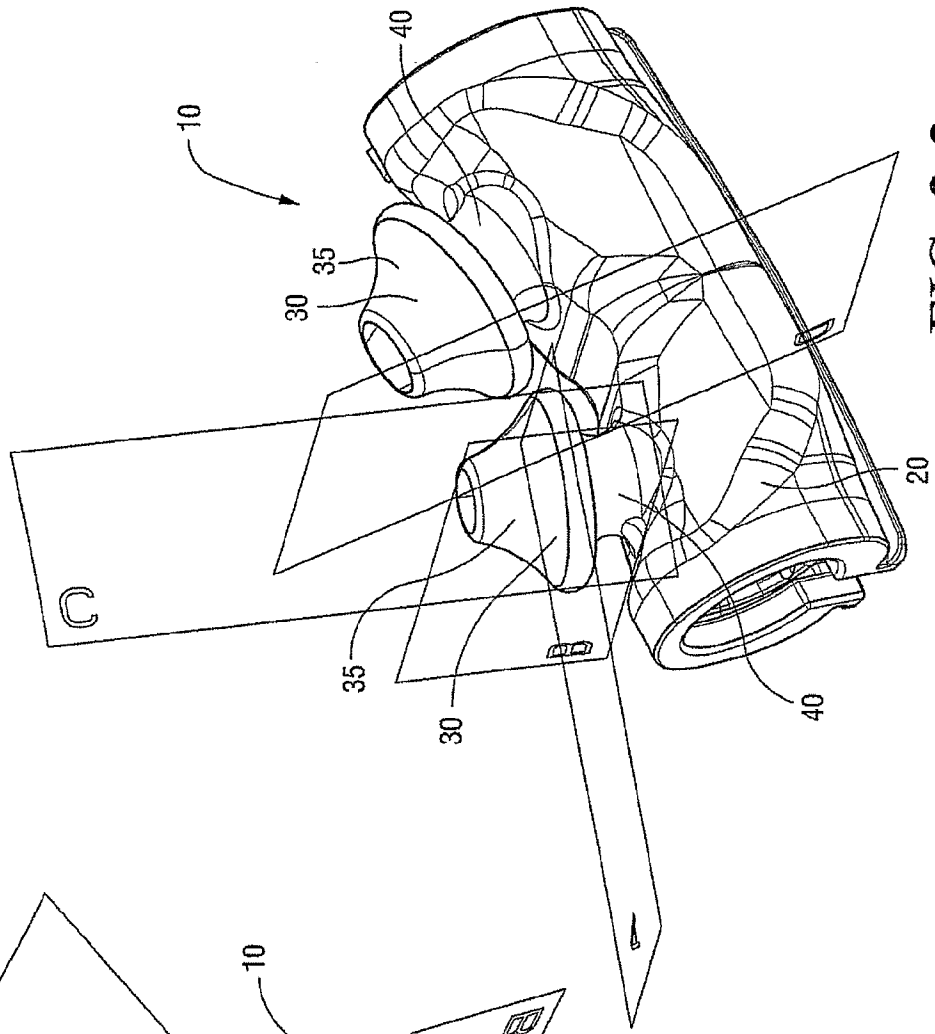

FIG. 2-2

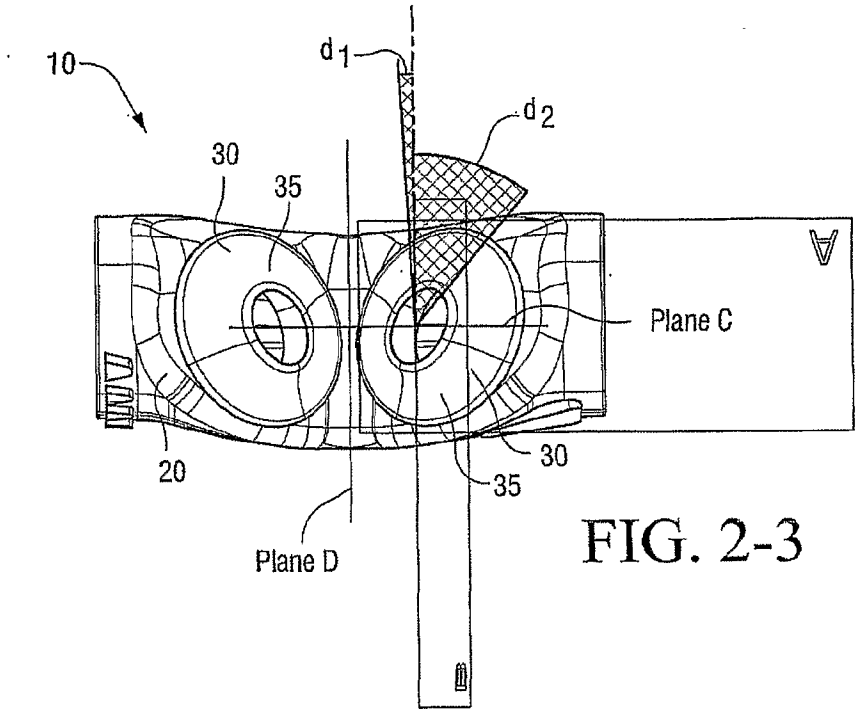
10
d1
d2
30
35
A
Plane C
20
30
35
Plane D

FIG. 2-3

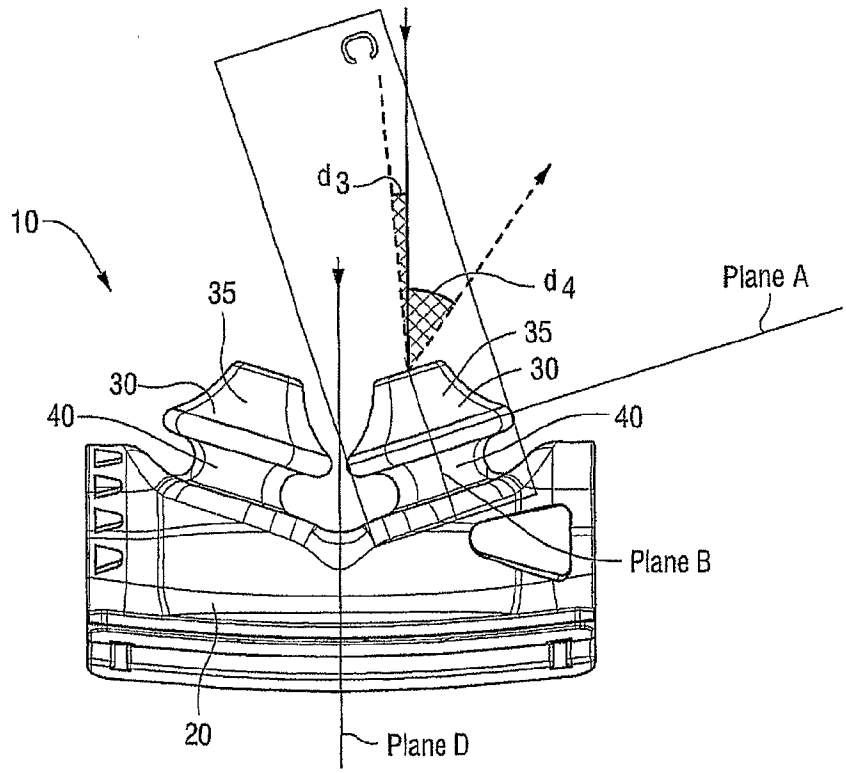
10
d3
d4
Plane A
35
35
30
30
40
40
Plane B
20
Plane D

FIG. 2-4

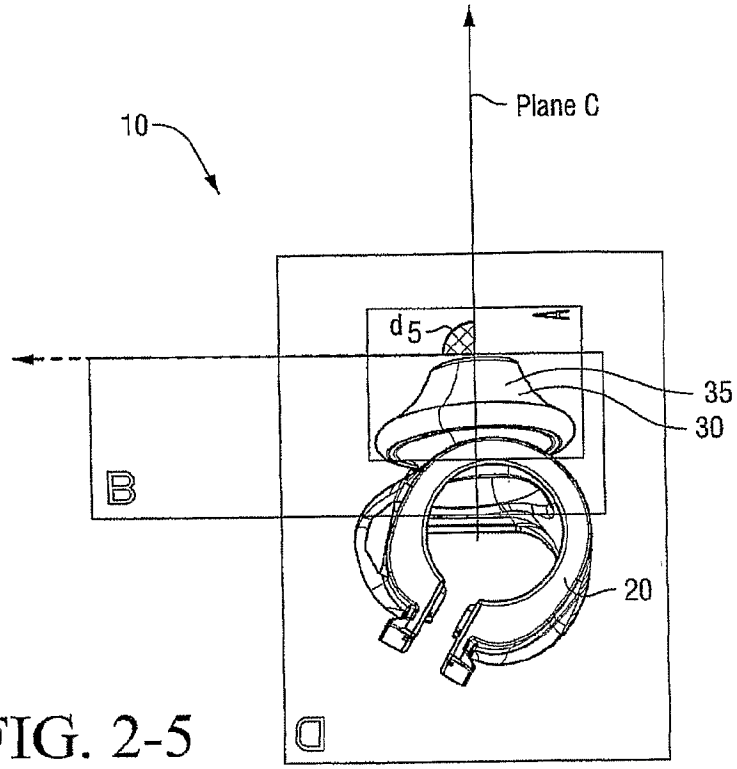

FIG. 2-5

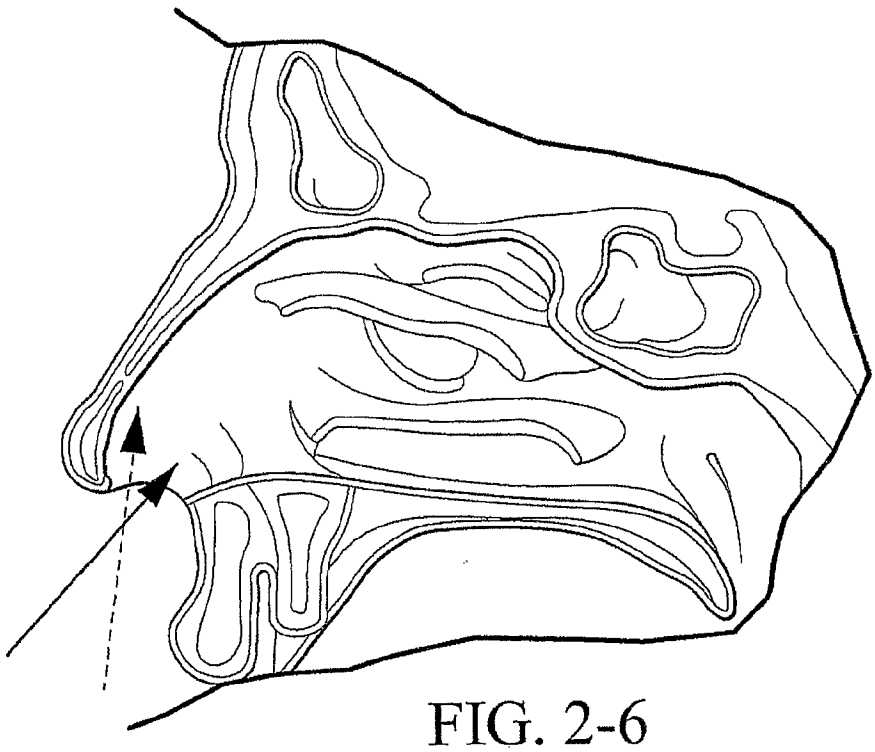

FIG. 2-6

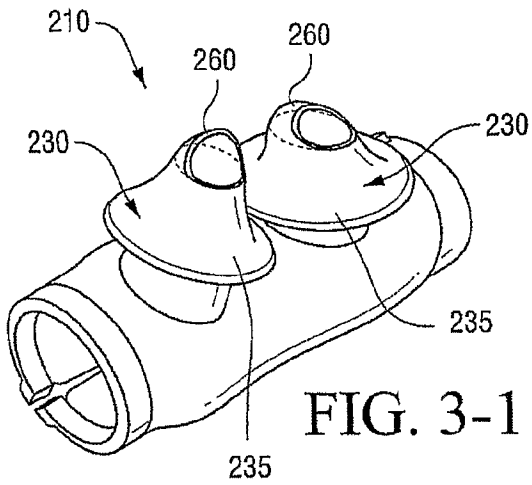

FIG. 3-1

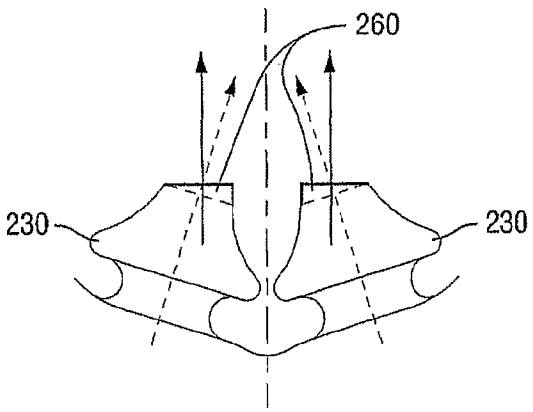

FIG. 3-2

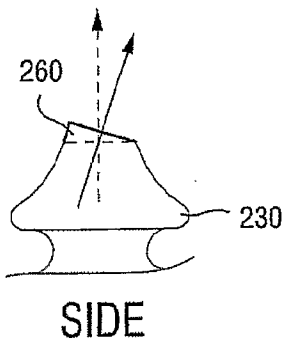

FIG. 3-3

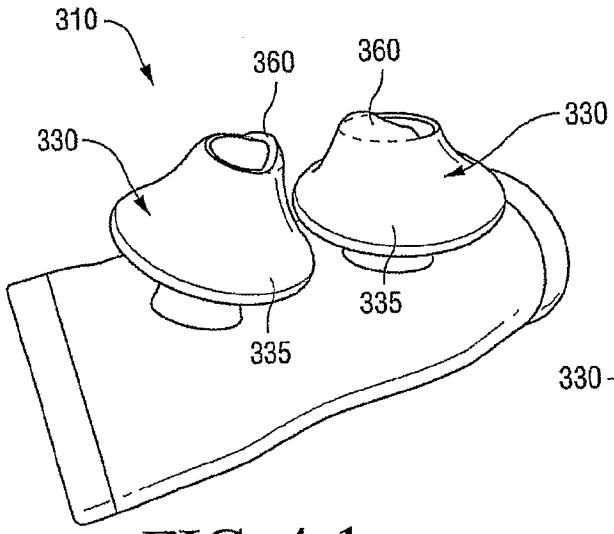

FIG. 4-1

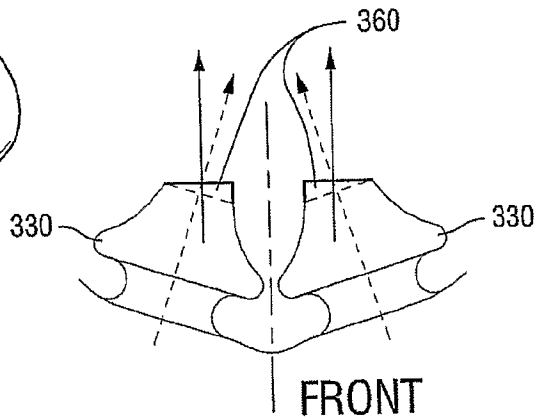

FIG. 4-2

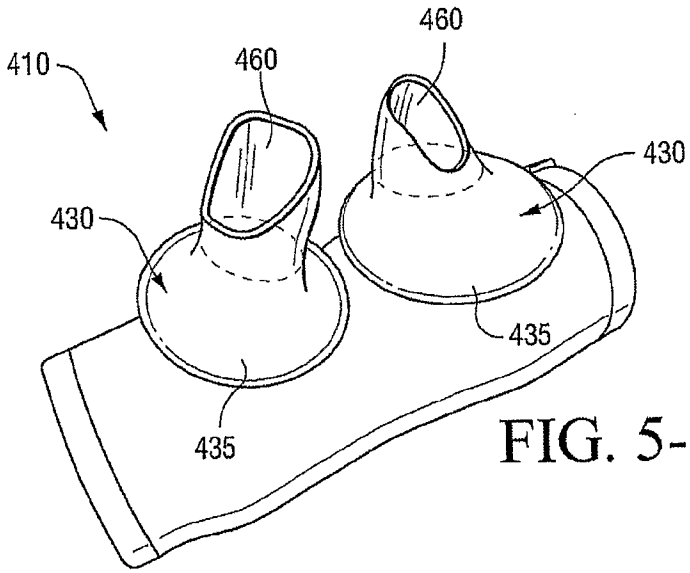

FIG. 5-1

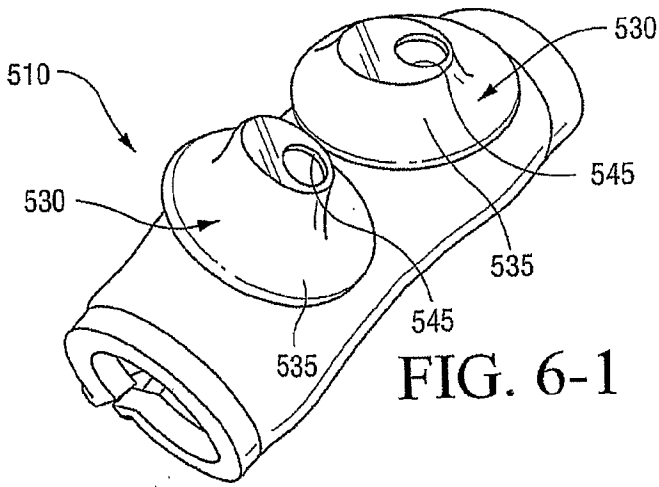

FIG. 6-1

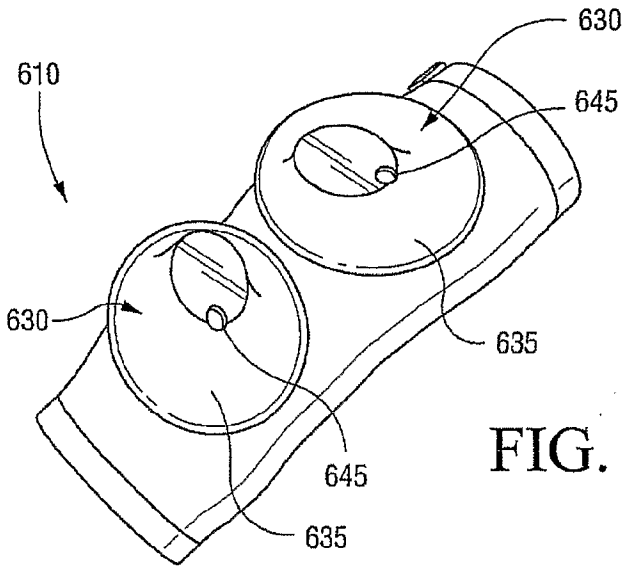

FIG. 7-1

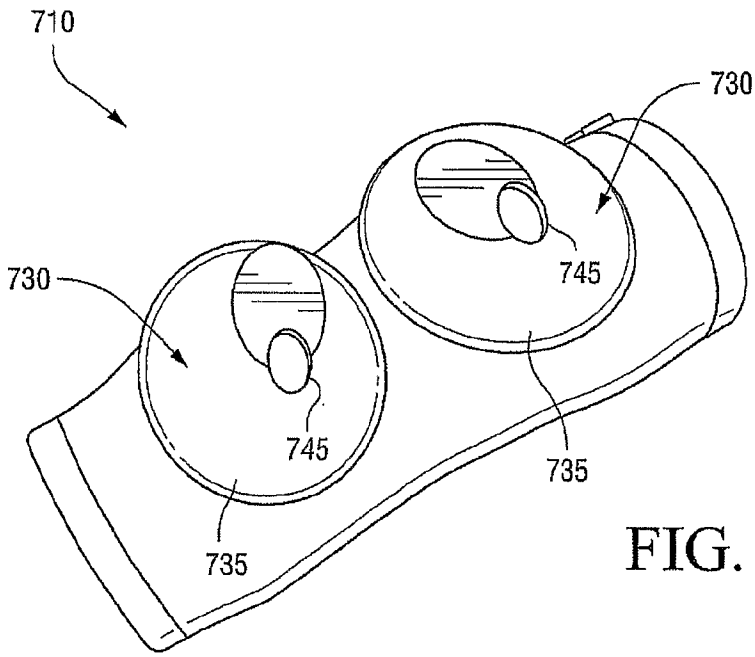

FIG. 8-1

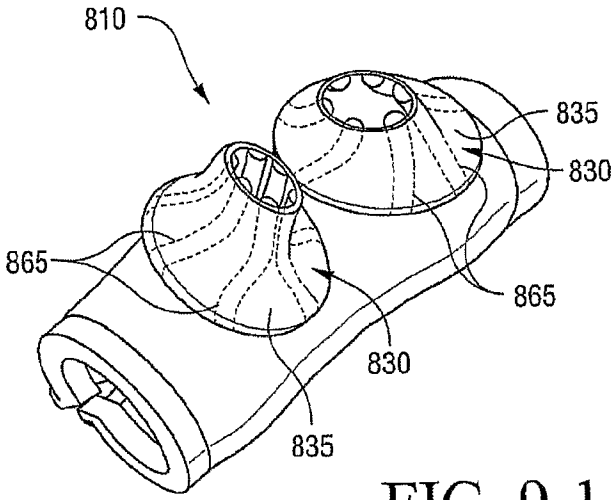

FIG. 9-1

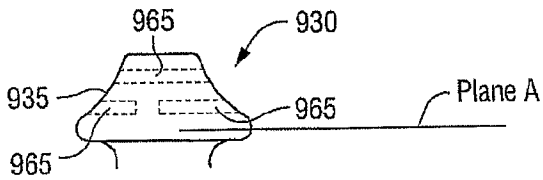

FIG. 9-2

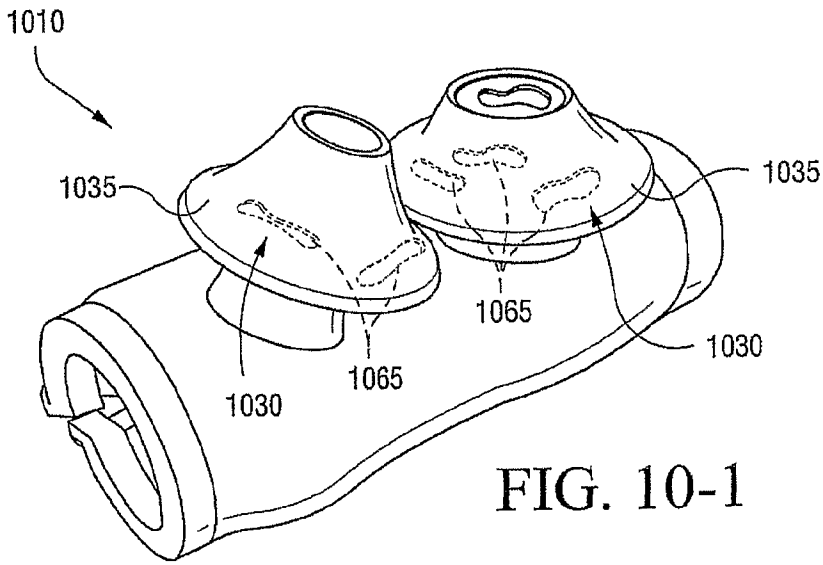

FIG. 10-1

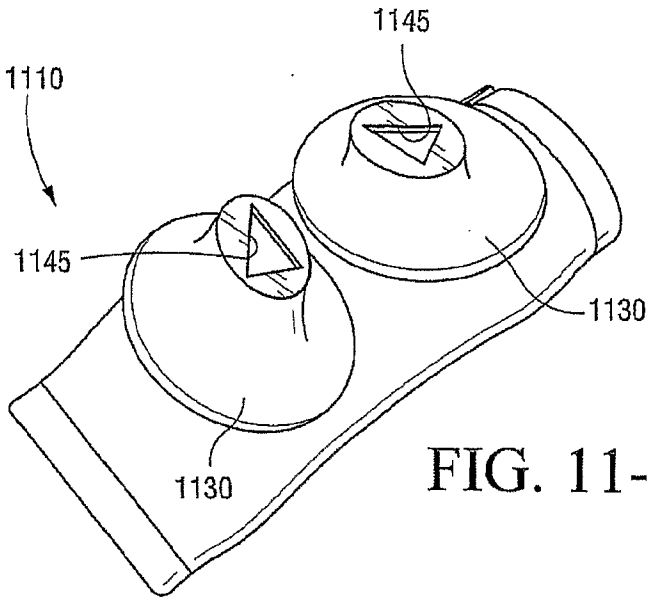

FIG. 11-1

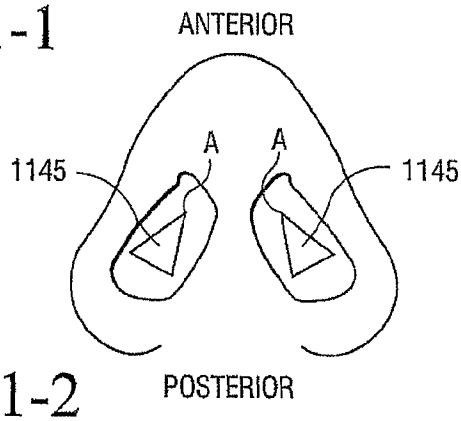

FIG. 11-2

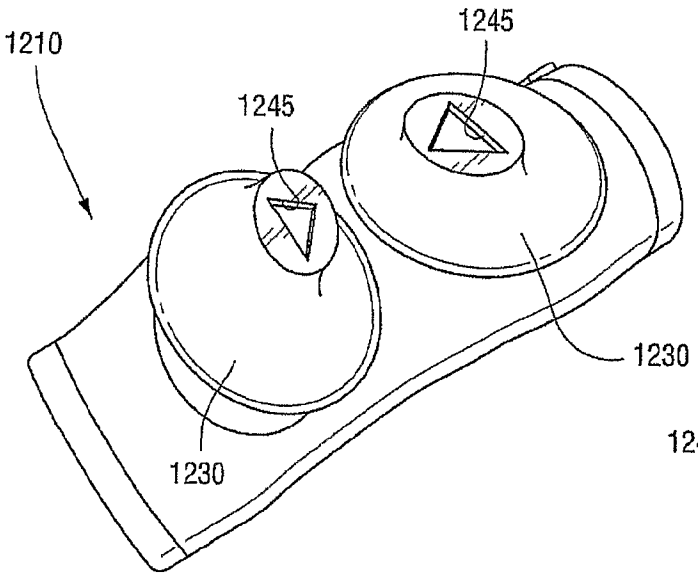

FIG. 12-1

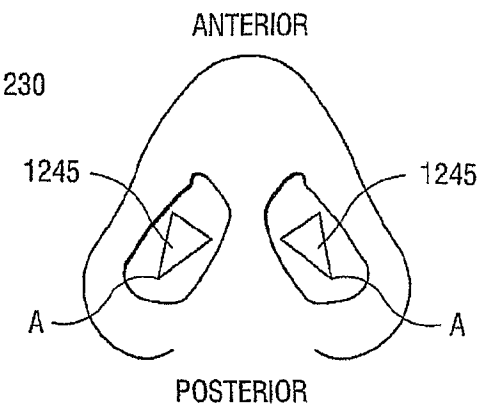

FIG. 12-2

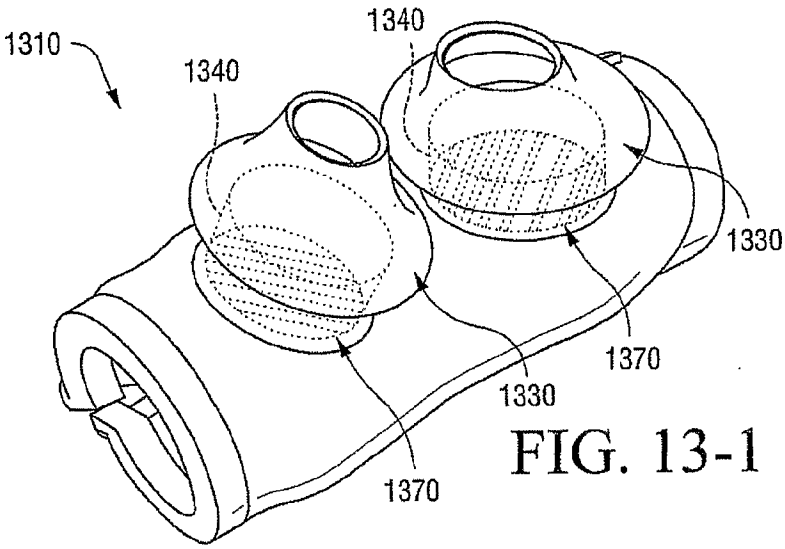

FIG. 13-1

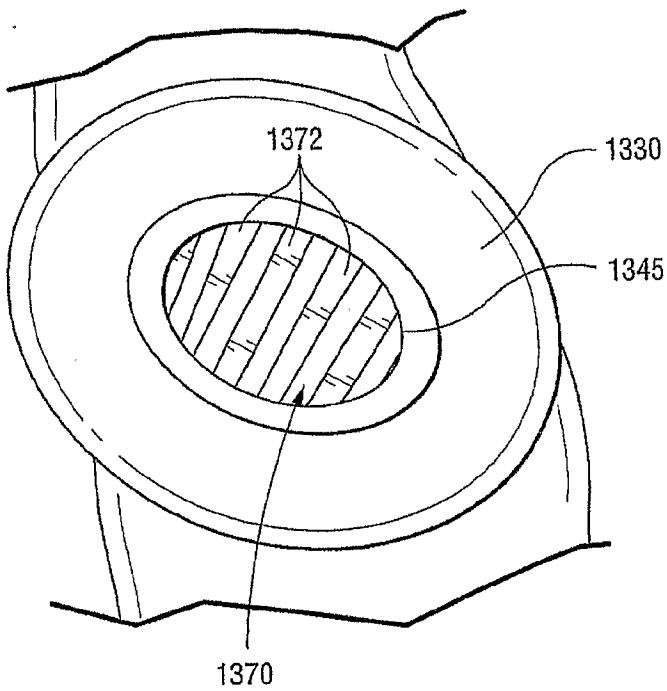

FIG. 13-2

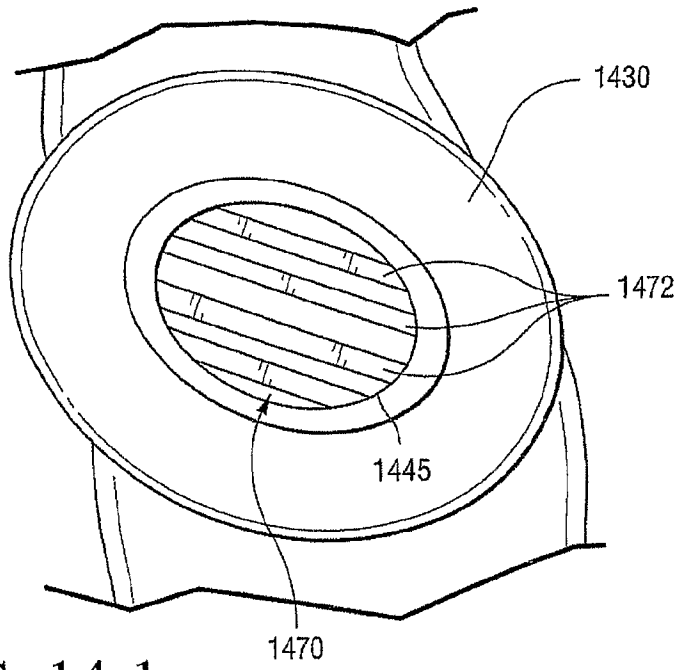

FIG. 14-1

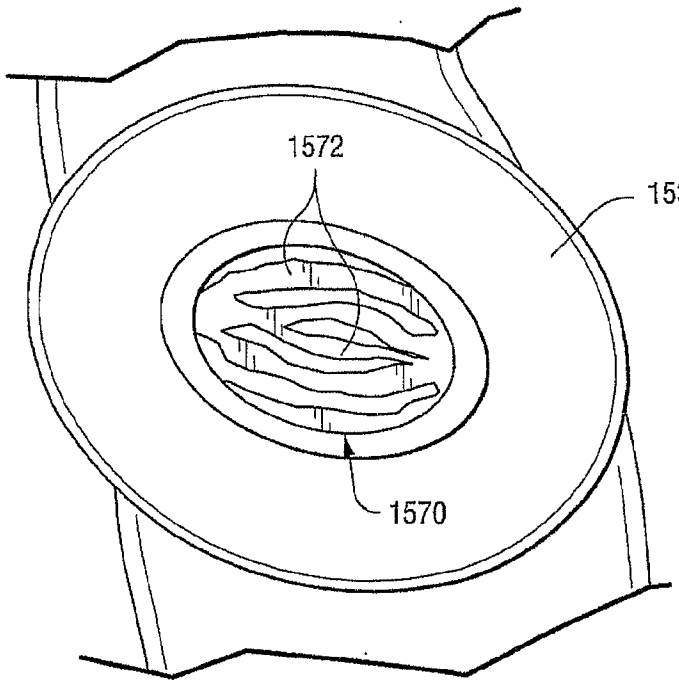

FIG. 15-1

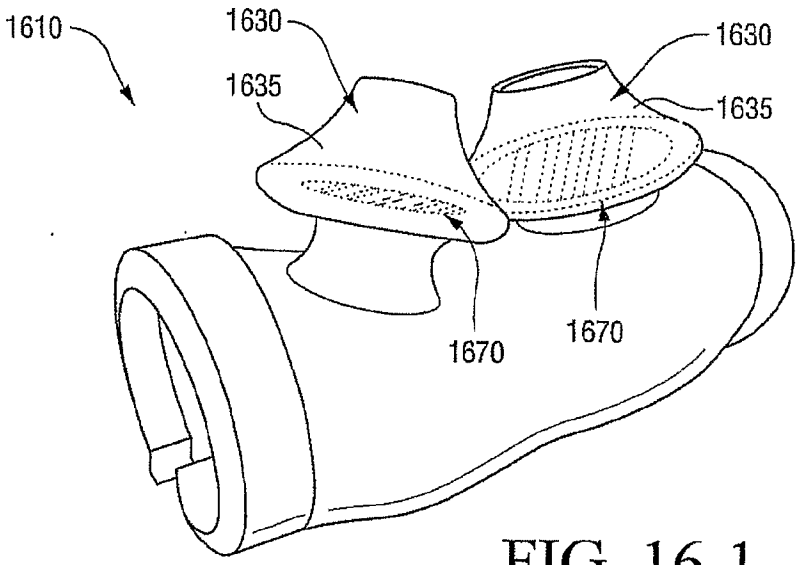

FIG. 16-1

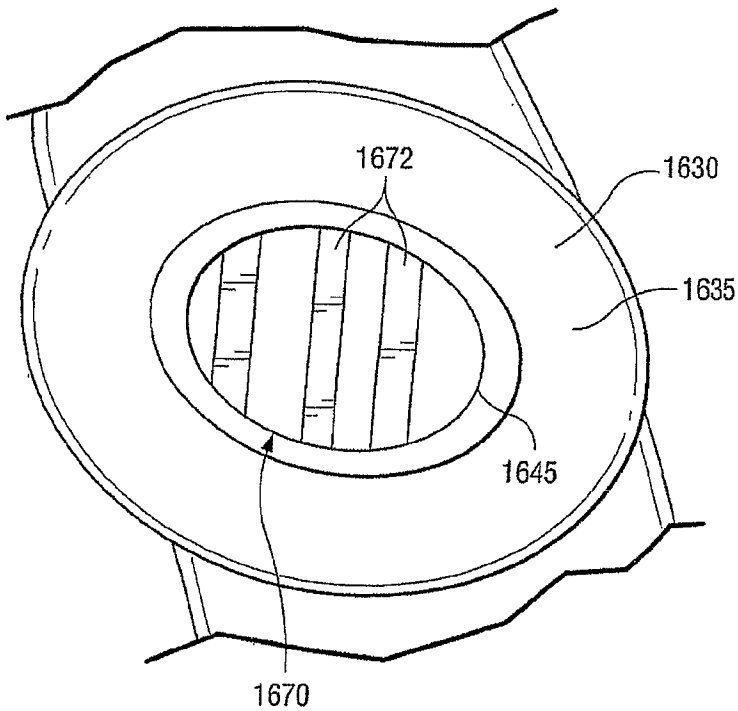

FIG. 16-2

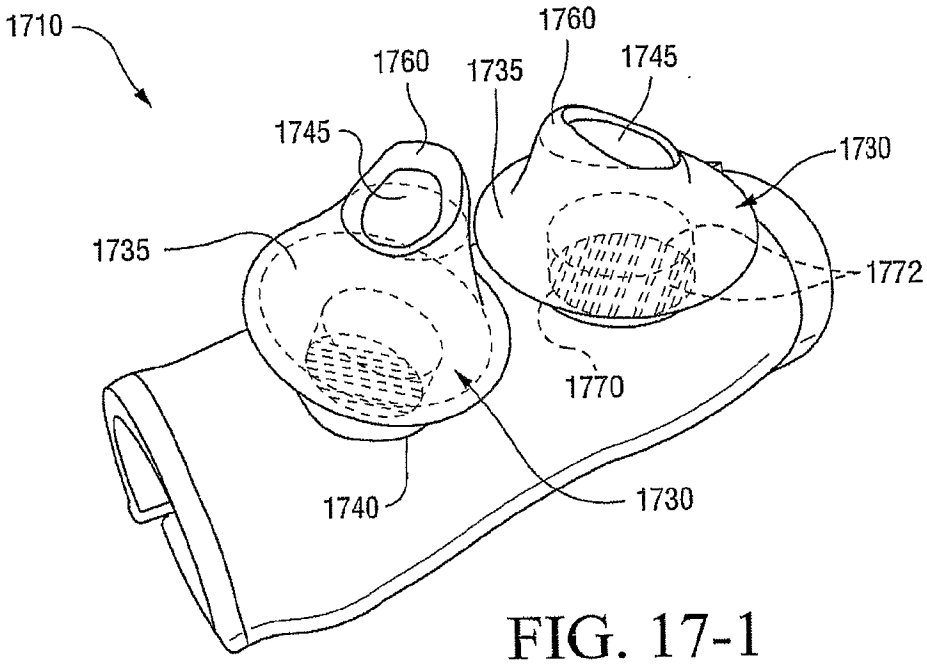

FIG. 17-1

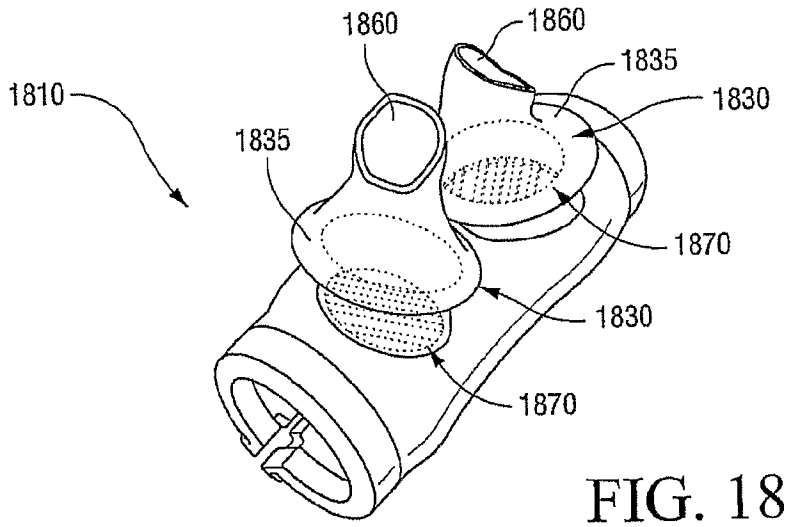

FIG. 18-1

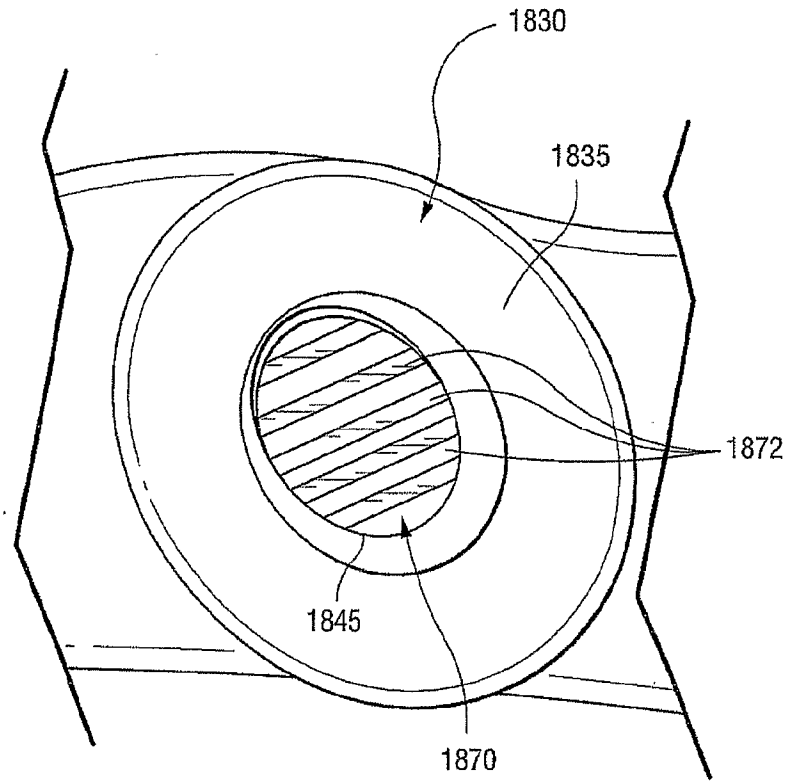

FIG. 18-2

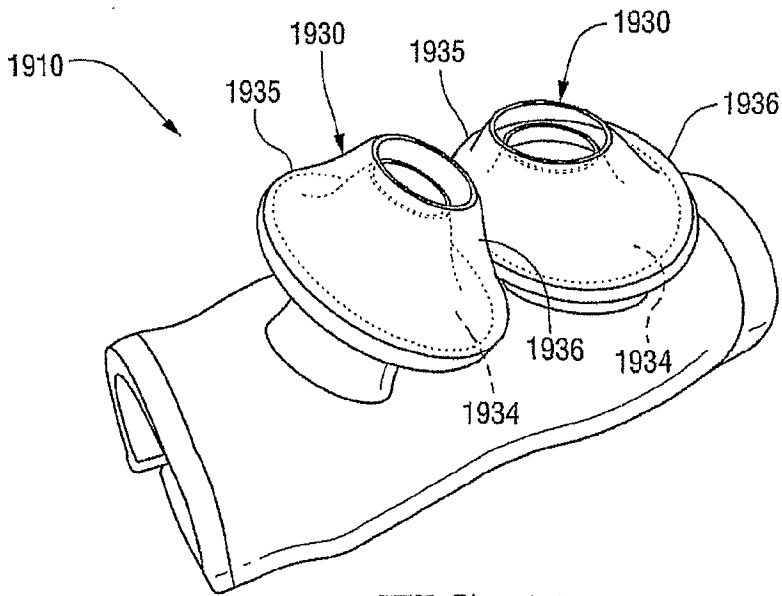

FIG. 19-1

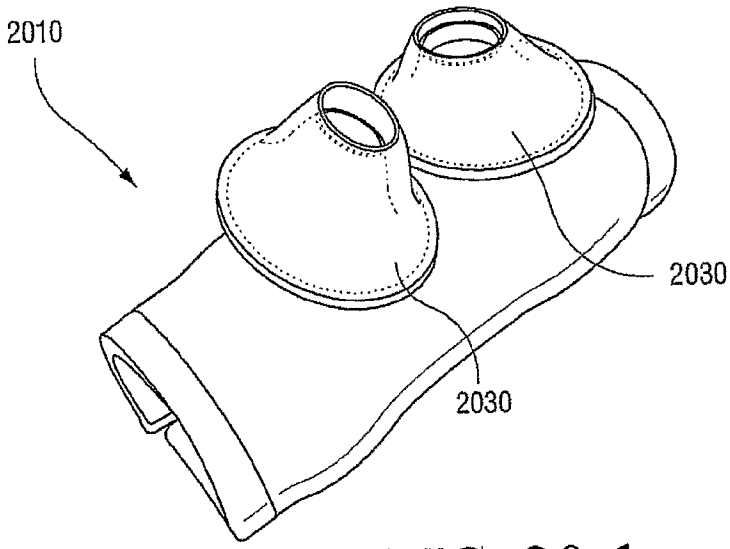

FIG. 20-1

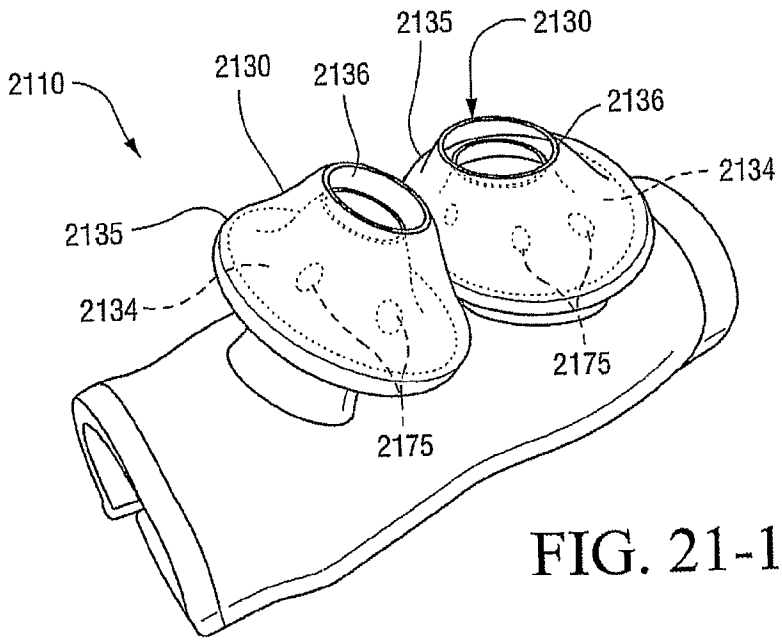

FIG. 21-1

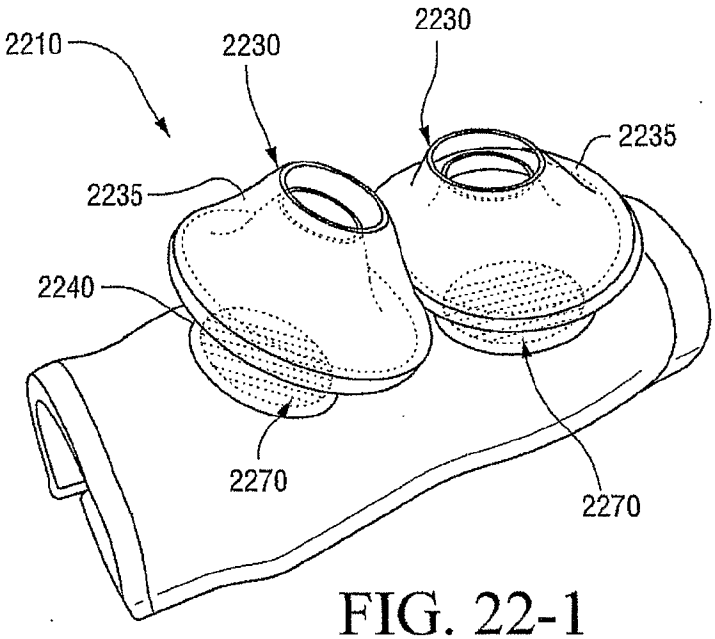

FIG. 22-1

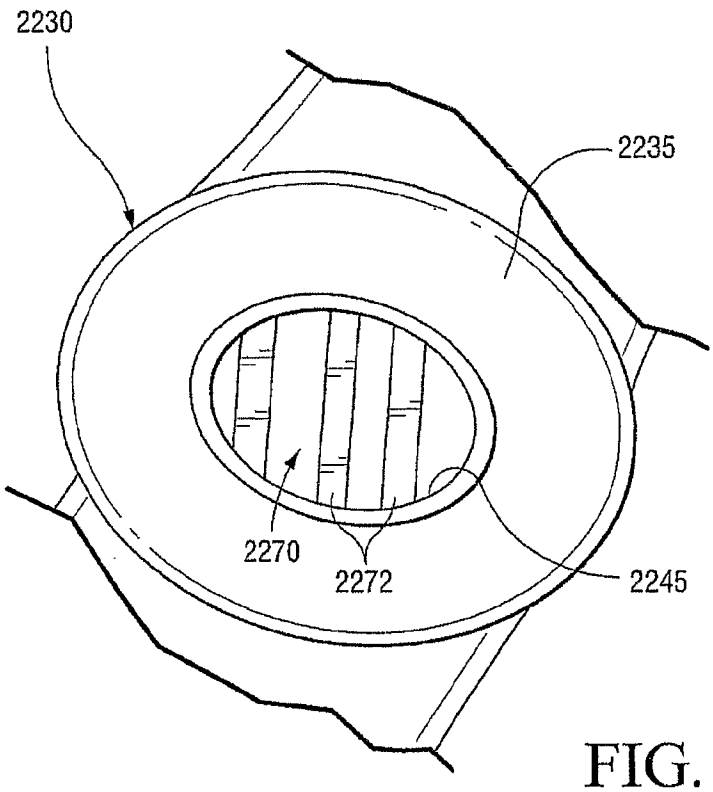

FIG. 22-2

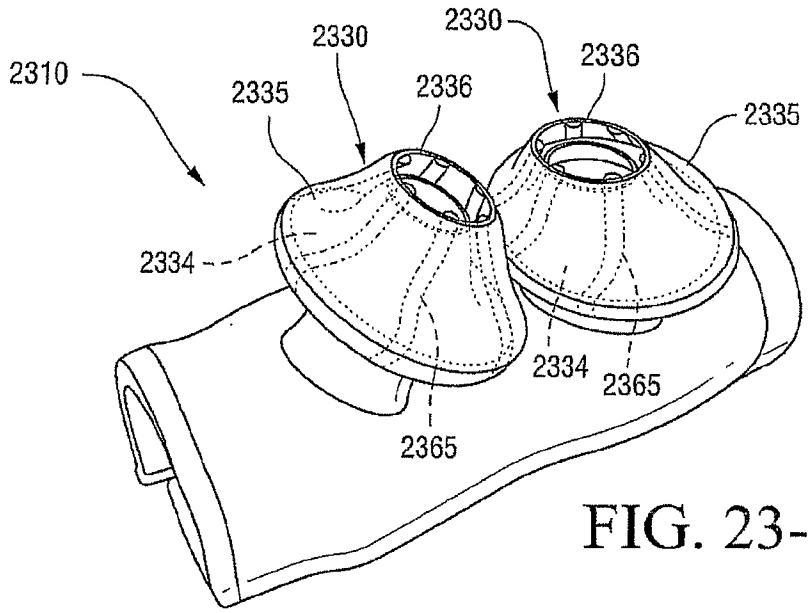

FIG. 23-1

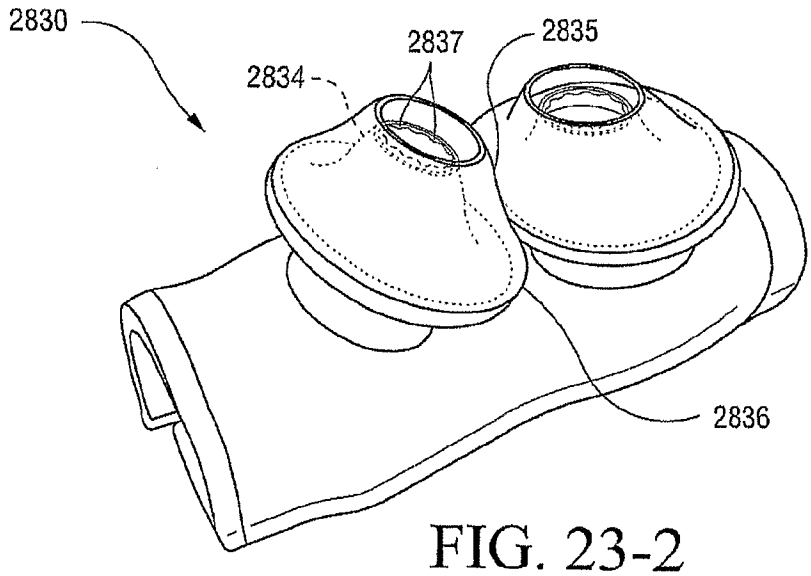

FIG. 23-2

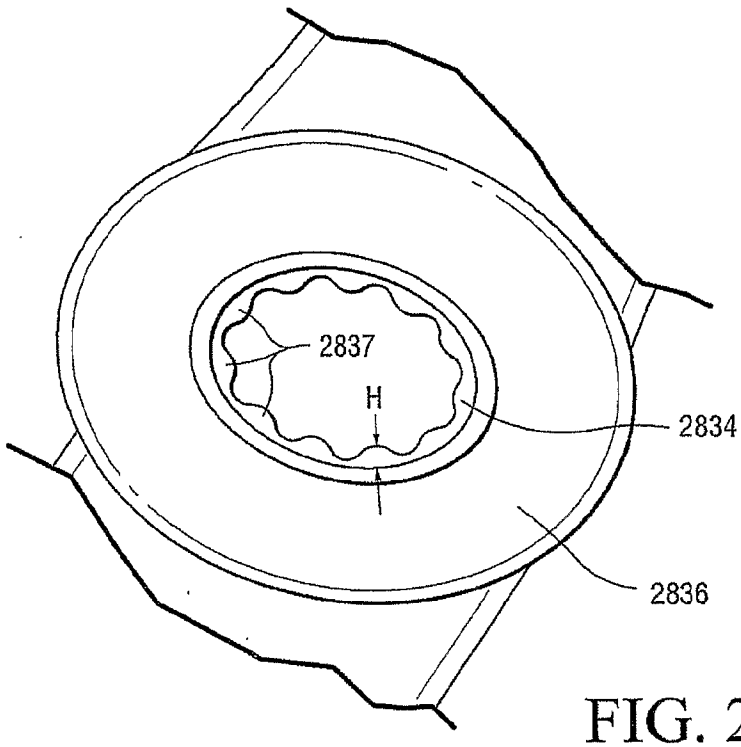

FIG. 23-3

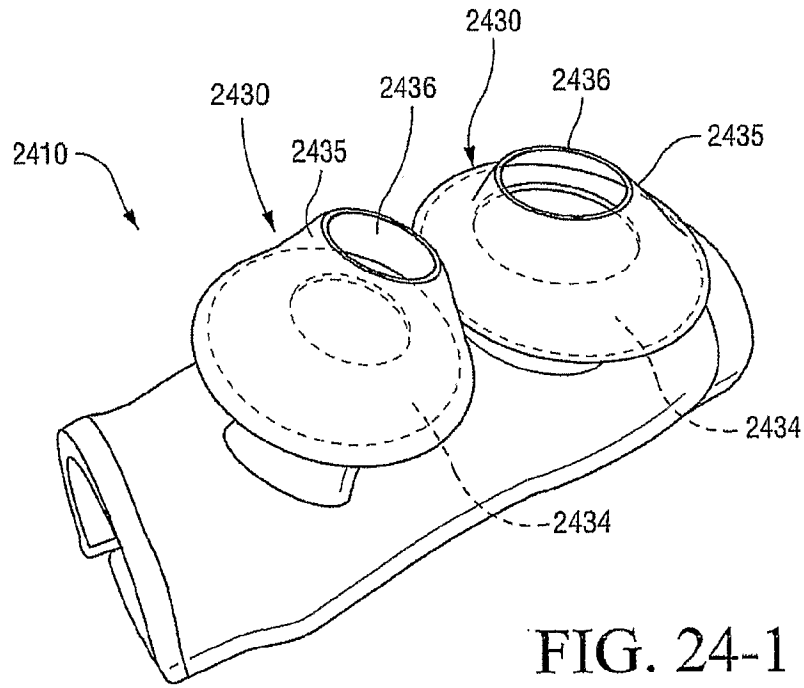

FIG. 24-1

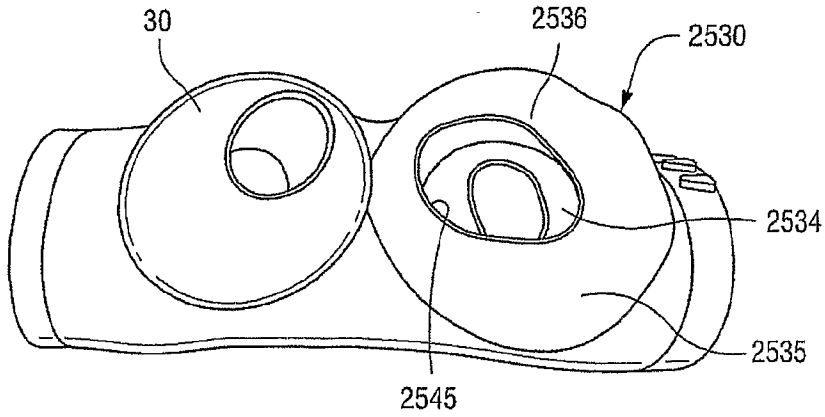

FIG. 25-1

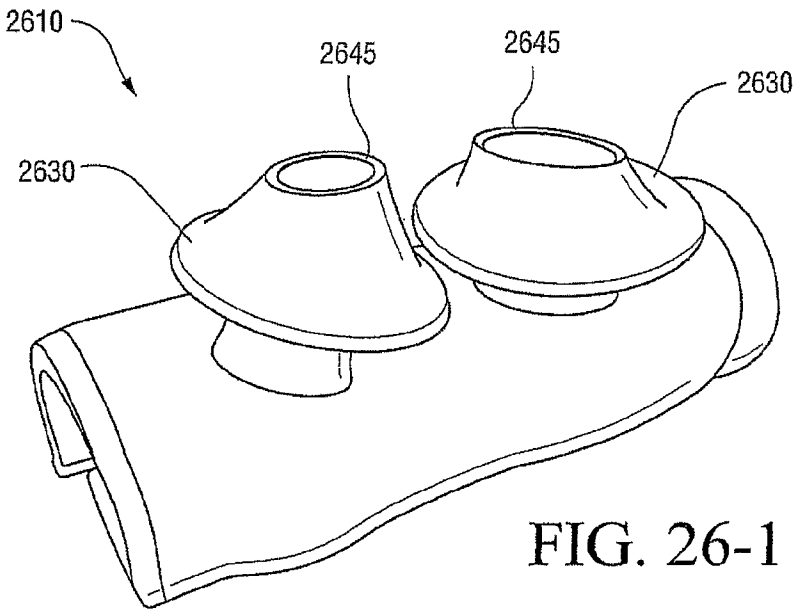

FIG. 26-1

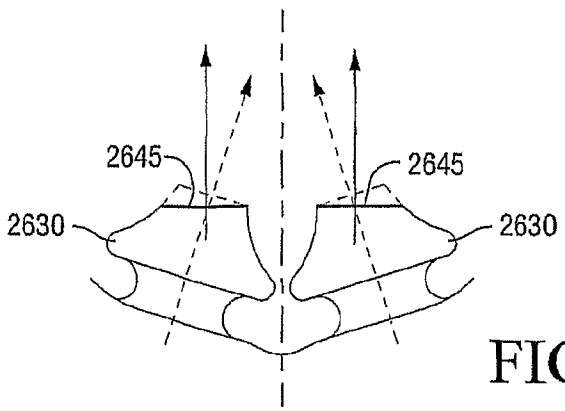

FIG. 26-2

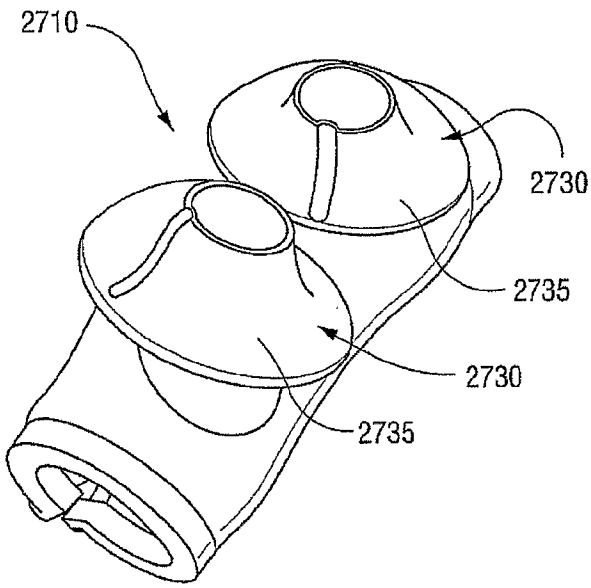

FIG. 27-1

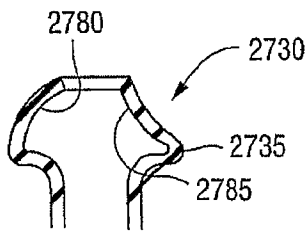

FIG. 27-2

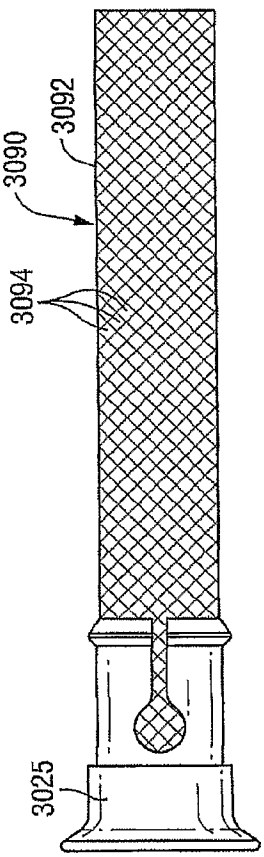

FIG. 28-1

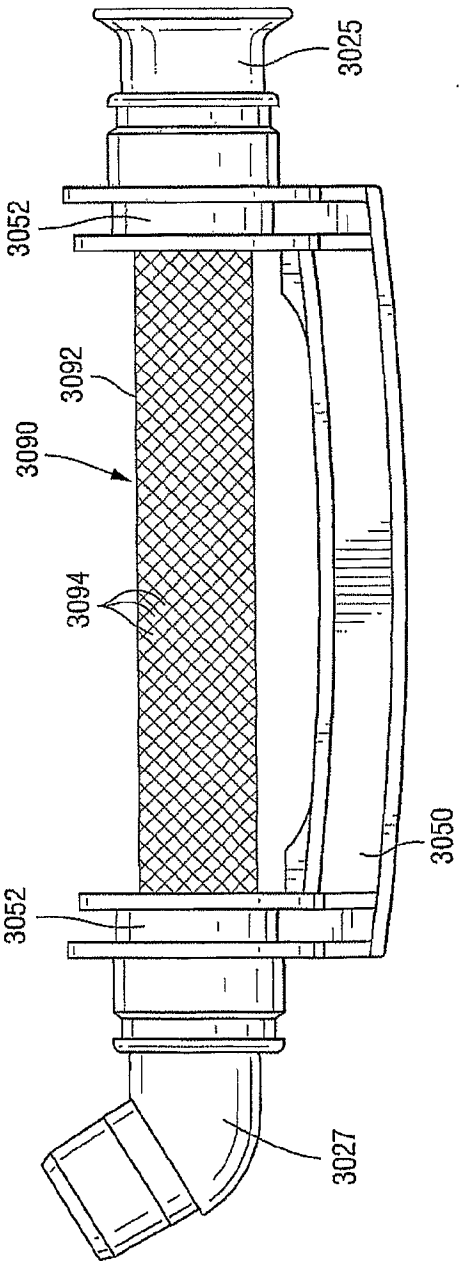

FIG. 28-2

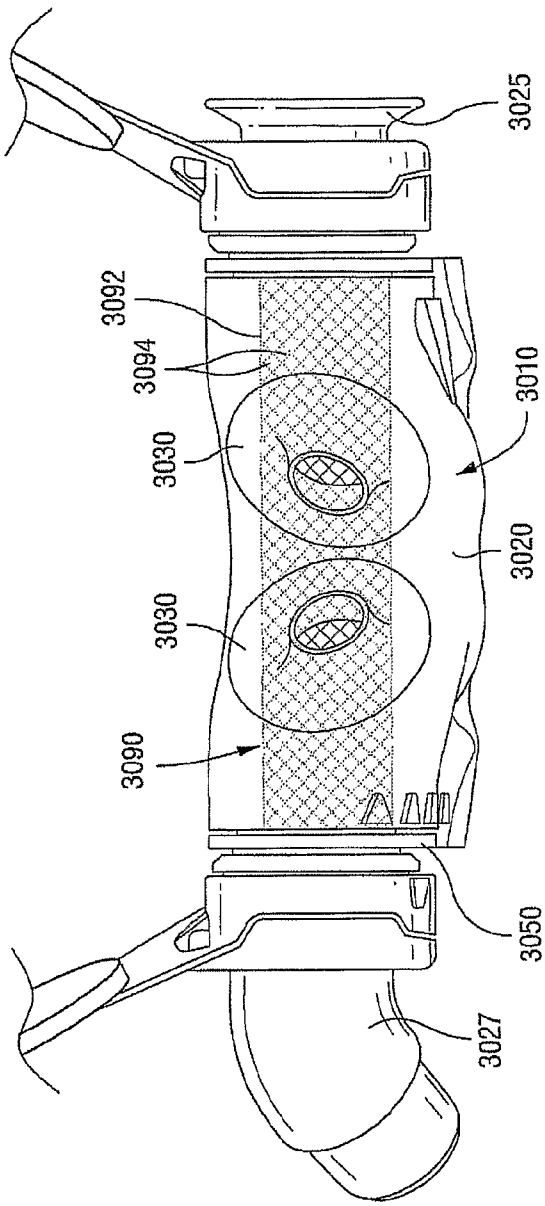

FIG. 28-3

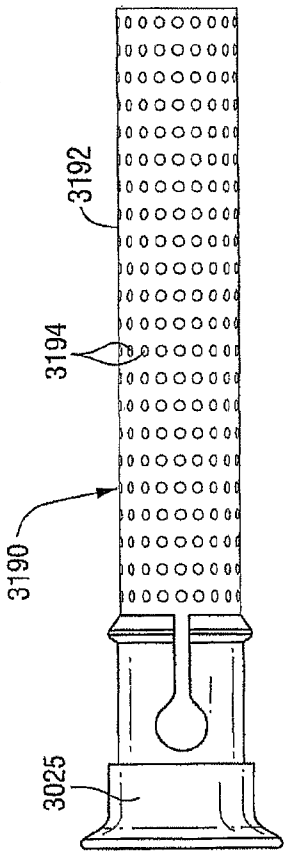

FIG. 28-4

CORRECTED VERSION

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2007/001060

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

A61M 16/06 (2006.01) ***A61M 15/08*** (2006.01) ***A62B 7/00*** (2006.01)

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
DWPI - IPC: A61M 16/- and A62B 7/- and Keywords: (nasal, prong, turbulence, grating, direct, irritation) and like terms

Google Patents – Keywords: (nasal, prong, turbulence, irritation, passage, dispersion) and like terms

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2005/079726 A1 (FISHER PAYKEL, HEALTHCARE LTD) 1 September 2005 See Abstract, Page 9 lines 10-13, Figures 5, 9, 12	1, 5, 19
X	US 3400714 A (SHERIDAN) 10 September 1968 See Abstract and Figure 3	3, 4, 28
X	WO 1987/003704 A1 (TIMMONS et al.) 18 June 1987 See Abstract, Figure 1, 2	1

[X] Further documents are listed in the continuation of Box C [X] 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	Date of mailing of the international search report
19 September 2007	28 SEP 2007

Name and mailing address of the ISA/AU

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Authorized officer
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AUSTRALIAN PATENT OFFICE
(ISO 9001 Quality Certified Service)
Telephone No : (02) 6283 2667

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2007/001060

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6986351 B2 (FIGLEY et al.) 17 January 2006 See Abstract, Figure 8, 11	
A	WO 2005/016407 A2 (INOMED TECHNOLOGIES) 24 February 2005 See whole document	
A	WO 2007/053878 A1 (RESMED LTD) 18 May 2007 See whole document	
A	WO 2003/026559 A2 (KURVE TECHNOLOGY, INC.) 3 April 2003 See whole document	
A	US 2006/0107958 A1 (SLEEPER) 25 May 2006 See whole document	
A	US 2005/0126574 A1 (WOOD) 16 June 2005 See whole document	
A	US 2005/0051177 A1 (WOOD et al.) 10 March 2005 See whole document	

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2007/001060

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:
[See supplemental sheet]

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2007/001060

Supplemental Box
(To be used when the space in any of Boxes I to VIII is not sufficient)

Continuation of Box No: III

This International Application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept.

In assessing whether there is more than one invention claimed, I have given consideration to those features which can be considered to potentially distinguish the claimed combination of features from the prior art. Where different claims have different distinguishing features they define different inventions.

This International Searching Authority has found that there are different inventions as follows:

- Claims 1-2, 5-7, 28-31 define nasal prongs for use in a respiratory system which sealingly communicate with the patient's nasal passage.It is considered that the head of these prongs directing in an angled direction comprises a first distinguishing feature.

- Claims 3-4, 8-18, 19-27, 32-45 define nasal prongs or mask system involving nasal prongs for use in a respiratory system which sealingly communicate with the patient's nasal passage.It is considered that the head of the nasal prongs being shaped so as to create turbulence within the nasal passagecomprises a second distinguishing feature.

- Claim 46 defines a method of producing a dispersion cartridge used to create turbulence in a mask system.It is considered that starting with a flat piece of material including a plurality of openings or pores and rolling it into a cylinder comprises a third distinguishing feature.

PCT Rule 13.2, first sentence, states that unity of invention is only fulfilled when there is a technical relationship among the claimed inventions involving one or more of the same or corresponding special technical features. PCT Rule 13.2, second sentence, defines a special technical feature as a feature which makes a contribution over the prior art.

Each of the abovementioned groups of claims has a different distinguishing feature and they do not share any feature which could satisfy the requirement for being a special technical feature. Because there is no common special technical feature it follows that there is no technical relationship between the identified inventions. Therefore the claims do not satisfy the requirement of unity of invention *a priori*.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/AU2007/001060

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
WO	2005079726						
US	3400714	CH	441629	DE	1491654	FR	1478253
		GB	1081807				
WO	8703704	CA	1255179	EP	0248082	US	4708446
US	6986351	US	6668828	US	6955171	US	7255105
		US	2003131849	US	2004163647	US	2005004511
		US	2005217668				
WO	2005016407	AU	13555/02	CA	2364183	CA	2368825
		CA	2416410	EP	1317940	EP	1317941
		US	6478026	US	6595215	US	6776162
		US	6807967	US	6863069	US	6994089
		US	6997177	US	7059328	US	7188624
		US	7191781	US	7234465	US	2002059935
		US	2002092527	US	2003116163	US	2004020493
		US	2005028823	US	2005034730	US	2005039757
		US	2005126574	US	2005133039	US	2005235999
		US	2005236000	US	2006150982	US	2007137653
		WO	2005016402				
WO	2007053878						
WO	03026559	AU	2002340083	AU	2003249623	EP	1450885
		US	7231919	US	2003079742	US	2003217748
		US	2007068514	WO	03099359		
US	2006107958						
US	2005126574	AU	13555/02	CA	2364183	CA	2368825
		CA	2416410	EP	1317940	EP	1317941
		US	6478026	US	6595215	US	6776162
		US	6807967	US	6863069	US	6994089
		US	6997177	US	7059328	US	7188624
		US	7191781	US	7234465	US	2002059935
		US	2002092527	US	2003116163	US	2004020493
		US	2005028823	US	2005034730	US	2005039757
		US	2005133039	US	2005235999	US	2005236000

		US	2006150982	US	2007137653	WO	2005016402
		WO	2005016407				
US	2005051177	AU	2003258103	US	6997187	US	7000613
		US	2005028821	US	2005045182	US	2005133040
		WO	2005016425	WO	2005025354	WO	2005025657

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX