[0086] Figure 6 is a top perspective view of the frame and forehead coupler, of Figure 2, assembled together.

[0087] Figure 7 is a top view of a forehead coupler.

[0088] Figure 8 is a top view of a forehead coupler.

[0089] Figure 9A is a front view of a forehead coupler assembled to a forehead strap.

[0090] Figure 9B is a top view of the forehead coupler of Figure 9A.

[0091] Figure 9C is a rear perspective view of the strap connector of Figures 9A and 9B.

[0092] Figure 10A is a rear perspective view of another embodiment of the forehead coupler of Figures 9A and 9B.

[0093] Figure 10B is a top view of the forehead coupler of Figure 10A.

[0094] Figure 10C is a front perspective view of the forehead coupler of Figure 10A.

[0095] Figure 11A is a top perspective of another embodiment of the forehead coupler of Figures 9A and 9B.

[0096] Figure 11B is a rear view of the forehead coupler of Figure 11A.

[0097] Figure 11C is a rear view of the forehead coupler of Figures 11A and 11B in a disconnected configuration.

[0098] Figure 12A is a top perspective view of a forehead coupler. [0099] Figure 12B is a top view of the forehead coupler of Figure 12A.

[0100] Figure 13A is a side view of a coupler connection assembled to the forehead coupler of Figures 9A, 9B and 9C.

[0101] Figure 13B is a side view of the coupler connection of Figure 13A.

[0102] Figure 14A is a perspective view of a coupler connection disconnected from a forehead coupler.

[0103] Figure 14B is a perspective view of the coupler connection of Figure 14A assembled a forehead coupler.

[0104] Figure 15A is a front view of a coupler connection disconnected from the forehead coupler of Figures 9A, 9B and 9C.

[0105] Figure 15B is a perspective view of the coupler connection of Figure 15A connected to the forehead coupler of Figures 9A, 9B and 9C.

[0106] Figure 16A is a perspective view of a headgear to frame connection in a non-secured configuration.

The side, forehead and top straps 162, 163 and 164 all have a fixed end 165 and a free end 166. The side straps 162 and forehead straps 163 extend laterally from the fixed ends 165 that connect to the rear portion 161, and the top straps 164 extend at an angle from the forehead straps 163. The side straps 162 connect to the headgear connections 121 of the frame 120 via a clip 167 and the forehead straps 163 connect to the forehead coupler 180. The top straps 164 are configured to pass over the top of a patient's head, in use, and are connected together via a buckle 168. The size of the headgear can be adjusted by folding the side, forehead or top straps 162, 163, or 164 back on themselves and securing the free ends 166 in place by means such as, but not limited to, hook and loop fastener, clips or clasps. This adjusts the in-use length of each of the side, forehead or top strap 162, 163, or 164 to be adjusted. As used herein the term "in-use length" shall mean the length of any of the side, forehead and/or top straps 162, 163, and/or 164 between the fixed end 165 and the point at which they connect with another component such as the buckle 168, clip 167 or forehead coupler 180. In alternative embodiments there may be a single fixed length top strap. The headgear can be made of a layered fabric such as Breath-oprene™ or any other appropriate material, and may be elastic and/or inelastic.

[0166] The forehead coupler 180 is configured to removably couple the forehead straps 163 and frame 120 together. When coupled together, the forehead straps 163 and forehead coupler 180 form a closed loop that is configured to extend around the patient's head and across their forehead, wherein the forehead coupler 180 is positioned near the center of the patient's forehead. The forehead coupler 180 is configured such that when it is removed from the frame 120 the closed loop remains intact. That is, the forehead coupler 180 allows a user to connect or disconnect the top strap from the forehead support of the frame 120 in a single action while still maintaining the loop tightness setting/connection of the top strap. This is beneficial as it allows the patient to remove the respiratory mask system 100 without altering the fit of the forehead straps, which improves ease of use and may lead to improved compliance with their therapy.

[0167] As shown in Figures 5A and 5B the forehead coupler 180 comprises a pair of strap connectors 181, a flexible linking member 182 and a frame connector 183. The strap connectors 181 comprise a substantially rigid plastic component having first and second strap slots 184 and 185 symmetrically separated by a central post 186. The strap slots are substantially rectangular in shape and are configured to receive a strap. The first strap slot 184 is configured to receive one of the forehead straps 163 and the second strap slot 185 is configured to receive one end of the flexible linking member 182. The size of the closed loop can be adjusted, to

[0178] Figures 10A, 10B and 10C shows another variation of the embodiment of Figures 9A, 9B and 9C, wherein the front side 497 of the strap connector 481 is convex and the frame connector 483 is secured to the strap connector 481 by means such as welding or over-moulding. The strap connector 481 comprises first strap slots 484 and second strap slot 485, wherein the frame connector 483 is configured to pass through the second strap slot 485 before being secured to the strap connector 481.

[0179] Figures 11A, 11B and 11C show a further variation of the forehead coupler 480 of Figures 9A, 9B and 9C. In this variation the strap connector 481 comprises two halves which are configured to be repeatedly connected and disconnected to each other. Each half of the strap connector 481 comprises an elongate strap slot 484 configured to receive one of the forehead straps 163. The two halves of the strap connector 481 are connected together by a button and hole type snap-fit fastener. It is to be understood that in other embodiments other types of snap-fit fasteners may be used and/or the connection between the two halves may be permanent. The frame connector 483 comprises a strap of fabric having two ends, wherein each of the ends is permanently secured to one half of the strap connector 481. The frame connector 483 forms a loop when the two halves of the strap connector are joined together, such that the loop may receive and/or retain a part of the forehead support 122 of the frame 120.

[0180] The embodiments of Figures 7 through 11C have all been numbered corresponding to the forehead coupler 180 of Figures 2 to 6, such that like features have had a value of 100 added to their reference numeral. For example, in Figure 5A the strap connector has a reference numeral of 181 and in the embodiment of Figure 7 the strap connector has a reference numeral of 281. Features with reference numerals that share the last two digits function in substantially the same way when assembled as a part of the respiratory mask system as a whole. Figures 12A and 12B have not been numbered strictly in this way. Only the forehead coupler as a complete component has been numbered with reference to the embodiment of Figures 2 to 6.

[0181] Figures 12A and 12B show yet another non-limiting exemplary embodiment of a forehead coupler 580. Forehead coupler 580 comprises a substantially flat and rectangular sleeve 581; having two short edges 582 and two long edges 583. The sleeve 581is configured to receive and retain a part of the forehead support 122 of the frame 120. The sleeve 581 comprises a front layer 584, back layer 585 and two strap slots 586. The strap slots 586 run parallel to and are proximal to the short edges 582. The front and back layers 584 and 585 are joined together around the perimeter of the strap slots 586, such that the short edges 582 are joined together and

applied, which can be advantageous during fitting and adjustment of the respiratory mask and headgear.

[0190] As shown in Figure 17C the forehead coupler 1000 has a front side 1008 and a back side 1009, wherein the front side 1008 is configured to face away from the patient's face, in use, and the back side 1009 is configured to face towards the patient's face. The strap guide 1006 comprises a flat, substantially rectangular portion that extends laterally from the inner edge 1007 formed by the strap apertures 1005. On the front side 1008 the strap guide 1006 is recessed such that a lip 1010 is formed along each of the edges of the strap guide 1006 that are perpendicular to the inner edge 1007. The lips 1010 are spaced apart by the length of the inner edge 1007. The lips are configured to locate and align the forehead straps 163 within the boundary of the forehead coupler 1000. The strap connector 1002 is configured such that a forehead strap 163 passes along the back side 1009 of the strap guide 1006, through the strap aperture 1005 and back over the front side 1008 of the strap guide 1006, before being secured in place. The free end 166 of the forehead strap 163 is secured to the forehead strap by means described in relation to previous embodiments.

[0191] The frame connector 1003 comprises a crossbar 1011 and a rib slot 1012. With reference to the view shown in Figure 17B, the crossbar 1011 comprises a solid beam that extends horizontally between the lower halves of the strap connectors 1002. It is configured to be received by the coupler connection 1004 of the frame 1001.The upper halves of the strap connectors 1002 are not connected and form the rib slot 1012. The rib slot 1012 comprises a gap between strap connectors 1002 having walls that are substantially perpendicular to the crossbar 1011 and curve outwardly in an upward direction from the crossbar 1011. The outward curvature of the walls of the rib slot 1012 provides a wide and smooth opening to guide the rib 1023 into the rib slot 1012, which allows the forehead coupler 1000 to be more easily aligned and connected to the coupler connection 1004 of the frame 1001. The rib slot 1012 is configured to engage with a corresponding rib that forms a part of the coupler connection 1004.

[0192] As shown in Figure 17D, the crossbar 1011 has a cross-sectional profile comprising a first end 1013 and a second end 1014 being connected by two flat sides 1015, wherein the first and second ends 1013 and 1014 have semicircular profiles. The diameter of the first end 1013 is smaller than the diameter of the second end 1014 such that the crossbar 1011 is asymmetrical from end-to-end and thus an acute angle is formed between the two flat sides 1015. The smaller diameter of the first end 1013 and the angled flat sides 1015 provide a lead in that reduces the force required to engage the frame connector 1003 with the coupler connection

slot 1312 is configured to engage with a corresponding rib 1323 that forms a part of the coupler connection 1304.

[0210] As shown in Figures 20G to 20K, the coupler connection 1304 of the frame 1301 is similar in configuration to the coupler connections 1004 and 1104. That is, similar to the coupler connections 1004 and 1104, the coupler connection 1304 comprises a hook having a shank 1317 that extends approximately 180° around a bend 1318 and into a return arm 1319, wherein a throat 1320 is formed between the shank 1317 and the return arm 1319. Further, the hook comprises a rib 1323, which is an elongate substantially rectangular extrusion that extends away from the shank 1317 towards the return arm 1319. Similar to the coupler connections 1004 and 1104, in operation, the throat 1320 is configured to receive the crossbar 1311 of the frame connector 1303. The return arm 1319 is configured to flex away from the shank 1317, about the bend 1318, such that the crossbar 1011 may pass through the throat opening 1322, which is narrower than the diameter of both the first and second ends 1313 and 1314 of the crossbar 1311. When the crossbar 1311 is positioned within the throat 1320, the rib 1323 is positioned within the rib slot 1312, which improves the stability of the connection between the forehead coupler 1300 and the coupler connection 1304. In other words, the rib 1323 is seated in the rib slot 1312 such that the rib 1323 contacts the two long edges 1315 of the rib slot 1312 and prevents or inhibits rotation of the frame connector 1303 within the throat 1320. That is, the contact between the sides of the rib 1323 and the two long edges 1315 of the rib slot 1312 obstructs rotation of the frame connector 1303 relative to the frame 1301. The rib 1323 is configured to be substantially the same width as the portion of the rib slot 1312 that is perpendicular to the crossbar 1311 and have a substantially narrower width than the return arm 1319 and the bump 1321. This at least substantially inhibits or preferably prevents the crossbar 1311 from being inserted into the throat 1320 in the wrong orientation. Further, an interference fit between the crossbar 1311 of the forehead coupler 1300 and the frame 1301 (i.e., the shank 1317 and the return arm 1319) reduces slop or free-play in the joint to prevent the frame 1301 from moving or rotating relative to the crossbar 1311. Further, the interference fit also provides an audible 'click' noise when the forehead coupler 1300 and the frame 1301 are connected together. The audible 'click' noise provides positive feedback for the user so that they know the forehead coupler 1300 and the frame 1301 are properly connected.

[0211] In contrast to the coupler connections 1004, 1104, the rib 1323 of the coupler connection 1304 is separated from the return arm 1319 by a gap 1328 (as shown in Figure 201) whereas the ribs 1023, 1117 extend all the way through the throat 1020, 1122 from the shank

illustrated, the crossbar 1311, the rib slots 1312, the flanges 1313, and the recesses 1314, are identical between the forehead coupler 1300_S and the forehead coupler $1300_{M/L}$ and only vary with respect to their positions relative to the strap apertures 1305_S, $1305_{M/L}$. Providing identical crossbars 1311, rib slots 1312, flanges 1313, and recesses 1314 provides identical connection structure for connecting to the frame 1301 between the forehead couplers 1300_S, $1300_{M/L}$ which allows interchangeability between the forehead couplers 1300_S, $1300_{M/L}$.

[0218] As shown in Figures 25A and 25B, the crossbar 1311 and the flanges 1313 have a combined vertical length L on both the small forehead coupler 1300_S and the medium/large forehead coupler $1300_{M/L}$. The combined vertical length L is identical on both the small forehead coupler 1300_S and the medium/large forehead coupler $1300_{M/L}$. Further, in Figure 25A, a distance X is measured from a lowermost edge of the crossbar 1311, which is also the lowermost edge of the medium/large forehead coupler $1300_{M/L}$, to the uppermost inner wall portion $1340_{M/L}$ of the strap apertures $1305_{M/L}$. Similarly, in Figure 25B, the distance X is measured from the lowermost edge of the small forehead coupler 1300_S to the uppermost inner wall portion 1340_S of the strap apertures 1305_S. The distance X is substantially identical on both the small forehead coupler 1300_S and the medium/large forehead coupler $1300_{M/L}$. However, the small forehead coupler 1300_S differs from the medium/large forehead coupler $1300_{M/L}$ in that the crossbar 1311 and the flanges 1313 on the small forehead coupler 1300_S are offset vertically upwards by the offset distance O_{CB} compared to the medium/large forehead coupler $1300_{M/L}$. That is, the crossbar 1311 and the flanges 1313 are shifted vertically upwards by the offset distance O_{CB} on the small forehead coupler 1300_S. As a result, when the small forehead coupler 1300_S is attached to the frame 1301, the apertures 1305_S will be positioned lower on the frame 1301 than the apertures $1305_{M/L}$ when the medium/large forehead coupler $1300_{M/L}$ is attached to the frame 1301. Preferably, the offset distance O_{CB} is approximately 5mm. That is, the apertures 1305_S are preferably positioned approximately 5mm lower than the apertures $1305_{M/L}$. However, it should be understood to one of ordinary skill in the art that the offset distance may depend upon the variance in size between small and medium/large mask sizes. Further, it should be understood to one of ordinary skill in the art that the distance X is measured from the uppermost inner wall portion 1340_S, $1340_{M/L}$ of the strap apertures 1305_S, $1305_{M/L}$ because the frame 1301 and the forehead couplers 1300_S, $1300_{M/L}$ are suspended and held by the forehead straps along the uppermost inner wall portion 1340s, 1340w, of the strap apertures 1305s, $1305_{M/L}$. In other words, the position of the uppermost inner wall portion 1340s, $1340_{M/L}$ of the strap apertures 1305s, $1305_{M/L}$ relative to the crossbar 1311 (i.e., or any other frame connector assembly) is

generally determinative of the position of the forehead straps relative to the frame 1301 since the forehead couplers 1300_S, $1300_{M/L}$ are suspended by the forehead straps by the uppermost inner wall portion 1340_S, $1340_{M/L}$ of the strap apertures 1305_S, $1305_{M/L}$. Even further, it should be understood to one of ordinary skill in the art that the combined vertical length L and the distance X are used to describe the comparative positions of the crossbar 1311 relative to the strap apertures 1305_S, $1305_{M/L}$. Varying of the position of the crossbar 1311 relative to the strap apertures 1305_S, $1305_{M/L}$ allows the position of the strap apertures 1305_S, $1305_{M/L}$ to vary between the forehead couplers 1300_S, $1300_{M/L}$ while still providing interchangeability of the forehead couplers 1300_S, $1300_{M/L}$.

[0219] Some respiratory masks have headgear to secure them to a patient's face. The headgear often includes adjustable straps for adjusting the size of the headgear to match a range of patient head sizes. A crown strap can include two strap portions that are joined together by a buckle at a centrally located point on the top of a patient's head. Figure 26 shows a perspective view of a prior respiratory mask 2100 comprising a mask body 2104 and headgear 2106. While a nasal mask is shown, the presently disclosed subject matter is applicable to other mask types, such as nasal pillows, full face, and under nose. The headgear 2106 is configured to provide a means of easily connecting and disconnecting at least a portion of the headgear 2106 to the mask body 2104. The headgear 2106 includes a top strap or crown strap 2110 and a buckle member 2112. The buckle 2112 can be arranged to couple two portions of the crown strap 2110. Each of the portions of the crown strap 2110 preferably has an end portion 2114 and the end portion 2114 can have a coupling member such as a hook and loop fastener. The strap portions are threaded through at least one aperture in the buckle 2112 and folded back on themselves before being secured in place. The strap portions are usually secured in place by a hook and loop fastener (such as VELCRO®) at the end portions 2114. There is a tab portion at the end portions 2114 that comprises the hook component of the fastener that is configured to attach to the material of the strap portion, which forms the loop component of the fastener.

[0220] Figures 27-34 illustrate an embodiment of a headgear adjustment and connection system that includes a pair of straps that are configured to be linked together such that their combined length is incrementally adjustable. The disclosed embodiments can be used with a crown strap, other straps (such as upper and lower mask attachment straps), or any other headgear component. For example, the system can be utilized in the crown strap of a headgear for an interface. The portions of the headgear and/or interface can be the same as or similar to the headgear and interface assembly shown in Figure 1, or can be of another suitable

arrangement. The disclosed embodiments allow for coupling of the two strap portions without the use of a buckle or other additional component. Preferably, one of the two strap portions includes an aperture and the other strap portion includes one or more notches that are configured to engage the aperture as the strap portions are securely coupled together. In some embodiments, the ends of the strap portions each have a fastener, such as a hook and loop fastener, which are configured to fasten or couple the end to a surface of the other strap portion.

[0221] As illustrated in Figures 27-34, the headgear strap 2120 comprises a female strap portion 2122 and a male strap portion 2124. The female strap portion 2122 includes a free end 2126 and an attached end 2141. The male strap portion has a free end 2128 and an attached end 2140. Preferably, the attached ends 2140 and 2141 are configured to be permanently attached or integrally formed with other portions of the headgear. In other embodiments, the attached ends 2140 and 2141 can be removably attached or secured. The strap portions 2122 and 2124 can be made of a flexible material and can be elastic or inelastic. In some embodiments the material of the strap portions 2122 and 2124 comprises laminated layers of one or more polymers, foams or fabrics, such as Breath-o-prene. In some embodiments, the strap portions 2122 and 2124 can have inner and outer fabric layers and a central foam or polymer layer. Other flexible and durable materials may be suitable for the female and male straps 2122 and 2124. In other embodiments, the strap portions 2122 and 2124 can be formed from a central foam layer with non-stretch or low-stretch inner and outer fabric layers.

[0222] Each of the free ends 2126 and 2128 of the female and male strap portions 2122 and 2124 preferably defines a grip member or tab that is configured to be grasped by a user during connection and adjustment of the headgear. The free ends 2126 and 2128 can be sized and shaped to be engaged and pulled on by the fingers of a user to move the strap portions 2122 and 2124 relative to one another. The grip members or tabs defined by the free ends 2126 and 2128 can also be configured to be thin and substantially flat so that they lay flat against the opposite strap portion when the strap portions 2122 and 2124 are coupled.

[0223] Female strap portion 2122 has an inner surface 2136 and an outer surface 2152. Male strap portion 2124 has an inner surface 2134 and an outer surface 2150. The inner surface 2136 of the female strap portion 2122 supports a fastener 2142 and the inner surface 2134 of the male strap portion 2124 supports a fastener 2144. Preferably, fasteners 2142 and 2144 are configured to couple or hold the free ends 2126 and 2128 of the female and male strap portions 2122 and 2124 to the outer surface of the opposite strap portion. In some embodiments, fasteners 2142 and 2144 comprise hook and loop fastening systems (such as VELCRO®).

Preferably, the outer surfaces 2150 and 2152 comprise a soft and/or textured fabric material that forms the loop component of the hook and loop fastener. Fasteners 2142 and 2144 can include a plastic hook component that is preferably fixed or permanently attached to the inner surface 2134, 2136 of the female and male straps 2122 and 2124 at or adjacent the free ends 2126 and 2128. The free ends 2126 and 2128 can be repeatedly coupled and decoupled from the outer surfaces 2150 and 2152 of the strap portions.

[0224] Fasteners 2142 and 2144 are preferably located entirely within the outer perimeter of free ends 2126 and 2128 of the female and male strap portions 2122 and 2124, such that there are no sharp edges exposed beyond the strap material. In the illustrated embodiment, the fastener 2142 comprises a hook component having a width A of between approximately 6 and 18 millimeters. In other embodiments, the width A is between approximately 10 and 14 millimeters. In another preferred embodiment, the width A is approximately 12 millimeters. The width B of the female and/or male strap portions 2122 and 2124 is preferably between approximately 10 and 24 millimeters and in some embodiments is between 16 and 20 millimeters. In another preferred embodiment, the width B is approximately 18 millimeters. Preferably, the difference in widths A and B, in combination with the hook component being slightly offset from the tip of each free end 2126 and 2128, provides that the edges of the free ends 2126 and 2128 are not coupled or attached to the opposing strap portion. This allows the patient/user to be able to lift the edges of the free ends 2126 and 2128 more easily for adjustment of the straps. The hook component can be the same for both the male and female strap portions.

[0225] Fasteners 2142 and 2144 can be secured in place on the straps by a welding process (ultrasonic or RF), adhesives, or any other form of attachment. The straps can also include 3D features at or adjacent to the free ends 2126 and 2128 of the strap portions 2122 and 2124. In some embodiments, by only welding the fasteners 2142 and 2144 and their hook component portions in certain areas, protruding or dimpled surfaces 2148 and 2149 can be formed in both the fasteners 2142 and 2144 and on the outer surfaces 2150 and 2152 of the strap portions. The dimpled surfaces 2148 and 2149 are formed where the fastener’s hook component and the strap material have not been compressed by the welding process. The regions of the fasteners 2142 and 2144 that are compressed during the welding process may have the hooks crushed or deformed such that they cannot grip onto the loop component on the strap surfaces.

[0226] Fasteners 2142 and 2144 and their hook component portions are preferably the same size and shape for both the female and male strap portions 2122 and 2124, and they

can be attached to the straps in the same manner. This is advantageous because the two strap portions 2122 and 2124 can be manufactured using a single process and tool. This minimizes manufacturing times and costs. Also, the 3D features forming dimpled surfaces 2148 and 2149 can provide improved tactile performance and usability of the free ends 2126 and 2128 of the female and male strap portions 2122 and 2124, such that it is easier to grip and couple/decouple the free ends 2126 and 2128.

[0227] Male strap portion 2124 preferably comprises a plurality of notches 2132 cut into one or more edges of the strap. In some embodiments, the notches 2132 are arranged in pairs, such that a notch 2132 on one edge of the strap portion 2124 is aligned with a corresponding notch 2132 on the opposite edge of the strap portion 2124. Preferably, a plurality of notch pairs 2132 are spaced evenly along part of the length of the male strap portion 2124, starting adjacent the free end 2128 and extending toward the attached end 2140. The notches 2132 are configured to provide incremental length adjustment of the headgear strap 2120. In the illustrated embodiment, there are two pairs of notches 2132 and each notch has a triangular or angled shape. The first pair of notches 2132 is offset or distanced from the tip of the free end 2128 so that the free end 2128 can define a tab or grasping portion between the notches 2132 and the tip of the free end 2128. In other embodiments there may as few as one pair of notches, and in others there can be three or more notch pairs 2132 that provide more adjustment options for the strap connection. Some embodiments can also have notches with different sizes and shapes. For example, some notches could be rectangular or circular in shape and could extend more or less into the edge of the strap. In other embodiments, the strap 2124 can have a plurality of individual notches along one edge of the strap 2124 without any notches along the opposite edge of the strap 2124. In such embodiments, the notch depth can allow the strap portion 2124 to fit flat within the aperture 2130. Only a single notch would be engaged with the aperture 2130 at each size setting. In yet other embodiments, the strap 2124 can include a plurality of notches that alternate between sides along the length of the male strap portion 2124. In such embodiments, the notch depth can allow the strap 2124 to fit flat within the aperture 2130 and a single notch would be engaged with the aperture at each size setting.

[0228] The incremental adjustment provided by the notches 2132 allows for controlled adjustment of the headgear size, in comparison to the continuous adjustment provided by prior art systems. Controlled incremental adjustment can be beneficial as it provides precise sizing settings that can be repeatedly selected. If the headgear is removed from the mask for cleaning, the female and male strap portions 2122 and 2124 can be disconnected without the

worry and inconvenience of losing the sizing of the headgear and having to refit it to the specific patient.

[0229] Female strap portion 2122 comprises an aperture 2130 that extends through a portion or length of the female strap portion 2122. Preferably, aperture 2130 extends through the free end 2126 and extends through the thickness of the strap portion 2122. The aperture 2130 can be a cut-out or hole that extends through both the inner surface 2136 and the outer surface 2152 of female strap portion 2122. Preferably, the aperture is offset or distanced from the tip of the free end 2126 such that the free end 2126 can be gripped between the aperture 2130 and the tip. The aperture 2130 is configured to receive the free end 2128 of the male strap portion 2124, thus linking the strap portions together. The notches 2132 of the male strap portion 2124 are configured to engage the aperture 2130 when the male strap portion 2124 passes through the aperture 2130. This arrangement of extending the male strap member 2124 through the aperture 2130 of the female strap portion 2122 with portions of the male strap member 2124 engaging the aperture 2130 can help to maintain the female and male strap portions 2122 and 2124 linearly aligned with each other, which provides consistent force vectors to support the mask on the patient's face. This arrangement can also help maintain a connection between the strap portions 2122 and 2124 during adjustment. This makes adjustment easier as the user does not have to hold the headgear in place on his head while adjusting the length.

[0230] Preferably, the aperture 2130 is located within the perimeter of, and extends through a portion of the fastener 2142 on the female strap portion 2122, as shown in Figure 27. The aperture 2130 can be punched out of the female strap portion 2122 as a secondary manufacturing step, after the fastener 2142 has been coupled to the strap portion 2122. Preferably, the aperture 2130 is positioned within a region of the fastener 2142 that is affixed or fused (by the welding process or adhesive) to the inner surface 2136, such that the hook component of the fastener 2142 is permanently joined around the entire perimeter of the aperture 2130. This reinforces the perimeter of the aperture 2130. In some embodiments, the hooks of the hook component of the fastener 2142 are crushed or deformed around the perimeter of the aperture 2130. The reinforced perimeter provides structure to the aperture 2130 that prevents it from deforming substantially as a result of forces applied to it by the male strap portion 2124 being drawn through the aperture 2130. This also makes it easier to draw the male strap portion 2124 smoothly through the aperture 2130. The reinforced perimeter also helps to engage the notches 2132 of the male strap portion 2124 during adjustment of the headgear size. It also provides a tactile response during adjustment so that the user can feel when each pair of

notches 2132 is engaged and the size of the headgear has been adjusted by an increment. Having the hooks of the hook component of the fastener 2142 crushed or deformed adjacent to the perimeter of the aperture 2130 also minimizes the chances of the male strap portion 2124 catching on the hooks during coupling and assembly. This may also improve the ease with which the male strap portion 2124 can be drawn through the aperture 2130.

[0231] Preferably, aperture 2130 is sized and shaped so that the male strap portion 2124 is folded, bent or curved about its longitudinal axis in order to pass through the aperture 2130. Preferably, the male strap portion 2124 is configured to lay flat within the aperture 2130 when it is arranged in a position in which notches 2132 are engaging the aperture 2130. In some embodiments, the width D of the male strap portion 2124 and its free end 2128 is greater than the width C or height H of the aperture 2130. As illustrated, the aperture 2130 can be configured to have a straight side on its perimeter and also a curved portion along the perimeter. The straight side extends perpendicular to the longitudinal axis of the female strap portion 2122 and the curved portion can be a semi-circular arc. In other preferred embodiments, the aperture can have a different shape such as triangular or square-shaped, wherein the height and width dimensions of the aperture allow the male strap portion 2124 to pass through in a folded or bent position. Preferably, the width D of the male strap portion 2124 is between approximately 10 and 24 millimeters and the width C of the aperture 2130 is between approximately 5 and 14 millimeters. In other preferred embodiments, the width D is between approximately 16 and 20 millimeters and the width C is between approximately 8 and 10 millimeters. In one preferred embodiment the width D is approximately 18 millimeters and the width C is approximately 9 millimeters. Is some preferred embodiments, the width D is approximately 1.5-2.5 times greater than the width C, and in one preferred embodiment the width D is approximately 2 times greater than the width C. Preferably, height H of aperture 2130 is less than width C and is equal to or less than half the maximum width D of the male strap portion 2124.

[0232] The width J of male strap portion 2124 between notches 2132 is approximately the same as width C of aperture 2130. This allows the male strap portion 2124 to extend in a flat manner within aperture 2130 when the notches 2132 are aligned with and engaging the aperture 2130. In other preferred embodiments, width J is less than width C. The curved portion of aperture 2130 has a perimeter or arc measurement P that defines the distance or length along the perimeter of the aperture 2130, excluding the straight side of aperture 2130. The measurement P is approximately the same as width D of the male strap portion 2124. In other preferred embodiments, measurement P is slightly less than width D and in other

embodiments measurement P is greater than width D. Preferably, width B of female strap portion 2122 is approximately the same as measurement P and width D. The female and male strap portions 2122 and 2124 can have the same maximum widths B and D such that when the strap portions 2122 and 2124 are coupled, their edges do not protrude or extend beyond one another, which provides a smooth and consistent edge (as can be seen in Figure 33). In one preferred embodiment, measurement P is approximately 18 millimeters.

[0233] By matching the perimeter measurement P of the aperture 2130 to the maximum width D of the male strap portion 2124, the size of the aperture 2130 can be minimized, while still allowing passage of the strap portion 2124 through the aperture 2130. Minimizing the size of the aperture 2130 helps to maintain the structural integrity of the female strap portion 2122 and maintains a close-fitting coupling between the female and male strap portions 2122 and 2124. A close fit between the strap portions 2122 and 2124 prevents unintentional disconnection of the straps. Allowing the male strap portion 2124 to flatten out when a pair of notches 2132 is aligned with the aperture 2130 permits the straps 2122 and 2124 to maintain a low profile when coupled, as shown in Figure 32. The notches 2132 can also function as an end stop feature, wherein the width of the male strap portion 2124 outside of the notches 2132 prevents it from unintentionally slipping through the aperture 2130.

[0234] As illustrated, aperture 2130 is sized and shaped to allow the free end 2128 of the male strap portion 2124 to pass through it, as shown in Figure 29. Both strap portions 2122 and 2124 can have approximately equal maximum widths B and D. In order for a consistent maximum width to be maintained along the lengths of the strap portions 2122 and 2124, the aperture 2130 preferably has a narrower width C than the maximum widths B and D of the strap portions 2122 and 2124. For the male strap portion 2124 to fit through the narrower aperture 2130, the strap portion 2124 is folded or bent such that its width is reduced to match or be smaller than the width C of the aperture 2130. In bending or folding the male strap portion 2124, its depth is increased so the aperture 2130 preferably has corresponding depth or height H. The dimensions of aperture 2130 can be selected to allow for the increased depth of the strap portion 2124 to pass through. Preferably, the hook component of the hook and loop fastener 2144 limits the ability of the male strap portion 2124 to be folded or bent to fit through the aperture 2130. Figure 30 shows the male strap portion 2124 being folded or bent as it passes through the aperture 2130. The hook component of the fastener 2144 buckles and bunches and can limit how narrow the strap portion 2124 can be bent, which in turn restricts how narrow the aperture width C can be.

[0240] Preferably, the male strap portion 2224 includes a transition 2266 at the end of the adjustment portion 2232 that is configured to provide a stop or engagement surface that deters decoupling of the strap portions 2222 and 2224. The male strap portion 2224 can also include a transition 2267 at the opposite end of the adjustment portion 2232 that is configured to provide an engagement surface or stop that limits movement of the aperture 2230 past that point and deters overtightening of the strap portions.

[0241] As illustrated, the male strap portion 2224 has a width R and the adjustment portion 2232 has a width Q. The female strap portion 2222 has a width T and the aperture has a width S. Preferably, the widths T and R of the strap portions 2222 and 2224 are substantially the same. In one preferred embodiment, the width Q of the adjustment portion 2232 is approximately the same as the width S of the aperture 2230. In such an arrangement, there is little or no friction or engagement between the adjustment portion 2232 and the aperture 2230 as the adjustment portion 2232 passes through the aperture 2230. However, the fasteners 2242 and 2244 engage the surface of the opposite strap portion and retain the coupling of the strap portions.

[0242] In another preferred embodiment, the widths R and T of the strap portions 2222 and 2224 are greater than the width Q of the adjustment portion 2232. The width Q of the adjustment portion 2232 can also be greater than the width S of the aperture 2230. In such an embodiment, there is friction or engagement between the adjustment portion 2232 and the aperture 2230 as the adjustment portion 2232 passes through the aperture 2230 which assists in the retention of the coupling of the strap portions 2222 and 2224. The greater the width Q relative to the width S, the more friction there is and more force is required to decouple the strap portions 2222 and 2224 or adjust them relative to one another. In another embodiment, the width Q is substantially the same as the width R of the strap portion 2224. In such an embodiment there are little or no transitions at the end of the adjustment portion 2230 to limit overtightening or deter uncoupling of the strap portions 2222 and 2224.

[0243] Unless the context clearly requires otherwise, throughout the description and the claims, the words “comprise”, “comprising”, and the like, are to be construed in an inclusive sense as opposed to an exclusive or exhaustive sense, that is to say, in the sense of “including, but not limited to.”

[0244] Where, in the foregoing description reference has been made to integers or components having known equivalents thereof, those integers or components are herein incorporated as if individually set forth.

CLAIMS:

1. A top strap connection assembly (2120) for providing incremental length adjustment to a top strap of a headgear, the top strap connection assembly comprising:

a female strap portion (2122) attached to the headgear, the female strap portion (2122) further comprising:

an aperture (2130) extending through the female strap portion (2122), and

a first fastener portion (2142) positioned on an inner surface (2136) of the female strap between the aperture (2130) and an end (2126) of the female strap portion (2122); and

a male strap portion (2124) attached to the headgear, the male strap portion (2124) further comprising:

a plurality of notches (2132) positioned along the length of the male strap portion (2124) on outer edges of the male strap portion, and

a second fastener portion (2144) positioned on an inner surface (2134) of the male strap between the plurality of notches and an end (2128) of the male strap portion (2124),

wherein the male strap is positioned within the aperture (2130) such that the plurality of notches (2132) engages the aperture (2130),

wherein the first fastener portion (2142) is fastened to an outer surface (2150) of the male strap portion (2124) and the second fastener portion (2144) is fastened to an outer surface (2152) of the female strap portion (2122).

2. The top strap connection assembly (2120) of claim 1, wherein the first and second fastener portions (2142, 2144) are hook portions of a hook and loop type fastener.

3. The top strap connection assembly (2120) of claim 1 or 2, wherein the first and second fastener portions (2142, 2144) include a three-dimensional projection that protrudes from the inner surfaces (2136, 2134) of the female and male strap portions (2122, 2124).

4. The top strap connection assembly (2120) of any one of claims 1-3, wherein the aperture (2130) extends through a portion of the first fastener portion (2142), preferably wherein the aperture (2130) is located within the perimeter of, and extends through a portion of, the first fastener portion (2142).

5. The top strap connection assembly (2120) of any one of claims 1-4, wherein a width of the female strap portion (2122) is approximately equal to a width of the male strap portion (2124).

6. The top strap connection assembly (2120) of any one of claims 1-5, wherein the aperture (2130) has a straight side and a curved side, preferably wherein a length of a perimeter of the curved side is substantially equal to the width of the male strap portion (2124).

7. The top strap connection assembly (2120) of claim 6, wherein the plurality of notches (2132) on the outer edges of the male strap portion (2124) are arranged in aligned pairs and the male strap portion (2124) includes a width between each aligned pair of notches, (2132) and wherein the width between each aligned pair of notches (2132) is substantially equal to a length of the straight side of the aperture (2130).

8. The top strap connection assembly (2120) of claim 6 or 7, wherein the aperture (2130) has a height extending along the length of the male strap portion (2124) and the height of the aperture (2130) is less than the length of the straight side of the aperture (2130).

9. The top strap connection assembly (2120) of any one of claims 6-8, wherein the width of the male strap portion (2124) is approximately between 1.5 and 2.5 times greater than a length of the straight side of the aperture (2130).

10. The top strap connection assembly (2120) of any one of claims 1-5, wherein the aperture (2130) has a semicircular shape and includes a straight side extending perpendicular to a longitudinal axis of the female strap portion (2122).

11. The top strap connection assembly (2120) of any one of claims 1-10, wherein the plurality of notches (2132) on the outer edges of the male strap portion (2124) are arranged in aligned pairs, preferably wherein a plurality of pairs of notches (2132) are spaced evenly along part of a length of the male strap portion (2124), preferably wherein a first pair of notches (2132) is offset or distanced from a tip of the end (2128) so that the end (2128) defines a tab or grasping portion between the notches (2132) and the tip of the end (2128).

12. The top strap connection assembly (2120) of any one of claims 1-11, wherein the male strap portion (2124) is configured to lay flat within the aperture (2130) when it is arranged in a position in which the plurality of notches (2132) engages the aperture (2130).

13. The top strap connection assembly (2120) of any one of claims 1-12, wherein the aperture is offset or distanced from a tip of the end (2126) of the female strap portion (2122) such that the end (2126) can be gripped between the aperture (2130) and the tip.

14. The top strap connection assembly (2120) of any one of claims 1-13, wherein each of the ends (2126, 2128) of the female and male strap portions (2122, 2124) defines a grip member or tab that is configured to be grasped by a user during connection and adjustment of the headgear, preferably wherein the grip members or tabs defined by the ends (2126, 2128) are configured to be thin and substantially flat so that they lay flat against the opposite strap portion when the female and male strap portions (2122, 2124) are coupled.

15. The top strap connection assembly (2120) of any one of claims 1-14, wherein the first and second fastener portions (2142, 2144) are located entirely within the outer perimeter of the ends (2126, 2128) of the female and male strap portions (2122, 2124).