## SUMMARY OF THE INVENTION

**[0006]** An object of the present invention is to provide an interface which will at least provide the industry and users with useful choice.

**[0007]** Some aspects of the present invention relate to headgear for use with an interface where the headgear is generally inelastic. Generally inelastic headgear is believed by the inventors to be superior to elastic headgear when used with pressures that vary dramatically over a treatment session, for example. However, generally inelastic headgear can be difficult to fit and use. For example, with generally inelastic headgear, there is a need for decoupling the headgear during donning, which can be problematic when it comes to adjusting the headgear for proper fit. Decoupling also can be difficult to manage for some users.

**[0008]** Certain features, aspects and advantages of the present invention relate to an interface assembly for use in providing a breathing treatment. The interface assembly can comprise a mask. The mask comprises a frame and a seal supported by the frame. Headgear can be connected to the mask and at least one of (i) an adjustment mechanism configured to be set to a use length for a loop defined by the mask and the headgear; and (ii) a break-fit assembly configured to selectively lengthen the loop defined by the mask and the headgear when a predetermined force has been exceeded and return to the use length when the predetermined force has not been exceeded.

**[0009]** In some such configurations, the interface assembly comprises both the adjustment mechanism and the break-fit assembly. In some such configurations, the adjustment mechanism couples the headgear to the mask. In some such configurations, the adjustment mechanism is positioned on the mask. In some such configurations, the adjustment mechanism is positioned on the headgear.

**[0010]** In some such configurations, the break-fit assembly joins the headgear and the mask. In some such configurations, the break-fit assembly joins the adjustment mechanism and the mask. In some such configurations, the break-fit assembly joins the adjustment mechanism and the headgear. In some such configurations, the break-fit assembly is positioned on the frame of the mask. In some such configurations, the break-fit assembly is positioned on the headgear.

configurations, the stretch biasing member provides a connection between the parts of the mechanical coupling of the break-fit assembly. In some such configurations, the mechanical coupling requires a first force to disconnect and second force to reconnect, the second force being less than the first force.

**[0020]** Certain features, aspects and advantages of the present invention relate to a break-fit assembly for a mask and headgear assembly. The break-fit assembly comprises a magnetic coupling that resists elongation from a first length to a second length until a force is applied that exceeds a predetermined force. The magnetic coupling comprising multiple parts and a stretch portion.

**[0021]** In some such configurations, the magnetic coupling fulfills a biasing function for the break-fit assembly. In some such configurations, the stretch portion provides a connection between two or more parts of the magnetic coupling.

**[0022]** Certain features, aspects and advantages of the present invention relate to a mask and headgear system comprising a mask configured to be positioned on a user's face and an adjustment mechanism configured to adjust the size of the headgear to accommodate different users.

**[0023]** In some such configurations, the headgear comprises a material that is substantially non-elastic. In some such configurations, the headgear is substantially non-stretch. In some such configurations, the adjustment mechanism comprises a buckle. In some such configurations, the buckle comprises a hook and loop fastener. In some such configurations, the adjustment mechanism comprises a reel and coil spring. In some such configurations, the adjustment mechanism includes a winding mechanism, a spool connected to the winding mechanism, and a flexible material band configured to be wound onto the spool.

**[0024]** The term "comprising" as used in the specification and claims means "consisting at least in part of". When interpreting a statement in this specification and claims that includes "comprising", features other than that or those prefaced by the term may also be present. Related terms such as "comprise" and "comprises" are to be interpreted in the same manner.

**[0025]** In this specification where reference has been made to patent specifications, other external documents, or other sources of information, this is generally for

the purpose of providing a context for discussing the features of the invention. Unless specifically stated otherwise, reference to such external documents is not to be construed as an admission that such documents, or such sources of information, in any jurisdiction, are prior art, or form part of the common general knowledge in the art.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0026]** Various forms of the interface will be described with reference to the accompanying drawings.

**[0027]** Figure 1 is a front view of an interface that is arranged and configured in accordance with certain features, aspects and advantages of the present invention.

**[0028]** Figure 2 is a side view of the interface of Figure 1.

**[0029]** Figure 3 is a perspective view of another interface that is arranged and configured in accordance with certain features, aspects and advantages of the present invention.

**[0030]** Figure 4 is a series of drawings illustrating the interface of Figure 3 being donned by a user.

**[0031]** Figure 5 is a rear view of headgear that is arranged and configured in accordance with certain features, aspects and advantages of the present invention.

**[0032]** Figure 6 is a perspective view of another interface that is arranged and configured in accordance with certain features, aspects and advantages of the present invention.

**[0033]** Figure 7 is a top view of the interface of Figure 6.

**[0034]** Figure 8 includes two simplified top views of the interface of Figure 6 showing how a strap length can be temporarily increased for donning of the interface.

**[0035]** Figure 9 is a top view and two section views of an interface that is arranged and configured in accordance with certain features, aspects and advantages of the present invention.

**[0036]** Figure 10 is a top view, two section views and a partial side view of an interface that is arranged and configured in accordance with certain features, aspects and advantages of the present invention.

points 112 and members 114 facilitate easy connection and disconnection of the mounting points 112 and mounting members 114. In some configurations, in addition to anchoring the headgear 110, at least one of the mounting points 112 and/or the mounting members 114 comprises a suitable mechanism for adjusting a length of the headgear 110.

**[0091]** The illustrated headgear 110, as described above, can be a single strap 110 that passes around the back of the head. To improve stability, the strap 110 can bifurcate near the mounting members 114 such that multiple mounting points 112 and multiple mounting members 114 can be used.

**[0092]** To provide a consistent experience for the user at varying treatment pressures, the headgear 110 preferably is substantially completely nonstretch. For example, the headgear 110 can be formed of a generally inelastic material or can comprise at least one generally inelastic component that extends generally from one of the mounting members 114 to the other of the mounting members 114. In some configurations, the headgear exhibits limited or no substantial creep. In other words, the headgear 110 can remain substantially the same length over its useful life; the material preferably does not shrink or stretch to a significant degree. By way of example but without limitation, suede is a material that is generally inelastic and that exhibits limited or no creep.

**[0093]** Surprisingly, a generally inelastic headgear assembly (e.g., headgear capable of elastic elongation of less than about 1 percent at a force of about or less than about 5 newtons) has been found to improve user comfort and seal performance over elastic headgear. The generally inelastic headgear 110 does not elongate as a treatment pressure increases or varies over the course of treatment. Rather, the headgear simply reacts to oppose any forces generated by the seal during use. As such, when adjusted for a proper fit at high treatment pressures, the user does not experience too tight of a fit when the pressure decreases to a lower treatment pressure. Moreover, with the headgear adjusted and ready for use, the user generally experiences limited or no preload prior to starting a treatment pressure.

**[0094]** With the generally inelastic headgear 110, the headgear 110 preferably comprises a manner of adjusting a length of the loop defined by the interface 100 (e.g., the headgear 110 and the frame 104 in Figures 1 and 2). Many manners of adjusting the length

will be described in more detail below. The adjustability facilitates customizing a fit of the inelastic headgear 110 to the particular physical anatomy of the user.

**[0095]** With the generally inelastic headgear 110, the headgear 110 preferably comprises a break-fit assembly. The break-fit assembly, many configurations of which will be described below, facilitates donning of the interface 100. The break-fit assembly can facilitate slight and controlled elongation of the loop defined by the interface 100 to allow the loop to expand sufficiently to slide into position around the head of the user. The extra length enables the user to pull the interface over the maximum circumference of the head while moving the headgear into position below and behind the maxima occipitus, for example. In some embodiments, the break-fit assembly provides between about 0 and 200 mm of expansion. This may be in one location or split over both sides of the associated interface.

**[0096]** The break-fit assembly also preferably will return to the original position, or a use length, once the interface 100 has been properly donned. In some configurations, the break-fit assembly will return automatically once the interface 100 has been donned.

**[0097]** The seal 102 and the frame 104 generally define a mask in the illustrated configuration. When breathing gases are supplied through the conduit 106 to a cavity defined within the mask, a lifting force is generated by the mask and the mask attempts to move away from the face of the user.

**[0098]** The headgear 110 opposes the lifting force. As described above, the break-fit assembly allows elongation of the loop defined by the interface 100 (e.g., by temporarily increasing a length of the strap). The break-fit assembly preferably only elongates after a break-free force has been applied to the assembly. The break-free force is greater than a maximum of the lifting force (i.e., a maximum of the lifting force generated at the highest expected treatment force). In some configurations, the break-free force is about 3 Newtons to about 8 Newtons.

**[0099]** As described above, the headgear 110 also can have a manner of adjusting the length of the loop. In some configurations, the length adjustment requires an adjustment force that is greater than the break-free force. In such configurations, to adjust the length, a force greater than that required to operate the break-fit assembly is required. As such, the adjustment force is greater than the break-free force and the break-free force is greater than

the maximum lifting force. The adjustment force also is greater than the maximum lifting force, which can be particularly relevant if a break-fit assembly is not used.

**[0100]** While the above-description has been generally directed to the assembly of Figures 1-2, the description of the materials and relative forces preferably applies to any assembly in which either or both of a break-fit assembly and an adjustment configuration have been provided. In addition, any combination of masks, break-fit assemblies and adjustment configurations described herein is possible, is specifically contemplated and should be understood to be within the scope of this disclosure and certain features, aspects and advantages of this invention.

**[0101]** With reference to Figure 3, another interface 120 is illustrated therein. The interface 120 also comprises a seal 122, a frame 124, a conduit 126 and headgear 130. While the interface 100 of Figures 1 and 2 was a nasal interface, the interface 120 of Figure 3 is a full face interface. Certain features, aspects and advantages of the present invention can be used with any style of interface, including but not limited to nasal, oral, oral-nasal, full face, or the like.

**[0102]** The illustrated headgear 130 comprises a break-fit assembly 132 and an adjustment mechanism 134. The break-fit assembly 132 is shown in connection with only the lower straps but the break-fit assembly 132 also could be used on any and/or all of the straps if desired. While both the break-fit assembly 132 and the adjustment mechanism 134 are shown integrated into the interface, it also is possible to incorporate only one of the break-fit assembly 132 and the adjustment mechanism 134 into the interface. Moreover, any suitable break-fit assembly and/or any suitable adjustment mechanism can be used.

**[0103]** The headgear 130 preferably comprises a generally inelastic portion 136, the break-fit assembly 132 to facilitate donning of the interface 120, and the adjustment mechanism 134 to allow customization of the headgear 130 to the individual user. In some configurations, the headgear 130 comprises Breathoprene with a nonstretch component added to it. For example, the material could be a three layer laminate (i.e., foam, UBL (unbroken loop) and a nonstretch layer). In some configurations, a nonstretch layer can be a center layer of a five or more layer laminate: nonstretch as a central layer with foam and UBL on each side.

position in which the flaps 154 can approach each other and the coupling portion 146 can join the flaps 154 along the seam 150.

**[0108]** In the illustrated configuration, the return component 152 comprises an elastic layer. For example, the return component 152 can comprise one or more portion formed of Lycra, rubber bands, and elastic knit. The elastic layer preferably can stretch up to about 40 mm when subjected to a tensile force of about 5 N (values may differ for a larger mask, such as a full-face mask). In some arrangements, rather than a full layer, the return component 152 can comprise strips, cords, bands or the like.

**[0109]** In the illustrated configuration, the coupling portion 146 comprises two components that are positioned at a lower portion of the headgear 140. Such a location is desired because it is less likely to be felt when sleeping in the headgear 140. Other locations are possible. In addition, while only two components are shown, more than two components are possible. In some configurations, the full length of the seam 150, a substantial portion of the full length of the seam 150 or a majority of the full length of the seam 150 can be formed of a magnetic material or the like such that the coupling portion 146 also can assist in pulling the seam 150 back together.

**[0110]** In some configurations, the break-fit assembly can be integrated into the frame and/or the seal. For example, with reference to Figures 6 through 8, an interface 160 has a frame 162 that incorporates a break-fit assembly 164. Thus, the break-fit assembly 164 shown in Figures 6 through 8 has been integrated into the mask (e.g., the frame of the mask).

**[0111]** With continued reference to Figure 6, the break-fit assembly 164 can have one or more flaps 166. The flaps 166 can seat against an outer surface 170 of the frame 162. As illustrated, the flaps 166 can be connected to the frame 162 with hinges 172. The illustrated flaps 166 can be connected to the frame 162 with one or more hinges; three hinges 172 are used in the illustrated interface 160. In some configurations, biasing members, such as springs or the like, can be used to provide a biasing force that will tend to return the flaps 166 to a closed or latched position, which position is described below.

**[0112]** Any suitable manner of holding the flaps 166 in position relative to the outer surface 170 of the frame 162 also can be used. In the illustrated configuration, a magnetic coupling 174 has been used. For example, the illustrated magnetic coupling 174 comprises at least one magnet and at least one corresponding component from a magnetic

material; the illustrated configuration comprises two magnets and two corresponding components from magnetic materials on each flap 166. For the coupling 174 to function, each paired component comprises at least one magnet and at least one component formed of a magnetic material (e.g., a material that is attracted to a magnet).

**[0113]** With reference to Figure 7, headgear 176 is connected to the flaps 166 in any suitable manner. The length of the flaps 166 between the hinges 172 and the point at which the headgear 176 couples to the flaps 166 defines the length by which the loop can be increased (e.g., two times this length can be added). Thus, lengthening the distance between the hinges and the coupling point can increase the usable length for the break-fit assembly 164 (as seen in Figure 6). In addition, while a single flap 166 is shown, the flaps 166 can comprise two or more leafs that accordion over each other. Thus, multiples of the length between the hinges and the coupling point can be attained.

**[0114]** With reference still to Figure 7, the flaps 166 can open independently of each other. On the left side of Figure 7, the flap 166 is opened and connected to the headgear 176. On the right side of Figure 7, the flap 166 is shown in solid lines in the closed or latched position and is shown moving to the opened position. As indicated by the dashed arrow, the flap 166 swings between the latched position and the open position. Both flaps 166 are shown in the closed position on the left in Figure 8 and both flaps 166 are shown in the open position on the right in Figure 8. The movement is shown in dashed lines in Figure 7.

**[0115]** With reference now to Figure 9, an interface 180 has a frame 182 and headgear 184. A break-fit assembly 186 can be positioned between the frame 182 and the headgear 184. The headgear 184 can comprise a generally inelastic portion 190. The generally inelastic portion 190 can extend between two break-fit assemblies. At least one break-fit assembly can connect the generally inelastic portion 190 to the frame 182, directly (see Figure 10) or indirectly (see Figure 9). In the configuration of Figure 9, two break-fit assemblies connect the generally inelastic portion 190 to the frame 182.

**[0116]** The break-fit assembly 186 comprises two magnetic members 192. As described above, the magnetic members 192 can include at least one magnet or a combination of at least one magnet and at least one magnetizable member (e.g., a ferrous material). The magnetic members 192 are oriented to be attracted to each other. As such,

when the magnetic members 192 are brought within a range to allow magnetic coupling, the magnetic members 192 self-align and self-connect.

**[0117]** The magnetic members 192 have a range of movement relative to each other that results in the magnetic members 192 moving outside of the range for magnetic coupling. For example, when the magnetic members 192 move beyond about 10 to about 20 mm apart, the magnetic coupling force is not strong enough to draw the magnetic members 192 back together.

**[0118]** Accordingly, to assist with reconnection and alignment, a flexible sheath 194 can envelop the magnetic members 192. Because the magnetic members 192 are very forgiving with respect to alignment, the flexible sheath 194 is sufficient to guide the magnetic members 192 back together and keep the magnetic members 192 generally on the same path for reconnection. The flexible sheath 194 can be any suitable elastic material. In some configurations, the flexible sheath 194 can be formed from silicone, a stretchy plastic material, a stretchy rubber material, or a stretch textile.

**[0119]** The magnetic members 192 can be fixed at least axially within the flexible sheath 194. In some configurations, the magnetic members 192 are fixed rotationally and/or axially within the flexible sheath 194. The magnetic members 192 can be attached to the flexible sheath 194 in any suitable manner. For example but without limitation, the magnetic members 192 can be glued, sewn, overmolded, or the like to secure the magnetic members 192 and the flexible sheath 194 together.

**[0120]** The magnetic member 192 closest to the frame 182 can be attached directly (see Figure 10) or indirectly (see Figure 9) to the frame 182. The magnetic member furthest from the frame 182 can be attached to an end of the generally inelastic member 190. In some configurations, the magnetic member 192 furthest from the frame 182 can be directly connected to the end of the generally inelastic member 190, as illustrated in Figure 9 for example but without limitation.

**[0121]** In the illustrated configuration, a portion of the sheath 194 extends along and/or wraps around at least a portion of the inelastic member 190. In some configurations, the sheath 194 extends the full distance or substantially the full distance from one side of the frame 182 to the other side of the frame 182. Moreover, in some configurations, the sheath 194 can be secured to at least a portion of the inelastic member 190. For example, the sheath

194 can be bonded to at least a portion of the inelastic member 190. Other configurations also are possible. In the illustrated configurations, a distance from the laterally outermost portion of the sheath 194 to the magnetic member 192 secured to the inelastic member 190 generally will not change. However, a distance from the laterally innermost portion of the sheath 194 to that same magnetic member 192 will vary due to stretching of the sheath 194

**[0122]** As illustrated in Figure 9, when the outer magnetic members 192 move away from the inner magnetic members 192, the length of the headgear 180 increases. The movement of the magnetic members 192 away from each other is resisted of the elastic material of the sheath 194. Thus, stretching of the sheath 194 establishes a restoration force that will act to return the magnetic members 192 toward each other for reconnection to a resting position. The resting position is a position where the break-fit assembly is connected by a force sufficient to withstand the forces generated by the seal of the interface during normal use of the CPAP plus hose drag. Hose drag can be any force applied to the mask system by the CPAP hose being pulled away from the user or being dragged over any surface. In other words, the force coupling the magnetic members 192 preferably is above a maximum force created by the pressurized breathing gases within the interface, which pressurized breathing gases originate from the CPAP blower force. For example but without limitation, at about 20 cm $H_2O$, there is a force of about 5 N pushing the mask away from the face of the users so the magnetic members 192 preferably exert a coupling force of greater than about 5 N. In some configurations, the magnetic attraction is preferably greater than about 4 to 5 N, which this takes into account a relatively high treatment pressure (e.g., about 20 cm $H_2O$) and a difficult to seal patient geometry.

**[0123]** With reference now to Figures 11 through 17, additional break-fit assemblies are illustrated therein. The break-fit assemblies illustrated in Figures 11 through 17 achieve a break-fit function through the use of mechanical couplings rather than magnetic couplings. Each of the break-fit assemblies can be connected to inelastic headgear as described above and can be used in place of, or in combination with, any of the other break-fit assemblies described herein. As described above, the break-fit assemblies facilitate a temporarily enlargement of a loop defined by the interface to ease donning; the mechanical arrangements described herein can provide an extension of between about 25 mm and about 100 mm in some configurations. In some configurations, the extension is between about 30

mm and about 70 mm. In some configurations, the extension is about 50 mm. It should be noted that the mechanical break-fit assemblies tend to have a longer axial length than the magnetic break-fit assemblies do. However, the mechanical break-fit assemblies offer other distinct advantages over the use of magnets.

**[0124]** With reference first to Figures 11 and 12, a break-fit assembly 200 has a construction that allows a separation of a first component and a second component at a predetermined force while facilitating rejoining of the first component and the second component in a mechanical manner. In the illustrated embodiment of Figures 11 and 12, the first component can comprise a post 202 with a head 204 and the second component can comprise a receptacle 206 with a resilient opening 210. The first component and the second component can be joined by a biasing member 212, such as an elasticated sleeve or spring, for example but without limitation. The biasing member 212 can be secured to the first component and the second component in any suitable manner. In addition, in the illustrated configuration, the biasing member 212 overlies any gap that will be created when the first component and the second component separate. Thus, the biasing member 212 can act to guide the reconnection of the first and second components.

**[0125]** The head 204 in the illustrated configuration has a gently sloping portion 216 and a more severely angled portion 214. Similarly, the receptacle 206 has a gently sloping portion 220 and a more sharply angled portion 222. The surfaces 214, 216, 220, 222 are but one configuration of surfaces that can be used. Advantageously, the illustrated configuration using the gently sloping interfaces 216, 220 facilitates a low coupling force while using the more sharply angled interfaces 214, 222 causes a higher separation force. Accordingly, the illustrated break-fit assembly 200 will separate at a relatively higher force than the force required by the assembly 200 to recombine. As with the assemblies discussed above, preferably, the assembly 200 will separate at a tensile load of about 4 N or 5 N or more.

**[0126]** With reference now to Figures 13 through 15, another break-fit assembly 230 has a construction that allows a separation of a first component and a second component at a predetermined force while facilitating rejoining of the first component and the second component in a mechanical manner. In the illustrated embodiment of Figures 13 through 15, the first component can comprise a post 232 with a head 234 and the second component can

comprise a receptacle 236 with an opening 240. The post 232 can extend through a wall that defines the receptacle 236. As such, the post 232 can slide within the receptacle 236. With the post 232 sliding within the receptacle 236, alignment generally results.

**[0127]** A return force between the first component and the second component can be created by a biasing member 242. In the illustrated assembly 230, the biasing member is positioned within the second component. As shown, the biasing member 242 is positioned within the receptacle 236. The biasing member 242 can be a spring, for example but without limitation. The illustrated biasing member 242 comprises a compression spring. A retainer 244 secures the biasing member 242 over the post 232. The retainer can be integrally formed with the post 232 or can be separately formed and secured thereto in any suitable manner. The biasing member 242 therefore bears against a surface of the receptacle 236 and the retainer 244.

**[0128]** With reference to Figure 14, the head 234 in the illustrated configuration has a gently sloping portion 246 and a more severely angled portion 248. Similarly, the receptacle 236 has a gently sloping portion 252 and a more sharply angled portion 250. The surfaces 246, 248, 250, 252 are but one configuration of surfaces that can be used. Advantageously, the illustrated configuration using the gently sloping interfaces 246, 252 facilitates rejoining at a low coupling force while using the more sharply angled interfaces 248, 250 results in separation occurring at a higher separation force. Accordingly, the illustrated break-fit assembly 230 will separate at a relatively higher force than the assembly 230 will recombine. As with the assemblies discussed above, preferably, the assembly 230 will separate at a tensile load of about 4 N or 5 N or more.

**[0129]** With reference now to Figures 16 and 17, another break-fit assembly 260 has a construction that also allows a separation of a first component and a second component at a predetermined force while facilitating rejoining of the first component and the second component in a mechanical manner. In the illustrated embodiment of Figures 16 and 17, the first component can comprise a post 262 with a head 264 and the second component can comprise a receptacle 266 with an opening 270. The post 262 can extend through a wall that defines the receptacle 266. As such, the post 262 can slide within the receptacle 266. With the post 262 sliding within the receptacle 266, alignment generally results.

**[0143]** The adjustment mechanism 330 can be connected to the headgear 326 in any suitable manner. For example, the headgear 326 can be formed within an inelastic member and can include hooks, clasps, or other mechanical connection members. Moreover, in some configurations, a break-fit assembly, including but not limited to any break-fit assembly described herein, can be interposed between the headgear 326 and the adjustment mechanism 330.

**[0144]** The adjustment mechanism 330 can be positioned within a housing of the frame 322. The adjustment mechanism 330 can be positioned around an inlet that is coupled to a supply conduit (not shown). Such a positioning provides an efficient use of space and results in a symmetric configuration. With reference to Figure 22, the adjustment mechanism 330 is shown in a simplified view. The adjustment mechanism 330 can comprise a reel disk 332 and a coil spring 334 (see Figure 23). In some configurations, a coil spring can be omitted. In some configurations, rather than the coil spring 334, such as that of Figure 22, an elastic outer member (not shown) can be used in a manner similar to that used in the configuration of Figures 18 through 20.

**[0145]** At least one extensible member 336 can be connected to the reel disk 332. Two extensible members 336 are shown in Figure 21 while a single extensible member is shown in Figures 22 and 23. When a single extensible member 336 is used, the member 336 preferably folds back over itself in at least one location. The extensible member 336 can be a cord, string, tape, or the like, for example but without limitation. The extensible member 336 preferably is generally inelastic and is mounted such that it can be unwound from and retracted back onto the reel disk 332.

**[0146]** The reel disk 332 can be mounted on a spool or axle (not shown) such that the reel disk 332 can rotate about an axis. A locking mechanism 338 can be provided to secure the length of extensible member 336 that is extended from the housing. The reel disk 322 can be provided with, or connected to a member that includes, locking structure 340, such as recesses, teeth, or the like. A locking pin 342 can be biased, such as by a spring 344 for example but without limitation, into the locking structure 340. In some configurations, a locking assembly using a friction brake or the like can be used. Desirably, the locking assembly reduces or eliminates the likelihood of further withdrawal of the extensible member. While the extensible member 336 can be retracted into the housing following

**[0155]** Any suitable movement can be used. In Figure 31, the outer body 386 can be rotated while the inner body 388 remains stationary or the outer body 386 can remain stationary while the inner body 388 rotates or both bodies 386, 388 may rotate. The relative movements can be created in any suitable manner. For example, linear movements can be controlled by a lever, a button or the like, which can be connected to one or both of the bodies 386, 388. Rotational movements also can be control by dials, levers, buttons or the like.

**[0156]** With reference now to Figures 32 through 34, another interface 400 is illustrated that includes a frame 402, a seal 404 and headgear 406. An adjustment mechanism 410 can be provided. With reference to Figures 33 and 34, the adjustment mechanism 410 comprises a rack and pinion assembly.

**[0157]** A pinion 412 can be mounted between two racks 414. The pinion 412 and the racks 414 can be positioned within the frame 402. The ends of the racks 414 can connect to the headgear 406 or can be integrated into the headgear 406. In some configurations, the racks 414 connect to the headgear 406 outside of the frame 402. In some configurations, the racks 414 connect to the headgear 406 inside of the frame 402. The racks 414 can be flexible enough to wrap slightly around the pinion 412 to provide more purchase between the racks 414 and the pinion 412 and bring the racks into alignment for generally symmetrical headgear attachment. In some configurations, relief recesses 415 can be provided to increase the flexibility of the racks 414.

**[0158]** With reference again to Figure 32, a ring or other input device 416 can be positioned on a surface of the frame 402. For example but without limitation, the ring 416 can be positioned on the front of the frame 402 and can surround a connector through which breathing gases are supplied to the interface 400. Rotation of the input device 416 causes rotation of the pinion 412.

**[0159]** The pinion 412 comprises teeth 418 and the racks 414 include cooperating teeth 420. As the pinion 412 rotates, the teeth 418, 420 cause axial movement of the racks 414. In this manner, the racks 414 can be used to adjust the loop. Any suitable locking mechanism can be used to lock the position of the headgear 406, the racks 414, the pinion 412 and/or the ring 416. For instance, a pin or the like can be used to inhibit rotation of the pinion 412 and/or the ring 416. In some configurations, a friction brake, a clamping

**[0169]** The end cap 490 and the base 491 together provide the same or a similar break-fit function as those described in Figures 9 and 10. When an axial force is applied to the end cap 490, the end cap 490 pulls away from the base 491 thereby loosening the tension on the headgear 476, which may be beneficial for ease of removal or adjustment. Because of the magnetic force between the end cap 490 and the base 491, the two elements may tend to be drawn back together when the force keeping them apart is removed or reduced. Other elements of the headgear 476 may also draw the two elements back together. For example, a resilient member 492 (as described in greater detail below) may comprise an elastic material that will draw the end cap 490 and the base 491 back toward each other if separated.

**[0170]** In some embodiments, the end cap 490 is secured to the upper portion of a telescoping member 484. In Figure 42, end cap 490 is shown as affixed to the upper portion of the fourth telescoping member 484. Because the fourth telescoping member 484 slides into and out of the third telescoping member 484, the base 491 positioned at the upper end of the third telescoping member 484 may be configured to accommodate such movement. For example, in some embodiments, the base 491 comprises an annular shape that allows the fourth telescoping member 484 to slide into and out of both the base 491 as well as the third telescoping member 484. Such movement comes into play in the break-fit operation of the end cap 490 and base 491. In some embodiment, the base 491 comprises any number of shapes having an interior opening to accommodate the fourth telescoping member 484. In some embodiments, the base 491 is positioned to one or more sides of the slot 496 of the third telescoping member 484. Thus, the movement of the fourth telescoping member 484 is not impeded and the end cap 490 can still be held in place with a magnetic force.

**[0171]** The members 484, the connecting cables 486, the end magnet and the end cap 490 can be enclosed with a resilient member 492. Any suitable resilient member 492 can be used. In some configurations, the resilient member 492 is a strip of material. In other applications, the resilient member 492 forms an envelope around the members 484 and the end cap 490. As best shown in Figure 42, the illustrated resilient member 492 resists movement of the end cap 490 away from the centerline CL. More importantly, the resilient member applies a restorative force when the members 484 extend outward.

**[0172]** Because the telescoping members 484 are nested and are slidingly connected and can include one or more connecting cables 486, the entire assembly can be

some configurations, only one of the first and second rings 530, 532 is secured against movement.

**[0181]** Of course, any other suitable locking mechanism can be used. Figure 49 illustrates a cam assembly 560. The cam assembly 560 can use a cam mounted to a lever. The first and second rings 530, 532 can be squeezed together by the cam. As such, when the lever is moved to the locked position, at least one of the first and second rings 530, 532 cannot rotate. In some configurations, both of the first and second rings 530, 532 cannot rotate. Another mechanism, illustrated in Figure 50, can include a threaded ring assembly 562, which features a locking ring that tightens against at least one of the first and second rings 530, 532. The locking ring, when tightened, can secure at least one or both of the first and second rings 530, 532 from rotation.

**[0182]** As discussed above, the adjustment mechanisms described herein can be used with break-fit assemblies where desired. With reference to Figure 46, an integration of an adjustment mechanism and a break-fit assembly will be described. The adjustment mechanism has been described above. To integrate a break-fit assembly 570, the end piece 544 and a plate 572 can be releasably coupled together. In some configurations, the end piece 544 and the plate 572 can be magnetically coupled. In some configurations, at least one of the end piece 544 and the plate 572 is or includes a magnet. The magnetic coupling between the end piece 544 and the plate 572 is sufficiently strong to allow the connection to remain during treatment yet sufficiently weak to allow separation between the end piece 544 and the plate 572 when donning the interface 510. The elastic member 548 continues to stretch even beyond the full range of adjustment by the adjustment mechanism 520 (e.g., about an additional 50 mm). Thus, if the adjustment mechanism 520 is locked at a position between collapsed and extended, the elastic member 548 will continue to stretch when the plate 572 breaks free from the end piece 544 during donning of the interface 510.

**[0183]** While the adjustment mechanism 520 described with respect to Figures 45 through 48 featured a coordinated expansion to both sides due to the interconnecting rings 530, 532, an adjustment mechanism 580 can have independent movement of the two sides. For example, the adjustment mechanism 580 shown in Figures 51-53 can allow adjustment of two sides independently of each other. As illustrated, the adjustment mechanism 580 can include at least a first gear 582 and a second gear 584. The first gear 582

Accordingly, these features facilitate molding with either headgear or another component of the interface.

**[0190]** With reference to Figure 54, a strap 610 is shown doubled back on itself. A slider 612 can be used to slide over at least a portion of the strap 610. The strap 610 can include one or more rails 614. The rails 614, as shown in Figure 55, can include a narrow rib 616 with an enlarged cap 618. When pressed together on itself, each rail 614 can deflect. As illustrated, the enlarged cap 618 can interlock with itself to join the strap. The slider 612, as it slides over the doubled over portion of the strap 610, helps to cause the rails 614 to interlock. As an adjustment mechanism, the straps 610 allow a significant length that can be used and, because of the construction and the interlocking of the rails 614, the straps 610 will not be prone to having a free end dangling. In other words, the excess length is easily managed.

**[0191]** With reference to Figure 57, another strap 620 is illustrated. The strap 620 comprises two rails 622. Each of the rails 622 can comprise a C-shaped cap 624 that sits atop a narrower rib 626. As illustrated, when pressed together, one of the two caps 624 will compress to fit inside of the other of the two caps 624. Thus, when the strap is doubled over itself and pressed together, the strap 620 doubled over portion can lock to itself in the longitudinal direction.

**[0192]** Figure 57 also illustrates a second strap 630. The strap 630 comprises four rails 632. Two of the rails 632 each comprise a C-shaped cap 634 that sits atop a narrower rib 636. Two of the rails 632 each comprise a small head 638 that sits atop a narrower rib 640. When pressed together, the small head 638 can snap into the recess of the C-shaped cap 634. Thus, when the strap 630 is doubled over itself and pressed together, the strap 630 can lock to itself in the longitudinal direction.

**[0193]** Figure 58 shows another strap 650. The strap 650 can lock to itself in a transverse direction. As illustrated, the strap 650 can comprise an end 652 with a stop 654. In addition, the end 652 can include a tab 656, which can be sized to accommodate a slider member 658. The slider member 658 can track along the axial direction of the strap 650.

**[0194]** One side of the illustrated strap 650 includes transversely extending ribs 660. The ribs 660 are shaped to enable the ribs 660 to lock together when pressed. The other side of the illustrated strap 650 is substantially smooth.

**[0195]** The slider member 658 has an opening large enough to accommodate two thicknesses of the strap 650 so long as the two thicknesses have the ribs 660 interlocked. Accordingly, the tab portion 656 is generally smooth on both sides such that, when the slider member 658 is positioned over the tab portion 656, the location of the tab portion 656 can be adjusted (see lower portion of Figure 58). Once positioned as desired, the slider member 658 can be slid away from the stop 654. As the slider member 658 traverses the strap 650, the ribs 660 are pressed together and the strap locks to itself in a transverse direction.

**[0196]** With reference now to Figures 59 through 62, an interface 700 is illustrated. The interface 700 includes a mask frame 702, a seal 704 and headgear 706. An adjustment mechanism 710 connects the headgear 706 to the balance of the interface 700.

**[0197]** In the illustrated configuration, the frame 704 comprises arms 712 that extend laterally outward. As illustrated, the arms 712 can include recessed grooves 714 that extend along one or both of the top and bottom.

**[0198]** The headgear 706 connects to a slide 720. In the illustrated configuration, the headgear 706 is pivotally connected to the slide 720. Other types of connections also can be used. The slide 720 can include a tooth 722 that fits into each of the recessed grooves 714 of the arms 712. The slide 720 should define a larger inside dimension than a corresponding outside dimension of the arm 712 such that the slide 720 can be compressed toward the arm 712.

**[0199]** With reference to Figure 60, the slide 720 generally is locked in position along the arm 712 until compressed. For example, as illustrated in Figure 60, compressing the slide 720 in the direction of the teeth (e.g., vertically as shown) releases the slide 720 and enables the slide 720 to translate along the arm 712. Figure 62 demonstrates that the slide 720 can include a tooth or friction generator 722 that contacts the arm 712 until the slide 720 is compressed. When the slide 720 is compressed toward the arm 712, a wall 724 of the slide 720 deflects away from the arm 712, which raises the tooth or friction generator 722 away from the arm 712 to facilitate movement of the slide 720 along the arm 712.

**[0200]** As illustrated in Figure 61, the arm 712 can include markings or indicia to assist with determining the location of the slide 720 along the length of the arm 712.

**[0201]** As discussed above, a non-stretching headgear generally indicates that the headgear should be set to a specific, customized size for each user. Preferably, the sizing is

WHAT IS CLAIMED IS:

1. An interface assembly for supplying breathing gases to a user, the interface assembly comprising:

a mask, the mask comprising;

a frame comprising first and second mounting points; and

a seal supported by the frame;

a breathing gas supply conduit connected to at least one of the seal and the frame; and

headgear connected to the frame, the headgear comprising a strap comprising first and second mounting members that cooperate with the first and second mounting points, respectively;

wherein the first mounting point comprises a first post and the first mounting member comprises a first resilient sleeve, the first resilient sleeve comprising a first passage comprising an inner dimension that is smaller than a corresponding outer dimension of the first post, and wherein first resilient sleeve is configured to cause tightening of the interface between the first sleeve and the first post upon the application of a tensile force in a direction away from the first post.

2. The interface assembly of claim 1, wherein when the first post is inserted into the first passage, the first resilient sleeve is stretched and becomes tight against the first post.

3. The interface assembly of claim 1 or 2, wherein the first resilient sleeve is formed from a woven material.

4. The interface assembly of any one of claims 1 to 3, wherein the first resilient sleeve is integrated into, or joined to, a first hook.

5. The interface assembly of claim 4, wherein the first hook is configured to connect the headgear to the mask.

6. The interface assembly of any one of claims 1 to 5, wherein the first passage comprises one or more tabs.

7. The interface assembly of claim 6, wherein the one or more tabs is configured to resist withdrawal of the first post from the first passage.

8. The interface assembly of any one of claims 1 to 7, wherein an end of the first resilient sleeve can be manipulated to effectively limit necking of the first sleeve while withdrawing the first post.

9. The interface assembly of any one of claims 1 to 8, wherein an end of the first resilient sleeve is configured to be moved axially away from the first post by axially compressing the first resilient sleeve.

10. The interface assembly of any one of claims 1 to 9, wherein the breathing gas supply conduit is connected to an inlet at a central portion of at least one of the seal and the frame.

11. The interface assembly of claim 10, wherein the inlet is on a distal side of the interface assembly and is positioned between the first and second mounting points.

12. The interface assembly of any one of claims 1 to 11, wherein the first post is configured to be inserted into the first passage leaving a portion of the first post uncovered by the first resilient sleeve.

13. The interface assembly of any one of claims 1 to 12, wherein the first post extends from the frame toward the user in use.

14. The interface assembly of any one of claims 1 to 13, wherein the second mounting point comprises a second post and the second mounting member comprises a second resilient sleeve, the second resilient sleeve comprising a second passage comprising an inner dimension that is smaller than a corresponding outer dimension of the second post, such that when the second post is inserted into the second passage, the second resilient sleeve is stretched and becomes tight against the second post.

15. The interface assembly of any one of claims 1 to 14, wherein the strap comprises a woven elastic material.

16. The interface assembly of any one of claims 1 to 15, wherein the interface is a nasal interface.