

MASK ASSEMBLIES AND HEADGEAR FOR RESPIRATORY THERAPY**BACKGROUND****Field**

[0001] The present disclosure relates to mask assemblies and headgear for respiratory therapy. In particular, the present disclosure relates to full-face mask assemblies that cover and/or seal against the mouth and nose of the user, nasal mask assemblies that cover the nose of the user, and oral mask assemblies. This application claims priority from our earlier US provisional patent application 63/611666 filed 18 December 2023, the entire contents of which are hereby incorporated by reference.

Description of Related Art

[0002] Obstructive sleep apnea is commonly treated with the application of positive airway pressure (PAP) therapy. PAP therapy involves delivering a flow of gas to a user at a therapeutic pressure above atmospheric pressure that can reduce the frequency and/or duration of apneas, hypopneas, and/or flow limitations. The therapy is often implemented by using a positive airway pressure device to deliver a pressurized stream of air through a conduit to a user through a mask assembly positioned on the face of the user.

[0003] Typical mask assemblies are configured to provide sealed communication with a user's airway by sealing around parts of the user's nose and/or mouth. These mask assemblies are commonly used to provide therapies such as, but not limited to, non-invasive ventilation (NIV) and continuous positive airway pressure (CPAP). CPAP therapy is commonly used to treat obstructive sleep apnea (OSA) and involves providing a constant supply of pressurized air to a user's airway.

[0004] Such mask assemblies typically comprise a mask, and headgear to mount the mask to the face of the user. The headgear typically comprises a plurality of headgear straps that extend over and/or around parts of the user's head. For example, a headgear might comprise a pair of side straps, each extending along a respective side of the user's face, and a rear and/or crown strap extending around the back and/or top of the user's head. Sometimes two pairs of side straps are provided, an upper pair and a lower pair.

[0005] To ensure that a sufficient seal is provided between the mask and the user's face, the headgear is configured to apply tension to the side straps to pull the mask onto

the face. To ensure sufficient tension is provided, the side straps can be inelastic. Sometimes one or more of the headgear straps are length adjustable, to enable the user to adjust the tension. Sometimes one or more of the headgear straps are releasably attached to the mask, for example via one or more clips.

[0006] Various problems exist in respect of such mask assemblies, and in particular with the headgear. One such problem can be that the mask is incorrectly set up when mounted on the user's head: for example one or more of the headgear straps can be over or under tightened. Sometimes one or more of the headgear straps must be correctly tightened every time the headgear is donned by the user. Sometimes, to doff the headgear from the user's head, the tension in one or more of the headgear straps has to be manually reduced, by adjusting the length of the strap, and/or one or more headgear straps have to be detached from the mask assembly. It can be confusing to a user, particularly in the dark or if the user has poor vision, which part of the headgear is which, and/or how the headgear should be attached to the mask. Any disconnected parts of the headgear can become twisted, tangled and/or inverted. It can be difficult to locate one or more loose strap ends behind the user's head, especially for user's with reduced mobility. There can be a problem with headgear that the user has to undertake multiple procedural steps to correctly don the headgear. There can be a problem with headgear that it is difficult to achieve a comfortable fit once the headgear is donned, or at least to achieve a comfortable fit every time the headgear is donned. A general problem in providing a mask assembly is to improve user adherence in wearing the mask assembly when required, and for as long as required, and/or to achieve the required seal with the user's face necessary for effective therapy.

[0007] A need exists to provide a headgear, and a mask assembly comprising headgear, with improved comfort and/or sealing performance and/or ease of use; and/or to improve on any one or more of the problems mentioned above; and/or to provide the public with a useful choice.

SUMMARY

[0008] The headgear and mask assemblies described herein have innovative aspects, no single one of which is indispensable or solely responsible for their desirable attributes. Without limiting the scope of the claims, some of the advantageous features will now be summarized.

[0009] According to an aspect of this disclosure there is provided headgear for mounting a mask on the head of a user, the headgear comprising:

a headgear strap comprising a strap portion; and

an elongate strap guide comprising a first end portion configured to be mounted on the mask, the remainder of the elongate strap guide extending away from the mask;

wherein the strap portion of the headgear strap is mounted on the elongate strap guide so that the strap portion of the headgear strap is movable along the elongate strap guide.

[0010] The headgear strap could comprise any of:

- a) A side strap.
- b) A crown strap.
- c) A rear strap.

[0011] According to an aspect of this disclosure there is provided headgear for mounting a mask on the head of a user, the headgear comprising:

a headgear strap comprising a forward portion; and

an elongate strap guide comprising a forward portion configured to be mounted on the mask, and a rearward portion configured to be distal from the mask;

wherein the forward portion of the headgear strap is mounted on the elongate strap guide so that the forward portion of the headgear strap is movable along the elongate strap guide between the forward and rearward portions of the elongate strap guide.

[0012] The forward portion of the headgear strap may be movable along the elongate strap guide between an engaged condition in which the headgear is configured to be retained on a head of a user, and a release or disengaged condition in which the headgear can be donned and/or doffed by the user. The forward portion of the headgear strap may be movable between a first location being a donned position proximal the mask, and a second location being a doffed position distal the mask.

[0013] When in the engaged condition, the headgear strap may be under tension sufficient to retain the mask on the head of the user. When in the disengaged condition, the headgear strap may be under reduced tension such that the mask and headgear can be doffed.

[0014] The headgear may comprise a rear strap configured to extend around the rear of the user's head when the headgear is donned by the user, a distance being defined between the rear strap and the forward portion of the elongate strap guide, the distance increasing when the forward end of the headgear strap is moved from the engaged to the disengaged conditions.

[0015] The headgear may be configured to be connected to the mask to form a continuous loop, the headgear strap being coupled to the elongate strap guide such that the length of the continuous loop can be increased without adjusting a length of the headgear strap, to doff the mask.

[0016] The elongate strap guide may comprise part of a connection structure configured to connect the headgear strap to the mask, the forward portion of the headgear strap being coupled to the elongate strap guide at a connection point of the connection structure, the connection structure being configured such that the connection point is movable towards and away from the mask.

[0017] The headgear strap may be configured to be movable between a donned position in which the at least one headgear strap is under tension, and doffing position in which the tension in the headgear strap is reduced, the headgear strap remaining coupled to the elongate strap guide when moving between the donned and doffing positions.

[0018] The headgear strap may be movable towards and away from the mask along the elongate strap guide, whilst remaining coupled to the elongate strap guide, and whilst the length of the headgear strap remains constant.

[0019] The side strap may be movably coupled to the elongate strap guide for movement along the elongate strap guide from a donned position proximal the mask, to a doffing position distal the mask.

[0020] The elongate strap guide may be sufficiently rigid to be self supporting.

[0021] The elongate strap guide may be flexible or includes a flexible portion.

[0022] The elongate strap guide may be shorter than the headgear strap.

[0023] The elongate strap guide may be straight or comprises at least one straight portion.

[0024] The elongate strap guide may be arcuate or comprises at least one arcuate portion.

[0025] A portion of the elongate strap guide may be substantially parallel with the headgear strap, when the forward portion of the headgear strap is positioned at the forward portion of the elongate strap guide.

[0026] The elongate strap guide may be inclined relative to the headgear strap, when the forward portion of the headgear strap is positioned at the forward portion of the elongate strap guide.

[0027] The elongate strap guide may comprise an elongate guide rail, the forward portion of the headgear strap being movable along the guide rail.

[0028] The guide rail may be substantially 'T' shaped in transverse cross section.

[0029] The guide rail may be substantially circular or elliptical in transverse cross section.

[0030] The elongate guide rail may form one margin of an elongate guide channel of the elongate strap guide.

[0031] The forward portion of the headgear strap may be directly mounted on the elongate strap guide, such that the material of the headgear strap contacts and engages the elongate strap guide.

[0032] The headgear may comprise a carriage that is movably coupled to the elongate guide rail, the forward portion of the headgear strap being coupled to the carriage.

[0033] The carriage and/or the elongate guide rail may comprise at least one anti-rotation feature configured to resist relative rotation of the carriage relative to the elongate guide rail.

[0034] The anti-rotation feature may comprise an elongate finger tab on the carriage configured to engage the elongate guide rail.

[0035] The carriage may comprise a strap connector configured to couple the forward portion of the headgear strap to the carriage.

[0036] The strap connector may comprise a post around which the forward portion of the headgear strap extends to couple the headgear strap to the carriage.

[0037] The strap connector may comprise an aperture or a loop through which the forward portion of the headgear strap extends to couple the headgear strap to the carriage.

[0038] The carriage may comprise a guide mount configured to couple the carriage to the elongate strap guide.

[0039] The guide mount may be configured to removably couple the carriage to the elongate strap guide.

[0040] The guide mount may comprise a protrusion configured to be at least partially received in a corresponding recess or channel of the elongate guide rail.

[0041] The guide mount may comprise a hook configured to receive part of the elongate guide rail and to be movable along the elongate guide rail.

[0042] The guide mount may comprise a loop through which the elongate guide rail extends to couple the carriage to the elongate guide rail.

[0043] The guide mount may comprise an elongate bore extending through a portion of the carriage, the elongate bore being configured to receive the elongate guide rail.

[0044] The elongate strap guide may comprise a longitudinal guide axis, the elongate bore comprising a longitudinal bore axis, the guide axis and bore axis being substantially parallel, when the elongate guide rail is received in the elongate bore.

[0045] The elongate bore may not be fully closed in transverse cross section, the elongate bore not fully extending around the periphery of the elongate guide rail, when viewed along the longitudinal guide axis of the elongate guide rail.

[0046] The elongate bore may be substantially 'C' shaped in transverse cross section, when viewed along the longitudinal guide axis of the elongate guide rail.

[0047] The elongate bore may be fully closed in transverse cross section, the elongate bore fully extending around the periphery of the elongate guide rail, when viewed along the longitudinal guide axis of the elongate guide rail.

[0048] The elongate bore, in transverse cross section, may be any one of:

- a. substantially circular;
- b. substantially elliptical;
- c. substantially quadrilateral;
- d. substantially triangular;
- e. substantially 'D' shaped.

[0049] The elongate bore may comprise an arcuate surface configured to engage an arcuate surface of the elongate guide rail.

[0050] The elongate bore may comprise an outwardly flared lead in portion configured to receive the elongate guide rail, when carriage is coupled to the elongate guide rail.

[0051] The outwardly flared lead-in portion may comprise a chamfered portion.

[0052] The shape of the elongate bore may vary along its length.

[0053] The elongate bore may comprise opposed ends, a relatively smaller bore portion being defined between the opposed ends.

[0054] The elongate strap guide may comprise a strap retainer configured to releasably retain the forward portion of the headgear strap:

- a. such that the forward portion of the headgear strap is retained in a desired position on the elongate strap guide; and/or
- b. such that movement of the forward portion of the headgear strap away from a desired position on the elongate strap guide is resisted.

[0055] The strap retainer may be positioned at the forward portion of the elongate strap guide, and is configured to retain the forward portion of the headgear strap at the forward portion of the elongate strap guide.

[0056] The elongate strap guide may comprise a plurality of strap retainers.

[0057] The plurality of strap retainers may be spaced apart along the elongate strap guide, each strap retainer configured to retain the forward portion of the headgear strap at different positions along the length of the elongate strap guide.

[0058] The headgear may comprise a pair of strap retainers, one strap retainer being at a forward portion of the elongate strap guide, and one strap retainer being at a rearward portion of the elongate strap guide.

[0059] The strap retainer may comprise a recess of the elongate strap guide, the forward portion of the headgear strap and/or a carriage to which the forward portion of the headgear strap is coupled, being movable into the recess.

[0060] The strap retainer may comprise a protrusion of the elongate strap guide, the forward portion of the headgear strap and/or a carriage to which the forward portion of the headgear strap is coupled, being movable into engagement with the protrusion.

[0061] The strap retainer may frictionally engage the headgear strap and/or a carriage to which the forward portion of the headgear strap is coupled,.

[0062] The strap retainer may engage the headgear strap and/or a carriage to which the forward portion of the headgear strap is coupled, with a snap fit.

[0063] The strap retainer may comprise an over-centre arrangement, configured such that a force must be applied by the user to move the headgear strap away from the forward portion of the elongate strap guide, and such that tension in the headgear strap can subsequently be reduced as the headgear strap is moved towards the rearward portion of the elongate strap guide.

[0064] The over-centre arrangement may comprise an end portion of the elongate strap guide, the end portion extending in a different direction from a body portion of the elongate strap guide. The end portion of the elongate strap guide may be arcuate.

[0065] The arcuate portion of the elongate strap guide may curve through an arc of more than 45° from an adjacent portion of the elongate strap guide; optionally between 80° and 105°, optionally between 90° and 100°, and optionally through about 95°.

[0066] The strap retainer may comprise a post; the headgear strap and/or a carriage to which the forward portion of the headgear strap is coupled, engaging the post.

[0067] The post may be substantially straight, or comprises a straight portion.

[0068] The post may be arcuate, or may comprise an arcuate portion.

[0069] The forward portion of the elongate strap guide may extend in a different direction from the rearward portion of the elongate strap guide.

[0070] The forward and rearward portions of the elongate strap guide may be inclined relative to one another.

[0071] The forward and rearward portions of the elongate strap guide may be inclined relative to one another by at least 45°.

[0072] The forward and rearward portions of the elongate strap guide may be joined by an intermediate portion.

[0073] The intermediate portion may be substantially straight.

[0074] The forward portion may be arcuate.

[0075] The forward portion may extend initially forwardly and upwardly away from a lower end of the forward portion, and then curves rearwardly into the intermediate portion.

[0076] The elongate strap guide and/or the mask may comprise a guide connector configured to connect the elongate strap guide to the mask.

[0077] The guide connector may be configured to removably connect the elongate strap guide to the mask.

[0078] The guide connector may be configured to connect the forward portion of the elongate strap guide to the mask.

[0079] The guide connector may comprise a mounting protrusion on one of the elongate strap guide and the mask, and an aperture or recess on the other of the elongate strap guide and the mask, the mounting protrusion being received in the aperture or recess to connect the elongate strap guide to the mask.

[0080] The mounting protrusion may extend away from the longitudinal axis of the elongate strap guide.

[0081] The mounting protrusion may extend in a direction perpendicular to the longitudinal axis of the elongate strap guide.

[0082] The guide connector may be integral with the elongate strap guide.

[0083] The guide connector may comprise a portion which is configured to be connected to the mask by any one or more of:

- a. adhesive;
- b. welding;
- c. hook and loop fastener;
- d. an interference/friction fit;
- e. a snap fit.

[0084] The guide connector may comprise any of:

- a. A post configured to be received in an aperture or recess on the mask.
- b. An aperture or recess configured to receive a post on the mask.

[0085] The rearward portion of the elongate strap guide may be mounted on the headgear.

[0086] The remainder of the elongate strap guide may not be mounted on the headgear.

[0087] The headgear may comprise a pair of side straps, being a first side strap extending along one side of the user's face, and a second side strap extending along the other side of the user's face.

[0088] The headgear strap may be one of the pair of side straps.

[0089] The headgear may comprise a pair of elongate strap guides, the forward portion of each side strap being coupled to a respective elongate strap guide.

[0090] The headgear may comprise two pairs of side straps being a lower pair of side straps extending below the user's ears, and an upper pair of side straps extending above the user's ears.

[0091] The headgear may comprise a pair of elongate strap guides, each elongate strap guide being mounted on a respective side strap of one of the lower or upper pairs of side straps.

[0092] Each elongate strap guide may be mounted to a respective side strap of the upper pair of side straps.

[0093] The headgear may comprise a crown strap.

[0094] The headgear may comprise a rear strap.

[0095] The headgear may comprise a rear panel.

[0096] The elongate strap guide, or at least a portion thereof, may be:

- a. Resiliently deformable; or
- b. Elastically deformable.

[0097] The elongate strap guide may be substantially rigid, at least in a direction along the longitudinal axis of the elongate strap guide.

[0098] The elongate strap guide may be flexible in a direction away from the longitudinal axis of the elongate strap guide.

[0099] The elongate strap guide may comprise a rigid inner guide rail located inside a flexible outer sleeve.

[0100] The outer sleeve component may be formed from a textile material.

[0101] At least a portion of the elongate strap guide may extend along and overlaps with a side strap of the headgear.

[0102] The side strap may be located above the headgear strap that is coupled to the elongate strap guide.

[0103] The elongate strap guide may substantially overlap the side strap along substantially all of the length of the elongate strap guide.

[0104] The elongate strap guide may extend along, and is spaced from, a side strap of the headgear.

[0105] A longitudinal axis of the elongate strap guide may be substantially parallel with a longitudinal axis of a side strap of the headgear.

[0106] The elongate strap guide may comprise an elongate mounting flange extending along the elongate strap guide, and configured to mount the elongate strap guide to the headgear.

[0107] The elongate mounting flange may be flexible, and optionally is made of a textile material.

[0108] The elongate strap guide may comprise a guide rail depending from the elongate mounting flange.

[0109] The elongate strap guide may be mounted to the headgear by any one or more of:

- a. Adhesive.
- b. Welding.
- c. Stitching.
- d. Overmoulding.
- e. Hook and loop fasteners.
- f. Press fit, snap fit, or barbed connectors.
- g. A hook or loop from which the elongate strap guide depends, the hook or loop receiving part of the headgear.

[0110] A portion of the elongate strap guide may be received in a pocket on the headgear, to mount the elongate strap guide to the headgear.

[0111] The headgear may comprise a finger grip configured to be gripped by a user to move the headgear strap along the elongate strap guide.

[0112] The headgear may comprise a length adjuster configured to adjust the length of one or more portions of the headgear.

[0113] The length adjuster may be configured to adjust the length of the headgear strap that is coupled to the elongate strap guide.

[0114] The length adjuster may be adjacent the mask, such that the length of the headgear side strap is adjusted at the forward portion of the headgear strap.

[0115] The length adjuster may be distal the mask, such that the length of the headgear strap is adjusted at the rearward end of the headgear strap.

[0116] The length adjuster may comprise a buckle, post, loop or hook, around or through which the headgear strap passes, the headgear strap comprising a free end configured to be gripped by a user and pulled on to pull the headgear strap through the buckle, post, loop or hook, to adjust the length of the headgear strap.

[0117] The headgear strap and/or the length adjuster may comprise a fastener configured, when fastened, to fix the length of the headgear strap once adjusted.

[0118] The fastener may comprise any one or more of:

- a. Hook and loop fastener; and/or
- b. One or more pins configured to be received in one or more apertures.

[0119] According to an aspect of this disclosure there is provided a mask assembly comprising:

- a. the headgear of any one of the preceding statements; and
- b. a mask.

[0120] The mask may comprise a cushion assembly comprising a flexible seal and a cushion support.

[0121] The cushion support may be more rigid than the flexible seal.

[0122] The mask may comprise a frame, the cushion assembly being mounted on the frame.

[0123] The elongate strap guide may be connected to the mask. The elongate strap guide may be connected to the frame.

[0124] The elongate strap guide may be connected to the cushion assembly.

[0125] The elongate strap guide may be integral with the mask.

[0126] The mask assembly may comprise a laterally extending arm extending away from the mask, wherein the elongate strap guide is mounted on, or comprises an integral part of, the laterally extending arm.

[0127] The mask assembly may comprise a guide connector configured to mount the elongate strap guide on the mask.

[0128] The guide connector may comprise a post which projects away from the mask, the elongate strap guide engaging the post.

[0129] The post may comprise a male portion configured to be received in a female portion of the elongate strap guide.

[0130] The post may comprise a female portion configured to receive a male portion of the elongate strap guide.

[0131] The post may comprise a conical portion when viewed in transverse cross section, the conical portion providing a seat against which the forward portion of the headgear strap rests when mounted on the post.

[0132] The post may be substantially straight, or comprises a substantially straight portion.

[0133] The post may be arcuate, or comprises an arcuate portion.

[0134] According to an aspect of this disclosure there is provided headgear for mounting a mask on the head of a user, the headgear comprising:

a pair of upper side straps, each upper side strap comprising a forward end configured to be mounted on the mask;

a pair of lower side straps, each having a forward end; and

at least one elongate strap guide having a forward portion configured to be mounted on the mask, and a rearward portion configured to be distal from the mask;

wherein the forward end of one of the lower side straps is mounted on the elongate strap guide for movement between the forward and rearward portions of the elongate strap guide so that the forward end of the lower side strap can be moved between an engaged condition where the forward end of the lower side strap is adjacent the mask, and a disengaged condition in which the forward end of the lower side strap is distal the mask, and the headgear can be doffed.

[0135] According to an aspect of this disclosure there is provided a mask assembly comprising:

a mask comprising a cushion configured to seal against the user's face, and

a headgear configured to be connected to the mask, the headgear comprising a plurality of headgear straps; wherein

the cushion and plurality of straps form a continuous loop; and

at least one headgear strap of the plurality of headgear straps is movably coupled to the headgear or the mask such that the length of the continuous loop can be increased without adjusting a length of any of the headgear straps, to doff the mask.

[0136] At least one headgear strap may be movably coupled to the mask for movement between engaged and disengaged conditions, the length of the continuous loop increasing when the at least one headgear strap is at the disengaged condition.

[0137] The at least one headgear strap may be proximal the mask when in the engaged condition.

[0138] The at least one headgear strap may be distal the mask when in the disengaged condition.

[0139] The at least one headgear strap of the plurality of headgear straps may be a side strap.

[0140] The mask assembly may comprise an elongate strap guide which extends away from the mask, the at least one headgear strap of the plurality of headgear straps is movably coupled to the elongate strap guide.

[0141] According to an aspect of this disclosure there is provided a mask assembly comprising:

a mask comprising a cushion configured to seal against a user's face;

headgear comprising a headgear strap; and

a connection structure configured to connect the headgear strap to the mask at a connection point of the connection structure, the connection structure being configured such that the connection point is movable towards and away from the mask.

[0142] The connection structure may comprise an elongate strap guide which extends away from the mask, the connection point being movable along the elongate strap guide.

[0143] The connection structure may comprise a carriage, the connection point being located at the carriage, the carriage being movable along the elongate strap guide.

[0144] Movement of the connection point may change the tension in the headgear strap.

[0145] According to an aspect of this disclosure there is provided a mask assembly comprising:

a mask comprising a cushion configured to seal against the user's face; and

a headgear configured to be connected to the mask, the headgear comprising a headgear strap; wherein

the headgear strap is configured to be movable between a donned position in which the at least one headgear strap is under tension, and doffing position in which the tension in the headgear strap is reduced, the headgear strap remaining connected to the mask when moving between the donned and doffing positions; the headgear strap being connected to the mask at a first location when in the donned position, the headgear strap being connected to the mask at a second location when in the doffing position.

[0146] The first location may be proximal the mask, and the second location is distal the mask.

[0147] The mask assembly may comprise an elongate strap guide which extends away from the mask, the headgear strap being movable along the elongate strap guide between the donned and doffing positions.

[0148] As the headgear strap is moved from the donned portion to the doffing position, the tension in the headgear strap may increase, before subsequently reducing.

[0149] The mask assembly may comprise a headgear strap retention feature configured to retain the headgear strap in the doffed position.

[0150] According to an aspect of this disclosure there is provided a mask assembly comprising:

a mask comprising a cushion configured to seal against the user's face; and

a headgear configured to be connected to the mask, the headgear comprising a headgear strap; wherein

the headgear strap is connected to the mask at a movable connection point; wherein the movable connection point is movable towards and away from a donned position proximal the mask, whilst maintaining the connection of the headgear strap to the mask.

[0151] The mask assembly may comprise an elongate strap guide which extends away from the mask, the movable connection point being movable along the elongate strap guide.

[0152] The connection point may be located on a carriage movable along the elongate strap guide.

[0153] The length of the headgear strap may remain constant during movement towards and away from the donned position.

[0154] The mask assembly may comprise a strap length adjuster configured to enable the length of the headgear strap to be adjusted.

[0155] According to an aspect of this disclosure there is provided a mask assembly comprising:

a mask comprising a cushion;

headgear comprising a headgear strap; and

an elongate strap guide configured to connect the headgear to the mask, the headgear strap being movably coupled to the elongate strap guide; wherein

the headgear strap is movable towards and away from the mask along the elongate strap guide, whilst remaining coupled to the elongate strap guide, and whilst the length of the headgear strap remains constant.

[0156] The elongate strap guide may comprise an elongate guide rail.

[0157] The elongate strap guide may comprise a carriage movably mounted on the elongate guide rail, the headgear strap being coupled to the carriage.

[0158] The carriage may comprise a strap length adjuster configured to enable the length of the headgear strap to be adjusted.

[0159] The length adjuster may comprise a post on the carriage around which the headgear strap is looped.

[0160] According to an aspect of this disclosure there is provided a mask assembly comprising:

a mask comprising a cushion;

headgear comprising a side strap; and

an elongate member extending away from the mask;

the side strap being movably coupled to the elongate member for movement along the elongate member from a donned position proximal the mask, to a doffing position distal the mask.

[0161] The elongate member may comprise a further strap of the headgear.

[0162] The further strap may be an upper side strap of the headgear, the side strap being a lower side strap of the headgear.

[0163] The elongate member may be integral with the mask.

[0164] The elongate member may be removably connected to the mask.

[0165] The elongate member may be an elongate guide rail.

[0166] According to an aspect of this disclosure there is provided a mask assembly comprising:

a mask comprising a cushion;

headgear comprising an upper side strap and a lower side strap;

the lower side strap being movably coupled to the upper side strap for movement toward and away from the mask.

[0167] The lower side strap may be directly coupled to the upper side strap, that is, the lower side strap directly contacts the upper side strap.

[0168] The lower side strap may be indirectly coupled to the upper side strap, that is, with one or more intermediate components coupled to both the upper side strap and the lower side strap.

[0169] The headgear may comprise an elongate rail, the lower side strap being coupled to the upper side strap using the elongate rail, wherein the one or more intermediate components comprises a carriage coupled to the elongate guide rail.

[0170] According to an aspect of this disclosure there is provided a mask assembly comprising:

a mask comprising a cushion;

headgear comprising a side strap; and

an elongate guide rail and a carriage; wherein

the elongate guide rail extends away from the mask, and the carriage is movably coupled to the guide rail for movement along the guide rail; the side strap being length adjustably connected to the carriage such that the length of the side strap can be adjusted.

[0171] The carriage may comprise a strap length adjuster configured to enable the length of the side strap to be adjusted, the side strap being connected to the carriage using the strap length adjuster.

[0172] The strap length adjuster may comprise a post on the carriage around which the side strap is looped.

[0173] The strap length adjuster may comprise an aperture on the carriage through which the side strap extends.

[0174] The mask assembly may comprise a fastener configured to resist movement of the side strap relative to the carriage, once the length of the side strap has been adjusted.

[0175] According to an aspect of this disclosure there is provided a headgear connection system for connecting a headgear comprising one or more headgear straps to a mask, the headgear connection system comprising:

an elongate guide rail for connection between the headgear and the mask; and

a carriage movably coupled to the elongate guide rail; wherein

the carriage comprises a headgear strap connector configured to connect a headgear strap of the headgear to the carriage.

[0176] The headgear connection system may comprise a guide mount configured to mount the elongate guide rail to the mask.

[0177] The guide mount may be configured to removably mount the elongate guide rail to the mask.

[0178] The headgear strap connector may comprise a strap length adjuster configured to enable the length of the headgear strap to be adjusted, the headgear strap being connected to the carriage using the strap length adjuster.

BRIEF DESCRIPTION OF THE DRAWINGS

[0179] Throughout the drawings, reference numbers can be reused to indicate general correspondence between reference elements. The drawings are provided to illustrate example embodiments described herein and are not intended to limit the scope of the disclosure.

[0180] **Figure 1** is a front view of a mask assembly and headgear in accordance with this disclosure, with the headgear in an engaged condition.

[0181] **Figure 2** is a perspective view from the front and side of the mask assembly and headgear of Figure 1.

[0182] **Figure 3** is a side view of the mask assembly and headgear of Figure 1.

[0183] **Figure 4** is a front view of a mask assembly and headgear in accordance with this disclosure, with the headgear in a disengaged condition.

[0184] **Figure 5** is a perspective view from the front and side of the mask assembly and headgear of Figure 4.

[0185] **Figure 6** is a side view of the mask assembly and headgear of Figure 4.

[0186] **Figure 7** is an enlarged side view of the mask assembly and headgear of Figures 1 to 3, showing a forward portion of the headgear in an engaged condition.

[0187] **Figure 8** is an enlarged side view of the mask assembly and headgear of Figures 1 to 3, showing a forward portion of the headgear in a partially disengaged condition.

[0188] **Figure 9** is an enlarged side view of the mask assembly and headgear of Figures 1 to 3, showing a forward portion of the headgear in a fully disengaged condition.

[0189] **Figure 10** is an enlarged view of the forward portion of an elongate strap guide of the mask assembly and headgear of Figures 1 to 9, showing a strap retention feature.

[0190] **Figure 11** is a front view of another mask assembly and headgear in accordance with this disclosure.

[0191] **Figure 12** is a perspective view from the front and side of the mask assembly and headgear of Figure 11.

[0192] **Figure 13** is a side view of the mask assembly and headgear of Figure 11.

[0193] **Figure 14** is a front view of another mask assembly and headgear in accordance with this disclosure.

[0194] **Figure 15** is a perspective view from the front and side of the mask assembly and headgear of Figure 14.

[0195] **Figure 16** is a side view of the mask assembly and headgear of Figure 14.

[0196] **Figure 17** is a front view of another mask assembly and headgear in accordance with this disclosure.

[0197] **Figure 18** is a perspective view from the front and side of the mask assembly and headgear of Figure 17.

[0198] **Figure 19** is a side view of the mask assembly and headgear of Figure 11.

[0199] **Figures 20** is a front view of another mask assembly and headgear in accordance with this disclosure.

[0200] **Figure 21** is a perspective view from the front and side of the mask assembly and headgear of Figure 20.

[0201] **Figure 22** is a side view of the mask assembly and headgear of Figure 20.

[0202] **Figure 23** is a front view of another mask assembly and headgear in accordance with this disclosure.

[0203] **Figure 24** is a perspective view from the front and side of the mask assembly and headgear of Figure 23.

[0204] **Figure 25** is a side view of the mask assembly and headgear of Figure 23.

[0205] **Figures 26 to 33** are sequential front views of the mask assembly and headgear of Figures 1 to 10 being mounted on the head of the user, and showing the headgear being moved from the fully disengaged condition of Figures 4 to 6 to the fully engaged condition of Figures 1 to 3, and back.

[0206] **Figure 34** is a side view of the mask assembly and headgear of Figures 1 to 10 prior to mounting on the head of the user.

[0207] **Figures 35 to 42** are sequential side views of the mask assembly and headgear of Figures 1 to 10 being mounted on the head of the user, showing the headgear being moved from the fully disengaged condition of Figures 4 to 6 to the fully engaged condition of Figures 1 to 3, and back.

[0208] **Figure 43** is a perspective view of a carriage of the mask assembly of Figures 1 to 10.

[0209] **Figure 44** is a sectional side view taken along a longitudinal axis of the carriage of Figure 43.

[0210] **Figure 45** is a perspective view of another carriage that could be used with the mask assembly of Figures 1 to 10.

- [0211] **Figure 46** is a sectional side view taken along a longitudinal axis of the carriage of Figure 43.
- [0212] **Figure 47** is a perspective view of a carriage mounted on an elongate strap guide of the mask assembly of Figures 14 to 16.
- [0213] **Figure 48** is a side view of the carriage and elongate strap guide of Figure 47, when in the engaged condition.
- [0214] **Figure 49** is a perspective view of another carriage mounted on an elongate strap guide of the mask assembly of Figures 14 to 16.
- [0215] **Figure 50** is a side view of the carriage and elongate strap guide of Figure 49 when in the engaged condition.
- [0216] **Figure 51** is a view from above of the carriage and elongate strap guide of Figures 49 and 50 on the mask assembly of Figures 14 to 16.
- [0217] **Figure 52** is a perspective, part sectional view of the carriage of the mask assembly of Figures 23 to 25.
- [0218] **Figure 53** is a side view of the carriage of Figure 52, when in the engaged condition.
- [0219] **Figure 54** is a perspective view of the carriage of Figures 52 to 53 mounted on the elongate strap guide of Figures 23 to 25.
- [0220] **Figure 55** is an enlarged view of a guide connector of the mask assembly of Figures 23 to 25.
- [0221] **Figure 56** is a perspective, part sectional view from above of the carriage of Figures 52 and 53, taken through line A-A of Figure 57.
- [0222] **Figure 57** is a part section side view of the carriage of Figures 52 and 53, mounted on the guide connector of Figure 55.
- [0223] **Figure 58** is a perspective view of an elongate strap guide in accordance with this disclosure.
- [0224] **Figures 59 and 60** are examples of mounting protrusions that can be used to mount an elongate strap guide to headgear.
- [0225] **Figures 61 and 62** show views from one side of two elongate strap guides in accordance with this disclosure, mounted on a headgear side strap.
- [0226] **Figures 63 and 64** show views from the other side of the two elongate strap guides of Figures 61 and 62.

[0227] **Figure 65** is a perspective view of a mask frame of the mask assembly of Figures 1 to 10, showing a guide connector for connection to an elongate strap guide in accordance with this disclosure.

[0228] **Figure 66** is a side view of part of the headgear and elongate strap guide of Figures 1 to 10.

[0229] **Figure 67** is an enlarged view of the elongate strap guide and guide connector the mask assembly of Figures 14 to 16.

[0230] **Figure 68** is an enlarged perspective view of a carriage and lower side strap of the mask assembly and headgear of Figures 17 to 19.

[0231] **Figure 69** is a plan view corresponding to Figure 68.

[0232] **Figure 70** is an enlarged perspective view corresponding to Figures 68 and 69, and also showing the forward end portion of the elongate strap guide.

DETAILED DESCRIPTION

[0233] Embodiments of mask assemblies, components and methods of assembly and manufacture will now be described with reference to the accompanying figures, wherein like numerals refer to like or similar elements throughout. Although several embodiments, examples and illustrations are disclosed below, it will be understood by those of ordinary skill in the art that the disclosures described herein extend beyond the specifically disclosed embodiments, examples and illustrations, and can include other uses of the disclosures and obvious modifications and equivalents thereof. The terminology used in the description presented herein is not intended to be interpreted in any limited or restrictive manner simply because it is being used in conjunction with a detailed description of certain specific embodiments of the disclosures. In addition, embodiments of the disclosures can comprise several novel features and no single feature is solely responsible for its desirable attributes or is essential to practicing the disclosures herein described.

[0234] With reference initially to Figures 1 to 10, a mask assembly 1 comprises a mask 3 and headgear 15.

[0235] The mask 3 comprises a frame 5, and a cushion assembly 7. The cushion assembly 7 comprises a cushion support 9 and a soft, flexible seal 11 mounted on the cushion support 9, the seal 11 forming a seal with the user's face when the mask 3 is worn by a user. The cushion support 9 may be rigid, or at least more rigid than the seal

11. The cushion support 9 is permanently or removably mounted on the frame 5. The flexible seal 11 may be softer and/ or more flexible than the cushion support 9.

[0236] A forward region of the mask 3 is connected to a breathing gas delivery conduit 13 via a connection between the conduit 13 and the frame 5 and/or cushion assembly 7.

[0237] The mask 3 is configured to be connected to the headgear 15 to mount the mask 3 on the head of a user. The headgear 15 is configured to be connected to the cushion support 9, or to the frame 5. The frame 3 may provide one or more connection features for connection to the headgear 15.

[0238] The frame 5 is made from material such as a plastics material which is relatively harder, less flexible and/or less deformable than the seal 11 of the cushion assembly 7, such that the frame 5 provides support to the cushion assembly 7. The frame 5 provides support to the cushion assembly 7 by resisting or limiting deformation of the cushion assembly 7, for example by engaging lateral portions of the cushion assembly 7. The frame 5 and cushion support 9 may be of the same material and/or have the same or similar hardness and/or flexibility.

[0239] The frame 5 and/or the cushion support 9, may be made from a plastics material comprising, solely or in combination:

- a) Nylon (Nylon 12, 11, 6);
- b) TPE – PEBA (Pebax® 7033, 7233);
- c) Polypropylene;
- d) Polycarbonate; and/or
- e) Co-polyester.

[0240] The cushion assembly 7 is configured to be mounted on the frame 5, and in this embodiment to be removably mounted on the frame 5. Mounting features can be provided to ensure the cushion assembly 7 can be mounted on the frame 5.

[0241] The cushion seal 11 is formed from a relatively soft, resiliently deformable, flexible material such as silicone, that enables the cushion seal 11 to deform against the contours of the user's face. The cushion assembly 7 defines an internal cavity that receives breathing gases from the breathing gas delivery conduit 13.

[0242] The mask assembly 1 can be provided in a range of sizes, for example small, medium and large. Some components of the mask assembly 1 may be provided in a single size and other components may be provided in a number of sizes. For example,

the frame 5 may be provided in a single size, and three different sizes of cushion assembly 7 or cushion seal 11 can fit to the frame 5. The headgear 15 may only be provided in one or two sizes that are interchangeable with different sizes of cushion assembly 7.

[0243] Throughout this specification, references to ‘forward’ mean to or at or towards the front of the mask assembly 1. References to ‘rearward’ mean to or at or towards the rear of the headgear, distal the mask 3. For example, with reference to figures 2 and 3, ‘forward’ is to the left hand side, and ‘rearward’ is to the right hand side.

[0244] Headgear 15 comprises a plurality of headgear straps, the straps being configured to extend around one or more parts of the user’s head, and to connect the headgear 15 to the mask frame 7, or to the cushion support 9.

[0245] The plurality of headgear straps may comprise one or more side straps that extend from the mask 3 along the sides of the user’s face, one or more crown straps that extend over the crown of the user’s head, and/or one or more rear straps that extend around the rear of the user’s head and/or one or more rear panels that extend across the rear of the user’s head.

[0246] Referring to Figures 1 to 10, headgear 15 comprises:

- a) a pair of lower side straps 17;
- b) a pair of upper side straps 19;
- c) a crown strap 20; and
- d) a rear panel 22.

[0247] Each lower side strap 17 extends below the user’s ears, and comprises a forward portion 17A adjacent the mask 3 and a rearward portion 17C distal the mask. The forward portions 17A, 19A terminate in respective forward ends, and the rearward portions 17C, 19C terminate in respective rearward ends. Each side strap 17, 19 extends between the forward and rearward ends. The forward portions 17A, 19A are connected to the mask 3. The rearward portions 17C, 19C are connected to a rear section of the headgear 15. The rear section of the headgear 15 to which the rearward portions 17C, 19C are connected could comprise the crown strap 20, a rear strap, the rear panel 22, or another rearward part or component of the headgear 15.

[0248] Each upper side strap 19 extends above the user’s ears, and comprises a forward portion 19A adjacent the mask 3, an intermediate portion 19B and a rearward portion 19C. Rearward portion 19C is connected to crown strap 20 which extends up

and over the crown of the user's head. The crown strap 20 comprises a rearwardly and downwardly directed portion that is connected to the rear panel 22.

[0249] Rear panel 22 is substantially oblong and extends across part of the back of the head of the user. Rear panel 22 has a greater surface area than, for example crown strap 21, and so distributes tensile forces over a greater area of the rear of the user's head. The rear panel 22 may be another shape, for example elliptical, circular or trapezoidal.

[0250] The straps 17, 19, 20 and rear panel 22 of headgear 15 may be permanently or releasably connected together, or a combination, and this will be described further below. A permanent connection could be provided by stitching, adhesive, and/ or welding for example. A releasable connection could be provided, for example, by one or more hook and loop fasteners, or any suitable buckle or clip, or a combination of a protrusion on one strap that is received in an aperture of another strap.

[0251] In this disclosure, the forward portions 19A of each upper side strap 19 are connected, via an upper side strap connection, to the mask 3, and in particular to the frame 5. The upper side strap connection can comprise, for example, a hook that clips onto a post on the mask frame 5 (or vice versa), or any other suitable connector on one or both of the upper side strap 19 and mask 3. The upper side strap connection can comprise a guide connector that connects an elongate strap guide 21 to the frame 5. The elongate strap guide 21 is described below.

[0252] In this disclosure the forward portion 17A of each lower side strap 17 is movably coupled to an elongate element of a connection structure that, at least partially, connects the headgear 15 to the mask 3. The elongate element can be an elongate strap guide 21 of the mask assembly 1. The elongate strap guide 21 could comprise part of the headgear 15, for connection to the mask 3, or could comprise part of the mask 3 for connection to the headgear 15.

[0253] The elongate strap guide 21 is an elongate element that comprises a forward portion 21A proximal the mask 3, an intermediate portion 21B that extends rearwardly along the side of the user's face away from the mask 3, and a rearward portion 21C that is distal the mask 3.

[0254] The forward portion 17A of the lower side strap 17 is coupled to, and can move along, the intermediate portion 21B of the elongate strap guide 21, between the forward and rearward portions.

[0255] In particular, the connection structure is configured such that the forward portion 17A is coupled to the elongate strap guide 21 at a movable connection point.

The movable connection point could be at an intermediate component such as a carriage 32 movably mounted on the elongate strap guide 21 as described further below. The connection point is movable towards and away from a first location being a donned position proximal the mask 3, whilst maintaining the connection of the headgear strap (for example lower side strap 17) to the mask 3. When moved away from the donned position, the connection point may be at a second location being a doffing position distal the mask 3.

[0256] The elongate element of the elongate strap guide 21 could comprise an elongate guide rail 27 to which the carriage 32 is movably coupled. Alternatively, the forward portion 17A of the lower side strap 17 may be coupled to the elongate element directly, that is, without an intermediate component.

[0257] Moving the forward portion 17A of the lower side strap 17 rearwardly along the elongate strap guide 21, away from the mask 3, releases, or at least reduces, the tension in the lower side strap 17, and facilitates removal of the mask assembly 1 from the head of the user, without disconnecting the forward portion 17A of the lower side strap 17 from the mask 3. In other words, the tension in the lower side strap 17 can be released or at least reduced, whilst the lower side strap 17 remains connected to the mask 3 (via the elongate strap guide 21).

[0258] When the forward portions 17A of the lower side straps 17 are positioned at the forward portions 21A of the elongate strap guides 21 (as shown in Figures 1 to 3), a distance D is defined from front to back of the mask assembly, between the seal 11 and the rear panel 22. When the forward portions 17A of the lower side straps 17 are positioned at the rearward portions 21C of the elongate strap guides 21 (as shown in Figures 4 to 6) the tension in the lower side straps 17 is released or reduced, allowing the distance D to be increased by the user. In other words, the mask 3, and in particular the cushion assembly 7, and the headgear 15 form a continuous loop around the user's head. The movable coupling of the lower side straps 17 to the elongate strap guides 21 enables the length of the continuous loop to be increased, without adjusting a length of any of the headgear straps, to doff the mask 3. This enables the mask assembly 1 to be removed from the head of the user, without disconnecting any part of the headgear 15 from the mask 3.

[0259] When the forward portions 17A of the lower side straps 17 are positioned at the forward portions 21A of the elongate strap guides 21, the forward portions 17A are in an engaged condition on the elongate strap guides 21, proximal the mask 3. When in

the engaged condition sufficient tension is applied through the lower and upper side straps 17, 19, to ensure the mask assembly 1 is correctly mounted on the user's head, with the desired comfort for the user, and the desired seal between the seal 11 and the user's face. The tension applied through the lower and upper side straps 17, 19 can be adjusted by adjusting the length of or more of the lower and upper side straps 17, 19, for example using length adjusters as described below. It is envisaged that the length of the lower and upper side straps 17, 19 need only be adjusted once, when first donning the mask assembly 1 during first use of the mask assembly 1. Once the length of the lower and upper side straps 17, 19 has been adjusted as desired, no further adjustment of the length of the lower and upper side straps 17, 19 would ordinarily be required.

[0260] When the forward portions 17A of the lower side straps 17 are positioned at the rearward portions 21C of the elongate strap guides 21, the forward portions 17A are in a disengaged condition on the elongate strap guides 21, distal the mask 3. When in the disengaged condition the distance D, and the size of the continuous loop, can be sufficiently increased by the user, such that the mask assembly 1 can be doffed and donned. The forward portions 17A of the lower side straps 17 are therefore movable between a donned position proximal the mask 3 to a doffing position distal the mask 3. When in the disengaged condition, the tension in the lower side straps 17, 19 may be reduced from the tension in the straps when in the engaged condition.

[0261] This doffing and donning process and headgear structure allows the mask assembly 1 to be easily removed from the user's head. In particular, this process and structure:

- a) provides clearance between the user's head (in particular the ears) and the lower side straps 17; and/or
- b) allows the lower portion of the rear panel 22 of headgear 15 to be pivoted or pulled away from the mask 3 and over the user's occiput; and/or
- c) is such that the continuous (lower) loop of the headgear 15 is enlarged to enable easier removal from the user's head. The continuous (lower) loop is formed by the rear panel 22 and the pair of lower side straps 17, in conjunction with the mask 3.

[0262] As described below, an over centre arrangement is provided such that a force must be applied by the user to move the lower side straps 17 away from the engaged condition, such that the tension in the lower side straps 17 can subsequently be reduced. The over-centre arrangement retains the lower side straps 17 in the engaged condition

by applying a minimum retention tension to the lower side straps 17. The user initially needs to increase the tension, above that minimum retention tension, to move the lower side straps 17 away from the engaged condition, such that the tension in the lower side straps 17 subsequently decreases.

[0263] The provision of one or more strap retention features helps ensure that the lower side straps 17 remain in the engaged condition, proximal the mask 3, until the user deliberately moves the lower side straps 17 away from that engaged condition.

[0264] With reference to Figure 10, as the user moves the lower side straps 17 away from the engaged condition, the tension in the lower side straps 17 may initially increase, as the user pushes the lower side strap 17 slightly forward of the rearmost point of the strap retention feature 30, to release the lower side strap 17 from the strap retention feature 30. As the lower side straps 17 are pushed forward, the lower side straps 17 and/or other portions of the headgear 15, are stretched slightly, increasing the tension as the lower side straps 17 are moved away from the engaged condition. The forwardmost point of the forward portion 27A of the guide rail 27 is forward of the rearmost portion of the strap retention feature 30, as can best be seen in Figure 10.

[0265] Once the lower side straps 17 have been moved away from the retention feature 30 and away from the engaged condition, the tension in the lower side straps 17 reduces as the lower side straps 17 move towards a rearmost position along the elongate strap guides 21. Once at the rearmost position on the elongate strap guides 21, the tension in the lower side straps 17 may be at a minimum, such that the size of the continuous loop can be increased, making it relatively easy for the user to doff the headgear 15.

[0266] With reference to Figures 1 to 10, a pair of the elongate strap guides 21 is provided, each associated with a respective lower side strap 17. It is envisaged that a single elongate strap guide 21 could be provided, associated with one lower side strap 17 only.

[0267] In the following description we refer to a single elongate strap guide 21 for clarity.

[0268] Referring to Figures 1 to 10, the elongate strap guide 21 is mounted on, or comprises an integral part of, an elongate arm 23 that extends rearwardly from the mask 3. The elongate strap guide 21 may be mounted on, or comprise an integral part of, the headgear 15. The elongate guide rail 21, and the carriage 32 comprise a headgear connection system for connecting the headgear 15 to the mask 3.

[0269] The arm 23 could be integral with the frame 5, or could be a separate component that is connected to the frame 5. In an alternative embodiment the arm 23 could be integral with or connected to the cushion support 9.

[0270] An elongate guide channel 25 extends substantially along the length of the arm 23. The arm 23 further comprises an elongate element in the form of an elongate guide rail 27 that forms the lower margin of the elongate guide channel 25. The forward portion 17A of the lower side strap 17 is movable along the guide rail 27.

[0271] The elongate strap guide 21 extends along part of the length of the upper side strap 19. The elongate strap guide 21 may be shorter than the upper side strap 19 and/or may be shorter than the lower side strap 17.

[0272] The guide rail 27 comprises a forward portion 27A proximal the mask 3, a substantially straight intermediate portion 27B and a rearward portion 27C distal the mask 3.

[0273] The forward portion 27A comprises a relatively short, lower end 29 adjacent the side of the mask frame 5 that leads to an arcuate portion 31 that extends initially forwardly and upwardly from the lower end 29, and then curves rearwardly into the intermediate portion 27B. The arcuate portion 31 of the forward portion 27A of the guide rail 27 therefore provides an end portion that extends in a different direction from a body portion of the guide rail 27, namely the intermediate portion 27B, of the guide rail 27. This upward, forward and then rearward shape of the arcuate portion 31 creates an over-centre arrangement for the side strap 17 and guide rail 27, whereby as the lower side strap 17 is moved away from the lower end 29, the lower side strap 17 has to initially be moved forwardly as it is moved up the strap retention feature 30 and up the arcuate portion 31, before then moving rearwardly and onto the intermediate portion 27B.

[0274] With reference to Figure 10, the over-centre arrangement can be seen with reference to tangent lines T1 and T2. Tangent line T1 is tangential to the apex portion 31A of the arcuate portion 31, namely the region of the arcuate portion 31 that is forwardmost. Tangent line T2 is tangential to the rearmost region of the lower end 29 of the forward portion 27A. The space between lines T1 and T2 defines a strap retention feature 30 that serves to retain the forward end 17A of the lower side strap 17 in that position. To release the forward end 17A of the lower side strap from the strap retention feature 30, the user must move the forward end 17A forwardly through the space defined between the tangent lines T1, T2.

[0275] The forward and rearward portions 21A, 21C of the elongate strap guide are inclined relative to one another. The axis of the forward portion 21A of the elongate guide rail 21 is at an angle greater than 45° to the axis of the adjacent, intermediate portion 21B.

[0276] In particular, the axis of the lower end 29 of the forward portion 27A of the guide rail 27 is at an angle greater than 45° to the axis of the adjacent, intermediate portion 27B. In this example the forward portion 27A of the guide rail 27 curves through an angle A of substantially 95° between the lower end 29 and the intermediate portion 27B, as can best be seen in Figures 6 and 10. Angle A could be between 80° and 105° in one example, more preferably 90° and 100° . The forward portion 27A functions as an over-centre arrangement to help retain the forward portion 17A of the lower side strap 17 in the engaged condition, as will be described below.

[0277] As can best be seen in Figures 3, 26 and 39, the rearward portion 27C is substantially straight and terminates in a relatively short portion of the guide rail 27, which projects upwardly away from the rearward portion 27C and whose axis may be substantially perpendicular to the axis of the rearward portion 27C. The rearward portion 27C functions as an end stop, limiting rearward movement of the forward portion 17A of the side strap 17.

[0278] The intermediate portion 27B of the guide rail 27 is substantially parallel with the longitudinal axis of the upper side strap 19.

[0279] The forward portion 17A of the lower side strap 17 could be coupled to the guide rail 27 by being looped around the guide rail 27 and then secured to the remainder of the lower side strap 17 via a suitable fastener, such as a hook and loop fastener for example.

[0280] However, with reference to Figures 1 to 10, an intermediate component comprising a carriage 32 is provided, the carriage 32 being movably coupled to the guide rail 27, with part of the carriage 32 being received in the elongate guide channel 25. The carriage 32 provides a connection point at which the lower side strap 17 is coupled to the guide rail 27. This connection point can be moved along the guide rail 27, whilst maintaining the coupling between the lower side strap 17 and the guide rail 27.

[0281] With additional reference to Figures 43 to 46, carriage 32 comprises a strap connector 33 for connecting the side strap 17 to the carriage 32. Strap connector 33 is in the form of a length adjuster comprising a post 35 and aperture or loop 37. The

forward portion 17A of the lower side strap 17 extends through the aperture 37, loops back on itself around the post 35, and is secured to the remainder of the lower side strap 17 via a suitable fastener 39, which can comprise a hook and loop fastener for example. The length of the lower side strap 17 can therefore be adjusted by pulling more or less of the lower side strap 17 through the aperture or loop 37.

[0282] Carriage 32 further comprises a guide mount 41 for mounting the carriage 31 on the guide rail 27. Guide mount 41 comprises a hook 43 which defines a slot 45 between the hook 43 and the body of the carriage 32, the guide rail 27 being received in the slot 45. The hook 43 resiliently deforms to allow the slot 45 to receive the guide rail 27, when the carriage 32 is initially mounted on the guide rail 27.

[0283] Alternatively, the guide mount 41 could comprise one or more protrusions configured to be received in a corresponding elongate recess or slot of the elongate strap guide 21. The axis of the elongate recess can be parallel to the longitudinal axis of the guide rail 27. For example, the protrusions could be received in the elongate channel 25 formed in the arm 23.

[0284] With additional reference to Figure 7, the process for doffing the mask assembly 1 begins with the carriage 32 being located at the lower end 29 of the forward portion 27A of the guide rail 27. When the side strap 17 is in this engaged condition, the direction of a tensile force T aligned with the longitudinal axis of the side strap 17 is greater than 45° to the axis of the straight lower end 29. This is because of the orientation of the axis of the lower end 29 relative to:

- a) the remainder of the elongate strap guide 21 and
- b) the tensile forces applied along the side strap 17 when the mask assembly 1 and headgear 15 are donned.. The tensile force T thus serves to retain the carriage 31 on lower end 29, with any additional tensile force applied at this stage through the side strap 17 increasing the retention force retaining the carriage 32 in this engaged condition. This also increases the engagement/sealing force of the seal 11 on the user's face.

[0285] With reference to Figure 8, to begin to doff the headgear 15, the user grips the carriage 32 and/or the forward end 17A of the side strap 17, and begins to move the carriage 32 along the lower end 29 of the guide rail 27 and onto the arcuate portion 31. In this partially disengaged condition, the tensile force T along the axis of the side strap 17 continues to retain the carriage 32 on the forward portion 27A of the guide rail 27.

The tensile force T may increase slightly as the user moves the carriage 32 away from the engaged condition, as the arcuate portion 31 protrudes forwards of the lower end 29. This retention continues until the user moves the carriage 32 sufficiently along arcuate portion 31 that the tensile force T is inclined at an angle that is less than 45° to the substantially straight intermediate portion 27B of the guide rail 27. Figure 8 shows the carriage 32 at this transition position.

[0286] With reference to Figure 10, a transition position occurs at the apex 31A of the arcuate portion 31, where the forwardly curved initial portion of the arcuate portion 31 transitions into the rearwardly curved portion that leads to the intermediate portion 27B of the guide rail 27. As described above, initially the user must move the carriage 32 forward of the engaged condition at the bottom of the guide rail 27, so that the carriage 32 moves forward along the forwardly curved initial portion before reaching the transition position. During this forward movement, the tension in the side strap 17 increases.

[0287] The user can then continue to apply rearwardly and upwardly directed force to the carriage 32 and/or to the forward portion 17A of the side strap 17 to move the carriage 32 beyond this transition position and onto the intermediate portion 27B of the guide rail 27. During this rearward movement, the tension in the side strap 17 reduces considerably.

[0288] With reference to Figure 9, the user can control the angle of the side strap 17 relative to the guide rail 27, and/or the position of the side strap 17 on the guide rail 27, to reduce the tensile force T along the axis of the side strap 17.

[0289] Once the carriage 32 is on the rearward portion of the arcuate portion 31, the carriage 32 can therefore be moved relatively easily along the guide rail 27, until the carriage 31 is at a fully disengaged condition at the rearward portion 27C of the guide rail 27. Rearward portion 27C of the guide rail 27 prevents the carriage 32 moving off the end of the guide rail 27. The tensile force is reduced as the user moves the forward portion 17A of the lower side strap 17 closer to the rear of the headgear 15. The spacing between the carriage 32 and the rear of the headgear 15 is reduced, while the length of the lower side strap 17 remains the same. Thus, the lower side strap 17 becomes loose and the tensile force is removed or reduced. This allows the lower loop of the headgear to be enlarged sufficiently to provide clearance between the user's head and the lower side straps 17, to enable the lower portion of the rear strap 22 to be pivoted or pulled away from the mask 3 and over the user's occiput.

[0290] During this movement of the carriage 32 and forward portion 17A of the side strap 17 from the engaged to disengaged conditions, the side straps 17 remain connected to the mask 3, as do the upper side straps 19. No disconnection of the headgear 15 from the mask 3 is therefore required to doff the mask assembly 1 from the user's head.

[0291] The donning process is a reverse of the above described doffing process, as seen with reference to Figures 26 to 34, and also with reference to Figures 35 to 42. Consequently, when donning and doffing the mask assembly 1, the user does not have to disconnect and reconnect any part of the headgear 15 with the mask 3. The forward portion 17A of the lower side strap 17 remains coupled to the carriage 32 at all times, including in each of the donned and doffing positions, and when moving along the guide rail 27 between the donned and doffing positions. This reduces the likelihood of the straps getting tangled and prevents the ends of the lower strap getting mislaid behind the user's head. Nor is any subsequent adjustment of the length of any of the headgear straps required. When the user first dons the mask assembly 1, the user can adjust the length of the headgear straps as required. For all subsequent uses no further adjustment should be required. For example, the length of the side straps 17 can remain constant throughout the donning and doffing process.

[0292] The carriage 32 may comprise one or more finger grips to facilitate the user gripping and moving the carriage 32. The finger grip(s) could comprise one or more textured, raised or recessed regions.

[0293] With reference to Figures 1 to 10, the shape of the elongate strap guide 21 is configured to be substantially the same as the shape of the upper side strap 19, and in particular at least the forward and intermediate portions 19A, 19B of the upper side strap 19. When viewed from the side, the profile of the elongate strap guide 21 substantially matches the profile of the upper side strap 19. The elongate strap guide 21 substantially overlaps the upper side strap 19. This minimises the overall side profile of the headgear 15, and provides a more minimalistic and aesthetically pleasing design.

[0294] The elongate strap guide is inclined relative to the lower side strap 17, when the forward portion 17A of the lower side strap 17 is positioned at the forward portion 21A of the elongate strap guide 21.

[0295] The elongate strap guide 21 is secured to the upper side strap 19 by any suitable fixings. These fixings may include an elongate pocket 47 of the upper side strap 19, into which a rearward end portion of the arm 23 is received, with the guide rail

27 extending below the pocket 47. The rearward end portion may be the only portion of the elongate strap guide 21 that is connected to the upper side strap 19, with the remainder of the elongate strap guide 21 not connected to the upper side strap 19.

[0296] The forward portion of the elongate strap guide 21 may be secured to the forward portion 19A of the upper side strap 19, via adhesive or welding or the like, noting that the guide rail 27 itself is free from the upper side strap 19 and not secured thereto. The elongate strap guide 21 may be mounted to the upper side strap 19 via mounting protrusions 24 on one of the components being received in corresponding apertures or recesses on the other component. With reference to Figures 57-59, the mounting protrusions 24 could comprise button/mushroom connectors, or L-shaped connectors.

[0297] The forward portion of the elongate strap guide 21 may be secured directly to the mask frame 5, for example via one or more guide connectors 100. For example, the forward portion of the elongate strap guide 21 could be secured to the mask frame via a guide connector comprising:

- a) one or more welded portions;
- b) adhesive;
- c) one or more mounting protrusions on the forward portion or the mask frame 5 being received in one or more recesses on the other of the forward portion of the mask frame 5;
- d) one or more hook and loop fasteners;
- e) one or more snap fit features provided on the forward portion and the mask frame 5.

[0298] For example, with reference to Figures 58 to 60, the elongate strap guide 21 may comprises a plurality of mounting protrusions 24 that project outwardly away from one side of the elongate strap guide 21, and which are configured to be received in corresponding mounting apertures or recesses on the upper side strap 19. With reference to Figure 59, the mounting protrusions 24 can each comprise a button or mushroom connector, each comprising a stem 24A and an enlarged head 24B that engages the upper side strap 19 and retains the elongate strap guide 21 in connection with the upper side strap 10. With reference to Figure 60, the mounting protrusions 24 can comprise a hook.

[0299] Such mounting protrusions 24 can also be seen with reference to Figures 61 to 64.

[0300] With reference to Figure 10, the elongate strap guide 21 may be provided with one or more strap retainers 30 configured to help retain the forward portion 17A of the side strap 17 in a desired position along the elongate strap guide 21. For example, a strap retainer 30 may be provided at the forward end of the elongate strap guide 21 to help retain the carriage 32 in the fully engaged condition to reduce the likelihood of the side strap 17 accidentally disengaging during use.

[0301] Likewise, a strap retainer 30 may be provided at the rearward end of the elongate strap guide 21 to help retain the carriage 32 in the fully disengaged condition, to help resist the carriage 32 from sliding forwardly along the guide rail 27, when the headgear 15 has been or is being doffed, for example with reference to Figure 13.

[0302] The strap retainers 30 can comprise a formation on the guide rail 27. For example, a strap retainer 30 can comprise a recessed portion or notch of the guide rail 27, into which the carriage 32 is received. The strap retainer 30 could comprise a thickened portion of the guide rail 27, dimensioned to be an interference or frictional fit with part of the carriage 32. The strap retainer 30 could comprise a magnet on one of the elongate strap guide 21 and carriage 32 configured to magnetically engage with metal or another magnet on the other of the elongate strap guide 21 and carriage 32.

[0303] The guide rail 27 may comprise the same profile, shape and/or size in transverse cross section along its length, or one or more of these features could vary along its length. The guide rail 27 may comprises one or more rail portions of different profile, shape and/or size in transverse cross section than another portion of the guide rail 27.

[0304] For example, the rearward portion 27C of the guide rail 27 may be relatively thin in order to be easier to mount on the upper side strap 19. This can also make rearward portion 27C of the guide rail 27 less bulky and more flexible, allowing the elongate strap guide 21 to better conform to the user's face for improved comfort. The rearward portion of the guide rail 27 may be around 1mm thick.

[0305] The forward portion 27A of the guide rail 27 may be relatively thick in order to provide more rigidity and support at the forward portion 27A. This may help to reduce buckling, folding or other deformation of the forward portion 27A of the guide rail 27. The forward portion 27A of the guide rail 27 may be around 3mm thick.

[0306] One or more portions of the guide rail 27 may, in transverse cross section, be:

- a) quadrilateral;
- b) triangular;
- c) circular;
- d) elliptical.

[0307] With reference to Figures 1 to 10 and Figures 43 to 57, the carriage 32 comprises a body with the strap connector 33 configured as a length adjuster comprising post 35 and strap aperture 37, and the guide mount 41 comprising the hook 43 and rail slot 45. The post 35 and strap aperture 37 are provided at the rear of the carriage 32, nearest to the lower side strap 17 in use. With reference to Figures 42 and 43, the hook 43 and slot 45 are provided on the side face 58 of the carriage 32 that is adjacent the user. The side face 60 of the carriage 32 that faces outwardly therefore has a clean look where the hook 43 cannot be easily seen from the side. Alternatively, with reference to Figures 44 and 45, the hook 43 may project from a forward portion of the carriage 32 so that that overall length of the carriage 32 increases and the hook 43 can be seen from the outer side face 58.

[0308] The length of the rail slot 45 may be greater than the width of the guide rail 27, for example two or three times greater.

[0309] The width of the rail slot 45 may be substantially equal to the width of the guide rail 27.

[0310] The lower side straps 17 and/or the upper side straps 19 may be length adjustable, via respective length adjusters.

[0311] The length of each lower side strap 19 may be adjusted by adjusting the extent to which the forward portion 17A of the lower side strap 17 is pulled through the strap aperture 37 of the length adjuster of carriage 32. The length of the lower side strap 17 can be shortened by pulling more of the forward portion 17A through the aperture 37 and then securing the lower side strap 17 at the desired length via a suitable fastener, for example a hook and loop fastener. The post 35 and strap aperture 37 therefore comprise a lower side strap adjuster on the carriage 32.

[0312] Each upper side strap 19 may also comprise a length adjuster. The length adjuster may be located in a forward position towards the mask 3, or in a rearward position distal the mask 3.

[0313] With reference to Figures 1-3, the upper side strap length adjuster is in a rearward position, distal the mask 3. The upper side strap length adjuster comprises a

buckle 50 secured to the crown strap 20, for example via stitching or via a loop of material 52 that extends around a rear post of the buckle 50 and which extends from the crown strap 20.

[0314] The buckle 50 comprises a forward post 54 and a strap aperture 56 through which the rearward portion 19C of the upper side strap 19 passes before looping back on itself and being secured to the remainder of the upper side strap 19, for example via a fastener such as a hook and loop fastener.

[0315] The upper side strap 19 is configured to have a relatively wide adjustment range by having a length adjustment portion of the upper side strap 19 that extends beyond a guide rail attachment portion of the upper side strap 19. In other words, there is a relatively long length of the upper side strap 19 that can be length adjusted by looping through buckle 50, without interference with the rear portion 27C of the guide rail 27. The buckle 50 is located at the rearward portion 19C of the upper side strap 19 adjacent or just rearward of the user's ear. The rearward portion 19C comprises a length adjustment portion of the upper side strap 19 that can be looped through the buckle 50. In some embodiments the length adjustment portion of the upper side strap 19 can be approximately the same length as the guide rail 27. The rearward portion 19C may be secured to the remainder of the upper side strap 19 by a suitable locking feature such as a hook and loop fastener, strap clamp/buckle, or by one or more pins on the rearward portion 19c received in one or more apertures on the remainder of the upper side strap 19.

[0316] This configuration allows for adjustment of the upper side strap 19 to be performed at the rearward part of the user's face, providing easier, more accessible, and more intuitive use for the user. Furthermore, this configuration provides a 'one to one ratio' adjustment, where a length adjusted along the upper side strap 19 is equivalent to a distance adjusted on the position of the mask frame 5, providing the user with direct feedback and an intuitive setup process, when first using the mask assembly 1 and headgear 15. This can help to prevent or reduce overtightening of the headgear 15, for example.

[0317] The guide rail 27 comprises one or more material properties that enable the guide rail 27 to provide the desired function. The guide rail 27 should desirably:

- a) Be sufficiently smooth to allow the carriage 32 to be slid along the guide rail 27 with a minimum of force, and without the carriage 32 sticking to the guide rail 27.

- b) Have a sufficiently low friction coefficient (μ) to allow the carriage 32 to be slid along the guide rail 27 with a minimum of force, and without the carriage 32 sticking to the guide rail 27.
- c) Have a sufficiently low friction coefficient (μ) so that when the carriage 32 has moved away from the engaged condition, the carriage 32 will slide back to the disengaged condition with minimal force applied by the user.
- d) Be sufficiently flexible, and therefore have a sufficiently low flexural modulus for the guide rail 27 to be able to flex in use to match the contours of the user's face, and so as not to dig into the user's face.
- e) Be self supporting such that the elongate strap guide 21 is sufficiently rigid, and therefore has a sufficiently high flexural modulus for the guide rail 27 to resist bending, kinking and folding as the carriage 32 is moved along the guide rail 7 between the engaged and disengaged conditions and vice versa.
- f) Be self supporting such that the elongate strap guide 21 is sufficiently rigid to retain its shape, and in particular to retain the shape of arcuate portion 31, and any recesses or protrusions provided as strap retainers.

[0318] The guide rail 27 may be formed from any one or a combination of:

- a) A polymer material.
- b) A metal material.
- c) A rubber material.

[0319] The guide rail 27, or portions thereof may be:

- a) Substantially solid.
- b) Hollow.

[0320] The guide rail 27 may be formed from Nylon 12, or TPE Everglide.

[0321] The flexural/bending modulus may be defined by:

$$E_{flex} = \frac{L^3 F}{4wh^3 \delta}, \quad E = \frac{\sigma}{\delta}$$

[0322] Example properties for the guide rail 27 are as follows:

Property	Nylon 12	TPE Everglide
Friction coefficient μ	0.39	0.12

T_m	184°C	204-215°C
E	1.82GPa	0.676GPa
E_{flex}	1.64GPa	0.689GPa

[0323] The elongate strap guide 21 is shorter than the upper strap 19 on which it is mounted. In particular, a rearmost portion of the upper strap 19 extends beyond the rearmost end of the elongate strap guide as defined by the straight portion 27C. This ensures that there is sufficient length of the upper strap 19 that is flexible and which can therefore allow the length of the upper strap 19 to be adjusted.

[0324] The guide rail 21 may be resiliently deformable or may be elastically deformable. The guide rail 21 may be substantially rigid, at least in a direction along the longitudinal axis of the elongate strap guide.

[0325] With reference to Figures 11 to 13, a mask assembly 51 is provided comprising similar features to mask assembly 1 described above with reference to Figures 1 to 10.

[0326] Guide rail 27 of the elongate strap guide 21 of headgear 15 comprises a length of metal wire 53 extending from the mask 3 to the rearward portion 19C of the upper side strap 19. The guide rail 27 extends below the upper side strap 19 with an intermediate rail portion 53B being substantially parallel with intermediate side strap portion 19B. A forward end 53A of the wire 53 is secured to a lower part of the mask frame 5. The metal wire 53 is bent to provide strap retainers 30 comprising arcuate wire portions at the forward end 53A and a rearward end 53C of the wire 53. At the forward end 53A the strap retainer 30 may comprise an over-centre arrangement as described elsewhere. The metal wire 53 is substantially circular in transverse cross section.

[0327] With reference to Figures 14 to 16 a mask assembly 61 is provided comprising similar features to mask assembly 1 described above with reference to Figures 1 to 10.

[0328] With reference to Figures 47 and 48, guide rail 27 of mask assembly 61 is mounted on, or comprises an integral part of, a planar, elongate mounting flange 63. The guide rail 27 projects outwardly from a lower margin of the flange 63. The guide rail 27 projects outwardly from both side faces of the flange 63, that is from the side face adjacent the user in use, and from the side face that faces away from the user in

use. The guide rail 27 and flange 63 comprise an inverse 'T' shaped transverse profile, comprising a first sub-rail 27D on one side of the flange 63, and another sub-rail 27E on the other side of the flange 63.

[0329] The upper margin of the flange 63 is mounted to a lower edge of the upper side strap 19, at a rearward portion 63B of the flange 63. A forward portion 63A of the flange 63 is pivotally mounted on mask frame 5.

[0330] The guide rail 27 and flange 63 are formed from a relatively rigid material, such as polypropylene, such that the guide rail 27 and flange 63 resist bending and folding forces that might be applied during movement of the carriage 32 from the engaged to the disengaged conditions. With reference to Figure 67, the guide rail 27 has a strap retainer 30 comprising a reduced width portion 65 at the forward portion 63A of the flange 63. Reduced width portion 65 also functions to provide tactile feedback to the user that the carriage 32 is in the engaged condition. The reduced width portion 65 provides a recess for the carriage 32 to sit in, where the front of the recess is rearward of a forwardmost edge of the guide rail 27.

[0331] The forwardmost end of the flange 63 comprises a guide connector comprising an elongate protrusion in the form of a mounting lug 66 that is pivotally mounted to the mask frame 5 via a pin, bolt, screw or rivet 68.

[0332] The forwardmost end of the elongate strap guide 21 further comprises an end stop 70 to limit the extent of forward movement of the side strap 17 or carriage 32.

[0333] In mask assembly 61, the carriage 32 is configured to move along both of the sub rails 27D, 27E of the guide rail 27, with the carriage 32 hanging below the guide rail 27. When the carriage 32 is located at the forward portion 27A of the guide rail 27, the carriage 32 is rearward of the forward portion 27A. The body of carriage 32 defines a through bore 67 configured to receive the guide rail 27, and an upper slot 69 in communication with the through bore 67 and configured to receive the lower part of the flange 63, as best shown in Figures 47 and 48. The portions of the carriage 32 adjacent the slot 69 comprise a pair of opposed projections 71 which rest on, and slide along, respective sub rails 27D, 27E.

[0334] Alternatively, with reference to Figures 49 to 51, the guide rail 27 may project from only one side of the flange 63 such that there is only one sub rail 27D. In this configuration the carriage 32 comprises only a single projection 71 adjacent upper slot 69, the single projection 71 resting on the single sub rail.

[0335] With reference to Figures 17 to 19 and 68 to 70, a mask assembly 81 is provided comprising similar features to mask assemblies 51 and 61 described above with reference to Figures 11 to 16.

[0336] In mask assembly 81, guide rail 27 of elongate strap guide 21 comprises a wire, similar to wire 53 described above with reference to Figures 1 to 13.. However, to improve comfort, the wire is wrapped in a fabric sleeve 83 (and consequently cannot be seen in Figures 17 to 19). Sleeve 83 defines an elongate pocket 85 that receives the wire, and an elongate flange 87 whose upper margin is secured to a lower margin or edge of the upper side strap.

[0337] With additional reference to Figures 68 to 70, the carriage 32 comprises a strap connector 33 for connecting the side strap 17 to the carriage 32. Strap connector 33 is in the form of length adjuster comprising a post 35 and aperture or loop 37. The forward portion 17A of the side strap 17 extends through the aperture 37, loops back on itself around the post 35 to enable a length of the lower side strap 17 to be adjusted, and is secured to the remainder of the side strap 17 via a suitable fastener 39, which can comprise a hook and loop fastener for example.

[0338] Carriage 32 further comprises a guide mount 41 for mounting the carriage 32 on the guide rail 27. Guide mount 41 comprises a slot 141 defined between a pair of resilient arms 143 depending from the body of the carriage 32, the wire 53 and pocket 85 being received in the mouth 141. The arms 143 resiliently deform to allow the mouth 141 to receive the wire 53 and pocket 85, when the carriage 32 is initially mounted on the wire 53 and pocket 85. The arms 143 are curved or partially-circular in cross-section to match the cross-section of the wire 53.

[0339] With reference to Figures 20 to 22, a mask assembly 91 is provided comprising similar features to mask assembly 1 described above with reference to Figures 1 to 10.

[0340] In mask assembly 91, elongate strap guide 21 comprises an elongate, soft, cord 93 whose forward end 93A is secured to the frame 5, and whose rearward end 93C is secured to the headgear 15 at the intersection between the rearward portion 19C of the upper side strap 19 and the crown and rear straps 20, 22. The rearward portion 93C may be secured using adhesive, and a reinforcing patch 95 may be provided to increase the bonding surface area. Alternatively, the patch 95 or the rearward portion 93C if the cord may be stitched in place. The cord 93 may be elastic.

[0341] The cord 93 is generally inclined relative to the longitudinal axis of the upper side strap 19. The rearward end 93C of the cord 93 is secured beyond the rearward end 19C of the upper side strap 19, and so the elongate strap guide 21 is longer than the upper strap 19, allowing a relatively greater distance of movement of the carriage 32 between the engaged and disengaged conditions than if the rearward end 93C was secured to the upper side strap 19. This allows a more significant release of lower side strap tension when doffing. This also allows the upper strap 19 to have an increased range of length adjustment as the guide rail 27 is not directly attached to the upper strap 19, and thus doesn't interfere with the length adjustment.

[0342] With reference to Figure 52, the carriage 32 comprises an elongate through bore 97 that receives the cord 93, each end of the bore 97 being radially outwardly flared/chamfered 98 to improve how smoothly the carriage 32 slides along the cord 93. The elongate bore 97 is not fully closed in transverse cross section, the elongate bore 97 not fully extending around the periphery of the elongate strap guide 21 or guide rail 27, when viewed along the longitudinal guide axis of the elongate strap guide 21. For example the elongate bore 97 may be substantially 'C' shaped in transverse cross section, when viewed along the longitudinal axis of the elongate strap guide 21. The elongate bore 97 comprises one or more arcuate surfaces configured to engage one or more arcuate surfaces of the guide rail 27 of the elongate strap guide 21. The bore 97 may comprise an outwardly flared lead-in portion, such as a chamfered or arcuate portion, configured to receive the elongate strap guide 21.

[0343] The elongate strap guide 21 comprises a longitudinal guide axis, the elongate bore 97 comprising a longitudinal bore axis, the guide axis and bore axis being substantially parallel, when the elongate strap guide 21 is received in the elongate bore 97.

[0344] The elongate bore 97, may in transverse cross section, be any one of:

- a) substantially circular;
- b) substantially elliptical;
- c) substantially quadrilateral;
- d) substantially triangular;
- e) substantially 'D' shaped.

[0345] The frame 5 may be provided with a strap retainer comprising a notch, recess or other formation configured to engage the carriage 32 when in the engaged condition,

to resist movement of the carriage 32. The cord 93 may be directly attached to the retainer. The retainer may be located at a lower corner of the frame.

[0346] With reference to Figures 23 to 26 a mask assembly 101 is provided comprising similar features to mask assembly 81 described above with reference to Figures 20 to 22.

[0347] In mask assembly 101, guide rail 27 of elongate strap guide 21 comprises an inner rail component 103 in the form of an elongate element being a tube or rod or filament 103, the inner rail component 103 being located in a fabric sleeve 83. The inner rail component 103 is relatively more rigid than the sleeve 83. Sleeve 83 defines an elongate pocket 85 that receives the flexible tube or rod or filament 103, and an elongate flange 87 whose upper margin is secured to the lower margin of the upper side strap 19. The elongate strap guide 21 thus comprises a relatively rigid inner guide rail component 103 that is located inside a relatively flexible outer sleeve component 83.

[0348] The rearward portions of the inner rail component 103 and sleeve 83, extend through a loop 105, which forms a clamp that clamps the inner rail component 103 and sleeve 83 together, the loop 105 depending from the rearward end 19C of the upper side strap 19. The loop 105 acts as an end-stop to prevent the carriage 32 from sliding of the rearward portion 21C of the elongate strap guide 21. Alternatively, the inner rail component 103 may extend along an entire length of the upper side strap 19. The rear end of the inner rail component 103 may pass through loop 50, and then loop back onto itself. This enables the length of the inner rail component 103 and thus the elongate strap guide 21 to be adjusted at the same time as the length of the upper side strap 19.

[0349] Again, with reference to Figures 52 to 57, the carriage 32 may comprise an elongate through bore 97 that receives the guide rail 27, each end of the bore 97 being radially outwardly flared/chamfered 98 to improve how smoothly the carriage 32 slides along the guide rail 27. The intermediate portion of the bore 97 is therefore of narrower diameter or cross-section than the opposed ends of the bore 97.

[0350] The forward portion 21A of the elongate strap guide 21 is connected to the frame 5, and in particular to a lower portion towards the side and rear of the frame 5, via a connector 107 provided on the frame 5.

[0351] With reference to Figures 55 to 57, connector 107 comprises a post 109 that projects generally upwardly away from the frame 5. The lower end 111 of the post 109 is connected to the frame 5, with the distal, upper end 113 of the post 109 spaced from a lateral side/edge of the frame 5.

[0352] The lower end 111 of the post 109 may be integral with the frame 5, or the post 109 may be a separate component that is connected to the frame 5 using adhesive or the like. The lower end 111 of the post 109 may extend from an elongate support 110 that extends laterally and rearwardly outwardly from the side of the frame 5.

[0353] The upper end 113 of the post 109 comprises a tip 115 configured to connect with the forward end of the flexible tube or rod 103. The tip 115 is inclined so as to project away from the post 109 such that the longitudinal axis of the tip 115 extends rearwardly, and is substantially parallel to the longitudinal axis of the upper side strap 19.

[0354] The flexible tube or rod 103 may be hollow so as to define a female forward end that receives the male tip 115. Alternatively, the tip 115 may be hollow so as to define a female end that receives the male forward end of the flexible tube or rod 103. The tip 115 and forward end of the flexible tube or rod 103 may be connected via a friction or interference fit, and/or an adhesive or welding may be used to make the connection

[0355] The post 109 may be a larger diameter than the diameter of the tip 115. During connection of the flexible tube or rod 103 onto the tip 115, the larger diameter portion of the post abuts the end of the flexible tube or rod 103 to limit the extent of insertion of the tip 115 into the flexible tube or rod 103. The tip 115 may be of tapering diameter towards its distal end.

[0356] The post 109 may comprise a strap retainer comprising a notch 117 formed by a narrower diameter or recessed portion of the post 109, configured to receive and retain the carriage 32 when in the engaged condition. The notch 117 and carriage 32 may be configured to snap-fit together when on the engaged condition, providing a tactile click to the user to indicate when the carriage 32 is in the engaged condition.

[0357] The post 109 may comprise an enlarged portion 121 part way along its length. The enlarged portion 121 is provided at the transition between the tip 115 and the remainder of the post 109 or notch 117. The enlarged portion 121 may be spherical. The enlarged portion 121 functions to help retain the carriage 32 in the engaged condition, once the carriage 32 has moved over the enlarged portion 121 and onto the remainder of the post 115. The enlarged portion 121 may form an upper limit or end of the notch 117. The enlarged portion 121 resists unintentional upwards movement of the carriage 32, such that a user has to apply an upwards force to move the carriage over/past the larger diameter portion 125. The width of the enlarged portion 121 is

substantially equal to the bore 97 of the carriage 32, such that the enlarged portion 121 engages the bore 97, as the carriage 32 is moved along the post 115.

[0358] The shaft of the post 109, adjacent the enlarged portion 121 may comprise a constant diameter portion 123, leading to a larger diameter base portion 125 adjacent the lower end 111 of the post 109. The larger diameter base portion 125 may be flared radially outwardly from the constant diameter portion 123, for example via a chamfer, to provide an end stop for the carriage 32. The larger diameter base portion 125 may be conical when viewed from the side. A lower end of the bore 97 of the carriage 32 may comprise a similarly flared portion 127 configured to abut the larger diameter base portion 125 of the post 109, when in the engaged condition. This enables the post 109 to support and stabilise the carriage 32 when in the engaged condition.

[0359] The body of the carriage 32 may comprise a substantially planar inner surface 131, that in use may be in contact with the user's face. The planar surface 131 improves the user's comfort by reducing any pressure concentration on the user's cheek/jaw.

[0360] The bore 97 of the carriage 32 comprises a through slot 133 in communication with the through bore 97 configured to receive the lower part of flange 87 of fabric sleeve 83. The portions of the carriage 32 adjacent the slot 133 comprise a pair of opposed projections 135 which rest on, and slide along, the flexible tube or rod 103.

[0361] The bore 97 of carriage 32 may be substantially circular in transverse cross section as viewed along the axis of the bore 97 with reference to Figure 56.

[0362] The bore 97 of carriage 32 may comprise a planar portion 137 in transverse cross section as viewed along the axis of the bore 97 with reference to Figure 56, the planar portion 137 being adjacent the planar surface 131. The bore 97 of the carriage 32 may be substantially 'D' shaped in transverse cross section. The planar surface 131 and the planar portion 137 may to some extent function as an anti-rotation feature to resist relative rotation between the carriage 31 and the guide rail 27.

[0363] The strap connector 33 for connecting the side strap 17 to the carriage 32 extends from the rear of the carriage 32. Strap connector 33 is in the form of a length adjuster comprising post 35 and aperture 37 through which the forward end of the lower side strap 17 extends before looping back on itself. This serves to enable the length of the lower side strap 17 to be adjusted, by pulling more of the forward portion 17A of the lower side strap 17 through the aperture 37.

[0364] With reference to Figures 53 to 57, the carriage 32 comprises a forwardly projecting, elongate finger tab 138, that projects away from the body of the carriage 32 along the longitudinal axis of the carriage 32. The longitudinal axis of the finger tab 138 is perpendicular to the longitudinal axis of the bore 97. The finger tab 138 is on an opposite part of the carriage 32 to the strap connector 33, and projects forwardly when the carriage 32 is in the engaged condition. The finger tab 138 may function as an anti-rotation feature by engaging with the flange 87 of the fabric sleeve 83 of the elongate strap guide 21.

[0365] The finger tab 138 allows the user to, more easily, push the carriage 32 away from the engaged condition, over the larger diameter portion 125 of post 109. The finger tab 138 may be sufficiently long to be gripped between a user's fingers.

[0366] The longitudinal axis of the finger tab 138 is aligned with a plane occupied by the flange 87 of fabric sleeve 83, and is perpendicular to the longitudinal axis of the flexible tube or rod 103. This assists in alleviating rotation of the carriage 32 relative to the elongate strap guide 21, when force is applied by the user to the tab 137, to move the carriage 32 from the engaged to the disengaged conditions.

[0367] Alternatively, the finger tab 138 may project from the carriage 32 in a different direction. For example, the finger tab 138 may project radially outwardly, in a direction perpendicular to the plane that the flange 87 occupies.

[0368] With reference to Figures 61 to 64, alternative elongate strap guides 21 are disclosed, for example, for use with the mask assembly 1 of Figures 1 to 10.

[0369] In Figures 61 and 63, the elongate strap guide 21 comprises an elongate element that forms the guide rail 27, and which is mounted on the upper side strap 19 via mounting protrusions 24 in the form of mushroom connectors as described above with reference to Figure 59. In this example three mounting protrusions 24 are provided, one at the rearward portion 21C of the elongate strap guide 21, and the other two adjacent the arcuate portion 23 or forward portion 21A of the elongate strap guide 21.

[0370] The intermediate and rear portions 19B, 19C of the upper side strap 19 are substantially straight and of uniform width. The intermediate portion 19B is of greater width than the remainder of the side strap 19 and leads to a narrower forward portion 19A. In particular, when viewed from the side, the increased width extends from the lower margin of the forward portion 19A of the upper side strap 19 towards the intermediate portion. The guide rail 27 is configured to extend along the increased

width forward portion, adjacent that lower margin of the forward portion 19A. This configuration provides an increased surface area of the upper side strap that does not overlap with the elongate strap guide 21, and to which the looped back rearward end 19C of the upper side strap 19 can be fastened to adjust the length of the upper side strap 19. This configuration enables a greater range of length adjustment because more of the upper side strap 19 is clear from the elongate strap guide 21.

[0371] With reference to Figures 62 and 64, the upper side strap 19 comprises a substantially uniform width along its entire length.

[0372] With continuing reference to Figures 63 and 64, and also to Figures 65 and 66, the mask assembly 1 is provided with guide connectors 100 configured to connect each elongate strap guide 21 to the mask 3, for example to the mask frame 5, noting that alternatively the elongate strap guides 21 could alternatively be connected to the cushion support 9.

[0373] The guide connectors 100 comprise an aperture or recess 102 at the forward end 21A of the elongate strap guide 21 that is configured to receive an elongate protrusion such as a post or a corresponding lug 104 that projects outwardly from the outer surface of the mask frame 5. The lug 104 extends substantially perpendicularly away from an outer surface of the mask frame 5. The lug 104 extends substantially perpendicularly away from the longitudinal axis of the elongate strap guide 21, when the strap guide is connected to the mask frame 5. Each lug 104 may be received in a respective recess 102 with a friction fit for example. Alternatively, the lugs 104 and recesses 102 could be connected together via adhesive, or via a snap-fit type engagement. It is envisaged that the recesses 102 could be provided on the mask frame 5 or cushion support 9, and the lugs 104 on the elongate strap guides 21. Recess 102 may be integral with the elongate strap guide 21, or could be a separate component secured thereto. Recess 102 is formed by a wall that protrudes from an inner surface of the elongate strap guide 21.

[0374] The guide connectors 100, and in particular, the recesses 102 are positioned at the forward end portion 19A of the upper side strap 19, forward of the forward end portion 27A of the guide rail 27. The recesses 102 extend upwardly from the forward end portion 27A of the guide rail 27, and project through a corresponding cutout in the upper side strap 19. This spaces the guide rail 27 away from the guide connector 100 so that movement of the carriage 32 is not inhibited by the guide connector 100, while minimising bulk. As with earlier elongate strap guides 21, the guide rail 27 may be

provided with one or more retention features 30, for example at the rearward end portion 27C with reference to figures 61 and 62.

[0375] Each recess 102 is elongate with its longitudinal axis extending generally upwardly. Each lug 104 is also elongate and extends generally upwardly. The engagement between the recesses 102 and lugs 104 is such that relative rotation between the mask frame 5 and elongate strap guides 21 is resisted. In other words, the relative angular position between the mask frame and elongate strap guides 21, when viewed from the side, is substantially fixed.

[0376] Each guide connector 100 may be located intermediate the forward pair of mounting protrusions 24. Each recess 102 may be integrally formed with a respective elongate strap guide 21.

[0377] The upper side strap 19 and the elongate strap guide 21 extend rearwardly from the mask 3. The elongate strap guide 21 is, or comprises part of, a laterally extending arm which may be integral with the frame 5 or the cushion support 9 of the mask 3, with the upper side strap 19 secured to the elongate strap guide 21 as described above.

[0378] Alternatively, the elongate strap guide 21 may be a separate component that is mounted on the frame 5 or cushion support 9, for example via a guide connector 100 as described above.

[0379] The recesses 102 and lugs 104 may provide a permanent connection between the elongate strap guide 21 and the mask frame 5, or may provide a releasable connection such that the elongate strap guides 21 can be repeatedly connected and disconnected from the mask frame 5.

[0380] This connection arrangement allows the entire headgear 15 to be removed from the mask 5 without losing adjustment settings of the straps of the headgear 15.

[0381] Certain terminology may be used in the description for the purpose of reference only, and thus are not intended to be limiting. For example, terms such as “above” and “below” refer to directions in the drawings to which reference is made. Terms such as “front,” “back,” “left,” “right,” “rear,” and “side” describe the orientation and/or location of portions of the components or elements within a consistent but arbitrary frame of reference which is made clear by reference to the text and the associated drawings describing the components or elements under discussion. For example, as the context may dictate, the terms “front” and/or forward can be used relative to components described herein positioned relatively or entirely distal to the

user's face when the mask assembly as described herein is worn by the user. As the context may dictate, the terms "rear" and/or "back" can be used relative to components described herein positioned relatively or entirely proximal to the user's face and/or components that are forward or at the front of the mask assembly when the mask assembly as described herein is worn by the user. Moreover, terms such as "first," "second," "third," and so on may be used to describe separate components. Such terminology may include the words specifically mentioned above, derivatives thereof, and words of similar import.

[0382] 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". Conditional language used herein, such as, among others, "can," "could," "might," "may," "e.g.," and the like, unless specifically stated otherwise, or otherwise understood within the context as used, is generally intended to convey that certain embodiments include, while other embodiments do not include, certain features, elements and/or states. Thus, such conditional language is not generally intended to imply that features, elements and/or states are in any way required for one or more embodiments or that one or more embodiments necessarily include logic for deciding, with or without author input or prompting, whether these features, elements and/or states are included or are to be performed in any particular embodiment.

[0383] The term "plurality" refers to two or more of an item. Recitations of quantities, dimensions, sizes, formulations, parameters, shapes and other characteristics should be construed as if the term "about" or "approximately" precedes the quantity, dimension, size, formulation, parameter, shape or other characteristic. The terms "about" or "approximately" mean that quantities, dimensions, sizes, formulations, parameters, shapes and other characteristics need not be exact, but may be approximated and/or larger or smaller, as desired, reflecting acceptable tolerances, conversion factors, rounding off, measurement error and the like and other factors known to those of skill in the art. Recitations of quantities, dimensions, sizes, formulations, parameters, shapes and other characteristics should also be construed as if the term "substantially" precedes the quantity, dimension, size, formulation, parameter, shape or other characteristic. The terms "approximately," "about," and "substantially" as used herein represent an amount close to the stated amount that still performs a

desired function or achieves a desired result. For example, in some embodiments, as the context may dictate, the terms “approximately”, “about”, and “substantially” may refer to an amount that is within less than or equal to 10% of the stated amount. The term “generally” as used herein represents a value, amount, or characteristic that predominantly includes, or tends toward, a particular value, amount, or characteristic. For example, as the context may dictate, the term “generally linear” can mean something that departs from exactly parallel by less than or equal to 15°.

[0384] Numerical data may be expressed or presented herein in a range format. It is to be understood that such a range format is used merely for convenience and brevity and thus should be interpreted flexibly to include not only the numerical values explicitly recited as the limits of the range, but also interpreted to include all of the individual numerical values or sub-ranges encompassed within that range as if each numerical value and sub-range is explicitly recited. As an illustration, a numerical range of “1 to 5” should be interpreted to include not only the explicitly recited values of about 1 to about 5, but should also be interpreted to also include individual values and sub-ranges within the indicated range. Thus, included in this numerical range are individual values such as 2, 3 and 4 and sub-ranges such as “1 to 3,” “2 to 4” and “3 to 5,” etc. This same principle applies to ranges reciting only one numerical value (e.g., “greater than 1”) and should apply regardless of the breadth of the range or the characteristics being described.

[0385] Any dimensions included in this disclosure are example dimensions of one or more components of a mask assembly in accordance with this disclosure, and are in mm.

[0386] A plurality of items may be presented in a common list for convenience. However, these lists should be construed as though each member of the list is individually identified as a separate and unique member. Thus, no individual member of such list should be construed as a de facto equivalent of any other member of the same list solely based on their presentation in a common group without indications to the contrary. Furthermore, where the terms “and” and “or” are used in conjunction with a list of items, they are to be interpreted broadly, in that any one or more of the listed items may be used alone or in combination with other listed items. The term “alternatively” refers to selection of one of two or more alternatives, and is not intended to limit the selection to only those listed alternatives or to only one of the listed alternatives at a time, unless the context clearly indicates otherwise.

[0387] Reference to any prior art in this specification is not, and should not be taken as, an acknowledgement or any form of suggestion that that prior art forms part of the common general knowledge in the field of endeavour in any country in the world.

[0388] The disclosure may also be said broadly to consist in the parts, elements and features referred to or indicated in the specification of the application, individually or collectively, in any or all combinations of two or more of said parts, elements or features.

[0389] Where, in the foregoing description reference has been made to integers or components having known equivalents thereof, those integers are herein incorporated as if individually set forth.

[0390] It should be noted that various changes and modifications to the presently preferred embodiments described herein will be apparent to those skilled in the art. Such changes and modifications may be made without departing from the spirit and scope of the disclosure and without diminishing its attendant advantages. For instance, various components may be repositioned as desired. It is therefore intended that such changes and modifications be included within the scope of the disclosure. Moreover, not all of the features, aspects and advantages are necessarily required to practice the present disclosure. Accordingly, the scope of the present disclosure is intended to be defined only by the claims that follow.

WHAT IS CLAIMED IS:

1. Headgear for mounting a mask on the head of a user, the headgear comprising:

a headgear strap comprising a forward portion; and

an elongate strap guide comprising a forward portion configured to be mounted on the mask, and a rearward portion configured to be distal from the mask;

wherein the forward portion of the headgear strap is coupled to the elongate strap guide so that the forward portion of the headgear strap is movable along the elongate strap guide between the forward and rearward portions of the elongate strap guide.
2. The headgear of claim 1 wherein the headgear is configured to be connected to the mask to form a continuous loop, the headgear strap being coupled to the elongate strap guide such that the length of the continuous loop can be increased without adjusting a length of the headgear strap, to doff the mask.
3. The headgear of claim 1 wherein the elongate strap guide comprises part of a connection structure configured to connect the headgear strap to the mask, the forward portion of the headgear strap being coupled to the elongate strap guide at a connection point of the connection structure, the connection structure being configured such that the connection point is movable towards and away from the mask.
4. The headgear of claim 1 wherein the headgear strap is configured to be movable between a donned position in which the at least one headgear strap is under tension, and doffing position in which the tension in the headgear strap is reduced, the headgear strap remaining coupled to the elongate strap guide when moving between the donned and doffing positions.
5. The headgear of claim 1 wherein the headgear strap is movable towards and away from the mask along the elongate strap guide, whilst remaining coupled to the elongate strap guide, and whilst the length of the headgear strap remains constant.
6. The headgear of claim 1 wherein the headgear strap is movably coupled to the elongate strap guide for movement along the elongate strap guide from a donned position proximal the mask, to a doffing position distal the mask.

7. The headgear of any one of claims 1 to 6 wherein the elongate strap guide is sufficiently rigid to be self supporting.
8. The headgear of any one of claims 1 to 6 wherein the elongate strap guide is flexible or includes a flexible portion.
9. The headgear of any one of the preceding claims wherein the elongate strap guide is shorter than the headgear strap.
10. The headgear of any one of the preceding claims wherein the elongate strap guide is straight or comprises at least one straight portion.
11. The headgear of any one of the preceding claims wherein the elongate strap guide is arcuate or comprises at least one arcuate portion.
12. The headgear of any one of the preceding claims wherein a portion of the elongate strap guide is substantially parallel with the headgear strap, when the forward portion of the headgear strap is positioned at the forward portion of the elongate strap guide.
13. The headgear of any one of claims 1 to 11 wherein the elongate strap guide is inclined relative to the headgear strap, when the forward portion of the headgear strap is positioned at the forward portion of the elongate strap guide.
14. The headgear of any one of the preceding claims wherein the elongate strap guide comprises an elongate guide rail, the forward portion of the headgear strap being movable along the guide rail.
15. The headgear of claim 14 wherein the guide rail is substantially 'T' shaped in transverse cross section.
16. The headgear of claim 14 wherein the guide rail is substantially circular or elliptical in transverse cross section.
17. The headgear of any one of claims 14 to 16 wherein the elongate guide rail forms one margin of an elongate guide channel of the elongate strap guide.

18. The headgear of any one of the preceding claims wherein the forward portion of the headgear strap is directly coupled to the elongate strap guide, such that the material of the headgear strap contacts and engages the elongate strap guide.
19. The headgear of any one of claims 14 to 17 comprising a carriage that is movably coupled to the elongate guide rail, the forward portion of the headgear strap being coupled to the carriage.
20. The headgear of claim 19 wherein the carriage and/or the elongate guide rail comprise at least one anti-rotation feature configured to resist relative rotation of the carriage relative to the elongate guide rail.
21. The headgear of claim 20 wherein the anti-rotation feature comprises an elongate finger tab on the carriage configured to engage the elongate guide rail.
22. The headgear of any one of claims 19 to 21 wherein the carriage comprises a strap connector configured to couple the forward portion of the headgear strap to the carriage.
23. The headgear of claim 22 wherein the strap connector comprises a post around which the forward portion of the headgear strap extends to couple the headgear strap to the carriage.
24. The headgear of claim 22 wherein the strap connector comprises an aperture or a loop through which the forward portion of the headgear strap extends to couple the headgear strap to the carriage.
25. The headgear of any one of claims 19 to 24 wherein the carriage comprises a guide mount configured to couple the carriage on the elongate guide rail.
26. The headgear of claim 25 wherein the guide mount is configured to removably couple the carriage on the elongate guide rail.
27. The headgear of claims 25 or 26 wherein the guide mount comprises a protrusion configured to be at least partially received in a corresponding recess or channel of the elongate guide rail.

28. The headgear of any one of claims 25 to 26 wherein the guide mount comprises a hook configured to receive part of the elongate guide rail and to be movable along the elongate guide rail.
29. The headgear of any one of claims 25 to 26 wherein the guide mount comprises a loop through which the elongate guide rail extends to couple the carriage to the elongate guide rail.
30. The headgear of any one of claims 25 to 26 wherein the guide mount comprises an elongate bore extending through a portion of the carriage, the elongate bore being configured to receive the elongate guide rail.
31. The headgear of claim 30 wherein the elongate strap guide comprises a longitudinal guide axis, the elongate bore comprising a longitudinal bore axis, the guide axis and bore axis being substantially parallel, when the elongate guide rail is received in the elongate bore.
32. The headgear of claim 30 or 31 wherein the elongate bore is not fully closed in transverse cross section, the elongate bore not fully extending around the periphery of the elongate guide rail, when viewed along the longitudinal guide axis of the elongate guide rail.
33. The headgear of claim 32 wherein the elongate bore is substantially 'C' shaped in transverse cross section, when viewed along the longitudinal guide axis of the elongate guide rail.
34. The headgear of 30 or 31 wherein the elongate bore is fully closed in transverse cross section, the elongate bore fully extending around the periphery of the elongate guide rail, when viewed along the longitudinal guide axis of the elongate guide rail.
35. The headgear of any one of claims 30 to 34 wherein the elongate bore, in transverse cross section, is any one of:
- a. substantially circular;
 - b. substantially elliptical;
 - c. substantially quadrilateral;
 - d. substantially triangular;

e. substantially 'D' shaped.

36. The headgear of any one of claims 30 to 35 wherein the elongate bore comprises an arcuate surface configured to engage an arcuate surface of the elongate guide rail.

37. The headgear of any one of claims 30 to 36 wherein the elongate bore comprises an outwardly flared lead-in portion configured to receive the elongate guide rail, when the carriage is coupled to the elongate guide.

38. The headgear of claim 37 wherein the outwardly flared lead-in portion comprises a chamfered portion.

39. The headgear of any one of claims 30 to 38 wherein the shape of the elongate bore varies along its length.

40. The headgear of claim 39 wherein the elongate bore comprises opposed ends, a relatively smaller bore portion being defined between the opposed ends.

41. The headgear of any one of the preceding claims wherein the elongate strap guide comprises a strap retainer configured to releasably retain the forward portion of the headgear strap:

- a. such that the forward portion of the headgear strap is retained in a desired position on the elongate strap guide; and/or
- b. such that movement of the forward portion of the headgear strap away from a desired position on the elongate strap guide is resisted.

42. The headgear of claim 41 wherein the strap retainer is positioned at the forward portion of the elongate strap guide, and is configured to retain the forward portion of the headgear strap at the forward portion of the elongate strap guide.

43. The headgear of claim 41 or 42 wherein the elongate strap guide comprises a plurality of strap retainers.

44. The headgear of claim 43 wherein the plurality of strap retainers are spaced apart along the elongate strap guide, each strap retainer configured to retain the forward portion of the headgear strap at different positions along the length of the elongate strap guide.

45. The headgear of claim 44 comprising a pair of strap retainers, one strap retainer being at a forward portion of the elongate strap guide, and one strap retainer being at a rearward portion of the elongate strap guide.

46. The headgear of any one of claims 41 to 45 wherein the strap retainer comprises a recess of the elongate strap guide, the forward portion of the headgear strap and/or a carriage to which the forward portion of the headgear strap is coupled, being movable into the recess.

47. The headgear of any one of claims 41 to 46 wherein the strap retainer comprises a protrusion of the elongate strap guide, the forward portion of the headgear strap and/or a carriage to which the forward portion of the headgear strap is coupled, being movable into engagement with the protrusion.

48. The headgear of any one of claims 41 to 47 wherein the strap retainer frictionally engages the headgear strap and/or a carriage to which the forward portion of the headgear strap is coupled.

49. The headgear of any one of claims 41 to 47 wherein the strap retainer engages the headgear strap and/or a carriage to which the forward portion of the headgear strap is coupled, with a snap fit.

50. The headgear of any one of claims 41 to 49 wherein the strap retainer comprises an over-centre arrangement, configured such that a force must be applied by the user to move the headgear strap away from the forward portion of the elongate strap guide, and such that tension in the headgear strap can subsequently be reduced as the headgear strap is moved towards the rearward portion of the elongate strap guide.

51. The headgear of claim 50 wherein the over-centre arrangement comprises an end portion of the elongate strap guide, the end portion extending in a different direction from a body portion of the elongate strap guide.

52. The headgear of claim 51 wherein the end portion of the elongate strap guide is arcuate.

53. The headgear of claim 52 wherein the arcuate portion curves through an arc of more than 45° from an adjacent portion of the elongate strap guide; optionally between

80° and 105°, optionally through between 90° and 100°, and optionally through about 95°.

54. The headgear of any one of claims 41 to 53 wherein the strap retainer comprises a post; the headgear strap and/or a carriage to which the forward portion of the headgear strap is coupled, engaging the post.

55. The headgear of claim 54 wherein the post is substantially straight, or comprises a straight portion.

56. The headgear of claim 54 wherein the post is arcuate, or comprises an arcuate portion.

57. The headgear of any one of the preceding claims wherein the forward portion of the elongate strap guide extends in a different direction from the rearward portion of the elongate strap guide.

58. The headgear of claim 57 wherein the forward and rearward portions of the elongate strap guide are inclined relative to one another.

59. The headgear of claim 58 wherein the forward and rearward portions of the elongate strap guide are inclined relative to one another by at least 45°.

60. The headgear of any one of the preceding claims wherein the forward and rearward portions of the elongate strap guide are joined by an intermediate portion,.

61. The headgear of claim 60 wherein the intermediate portion is substantially straight.

62. The headgear of any one of claims 57 to 61 wherein the forward portion is arcuate.

63. The headgear of claim 62 wherein the forward portion extends initially forwardly and upwardly away from a lower end of the forward portion, and then curves rearwardly into the intermediate portion.

64. The headgear of any one of the preceding claims wherein the elongate strap guide and/or the mask comprises a guide connector configured to connect the elongate strap guide to the mask.

65. The headgear of claim 64 wherein the guide connector is configured to removably connect the elongate strap guide to the mask.
66. The headgear of claim 64 or 65 wherein the guide connector is configured to connect the forward portion of the elongate strap guide to the mask.
67. The headgear of any one of claims 64 to 66 wherein the guide connector comprises a mounting protrusion on one of the elongate strap guide and the mask, and an aperture or recess on the other of the elongate strap guide and the mask, the mounting protrusion being received in the aperture or recess to connect the elongate strap guide to the mask.
68. The headgear of claim 67 wherein the mounting protrusion extends away from the longitudinal axis of the elongate strap guide.
69. The headgear of claim 68 wherein the mounting protrusion extends in a direction perpendicular to the longitudinal axis of the elongate strap guide.
70. The headgear of any one of claims 64 to 69 wherein the guide connector is integral with the elongate strap guide.
71. The headgear of any one of claims 64 to 69 wherein the guide connector comprises a portion which is configured to be connected to the mask by any one or more of:
- a. adhesive;
 - b. welding;
 - c. hook and loop fastener;
 - d. an interference or friction fit;
 - e. a snap fit.
72. The headgear of any one of claims 64 to 71 wherein the guide connector comprises any one of:
- a. A post configured to be received in an aperture or recess on the mask.
 - b. An aperture or recess configured to receive a post on the mask.
73. The headgear of any one of the preceding claims wherein the rearward portion of the elongate strap guide is mounted on the headgear.

74. The headgear of claim 73 wherein the remainder of the elongate strap guide is not mounted on the headgear.

75. The headgear of any one of the preceding claims comprising a pair of side straps, being a first side strap extending along one side of the user's face, and a second side strap extending along the other side of the user's face.

76. The headgear of claim 75 wherein the headgear strap is one of the pair of side straps.

77. The headgear of claim 75 or claim 76 comprising a pair of elongate strap guides, the forward portion of each side strap being coupled to a respective elongate strap guide.

78. The headgear of any one of claims 75 to 77 comprising two pairs of side straps being a lower pair of side straps extending below the user's ears, and an upper pair of side straps extending above the user's ears.

79. The headgear of claim 78 comprising a pair of elongate strap guides, each elongate strap guide being mounted on a respective side strap of one of the lower or upper pairs of side straps.

80. The headgear of any one of claims 75 to 79 wherein each elongate strap guide is mounted to a respective side strap of the upper pair of side straps.

81. The headgear of any one of the preceding claims comprising a crown strap.

82. The headgear of any one of the preceding claims comprising a rear strap.

83. The headgear of any one of the preceding claims comprises a rear panel.

84. The headgear of claim 1 wherein the elongate strap guide, or at least a portion thereof, is:

- a. Resiliently deformable; or
- b. Elastically deformable.

85. The headgear of claim 1 wherein the elongate strap guide is substantially rigid, at least in a direction along the longitudinal axis of the elongate strap guide.

86. The headgear of claim 1 wherein the elongate strap guide is flexible in a direction away from the longitudinal axis of the elongate strap guide.
87. The headgear of any one of the preceding claims wherein the elongate strap guide comprises a rigid inner guide rail located inside a flexible outer sleeve.
88. The headgear of claim 87 wherein the outer sleeve is formed from a textile material.
89. The headgear of any one of claims 75 to 88 wherein at least a portion of the elongate strap guide extends along and overlaps with a side strap of the headgear.
90. The headgear of claim 89 wherein the side strap is located above the headgear strap that is coupled to the elongate strap guide.
91. The headgear of claim 90 wherein the elongate strap guide overlaps the side strap along substantially the length of the elongate strap guide.
92. The headgear of any one of claims 1 to 90 wherein the elongate strap guide extends adjacent along, and is spaced from, a side strap of the headgear.
93. The headgear of any one of the preceding claims wherein a longitudinal axis of the elongate strap guide is substantially parallel with a longitudinal axis of a side strap of the headgear.
94. The headgear of any one of the preceding claims wherein the elongate strap guide comprises an elongate mounting flange extending along the elongate strap guide, and configured to mount the elongate strap guide to the headgear.
95. The headgear of claim 94 wherein the elongate mounting flange is flexible, and optionally is made of a textile material.
96. The headgear of claim 94 or 95 wherein the elongate strap guide comprises a guide rail depending from the elongate mounting flange.
97. The headgear of any one of the preceding claims wherein the elongate strap guide is mounted to the headgear by any one or more of:
- a. Adhesive.
 - b. Welding.

- c. Stitching.
- d. Overmoulding.
- e. Hook and loop fasteners.
- f. Press fit, snap fit, or barbed connectors.
- g. A hook or loop from which the elongate strap guide depends, the hook or loop receiving part of the headgear.

98. The headgear of any one of the preceding claims wherein a portion of the elongate strap guide is received in a pocket on the headgear, to mount the elongate strap guide to the headgear.

99. The headgear of any one of the preceding claims comprising a finger grip configured to be gripped by a user to move the headgear strap along the elongate strap guide.

100. The headgear of any one of the preceding claims comprising a length adjuster configured to adjust the length of one or more portions of the headgear.

101. The headgear of claim 100 wherein the length adjuster is configured to adjust the length of the headgear strap that is coupled to the elongate strap guide.

102. The headgear of claim 101 wherein the length adjuster is adjacent the mask, such that the length of the headgear strap is adjusted at the forward portion of the headgear side strap.

103. The headgear of claim 103 wherein the length adjuster is distal the mask, such that the length of the headgear strap is adjusted at the rearward end of the headgear strap.

104. The headgear of any one of claims 100 to 103 wherein the length adjuster comprises a buckle, post, loop or hook, around or through which the headgear strap passes, the headgear strap comprising a free end configured to be gripped by a user and pulled on to pull the headgear strap through the buckle, post, loop or hook, to adjust the length of the headgear strap.

105. The headgear of any one of claims 100 to 104 wherein the headgear strap and/or the length adjuster comprises a fastener configured, when fastened, to fix the length of the headgear strap once adjusted.

106. The headgear of claim 105 wherein the fastener comprises any one or more of:
- a. Hook and loop fastener; and/or
 - b. One or more pins configured to be received in one or more apertures.
107. A mask assembly comprising:
- a. the headgear of any one of the preceding claims; and
 - b. a mask.
108. The mask assembly of claim 107 wherein the mask comprises a cushion assembly comprising a flexible seal and a cushion support.
109. The mask assembly of claim 108 wherein the cushion support is more rigid than the flexible seal.
110. The mask assembly of any one of claims 107 to 109 wherein the mask comprises a frame, the cushion assembly being mounted on the frame.
111. The mask assembly of any one of claims 107 to 110 wherein the elongate strap guide is connected to the mask.
112. The mask assembly of claim 111 wherein the elongate strap guide is connected to the frame.
113. The mask assembly of any one of claims 107 to 109 wherein the elongate strap guide is connected to the cushion assembly.
114. The mask assembly of any one of claims 107 to 113 wherein the elongate strap guide is integral with the mask.
115. The mask assembly of any one of claims 107 to 114 comprising a laterally extending arm extending away from the mask, wherein the elongate strap guide is mounted on, or comprises an integral part of, the laterally extending arm.
116. The mask assembly of any one of claims 107 to 115 comprising a guide connector configured to mount the elongate strap guide on the mask.
117. The mask assembly of claim 116 wherein the guide connector comprises a post which projects away from the mask, the elongate strap guide engaging the post.

118. The mask assembly of claim 117 wherein the post comprises a male portion configured to be received in a female portion of the elongate strap guide.

119. The mask assembly of claim 117 wherein the post comprises a female portion configured to receive a male portion of the elongate strap guide.

120. The mask assembly of any one of claims 117 to 119 wherein the post comprises a conical portion when viewed in transverse cross section, the conical portion providing a seat against which the forward portion of the headgear strap rests when mounted on the post.

121. The mask assembly of any one of claims 117 to 120 wherein the post is substantially straight, or comprises a substantially straight portion.

122. The mask assembly of any one of claims 117 to 121 wherein the post is arcuate, or comprises an arcuate portion.

123. A mask assembly comprising:
a mask comprising a cushion configured to seal against the user's face, and
a headgear configured to be connected to the mask, the headgear comprising a plurality of headgear straps; wherein
the mask and plurality of straps form a continuous loop; and
at least one headgear strap of the plurality of headgear straps is movably coupled to the headgear or the mask such that the length of the continuous loop can be increased without adjusting a length of any of the headgear straps, to doff the mask.

124. The mask assembly of claim 124 wherein the at least one headgear strap is movably coupled to the mask for movement between engaged and disengaged conditions, such that the length of the continuous loop can be increased when the at least one headgear strap is at the disengaged condition.

125. The mask assembly of claim 125 wherein the at least one headgear strap is proximal the mask when in the engaged condition.

126. The mask assembly of claim 125 when the at least one headgear strap is distal the mask when in the disengaged condition.

127. The mask assembly of any one of claims 124 to 126 wherein the at least one headgear strap of the plurality of headgear straps is a side strap.

128. The mask assembly of any one of claims 124 to 127 comprising an elongate strap guide which extends away from the mask, the at least one headgear strap of the plurality of headgear straps is movably coupled to the elongate strap guide.

129. A mask assembly comprising:
a mask comprising a cushion configured to seal against a user's face;
headgear comprising a headgear strap; and
a connection structure configured to connect the headgear strap to the mask at a connection point of the connection structure, the connection structure being configured such that the connection point is movable towards and away from the mask.

130. The mask assembly of claim 129 wherein the connection structure comprises an elongate strap guide which extends away from the mask, the connection point being movable along the elongate strap guide.

131. The mask assembly of claim 130 wherein the connection structure comprises a carriage, the connection point being located at the carriage, the carriage being movable along the elongate strap guide.

132. The mask assembly of any one of claims 129 to 131 wherein movement of the connection point changes the tension in the headgear strap.

133. A mask assembly comprising:
a mask comprising a cushion configured to seal against the user's face; and
a headgear configured to be connected to the mask, the headgear comprising a headgear strap; wherein

the headgear strap is configured to be movable between a donned position in which the at least one headgear strap is under tension, and doffing position in which the tension in the headgear strap is reduced, the headgear strap remaining connected to the mask when moving between the donned and doffing positions; the headgear strap being connected to the mask at a first location when in the donned position, the headgear strap being connected to the mask at a second location when in the doffing position.

134. The mask assembly of claim 133 wherein the first location is proximal the mask, and the second location is distal the mask.

135. The mask assembly of claim 133 or claim 134 comprising an elongate strap guide which extends away from the mask, the headgear strap being movable along the elongate strap guide between the donned and doffing positions.

136. The mask assembly of any one of claims 133 to 135 wherein as the headgear strap is moved from the donned position to the doffing position, the tension in the headgear strap increases, before subsequently reducing.

137. The mask assembly of any one of claims 133 to 136 comprising a headgear strap retention feature configured to retain the headgear strap in the doffed position.

138. A mask assembly comprising:
a mask comprising a cushion configured to seal against the user's face; and
a headgear configured to be connected to the mask, the headgear comprising a headgear strap; wherein
the headgear strap is connected to the mask at a movable connection point;
wherein the movable connection point is movable towards and away from a donned position proximal the mask, whilst maintaining the connection of the headgear strap to the mask.

139. The mask assembly of claim 138 comprising an elongate strap guide which extends away from the mask, the movable connection point being movable along the elongate strap guide.

140. The mask assembly of claim 139 wherein the connection point is located at a carriage movable along the elongate strap guide.

141. The mask assembly of any one of claims 138 to 140 wherein the length of the headgear strap remains constant during movement towards and away from the donned position.

142. The mask assembly of any one of claims 138 to 141 comprising a strap length adjuster configured to enable the length of the headgear strap to be adjusted.

143. A mask assembly comprising:

a mask comprising a cushion;
headgear comprising a headgear strap; and
an elongate strap guide configured to connect the headgear to the mask, the headgear strap being movably coupled to the elongate strap guide; wherein
the headgear strap is movable towards and away from the mask along the elongate strap guide, whilst remaining coupled to the elongate strap guide, and whilst the length of the headgear strap remains constant.

144. The mask assembly of claim 143 wherein the elongate strap guide comprises an elongate guide rail.

145. The mask assembly of claim 144 wherein the elongate strap guide comprises a carriage movably mounted on the elongate guide rail, the headgear strap being coupled to the carriage.

146. The mask assembly of any one of claims 143 to 145 wherein the carriage comprises a strap length adjuster configured to enable the length of the headgear strap to be adjusted.

147. The mask assembly of claim 146 wherein the length adjuster comprises a post on the carriage around which the headgear strap is looped.

148. A mask assembly comprising:
a mask comprising a cushion;
headgear comprising a side strap; and
an elongate member extending away from the mask;
the side strap being movably coupled to the elongate member for movement along the elongate member from a donned position proximal the mask, to a doffing position distal the mask.

149. The mask assembly of claim 148 wherein the elongate member comprises a further strap of the headgear.

150. The mask assembly of claim 149 wherein the further strap is an upper side strap of the headgear, the side strap being a lower side strap of the headgear.

151. The mask assembly of claim 150 wherein the elongate member is integral with the mask.

152. The mask assembly of claim 151 wherein the elongate member is removably connected to the mask.

153. The mask assembly of any one of claims 148 to 152 wherein the elongate member is an elongate guide rail.

154. A mask assembly comprising:
a mask comprising a cushion;
headgear comprising an upper side strap and a lower side strap;
the lower side strap being movably coupled to the upper side strap for movement toward and away from the mask.

155. The mask assembly of claim 154 wherein the lower side strap is directly coupled to the upper side strap, that is, the lower side strap directly contacts the upper side strap.

156. The mask assembly of claim 155 wherein the lower side strap is indirectly coupled to the upper side strap, that is, with one or more intermediate components coupled to both the upper side strap and the lower side strap.

157. The mask assembly of claim 156 comprising an elongate rail, the lower side strap being coupled to the upper side strap using the elongate rail, wherein the one or more intermediate components comprises a carriage coupled to the elongate guide rail.

158. A mask assembly comprising:
a mask comprising a cushion;
headgear comprising a side strap; and
an elongate guide rail and a carriage; wherein
the elongate guide rail extends away from the mask, and the carriage is movably coupled to the guide rail for movement along the guide rail;
the side strap being length adjustably connected to the carriage such that the length of the side strap can be adjusted.

159. The mask assembly of claim 158 wherein the carriage comprises a strap length adjuster configured to enable the length of the side strap to be adjusted, the side strap being connected to the carriage using the strap length adjuster.

160. The mask assembly of claim 159 wherein the strap length adjuster comprises a post on the carriage around which the side strap is looped.

161. The mask assembly of claim 160 wherein the strap length adjuster comprises an aperture on the carriage through which the side strap extends.

162. The mask assembly of any one of claims 158 to 161 comprising a fastener configured to resist movement of the side strap relative to the carriage, once the length of the side strap has been adjusted.

163. A headgear connection system for connecting a headgear comprising one or more headgear straps to a mask, the headgear connection system comprising:
an elongate guide rail for connection between the headgear and the mask; and
a carriage movably coupled to the elongate guide rail; wherein
the carriage comprises a headgear strap connector configured to connect a headgear strap of the headgear to the carriage.

164. The headgear connection system of claim 163 comprising a guide mount configured to mount the elongate guide rail to the mask.

165. The headgear connection system of claim 164 wherein the guide mount is configured to removably mount the elongate guide rail to the mask.

166. The headgear connection system of any one of claims 163 to 166 wherein the headgear strap connector comprises a strap length adjuster configured to enable the length of the headgear strap to be adjusted, the headgear strap being connected to the carriage using the strap length adjuster.