[00224] A CPAP apparatus is a gases supply and optionally gases humidification apparatus. The apparatus is operable to provide respiratory assistance to patients or users who require a supply of gas (humidified or otherwise) at positive pressure for the treatment of diseases such as Obstructive Sleep Apnea (OSA), snoring, or Chronic Obstructive Pulmonary Disease (COPD) and the like. A CPAP apparatus would typically include a humidifier liquid chamber, so as to form a combined assisted breathing unit and humidifier.

[00225] CPAP apparatuses, when used with a humidifier, typically have a structure where gases at a required pressure are delivered from an assisted breathing unit or blower unit to a liquid chamber downstream from the blower. As the gases pass through the liquid chamber, they become saturated with liquid vapour (e.g. water vapour). A flexible tubular gases conduit delivers the gases to a user or patient downstream from the humidifier chamber.

[00226] A high flow apparatus may be used to deliver a high gas flow or high flow therapy to a patient to assist with breathing and/or treat breathing disorders including chronic obstructive pulmonary disease (COPD). A high flow apparatus includes a gases supply and typically includes a humidification apparatus.

[00227] The breathing assistance apparatuses typically have one or more accessories such as a breathing conduit and a patient interface such as a cannula or mask for delivering gases to a patient. The conduit enables gases to be delivered from the housing of the breathing assistance apparatus to the patient. For example, the apparatus may be placed on a floor or other support surface, and the patient may be in a bed. The breathing assistance apparatus may have a recess for receipt of a humidifier liquid chamber. The liquid chamber will receive liquid from, for example, a flexible liquid bag that delivers liquid to a humidifier liquid chamber via one or more tubes. Alternatively, the liquid chamber can be removed and refilled as required. The recess will contain a heater plate to heat the liquid chamber, to humidify gases passing through the liquid chamber. The humidified gases are then delivered to the patient.

[00228] In general terms, the apparatus 10 comprises a main housing 100 that contains a flow generator 11 in the form of a motor/impeller arrangement, a humidifier 12, a controller 13, and a user I/O interface 14 (comprising, for example, a display and input device(s) such as button(s), a touch screen, or the like). The controller 13 is configured or programmed to control the components of the apparatus, including: operating the flow generator 11 to create a flow of gas (gas

of seals 173, with the port 163 having a corresponding plurality of recesses 163b to accommodate each seal. Alternatively, in the configuration shown, the plurality of sealing elements 175 are incorporated into a single seal 173 that is located in a single recess 163b.

[00275] Having a plurality of sealing elements 175 on a single seal 173 is preferable to having a plurality of seals on the port 163, as it reduces the number of seals that need to be attached during manufacturing. Additionally, the increased width of the seal when providing a plurality of sealing elements 175 reduces the chance of the seal turning inside out during assembly onto the port 163.

[00276] Having a plurality of sealing elements 175 is beneficial in providing redundancy in the seal between the breathing assistance apparatus base unit 50 and the liquid chamber 151. This reduces the chance of a breathing gas leak and/or liquid moving into the base unit 50 occurring as it would require the seals provided by each of the sealing elements 175 to fail. Additionally, having one sealing element 175, i.e. a forward sealing element, closer to the terminal end 163a of the port 163 (compared to a single centrally-located sealing element) allows a seal to be formed between the liquid chamber 151 and the breathing assistance apparatus 10 even if the liquid chamber is not fully connected onto the port 163. Having a plurality of sealing elements 175 also helps to align the liquid chamber 151 in the recess 108 and align the ports 159, 163, by providing multiple points of contact between the ports 159, 163. The rearmost sealing element 175 on the port 163 limits the position of the liquid chamber 151 more than the forward sealing element on the port. That is because the rearmost sealing element is further from the centre of the liquid chamber 151, so tolerance between that sealing element and the liquid chamber port 159, 163 equates to a smaller available amount of angular rotation of the liquid chamber 151.

[00277] When a plurality of sealing elements is provided, the sealing elements may be spaced equally apart with respect to each other along the base 173a. In other configurations, the distance between the sealing elements may not be equal.

[00278] In some configurations, the distance between the sealing elements is equal to the distance between the forward sealing element and the terminal end 163a of the gas inlet port 163. In other configurations, the distance between the sealing elements may not be equal to the distance between the forward sealing element 175 and the terminal end 163a.

liquid chamber. In some configurations, the wiper seal may not have the bulbous tip 175a.

[00284] Referring to figure 12, the radial height h1, h2 of each wiper seal is such that in an unflexed position, the diameter of the wiper seal is greater than the inner diameter of the base unit connection port 159 of the liquid chamber. When the liquid chamber 151 is inserted into the recess 108, the wiper seal will contact the inner wall of the base unit connection port 159 of the liquid chamber and will flex downwards towards the base 173a of the seal 173 to accommodate the smaller inner diameter of the base unit connection port 159 of the liquid chamber. The elasticity of the seal will mean that the wiper seal 175 resists this flexing, thereby providing a sealing force between the points of contact on the base unit connection port 159 of the liquid chamber and the tip 175a of the wiper seal. This configuration accommodates slight variations in sizes of both the wiper seals 175 and the port 159 of the liquid chamber due to manufacturing tolerances, as the wiper seals would flex to accommodate the exact diameter of the liquid chamber port.

[00285] Another advantage of the wiper seals 175 is the low resistance they provide to axial movement. Unlike other seals, the wiper seals' ability to flex and conform to the inner surface of the base unit connection port of the liquid chamber results in a low amount of friction, thereby making it easier to connect and disconnect the liquid chamber 151 from the housing 100 of the base unit 50 of the breathing assistance apparatus 10.

[00286] A wiper seal 175 does, however, provide slightly more resistance to movement of the liquid chamber 151 in one scenario. When the liquid chamber is being moved in a first direction (e.g. towards the housing 100 in an insertion direction CID when being connected), the wiper seal 175 will be flexed in a first orientation. When the liquid chamber is being moved in a second direction (e.g. away from the housing 100 in a removal direction CRD when being disconnected), the wiper seal 175 will be flexed in a second orientation. Therefore, when the liquid chamber 151 first moves in one direction after moving in the other direction, the wiper seal 175 will also swap from one orientation to the other. This occurs by the wiper seal 175 folding over itself in the gap between the base 173a of the seal and the inner surface of the liquid chamber port 159. This folding results in the wiper seal 175 flexing more than it regularly would during ordinary movement of the two components, and as such temporarily provides greater resistance to movement of the liquid chamber 151 than usual.

[00312] Figure 11 schematically shows a position 176 of temperature sensor(s) such as thermistor(s) in the removable elbow 171. The thermistors are located in the rear vertical wall of the upstanding portion of the elbow, close to the curved transition region between the vertical and horizontal elbow portions. At this location, the thermistors are relatively shielded from the heat produced by the heater plate 140, allowing for more accurate estimations of the temperature of gases flowing through the removable elbow 171 to be made.

[00313] The elbow 171 has electrical connectors 179 positioned in an upstanding chimney 179a, the connectors configured to provide power from a main power board of the apparatus 10 to the heater wires 16a in the conduit 16.

[00314] As mentioned above, the shroud 190 is designed to not be removed during regular use. The shroud has features that allow it to be clipped onto a screen carrier 211, which in turn is fastened to the upper chassis 102 to become part of the housing 100. The screen carrier 211 can connect to and support a display 212. In alternative configurations, the screen carrier 211 may not be provided, and the shroud 190 may clip directly to part of the housing 100, such as an upper surface or upper chassis 102 of the housing.

[00315] Figures 16 to 19 show features on the shroud 190 and screen carrier 211 for attaching the components together without the use of fasteners. The shroud 190 is configured to attach to the screen carrier 211 of the housing 100 via two movements; an initial movement of the shroud in a first direction followed by a subsequent movement of the shroud in a second direction that is offset from the first direction. In one configuration, the second direction is transverse to the first direction. In the form shown, the shroud 190 is configured to initially be moved in a first downward direction DD, followed by a movement in a second rearward direction RD, relative to the screen carrier 211 and thereby the housing 100. In the form shown, the downward direction DD is vertical and the rearward direction RD is horizontal.

[00316] The shroud 190 is configured so that the shroud cannot be detached from the screen carrier 211 of the housing solely by pulling the removable elbow 171 in the second forwards direction relative to the housing 100.

[00317] As shown in figures 17 and 18, each side 197 of the shroud 190 is shaped to be complementary to the shape of the screen carrier 211. The sides of the screen carrier 211 of the housing 100 have two forwardly directed horizontal protrusions 213 (one per side wall) that engage with complementary rearwardly open

difficult to clean, which might mean the shroud would need to be removed for satisfactory cleaning. Avoiding such a gap enables the shroud 190 to be non-removable or difficult to remove, without creating cleaning issues.

[00326] The removable elbow 171 is removable from the housing 100 when the shroud 190 is attached to the housing.

[00327] In an alternative configuration, one or more of the engagement protrusions 198, 217 can be replaced with an engagement recess. One side of the engagement recess would have a surface that is complementary to the second side of the engagement protrusion in order to inhibit disassembly in a similar way to the above configuration. In a further configuration, one or more of the engagement protrusions 198, 217 could be replaced with a combination of an engagement protrusion and engagement recess, such that a complementary engagement protrusion engages over the engagement protrusion and within the engagement recess.

[00328] A similar shroud 190 and screen carrier 211 and/or housing 100 engagement configuration could be used where the shroud 190 acts as a cover for part of the housing or another component, but where the component that is covered is not removable.

[00329] Referring to figure 7 and 8, the removable elbow 171 also includes an electrical connection. The elbow 171 has an inlet for pneumatically connecting to a first accessory for the breathing assistance apparatus 10, such as the liquid chamber 151, an outlet for pneumatically and optionally electrically connecting to a second accessory for the breathing assistance apparatus, such as the patient conduit 16, and a printed circuit board (PCB) electrical connector 178 for electrically connecting to the breathing assistance apparatus 10 to form an electrical connection with an electrical component in the housing. The electrical connection provides an electrical link between the base unit 50 of the apparatus 10 and the temperature sensors 176 embedded in the elbow, as well as between the base unit 50 of the apparatus 10 and the conduit 16 (when the conduit has one or more sensors and/or a heating element), via an electrical interconnecting assembly 221 in the housing which will be described below. The PCB electrical connector 178 electrically connects to the electrical interconnecting assembly 221 when the removable elbow 171 is connected to the housing 100.

[00330] The pneumatic inlet connection of the removable elbow 171 is provided by the humidified gas inlet port 163, the pneumatic outlet connection is provided by

the patient outlet port 30, and the outlet electrical connection is provided by connectors 179 (figure 9) that are provided in the chimney 179a that extends upwardly parallel to an axis of the port 30.

[00331] The humidified gas inlet port 163 and the patient outlet port 30 are in fluid communication with each other via a gas flow path in the removable elbow. Electrical connectors 178, 179 of the removable elbow are pneumatically isolated from the gas flow path between the humidified gas inlet port 163 and the patient outlet port 30, via at least one wall of the removable elbow. For example, the body of the removable elbow may be injection moulded plastic material, with isolated regions provided for the electrical connectors that are separate and isolated from the gas flow path.

[00332] Because the portion of the removable elbow, namely PCB electrical connector 178, that is configured to form the electrical connection with the electrical component in the housing (the electrical interconnecting assembly 221) is pneumatically isolated from the gas flow path of the removable elbow, coupling the removable component to the housing solely provides an electrical connection between the PCB electrical connector 178 and the electrical interconnecting assembly 221. It does not form a direct pneumatic connection between the gas flow path in the removable elbow 171 and the housing 100. Instead, the gas flow path in the removable elbow provides a pneumatic connection between the first accessory (the liquid chamber 151) and the second accessory (the patent conduit 30).

[00333] In the configuration shown, the PCB electrical connector 178 is partly housed in a housing 178a that is integrally formed with the elbow. The PCB electrical connector projects rearwardly from the housing 178a to insert into an electrical connector on the base unit 50 of the apparatus 10 in a horizontal direction (i.e. the same rearward insertion direction CID in which the liquid chamber 151 connects to the housing 100 of the base unit 50 and the same rearward direction RD in which the shroud 190 connects to the screen carrier 211). As such, the removable elbow 171 can be horizontally connected to the apparatus in the rearward direction RD, with the liquid chamber 151 being horizontally connected to the two apparatus ports 161, 163 after that. Alternatively, the liquid chamber 151 can initially be connected to the removable elbow 171, with the assembled liquid chamber 151 and elbow 171 then being connected to the base unit 50 of the apparatus together by moving them in the rearward direction together.

extends from a position at or adjacent each end of the body of the handle. A distal end of the arm 265 is coupled to a tab 267 that projects forwardly and outwardly from the arm 265. The arcuate arm 265 and tab 267 project outwardly from a planar plate 264 (figure 27) that has an arcuate periphery. The planar plate 264 has dimensions corresponding to the dimensions of the transversely shallow rear portion 112a of the recess.

[00365] The connecting features 265, 267 of the handle 261 engage with the transversely deep forward portion 112b and arcuate slot 112c. The upper edge of the arcuate arm 263 forms a close fit with a semi-circular upper wall of the transversely deep forward portion 112b of the recess. Additionally, the arcuate slot 112c forms a close fit with upper and lower edges of the arcuate arm 263, so that the handle 261 follows the desired path of movement.

[00366] The tab 267 of the protrusion travels within the transversely deep forward portion 112b of the recess. The length of the tab 267 is configured to form a close fit with the upper and lower arcuate walls of the transversely deep forward portion 112b. When the handle 261 is lifted, the tab 267 rotates in the transversely deep forward portion 112b with respect to the housing 100, with the tab shifting between a forward boundary wall 112b' and a substantially vertical rear boundary wall 112b" which is defined by the transversely shallow rear portion 112a of the recess. When the handle reaches an approximately vertical position as shown in figure 24, the tab 267 will contact the rear boundary wall 112b", thereby limiting the movement of the handle 261.

[00367] Because the handle 261 connects to inner vertical walls of the upper chassis 102, the handle is prevented from being removed once the screen carrier 211 is attached to the upper chassis 102.

[00368] The handle 261 also includes an aperture 268 to accommodate a gas port 275 on a filter module 271, when the filter module is received in a filter recess 118 in the housing and when the handle is in a storage position. The aperture 268 is positioned along one side member of the handle, and is positioned closer to the transverse carrying portion 262 of the handle 261 that can be used to carry the apparatus 10, than it is to the connecting features 263-267 on that side member of the handle that movably connect the handle to the housing. The transverse carrying portion 262 extends from an end of the side member opposite to the end with the connecting features.

electrical connector 1178 projects rearwardly from the housing 1178a to insert into an electrical connector on the base unit 50 of the apparatus 10 in a horizontal direction (i.e. the same rearward insertion direction CID in which the liquid chamber 151 connects to the housing 100 of the base unit 50 and the same rearward direction RD in which the shroud 190 connects to the screen carrier 211). As such, the removable elbow 1171 can be horizontally connected to the apparatus in the rearward direction RD, with the liquid chamber 151 being horizontally connected to the two apparatus ports 161, 163 after that. Alternatively, the liquid chamber 151 can initially be connected to the removable elbow 1171, with the assembled liquid chamber 151 and elbow 171 then being connected to the base unit 50 of the apparatus together by moving them in the rearward direction together.

[00438] As shown in figures 28 to 36, the PCB electrical connector 1178 of the removable elbow 171 inserts into an electrical interconnecting assembly 221 of the base unit 50 of the apparatus 10. The interconnecting assembly 221 is made up of three components; the socket 231, the PCB 241, and the overmould 251.

[00439] As explained above in relation to Figures 29 and 30, the socket 231 comprises a housing 232 that defines a receptacle 233 to receive the PCB electrical connector 1178 of the removable elbow 1171. A forward portion 233a of the receptacle 22 has relatively large vertical and horizontal dimensions to receive the housing 1178a of the electrical connector. A rear portion 233b of the receptacle 233 has relatively small vertical and horizontal dimensions to receive the portion of the PCB electrical connector 1178 that projects rearwardly from the housing 1178a. The rear portion 233b is defined between upper and lower ribs 234 that extend into the rear part of the receptacle from upper and lower walls thereof. The rear portion 233b of the receptacle is configured to form a close or tight fit with the PCB electrical connector 1178 to assist with holding the removable elbow 1171 in connection with the socket 231. The forward portion 233a of the receptacle may be configured to form a close or tight fit with the housing 1178a of the PCB electrical connector 178 to assist with holding the removable elbow 1171 in connection with the socket 231. Alternatively, that may form a looser fit.

[00440] The housing 1178a of the removable elbow 1171 carries a seal 1182. The seal 1182 is configured to engage against the inner surface of the forward portion 233a of the receptacle 233 of the socket 231 when the removable elbow 1171 is engaged with the electrical interconnecting assembly 221 of the base unit 50 of the apparatus. The seal 1182 provides a pneumatic and/or liquid seal between the

upper surface 6705 of the seal would sealingly contact the lower surface 6704 of the upper chassis 3102', and the lower surface 6707 of the seal would sealingly contact the upper surface 6706 of the lower chassis 3202'.

[00494] As shown in figures 68A and 68B, the seal 6703 has an undulating shape with peaks and troughs. The seal 6703 has a substantially horizontal upper portion 6709 and a substantially horizontal lower portion 6711. A first inner portion 6713 extends at an angle inwardly and downwardly from the left side of the upper portion 6709, forming a bend 6710. A second inner portion 6715 extends at an angle inwardly and upwardly from the left side of the lower portion 6711 forming a bend 6712. The first inner portion 6713 and the second inner portion 6715 met at the inner side (right side of figures 68A and 68B) of the seal forming bend 6716. The upper portion, lower portion, and inner portions form a sideways M-shaped seal. The seal 6703 is symmetrical about a horizontal centre line. This symmetry advantageously ensures that the seal 6703 deforms evenly when a vertical force is applied. Additionally, the sideways M-shape allows the seal 6703 to bend in the central region whilst the upper and lower surfaces of the seal remain substantially horizontal. In an alternative configuration, the seal 6703 may have fewer bends and/or fewer inner portions, such as a Z shape. In a further alternative configuration, the seal 6703 may have more bends or inner portions.

[00495] Once assembled, the contact described above would cause the seal 6703 to deform into a folded position. The seal would deform via a folding motion instead of simply compressing. As such, the seal 6703 is capable of a greater range of motion resulting from the same force when compared with a typical compressive seal. This allows the seal 6703 to be able to conform to the shape of the cavity 6701 even in the event of significant variations resulting from flexing of the components, manufacturing variation, and the like.

[00496] When compressed from the orientation in figure 68A to the compressed orientation in figure 68B, the portions of the seal flex or fold such that the upper portion 6709 and the lower portion 6711 move closer together. The upper surface 6705 and lower surface 6707 form sealing surface that seal the filter to prevent pressurised gases from leaking out of the filter module 271 and into the housing of the main control and power circuit boards. The biasing force from the central undulating shape creates a seal.

[00497] The seal 6703 is manufactured from an elastomeric material. The seal 6703 is manufactured from silicone, which exhibits low amounts of material creep (cold