United States Patent [19]

Ansite et al.

[11] **3,910,269**

[45] **Oct. 7, 1975**

[54] **INTEGRATED HELMET AND MASK STRUCTURE**

[75] Inventors: **William K. Ansite**, Glendale; **John J. Mitchell, Jr.**, Arcadia, both of Calif.

[73] Assignee: **Sierra Engineering Co.**, Sierra Madre, Calif.

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[21] Appl. No.: **449,777**

Related U.S. Application Data

[62] Division of Ser. No. 255,838, May 22, 1972, Pat. No. 3,833,935.

[52] **U.S. Cl.** **128/142;** 128/142.7

[51] **Int. Cl.²** **A62B 7/00**

[58] **Field of Search** 128/141, 142, 146.7, 142.3, 128/142.7, 142.2, 142.5; 2/6

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Primary Examiner—Richard A. Gaudet
Assistant Examiner—Lee S. Cohen

[57] **ABSTRACT**

For flying personnel there is provided a hard shell helmet suitably padded and held out of close contact with the head. An integrated visor assembly has an articulated attachment to the helmet movable between an operative position over the wearer's face and a lifted position extending over the top of the helmet removed from the face. Compound leverage elements making up the attachment determine a path of movement for the visor assembly such that it travels an irregular path allowing it to first lift clear of contact with the face and then travel upwardly to its lifted position. An inflatable seal extends around the perimeter of the visor assembly, the seal being inflated with air from the oxygen supply for the breathing mask when in operation over the face of the wearer and being collapsed when deflated providing additional clearance for ease of removal from the face and for storage in its lifted position.

7 Claims, 13 Drawing Figures

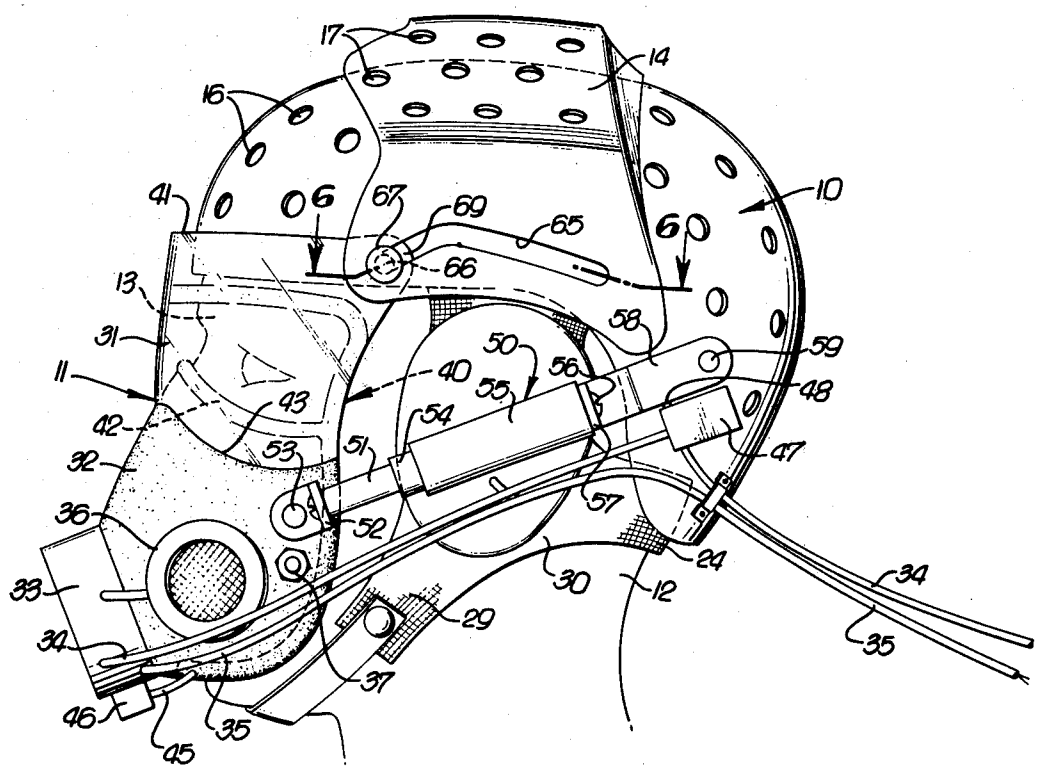


FIG. 1.

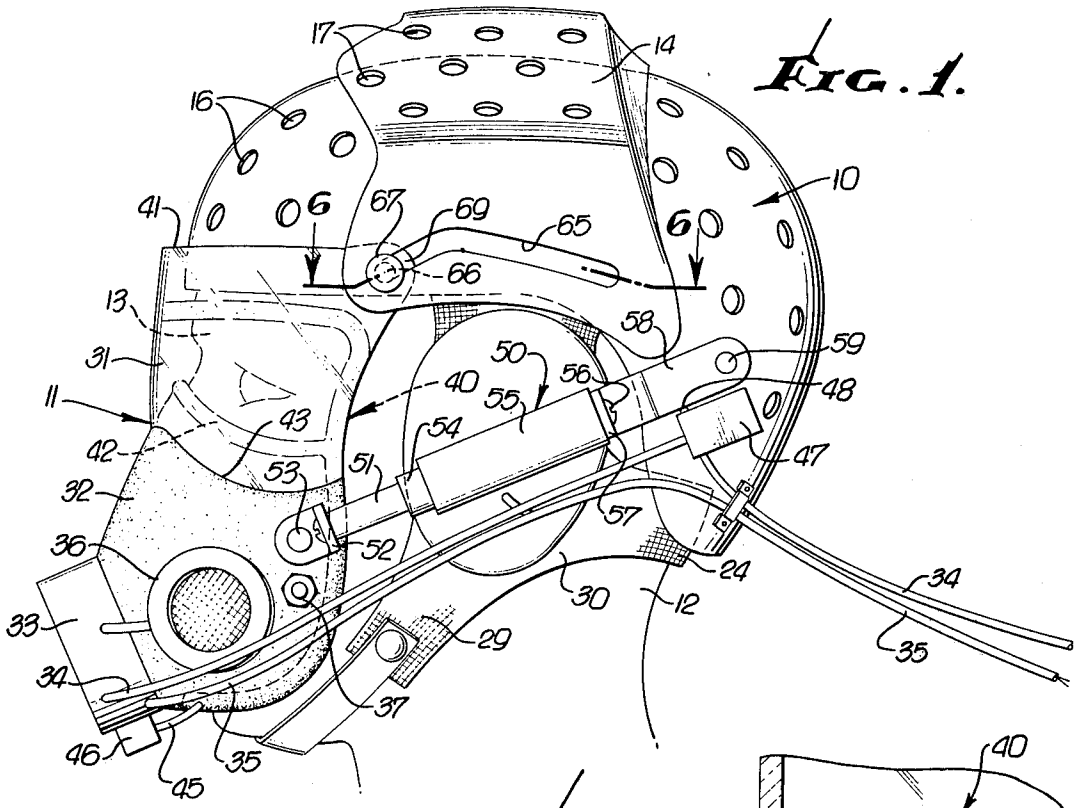


FIG. 3.

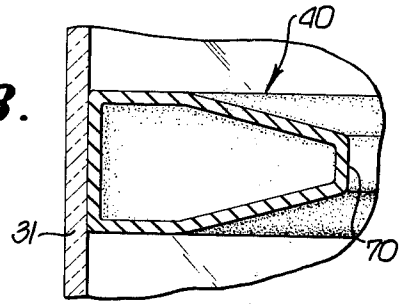


FIG. 2.

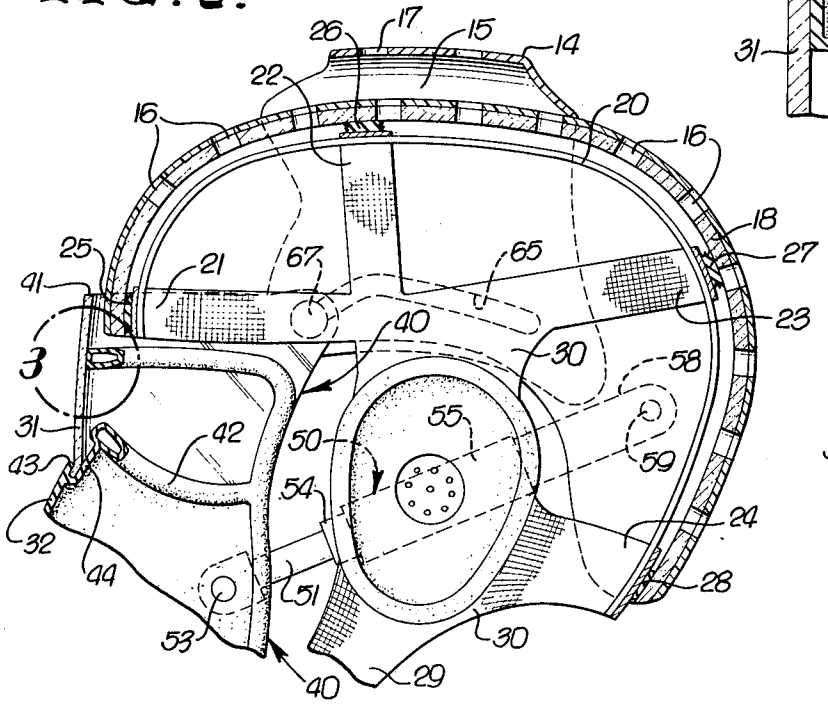


FIG. 4.

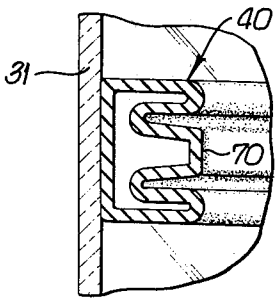


FIG. 5.

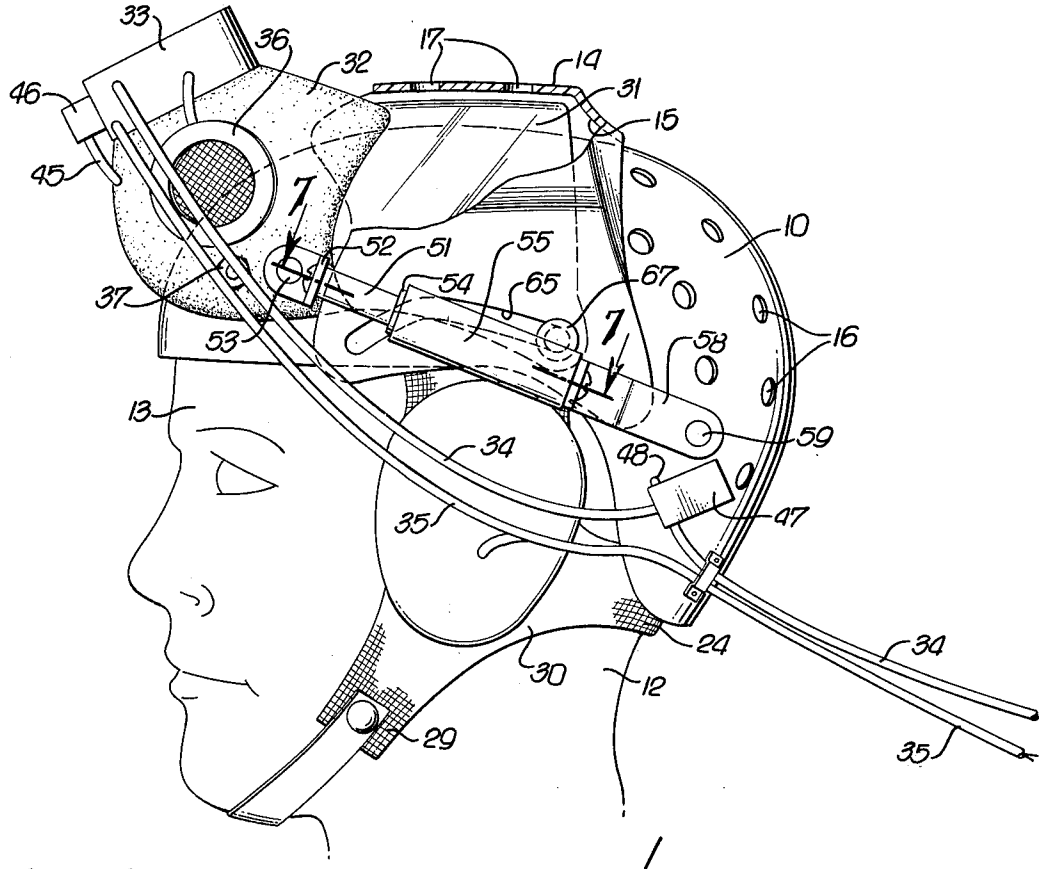


FIG. 6.

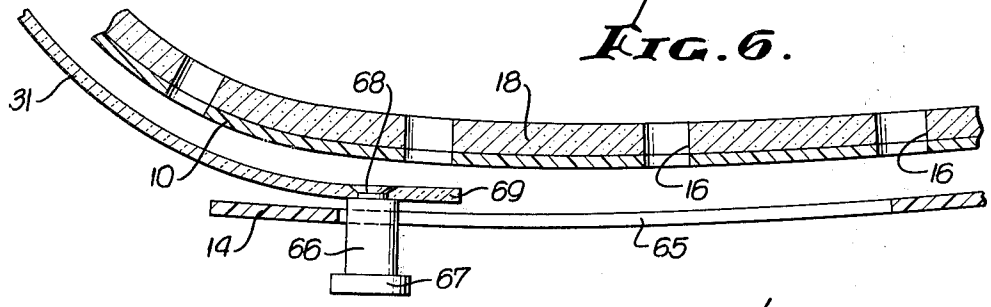


FIG. 7.

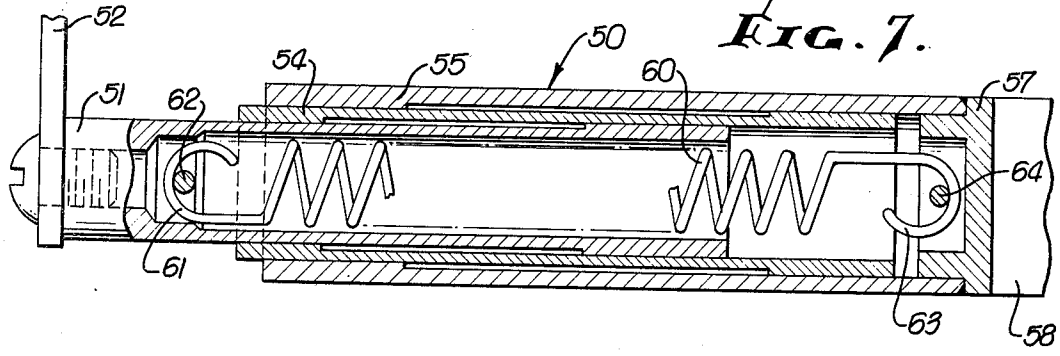


FIG. 8.

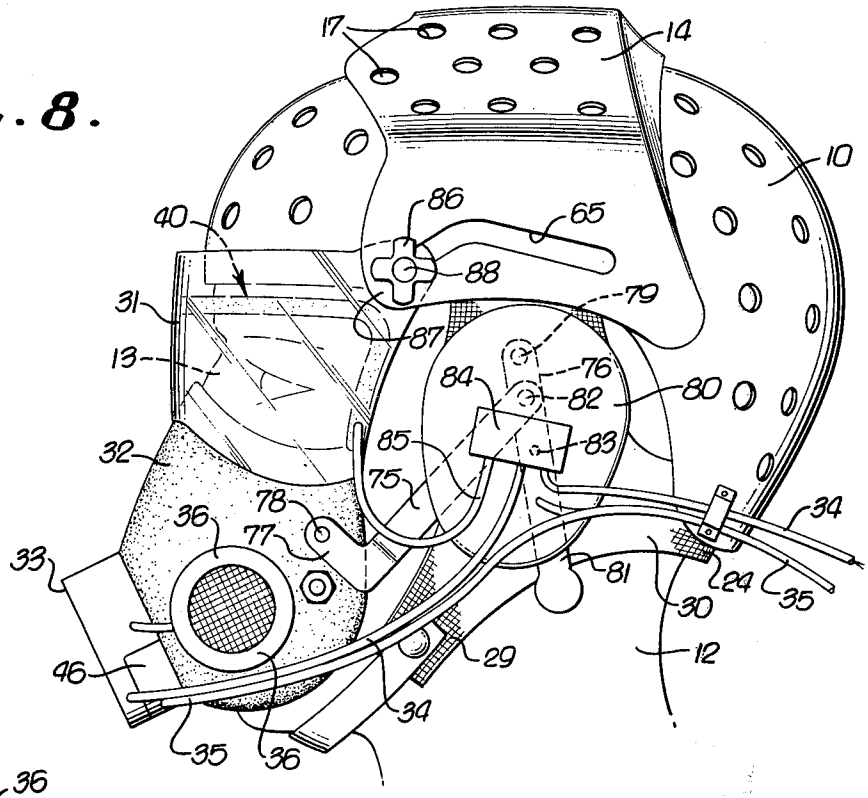
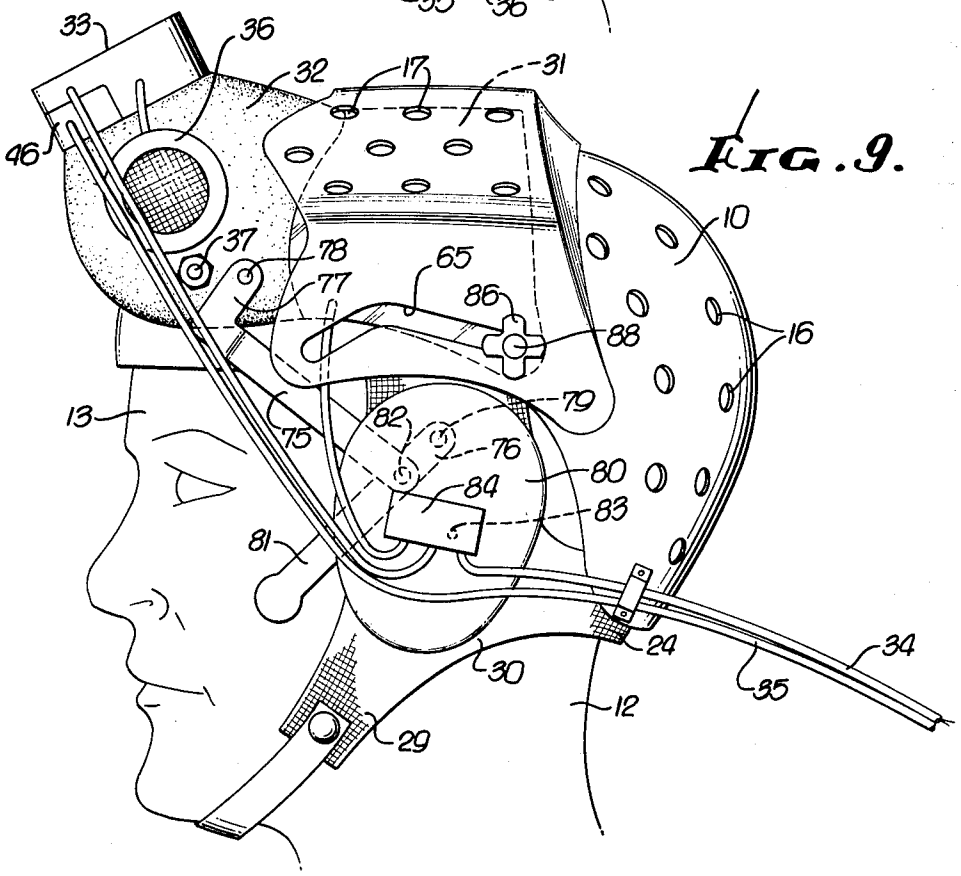

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81
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FIG. 9.


33
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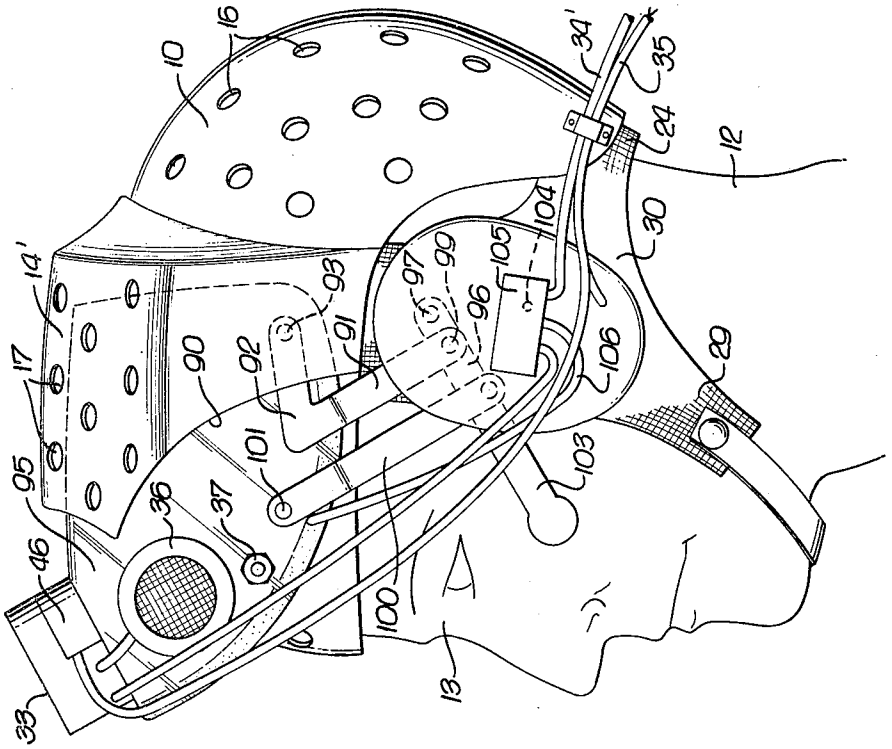

10
16
34'
35
24
12
30
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105
99
97
96
93
91
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92
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106
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103
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14'
95
36
37
46
100
13
33

FIG. 11.

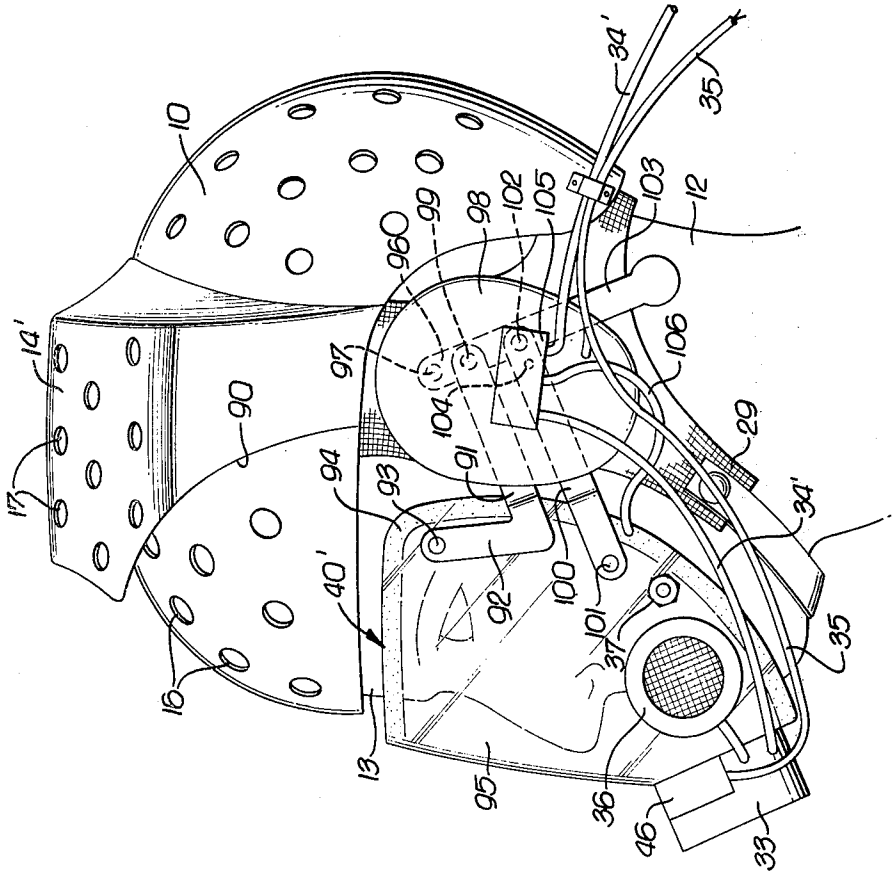

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106
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14'
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95
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FIG. 10.

FIG. 13.

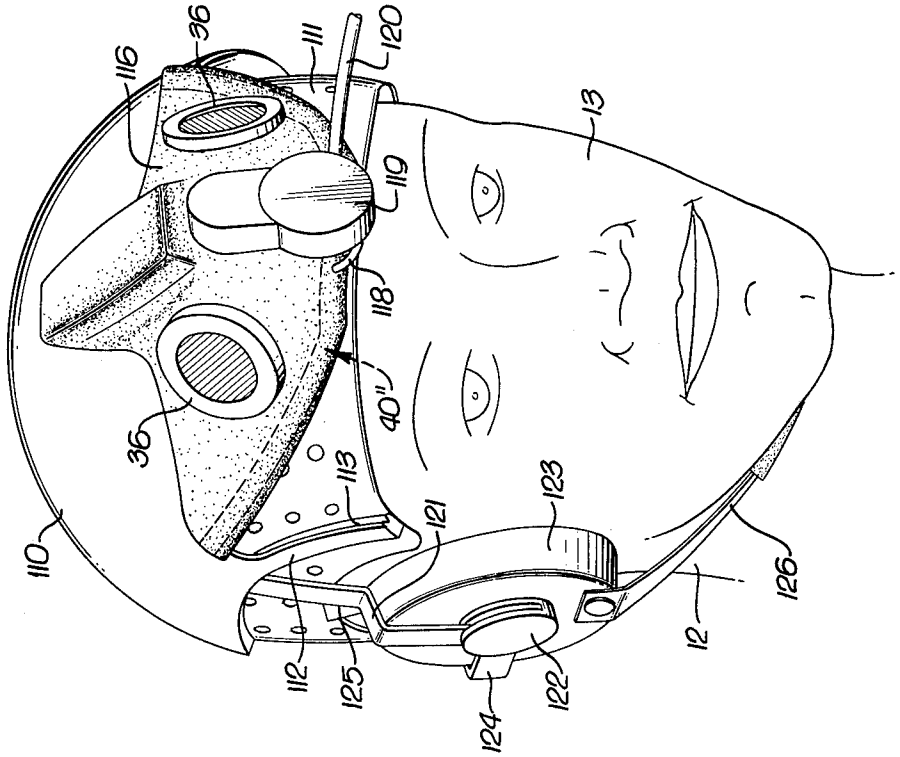
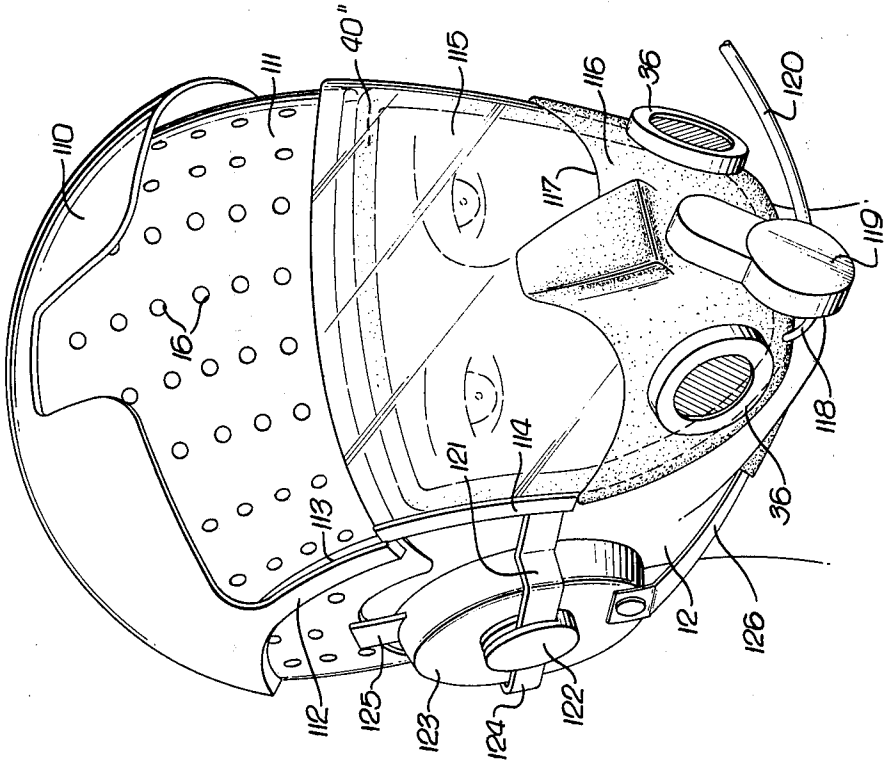

36
111
120
116
13
119
118
40"
36
113
123
121
110
126
112
125
124
122
12

FIG. 12.


40"
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110
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119'
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112
125
123
124
122

INTEGRATED HELMET AND MASK STRUCTURE

This is a division of application Ser. No. 255,838, filed May 22, 1972.

As aircraft capabilities continuously involve increased speeds, demands upon the men who fly them experience a change which, in part, adds greatly to the mental and physical stresses experienced. Physical discomforts are variable in nature and additive. Movement within the cockpit is confined and restricted. Added to this is the weight and restrictiveness of equipment worn by the pilot and crew and the heat generated within his personal flight safety equipment which, over long periods of flight duty, create extensive discomfort. Personal flight equipment can be said to comprise chiefly of a flight protection helmet equipped with oxygen mask, head-set or ear phones and a smoke-protective visor.

Respecting currently available personal equipment, a complaint and consequently a defect in addition to being too hot, too heavy, excessively cumbersome and too restrictive, is that the equipment has too many non-integrated components. Whatever remedy may be offered, however, the protection must still include protection against head injury as a result of buffeting or turbulence upon ejection, cabin or cockpit decompression, either explosive or otherwise, and eye protection from the smoke of cabin or cockpit fires as well as from spalling.

It is therefore among the objects of the invention to provide a new and improved helmet and mask integrated structure wherein the mask and communication equipment are so connected to the helmet itself as to present a more integrated combination which, at the same time, is cool and comfortable when worn.

Another object of the invention is to provide a new and improved helmet and mask integrated structure which is low in profile despite the need for a leverage or related mechanism to permit the mask assembly to be removed from the face.

Still another object of the invention is to provide a new and improved helmet and mask integrated structure provided with an inflatable seal between the mask assembly and the face of the wearer which can, when desired, be inflated automatically by oxygen pressure normally supplied to the mask and which provides for sufficient mask clearance of the face during donning.

Still further among the objects of the invention is to provide a mask assembly including an inflatable seal which is of such design and construction that it can be readily fitted to faces of different shape and size without need for changing the shape and size of the mask assembly and associated helmet shell.

With these and other objects in view, the invention consists in the construction, arrangement, and combination of the various parts of the device, whereby the objects contemplated are attained, as hereinafter set forth, pointed out in the appended claims and illustrated in the accompanying drawings.

In the drawings:

FIG. **1** is a side elevational view of one form of the helmet and mask integrated structure shown in operating position on the head of a wearer.

FIG. **2** is a longitudinal sectional view of the structure of FIG. **1.**

FIG. **3** is a fragmentary cross sectional view taken on the circular line **3** of FIG. **2** with the seal inflated.

FIG. **4** is a fragmentary sectional view similar to FIG. **3** but with the seal deflated.

FIG. **5** is a side elevational view similar to FIG. **1** but with the visor assembly lifted into inoperative position.

FIG. **6** is a fragmentary cross sectional view on the line **6—6** of FIG. **1.**

FIG. **7** is a fragmentary longitudinal sectional view on the line **7—7** of FIG. **5.**

FIG. **8** is a side elevational view of a second form of the invention shown in position on the head of a wearer.

FIG. **9** is a side elevational view of the same form of the device as in FIG. **8** but with the visor assembly lifted into inoperative position.

FIG. **10** is a side elevational view of another form of the device shown in operative position.

FIG. **11** is a side elevational view of the device of FIG. **10** but with the visor assembly lifted into inoperative position.

FIG. **12** is a front perspective view of a modified form of the invention as shown in operative position on the head of a wearer.

FIG. **13** is a front perspective view similar to FIG. **12** but with the visor assembly lifted into inoperative position.

In an embodiment of the invention chosen for the purpose of illustration, there is shown a hard helmet shell **10** equipped with a visor assembly indicated generally by the reference character **11** shown mounted on the head **12** of a wearer with the visor assembly in operative position applied to the wearer's face **13.** A visor cover **14** is fixed in position at the crown of the helmet shell and provides a pocket **15.** Extending through the helmet shell is a series of ventillating perforations **16,** and perforations **17** in the visor cover assist the perforations **16** which open into the pocket **15.** Perforations serve two functions; to provide for ventilation; to reduce weight, yet still provide protection. A shock or energy absorbing liner **18** extends around the entire inner surface of the helmet shell, the liner being of some appropriate foam cushion.

For supporting the helmet shell and perforce the helmet and mask integrated structure on the crown of the head **12,** there is provided a sling **20** extending fore and aft and to which are applied a forehead cross-web **21,** a crown cross web **22,** a rear cross-web **23** and a nape cross-web **24** attached to the sling at the junctions shown. The sling and cross-webs are provided with elastomer pads **25, 26, 27** and **28** of appreciable depth sufficient to support the helmet shell in a position removed from contact with the head of the wearer providing a space from which heat from the wearer's head can pass outwardly through the perforations **16.** A chin strap **29** serves to hold the sling and cross-webs in position, the chin strap and the cross-webs being all attached to a lateral webbing **30** surrounding the wearer's ears.

It will be understood that the lining of the helmet shell normally is spaced clear of the head of the wearer and that this spacing may vary to some extent depending upon the shape of the wearer's head and the height of the elastomer pads. The pads, moreover, are yieldable and the sling and cross-webs are likewise yieldable so that should there be an impact on the helmet shell sufficient to compress the pads at one location or another, the wearer's head will strike the liner. The liner is of a character capable of absorbing the impact and

the energy is dissipated, thereby protecting the head of the wearer.

It should be noted that the attachment of the ear cups to the helmet is flexible to allow lateral spreading to clear the ears for rapid donning. These flexible attachments facilitate folding ear cups into the inside of helmet shell for minimum storage volume.

The visor assembly **11** in this embodiment consists of two parts, namely, an eye area shell section **31** at a location surrounding the eyes of the wearer and an oral-nasal area shell section **32** which is the portion usually identified as a breathing mask and upon which is mounted a regulator **33** capable of accommodating appropriate valving (not shown) for an air or oxygen line **34** and a microphone (not shown) supplied by a microphone line **35.**

In this embodiment there is also provided a compensated exhalation valve **36** and a relief valve **37** of substantially conventional construction.

For sealing the perimeter of the visor assembly to the face **13** of the wearer, use is made of a seal indicated generally by the reference character **40** which in the chosen embodiment is a hollow tube, as indicated in FIGS. **3** and **4.** As shown in FIGS. **1** and **2,** the tube extends around the lower and side edges of the oral-nasal area shell section **32,** the side edges of the eye area shell section **31** and across the upper or forehead portion of the eye area shell section **31** at a location slightly removed from an upper edge **41.** To the extent described, the seal is continuous and endless. In addition, there is a transverse section **42** of the seal which extends across the eye area shell section near the line **43** of junction between the eye area shell section and the oral-nasal area shell section. As shown in FIG. **2,** the transverse section **42** is actually attached to a web **44** which lies inside of the eye area shell section **31.** The transverse section, moreover, is in communication with the seal **40** at the point of junction.

For inflating the seal, use is made of an air line **45,** shown in FIG. **1,** which extends from an air switch **46** supplied in turn from the mask regulator **33.**

In the air or oxygen line **34** is interposed an air valve **47** on which is an actuator button **48** which normally tends to move to a shutoff position. As shown in FIG. **1,** the actuator button is moved to an "on" position by engagement therewith of a portion of a composite arm **50.** A microphone switching arrangement also might be incorporated to switch "off" an external microphone (boom microphone) and switch on the microphone inside the mask.

As shown in FIG. **7** in company with FIG. **1,** the composite arm consists of a plunger **51,** an outer end of which is attached to a bracket **52** which, in turn, has a pivotal attachment **53** to the side of the oral-nasal area shell section **32.**

A telescoping sleeve **54** forms a connection between the plunger **51** and a hollow cylinder **55.** The cylinder is in turn attached by means of a screw **56** to a bracket **57,** the bracket being part of an arm **58** which has a pivotal attachment **59** to the helmet shell **10.**

As shown in FIG. **7,** a spring **60** has one end **61** secured by a spring keeper **62** to the plunger **51** and has its other end **63** secured to a keeper **64** which is anchored to the bracket **57.** The spring under tension is biased to draw the visor assembly in a direction from left to right as viewed in FIG. **1** so that the seal **40** is drawn into engagement with the face **13** of the wearer.

To assist in shifting the visor assembly **11** from the operative position shown in FIG. **1** to the withdrawn position of FIG. **5,** use is made of a slot **65** in the visor cover **14** within which travels the shank **66** of a knob **67,** the shank **66** being riveted at **68** to an adjacent edge **69** of the eye area shell section **31.**

Although only one side of the visor assembly is shown in FIG. **1,** it will be understood that the other side is identical except for being a right-hand side counterpart of the composite arm **50** and the slot **65** containing the shank **66.** Connected as described, the visor assembly and helmet shell are an integrated structure in that, except for the upward and downward motion about the pivot joints, the visor assembly is firmly held in a fixed relationship with respect to the helmet shell.

When the visor assembly is to be moved from the operative position of FIG. **1** to the elevated position of FIG. **5,** the mask regulator, protruding as it does, can be made use of in a sense as a handle when the visor assembly is lifted upwardly or counter clockwise as viewed in FIG. **5.**

When this occurs, the arm **58** is moved from its position of engagement with the actuator button **48** and the air valve **47** then closes off the air line **34** so that no air flows either to the mask regulator **33** or to the seal **40** through the air line **45.**

When this circumstance prevails, the seal **40** will collapse to the position shown in FIG. **4** by reason of the fact that the seal initially is given the collapsed form of FIG. **4** when molded. Collapsing as described, a sealing face **70** has a seal **40,** which is the portion of the seal which actually engages the skin on the face **13** and draws away from the skin an appreciable distance, namely, about half the inflated height of the seal as shown in FIGS. **3** and **4.** This provides adequate clearance so that when the mask assembly is lifted progressively from the position of FIG. **1** to the position of FIG. **5,** there will be no resistance to its lifting. Additionally, when the mask assembly is elevated, the composite arm **50** then in an over-center position functions to pull the visor assembly toward the visor cover **14** until the eye area shell section is drawn into the pocket **15.**

Conversely when the mask assembly is to be lowered into operating position, the mask regulator **33** and visor assembly is swung downwardly or counter-clockwise as viewed in FIG. **5,** initially extending the spring **60** as it swings, until the positions of FIG. **1** are then accomplished. At this point the arm **58** engages the actuator button **48** thereby to admit automatically air from the air or oxygen line **34** to the mask regulator **33** and thence into the mask. At the same time, air under pressure passes through the air switch **46** and air line **45** into the seal **40** causing it to be inflated to the position of FIG. **3.** In this position the sealing face **70** will be drawn gently into engagement with the face of the wearer thereby sealing all of that portion of the visor assembly which is defined by the perimeter of the seal as shown in FIGS. **1, 2** and **5.**

In the form of invention of FIGS. **8** and **9,** there is substituted for the composite arm **50** a compound lever assembly consisting of a lever arm **75** and lever arm **76.** The lever arm **75** has a bent end section **77** extending at right angle to the lever arm, the end section **77** having a pivot connection **78** to the edge of the oral-nasal area shell section **32.**

The lever arm **76** has a pivot connection **79** to an ear receptacle **80** which is an integral part of the helmet

shell **10.** An extension **81** of the lever arm **76** protrudes below the ear receptacle and there is a pivot connection **82** between the lever arm **75** and the lever arm **76** at a location not far removed from the pivot connection **79.** An actuator button **83** on an air valve **84** serves to automatically open the air valve when the extension **81** is in the position shown in FIG. **8** thereby to inflate the seal **40** while the visor assembly is in a position against the face **13** of the wearer.

Conversely when the visor assembly is lifted to the position of FIG. **9,** the extension **81** moves out of engagement with the actuator button **83** thereby permitting the air valve to close and cut off the air supply whereupon the seal **40** collapses in the manner previously described. in this form of invention, an air line **85** extends from the air valve **84** to a side portion of the seal **40** as shown in FIG. **8.**

When the visor assembly is in the operating position of FIG. **8** and the wearer wishes to press it more snugly against his face, the extension **81** can be employed to help tighten the seal by pushing rearwardly against the extension. When it has been pushed far enough, a locking button **86,** of substantially conventional construction, can be turned to tighten engagement of a corner tab **87** of the eye area shell section **31** to the visor cover **14** which is immediately adjacent the end of the slot **65.**

When the visor assembly is to be lifted clear of the face the locking button **86** is loosened. The visor assembly can then be lifted to the position of FIG. **9.** Meanwhile the locking button and its attached shank **88** move to the opposite end of the slot **65** and there again can be tightened so as to be capable of holding the visor assembly in the elevated position until it is to be released.

Additionally, this engagement of the extension **81** from the actuator button **83** causes the air valve **84** to shut off the supply of air and the seal **40** thereupon will collapse.

In the form of invention of FIGS. **10** and **11,** the visor cover **14'** is cut away at **90** and the slot **65** dispensed with. A lever system of three lever arms is made use of for holding and guiding the visor assembly relative to the helmet shell. The lever system consists of a lever arm **91** having a bent section **92** at one end which by means of a pivot connection **93** is attached to a corner **94** of a transparent visor **95.** A lever arm **96** has a pivot conection **97** to an ear receptacle **98** which is an integral part of the helmet shell **10.** A pivot connection **99** interconnects the lever arm **91** with the lever arm **96.**

Another lever arm **100** has a pivot connection **101** at one end to the visor **95** about midway between the top and the bottom. At the other end of the lever arm is a pivot connection **102** which connects the lever arm **100** to the lever arm **96** at a location farther away from the pivot connection **97** than the pivot connection **99** previously described. An extension **103** of the lever arm **96** protrudes to a position below the ear receptacle **98.**

An actuator button **104** on an air valve **105** serves a function similar to the previously described actuator button **83** in that in the lowered or operative position of FIG. **10,** the actuator button **104** is tripped by the lever arm **100** and causes the air valve to open thereby to inflate a seal **40'.** When the visor assembly is lifted to the position of FIG. **11,** the lever arm **100** is moved free of the actuator button **104** causing it to shut off the supply of air whereupon to collapse the seal **40'.**

In this form of the invention the visor **95** is substantially a single piece transparent visor which covers the surface of the wearer's face **13** both above and around the eyes and around and below the nose and mouth. In this way a single perimetrical seal **40'** extending around the edge of the visor **95** forms a seal between the visor and the face of the wearer. An air line **106** communicates between the air valve **105** and the seal **40'** so that air from an air or oxygen line **34'** can be made to supply both air pressure for the seal **40'** and air to the mask regulator **33** which communicates with the area beneath the visor **95** in a substantially conventional manner.

A somewhat different form of helmet and mask integrated structure is shown in FIGS. **12** and **13.** There a visor cover **110** mounted on a helmet shell **111** is provided with a pair of forwardly extending extensions **112** in each of which is a track **113.** A shoe **114** on either side of an eye area shell section **115** is curved to match the curvature of the track **113** and is adapted to slide with respect to the track as the eye area shell section is moved upwardly from the position in FIG. **12** to the position of FIG. **13.** A mask section **116** adapted to extend around the nose and mouth of the wearer is integrally attached to the eye area shell section along the line **117.**

A seal **40''** of the same general character as the seals **40** and **40'** heretofore described, extends around the perimeter of the eye area shell section **115** and the mask section **116,** the seal being supplied with air through an air line **118** fed from a mask regulator **119.** The mask regulator is in turn supplied by an air line **120.**

To additionally hold and guide the eye area shell section and hence what constitutes a mask assembly, there is provided a pair of lift arms **121,** one on each side, one only being shown in FIGS. **12** and **13.** The lift arm **121** is pivoted beneath a pivot connection **122,** the pivot connection being mounted upon and anchored to an ear receptacle **123.**

The ear receptacle **123** is made to act substantially integrally with the helmet shell **110** by employment of a rear strap **124** and an upper strap **125.** The straps may be either a synthetic plastic resin material or a spring metal material which by flexing in the direction of the flat areas permits the ear receptacles to be easily moved upwardly away from the head and ears of the wearer when the helmet is to be donned and which, upon release, will cause the ear receptacles to be sprung inwardly into contact with the area around the ears of the wearer by virtue of the return acting spring effect of the straps **124** and **125.** A chin strap **126** helps hold the assembly in place.

Here, again, except for the movement up and down of the visor and mask combination relative to the helmet shell, the helmet shell and the visor and mask combination have only very limited movement in any other direction thereby making them a substantially integrated structure, which fits under the visor cover **110** when elevated to the position of FIG. **13,** and which snugly seals around the face of the wearer in the position of FIG. **12.**

While the invention has herein been shown and described in what is conceived to be a practical and effective embodiment, it is recognized that departures may be made therefrom within the scope of the invention, which is not to be limited to the details disclosed herein

but is to be accorded the full scope of the claims so as to embrace any and all equivalent devices.

Having described the invention, what is claimed as new in support of Letters Patent is:

1. An integrated helmet and mask structure for the head and face of a wearer, said structure comprising a hard helmet shell, a visor assembly including a mask shell and having an articulated attachment on each side to the helmet shell and valve means on the mask shell including a supply of breathing gas for directing such gas to the mask structure, said mask shell having an inner surface adapted to face the face of the wearer, means for moving the mask shell toward and away from a position adjacent the face of a wearer, a hollow sealing tube extending around the edge of the mask shell on the side thereof facing the face, said sealing tube having a fixed sealed attachment to said mask shell, a hose in communication between the valve means and the sealing tube for introducing breathing gas from the supply for the valve means into said tube, said tube having a normally collapsed condition in a direction perpendicular with respect to the inner surface of the mask shell at all locations of attachment, said sealing tube being withdrawn from the adjacent face of the wearer when not subject to gas under pressure and an inflated condition when subject to gas under pressure, the tube when in inflated condition under pressure of gas from said gas supply being adapted to have a sealing relationship with the face of the wearer.

2. An integrated helmet and mask structure as in claim **1** wherein said valve means is mounted on the helmet shell and includes a mask supply line and a seal supply line, and a valve actuator in operative relationship with the seal supply line.

3. An integrated helmet and mask structure as in claim **2** wherein said valve actuator has an open condition when out of engagement with a portion of said articulated attachment wherein there is an open connection for gas under mask pressure to said sealing tube, said valve actuator having a closed condition when said articulated attachment is at a position of engagement with said valve actuator wherein there is a closed connection shutting off gas under mask pressure to the sealing tube whereby the tube is deflated.

4. An integrated helmet and mask structure as in claim **1** wherein the sealing tube is an endless tube extending around the perimeter of said mask shell.

5. An integrated helmet and mask structure as in claim **4** wherein there is a transverse section of sealing tube extending across the interior of said mask shell at a location intermediate an eye surrounding area and an oral-nasal surrounding area, and wherein said transverse section is connected to the sealing tube and subject to respectively inflated and collapsed conditions when the remainder of the sealing tube is subject to respectively inflated and collapsed conditions.

6. An integrated helmet and mask structure as in claim **5** wherein there is a flexible web between said transverse section of the sealing tube and said oral-nasal surrounding area of the visor, said web comprising a flexible attachment for the sealing tube to the visor.

7. An integrated helmet and mask structure as in claim **1** wherein said sealing tube has a long dimension substantially perpendicular to said inner surface and a substantially short dimension at right angles thereto, said sealing tube having a normally collapsed condition in the direction of said long dimension to which it returns when not subject to internal air pressure.

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