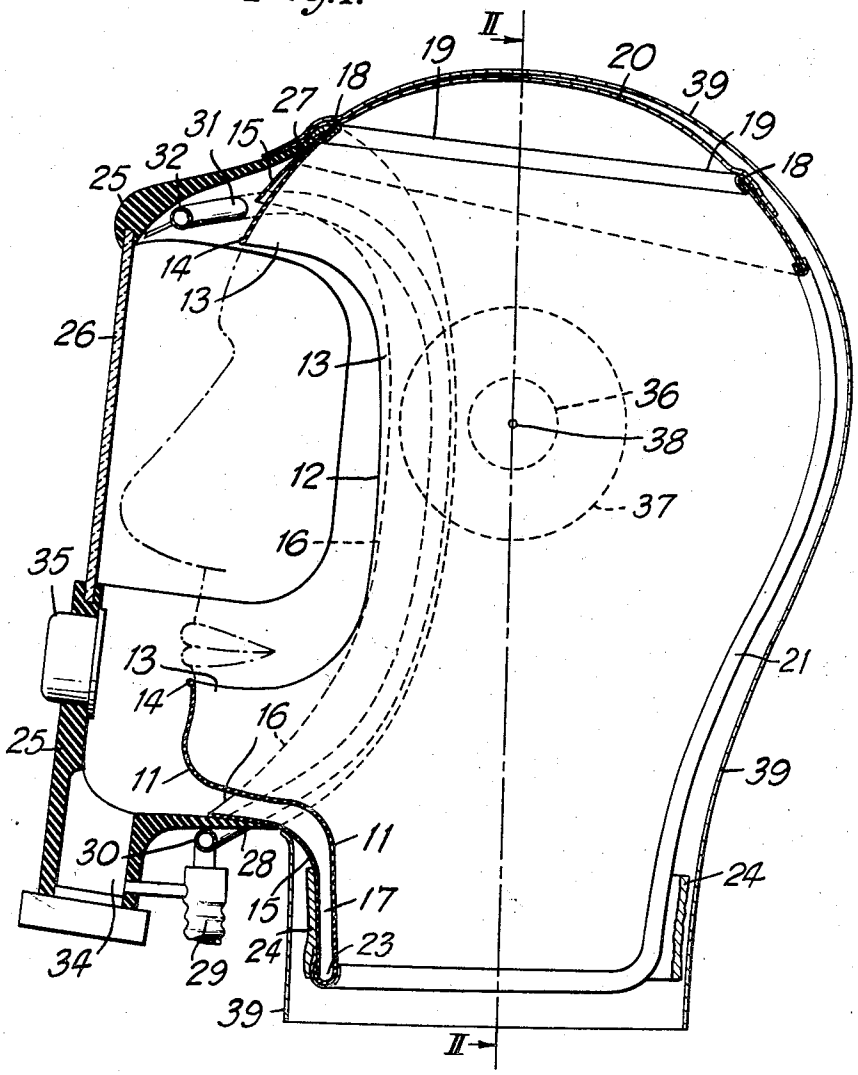
Nov. 25, 1958 J. R. C. QUILTER ET AL 2,861,567

PRESSURIZED HELMET FOR AVIATORS

Filed Jan. 10, 1950

2 Sheets-Sheet 1

Fig. 1.



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2 Sheets-Sheet 2

Fig. 2.

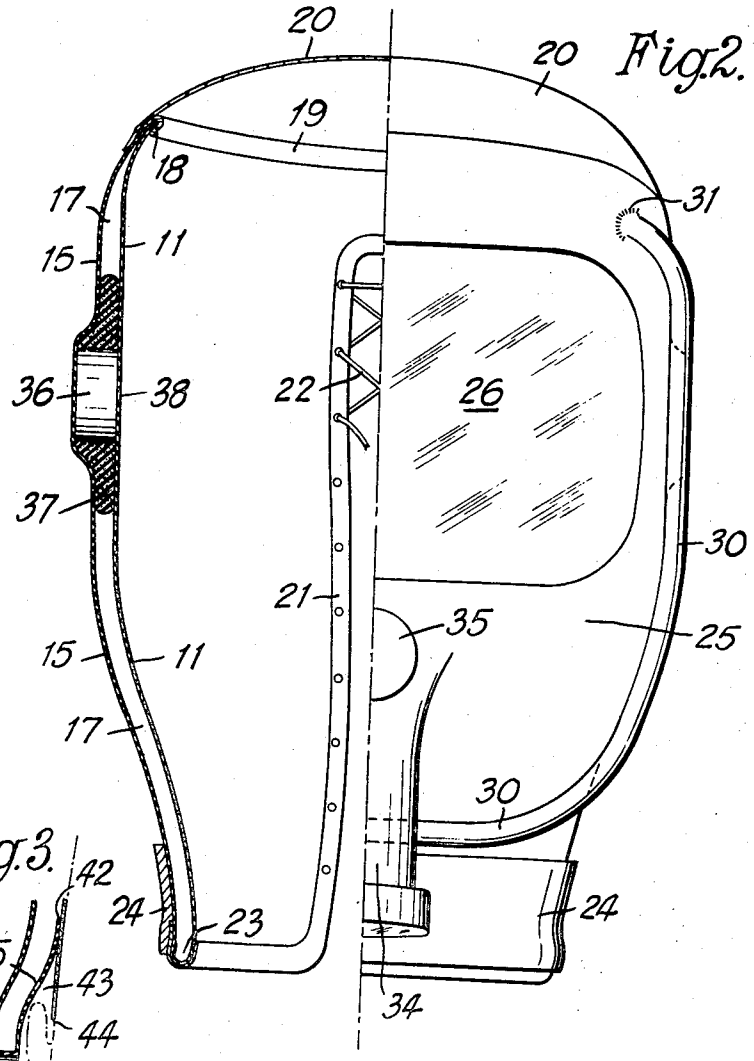
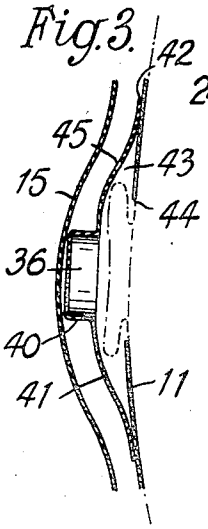


Fig. 3.



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PRESSURIZED HELMET FOR AVIATORS

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Application January 10, 1950, Serial No. 137,692

20 Claims. (Cl. 128—141)

This invention relates to pressurized helmets for aviators, including air crews and passengers, so as to render them capable of breathing a supply of oxygen under pressure when the aircraft reaches high altitudes, for example above 40,000 feet.

It is known that the human body, even when supplied with oxygen at a suitable pressure by way of a nose and mouth mask, is incapable of maintaining life at altitudes in excess of 45,000 feet above sea level, when clothed in normal flying equipment, and having no external partial pressure applied to the head and body. The altitude of 40,000 feet is usually considered to be the safe limit of height at which it is possible to breathe oxygen without the employment of a pressurized suit or provision of a pressurized cabin.

For high-altitude flying, it is therefore necessary to use equipment such as a pressurized helmet in conjunction with a pressurized flying suit which applies pressure to the whole or greater part of the body, oxygen being transmitted through the helmet to the wearer's lungs, for example at approximately 2½ pounds per square inch above the ambient pressure; the helmet should be so arranged as to allow for the discharge of the exhaled gases and should also be adapted to exert pressure upon the external surfaces of the head and neck, or upon certain regions of those surfaces.

Pressurized helmets similar to those worn by divers, with the head totally enclosed in a rigid container sealed around the neck or to an inflatable suit, are obviously not suitable for aviation purposes.

Helmets constructed mainly of flexible materials, with a rigid front window or mask, have already been proposed, the helmet being closed by fastening means extending over the top and down the back of the helmet, and the mask being sealed to the wearer's face by a rubber tube or bladder of approximately annular shape which is inflated by oxygen at a pressure greater than that of the oxygen supplied for breathing purposes; such a helmet must be carefully fitted to each individual wearer, its adjustment being a complex operation, and the pressure differential necessitates a compensatory regulating valve in the oxygen circuit, which makes the helmet complicated and expensive.

The present invention has for its main object to provide an improved pressurized helmet constructed mainly of flexible materials, but dispensing with the compensatory or "pressure-drop" valve, the helmet-inflationary pressure and the breathing pressure being common and equal to one another.

Another object of the invention is to provide an improved pressurized helmet in which the sealing of the helmet to the wearer's face, while exposing his eyes, nose and mouth to the pressure, relies initially upon a light mechanical action at the time of donning the helmet, the seal being thereafter secured by the pressure of oxygen within the helmet, so that the greater this oxygen pressure within the helmet, the greater will be the sealing effect.

A further object of the invention is to provide an improved pressurized helmet which can be donned very readily and is adapted to fit individual heads of different sizes and shapes, so that a relatively small range of helmets need be supplied for fitting snugly to all individual heads.

Other objects of the invention are to give pressurized support to required areas of the head, particularly in the vicinity of the back of the jaw, to balance the pressure upon the ears with that upon the respiratory organs, to prevent the transparent panel or window of the frontal mask from becoming misted over due to the condensation of moisture inside the mask, to equalize the areas exposed to oxygen pressure at the top and bottom of the helmet so as to reduce any tendency to lifting the helmet away from the wearer's body, to increase comfort in wear by dispensing with tight lacing as means for obtaining the pressure seal, and to cheapen construction by dispensing with the compensatory or "pressure-drop" valve which is an expensive and delicate mechanism.

The invention is hereafter more fully described and claimed, reference being had in the description to the accompanying drawings, in which:

Fig. 1 is a sectional elevation of the helmet in a preferred embodiment, parts of the wearer's face being indicated in profile by chain lines.

Fig. 2 is a front elevation of the helmet, the left half being shown in section on the line II—II of Fig. 1.

Fig. 3 is a detail corresponding to part of Fig. 2, and showing an alternative mounting of the ear-piece.

Referring to Figs. 1 and 2, the improved helmet comprises a skin or liner **11** made of flexible material substantially impervious to oxygen under the pressure employed, such as thin sheet rubber, adapted to fit snugly in contact with the wearer's head, the material used being one not liable to cause injury to his skin. This skin **11** substantially encloses the wearer's head and chin, but is formed with a front aperture **12** over his eyes, nose and mouth. The edges **13** of this aperture are sealed to the wearer's face by making light contact therewith at the time of fitting the helmet, the edges being preferably beaded at **14** for reinforcement; these edges are subsequently pressed against the face with a self-sealing action by the pressure of oxygen admitted into the helmet, as hereafter explained. A pressure-retaining outer skin or cover **15**, also made of flexible and gas-proof material such as sheet rubber or plastic, for example polyvinyl chloride, reinforced with nylon, cotton or other fabric so as to withstand internal pressure and to protect the inner skin **11**, surrounds the latter; this cover **15** has a front opening **16**, larger than the front aperture **12** of the inner skin **11**, so that the re-entrant beaded edges **13**, **14** are exposed to the oxygen pressure inside the helmet. The oxygen has also free access to the narrow enclosed space **17** between the skin **11** and the cover **15** at the sides and back of the helmet and around its neck portion, the helmet-inflationary pressure in this space **17** being the same as the oxygen-breath pressure so that no differential compensatory or regulatory valve is required.

Both the skin **11** and the cover **15** are cut away at the top, their adjacent edges **18** being here joined together in a gas-tight manner, as by an adhesive tape **19**, and connected to a panel **20** of flexible material, such as nylon fabric, which rests upon the crown of the wearer's head. The skin **11** and cover **15** are also slit at the back so as to enable the helmet to be readily fitted in place, the adjacent edges of the skin and cover being joined together in a gas-tight manner, as by an adhesive tape **21**, and the opposite sides of the slit being adjustably fastened together, for example by lacing **22**. The adhesive tape **21** joining the edges of the skin and cover is continued from the bottom of the slit around the neck portion of the helmet, so as to reinforce the junction

of the skin and cover at this part; in the construction illustrated, the junction around the neck portion is formed by a channel 23 molded externally at the bottom of the skin 11, the cover 15 having its bottom edge lapped partly around the channel 23 and overlapped by the continuation of the tape 21. A strap 24 extending around the joint may be arranged to assist the closure of the helmet in conjunction with the fastening means 22 for the slit back portions of the skin and cover.

A frontal mask 25, preferably molded of reinforced rubber or plastic material, with an inserted window 26 of transparent plastic or the like, has its edges suitably joined to the skin 11 and cover 15. As seen in Fig. 1, the upper edge of the mask 25 rests upon the cover 15 over the wearer's forehead, and is tapered to a feather-edge 27 which is sealed under the tape 19. At the bottom of the mask, its tapered rear edge 28 is joined to the cover 15 by vulcanization or adhesive, and its lateral edges are similarly joined to the external surface of the cover 15, as indicated by dotted lines in Fig. 1.

The oxygen supply to the helmet from a feed-tube 29 preferably enters a U-shaped tube 30 attached to the mask 25 beneath the wearer's chin, the two limbs of this tube 30 extending up on opposite sides of the window 26 and then curving forwards to enter the upper part of the mask at 31 and to be attached therein to a distribution tube 32; the latter delivers the oxygen substantially above the level of the wearer's eyes and downwardly behind the window 26. A non-return valve of the known kind for compensated exhalation may be attached to a tubular projection 34 at the bottom of the mask.

The oxygen admitted to the mask 25, under a pressure of about 2½ pounds per square inch for example, acts upon the re-entrant beaded edges 13, 14 of the skin 11 so as to seal those edges firmly against the wearer's face; the oxygen also has access to the space 17 between the skin 11 and the cover 15, so that the skin is held in sealed contact with the wearer's head and neck by this same oxygen pressure, which maintains the outer cover or pressure-retaining skin 15 inflated against the ambient atmosphere. The purpose of cutting away the top portion of the inflatable helmet, and fitting the flexible panel 20, is to balance the areas at the top and bottom of the helmet which are subject to the oxygen pressure, thus preventing the helmet from being raised or lowered by the internal oxygen pressure. It will be understood that the actual pressure upon the external surface of the head and neck may be applied by gas or air pressing upon the surface, either directly (as upon the parts exposed by the aperture 12) or through a non-porous flexible medium (as upon the chin and throat covered by the lower part of the skin 11), or by a porous material of limited extensile property which is stretched and tensioned over the surface (as over the crown of the head covered by the panel 20) so as to limit its expansion under the very low ambient pressure at high altitudes.

The usual microphone transmitter is shown diagrammatically at 35, mounted in the mask beneath the window 26; receiving ear-pieces 36 are shown as being fitted in the space 17 between the skin 11 and the cover 15 of the helmet, with shock-absorbing rubber padding or the like as indicated at 37, the skin 11 having small holes 38 therein to register with the positions of these ear-pieces, so as to allow for pressure-balance across the ears and the respiratory organs, while maintaining the seal.

In addition, the entire helmet, with the exception of the frontal mask 25 and the neck portion adjacent to the channel 23, may be covered with nylon fabric or the like, as indicated in Fig. 1 at 39, with lacing at the sides and over the crown of the head for purposes of individual adjustment.

This outer covering or hood 39 may be slotted at the back, over the slit edges of the skin 11 and cover 15, the slot being provided with suitable fastening means, such as a sliding clasp, lacing or the like. The object of this outer covering or hood is mainly to resist the internal oxygen pressure in the space 17 of the helmet and thus to prevent undue swelling of the latter upon inflation; it also serves to restrict its external size and shape, so that it will conform more closely to the individual wearer's head than would otherwise be possible.

Fig. 3 illustrates an alternative mounting for the receiving ear-pieces 36, with the object of providing a more comfortable but highly effective sealing of the inner skin 11 of the helmet around the wearer's ears, without exerting undue local pressure upon the latter. As shown, each ear-piece 36 is mounted in a socket 40 molded in the middle of a rubber capping or patch 41 of sufficient size to fit freely over the ear, its margin 42 being vulcanized or otherwise attached to the skin 11, leaving a cavity 43 to enclose the ear; the skin 11 is formed with a slit or narrow aperture 44 through which the ear can be passed before the helmet is fastened up at the rear, the edges of the aperture then exerting a light mechanical pressure upon the adjacent parts of the head. The patch 41 is formed with a small hole 45 to admit oxygen into the cavity 43 from the space 17, the pressure of this oxygen holding the edges of the slit or aperture 44 in firm contact with the head around and behind the ear, just as the oxygen holds the re-entrant edges 13, 14 of the frontal aperture 12 in contact with the face of the wearer.

It will be understood that various modifications may be made in the construction of the pressurized helmet, as the judgment of the manufacturer may dictate, without departing from the spirit and scope of the present invention as defined in the appended claims.

What we claim is:

1. In a pressurized helmet of the kind described and associated with means for supply of oxygen under pressure, the combination of a skin shaped to fit the wearer's head and held in contact with his head by the pressure of the oxygen supply, said skin being apertured to admit oxygen to the wearer's respiratory organs, and a flexible gas-tight cover loosely enclosing said apertured skin, said cover including means for admission of said oxygen supply.

2. A gas-tight pressurized helmet of the kind described, having an internal skin adapted to enclose substantially the whole of the wearer's head but having an apertured portion adapted to fit around his face, the edges of said apertured portion making light engagement with his face when said helmet is fitted.

3. In a pressurized helmet of the kind described and associated with means for supply of oxygen under pressure, the combination of an outer gas-tight skin, means for admitting said oxygen supply to the interior of the skin and an inner skin shaped to fit the wearer's head, said inner skin being connected to said outer skin and held in contact with the wearer's head by the pressure of said oxygen, said inner skin having at least one aperture to admit oxygen to the wearer's respiratory organs, and the edges of said aperture making light engagement with the wearer's face irrespective of said oxygen pressure.

4. A pressurized helmet for aviators, comprising in combination an inner skin arranged to fit closely around the wearer's head, said inner skin having an aperture located to leave the wearer's face substantially free, an outer cover arranged to fit less closely over said inner skin and face, said outer cover being gas-tight and enclosing the whole of the wearer's head, means for joining the marginal portions of said inner skin and outer cover in a gas-tight manner to provide an inflatable bag, and means for introducing oxygen under pressure into said bag, the oxygen pressure within said bag causing the edges of said aperture to form an airtight seal around the wearer's face.

5. In a pressurized helmet of the kind described, the combination of a thin sheet rubber member enclosing

the wearer's head but having an aperture over his face for breathing purposes, a flexible outer member around said rubber member, said members being fastened together in a gas-tight manner to enclose a narrow space between them, a relatively rigid frontal mask attached to said outer member and forming therewith a gas-tight enclosure in communication with said narrow space, and means for supplying oxygen under pressure to said gas-tight enclosure, said outer member being inflated by the oxygen pressure, and said rubber member being held in contact with the wearer's head by said oxygen pressure in said narrow space and having the edges of its aperture sealed against his face by the same oxygen pressure in said gas-tight enclosure.

6. A gas-tight pressurized helmet of the kind described and associated with means for supply of oxygen under pressure to said helmet, comprising means for admitting said oxygen under pressure to the interior of the helmet for breathing purposes, and internal means for applying the oxygen pressure within said helmet over substantially the whole of the wearer's head while leaving part of his face exposed for breathing the oxygen within said helmet, said pressure-applying means being sealed around the exposed part of the wearer's face by the same oxygen pressure.

7. A gas-tight pressurized helmet of the kind described and associated with means for supply of oxygen under pressure to said helmet, having an internal sheet rubber skin shaped to fit substantially the whole of the wearer's head and chin but having an apertured portion adapted to fit around his face, and means for admitting said oxygen supply to said helmet for holding said skin in contact with the wearer's head and chin, maintaining the edges of said apertured portion in sealing engagement with his face and also supplying oxygen at the same pressure for inhalation through an aperture in said apertured portion.

8. In a pressurized helmet of the kind described, the combination of an inner member made of flexible sheet material and enclosing the wearer's head but having an aperture over his face for breathing purposes, a flexible outer member around said inner member, said members being fastened together in a gas-tight manner to enclose a narrow space between them, a relatively rigid frontal mask attached to said outer member and forming therewith a gas-tight enclosure in communication with said narrow space, means for supplying oxygen under pressure to said gas-tight enclosure, and means for distributing said oxygen behind said mask for passage downwards in front of said aperture, said outer member being inflated by the oxygen pressure, and said inner member being held in contact with the wearer's head by said oxygen pressure in said narrow space with the edges of its aperture sealed against his face by the same oxygen pressure in said gas-tight enclosure.

9. In a pressurized helmet of the kind described, the combination of an inner member made of flexible sheet material and enclosing the wearer's head but having an aperture over his face for breathing purposes, a flexible outer member around said inner member, said outer member having an aperture of larger area than the first-mentioned aperture but located substantially symmetrically in relation thereto, said members being fastened together in a gas-tight manner to enclose a narrow space between them, a relatively rigid frontal mask attached to said outer member and covering the aperture therein so as to form with said outer member a gas-tight enclosure in communication with said narrow space, and means for supplying oxygen under pressure to said gas-tight enclosure, said outer member being inflated by the oxygen pressure, and said inner member being held in contact with the wearer's head by said oxygen pressure in said narrow space, the edges of the first-mentioned aperture being sealed against the wearer's face by the same oxygen pressure in said gas-tight enclosure.

10. In a pressurized helmet of the kind described, the combination of an inner member made of flexible continuous material and enclosing the wearer's head but having an aperture over his face for breathing purposes, the back portion of said inner member being slitted, a flexible outer member around said inner member, the back portion of said outer member being slitted, means for fastening together said inner and outer members in a gas-tight manner to enclose a narrow space between them, a relatively rigid frontal mask attached to said outer member and forming therewith a gas-tight enclosure in communication with said narrow space, and means for supplying oxygen under pressure to said gas-tight enclosure, said outer member being inflated by the oxygen pressure, and said inner member being held in contact with the wearer's head by said oxygen pressure in said narrow space with the edges of its aperture sealed against his face by the same oxygen pressure in said gas-tight enclosure.

11. In a pressurized helmet of the kind described, the combination of a flexible inner member enclosing the wearer's head but having an aperture over his face for breathing purposes, the back portion of said member being slitted vertically, a flexible outer member around said inner member, the back portion of said outer member being slitted vertically, means for fastening together said inner and outer members in a gas-tight manner to enclose a narrow space between them, a relatively rigid frontal mask attached to said outer member and forming therewith a gas-tight enclosure in communication with said narrow space and means for supplying oxygen under pressure to said gas-tight enclosure, said outer member being inflated by the oxygen pressure, and said inner member being held in contact with the wearer's head by said oxygen pressure in said narrow space with the edges of its aperture sealed against his face by the same oxygen pressure in said gas-tight enclosure.

12. In a pressurized helmet of the kind described, the combination of a flexible inner member enclosing the wearer's head but having an aperture over his face for breathing purposes and a portion cut away over the crown of his head, a flexible outer member around said inner member, said outer member having a portion cut away over the crown of the wearer's head, said inner and outer members being fastened together in a gas-tight manner around the wearer's neck the edges of said inner and outer members at said cut away portions being connected together in a gas-tight manner, a flexible panel replacing said cut away portions and connected to said connected edges, and means for supplying oxygen under pressure to the interior of said outer member, the oxygen pressure holding said inner member in contact with the wearer's head, said flexible panel having an area approximately equal to the sectional area of the wearer's neck and being subject to pressure only by the ambient atmosphere, whereby lifting of the helmet by the internal oxygen pressure is substantially obviated.

13. A pressurized helmet of the kind described and associated with means for supply of oxygen under pressure, said helmet comprising a flexible cover inflated by the pressure of the oxygen supply, a flexible liner within said cover, and fastened thereto in a gas-tight manner, said liner being shaped to fit the wearer's head, said liner having an aperture partly exposing the wearer's face to said oxygen pressure for breathing purposes, the edges of said aperture making light engagement with his face when said helmet is fitted, said cover and liner being divided at the rear to facilitate positioning on the wearer's head, and an outer pressure-resistant hood made of flexible material surrounding said cover, said outer hood being divisible at the rear to facilitate positioning on the wearer's head.

14. A pressurized helmet of the kind described and associated with means for supply of oxygen under pressure, said helmet comprising a flexible cover inflated by the pressure of the oxygen supply, a flexible liner within said cover, and fastened thereto in a gas-tight manner,

said liner being shaped to fit the wearer's head but having an aperture over his face for breathing purposes, said liner being held in contact with the wearer's head by the oxygen pressure within said cover, the edges of said aperture making light engagement with his face when the helmet is fitted and being sealed against the face by said oxygen pressure, a face-mask of relatively rigid material attached to said cover, said cover and mask forming a gas-tight enclosure, and an outer pressure-retaining hood of flexible material surrounding said cover but exposing said mask.

15. In a pressurized helmet of the kind described and associated with means for supply of oxygen under pressure, the combination of an outer skin inflated by the pressure of said oxygen supply, and an inner skin shaped to fit the wearer's head and held in contact with his head by the pressure of said oxygen, said outer and inner skins being fastened together in a gas-tight manner to enclose a narrow space between them, said inner skin having at least one aperture to admit oxygen to the wearer's respiratory organs and two other apertures for passage of the wearer's ears from the interior to the exterior of said inner skin, and the edges of all said apertures making light engagement with the wearer's head when the helmet is fitted and being thereafter sealed against the wearer's head by said oxygen pressure.

16. In a pressurized helmet of the kind described, comprising an inner skin arranged to fit closely around the wearer's head but apertured over his face for breathing purposes, a flexible outer member around said inner skin, said inner skin being fastened to said outer member in a gas-tight manner to enclose a narrow space between them, said outer member forming a gas-tight enclosure in communication with said narrow space, means for supplying oxygen under pressure to said gas-tight enclosure, said inner skin being apertured for passage of the wearer's ears to the exterior of said inner skin, and patches covering the wearer's ears when passed to the exterior of said inner skin, said patches being secured to said inner skin and being apertured for leakage of said oxygen pressure from said narrow space to beneath said patches, said apertured inner skin being maintained in sealing contact with the wearer's head around his ears as well as around his face by said oxygen pressure.

17. In a pressurized helmet of the kind described, the combination of a flexible inner member enclosing the wearer's head but having an aperture over his face for breathing purposes, a flexible outer member around said inner member, said outer member having a portion cut away over the crown of the wearer's head, the area of said cut away portion being approximately equal to the sectional area of the wearer's neck, the edge of said outer member at said cut away portion being connected to said inner member in a gas-tight manner, said inner and outer members being connected together in a gas-tight manner around the wearer's neck, and means for supplying oxygen under pressure to the interior of said outer member, the portion of said inner member registering with the cut away portion of said outer member being held only lightly in contact with the wearer's head, and the remainder of said inner member being held firmly in contact with the wearer's head by the pressure of oxygen within said outer member.

18. In a pressurized helmet of the kind described, the combination of a flexible inner member enclosing the wearer's head but having an aperture over his face for breathing purposes, a flexible outer member around said inner member, said outer member having a portion cut away over the crown of the wearer's head, the area of said cut away portion being not less than the sectional area of the wearer's neck, the edge of said outer member at said cut away portion being connected to said inner member in a gas-tight manner, said inner and outer members being connected together in a gas-tight manner around the wearer's neck, and means for supplying oxygen under pressure to the interior of said outer member, the portion of said inner member registering with the cut away portion of said outer member being held in contact with the wearer's head only by the pressure of the ambient atmosphere and the remainder of said inner member being held in contact with the wearer's head by the pressure of oxygen within said outer member.

19. In a pressurized helmet of the kind described, the combination of a flexible inner member enclosing the wearer's head but having an aperture over his face for breathing purposes, a flexible outer member around said inner member, said inner and outer members having portions cut away over the crown of the wearer's head, the edges of said inner and outer members at said cut away portions being connected together in a gas-tight manner, said inner and outer members being connected together in a gas-tight manner around the wearer's neck, a flexible but inextensible panel connected to the edges of said inner and outer members at said cut away portions, and means for supplying oxygen under pressure to the interior of said outer member, the oxygen pressure holding said inner member in contact with the wearer's head, and said flexible panel being tightened over the crown by the tension in said outer member due to said oxygen pressure.

20. In a pressurized helmet of the kind described, the combination of a flexible inner member enclosing the wearer's head but having an aperture over his face for breathing purposes, a flexible outer member around said inner member, said inner and outer members having approximately equal portions cut away over the crown of the wearer's head, the area of each said cut away portion being not less than the sectional area of the wearer's neck, the edges of said inner and outer members at said cut away portion being connected together in a gas-tight manner, said inner and outer members being connected together in a gas-tight manner around the wearer's neck, a flexible panel connected to the edges of said inner and outer members at said cut away portions, and means for supplying oxygen under pressure to the interior of said outer member, the oxygen pressure holding said inner member in contact with the wearer's head, and the ambient pressure holding said flexible panel in contact with the crown of his head.

References Cited in the file of this patent

UNITED STATES PATENTS

2,465,973	Bulbulian	Mar. 29, 1949

FOREIGN PATENTS

801,610	France	of 1936
51,303	Germany	of 1890