BREATHING EQUIPMENT

The invention relates to protective breathing equipment comprising a breathing mask, a harness enabling it to be put quickly into place on the face, and sometimes also goggles for providing protection against smoke, and optionally integrated with the mask.

Protective breathing equipment that can be donned quickly is already known (EP-A-0 288 391), in particular for the technical crew of passenger carrying airplanes, the equipment comprising a breathing mask provided with a regulator for connection to a source of pressurized breathing gas (generally oxygen) and a harness having at least one extensible strap whose ends are connected to the mask and which includes an element that is temporarily inflatable by the pressurized gas to lengthen the strap until it is large enough to enable the user to engage the harness on the head, and can be scavenged to cause the strap to tighten so as to press the mask against the face and hold it in place.

The equipment described by way of example in document EP 0 288 391 enables the pressure in the inflatable element to be adjusted so as to give it a value between the complete deflation pressure and the fully inflated pressure so as to reduce the discomfort created by wearing the mask continuously under conditions of flight that make it compulsary to wear the mask.

That solution is entirely satisfactory from the comfort point of view. However, it complicates the pressure control means. Furthermore, inevitable leaks, e.g. due to the porosity of the inflatable element, lead to breathing gas under pressure being consumed during periods while the mask is being used in the "comfort" position.

The present invention seeks in particular to provide protective breathing equipment that provides a degree of comfort at least equivalent to that of existing equipment during periods in which the mask is worn while there is

no need to press it hard against the face to overcome the high pressure of the breathing gas, and that reduces breathing gas consumption during these periods.

For this purpose, the invention provides in particular equipment of the above-defined kind, in which the extensible strap is connected to the face-piece via at least one mechanical member of length that is adjustable by the user while wearing the equipment.

The mechanical member may be constituted by a rack fixed to one end of the strap and a pawl carried by the face-piece, allowing the strap and the face-piece to move relative to each other in the tightening direction, the pawl being releasable to allow the rack to move in the opposite direction. This disposition can be inverted, with the rack then being fixed to the face-piece.

The pneumatic connection between the face-piece, which carries the means controllable by the user for inflating the inflatable element, and said inflatable element is designed to allow for relative sliding. In order to ensure that the inflation command causes the rack to come into its position of maximum tightness, this result can be achieved by extending the rack by a hollow piston that is movable in a cylinder fast with the face-piece. The piston then divides the cylinder into two compartments, one of which is connected to the inflation feed for the inflatable element and the other of which is connected to the atmosphere.

The protection equipment can be associated with an aneroid capsule constituting an altitude detector for automatically causing the cylinder compartment to be put at the pressure which gives rise to maximum tightening in the event of depressurization of the environment.

The above features and others will appear more clearly on reading the following description of particular embodiments given as non-limiting examples. The description refers to the accompanying drawings, in which:

- Figure 1 is a perspective view showing the outer appearance of protective equipment suitable for implementing the invention;

- Figure 2 is a diagrammatic section view on a larger scale showing the components of the equipment that enable the equipment to be donned quickly and that enable the pressure with which the mask is pressed against the face to be adjusted; and

- Figure 3 is similar to a fraction of Figure 2 and shows a modified embodiment.

The emergency breathing equipment shown in Figure 1 is shown in the conditions when the harness is inflated, and it can be considered as comprising a mask 8 and a harness 10. The mask shown has an oral-nasal face-piece which is fixed to a demand regulator 13 and to a rigid connection block 12. The connection block is provided with a coupling for connection with a flexible hose 14 for connection to a source of pressurized breathing gas (generally oxygen). The harness shown has two straps 16, each having an inner tube 17 made of a material that allows the tube to lengthen and contained in an inextensible sheath 19 that limits the extent to which the tube can lengthen (Figure 2). Depending on the intended use, the regulator can operate with or without dilution with air drawn from the cockpit, and with or without an option to be put under positive relative pressure.

The regulator is connected to the feed hose 14 via the connection block 12. The block carries means for manually controlling inflation of the straps 16, e.g. constituted by a cock designed to be actuated by manually squeezing together two lugs 18 carried by the connection block 12, one of which lugs is mounted to tilt.

The cock is constituted in such a manner as to put a volume inside the connection block 12 and the straps 16 into communication with the atmosphere when it is free, thus allowing the straps to deflate and retract, thereby

pressing the mask against the face. When the cock is actuated, it admits pressurized gas from the feed hose 14 into the inside volume, thereby causing the straps to lengthen sufficiently to enable the equipment to be donned quickly.

In accordance with the invention, at least one of the branches of the harness is connected to the demand regulator via a mechanical length-adjustment member. In the example shown in Figure 1, two such members 20 are provided, each connecting one end of the harness to the regulator or to the connection block. The length of the inner tube 17 when in the relaxed condition is selected so as to ensure that the harness will still press the mask against the face with sufficient pressure when the adjustment member is at its minimum length, even for wearers having the smallest expected head size. It is generally accepted that the minimum round-the-head measurement is of 56 cm.

The cock enabling the harness to be completely inflated or scavenged can have the conventional structure shown in Figure 2. In which case, there is a passage 22 in the housing of the rigid connection block 12 with a plunger 24 mounted in the passage to constitute a dual shut-off member. One end of the passage is connected to the inlet for pressurized breathing gas. The other end is open to the atmosphere. A first O-ring 26 carried by the plunger 24 bears against a cylindrical portion of the passage 22 and separates the gas inlet from an inside volume of the block so long as the plunger 24 is held by the admission pressure in contact with the lug 18 in rest position. When the lug 18 is moved manually in the direction shown by arrow f, it pushes the plunger to a position where it puts the gas inlet into communication with the inside volume. Simultaneously, the displacement of the plunger brings a second O-ring 28 to bear against a frustoconical portion of the passage and separates the inside volume from the atmosphere.

The adjustment member 20 includes a rack 30 extended by an endpiece 32 having an airtight connection with the end of the harness. At its end opposite from the endpiece 32, the rack is extended by an annular piston 34.

The portion of the adjustment member that is slidable relative to the rack is constituted by an arm of the housing 12 which houses a rack pawl 36 fitted with an unlocking pushbutton 38. A spring 40 urges the pawl 36 into a position where it engages the rack 30 and prevents it from moving in a direction that corresponds to lengthening the adjustment member. The arm of the housing also contains a cylinder which is divided by the annular piston 34 into a compartment 42 connected to the atmosphere via a port 44, and a second compartment 46.

The inside volume of the cock communicates with the tube 17 via holes in alignment formed through the arm of the housing, the rack 30, and the endpiece 32. A path 47 balances the pressure that exists in the compartment 46 with the pressure in the harness. O-rings carried by the piston 34 separate the compartments 42 and 46 in leakproof manner.

The equipment is used as follows.

Donning:

When the user desires to put on the mask which is then in its storage box, the user grasps the connection block 12, extracts it from the box, and squeezes the lugs 18 together.

Breathing gas is then admitted into the harness and, via passage 47, into compartment 46. The force exerted on the annular piston 34 moves it (to the right in Figure 2) so as to bring the adjustment member into its minimum-length position. Once the user has placed the mask against his face, he releases the lugs 18. The mask is then pressed against the face with maximum force.

Reducing tightness:

In order to reduce tightness, it suffices for the user to press briefly the pushbutton 38 to release the

pawl 36 temporarily. The rack can then move backwards. As soon as the pushbutton 38 is released, the pawl 36 is driven by the spring 40 to lock the rack again.

Increasing tightness:

To increase the tightness of the mask, it suffices to push in the rack, which can be provided with a collar 50 for this purpose.

If emergency tightening is necessary, it can be performed by pushing home the collar 50 of the adjustment member (or of each adjustment member). It is also possible to perform such tightening by fully inflating the harness by squeezing the lug 18. The compartment 46 is then pressurized and "resets" the rack by moving it into the rightmost position. As soon as the lug is released, the harness returns to its position of maximum tightness.

To make the adjustment more progressive, it is possible to replace the one-piece pawl 36 and pushbutton 38 unit by two pieces which are coupled together by a spring, and to provide the pushbutton with a ratchet that is capable of engaging in an appropriate set of teeth of the rack 30. This second set of teeth of the rack 30 allows an advance of one step only for each press on the pushbutton 38.

Removing the mask:

When the user desires to put the mask back into its box, he inflates the harness fully by acting on the lug 18. The pressure in the compartment 36 automatically resets the rack. Once the mask has been removed, the user merely has to release the lug 18 for the harness to become flexible again and allow the mask to be stored in a state such that tightness will be maximum in the event of the equipment being put back on the head.

When two mechanical adjustment members are provided, only one of them needs to have a pneumatic connection with the straps.

Figure 3 shows a modified embodiment which gives rise to maximum tightness in the event of depressurization. In figure 3 some of the elements already shown in Figure 2 are designated by the same reference numerals. Emergency tightening is caused by pressurization of compartment 46 caused by a barometer capsule 52. This capsule is subjected to ambient pressure. It is provided with a push rod 54 which forces opening of a valve 56 when ambient pressure drops below a predetermined value. The valve 56 then communicates the pressurized breathing gas inlet with the compartment 46 that is connected to the atmosphere via a constriction 58 that allows the compartment 46 subsequently to deflate slowly. A check valve 60 connects the downstream side of the valve 56 to the internal volume of the housing 12 and to the harness so as to avoid gas escape to the surrounding air.

In the event of depressurization while the rack is in an intermediate position, the capsule causes the compartment 46 to be put under pressure and causes full reset of the rack. The constriction 58 allows the pressure in the compartment 46 to drop only from the moment when it is no longer fed from the valve 56. The check valve 60 prevents flow to the surrounding air while the compartment 46 is being pressurized.



CLAIMS

1/ Protective breathing equipment comprising a breathing mask provided with a regulator for connection to a source of pressurized breathing gas (generally oxygen) and a harness having at least one extensible strap whose ends are connected to the mask and which includes an element (17) that is temporarily inflatable by the pressurized gas to lengthen the strap until it is large enough to enable the user to engage the harness on the head, and exhaustible to allow the strap to tighten so as to press the mask against the face and hold it in place, the equipment being characterized in that the extensible strap is connected to the face-piece by at least one mechanical member (20) of length that is adjustable by the user while wearing the equipment.

2/ Equipment according to claim 1, characterized in that the mechanical member comprises a rack (30) fixed to one end of the strap and a pawl (36) carried by the face-piece, allowing the strap and the face-piece to move relative to each other in the tightening direction, the pawl being releasable to allow the rack to move in the direction opposite to tightening.

3/ Equipment according to claim 2, characterized in that the pawl is disengagable by means of a pushbutton (38) acting against a spring (40).

4/ Equipment according to claim 2 or 3, characterized in that the rack is extended by a hollow annular piston (34) movable in a cylinder secured to the face-piece, the piston subdividing the cylinder into two compartments, comprising a first compartment connected to the feed for the inflatable element and another compartment provided with a calibrated leak to the atmosphere, pressurizing the first compartment causing the rack to be moved.

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5/ Equipment according to claim 4, characterized in that it includes an aneroid capsule (52) constituting an altitude detector and automatically putting the first compartment of the cylinder into communication with the source to cause maximum tightening in the event of depressurization of the surroundings.

6/ Equipment according to claim 5, characterized in that the aneroid capsule controls a valve for putting the first compartment into communication with the pressurized breathing gas inlet.

7/ Equipment according to claim 2 or 3, characterized in that it includes an aneroid capsule for automatically tightening the mechanical member in the event of depressurization.