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(54) Breathing apparatus.

(57) A breathing apparatus comprising a hood has inflatable means for reducing the dead volume of the hood. The inflatable means may be a chamber formed by a flexible membrane attached to the hood, the chamber being inflatable by the individual exhaling through a one-way valve or by reduced pressure in the hood created as the individual inhales thereby causing air to flow into the chamber through a one-way valve from outside the hood.

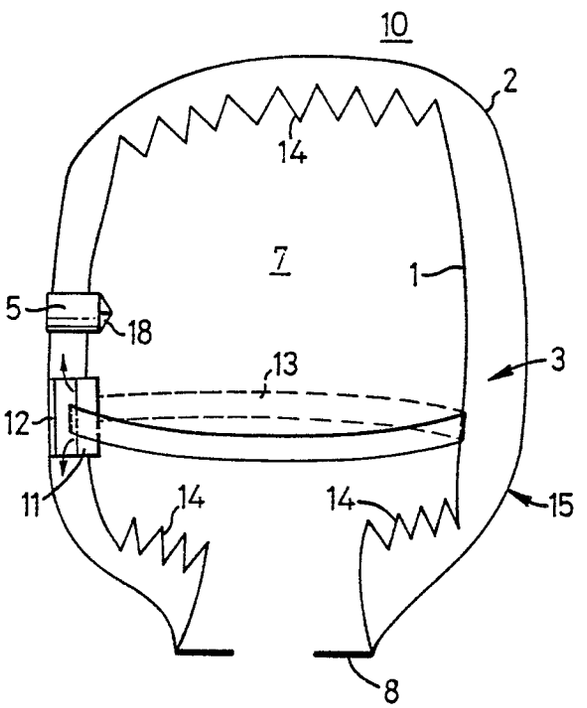

FIG. 1

BREATHING APPARATUS

This invention relates to breathing apparatus and in particular to breathing apparatus suitable for protecting individuals from toxic or noxious atmospheres.

It is known to provide breathing apparatus in the form of a hood of heat resistant plastics material which may be used in the event of a fire related emergency to protect individuals from the effects of smoke and fire. It is also known to provide protective masks which may be used in the event of an emergency to protect individuals from the effects of spillage, release etc. of toxic or noxious liquids, gases, vapours, dusts and the like. Such protective hoods and masks may be pulled over the head of the individual and provide a limited volume of clean air which may suffice to sustain the individual whilst he or she attempts to escape from the emergency. Such hoods and masks may suitably be used in emergencies in confined spaces, such as hotels, factories, homes, vehicles, subway trains, ships, aircraft and the like. The limited amount of clean air may be provided by means of suitable filters. Alternatively, compressed oxygen or air may be supplied to the hood or mask.

A problem often associated with the use of such breathing apparatus, especially when used in conjunction with filters is that exhaled air tends to accumulate in the dead volume of the hood or mask and can then be re-inhaled. This recycled air contains a higher concentration of carbon dioxide and a lower concentration of oxygen than fresh air and the discrepancy tends to increase with use. The build up of carbon dioxide and reduction in oxygen are particularly acute when the individual is performing strenuous activity such as attempting to escape from a hazardous environment.

The build up of carbon dioxide can cause discomfort to the individual and at higher levels can lead to hyperventilation and exhaustion. The fall in oxygen concentration can lead to dangerous hypoxia.

One way of reducing the effect of recirculated carbon dioxide and falling oxygen concentration is to reduce the dead-volume of the hood or mask (the dead-volume is the region between the head of the individual and the inner surfaces of the hood or mask) so that exhaled air is less likely to accumulate and the individual wearing the hood or mask breathes a higher proportion of fresh air provided by filters or by a compressed air supply. This is difficult to achieve when it is desirable to have a standard size hood which must be of sufficient size to fit a large head, for example about 7 litres head volume, and a small head, for example about 3 litres head volume, since this could result in up to about 4 litres being enclosed in the hood in which recycled air can build up.

Thus, according to the present invention there is provided breathing apparatus comprising a hood adapted to enclose the head of an individual, characterised in that the hood has inflatable means capable of reducing the dead-volume of the hood.

In use, the hood is placed over the head of an individual so that the head is enclosed by the hood and the inflatable means is inflated so as to reduce the dead-volume of the hood.

Breathable gas may be supplied to the hood by means which may comprise suitable filters which allow air from outside the hood to pass to the enclosed region. Breathable gas may be supplied to the hood as compressed air or oxygen through a suitable demand valve to the enclosed region.

The inflatable means may be inflated by means of a compressed air or gas supply either separately provided for the purpose or through a suitable regulator from a compressed air or oxygen containing gas supply for the individual. The inflatable means may thus be controlled automatically or manually by the individual.

According to one embodiment of the present invention the inflatable means may be one or more inflatable balloons or bags which may be inflated by air, gas or liquid to reduce the dead-volume of the hood.

According to a second embodiment of the present invention the inflatable means may comprise a flexible membrane attached to the hood to define a substantially air-tight chamber whereby inflation of the chamber reduces the dead-volume of the hood. The membrane should be flexible so that when the chamber is inflated the membrane is urged towards the head of the individual so as to reduce the dead-volume of the hood. The membrane may be attached to the hood to give any required shape to the chamber, provided the flexibility of the membrane is maintained so that it can be urged towards the head of the individual so as to reduce the dead-volume of the hood. The membrane may have pleats or folds to provide flexibility.

In this second emodiment of the present invention the chamber may be inflated through a one-way valve. In one embodiment the one-way valve may be adapted to allow air to pass from the dead-volume of the hood to the chamber such that the chamber may be inflated by an individual wearing the hood and exhaling through the one-way valve. The valve should have a cracking pressure which is

set to allow air exhaled by the individual to tend to pass into the air-tight chamber rather than leave the hood by another route (eg through the filters) until the chamber is inflated. Preferably, the membrane is more flexible than the hood. The valve may be a flap valve or a step valve. The one-way valve may be positionable adjacent the nose and mouth of the individual by means of an elasticated strap which may be placed around the head of the individual. If such an embodiment uses filters these may tend to be pushed against the face of the individual by the strap so spacers may be required to keep the filters away from the face of the individual so as to maintain their available area. The one-way valve may have a breathing tube into which the individual may breathe. This tube may direct the exhaled air towards the valve whilst still being in communication with the dead-volume. In use, the hood is placed over the head of an individual so that the head is enclosed by the hood. As the individual exhales onto the one-way valve, air tends to pass through the one-way valve to inflate the chamber rather than leaving the hood by another route (eg through filters). As the chamber is inflated the flexible membrane is urged towards the head of the individual reducing the dead-volume of the hood.

In another embodiment the one-way valve may be adapted to allow air to pass from outside the hood into the chamber and the hood is less flexible than the membrane. In use, whenever a reduced pressure is created in the dead-volume of the hood, air is drawn from outside the hood, through the one-way valve into the chamber so as to inflate it. This urges the flexible membrane towards the head of the individual and reduces the dead-volume of the the hood. The pressure inside the enclosed region of the hood may be reduced by the individual inhaling air from outside the hood through filters offering some resistance to air flow. The pressure inside the dead-volume of the hood may also be reduced by the individual inhaling air from a compressed air or oxygen supply through a suitable demand valve. The one-way valve should have as low a resistance as possible to air flow from outside the hood to the chamber. Thus, when air is provided to the individual through filters, the flow of air from outside through the one-way valve should be freer than the flow through the filters. In order to retain vision for the individual in the situation that the air outside the hood contains smoke and soot, the membrane may be attached to the inner surfaces of the hood around a window area of the skin of the hood so that the chamber is not present in front of the individual's eyes. Alternatively, the one-way valve may have a low resistance particulate filter to remove soot and smoke from the air entering the chamber, the membrane and the hood both being transparent. It is envisaged that in this embodiment the hood may have more than one one-way valve. In this embodiment it is believed that as inspiratory pressure of the user increases through physical exertion or blocking of filters with smoke and soot particles the efficiency of air being drawn into the chamber will increase and thus will off-set the tendency for the dead-volume to increase with increased ventilation.

If the breathing apparatus uses filters to provide air to the individual from outside, then the hood may also have a low cracking pressure one-way valve which allows air to pass from the dead-volume to the outside. This valve may be of the mushroom type. This offers the advantage that exhaled air may leave the hood without passing through the filters and so may increase the operating life of the filters. Furthermore, by providing a low resistance route for exhaled air to leave the hood, the dead-volume of the hood may be less likely to increase due to increasing resistance to exhaled air passing out through the filters as they clog up with smoke and soot particles.

It is envisaged that other methods of reducing the dead-volume of the hood may be used in conjunction with the method of the present invention, for example, a system of one or more elasticated straps to urge the hood or membrane towards the head of the individual.

It is envisaged that the hood may be fabricated in such a way as to minimise the dead-volume of the hood. Thus for example, if the hood comprises two substantially rectangular sheets of material joined along a seam on three sides to form a bag then the seam may be arranged in use to be positioned from front to back of the head rather than side to side of the head.

It is envisaged that the hood may also have other means for reducing the build up of carbon dioxide, for example an adsorbant for carbon dioxide within the dead volume of the hood.

According to the present invention there is also provided a method for protecting an individual comprising enclosing the head of the individual within the hood of a breathing apparatus, characterised in that the method also comprises inflating an inflatable means within the enclosed region to reduce the dead-volume of the hood.

The invention will now be described by way of example only and with reference to the accompanying drawings.

Figure 1 represents in schematic part cross-section a breathing apparatus according to the present invention. Figure 2 represents in schematic part cross-section a breathing apparatus according to the present invention having a breathing tube. Figure 3 represents in schematic part cross-section a breathing apparatus according to the present

invention.

In Figure 1, a breathing apparatus comprises a hood (15) adapted to enclose the head (not shown) of an individual. The hood (15) comprises a flexible internal membrane (1) and a skin (2), the internal membrane being attached to the skin to define therebetween an inflatable substantially air-tight chamber (3). The skin and the membrane may be suitably transparent, heat resistant plastics material. The hood has a dead-volume (7) which is the region between the head of the individual and the inner surfaces of the hood. The hood has a one-way valve (11) which is adapted to allow air to flow from the dead-volume (7) of the hood (15) into the chamber (3). The valve (11) is attached to the skin by a stiffener (12). The valve (11) has an elasticated strap (13) which in use, urges the valve towards the nose and mouth (not shown) of an individual wearing the hood. The strap is positioned between the skin of the hood and the membrane and may be attached to the membrane so as to urge it towards the head of the individual. The hood has suitable filters (5) (shown schematically) through which air may be drawn from outside (10) by an individual (not shown) wearing the hood. The filters have spacers (18) to keep them away from the face of the individual to maintain their available area. The hood has a neck seal (8) which may be an elasticated annular ring which seals against the neck (not shown) of the individual. The internal membrane (1) has folds (14) or pleats which provide flexibility. The cracking pressure of the one-way valve is selected so that in use exhaled air tends to pass into the chamber rather than out. through the filters until the chamber is inflated.

In use, the hood (15) is placed over the head (not shown) of an individual so that the head of the individual is enclosed by the hood. The one-way valve is held adjacent to the nose and mouth of the individual by the strap (13). As the individual inhales through the filters and exhales, some of the exhaled air passes through the one-way valve (11) and inflates the chamber (3), urging the internal membrane (1) towards the head of the individual and reducing the dead-volume of the hood. The exhaled air tends to pass into the chamber rather than out through the filters until the chamber is inflated.

Figure 2 represents a breathing apparatus similar to that in Figure 1 except that it does not have the elasticated strap (13), and has a breathing tube (16) provided on the valve. The breathing apparatus comprises a hood (15) adapted to enclose the head (not shown) of an individual. The hood (15) comprises a flexible internal membrane (1) and a skin (2), the membrane being attached to the skin to define therebetween an inflatable substantially air-tight chamber (3). The skin and the membrane may be suitably transparent, heat resistant plastics material. The hood has a dead-volume (7) which is the region between the head of the individual and the inner surface of the hood. The hood has a one-way valve (11) which is adapted to allow air to flow from the dead-volume (7) of the hood (15) into the chamber (3). The valve (11) is attached to the skin by a stiffener (12). The valve (11) has a breathing tube (16) which has slots (17) in communication with the dead-volume (7). The breathing tube is capable of directing exhaled air from the individual towards the valve. The individual may inhale air from the dead-volume through the slots (17). The hood has suitable filters (5) (shown schematically) through which air may be drawn from outside (10) by an individual (not shown) wearing the hood. The filters may have spacers (18) to keep them away from the face of the individual to maintain their available area. The hood has a neck seal (8) which may be an elasticated annular ring which seals against the neck (not shown) of the individual. The internal membrane (1) has folds (14) or pleats which provide flexibility. The cracking pressure of the one-way valve is selected so that in use exhaled air tends to pass into the chamber rather than out through the filters until the chamber is inflated.

In use, the hood (15) is placed over the head (not shown) of an individual so that the head of the individual is enclosed by the hood. The individual places the breathing tube in his mouth and exhales. The tube directs the exhaled air towards and through the one-way valve (11) so as to inflate the chamber (3) urging the internal membrane (1) towards the head of the individual and reducing the dead-volume (7) of the hood. The exhaled air tends to pass into the chamber rather than out through the filter until the chamber is inflated. The individual inhales air through the filters and thence through the slots (17) in the breathing tube.

In Figure 3 a breathing apparatus comprises a hood (15) adapted to enclose the head (not shown) of an individual. The hood has a dead-volume (7) which is the region between the head of the individual and the inner surfaces of the hood. The hood comprises a flexible internal membrane (1) and a less flexible skin (2), the internal membrane being attached to the skin to define therebetween a substantially air-tight chamber (3). The skin and the membrane may be suitably transparent, heat resistant plastics material. The skin (2) has a one-way valve (4) (shown in schematic form) adapted to allow air from outside (10) the hood to pass into the chamber (3). The one-way valve (4) has a low resistance filter (9) to remove smoke and soot particles. The hood has a suitable filter (5) (shown in schematic form) through which air may be drawn from outside (10) by an individual (not shown)

wearing the hood. The hood has a neck seal (8) which may be an elasticated annular ring which seals against the neck (not shown) of the individual. The hood also has a one-way mushroom valve (6) (shown in schematic form) adapted to allow exhaled air from the individual (not shown) to pass from the dead-volume (7) to the outside (10).

In use, the hood is placed over the head (not shown) of an individual. Whenever a reduced pressure is created in the dead-volume (7), by the individual inhaling through the filter (5), air tends to be drawn in from outside (10) the hood through the one-way valve (4) so as to inflate the chamber (3), urging the internal membrane (1) towards the head of the individual and reducing the dead-volume (7) of the hood. The cracking pressures of the valve (4) is selected so that in use air tends to pass into the chamber until it is inflated. When the individual exhales, air tends to pass out of the dead-volume (7) through the one-way mushroom valve (6) rather than through the filter (5).

Claims

1. Breathing apparatus comprising a hood adapted to enclose the head of an individual, characterised in that the hood has inflatable means capable of reducing the dead-volume of the hood.

2. Breathing apparatus according to claim 1 in which the inflatable means comprises a flexible membrane attached to the hood so as to define a substantially air-tight chamber whereby inflation of the chamber reduces the dead-volume of the hood.

3. Breathing apparatus according to claim 2 in which the chamber may be inflated through a one-way valve.

4. Breathing apparatus according to claim 3 in which the one-way valve is adapted to allow air to pass from the dead-volume of the hood to the chamber such that the chamber may be inflated by an individual wearing the hood, and exhaling through the one-way valve.

5. Breathing apparatus according to claim 4 in which the one-way valve is a flap valve or step valve.

6. Breathing apparatus according to claim 4 in which the one-way valve is positionable, in use, adjacent the nose and mouth of an individual wearing the hood by means comprising an elasticated strap.

7. Breathing apparatus according to claim 6 in which the strap is attached to the membrane so as to urge it towards the head of the individual.

8. Breathing apparatus according to claim 4 in which the one-way valve has a breathing tube adapted to direct the exhaled air of the individual towards the valve.

9. Breathing apparatus according to claim 3 in which the one-way valve is adapted to allow air to pass from outside the hood into the chamber and the hood is less flexible than the membrane.

10. Breathing apparatus according to claim 9 in which the one-way valve has a particulate filter.

11. Breathing apparatus according to claim 9 or claim 10 in which the hood has a one-way valve adapted to allow exhaled air to pass from the dead-volume to the outside.

12. Breathing apparatus according to any one of claims 2 to 11 in which the membrane has pleats or folds.

13. Breathing apparatus according to any one of the preceding claims in which the hood comprises heat resistant plastics material.

14. Breathing apparatus according to any one of the preceding claims in which the hood has one or more elasticated straps capable of urging the hood towards the head of the individual.

15. Breathing apparatus according to any one of the preceding claims comprising a hood of two substantially rectangular sheets of material joined along a seam on three sides such that in use the seam is positionable from front to back of the head of an individual.

16. Breathing apparatus according to any one of the preceding claims in which the hood has means for absorbing carbon dioxide in the dead volume of the hood.

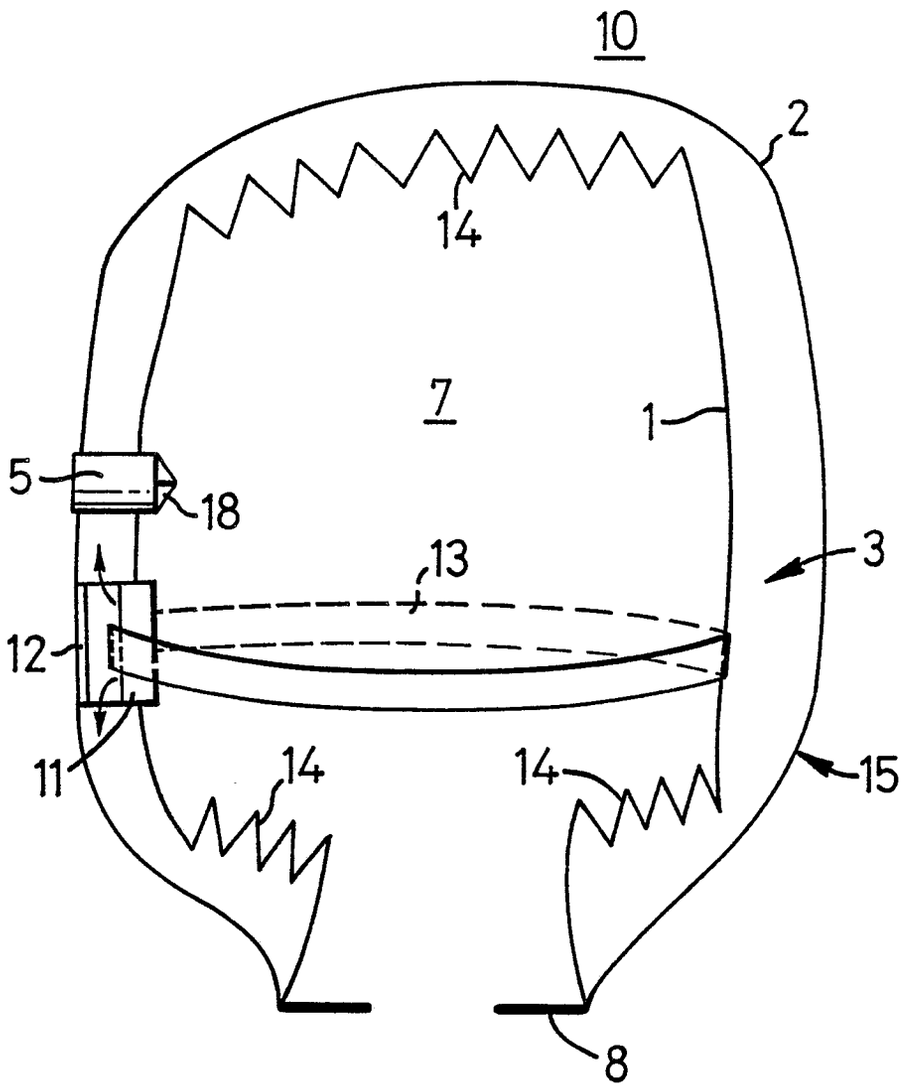

FIG. 1

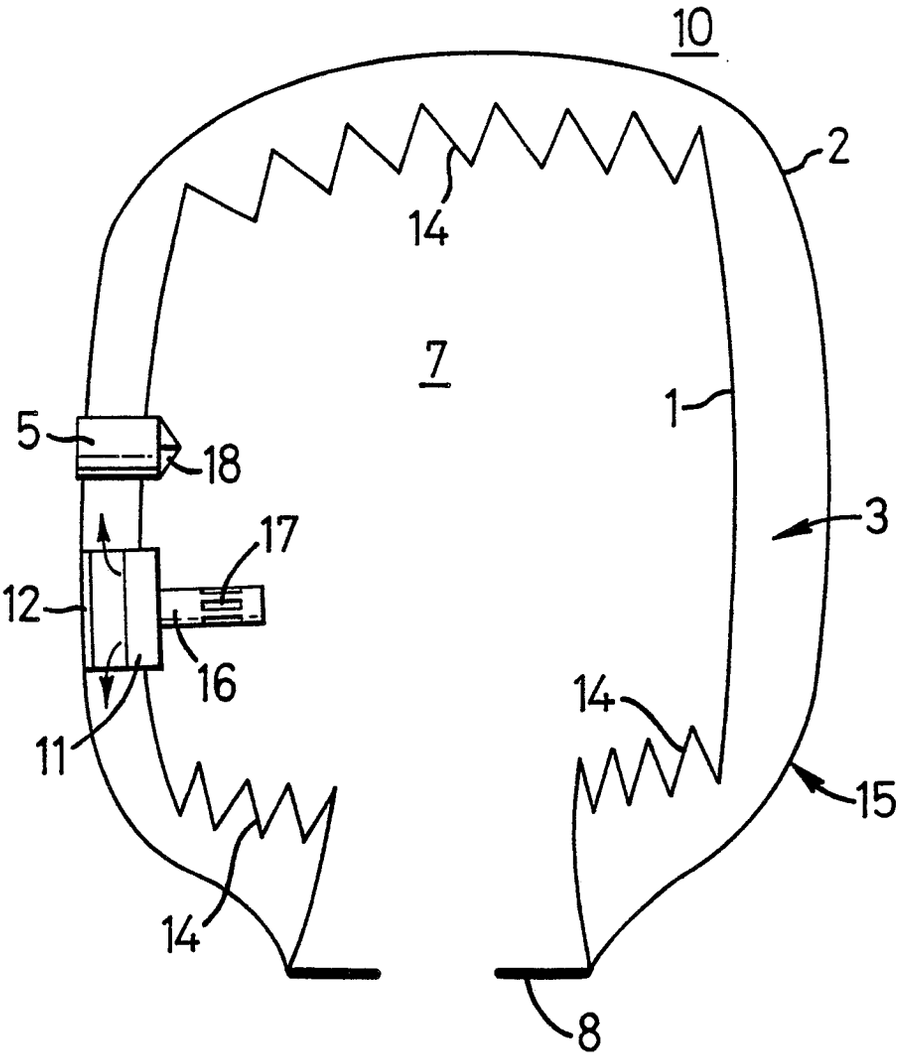

FIG. 2

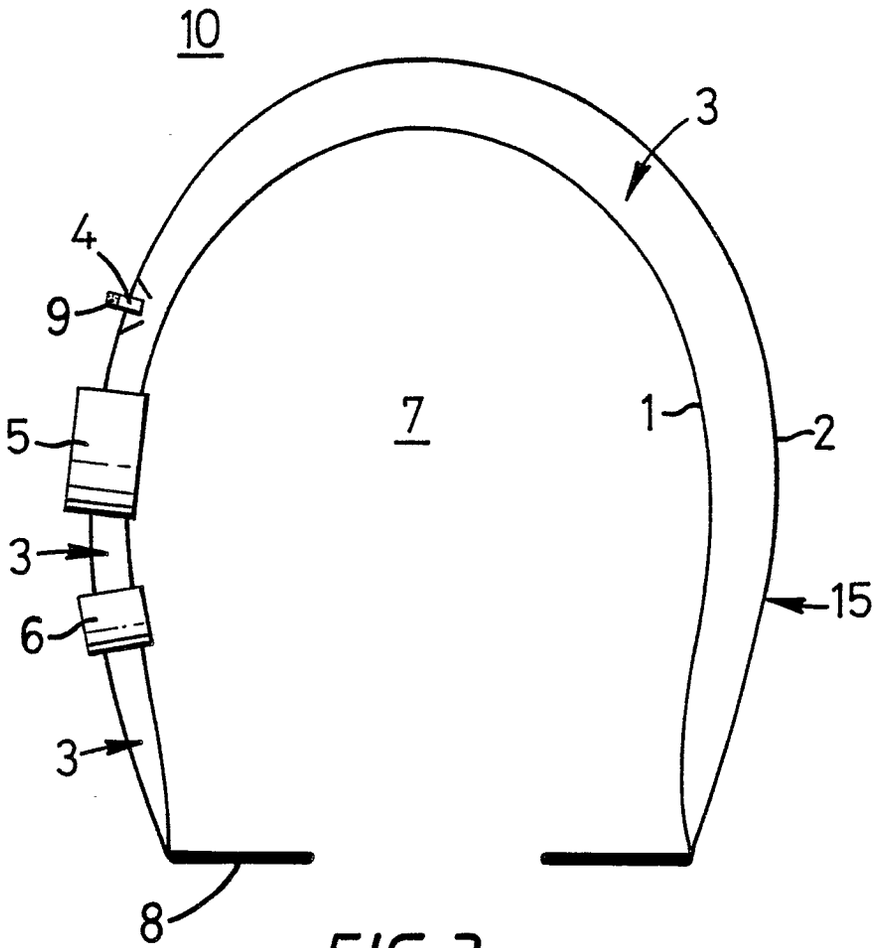

FIG. 3