(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 998 959 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
10.05.2000 Bulletin 2000/19

(51) Int Cl.[7]: **A62B 33/00**

(21) Application number: **99630018.2**

(22) Date of filing: **12.02.1999**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **06.11.1998 US 188022**

(71) Applicant: **Black Diamond Equipment, Ltd.**
Salt Lake City, Utah 84124 (US)

(72) Inventors:
- **Beidleman, Neil**
  Aspen, Colorado 81611 (US)
- **Margid, Jordan**
  Salt Lake City, Utah 84106 (US)
- **Crowley, Thomas J.**
  Aurora, Colorado 80014 (US)
- **Siberell, Richard**
  Bozeman, Montana 59715 (US)

(74) Representative: **Schmitz, Jean-Marie et al**
Dennemeyer & Associates Sàrl
P.O. Box 1502
1015 Luxembourg (LU)

(54) Emergency breathing device

(57) A combination outer clothing article and emergency breathing device includes a pocket in the clothing article for receiving the device body, an upper tube and mouthpiece extending from the device body to a releasable fastener on the clothing article, and an exhaust tube extending from the device body to a back side of the clothing article. The device body includes an inhalation chamber with a pair of inhalation valves. The inhalation chamber includes a perforated frame sheet, a quantity of porous stuffing material, and a filter bag that is substantially impermeable to snow yet allows for the free passage of air therethrough. The pair of inhalation valves provides redundancy and potentially makes inhaling easier than exhaling. Each of the valves include a design that has a valve flap that is displaced from the valve seat in the valve flap's rest position so that the valve flap is not likely to freeze against the valve seat due to moisture in the exhaled breath and the freezing temperatures that will be encountered in an avalanche.

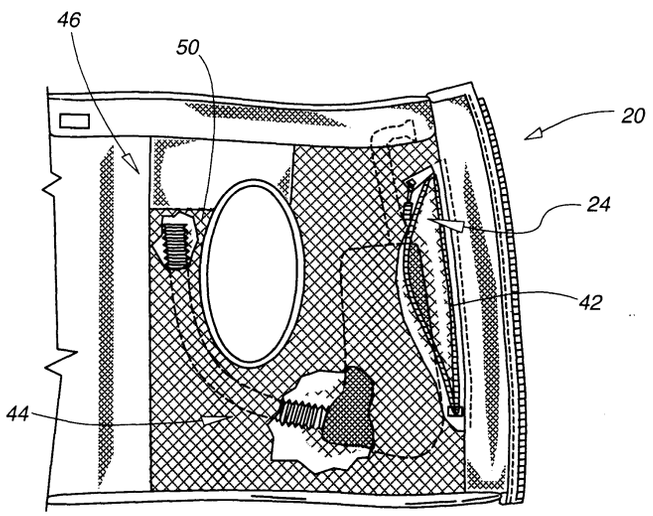

Fig. 4

EP 0 998 959 A1

Description

[0001] The present invention relates to an emergency breathing device for use by persons buried in snow, and more particularly relates to an emergency breathing device that is integrated into an article of outer clothing to be worn by an outdoor sports enthusiast such as a skier, and that has a valve arrangement therein with improved characteristics.

BACKGROUND OF THE INVENTION

[0002] An increasing number of people are participating in outdoor winter sports, including downhill and cross-country skiing, snowboarding, snowshoeing, snowmobiling, and the like. At the same time, avalanche dangers have not decreased. In the mountainous areas of Europe, Japan, Canada, and the United States, a significant number of people die every year from avalanche deaths. While a portion of avalanche victims die from physical injuries suffered during the avalanche, the majority die from suffocation beneath the snow. Of those buried under snow, only thirty percent survive more than thirty-five minutes.

[0003] There are many potential avenues that have been explored to reduce the number of injuries and death due to avalanches. These have included laws prohibiting skiing in certain areas where avalanche conditions are likely and are not being monitored, warning signs seeking to prevent people from entering areas of high avalanche danger, and overt measures taken to induce avalanches in certain controlled areas that are monitored so no people are in the vicinity. Examples of these overt measures include controlled blasting of explosives on or near ski slopes to cause avalanches during the hours when a ski resort is closed. In addition, efforts have been made to educate the relevant public about avalanches, to assist the public in avoiding areas of high avalanche danger, as well as steps to take when proceeding through areas of high avalanche danger and steps to take when caught in an avalanche.

[0004] Many emergency breathing devices have been developed for firefighters and others who may need a temporary breathing source in emergencies. Nearly all of these devices include either oxygen canisters or apparatus for generating oxygen. The devices with oxygen canisters have many drawbacks. The drawbacks can depend on the size of the oxygen canister. If the canister is too small, it may only provide enough oxygen for ten to fifteen minutes of breathing, which may not be long enough to allow a typical avalanche victim to survive. If the oxygen canister is larger, it is typically too large, heavy, and bulky for a skier, snowboarder, snowshoer, or snowmobiler to be likely to wear.

[0005] In addition, instead of oxygen canisters, some devices include apparatus for chemically generating oxygen. These chemical oxygen generators can have their own drawbacks such as size and weight, and in addition they typically generate an excessive amount of heat in the process of oxygen generation. The design of devices using such oxygen generators have to include the ability to draw heat away from the generator and the user, so that the user is not burned by the excessive heat.

[0006] As an alternative to emergency breathing devices with oxygen canisters and oxygen generators, a device has been developed to allow a user to breathe air directly through snow. This device is disclosed in U. S. Patent Number 5,490,501, issued to Crowley. The device is based on the recognition that snow contains air in quantities of fifty to ninety-five percent by volume. The device includes inhalation and exhalation chambers with outer membranes that are in direct contact with the snow. These membranes are sufficiently porous to allow air to pass through, yet do not allow snow to pass therethrough. The size of the inhalation and exhalation chambers are sufficiently large enough to allow a sufficient amount of air to be drawn into the inhalation and out of the exhalation chamber under normal human respiratory pressures.

[0007] The Crowley device does, however, have several characteristics that can be greatly improved upon. First of all, the device is large and bulky and is not likely to receive the widespread acceptance and use that is desirable among outdoor enthusiasts. In addition, the device has mechanical parts therein, including valves, that can become frozen or stuck due to the moisture inherent in exhaled breath in combination with the cold temperatures experienced when buried under snow. Also, it is desirable for the breathing device to be convenient yet unobtrusive in use.

[0008] It is against this background, and the desire to solve the problems of the prior art, that the present invention has been developed.

SUMMARY OF THE INVENTION

[0009] The present invention is directed to an emergency breathing device for use by a user whose face is buried in snow, the snow having breathable air contained therein. The device includes a mouthpiece, an elongated, extendible conduit pivotably attachable at a first end to the mouthpiece and in fluid communication therewith, the conduit also having a second end, at least one inhalation valve having a first side in fluid communication with a central point of the elongated conduit, the at least one inhalation valve having a second side, the first side and the second side of the inhalation valve having a valve member positioned therebetween to allow fluid to flow from the second side to the first side and to substantially prevent fluid flow from the first side to the second side, and an inhalation chamber attached to the second side of the inhalation valve and in fluid communication therewith. The inhalation chamber includes a frame member, a porous spacer material, and a bag containing the frame member and the spacer material, the bag including at least a portion that is substantially

impermeable to snow yet allows the passage of air therethrough between an exterior and an interior of the bag. The device also includes an exhalation valve having a first side attachable to and in fluid communication with the second end of the conduit, the exhalation valve having a second side, the first side and the second side of the exhalation valve having a valve member positioned therebetween to allow fluid to flow from the first side to the second side and to substantially prevent fluid flow from the second side to the first side. The device further includes an exhalation chamber attached to the second side of the exhalation valve, the exhalation chamber including at least a portion that is substantially impermeable to snow yet allows the passage of air therethrough between an interior and an exterior of the exhalation chamber.

[0010] The frame member may include a frame sheet. The frame sheet may be composed of polyethylene. The porous spacer material may be composed of a three-dimensional geomatrix of monofilaments. The bag may be composed of woven fabric. The device may further include a second inhalation valve having a first side in fluid communication with a central point of the elongated conduit, the second inhalation valve having a second side, the first side and the second side of the second inhalation valve having a valve member positioned therebetween to allow fluid to flow from the second side to the first side and to substantially prevent fluid flow from the first side to the second side, wherein the first and second inhalation valves are spaced apart from each other in the vicinity of the central point of the elongated conduit.

[0011] The present invention is also directed to an emergency breathing device for use by a user whose face is buried in snow, the snow having breathable air contained therein. The device includes a mouthpiece, a pair of inhalation valves, each having a first side in fluid communication with the mouthpiece, the pair of inhalation valves each having a second side, and an inhalation chamber in fluid communication with the second side of each of the inhalation valves, the inhalation chamber having at least a portion thereof that is substantially impermeable to snow yet allows for the passage of air from an exterior to an interior thereof. The device also includes an exhalation valve having a first side in fluid communication with the mouthpiece, the exhalation valve having a second side and an exhalation chamber in fluid communication with the second side of the exhalation valve, the exhalation chamber having at least a portion thereof that is substantially impermeable to snow yet allows for the passage of air from an interior to an exterior thereof.

[0012] The pair of inhalation valves and the exhalation valve may each have a cross-sectional area, wherein the cross-sectional area of the inhalation valves together is greater than that of the exhalation valve. The cross-sectional area of the inhalation valves together may be at least twice that of the exhalation valve.

[0013] The present invention is also directed to the combination of an article of clothing to be worn by a user and an emergency breathing device for use by the user when the face of the user is buried in snow, the snow having breathable air contained therein. The combination includes an article of outer clothing including a pocket therein for containing the emergency breathing device, the pocket having at least a portion thereof that forms an outer surface of the clothing article and is sufficiently permeable to air to allow the emergency breathing device to draw air therethrough. The pocket also includes a releasable fastener located proximate to the upper chest, neck, and shoulder area of the clothing article The combination further includes an emergency breathing device that includes a device body including inhalation and exhalation chambers each having portions thereof that are substantially impermeable to know yet allow the passage of air therethrough. The device also includes an elbowed mouthpiece having a first end for placing in the user's mouth, the mouthpiece also having a second end in fluid communication with the first end and an elongated, extendible conduit pivotably attachable at a first end to the second end of the elbowed mouthpiece and at a second end to the device body. The conduit is selectively in fluid communication with the inhalation and exhalation chambers to allow the user to breathe through the emergency breathing device by breathing through the mouthpiece. The conduit extends out of the pocket of the clothing article to the vicinity of the releasable fastener where the mouthpiece is releasably stowed, and further wherein the fastener can be selectively released from the fastener by the user and the mouthpiece and conduit selectively manipulated to extend the conduit until the mouthpiece is in the vicinity of the user's mouth and to pivot the mouthpiece to a desired angle to be able to comfortably place the mouthpiece in the user's mouth.

[0014] The pocket may be defined on a front side of the article of clothing. The pocket may communicate with a passageway defined from the front side of the article of clothing to the back side of the article of clothing, wherein the exhalation chamber extends along the passageway.

[0015] The present invention is also directed to a valve in an emergency breathing apparatus having a conduit therein, the conduit having a longitudinal axis therethrough. The valve includes a fixed valve seat located within the conduit, the valve seat having sealing surfaces thereon that all lie substantially within a first plane and a flexible valve flap mounted in cantilever fashion to the conduit proximate to the valve seat, the flexible valve flap being adapted to flex toward the valve seat and substantially and releasably seal the valve to substantially prevent fluid flow therethrough when the valve is subjected to a fluid pressure differential wherein greater pressure exists in the conduit on the valve flap side of the valve, and the flexible flap being adapted to flex away from the valve seat to allow fluid to flow

through the valve seat toward the valve flap when the valve is subjected to a fluid pressure differential wherein greater pressure exists on the valve seat side of the valve. The mounting of the valve flap in the conduit causes the valve flap to substantially lie in a rest position within a second plane when there is substantially no fluid pressure differential across the valve, and further wherein the first plane and the second plane intersect with each other so that in the rest position of the valve flap, a substantial majority of the valve flap is displaced from the sealing surfaces of the valve seat.

[0016] The second plane may be perpendicular to the longitudinal axis and the first plane may not be perpendicular to the longitudinal axis..

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] The accompanying drawings, which are incorporated in and form a part of the specification, illustrate the preferred embodiments of the present invention, and together with the descriptions serve to explain the principles of the invention.

[0018] **In the Drawings:**

[0019] Figure 1 is a perspective view of a user wearing the combination clothing article and emergency breathing device of the present invention, with the mouthpiece of the emergency breathing device in a stowed position.

[0020] Figure 2 is a view similar to Figure 1 showing the mouthpiece and upper tube of the breathing device extended and in place in the user's mouth.

[0021] Figure 3 is a perspective view of the article of clothing and breathing device of Figure 1.

[0022] Figure 4 is a side view of the inside panel of the article of clothing of Figure 1, showing the location of the breathing device within a pocket in the clothing article.

[0023] Figure 5 is a side view of the breathing device of Figure 1.

[0024] Figure 6 is a lateral side view of the breathing device of Figure 1, showing the mouthpiece in a swiveled or rotated position.

[0025] Figure 7 is an exploded view of the breathing device of Figure 1, with the filter bag removed.

[0026] Figure 8 is an assembled view of the breathing device of Figure 1, with the filter bag removed, and showing a portion of the stuffing material removed to show the frame sheet.

[0027] Figure 9 is a sectional view taken along line 9-9 of Figure 3, showing air passing into the inhalation chamber and through one of the inhalation valves.

[0028] Figure 10 is a side view of a portion of the breathing device of Figure 1, showing an upper tube in an extended position.

[0029] Figure 11 is a close-up view of a front portion of the clothing article showing the location where the upper tube and mouthpiece, shown in phantom, would extend from the article of clothing.

[0030] Figure 12 is a sectional view taken along line 12-12 of Figure 8, showing the rotatable connection of the mouthpiece to the upper tube.

[0031] Figure 13 is a perspective view of the neck of the mouthpiece.

[0032] Figure 14 is a sectional view taken along line 14-14 of Figure 8, showing tie members on the device body holding a portion of the device body together.

[0033] Figure 15 is a sectional view taken along line 15-15 of Figure 8, showing tie members on the device body holding another portion of the device body together.

[0034] Figure 16 is a sectional view taken along line 16-16 of Figure 8, showing the interior of the upper inhalation valve.

[0035] Figure 17 is a sectional view taken along line 17-17 of Figure 16, showing the inhalation valve from the valve flap side thereof.

[0036] Figure 18 is a sectional view taken along line 18-18 of Figure 16, showing the inhalation valve from the valve seat side thereof.

[0037] Figure 19 is a sectional view taken along line 19-19 of Figure 16, showing the valve flap in a rest position relative to the valve seat.

[0038] Figure 20 is a sectional view similar to Figure 19, showing the valve in a closed condition with the valve flap against the valve seat.

[0039] Figure 21 is a sectional view similar to Figure 19, showing the valve in an open condition with the valve flap flexed away form the valve seat.

[0040] Figure 22 is a view similar to Figure 19, showing an alternative embodiment of a valve, with a duckbill configuration.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0041] The present invention includes an article of outer clothing 20 and an emergency breathing device 22 received within a pocket 24 in the clothing article 20 and extending therefrom, as shown in Figure 1-4. The breathing device 22 includes a device body 26 with a main conduit 30 extending therethrough, an upper tube 32 of the main conduit 30 attached to the device body 26, a mouthpiece 34 attached to the upper tube 32, and an exhaust tube 36 portion on the main conduit 30 attached to an opposite end of the device body 26 from the upper tube 32. The breathing device 22 and clothing article 20 are partially based on the device disclosed in U.S. Patent No. 5,490,501, the contents of which are incorporated herein by reference.

[0042] The clothing article 20 (Figures 1-4) could be any type of clothing article that may be worn as an outer layer by an outdoor sports enthusiast or other person that has reason to be in areas of possible avalanche danger These types of outer clothing articles could include parkas, powder jackets, fleece jackets, and the like. For ease of illustration, the clothing article is shown in the figures of this patent application as a vest. The

pocket 24 is located on a front side of the clothing article 20. The pocket 24 is constructed to provide a fabric 40 on an outer side thereof that is a webbed or mesh fabric, or other fabric that provides sufficient spacing between the fine portions of the fabric 40 to allow air to easily pass therethrough yet substantially prevent snow from passing therethrough. A zipper 42 located on the inside surface of the front side of the clothing article 20 allows selective access to the pocket so as to be able to remove and replace the breathing device 22 from and to the pocket 24. A passageway 44 in the clothing article 20 leads away from the pocket 24 to the back side 46 of the clothing article 20. In a similar fashion to the fabric 40 on the outer surface of the pocket 24, the passageway 44 includes a fabric 50 with the same breathable characteristics. A releasable fastener 52 (Figures 1-3 and 11) located at an upper end of the pocket on the outer surface of the front side of the article 20 includes a flap 54 with one portion 56 of a hook and loop connector that mates with a fixed portion 58 of a hook and loop connector.

[0043] The device body 26 (Figure 5 and 6) of the breathing device 22 is designed and adapted to fit within the pocket 24 in the clothing article 20. The device body 26 includes an inhalation chamber 40 and two inhalation valves 42 and 44, the upper and lower inhalation valves, respectively, as seen in Figure 7. The two inhalation valves 42 and 44 are separated by a middle tube 46 of the main conduit 30. A lower tube 50 of the main conduit 30 extends downward from the lower inhalation valve 44 and connects to an exhalation valve 52

[0044] The inhalation chamber 60 (Figures 6-9) includes a frame sheet 80 that provides some shape and rigidity to the device body 26, a stuffing material 82 that is highly porous to provide a thickness to the inhalation chamber 60 without impeding the flow of air therethrough, and a filter bag 84 that surrounds the frame sheet 80 and stuffing material 82. The frame sheet 80 is preferably composed of polyethylene, or other suitable material that is rigid enough to give the chamber 60 a shape but flexible enough to be comfortably worn in the clothing article 20. The frame sheet 80 is perforated so as to not impede the free flow of air through the inhalation chamber 60. The stuffing material 82 is preferably composed of a three-dimensional geomatrix of heavy nylon monofilaments fused at their intersections, such as Enkamat Type 7020 by Akzo Nobel that is 95% open space by volume, and may be provided within the inhalation chamber 60 in a thickness of 1.5 centimeters. The frame sheet 80 is fastened to the stuffing material 82 by a plurality of ties 86, as shown in Figures 7, 8, 14, and 15. The filter bag 84 is preferably composed of woven fabric, or any other suitable material that has the desired characteristics of being substantially impermeable to snow yet allows air to freely pass therethrough under normal respiratory pressures. Preferably the fabric may include three separate layers with the two inner layers being fine mosquito netting and the outer layer being slightly more porous. The filter bag 84 contains not only the frame sheet 80 and stuffing material 82, but also the upper and lower inhalation valves 62 and 64, the middle tube 66 therebetween, and the lower tube 70 and exhalation valve 72.

[0045] The two inhalation valves 62 and 64 (Figures 16-21) are identical, so only the upper inhalation valve 62 will be described in detail. The valve 62 includes a tri-port connector 88 that is a T-shaped, 3-ported conduit. The upper part 90 of the T-shape is connected at one end to the upper tube 32 and at an opposite end to the middle tube 66. The other part 91 of the T-shape connects to a one-way valve 92. The one-way valve 92 includes a valve conduit 94, a valve seat 96, and a valve flap 100 As can be seen best in Figures 19-21, the valve flap 100 is mounted on one side thereof along an inner wall of the valve conduit 94 The valve flap 100 is preferably composed of silicone, or any other suitable material that provides the desired characteristics of being extremely flexible so as to be able to be forced away from and toward the valve seat 96 as desired under fluid pressure. The valve flap 100 is generally disc-shaped and has an outer diameter just less than the inner diameter of the valve conduit 94.

[0046] The valve seat 96 (Figures 16-21) includes flat, sealing portions 102 particularly around the outer periphery of the valve seat 96. The sealing portions 102 also extend across portions of the inner radial area of the valve seat 96 so as to support the valve flap 100 when the valve flap 100 is against the valve seat 96. The valve seat 96 also includes a plurality of apertures 104 therethrough. Preferably, but not necessarily, the valve seat 96 is provided along a plane that is not normal to a longitudinal axis through the valve conduit 94. By having the valve seat 96 provided at this off angle, and with the valve flap 100 mounted so as to be in a rest position that is generally in a plane that is normal to the longitudinal axis through the valve conduit 94, the valve flap 100 in its rest position is generally displaced from the valve seat 96. The only portion of the valve flap 100 that is in contact with the valve seat 96 even when the valve flap 100 is in its rest position (Figure 19), is the portion of the valve flap 100 adjacent to and that is part of the connection of the valve flap 100 to the inner side wall of the valve conduit 94 With the remainder of the valve flap 100 displaced from the valve seat 96, the valve flap 100 will only contact the sealing portions 102 of the valve seat 96, when the valve 92 is closed This reduces the chances of the valve flap 100 freezing to the valve seat 96 due to the moisture in the exhaled breath and the relatively low temperatures in an avalanche.

[0047] A fluid pressure differential within the valve conduit 94 can cause the valve flap 100 to flex toward and against the valve seat 96 (Figure 20). This will occur when the fluid pressure is relatively greater on the valve flap 100 side of the valve 92 as compared to the fluid pressure on the valve seat 96 side of the valve 92. Under this fluid pressure condition, the valve 92 will be closed

and will substantially prevent fluid from flowing along the valve conduit 94 through the valve 92.

[0048] When the fluid pressure differential within the valve conduit 94 causes the fluid pressure to be relatively higher on the valve seat 96 side of the valve 92 than on the valve flap 100 side of the valve 92, the valve flap 100 will flex further away from the valve seat 96 from its rest position and will allow the easy flow of air, or any other fluid, along the valve conduit 94 (Figure 21). Because the upper inhalation valve 62 is in fluid communication with the mouthpiece 34 through the main conduit 30, it can be appreciated that the valve 92 will open when the user lowers the pressure on the valve flap 100 side of the valve 92 by attempting to inhale. Subsequently, when the user exhales through the mouthpiece 34, the fluid pressure on the valve flap 100 side of the valve 92 will be greater than on the other side and will cause the valve to close during the exhalation process.

[0049] The lower inhalation valve 64 has an identical structure to the upper inhalation valve 62 and functions identically. By having two inhalation valves, some redundancy is provided for the device 22. It is deemed relatively less important to provide redundancy for the exhalation valve since the user can simply exhale around the mouthpiece if necessary. It is possible that the additional inhalation valve will reduce the respiratory pressure necessary for inhalation as compared to exhalation with the device 22. In addition, in an analogous fashion to a high altitude breathing technique known as "pressure breathing," use of the device 22, with a relatively higher pressure required for exhalation compared to inhalation, may increase oxygen intake. Each of the inhalation valves 62 and 64 provide fluid communication between the main conduit 30 and the interior of the inhalation chamber 60 in the vicinity of the frame sheet 80 and stuffing material 82.

[0050] As an alternative structure, each of the valves could be duckbill valves 106 as shown in Figure 22. The valve 106 is retained between a lip 109 on the valve conduit 92 and the lower part 91 of the tri-port connector 88. The duckbill valve 106 includes an upper and a lower flap 107 and 108 that flex to separate when the fluid pressure is greater on the lip 109 side of the valve 106 than the other side.

[0051] The exhalation valve 72 (Figure 8) includes a straight conduit 110 that connects at opposite ends to the lower tube 70 and the exhaust tube 36. In a very similar fashion to the inhalation valves 62 and 64, the exhalation valve 72 also includes a valve flap mounted in a cantilever fashion to an inner side wall of the conduit 110. Also, the valve 72 includes a valve seat that is formed substantially in a plane that is not normal to the longitudinal axis through the conduit 110. The valve seat is located along the main conduit 30 closer to the mouthpiece 34 than is the valve flap. The valve flap is mounted in a fashion so that in a rest position it generally is in a plane normal to the longitudinal axis through the conduit 110. Other than the fact that the inhalation valves 62 and 64 are connected to tri-port connectors while the exhalation valve 72 is located in a straight conduit 110, the functionality is analogous. In other words, during inhalation, the fluid pressure differential in the conduit 110 causes the valve flap to flex against the valve seat and close the valve 72. During exhalation, the fluid pressure differential in the conduit 110 causes the valve flap to flex away from the valve seat and open the valve 72. The exhalation valve 72 could also be a duckbill valve 106 like the inhalation valves 62 and 64

[0052] The exhaust tube 36 (Figures 4-8) can be provided in any of several forms. One form would include a simple flexible tube 120 with a port 122 at an end thereof opposite from the end connected to the exhalation valve 72. Another form could be similar to the first form wherein the flexible tube 120 would have a plurality of perforations 124 therethrough, as shown in Figures 5-8, all along its length so as to pass air to the exterior thereof through the perforations 124 in addition to, or instead of a port. In this case, it may be desirable to provide a bag surrounding the exhaust tube 36 in a similar fashion to the filter bag 84 of the inhalation chamber. It may also be desirable to provide stuffing material between the flexible tube 120 and the filter bag 84 in a similar fashion to the inhalation chamber 60. In a third alternative would be to have an exhaust tube 36 that was more of an exhalation chamber in a similar design to that of the inhalation chamber 60.

[0053] Each of the tubes in the main conduit 30, including the upper tube 32, the middle tube 66, the lower tube 70, and the exhaust tube 36, may be composed of a corrugated high density polyethylene (HDPE) tubing material, such as Expandoflex by Cleveland Tubing of Cleveland, Tennessee. This material allows each of the tube portions to be extended in length in any position between a fully retracted position and a full extended position. The tubing may have a 4 to 1 expansion range. The corrugated nature of the tubing also allows the tubing to be curved such as is required for the lower tube 70, may be required for the exhaust tube 36 and the upper tube 32 as well.

[0054] Preferably, the upper tube 32 (Figures 5-8 and 18) may be extendible between a minimum length of six centimeters (Figure 8) and a maximum length of twenty-four centimeters (Figure 10) when extended. The upper tube 32 extends out of the pocket 24 in the vicinity of the releasable fastener 52 on the clothing article 20. The upper tube 32 has a collar (Figure 12) provided at an upper end thereof. The mouthpiece 34 includes a neck 132 (Figures 12 and 13) that mates with and rotatably attaches to the collar 130 of the upper tube 32. This rotatable connection allows the mouthpiece 34 to be rotated to any desired position relative to the upper tube 32. The mouthpiece 34 includes an elbow 134 formed in a central portion thereof and has an end 136. The mouthpiece is preferably composed of a dual-density plastic and the end 136 is shaped so as to be comfortable for being engaged by the lips and teeth of the user.

[0055] In operation, the user would wear the clothing article 20 with the breathing device 22 inserted therein when they are likely to be in or traveling to conditions of possible avalanche danger (Figure 1). When the likelihood of avalanche danger becomes imminent, the user can release the releasable fastener 52 and manipulate the mouthpiece 34 and upper tube 32 to extend the upper tube 32 until the mouthpiece 34 is proximate to and/or in the mouth of the user (Figure 2).

[0056] The device body 26 could possibly be located other than on the front side of the clothing article 20, but it is preferred that the distance between the mouthpiece 34 and the inhalation valves 62 and 64 not grow too large because of the exhaled air that will remain in that conduit between the mouthpiece 34 and the inhalation valves 62 and 64 and will be part of the next inhaled breath. It is desirable to minimize this volume of exhaled air that is re-inhaled

[0057] The foregoing description is considered as illustrative only of the principles of the invention. Furthermore, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and process shown as described above. Accordingly, all suitable modifications and equivalents may be resorted to falling within the scope of the invention as defined by the claims which follow.

Claims

1. An emergency breathing device for use by a user whose face is buried in snow, the snow having breathable air contained therein, comprising:

a mouthpiece,

an elongated, extendible conduit pivotably attachable at a first end to the mouthpiece and in fluid communication therewith, the conduit also having a second end;

at least one inhalation valve having a first side in fluid communication with a central point of the elongated conduit, the at least one inhalation valve having a second side, the first side and the second side of the inhalation valve having a valve member positioned therebetween to allow fluid to flow from the second side to the first side and to substantially prevent fluid flow from the first side to the second side;

an inhalation chamber attached to the second side of the inhalation valve and in fluid communication therewith, the inhalation chamber including:

a frame member;

a porous spacer material; and

a bag containing the frame member and the spacer material, the bag including at least a portion that is substantially impermeable to snow yet allows the passage of air therethrough between an exterior and an interior of the bag;

an exhalation valve having a first side attachable to and in fluid communication with the second end of the conduit, the exhalation valve having a second side, the first side and the second side of the exhalation valve having a valve member positioned therebetween to allow fluid to flow from the first side to the second side and to substantially prevent fluid flow from the second side to the first side; and

an exhalation chamber attached to the second side of the exhalation valve, the exhalation chamber including at least a portion that is substantially impermeable to snow yet allows the passage of air therethrough between an interior and an exterior of the exhalation chamber.

2. An emergency breathing device as defined in claim 1, wherein the frame member includes a frame sheet.

3. An emergency breathing device as defined in claim 2, wherein the frame sheet is composed of polyethylene.

4. An emergency breathing device as defined in claim 1, wherein the porous spacer material is composed of a three-dimensional geomatrix of monofilaments.

5. An emergency breathing device as defined in claim 1, wherein the bag is composed of woven fabric.

6. An emergency breathing device as defined in claim 1, further including a second inhalation valve having a first side in fluid communication with a central point of the elongated conduit, the second inhalation valve having a second side, the first side and the second side of the second inhalation valve having a valve member positioned therebetween to allow fluid to flow from the second side to the first side and to substantially prevent fluid flow from the first side to the second side, wherein the first and second inhalation valves are spaced apart from each other in the vicinity of the central point of the elongated conduit.

7. An emergency breathing device for use by a user whose face is buried in snow, the snow having breathable air contained therein, comprising:

a mouthpiece;

a pair of inhalation valves, each having a first side in fluid communication with the mouthpiece, the pair of inhalation valves each having a second side;

an inhalation chamber in fluid communication with the second side of each of the inhalation valves, the inhalation chamber having at least a portion thereof that is substantially impermeable to snow yet allows for the passage of air from an exterior to an interior thereof,

an exhalation valve having a first side in fluid communication with the mouthpiece, the exhalation valve having a second side; and

an exhalation chamber in fluid communication with the second side of the exhalation valve, the exhalation chamber having at least a portion thereof that is substantially impermeable to snow yet allows for the passage of air from an interior to an exterior thereof.

8. An emergency breathing device as defined in claim 7, wherein the pair of inhalation valves and the exhalation valve each have a cross-sectional area, wherein the cross-sectional area of the inhalation valves together is greater than that of the exhalation valve.

9. An emergency breathing device as defined in claim 8, wherein the cross-sectional area of the inhalation valves together is at least twice that of the exhalation valve.

10. In combination, an article of clothing to be worn by a user and an emergency breathing device for use by the user when the face of the user is buried in snow, the snow having breathable air contained therein, the combination comprising:

an article of outer clothing including:

a pocket therein for containing the emergency breathing device, the pocket having at least a portion thereof that forms an outer surface of the clothing article and is sufficiently permeable to air to allow the emergency breathing device to draw air therethrough; and

a releasable fastener located proximate to the upper chest, neck, and shoulder area of the clothing article; and

an emergency breathing device including:

a device body including inhalation and exhalation chambers each having portions thereof that are substantially impermeable to know yet allow the passage of air therethrough;

an elbowed mouthpiece having a first end for placing in the user's mouth, the mouthpiece also having a second end in fluid communication with the first end;

an elongated, extendible conduit pivotably attachable at a first end to the second end of the elbowed mouthpiece and at a second end to the device body;

wherein the conduit is selectively in fluid communication with the inhalation and exhalation chambers to allow the user to breathe through the emergency breathing device by breathing through the mouthpiece; and

wherein the conduit extends out of the pocket of the clothing article to the vicinity of the releasable fastener where the mouthpiece is releasably stowed, and further wherein the fastener can be selectively released from the fastener by the user and the mouthpiece and conduit selectively manipulated to extend the conduit until the mouthpiece is in the vicinity of the user's mouth and to pivot the mouthpiece to a desired angle to be able to comfortably place the mouthpiece in the user's mouth.

11. A combination as defined in claim 10, wherein the pocket is defined on a front side of the article of clothing.

12. A combination as defined in claim 11, wherein the pocket communicates with a passageway defined from the front side of the article of clothing to the back side of the article of clothing, wherein the exhalation chamber extends along the passageway.

13. In an emergency breathing apparatus having a conduit therein, the conduit having a longitudinal axis therethrough, a valve located in the conduit, the valve comprising:

a fixed valve seat located within the conduit, the valve seat having sealing surfaces thereon that all lie substantially within a first plane; and

a flexible valve flap mounted in cantilever fashion to the conduit proximate to the valve seat, the flexible valve flap being adapted to flex toward the valve seat and substantially and re-

leasably seal the valve to substantially prevent fluid flow therethrough when the valve is subjected to a fluid pressure differential wherein greater pressure exists in the conduit on the valve flap side of the valve, and the flexible flap being adapted to flex away from the valve seat to allow fluid to flow through the valve seat toward the valve flap when the valve is subjected to a fluid pressure differential wherein greater pressure exists on the valve seat side of the valve;

wherein the mounting of the valve flap in the conduit causes the valve flap to substantially lie in a rest position within a second plane when there is substantially no fluid pressure differential across the valve, and further wherein the first plane and the second plane intersect with each other so that in the rest position of the valve flap, a substantial majority of the valve flap is displaced from the sealing surfaces of the valve seat.

14. A valve as defined in claim 13, wherein the second plane is perpendicular to the longitudinal axis and the first plane is not perpendicular to the longitudinal axis.

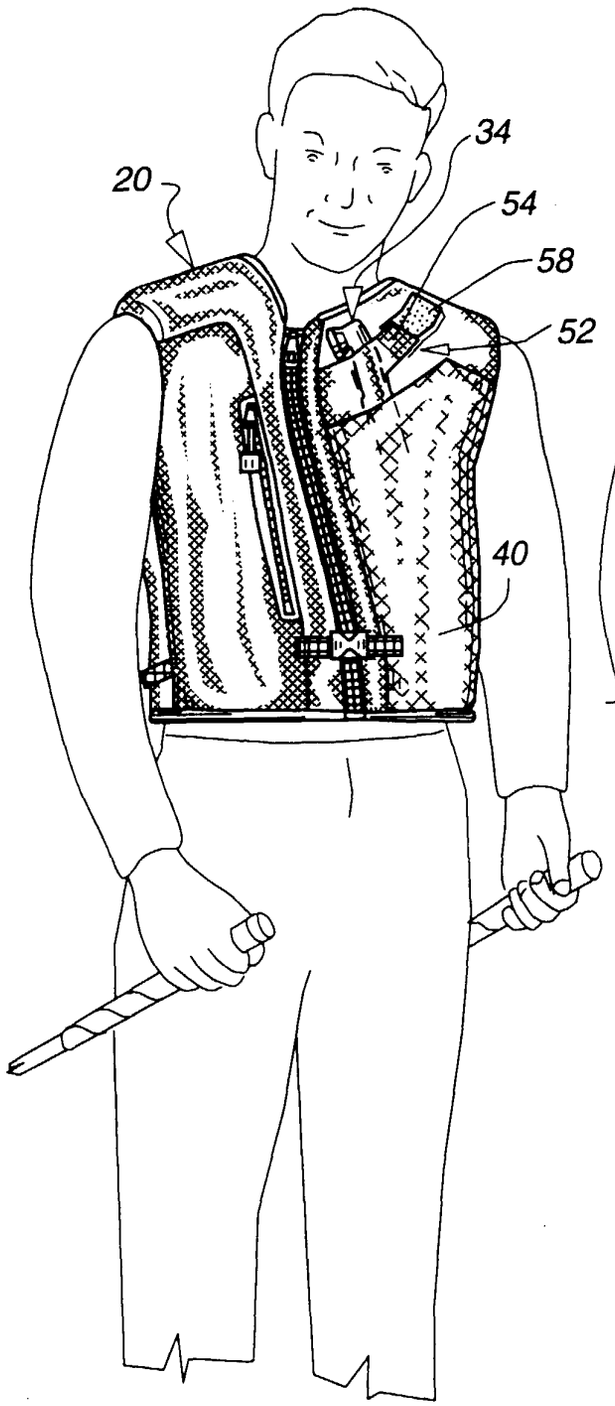

Fig. 1

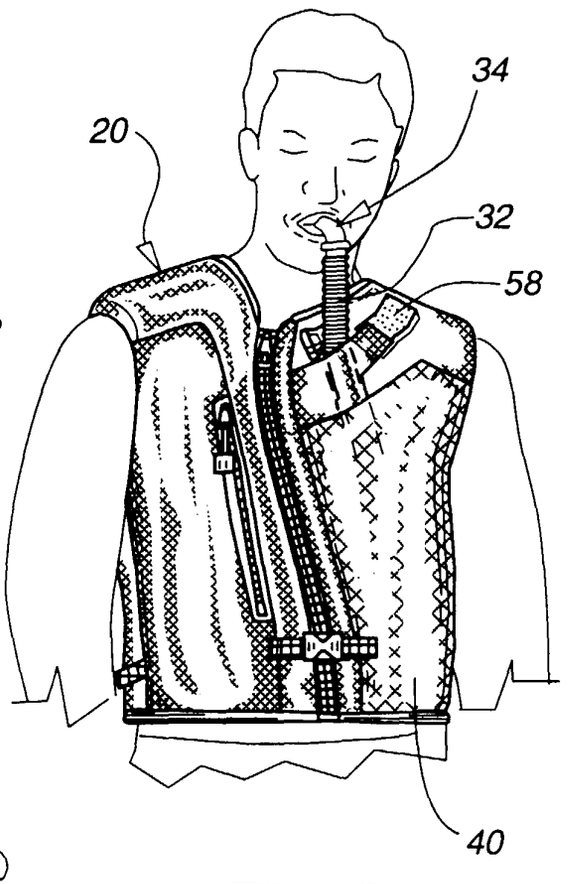

Fig. 2

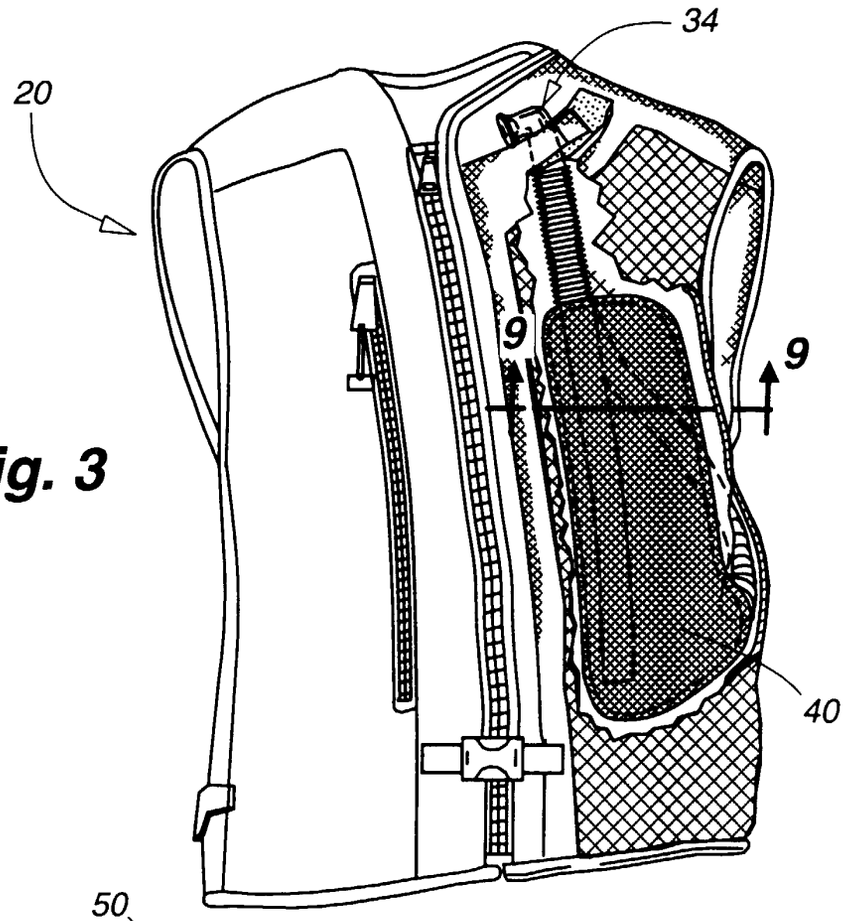

Fig. 3

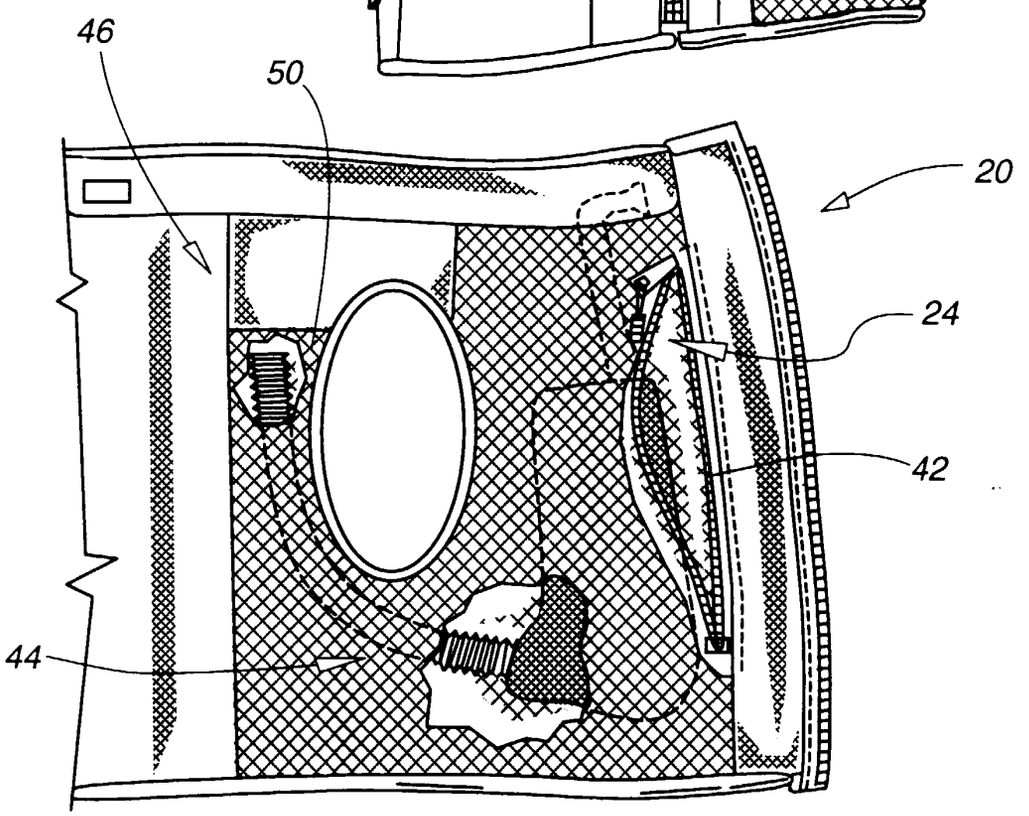

Fig. 4

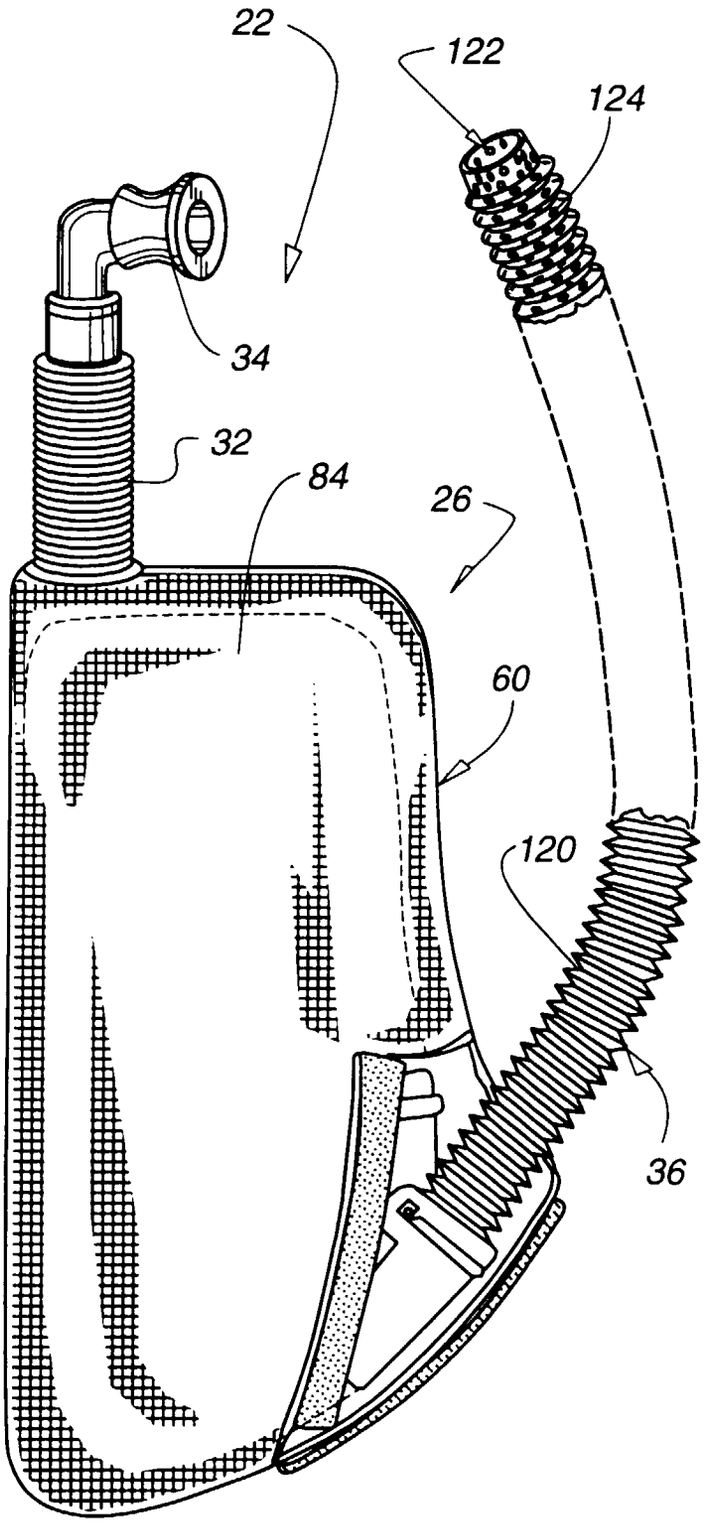

Fig. 5

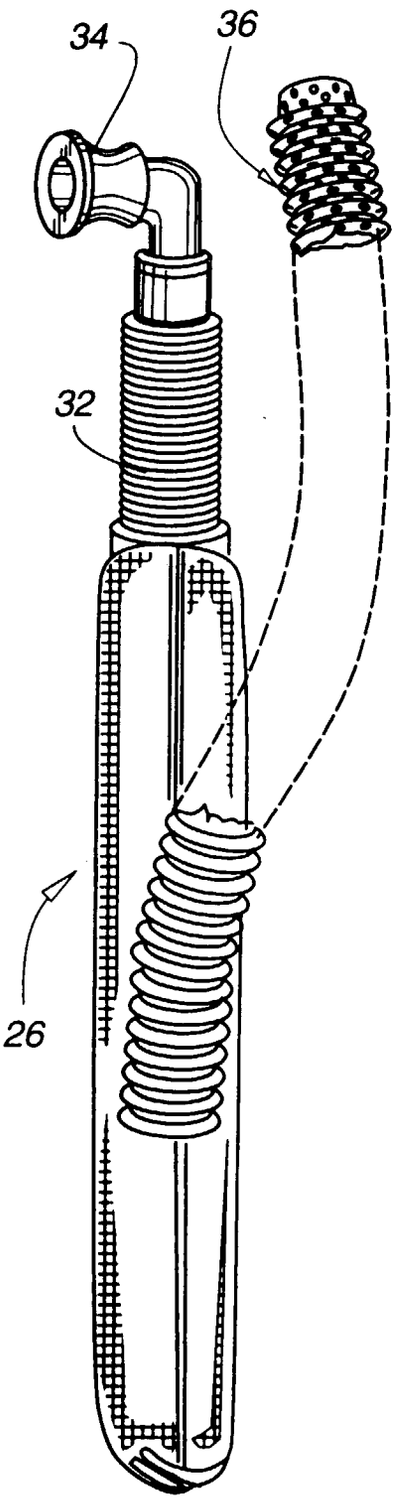

Fig. 6

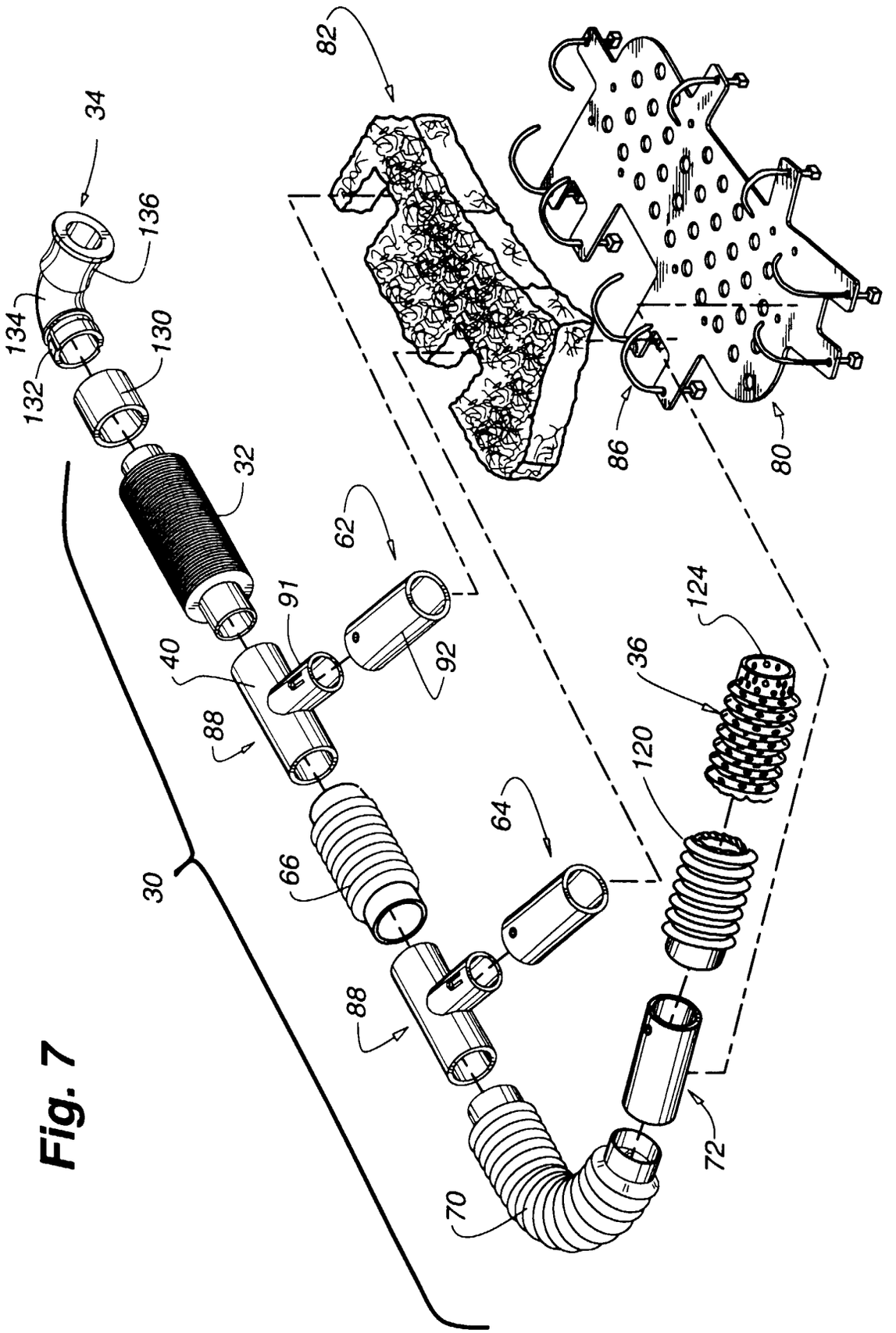
82
34
136
134
130
132
32
62
91
40
92
88
124
36
120
64
66
30
88
72
70
86
80

Fig. 7

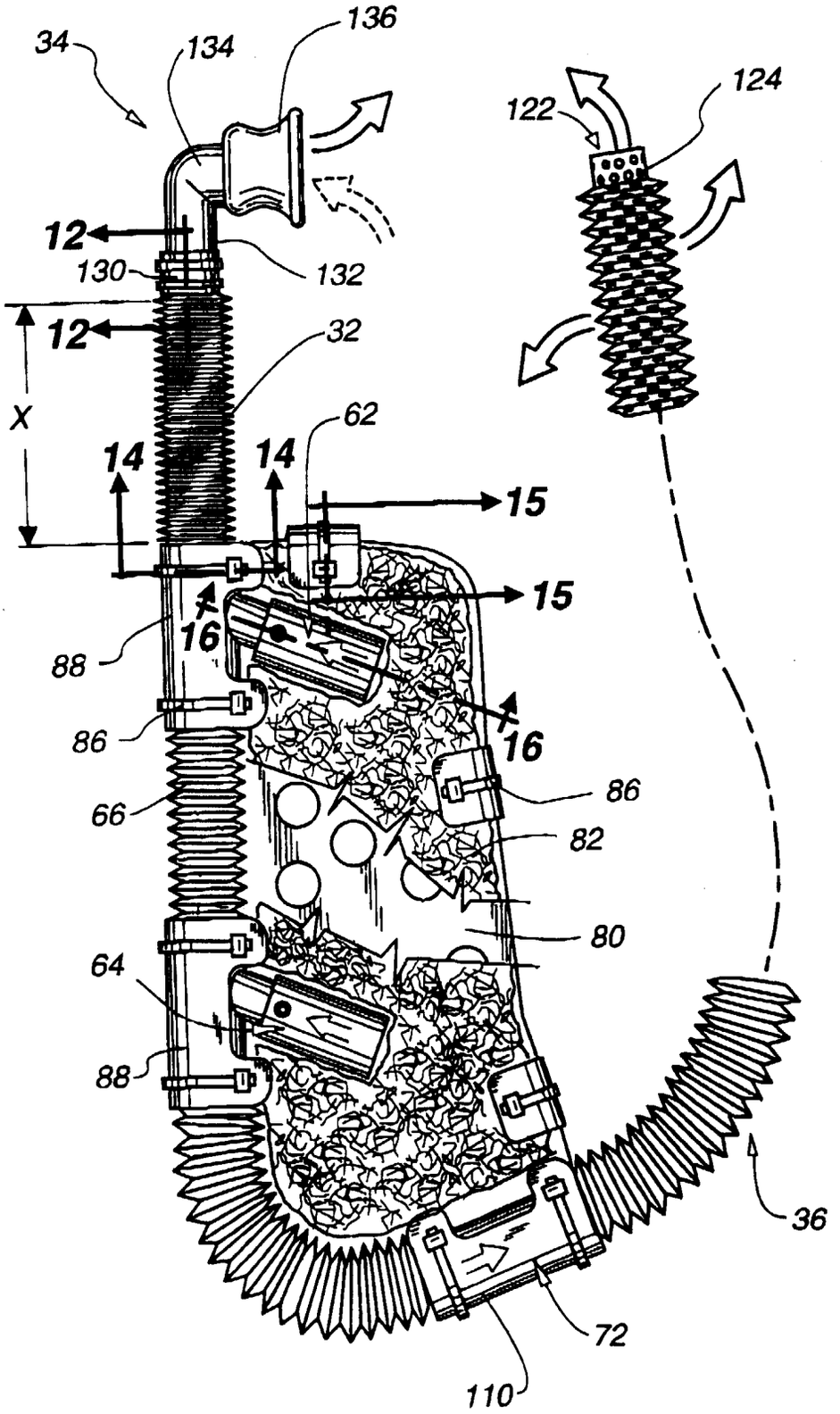
34
134
136
122
124
12
130
132
12
32
X
62
14
14
15
15
16
16
88
86
66
86
82
80
64
88
36
72
110

Fig. 8

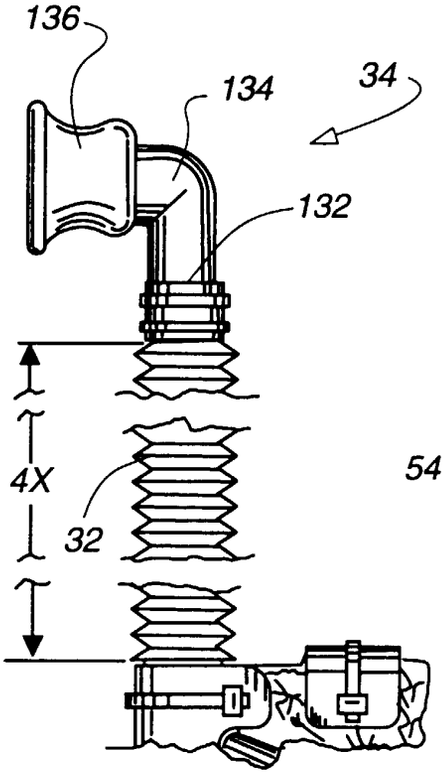

Fig. 10

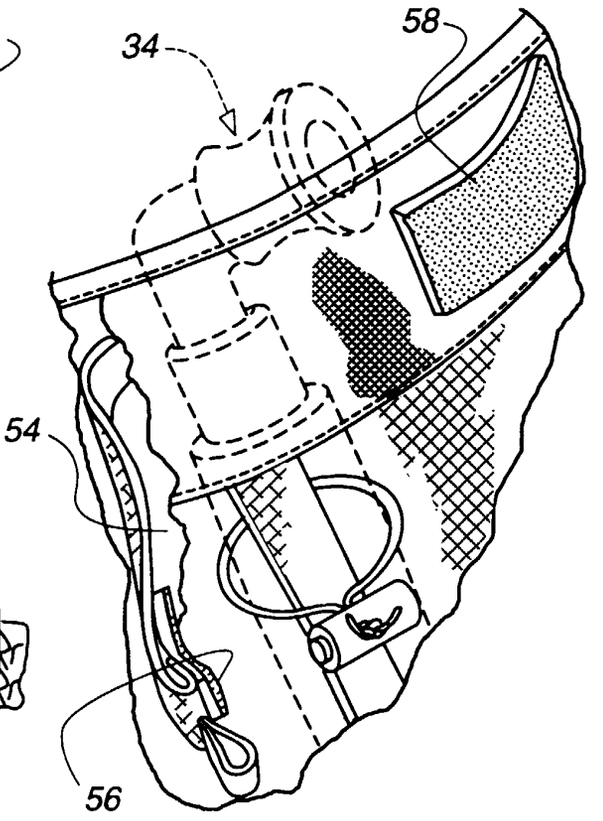

Fig. 11

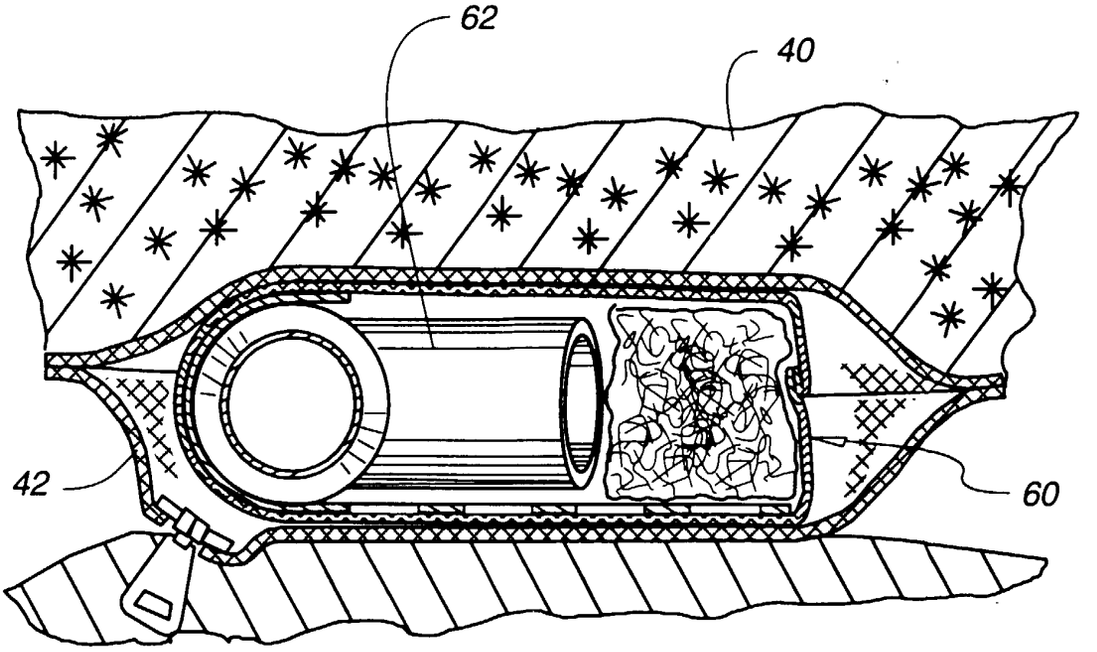

Fig. 9

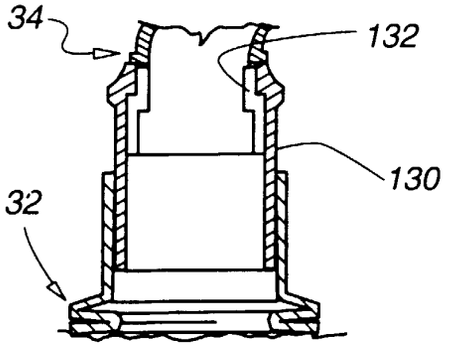

Fig. 12

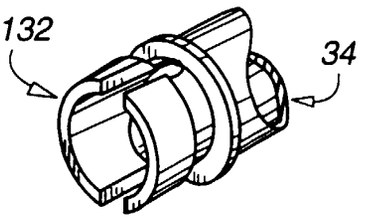

Fig. 13

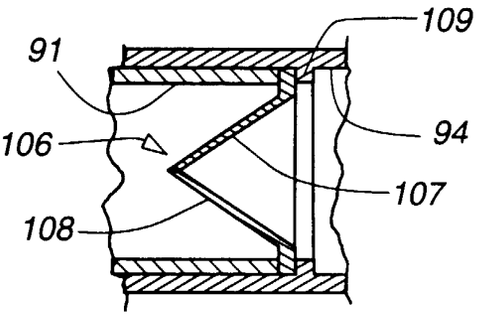

Fig. 22

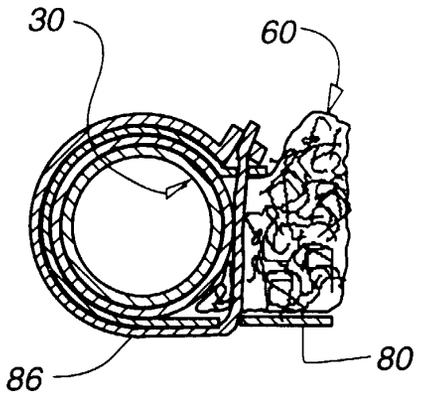

Fig. 14

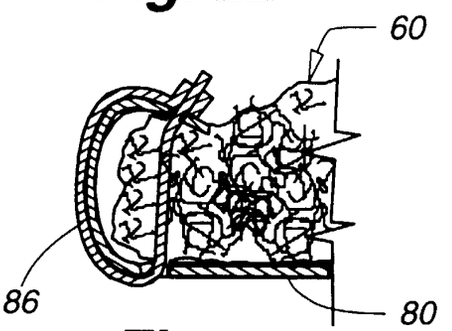

Fig. 15

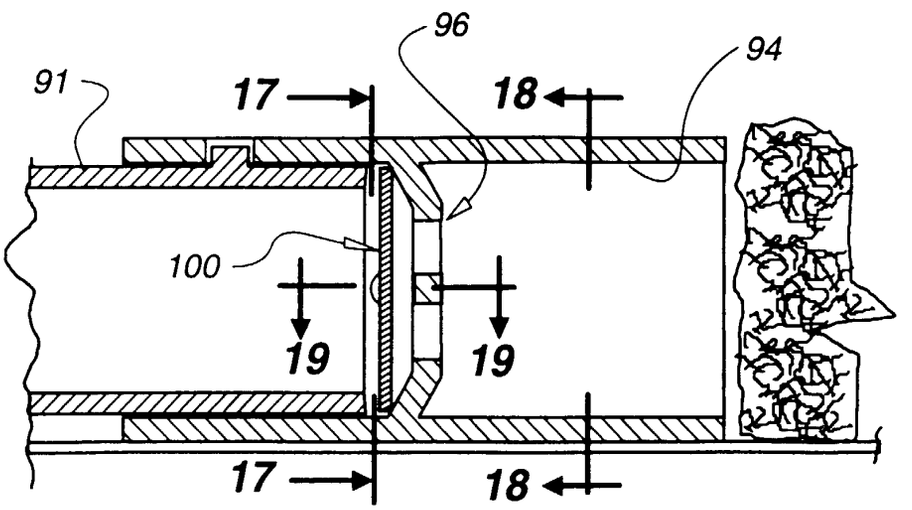

Fig. 16

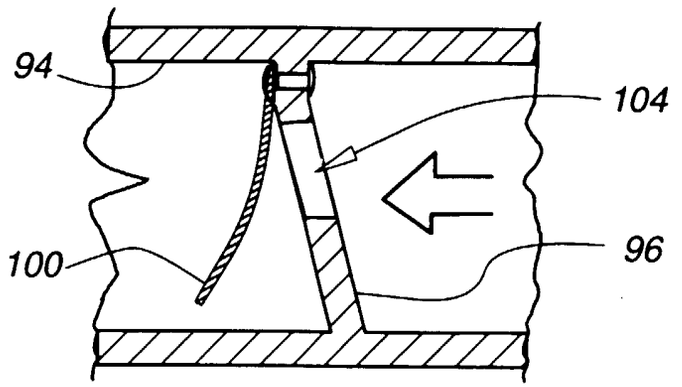

Fig. 21

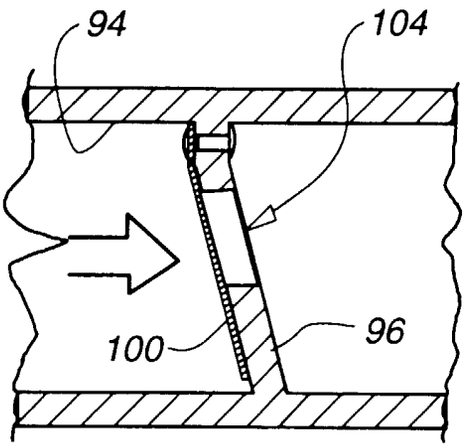

Fig. 20

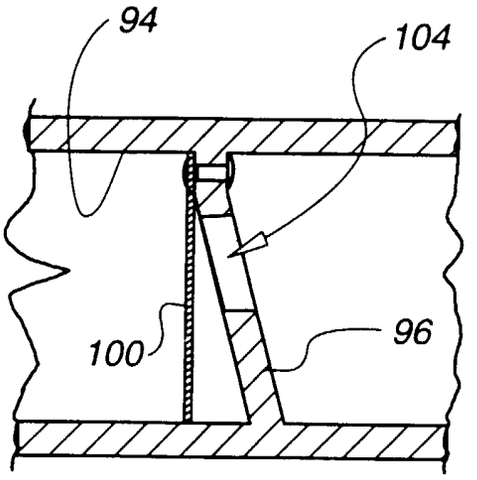

Fig. 19

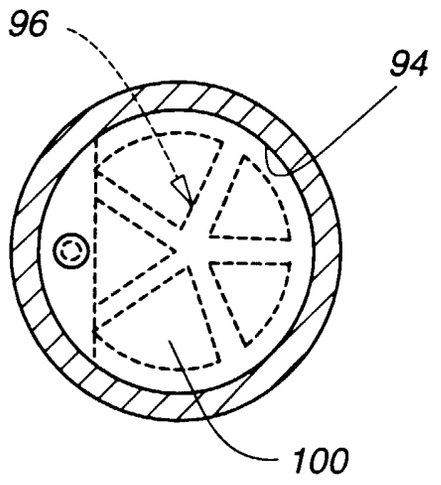

Fig. 17

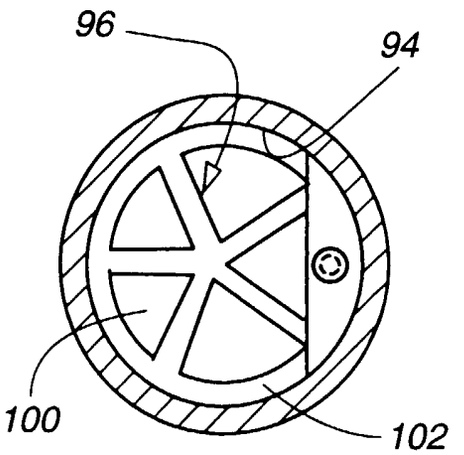

Fig. 18

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 99 63 0018

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	US 5 490 501 A (CROWLEY THOMAS J) 13 February 1996 (1996-02-13) * abstract * * column 7, line 4 - line 28 * * column 7, line 66 - column 8, line 3 * * figures 1-3 * ---	1-6	A62B33/00
A	US 4 062 359 A (GEAGHAN MARK E) 13 December 1977 (1977-12-13) * abstract * * figures 1,2 * ---	1-6	
A	US 5 063 923 A (PERONI ROBERT) 12 November 1991 (1991-11-12) * abstract * * figures 1-3 * ---	1-6	
A	US 4 683 869 A (WILCOX ROBERT B) 4 August 1987 (1987-08-04) * abstract * * figure 1 * ---	1-6	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
A	US 4 461 292 A (MONTALBANO ANTHONY P) 24 July 1984 (1984-07-24) * abstract * * figure 2 * ---	1-6	A62B A63B A61M
A	US 4 441 494 A (MONTALBANO ANTHONY P) 10 April 1984 (1984-04-10) * abstract * * figures 1-3 * -----	1-6	

~~The present search report has been drawn up for all claims~~

Place of search	Date of completion of the search	Examiner
THE HAGUE	23 November 1999	Ottesen, R

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

European Patent Office

Application Number
EP 99 63 0018

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

1-6

European Patent Office

LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 99 63 0018

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. Claims: 1-6

   Emergency breathing device for snow buried, comprising an inhalation chamber with:

   - A frame member.

2. Claims: 7-9

   Emergency breathing device for snow buried, comprising an inhalation chamber with:

   - A pair of inhalation valves.

3. Claims: 10-12

   Clothing article to be worn by a user and an emergency breathing device for snow buried comprising:

   - A releasable fastener.
   - An elbowed mouthpiece.
   - An conduit that extends out of a pocket to the vicinity of a releasable fastener.

4. Claims: 13,14

   Valve for an emergency breathing apparatus, in which the seat position is displaced from the sealing surface.

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 99 63 0018

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

23-11-1999

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5490501 A	13-02-1996	NONE	
US 4062359 A	13-12-1977	NONE	
US 5063923 A	12-11-1991	NONE	
US 4683869 A	04-08-1987	NONE	
US 4461292 A	24-07-1984	US 4441494 A	10-04-1984
		CA 1185142 A	09-04-1985
		EP 0073246 A	09-03-1983
		JP 58500313 T	03-03-1983
		WO 8203013 A	16-09-1982
US 4441494 A	10-04-1984	EP 0073246 A	09-03-1983
		JP 58500313 T	03-03-1983
		WO 8203013 A	16-09-1982
		US 4461292 A	24-07-1984

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82