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CA 2683542 C 2013/03/12

(11)(21) 2 683 542

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(22) Date de dépôt/Filing Date: 2009/10/27

(41) Mise à la disp. pub./Open to Public Insp.: 2010/05/07

(45) Date de délivrance/Issue Date: 2013/03/12

(30) Priorité/Priority: 2008/11/07 (US61/193,227)

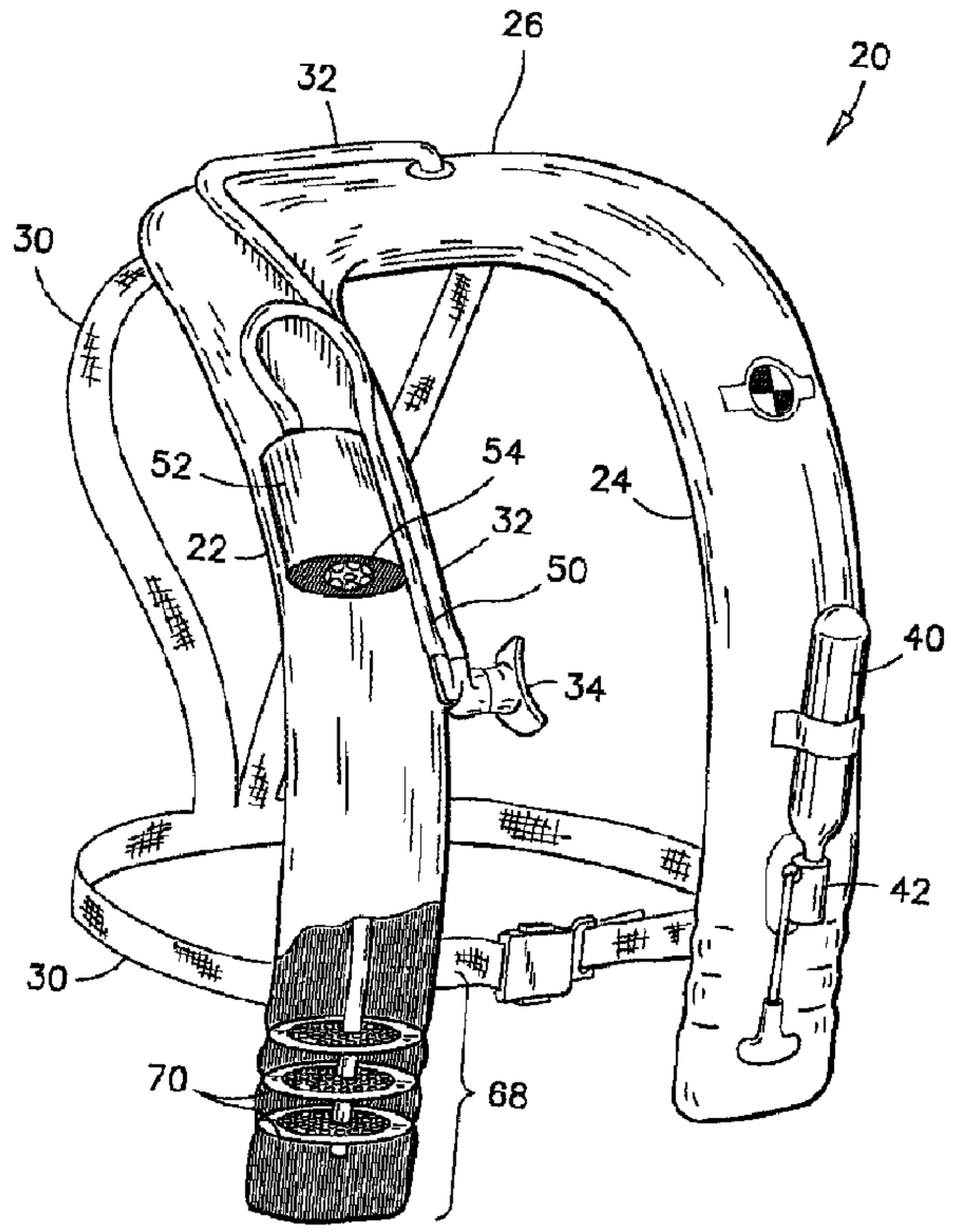
(51) Cl.Int./Int.Cl. *A62B 7/00* (2006.01),
B01D 53/62 (2006.01)

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(54) Titre : SAC RESPIRATOIRE D'URGENCE
(54) Title: EMERGENCY BREATHING BAG



(57) Abrégé/Abstract:
The breathing bag has an upper region; a lower region; a conduit for delivering exhaled air to the lower region and a conduit for withdrawing breathable air from the upper region. The device also has a baffle mounted therein for entrapping exhaled air in the lower region and for causing the exhaled air to remain in a low turbulence mode, for promoting a separation of oxygen and carbon dioxide from the exhaust air by stratification and for causing carbon dioxide to accumulate in the lower region of the bag. Consequently, the breathable air rising from the lower region of the bag has a higher oxygen content. In another aspect of the invention, a method for separating carbon dioxide and oxygen by stratification from exhaled air is also described.

ABSTRACT OF THE DISCLOSURE

The breathing bag has an upper region; a lower region; a conduit for delivering exhaled air to the lower region and a conduit for withdrawing breathable air from the upper region. The device also has a baffle mounted therein for entrapping exhaled air in the lower region and for causing the exhaled air to remain in a low turbulence mode, for promoting a separation of oxygen and carbon dioxide from the exhaust air by stratification and for causing carbon dioxide to accumulate in the lower region of the bag. Consequently, the breathable air rising from the lower region of the bag has a higher oxygen content. In another aspect of the invention, a method for separating carbon dioxide and oxygen by stratification from exhaled air is also described.

TITLE: EMERGENCY BREATHING BAG

FIELD OF THE INVENTION

This invention pertains to a breathing bag having baffles mounted at the lower end of the bag, for causing exhaled air to remain in a still mode inside the bag and for separating oxygen and carbon dioxide from exhaled air by stratification, thereby reducing the carbon dioxide content in re-breathable air rising to the upper portion of the bag.

BACKGROUND OF THE INVENTION

A breathing bag is used as a breathing aid in the presence of smoke or toxic fumes, for getting out of a house on fire, for example. A high pressure cylinder of oxygen may be attached to the bag to provide oxygen for a limited period of time. Whether an oxygen cylinder is provided or not, exhaled air contains a substantial amount of oxygen, and it is possible to re-breathe exhaled air several times in an emergency situation.

It is known that ambient air contains about 21% oxygen. It is also known that a recommended minimum oxygen content in breathable air is about 15%, because a lower amount could cause hallucinations. It is further known that a person breathing normally consumes about 5% of the oxygen present in ambient air, while a person hyperventilating in a panic situation absorbs only about 3%. Therefore, it is believed that in many circumstances, the air exhaled into a breathing bag still contains oxygen and can be re-breathed again. When the breathable gas in the high pressure cylinder is a mixture of gas rich in oxygen, such as 90% oxygen for example, this gas can be re-breathed several times before it reaches the 15% lower limit.

Several types of closed-circuit breathing bags can be found in the prior art. Examples of the prior art breathing devices are described in the following documents:

US Patent 896,447 issued to S. S. Hall et al. on August 18, 1908;

US Patent 4,154,234 issued to R. L. Baker on May 15, 1979;

US Patent 4,164,218 issued to F. E. Martin on August 14, 1979;

US Patent 4,362,153 issued to J. G. Wilson et al., on December 7, 1982;

US Patent 4,586,500 issued to M. H. Glynn on May 6, 1986;

US Patent 4,794,923 issued to J. A. Bartos on January 3, 1989;

US Patent 4,817,597 issued to S. Tanaka on April 4, 1989;

US Patent 4,821,711 issued to W. Eckstein et al., on April 18, 1989;

US Patent 4,879,996 issued to V.H. Harwood, Jr. et al., on Nov.14, 1989;

US Patent 4,917,081 issued to J. A. Bartos on April 17, 1990;

US Patent 4,938,211 issued to M. Takahashi et al., on July 3, 1990;

US Patent 5,165,394 issued to J. Hochberg on November 24, 1992;

US Patent 5,720,279 issued to Y. Furuichi et al., on February 24, 1998;

US Patent 5,724,958 issued to B. Farnworth et al., on March 10, 1998;

US Patent 6,279,571 issued to R. Meckes on August 28, 2001;

US Patent 6,761,162 issued to L. J. Swann on July 13, 2004;

US Patent 7,028,687 issued to M. Silver et al., on April 18, 2006;

CA Patent 713,356 issued to I. Streimer on July 13, 1965;

CA Patent 787,696 issued to L. R. Phillips on June 18, 1968;

CA Patent 1,020,840 issued to L. Yi-Sheng et al., on November 15, 1977;

CA Patent Appl. 2,024,439 filed by F. W. Arnoth, on August 31, 1991; This application was published on March 02, 1991;

The apparatus of the prior art are presented herein only to show the state of the art in the field of the invention. These apparatus are characterized in that they have either a carbon dioxide scrubber mounted therein between

an exhaled air compartment and a breathable air compartment, or an oxygen-generating canister therein, in which carbon dioxide and moisture in exhaled air enter into a chemical reaction with the content of the canister to produce oxygen.

At least one breathing bag of the prior art has the option to re-breath the content of the bag several times. This breathing bag is described in a patent granted to the inventor of the present emergency breathing bag. This patent is identified as follows:

US Patent 7,047,966 issued to Robert E. Stewart on May 23, 2006.

While the apparatus of the prior art have their own merits, the prior art literature in the field of breathing devices does not disclose the possibility of purifying re-breathable gas by stratification in a breathing device. Stratification of gases is well known in the mining industry for example, as explained in:

US Patent 4,512,610 issued to Clark J. Gilbert et al. on April 23, 1985. This document discloses the fact that blowers are used in mines to prevent stratification of gases in the mine atmosphere.

Although the phenomenon of separating gases by stratification is known generally, the prior art is silent concerning the possibility of purifying air by stratification in a breathing apparatus for increasing the quality of re-breathable air in that apparatus.

SUMMARY OF THE INVENTION

In the present invention, there is provided a breathing bag that has baffles therein for promoting the separation of oxygen and carbon dioxide in

exhaled air, by stratification. The oxygen-rich air is thereby separated from the exhaled air and it is selectively entrained in the re-breathable air to increase the oxygen content of the re-breathable air.

More specifically, there is provided a breathing bag having an upper region; a lower region; a conduit for delivering exhaled air in the lower region and a conduit for withdrawing breathable air from the upper region. The device also has a baffle mounted therein for entrapping exhaled air in the lower region and for causing the exhaled air to remain in a low turbulence mode for promoting a separation of oxygen and carbon dioxide from the exhaled air by stratification, and for causing carbon dioxide to accumulate in the lower region. Consequently, the breathable air rising to the upper portion of the bag has a better quality.

In another aspect of the present invention, there is provided a method for purifying exhaled air in a breathing device, comprising the steps of;

a) providing a compartment in a breathing device and a baffle mounted in a lower region of that compartment;

b) delivering exhaled air in a lower region of that compartment below the baffle means;

c) slowing down a passage of the exhaled air from the lower region through the baffle means;

d) causing the exhaled air to separate by stratification in the lower region, into an oxygen-rich portion and a carbon dioxide portion;

e) causing the oxygen-rich portion to rise to an upper region of the compartment; and

f) withdrawing the oxygen-rich portion from the upper region of the compartment.

This brief summary has been provided so that the nature of the invention may be understood quickly. A more complete understanding of the invention can be obtained by reference to the following detailed description of the preferred embodiment thereof in connection with the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred embodiment of the present invention is illustrated in the accompanying drawings in which like numerals denote like parts throughout the several views, and in which:

FIG. 1 is a perspective front and side view of the preferred emergency breathing bag according to a preferred embodiment of the present invention;

FIG. 2 is a schematic illustration of the preferred emergency breathing bag.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to **FIGS. 1** and **2** simultaneously, the preferred emergency breathing bag **20** will be described. The preferred breathing bag **20** has an inverted U-shape with two leg portions **22**, **24** and an upper connector **26** joining the leg portions **22**, **24** together. A harness **30** is preferably affixed to the preferred breathing bag **20**, for wearing the emergency breathing bag **20** comfortably, around one's neck for example with each leg portion **22**, **24** laid downward on the wearer's torso.

The preferred emergency breathing bag **20** contains a reserve of breathable

air. This breathable air is passed on to the user by way of an outlet hose **32** connected to a mouthpiece **34**. The outlet hose **32** is connected to the upper connector **26**, at the highest portion of the breathing bag **20**.

A cylinder **40** of oxygen under pressure is preferably provided on the emergency breathing bag **20**. This cylinder of oxygen **40** is preferably mounted at an intermediate position along leg portion **24** for example. The preferred cylinder of oxygen **40** has a seal-puncturing operator **42**. This operator is referred to by some manufacturers as an inflator. The preferred inflator **42** is operable by pulling on a handle which is tied to the inflator's mechanism by a string. The preferred inflator **42** is available from Halkey-Roberts™, a manufacturer located in St-Petersburg, Florida, USA.

The preferred oxygen cylinder **40** can be of any convenient size and pressure. The operator **42** preferably has a low flow rating, or is modified to release oxygen at a low flow. In that respect, a slow flow rate of about 3.5 liters per minute is suggested for most emergency applications, but other flow rates may also work depending on the intended use of the emergency breathing bag **20**.

The air exhaled by the user is forced from the mouthpiece **34** into an exhaled air hose **50** and into a carbon dioxide absorbing canister **52**. The content of this canister is not provided herein because it is not the focus of the present invention, and it is generally well known in the field of breathing devices. One such supplier of carbon dioxide absorber is Micropore Inc. located at 350F Pencader Drive, Newark, Delaware, USA, 19702. This carbon dioxide absorber is identified under the trademark of ExtendAir ™.

The preferred carbon dioxide absorbing canister **52** has an outlet port **54** and a relief valve (not shown) on that port. Excess pressure buildup on that port is vented outside the bag **20** through the outlet port **54**. Excess pressure is defined as slightly above atmospheric pressure. Although a carbon dioxide absorbing canister **52** is described herein, a filtering device for filtering and recovering oxygen from carbon dioxide may also be used in the preferred emergency breathing bag **20**.

The air inlet hose **32**, the mouthpiece **34** and the exhaled air hose **50** have one or more one-way valves therein to control the flow of air there through. These one-way valves are not illustrated herein and are not described in details because they are not the focus of the present invention.

Referring particularly to **FIG. 2**, the flow path of air inside the emergency breathing bag **20** is illustrated. The cross-hatching or shaded area in **FIG. 2** represents the inside region of the emergency breathing bag **20**. The arrows in the cross-hatching represent the flow of gases inside the emergency breathing bag **20**.

The oxygen from the pressurized cylinder **40** is released into the leg portion **24** of the emergency breathing bag and accumulates in the upper connector **26**. This oxygen is inhaled by the user through the inlet hose **32** and the mouthpiece **34**.

The exhaled air is passed through the exhaled air hose **50** and into the carbon dioxide absorbing canister **52**. The excess exhaled air is expelled through the outlet port **54** and the relief valve of the carbon dioxide absorbing canister **52.**

The exhaled air passing through the carbon dioxide absorbing canister **52**, is purified and is forced through a filter **60** and into a T-connector **62** to which is connected two exhaled air distribution hoses **64**, **66**. The purpose of the filter **60** is to remove any particles from the exhaled air, such as crystals forming through the material inside the carbon dioxide absorbing canister **52**.

The filtered exhaled air is delivered through the distribution hoses **64**, **66** to the lower compartments **68** of both leg portions **22**, **24** of the emergency breathing bag **20**, below a series of spaced-apart baffles **70** in these lower compartments **68**. These baffles **70** have perforations therein as better seen in **FIG. 1**, to let exhaled air migrate upward there through slowly.

The baffles **70** are preferably made of a perforated flexible membrane material that is bonded to the walls of each lower compartment **68**. One may also use baffles **70** made of stiff material, supported by spacers extending from the bottom end of each lower compartment **68**. The material of the baffles **70** and the way these baffles are mounted inside the lower compartments **68** are not the focus of the present invention. It is the function of these baffles **70** that is of interest herein.

The function of the perforated baffles **70** is to entrap and to retain exhaled air in the lower compartments **68** of both leg portions **22**, **24** as long as possible in a still mode to promote the stratification of the exhaled air. Carbon dioxide is heavier than oxygen, and therefore has a tendency to sink and to separate from the oxygen content in the exhaled air.

It will be appreciated that means other than a perforated baffle **70** can be used to reduce the turbulence and velocity of the air moving in the lower

regions of the breathing bag **20**. It is believed that a series of fins along the side walls of both leg portions **22**, **24**, or a porous, sponge-like material mounted in the lower compartments **68** might also work as good as the perforated baffles **70**. For this reason, the baffles **70** are referred to as baffle means **70**, and the expression should be understood as encompassing all flow-restrictive devices or material to retain air in a still mode in the leg portions of the emergency breathing bag **20**. Although three baffles **70** have been illustrated in the drawings, these drawings should not be restrictive. More or less than three baffles **70** can work. Similarly, each lower compartment **68** may be longer or shorter than the proportion shown in the drawings.

A secondary advantage of the baffles **70** is their ability to dissipate heat generated by the separation of oxygen and carbon dioxide in the carbon dioxide absorbing canister **52**. The breathable air inside the bag **20** is therefore cooler than the air in another breathing bag without baffle.

The breathable air inside the emergency breathing bag **20** is also cooler than in other breathing bag because of the fact that portions of the carbon dioxide and heat in exhaled air are released through the relief valve **54** of the carbon dioxide absorbing canister **52**.

In use, the emergency breathing bag is worn by a user, and the operator **42** on the oxygen cylinder **40** is activated. Oxygen is delivered slowly into the emergency breathing bag **20**, and carbon dioxide is expelled through the relief valve **54** of the carbon dioxide canister **52** at about the same flow rate as the supply of oxygen from the oxygen cylinder **40** and operator **42**. When the oxygen cylinder **40** is empty there should be no more flow through the relief valve **54**. The exhaled air is simply circulated through

the mouthpiece **34**, through the carbon dioxide absorbing canister **52** and back into the emergency breathing bag **20** to be re-breathed again.

Because of the structure of the emergency breathing bag **20** and the baffle means **70**, the exhaled air rising to the upper connector **26** and available for re-breathing has a higher oxygen content than other breathing devices where exhaled air is re-breathed directly.

While two leg portions **22**, **24** are illustrated and described herein, it is possible to use only one rectangular bag having a longer vertical dimension, wherein the air rising toward the mouth piece of the breathing device has its carbon dioxide content partly reduced by stratification. Similarly, it is possible to used three or more compartments mounted in series to obtain three or more separation phases.

It should also be considered that the carbon dioxide absorbing canister **52** is not essential in the preferred breathing bag **20**. For example, one may consider to modify the pillow-shaped breathing bag described and illustrated in Applicant's previous **US Patent 7,047,966**, with added baffles and exhaled air distribution hoses to obtain the benefits of separating carbon dioxide from exhaled air in a breathing device.

Furthermore, it should also be understood that the oxygen cylinder **40** is not essential in the preferred breathing bag **20**. A user of the breathing bag **20** may partly inflate the breathing bag by mouth prior to use, and re-breathe the same air several times.

And of course, the harness **30** is not essential for providing no contribution to the purification of the breathable air inside the preferred emergency

breathing bag **20**.

CLAIMS

What is claimed is;

1. An emergency breathing bag containing breathable air and having;

an upper region; a lower region; means for delivering exhaled air in said lower region and means for withdrawing said breathable air from said upper region; and

baffle means mounted therein for causing said exhaled air to be restrained in a still mode in said lower region, for promoting a separation of carbon dioxide and oxygen from said exhaled air by stratification and for causing said oxygen to rise to said upper region.

2. The emergency breathing bag as claimed in **claim 1**, wherein said baffle means are made of perforated membrane material.

3. The emergency breathing bag as claimed in **claim 1**, wherein said means for delivering exhaled air in said lower region comprises a carbon dioxide absorbing canister for removing a portion of carbon dioxide in said exhaled air.

4. The emergency breathing bag as claimed in **claim 1**, wherein said means for delivering exhaled air in said lower region comprises exhaled air distribution hoses extending under said baffle means and into said lower region.

5. The emergency breathing bag as claimed in **claim 1**, comprising an inverted U-shaped bag with two leg portions and an upper connector joining said leg portions together.

6. The emergency breathing bag as claimed in **claim 5**, wherein said means for withdrawing said breathable air is a hose connected to said upper connector.

7. The emergency breathing bag as claimed in **claim 1**, further comprising a cylinder of oxygen under pressure connected thereto for delivering oxygen therein.

8. The emergency breathing bag as claimed in **claim 3**, wherein said carbon dioxide absorbing canister has a relief valve and an outlet port for releasing excess pressure therein.

9. The emergency breathing bag as claimed in **claim 8**, wherein said relief valve is set at slightly above atmospheric pressure.

10. The emergency breathing bag as claimed in **claim 5**, further comprising a harness for retaining said inverted U-shaped bag around a user's neck with said leg portions extending downward over said user's torso.

11. A breathing bag containing breathable air and having;

a mouthpiece;

an inverted U-shaped bag having two spaced apart leg portions extending vertically and an upper connector extending

horizontally and connecting said leg portions together; each of said leg portions having a lower region;

exhaled air hoses connected to said inverted U-shaped bag and to said mouthpiece for delivering exhaled air in said lower regions;

an outlet hose connected to said upper connector and to said mouthpiece for withdrawing said breathable air therefrom; and

baffle means mounted in said leg portions for causing said exhaled air to be restrained in a still mode in said lower regions for promoting a separation of carbon dioxide and oxygen from said exhaust air by stratification and for causing said oxygen to rise to said upper connector.

12. The breathing bag as claimed in **claim 11**, wherein said baffle means are made of perforated membranes and are mounted in said lower regions, and said exhaled air hoses extending below said baffles means.

13. The breathing bag as claimed in **claim 12**, further comprising a cylinder of oxygen under pressure connected to one of said leg portions for delivering oxygen in said one leg portion, and a carbon dioxide absorbing canister connected to another one of said leg portions for removing carbon dioxide from said exhaled air hoses.

14. The breathing bag as claimed in **claim 13**, wherein said carbon dioxide canister has a relief valve therein for releasing excess pressure therein.

15. The breathing bag as claimed in **claim 14**, further comprising a harness for retaining said inverted U-shaped bag around a user's neck with said leg portions extending downward over said user's torso.

16. A method for purifying exhaled air in a breathing device, comprising the steps of:

providing a compartment in said breathing device and baffle means mounted in said compartment;

delivering exhaled air in a lower region of said compartment below said baffle means;

slowing down a passage of said exhaled air from said lower region through said baffle means;

causing said exhaled air to separate by stratification in said lower region, into an oxygen-rich portion and a carbon dioxide portion;

causing said oxygen-rich portion to rise to an upper region of said compartment; and

withdrawing said oxygen-rich portion from said upper region of said compartment.

17. The method as claimed in **claim 16**, further comprising the step of introducing oxygen in said compartment above said baffle means.

18. The method as claimed in **claim 17**, further comprising the step of removing a portion of carbon dioxide from said exhaled air prior to said step of delivering exhaled air to said lower region of said compartment.

19. The method as claimed in **claim 18**, further comprising the step of removing heat from said exhaled air prior to said step of delivering exhaled air to said lower region of said compartment.

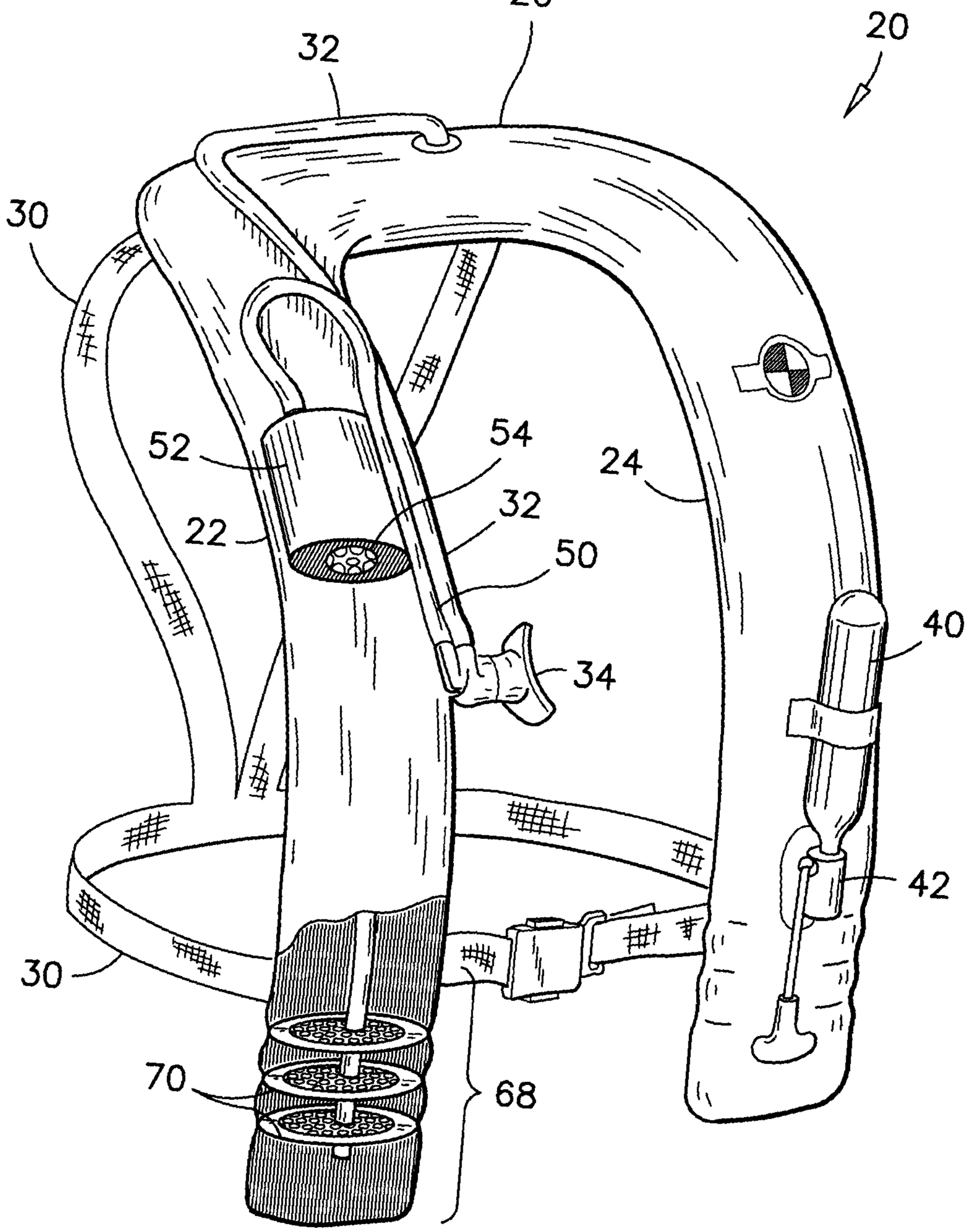


FIG. 1

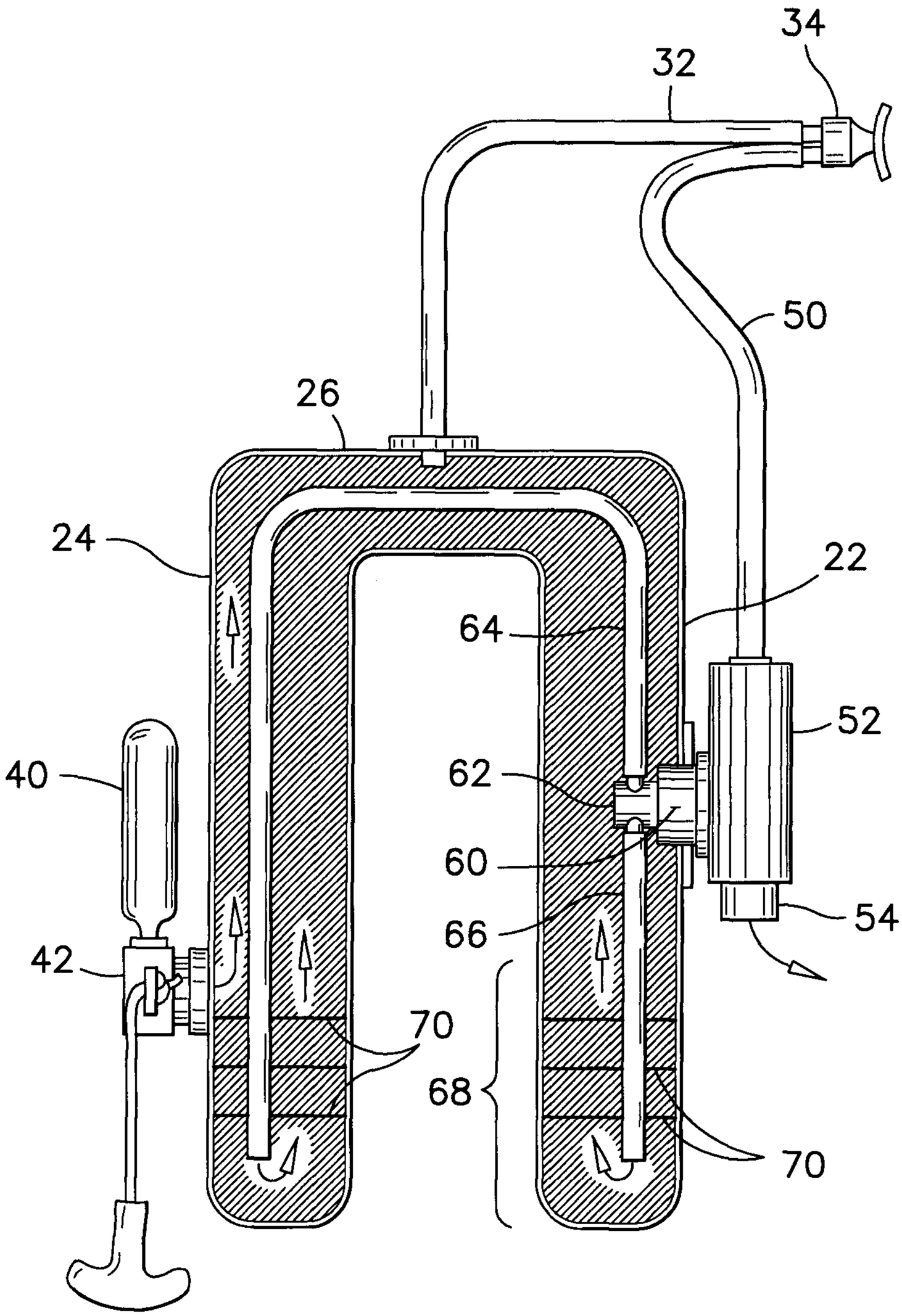
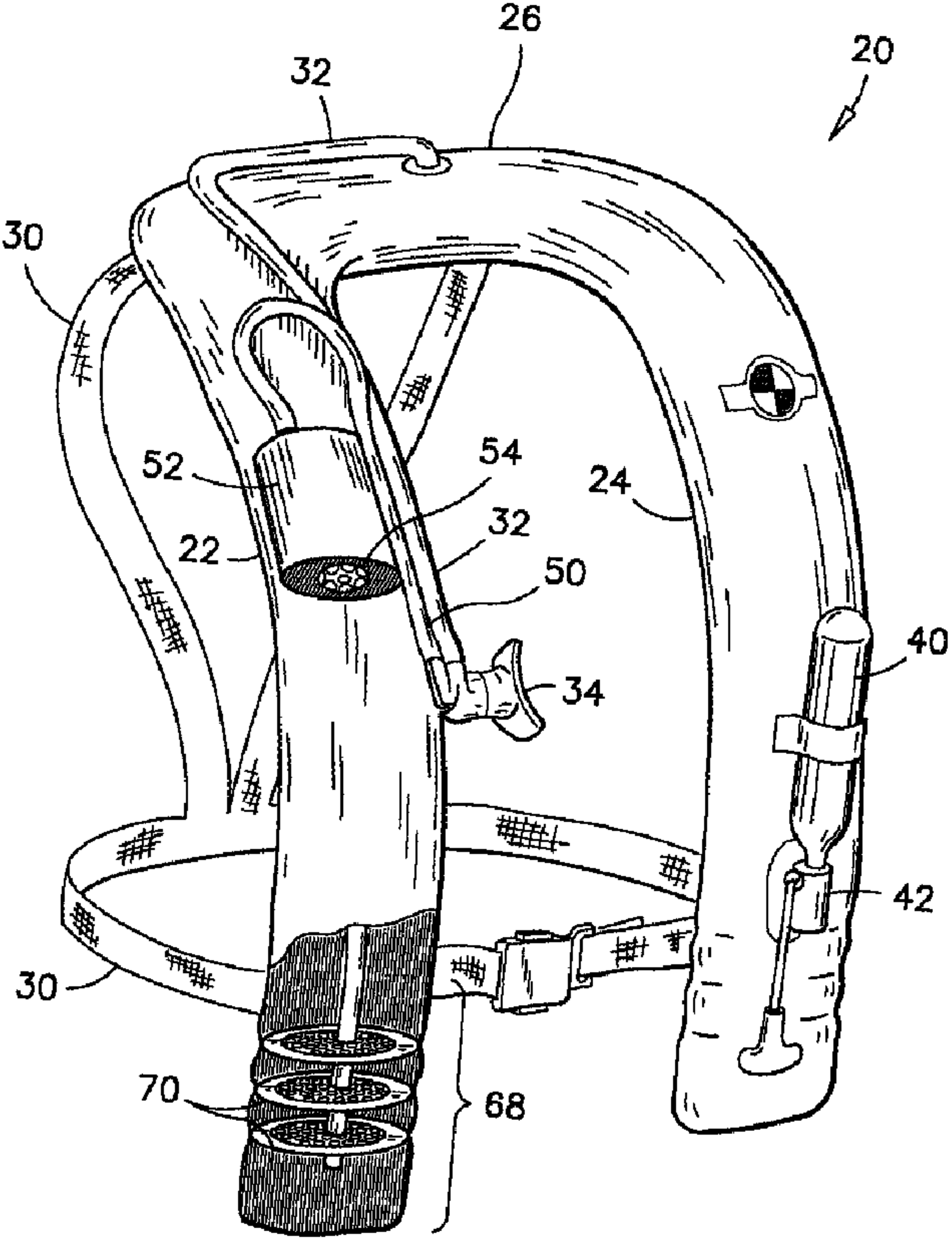


FIG. 2


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