United States Patent

[11] **3,568,672**

[72] Inventor **Charles D. Cupp**
Lancaster, N.Y.

[21] Appl. No. **838,864**
[22] Filed **July 3, 1969**
[45] Patented **Mar. 9, 1971**
[73] Assignee **"Automatic" Sprinkler Corporation of America**
Cleveland, Ohio

[54] **BUBBLE DISPERSION DEVICE FOR UNDERWATER BREATHING APPARATUS**
7 Claims, 5 Drawing Figs.

[52] U.S. Cl. **128/142,** 181/39
[51] Int. Cl. **A62b 7/00,** F01n 7/12
[50] Field of Search 128/142, 147, 142.5, 142.6, 142.2, 142.3; 181/39; 128/145.5, 145.6, 145.7, 145.8

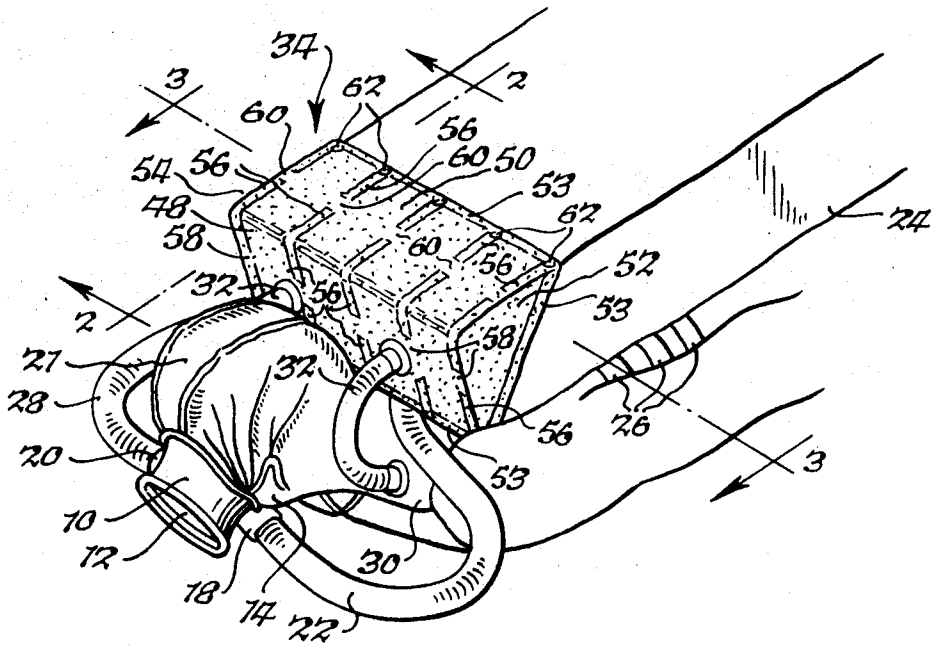
[56] **References Cited**

UNITED STATES PATENTS

2,485,908	10/1949	Morrow	128/142.3
2,823,670	2/1958	Page	128/147
3,474,782	10/1969	Cupp	128/142

Primary Examiner—Richard A. Gaudet
Assistant Examiner—J. B. Mitchell
Attorney—Christel and Bean

ABSTRACT: An exhalation dispersing apparatus for use in a water medium comprising a bag adapted to fit and be secured to one end of a container pack which houses cylinders of breathing gas and accessory equipment. The bag comprises substantially coextensive inner and outer liners sealed together along their marginal edges and also along transverse portions thereof to form a plurality of longitudinally spaced dispersing chambers. Cross flow passages are provided between adjacent chambers. A pair of exhalation conduits are connected from a breathing apparatus to the dispersing bag and a plurality of closely spaced, self-sealing apertures are formed over substantially the entire outer liner for dispersing the exhaled gas from the chambers into the ambient water in the form of minute bubbles.



PATENTED MAR 9 1971

3,568,672

SHEET 1 OF 2

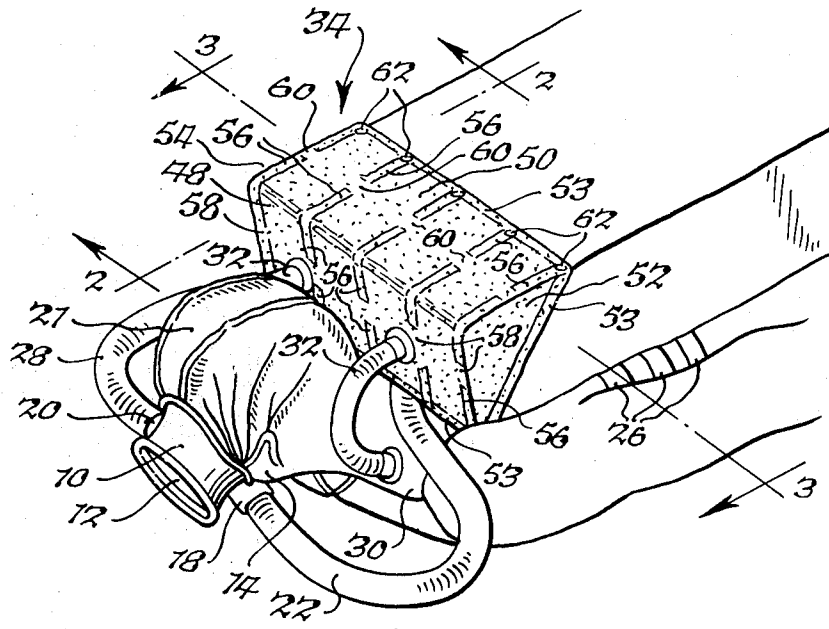


Fig. 1.

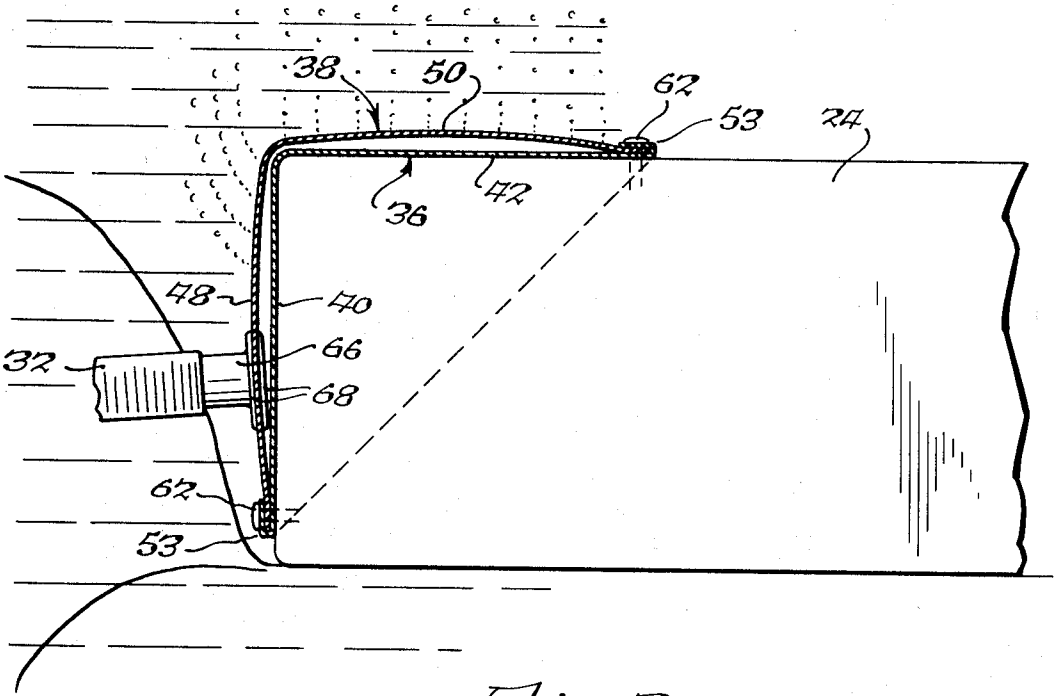
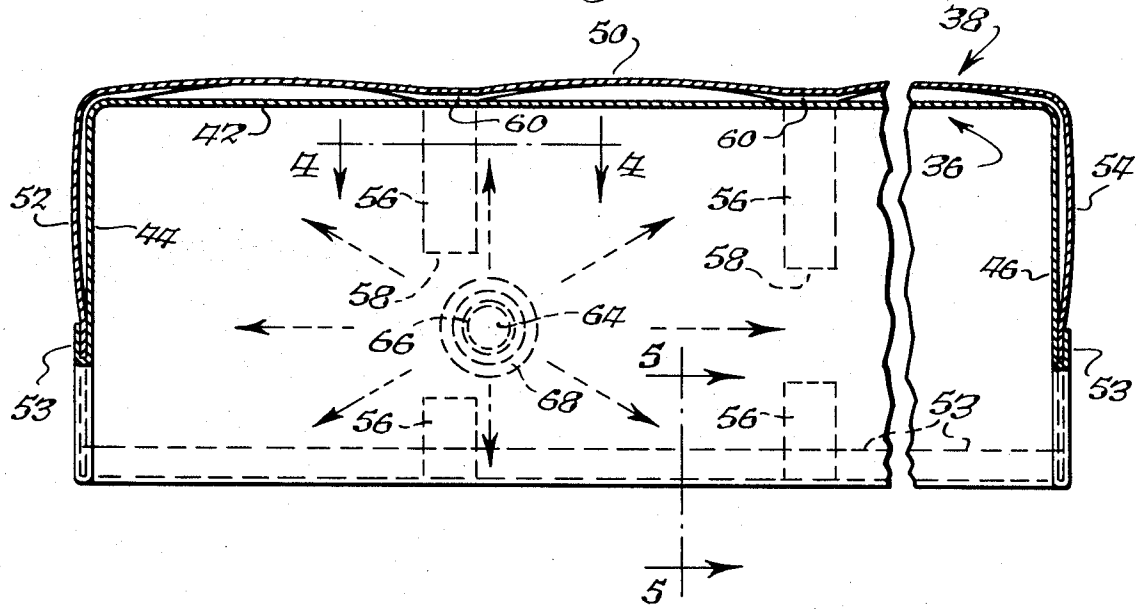


Fig. 2.

INVENTOR.
Charles D. Cupp
BY
Christel & Bean
ATTORNEYS.

Fig. 3.



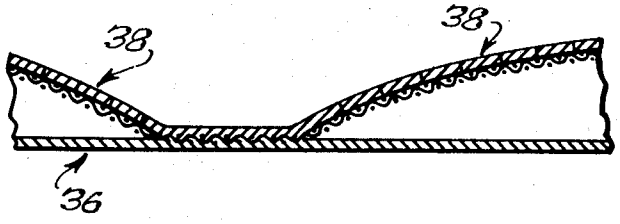


Fig. 4.

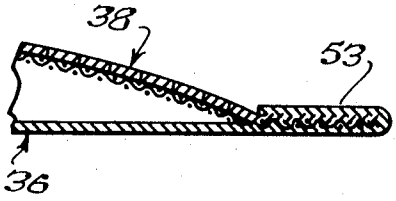


Fig. 5.

INVENTOR.
Charles D. Cupp
BY
Christel & Bean
ATTORNEYS.

BUBBLE DISPERSION DEVICE FOR UNDERWATER BREATHING APPARATUS

BACKGROUND OF THE INVENTION

This invention relates to gas dispersal apparatus and, more particularly, to apparatus for dispersing exhaled gas from breathing apparatus carried by an underwater wearer into an ambient water medium.

In providing a satisfactory exhaust gas dispersal apparatus for underwater breathing apparatus, the two prime considerations are adequate noise abatement and the problem of minimizing surface detection. The reasons for reducing the noise level of exhaust gas in underwater breathing equipment are to provide a greater safety margin while working on or near acoustical mines, to minimize sonar detection, and to improve underwater communications. The importance of minimizing surface detection is obvious, particularly since a large potential market of underwater breathing apparatus is for military and security use.

A critical problem encountered with the use of most known underwater breathing apparatus is that large bubbles of exhaled gas are created upon exhalation by the user of the apparatus. These large bubbles rise to the surface of the water and can be readily detected. Also, they create an unacceptable noise level. Prior attempts to solve this problem usually have resulted in cumbersome devices which are awkward and tend to inhibit the user's freedom of movement.

Also, it is desirable to locate breathing components working against ambient pressure at an elevation above the balanced breathing zone which is the area positioned in vertical alignment with the nose at about the level of the larynx or suprasternal notch. Otherwise, the swimmer must develop excessive exhalation effort to exhale against ambient water pressure at a depth greater than that of his balanced breathing zone.

One successful solution to these problems is disclosed in my pending application Ser. No. 536,390, now U.S. Pat. No. 3,474,782 filed Mar. 22, 1966 in the form of a bubble dispersing helmet. This invention provides an alternative solution offering an even greater dispersion area and usable either in conjunction with or in lieu of such helmet.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an exhalation dispersing apparatus for an underwater user which minimizes the visual and acoustical level of exhaled gas and reduces the resistance to exhaust.

Another object of this invention is to provide the foregoing apparatus with exhaust routes into the ambient water medium at an elevation above the balanced breathing zone at all positions normally assumed by an underwater user.

A further object of the present invention is to provide an exhalation dispersing bag which can be conveniently carried about and has a relatively large dispersing area to materially reduce exhaust flow resistance at the bag inlets.

Generally speaking, the dispersion apparatus of this invention comprises a dispersing bag adapted to fit and be secured to the upper end of an enclosure pack which contains the breathing gas supply and accessory equipment and which is secured by a suitable harness to the body of an underwater user. The bag is connected to one or more exhaled gas conduits and is formed of an inner and outer liner sealed together at their respective marginal edges, the outer liner being of a relatively large area and having a multiplicity of minute apertures closely spaced for dispersing exhaled gas into an ambient water medium.

The foregoing and other objects, advantages and characterizing features of the present invention will become clearly apparent from the ensuing detailed description of an illustrative embodiment thereof, taken together with the accompanying drawings wherein like reference numerals denote like parts throughout the various views.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of an exhalation dispersion apparatus of this invention in combination with breathing equipment worn and carried by an underwater user;

FIG. 2 is a fragmentary vertical sectional view taken about on line 2–2 of FIG. 1;

FIG. 3 is a fragmentary vertical sectional view taken about on line 3–3 of FIG. 1;

FIG. 4 is a fragmentary horizontal sectional view taken about on line 4–4 of FIG. 3 illustrating the inner and outer liners of the dispersion apparatus joined together at a typical seam; and

FIG. 5 is a fragmentary vertical sectional view taken about on line 5–5 of FIG. 3 showing the connection between the marginal edges of the inner and outer liners.

DETAILED DESCRIPTION OF AN ILLUSTRATIVE EMBODIMENT

Referring now in detail to the drawings, there is shown in FIG. 1 a typical full-face scuba face mask **10** having a transparent front lens **12**, a chin strap **14**, and a mouthpiece tube assembly **16** having the usual inhalation valve **18** and exhalation valve **20**. Mask **10** is secured to a headpiece **21** adapted to substantially conform to and fit over the head of the wearer. Headpiece **21** substantially encloses the entire head including the forehead, the top and back of the head and both sides thereof including the ears but excluding the front facial features.

A conduit or hose **22** connects inhalation valve **18** to a source of breathing gas (not shown) enclosed in a rectangularly shaped enclosure pack **24** housing cylinders of breathing gas under pressure and accessory equipment well known in the art. Enclosure pack **24** can be formed of a suitable elastic material provided with a substantially rigid frame construction to maintain pack **24** in the desired shape. A plurality of straps **26** are mounted on pack **24** and are adapted to be secured about the wearer's body. A conduit **28** connects exhalation valve **20** to a breathing bag **30** located about the wearer's shoulders. A pair of flexible exhaust conduits **32** connect breathing bag **30** to a dispersion bag, generally designated **34**, secured to the end of pack **24** adjacent headpiece **21**.

Dispersion bag **34** comprises an inner pack liner **36** and an outer dispersion liner **38** substantially coextensive therewith. Inner liner **36** is formed of a rubberized, impermeable, two-way stretch fabric and has two right angularly related sides **40** and **42** (FIG. 2) contiguous with the upper and rear sides of pack **24**. (The terms upper and rear having reference to an upright position.) A pair of flaps **44** and **46** (FIG. 3) extending in a direction normal to sides **40** and **42** form opposite ends of liner **36** and are contiguous to the upper end portions of the opposite lateral sides of pack **24**. Flaps **44** and **46** are sealed to sides **40** and **42** along their adjacent ends.

Outer dispersion liner **38** also is formed of an elastic two-way stretch fabric, similar to the fabric used for inner liner **36**, and like liner **36**, comprises a pair of right angularly related sides **48** and **50** and a pair of end flaps **52** and **54** sealed to sides **48** and **50**. Outer liner **38** is substantially coextensive with and even somewhat larger than inner liner **36** so that it can fit over inner liner **36** and form a chamber therebetween.

The peripheral portions of outer liner **38** and inner liner **36** are secured together by an adhesive. The outer marginal edges of inner liner **36** are turned up, folded back and cemented along the outer marginal edges of outer liner **38** in sealing engagement therewith as shown at **53** in FIG. 5. Also, inner and outer liners **36** and **38** as shown at **54** in FIG. 4 to form transversely extending seams **56** defining four longitudinally spaced transverse dispersion chambers extending from the peripheral forward portion of sides **40** and **48** to the peripheral rearward portion of sides **40** and **48** to the peripheral rearward portion of sides **42** and **50**. However, portions of inner and outer liners **36** and **38** along seams **56** are not cemented together thereby

to provide passages 58 and 60 between adjacent chambers. In lieu of using an adhesive, portions of inner and outer liners 36 and 38 can be secured together along seams 56 by heat sealing the same, employing a pressure sensitive tape, or in any other manner desired.

The forward peripheral portions of sides 40, 48 and the rearward peripheral portions of sides 42, 50 are secured to the upper end of pack 24 as by means of fasteners, such as rivets 62 for example. As shown in FIG. 1, a rivet 62 is provided at the opposite ends of each seam 56.

A pair of spaced openings 64 are provided in side 48 of outer liner 38 and receive fittings 66 having grommets 68 thereon suitably secured about openings 64 to provide a fluid tight seal. Fittings 66 are connected to the ends of exhaust conduits 32 remote from breathing bag 30.

In order to permit the escape of exhaled air from the chambers in dispersion bag 34 during the exhalation period of the breathing cycle of an underwater swimmer while precluding the ingress of water into the chambers, a plurality of closely spaced, minute apertures are formed through outer dispersion liner 38. The apertures are spaced over the entire liner surface including end flaps 52 and 54 and cause the escaping exhaust gas to be broken up into minute bubbles, difficult to detect acoustically or visually.

Such apertures can be formed, in the preferred manner, by puncturing outer liner 38 at closely spaced intervals completely thereacross. Such punctures in the rubberized fabric of liner 26 does not remove any of the liner material, but forms minute apertures which tend to close and become self-sealing. This self-sealing feature is very important because it prevents the ingress of water to the chambers during the inhalation portion of the breathing cycle. If desired, the apertures can take the form of very small diameter openings, sufficiently small so that water entry is precluded during the inhalation period of the breathing cycle due to the formation of a surface tension film over each opening.

A significant feature of this invention is that dispersion bag 34 covers a relatively large area so that during the exhalation period, the exhaled gas is permitted to expand within the large volume chambers to provide a very low resistance to the incoming exhaled gas through exhaust conduits 32. Thus, the effort expended by the user to exhale is kept at a minimum.

Should the inner surfaces of both liners tend to stick together at various points in the dispersing chambers and impede regular flow of exhaled gas into the chambers and out through the apertures, passages 58 and 60 compensate for this by establishing cross flow communication between adjacent chambers. Thus, any temporary closing of one of the chambers by the sticking together of liners 36 and 38 near the entrance to the chambers, is bypassed by cross flow passages 58 and 60 thereby providing regular, uninterrupted gas communication with all chambers. Inlet fittings 66 are positioned closely adjacent passages 58 but spaced from cemented seams 56.

In use, exhaled gas from mask 10 passes into bag 30 and therefrom through exhaust conduits 32 and fittings 66 into the dispersion chambers defined between seams 56 wherein it expands and escapes through the apertures in outer liner 38 into the ambient water medium. The exhaled gas, being dispersed through a multiplicity of minute apertures is broken up into minute bubbles which rise from dispersion bag 34 upwardly in the surrounding water medium with a minimum of noise to the surface of the water with a minimum disturbance.

An escape route for exhaled gas is provided at an elevation above the hereinbefore mentioned balanced breathing zone in all normal positions of use of the breathing apparatus. When upright, side 48 of liner 38 is above this zone. With the swimmer in a prone position, face down, side 50 is above this zone due to the thickness of pack 24 and with the swimmer prone on either side, one of the flanges 52 or 54 of liner 38 is above such zone due to the width of said pack 24. Accordingly, no excessive exhalation effort on the part of the swimmer normally will be required. Also, because of the large space provided in the dispersing chambers, very little resistance will be encountered by the exhaled gases entering the dispersing chambers. The sides 48, 50 extend substantially completely across the back of the wearer, from shoulder to shoulder, and with flaps 52, 54 provide a dispersion area exceeding the aforesaid helmet configuration.

A preferred embodiment of this invention having been disclosed in detail, it is to be understood that this has been done by way of illustration only.

I claim:

1. Means for dispersing exhaled gas from an underwater breathing apparatus comprising: a container pack enclosing components of a breathing apparatus; an elastic bag; means for mounting said bag on said container pack; means for conveying exhaled gas from a breathing apparatus to said bag; said bag comprising an inner liner conforming to the shape of a portion of said pack and an outer dispersion liner forming at least one chamber therebetween; said outer dispersion liner having a plurality of closely spaced minute apertures passing therethrough over substantially the entire surface thereof providing passages between said chamber and an ambient water medium.

2. Dispersing means according to claim 1 wherein said apertures are self-sealing punctures.

3. Dispersing means according to claim 1 wherein said apertures are minute diameter openings.

4. Dispersing means according to claim 1 wherein said bag includes means connecting portions of said inner and outer liners at spaced intervals forming a plurality of chambers within said bag.

5. Dispersing means according to claim 4 wherein said bag includes passages establishing communication between adjacent chambers.

6. Dispersing means according to claim 1 wherein said inner and outer liners are connected together along their marginal edges and along portions between said marginal edges to form a plurality of chambers within said bag.

7. Means for dispersing exhaled gas from an underwater breathing apparatus comprising: an elastic bag; means for mounting said bag on a container pack containing components of a breathing apparatus; means for conveying exhaled gas from a breathing apparatus to said bag; said bag comprising an inner liner conforming to the shape of a portion of said pack and an outer dispersion liner forming at least one chamber therebetween; said outer dispersion liner having a plurality of closely spaced minute apertures passing therethrough over substantially the entire surface thereof providing passages between said chamber and an ambient water medium; said inner and outer liners each having a pair of substantially right angularly related side portions and a pair of end flaps extending between said side portions, said side portions being of generally rectangular configuration adapted to extend substantially completely across the back of a wearer.