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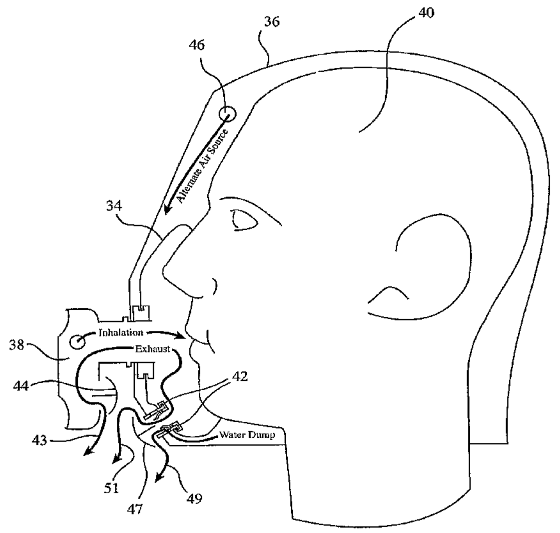

(57) Abstract: A tubular body (48) is operatively coupled to an oral nasal mask (34) and provided with lateral apertures (50) adapted for fluid flow. A flexible valve (56) is mounted onto one end of the tubular body (48) and adapted to seal the lateral apertures (50) under normal operation conditions and expose the lateral apertures (50) for fluid flow during emergency operation conditions. The sealed lateral apertures (50) keep exhaust gases from escaping the oral nasal mask (34) and contaminating the interior of the diving equipment during normal operation conditions. The exposed lateral apertures (50) allow air from an alternate source (46) to reach the mouth and nose of a user covered by the oral nasal mask (34) during emergency operation conditions. The exposed lateral apertures (50) allow excess water to be removed from inside the diving equipment. The valve system may be implemented as an integrated regulator mount nut/valve system (70).

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

VALVE SYSTEM FOR UNDERWATER DIVING EQUIPMENT

TECHNICAL FIELD

The present invention relates to underwater diving equipment and more particularly to a valve system for use with Full-Face Mask (FFM), SCUBA (Self Contained Underwater Breathing Apparatus) diving equipment and/or the like.

BACKGROUND ART

Underwater diving equipment typically includes a breathing regulator that is connected via a hose to a SCUBA (Self Contained Underwater Breathing Apparatus) air tank or a surface supplied air umbilical. Underwater diving equipment comes in a variety of configurations including FFMs (Full Face Masks), diving helmets, SCUBA and/or the like. A wide variety of underwater diving helmets and FFMs has been used over the years. In the beginning, diving helmets were configured basically as upside down buckets that had look-out windows and an air supply hose connected to it that supplied air from the surface to the diver. As time progressed, these helmets became more advanced and the physics of diving better understood.

Modern day diving helmets have been improved in many ways with features like, being able to be connected to a dry suit or the inclusion of a neck dam to keep the water out and the inside of the helmet, most of the time, dry. New breathing systems have been designed including emergency or alternate air sources, and electronic communications have been added, just to name a few.

One problem with the older diving helmets (commonly known as "heavy gear") is that the CO_2 that is expired by the diver can build up in the helmet causing a potentially dangerous situation for the diver. Air consumption is another concern. These "heavy gear" diving helmets are essentially free flow helmets, i.e. air is constantly flowing through the helmet to “flush” the CO_2 out of the helmet. In these types of helmets, the air flow rates need to be quite high which results in consumption of a great deal of air to maintain a safe CO_2 level.

In modern day diving helmets or FFMs, these problems have been solved by using what is commonly known as an "oral nasal" mask. The oral nasal mask is a relatively small rubber mask that is installed on the inside of the diving helmet or FFM to seal against the face of the diver covering his/her nose and mouth. The purpose of the oral nasal mask is to direct the flow of exhaust gases out of the helmet or FFM keeping the CO_2 levels within the helmet or FFM to a minimum.

Nowadays, to conserve air, most diving helmets or FFMs use what is called a "demand regulator." This is a breathing regulator, similar to a SCUBA diving regulator, which can be mounted onto a diving helmet or FFM. The demand regulator has a rubber diaphragm that collapses inward with each breath opening a small valve that supplies the diver with air on demand. This small valve is designed to turn off when the diver is exhaling or holding his/her breath conserving the amount of air being consumed by the diver.

The oral nasal mask itself has gone through an evolution. When oral nasal masks were first used, many masks had one or more apertures in the bottom area of the mask that would allow water that had sometimes leaked into the helmet or FFM to pass through to the interior of the oral nasal mask and ultimately be expelled out of the exhaust port of the breathing regulator. In this regard, Fig. 1 schematically shows an aperture **10** in the bottom area of a conventional oral nasal mask **12** covering the mouth and nose of a user **14**. Oral nasal mask **12** is disposed within a diving helmet **16**, and is operatively coupled to a breathing regulator **18**. Helmet water is dumped via aperture **10** and the exhaust port of breathing regulator **18**. Helmet water is excess water that may have accumulated in the bottom portion of the helmet. It was later learned that the provision of such aperture(s) was beneficial only when a small amount of water was left over in the bottom of the oral nasal mask. This left over water was instrumental in blocking the exhaust gases from escaping the oral nasal mask via the aperture(s) and contaminating the inside of the diving helmet during exhalation.

Another oral nasal mask configuration, and currently the most commonly used, is one that has a rubber mushroom-type valve installed in the upper portion of the oral nasal mask. A mushroom-type valve is a one-way valve that has a diaphragm resembling a mushroom. The mushroom-type valve in the upper portion of the oral nasal mask is oriented such that the air is allowed to flow from inside the helmet to the interior of the oral nasal mask. A rubber mushroom-type valve **20** disposed within the upper portion of an oral nasal mask **22** is schematically shown, for example, in Fig. 2. Oral nasal mask **22** covers the mouth and nose of a user **24**. Oral nasal mask **22** is disposed within a diving helmet **26**, and is operatively coupled to a breathing regulator **28**. Helmet water is dumped via an additional rubber mushroom-type valve **30** bypassing the exhaust port of breathing regulator **28**. Rubber mushroom-type valve **30** is provided in the lower portion of diving helmet **26** (Fig. 2). Helmet water is dumped directly into the surrounding water via mushroom-type valve **30**, as shown by directional arrow **32** in Fig. 2.

Most helmets and FFMs presently are equipped with an emergency or alternate air source which is usually controlled by the diver turning a valve that is mounted either to the side of the helmet or FFM or is mounted to the divers harness. When used properly, the alternate air enters the side of the helmet or FFM, as shown, for example, in reference to Figs. 1 - 2. For example in Fig. 2, alternate air within helmet **26** enters oral nasal mask **22** via rubber mushroom valve **20**. The incoming alternate air within helmet **26** forces excess water built up inside helmet **26** out into the surrounding water via mushroom-type valve **30** (Fig. 2).

DISCLOSURE OF THE INVENTION

Exemplary embodiments disclosed herein are generally directed to a valve system for underwater diving equipment.

In accordance with one aspect of the invention, the valve system comprises a substantially tubular body provided with a plurality of lateral apertures adapted for fluid flow. The tubular body is operatively coupled to an oral nasal mask which is part of the diving equipment. The valve system also comprises a flexible valve configured for mounting onto one end of the tubular body.

The mounted flexible valve is adapted to seal the lateral apertures from inside the hollow interior of the tubular body under normal operation conditions and expose the same for fluid flow during emergency operation conditions. The sealed lateral apertures keep exhaust gases from escaping the oral nasal mask and contaminating the interior of the diving equipment during normal operation conditions. The exposed lateral apertures allow air within the diving equipment to reach the mouth and nose of a user covered by the oral nasal mask during emergency operation conditions. Excess water accumulated in the diving equipment is dumped outside via the exposed lateral apertures.

In accordance with another aspect of the invention, the valve system comprises a substantially ring-shaped body provided with a plurality of inner annular apertures adapted for fluid flow. The ring-shaped body is operatively coupled between an oral nasal mask and a breathing regulator. The oral nasal mask and breathing regulator are part of the diving equipment. The valve system also comprises a flexible valve configured for mounting within the ring-shaped body.

The mounted flexible valve is adapted to seal the inner annular apertures under normal operation conditions and expose the same for fluid flow during emergency operation conditions. The sealed inner annular apertures keep exhaust gases from escaping the oral nasal mask and contaminating the interior of the diving equipment during normal operation conditions. The exposed inner annular apertures allow air within the diving equipment to reach the mouth and nose of a user covered by the oral nasal mask during emergency operation conditions. Excess water accumulated in the diving equipment is dumped outside via the exposed inner lateral apertures.

In accordance with yet another aspect of the invention, the valve system comprises a substantially tubular valve assembly operatively coupled between an oral nasal mask and a breathing regulator. The oral nasal mask and breathing regulator are part of the diving equipment. The valve system also comprises means for controlling the exhaust gas levels within the diving equipment under normal operation conditions, and means for providing an alternate source of breathing gas for the user under emergency operation conditions. The valve system further comprises means for removing excess water accumulated in the diving equipment when the alternate source of breathing gas is activated by the user.

In accordance with still another aspect of the invention, the valve system comprises a substantially ring-shaped valve assembly operatively integrated between an oral nasal mask and a breathing regulator. The oral nasal mask and breathing regulator are part of the diving equipment. The valve system further comprises means for controlling the exhaust gas levels within the diving equipment under normal operation conditions, and means for providing an alternate source of breathing gas for the user under emergency operation conditions. The valve system also comprises means for removing excess water accumulated in the diving equipment when the alternate source of breathing gas is activated by the user.

These and other aspects of the invention will become apparent from a review of the accompanying drawings and the following detailed description of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is generally shown by way of reference to the accompanying drawings in which:

Figure 1 is a schematic cut away view of a conventional oral nasal system (used in conjunction with a diving helmet) showing the routing of air/exhaust gases within the diving helmet and the path of water removal from the diving helmet;

Figure 2 is a schematic cut away view of another conventional oral nasal system (used in conjunction with a diving helmet) showing the routing of air/exhaust gases within the diving helmet and the path of water removal from the diving helmet;

Figure 3 is a schematic cut away view of an oral nasal mask disposed within a diving helmet and operatively coupled to a breathing regulator with the routing of exhaust gases and helmet water via an integral valve system constructed in accordance with an exemplary embodiment of the present invention;

Figure 4 shows schematically the valve system of Fig. 3 under normal operation conditions;

Figure 5 shows schematically the valve system of Fig. 3 under emergency or helmet water dump operation conditions;

Figure 6 is an exploded view of the valve system of Fig. 3 with associated breathing regulator components;

Figure 7 is a side perspective view of the valve system of Fig. 6 with the valve system being in an closed state;

Figure 8 is a side perspective view of the valve system of Fig. 6 with the valve system being in a partially open state;

Figure 9 is a schematic cut away view of an oral nasal mask disposed within a diving helmet and operatively coupled to a breathing regulator with the routing of exhaust gases and helmet water under normal operation conditions via an integrated regulator mount nut/valve system constructed in accordance with another exemplary embodiment of the present invention;

Figure 10 shows schematically the integrated regulator mount nut/valve system of Fig. 9 under emergency or helmet water dump operation conditions;

Figure 11 is an exploded view of the integrated regulator mount nut/valve system of Fig. 9 with associated breathing regulator components;

Figure 12 is a top perspective view of the valve system of Fig. 11 with the valve system being in an closed state; and

Figure 13 is a top perspective view of the valve system of Fig. 11 with the valve system being in a partially open state.

MODE(S) FOR CARRYING OUT THE INVENTION

The detailed description set forth below in connection with the appended drawings is intended as a description of exemplary embodiments and is not intended to represent the only forms in which the exemplary embodiments may be constructed and/or utilized. The description sets forth the functions and the sequence of steps for constructing and operating the exemplary embodiments in connection with the illustrated embodiments. However, it is to be understood that the same or equivalent functions and sequences may be accomplished by different embodiments that are also intended to be encompassed within the spirit and scope of the present invention.

Some embodiments of the present invention will be described in detail with reference to a valve system for underwater diving helmet or full-face mask applications as generally shown in Figures 3 - 13. Additional embodiments, features and/or advantages of the invention will become apparent from the ensuing description or may be learned by practicing the invention. In the figures, the drawings are not to scale with like numerals referring to like features throughout both the drawings and the description.

Figure 3 is a cut away view of an oral nasal mask **34** disposed within a diving helmet **36**, and operatively coupled to a demand-type breathing regulator **38**. Oral nasal mask **34** is configured to cover the mouth and nose of a user **40**. Oral nasal mask **34** may be made of elastic material(s) such as natural and/or synthetic rubber. Oral nasal mask **34** includes a side opening **35** (Fig. 6) adapted for mounting a microphone, as well as a frontal opening **39** (Fig. 6) adapted to accommodate a standard breathing regulator mount nut **37** (Fig. 6).

Breathing regulator **38** (Figs. 3 - 5) includes a housing **41** (Fig. 6) adapted at one end to mount to oral nasal mask **34** via nut **37**. Regulator housing **41** is adapted to receive a rubber mushroom-type valve **44** (Figs. 3 - 6) that is oriented to allow exhaust gases from user **40** to exit breathing regulator **38** defining a main exhaust gas pathway **43** (Figs. 3 - 4). Regulator housing **41** is also adapted to receive a standard diaphragm **45** (Fig. 6).

Helmet water is dumped via an integral valve system **42** (Figs. 3 - 8) and a mushroom-type valve **47** (Figs. 3 - 6) bypassing main exhaust gas pathway **43**. The water dump pathway is generally shown by directional arrow **49** in Figs. 3 and 5. Mushroom-type valve **47** is mounted downstream from integral valve system **42** and oriented to allow helmet water and exhaust gases to exit diving helmet **36** into the surrounding water (Fig. 3). An auxiliary exhaust gas pathway **51** (Figs. 3 - 4) is defined by integral valve system **42** and mushroom-type valve **47**.

In accordance with an exemplary embodiment of the present invention, integral valve system **42** (Figs. 3 - 8) comprises a substantially tubular body **48** (Fig. 6) made from a rigid material, such as metal, plastic and/or the like. Rigid tubular body **48** is provided with a plurality of lateral apertures **50** (Figs. 6 - 8) adapted to allow air from an alternate source **46** (Figs. 3, 5 - 6) to reach the user's mouth and nose (covered by oral nasal mask **34**) during emergency or helmet water dump operation.

Tubular body **48** is provided at a front end **52** (Fig. 6) with an annular outwardly protruding lip **54** (Fig. 6) adapted for mounting a flexible valve **56** (Fig. 6). In this regard, "outwardly protruding" is generally defined as pointing away from the hollow interior of rigid body **48**. Rigid body **48** is also provided with an annular groove **55** (Figs. 6 - 8) that is disposed between outwardly protruding lip **54** (Fig. 6) and lateral apertures **50** (Figs. 6 - 8). Annular groove **55** is used to mount and seal oral nasal mask **34** which is suitably apertured (not shown) at a bottom portion **57** (Fig. 6) thereof.

Tubular body **48** is provided at a rear end **53** with an integral annular flange **62** (Figs. 6 - 8) adapted for mounting onto the interior wall surface of helmet **36**. In one embodiment, annular flange **62** is screwed and sealed onto the interior surface of the helmet of FFM shell. Other means of mounting tubular body **48** onto the helmet or FFM shell may be utilized, provided such other mounting means do not deviate from the intended scope and spirit of the present invention.

Flexible valve **56** has an annular top **58** (Figs. 6 - 8) configured to mount securely onto outwardly protruding lip **54** (fig. 6) of rigid tubular body **48**. Flexible valve **56** also has a tubular body **60** (Figs. 6 - 8) configured to match and seal against the inner surface of tubular body **48** completely covering lateral apertures **50** (Figs. 6 - 8) from inside. Tubular valve body **60** is disposed under annular top **58**, as generally shown in Figs. 6 - 8. Flexible valve **56** may be made of elastic material such as natural rubber, synthetic rubber and/or the like. The elastic material is suitable for valve use in accordance with the general principles of the present invention. Other valve material(s) or combinations of materials may be utilized, as needed, as long as there is no departure from the intended purpose of the present invention.

Under normal operation conditions, user **40** inhales air from a main air supply via breathing regulator **38** (Fig. 3) with flexible valve **56** (of integral valve system **42**) being closed to keep the CO_2 gas exhaled by user **40** from escaping oral nasal mask **34** and contaminating the interior of diving helmet **36**. Flexible valve **56** is in a "closed" state when its tubular elastic body **60** completely covers (seals) lateral apertures **50** from inside, as generally depicted in Fig. 7.

The exhaled CO_2 gas exits oral nasal mask **34** via main exhaust gas pathway **43** (Figs. 3 - 4), as well as via auxiliary exhaust gas pathway **51** (Figs. 3 - 4) with the latter involving the passage of CO_2 gas through the hollow interior of rigid tubular body **48** (Fig. 6) and mushroom-type valve **47** (Figs. 3 - 6). With flexible valve **56** in a "closed" state, exhaled CO_2 gas from oral nasal mask **34** that passes through the hollow interior of rigid body **48** (Fig. 6) is prevented from entering the interior of helmet **36** via lateral apertures **50** which are completely covered (sealed) on the inside by tubular elastic valve body **60**, as generally shown in Figs. 4 and 7.

The availability of two (main and auxiliary) exhaust gas pathways for exhaled CO_2 gas during normal operation conditions helps reduce the exhalation work of breathing for user **40** and lowers breathing resistance. A person skilled in the art would recognize that the two (main and auxiliary) exhaust gas pathways may also be viewed as one common exhaust gas pathway, in which case the auxiliary portion serves advantageously as extension of the main exhaust gas pathway.

In case of emergency or under helmet water dump operations, user **40** has access to air from an alternate air supply. Alternate air enters diving helmet **36** via port **46** (Figs. 3, 5 - 6). The incoming alternate air forces flexible elastic valve **56** to open due to associated pressure increase inside helmet **36**. Specifically, tubular elastic valve body **60** is forced to flex inward (within the hollow interior of rigid body **48**) away from lateral apertures **50** exposing the same for fluid entry, as generally depicted in Figs. 5 and 8. Alternate air from helmet **36** enters oral nasal mask **34** via exposed apertures **50** (Fig. 8) providing an emergency air supply pathway **59** (Fig. 5) for user **40**. The pressure increase inside helmet **36** caused by incoming alternate air also forces helmet water out (into the surrounding water) via exposed lateral apertures **50**, as generally shown by directional arrow **49** (Fig. 5).

In accordance with another exemplary embodiment of the present invention, an integrated breathing regulator mount nut/valve system **70** includes a flexible valve **72** operatively coupled to a substantially ring-shaped body **78** (Figs. 11 - 13). Flexible valve **72** includes a tubular member **76** rising from a flat washer-like body **74** (Figs. 11 - 13). Flexible valve **72** is made of elastic material such as natural rubber, synthetic rubber and/or the like. The elastic material is suitable for valve use in accordance with the general principles of the present invention.

Ring-shaped body **78** (Figs. 11 - 13) is made from rigid material such as metal, plastic and/or the like. Rigid ring-shaped body **78** is configured at a rear end **80** to operatively mount to an oral nasal mask **79**, as generally illustrated in Fig. 11. Ring-shaped body **78** is further configured at a front end **82** to mount to a breathing regulator housing **84** (Fig. 11) via an appropriately configured opening **85** on a diving helmet **87** (Figs. 9 - 11). Breathing regulator housing **84** is adapted to receive a mushroom-type valve **86** (Figs. 9 - 11) and a standard diaphragm **88** (Fig. 11).

As generally depicted in reference to Figs. 11 - 13, ring-shaped body **78** is provided with an inner annular lip **90**, which is recessed inward relative to front end **82**, and a plurality of inner annular apertures **92** disposed between inner lip **90** and the interior tubular wall surface of rigid body **78**. Inner annular apertures **92** are adapted to allow air from an alternate air source to reach the user's mouth and nose (covered by oral nasal mask **79**) under emergency or helmet water dump operations.

Inner annular lip **90** is configured to receive and securely retain elastic tubular member **76** of flexible valve **72**, as generally shown in Figs. 12 - 13. Flat washer-like body **74** (of flexible valve **72**) is configured to cover completely (seal) inner annular apertures **92** when tubular member **76** is securely mounted on inner lip **90**. Rigid ring-shaped body **78** is also provided with an annular slot **77** (Figs. 9 - 10) that provides access to the underside of inner annular apertures **92**. Annular slot **77** is disposed proximate to rear end **80** (Fig. 11) of rigid ring-shaped body **78**.

Under normal operation conditions, user **100** inhales air from a main air supply via a breathing regulator **102** (Fig. 9). Breathing regulator **102** includes housing **84** (Fig. 11) with associated mushroom-type valve **86** (Figs. 9 - 11). In this case, flexible valve **72** (of integrated regulator mount nut/valve system **70**) is closed to keep the CO_2 gas exhaled by user **100** from escaping oral nasal mask **79** and contaminating the interior of diving helmet **87**. Flexible valve **72** is in a "closed" state when its flat washer-like body **74** completely covers (seals) inner annular apertures **92**, as generally depicted in Fig. 12.

The exhaled CO_2 gas exits oral nasal mask **79** via regulator exhaust gas pathway **104** (Fig. 9) that includes passage through the hollow interior of rigid ring-shaped body **78** of integrated regulator mount nut/valve system **70** and associated mushroom-type valve **86**. With flexible valve **72** in a "closed" state, exhaled CO_2 gas from oral nasal mask **79** passing through rigid ring-shaped body **78** is prevented from entering the interior of helmet **87** via inner annular apertures **92** which are completely covered (sealed) by flat washer-like body **74** (Fig. 12).

In case of an emergency or under helmet water dump operations, user **100** has access to air from an alternate air supply. Alternate air enters diving helmet **87** via port **106** (Figs. 10 - 11). The incoming alternate air forces flexible elastic valve **72** to open due to associated pressure increase inside helmet **87**. Specifically, flat washer-like body **74** is forced to flex away from inner annular apertures **92** exposing the same for fluid entry, as generally depicted in Fig. 13. Alternate air from inside helmet **87** enters oral nasal mask **79** via annular slot **77** and exposed annular apertures **92**, providing an emergency air supply pathway **108** for user **100**, as generally shown in Fig. **10**. The pressure increase inside helmet **87** caused by incoming alternate air also forces helmet water out (into the surrounding water) via annular slot **77**, exposed annular apertures **92** and mushroom-type valve **86**, as generally shown by water dump pathway **110** (Fig. 10).

Integrated valve system **70** (Figs. 9 - 13) advantageously lowers the number of components needed to construct a valve system of the type generally described hereinabove and shown in reference to Figs. 3 – 8, while retaining the same functionality.

A person skilled in the art would readily appreciate that the valve system of the present invention in its various embodiments may be adapted for use with a full-face mask (FFM), SCUBA (Self Contained Underwater Breathing Apparatus) diving equipment and/or the like. The diving equipment utilized in accordance with the present invention may receive surface supplied breathing gas via an umbilical. The valve system of the present invention may be assembled in other ways and/or with other suitable components and/or materials, as long as there is no departure from the intended purpose and scope of the present invention.

The exemplary embodiments described hereinabove are merely illustrative of the general principles of the present invention. Various design modifications may be employed that would reside within the scope of the invention. Thus, by way of example, but not of limitation, alternative configurations may be utilized in accordance with the teachings herein. Accordingly, the drawings and description are illustrative and not meant to be a limitation thereof.

Moreover, all terms should be interpreted in the broadest possible manner consistent with the context. In particular, the terms "comprises" and "comprising" should be interpreted as referring to elements, components, or steps in a non-exclusive manner, indicating that the referenced elements, components, or steps may be present, or utilized, or combined with other elements, components, or steps that are not expressly referenced. Thus, it is intended that the invention cover all embodiments and variations thereof as long as such embodiments and variations come within the scope of the appended claims and their equivalents.

INDUSTRIAL APPLICABILITY

The present invention has a wide range of industrial applicability. Particularly, when configured and used in accordance with the general principles of the present invention, the valve system in its various embodiments may be adapted for use with a Full-Face Mask (FFM), SCUBA (Self Contained Underwater Breathing Apparatus) diving equipment and/or the like. The valve system of the present invention allows the user access to air from an alternate air supply source in case of emergency or under helmet water dump operations. Under normal operation conditions, the user inhales air form a main air supply via a breathing regulator.

CLAIMS

WHAT IS CLAIMED:

1. A valve system for underwater diving equipment, said valve system comprising:

a substantially tubular body provided with a plurality of lateral apertures adapted for fluid flow, said substantially tubular body being operatively coupled to an oral nasal mask, the oral nasal mask being part of the diving equipment; and

a flexible valve configured for mounting onto one end of said substantially tubular body, said mounted flexible valve being adapted to seal said lateral apertures from inside the hollow interior of said substantially tubular body under normal operation conditions and expose said lateral apertures for fluid flow during emergency operation conditions, said sealed lateral apertures keeping exhaust gases from escaping the oral nasal mask and contaminating the interior of the diving equipment during normal operation conditions, said exposed lateral apertures allowing air within the diving equipment to reach the mouth and nose of a user covered by the oral nasal mask during emergency operation conditions, wherein excess water accumulated in the diving equipment is dumped outside via said exposed lateral apertures.

2. The valve system of Claim 1, wherein said flexible valve is in a "closed" state during inhalation of air from a main air supply via a breathing regulator during normal operation conditions.

3. The valve system of Claim 2, wherein the breathing regulator is operatively coupled between the oral nasal mask and a first one-way valve oriented to pass fluid away from the breathing regulator.

4. The valve system of Claim 3, wherein the operatively coupled breathing regulator and said first one-way valve define a main exhaust gas pathway for the user.

5. The valve system of Claim 4, wherein said substantially tubular body is operatively coupled between the oral nasal mask and a second one-way valve oriented to pass fluid away from the oral nasal mask.

6. The valve system of Claim 5, wherein the hollow interior of said operatively coupled tubular body and said second one-way valve define an auxiliary exhaust gas pathway for the user.

7. The valve system of Claim 6, wherein said main and auxiliary exhaust gas pathways help reduce the exhalation work of breathing for the user.

8. The valve system of Claim 7, wherein said flexible valve is in an "open" state during inhalation of air from an alternate air supply source during emergency operation conditions, said supplied alternate air forcing said flexible valve to open due to associated pressure increase inside the diving equipment.

9. The valve system of Claim 8, wherein alternate air from inside the diving equipment enters the oral nasal mask via said exposed lateral apertures providing an emergency air supply pathway for the user.

10. The valve system of Claim 2, wherein the breathing regulator is a demand-type breathing regulator.

11. The valve system of Claim 9, wherein said mounted flexible valve includes an elastic tubular body configured to seal said lateral apertures from inside the hollow interior of said substantially tubular body under normal operation conditions.

12. The valve system of Claim 11, wherein said elastic tubular body is forced to flex away from said lateral apertures within the hollow interior of said substantially tubular body by incoming alternate air under emergency operation conditions.

13. The valve system of Claim 1, wherein the underwater diving equipment is a diving helmet.

14. The valve system of Claim 1, wherein the underwater diving equipment is a full-face mask (FFM).

15. The valve system of Claim 1, wherein the underwater diving equipment is a self contained underwater breathing apparatus (SCUBA).

16. The valve system of Claim 1, wherein the underwater diving equipment receives surface supplied breathing gas via an umbilical.

17. A valve system for underwater diving equipment, said valve system comprising:

a substantially ring-shaped body provided with a plurality of inner annular apertures adapted for fluid flow, said substantially ring-shaped body being operatively coupled between an oral nasal mask and a breathing regulator, the oral nasal mask and breathing regulator being part of the diving equipment; and a flexible valve configured for mounting within said substantially ring-shaped body, said mounted flexible valve being adapted to seal said inner annular apertures of said substantially ring-shaped body under normal operation conditions and expose said inner annular apertures for fluid flow during emergency operation conditions, said sealed inner annular apertures keeping exhaust gases from escaping the oral nasal mask and contaminating the interior of the diving equipment during normal operation conditions, said exposed inner annular apertures allowing air within the diving equipment to reach the mouth and nose of a user covered by the oral nasal mask during emergency operation conditions, wherein excess water accumulated in the diving equipment is dumped outside via said exposed inner annular apertures.

18. The valve system of Claim 17, wherein said flexible valve is in a “closed” state during inhalation of air from a main air supply via the breathing regulator and the hollow interior of said substantially ring-shaped body during normal operation conditions.

19. The valve system of Claim 18, wherein the breathing regulator is operatively coupled to a one-way valve oriented to pass fluid away from the breathing regulator.

20. The valve system of Claim 19, wherein the operatively coupled breathing regulator, the hollow interior of said substantially ring-shaped body, and said one-way valve define an exhaust gas pathway for the user.

21. The valve system of Claim 20, wherein said flexible valve is in an “open” state during inhalation of air from an alternate air supply source during emergency operation conditions, said alternate air forcing said flexible valve to open due to associated pressure increase inside the diving equipment.

22. The valve system of Claim 20, wherein said substantially ring-shaped body is further provided with an annular slot, said annular slot providing access to the underside of said annular apertures, said annular slot being disposed proximate to one end of said substantially ring-shaped body.

23. The valve system of Claim 22, wherein alternate air from inside the diving equipment enters the oral nasal mask via said annular slot and said exposed inner apertures providing an emergency air supply pathway for the user.

24. The valve system of Claim 17, wherein the breathing regulator is a demand-type breathing regulator.

25. The valve system of Claim 23, wherein said mounted flexible valve includes a substantially flat washer-like body configured to seal said inner annular apertures of said substantially ring-shaped body under normal operation conditions.

26. The valve system of Claim 25, wherein said substantially flat washer-like body is forced to flex away from said inner annular apertures of said substantially ring-shaped body by incoming alternate air under emergency operation conditions.

27. The valve system of Claim 25, wherein said mounted flexible valve further includes a tubular member configured for mounting within said substantially ring-shaped body.

28. The valve system of Claim 17, wherein said substantially ring-shaped body has an integrated regulator mount nut functionality.

29. The valve system of Claim 17, wherein the underwater diving equipment is a diving helmet.

30. The valve system of Claim 17, wherein the underwater diving equipment is a full-face mask (FFM).

31. The valve system of Claim 17, wherein the underwater diving equipment is a self contained underwater breathing apparatus (SCUBA).

32. The valve system of Claim 17, wherein the underwater diving equipment receives surface supplied breathing gas via an umbilical.

33. The valve system of Claim 1, wherein said substantially tubular body is made of rigid material.

34. The valve system of Claim 17, wherein said substantially ring-shaped body is made of rigid material.

35. The valve system of Claim 1, wherein said flexible valve is made of elastic material.

36. The valve system of Claim 17, wherein said flexible valve is made of elastic material.

37. The valve system of Claim 23, wherein said annular slot, said exposed inner apertures, and said one-way valve define an excess water dump pathway for the user.

38. A valve system for underwater diving equipment, said valve system comprising:

a substantially tubular valve assembly operatively coupled between an oral nasal mask and a breathing regulator, the oral nasal mask and breathing regulator being part of the diving equipment;

means for controlling the exhaust gas levels within the diving equipment under normal operation conditions;

means for providing an alternate source of breathing gas for the user under emergency operation conditions; and

means for removing excess water accumulated in the diving equipment when the alternate source of breathing gas is activated by the user.

39. The valve system of Claim 6, wherein each of said first and second one-way valves is a mushroom-type valve.

40. The valve system of Claim 19, wherein said one-way valve is a mushroom-type valve.

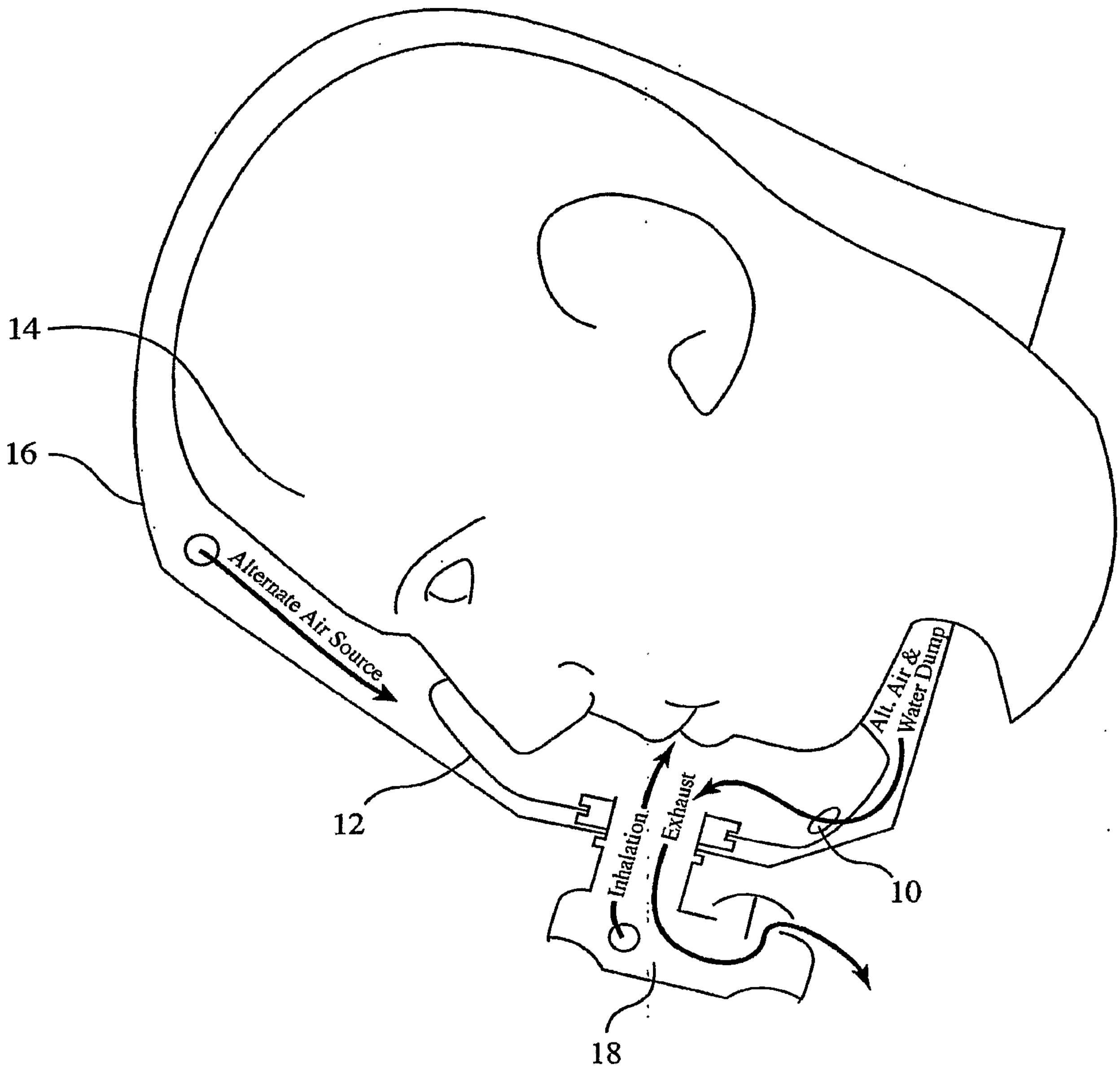
41. A valve system for underwater diving equipment, said valve system comprising:

a substantially ring-shaped valve assembly operatively integrated between an oral nasal mask and a breathing regulator, the oral nasal mask and breathing regulator being part of the diving equipment;

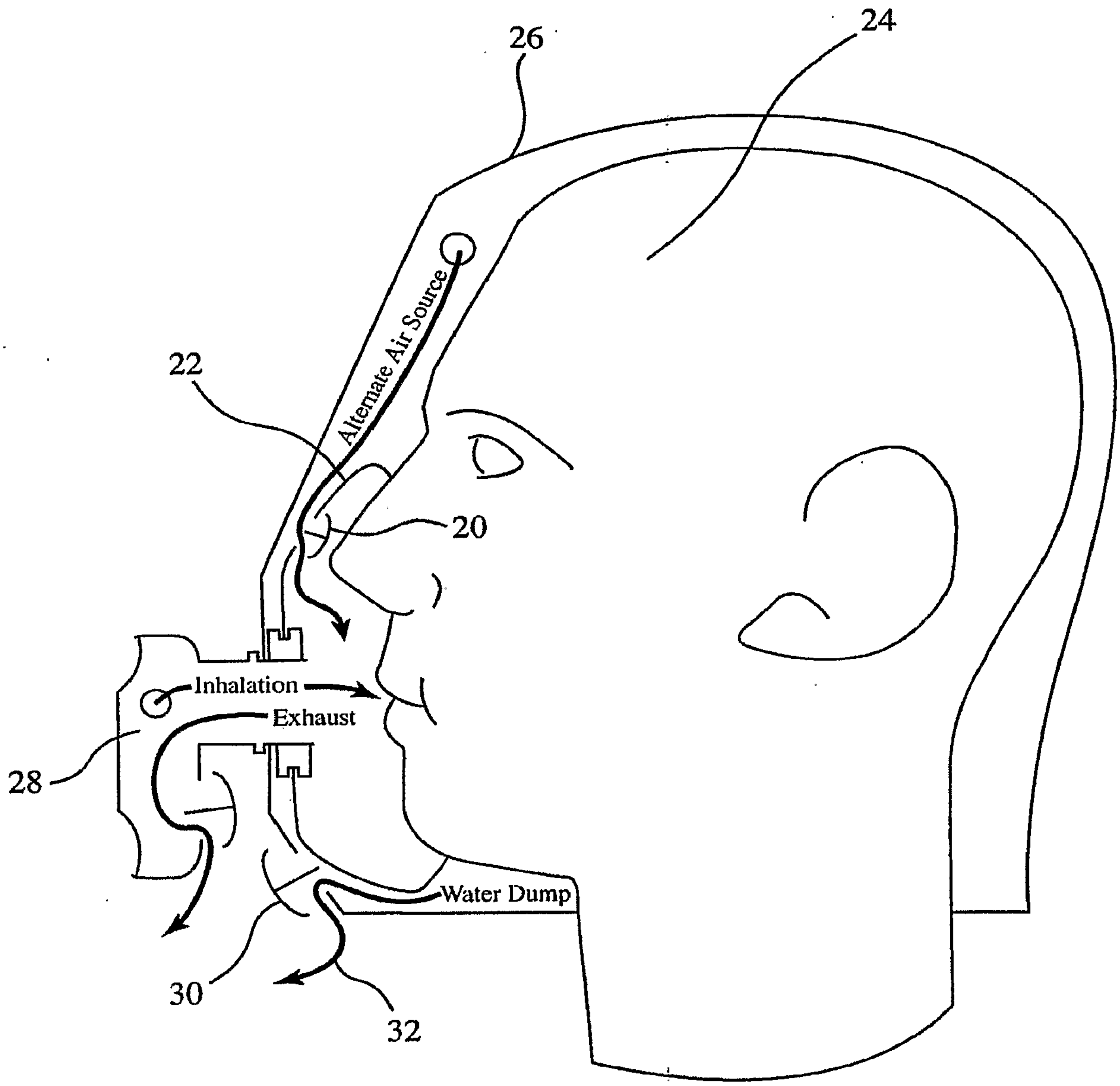
means for controlling the exhaust gas levels within the diving equipment under normal operation conditions;

means for providing an alternate source of breathing gas for the user under emergency operation conditions; and

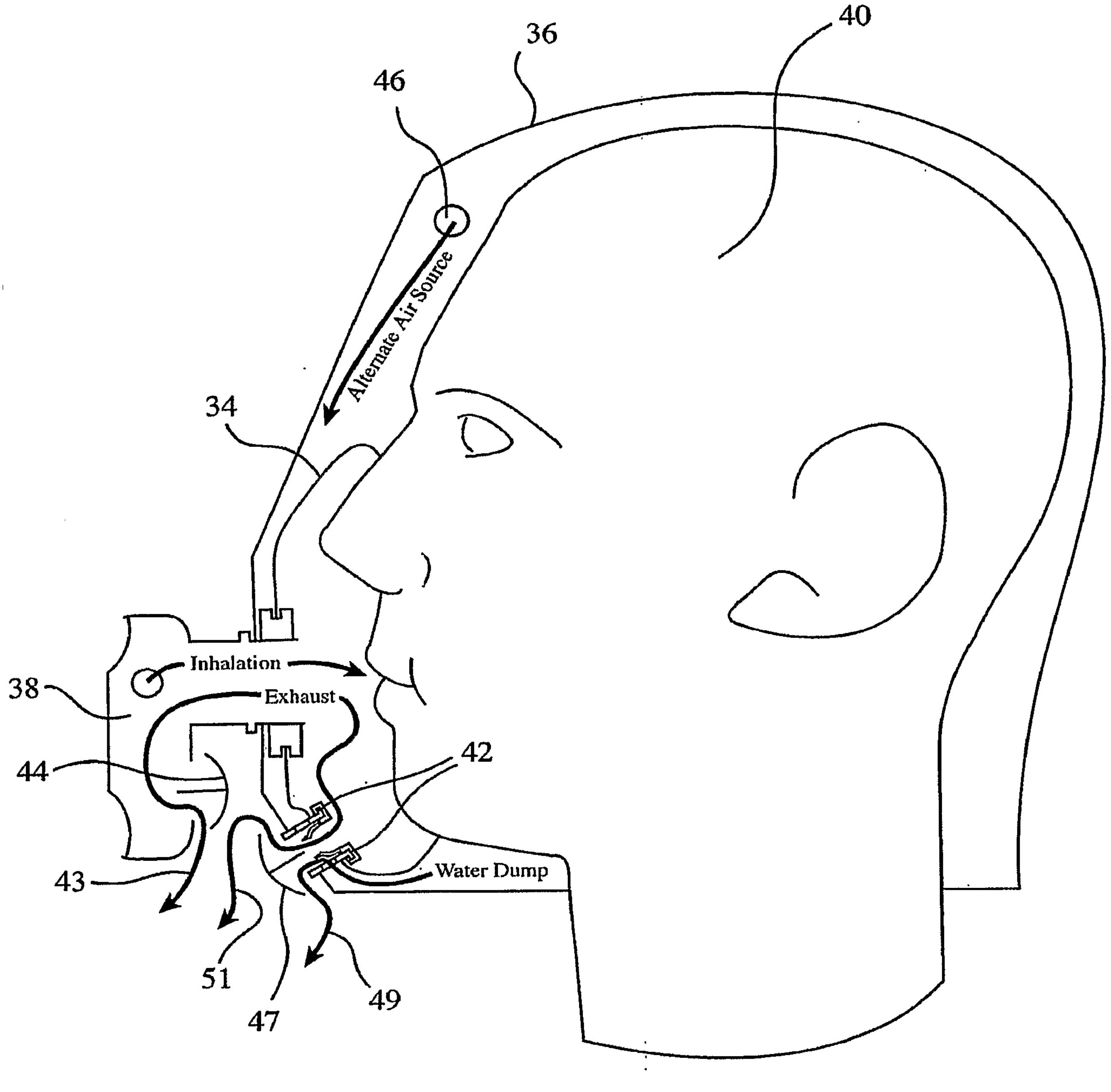
means for removing excess water accumulated in the diving equipment when the alternate source of breathing gas is activated by the user.



Prior Art
Fig. 1



Prior Art
Fig. 2



40
36
46
Alternate Air Source
34
Inhalation
Exhaust
38
44
42
Water Dump
43
51
47
49

Fig. 3

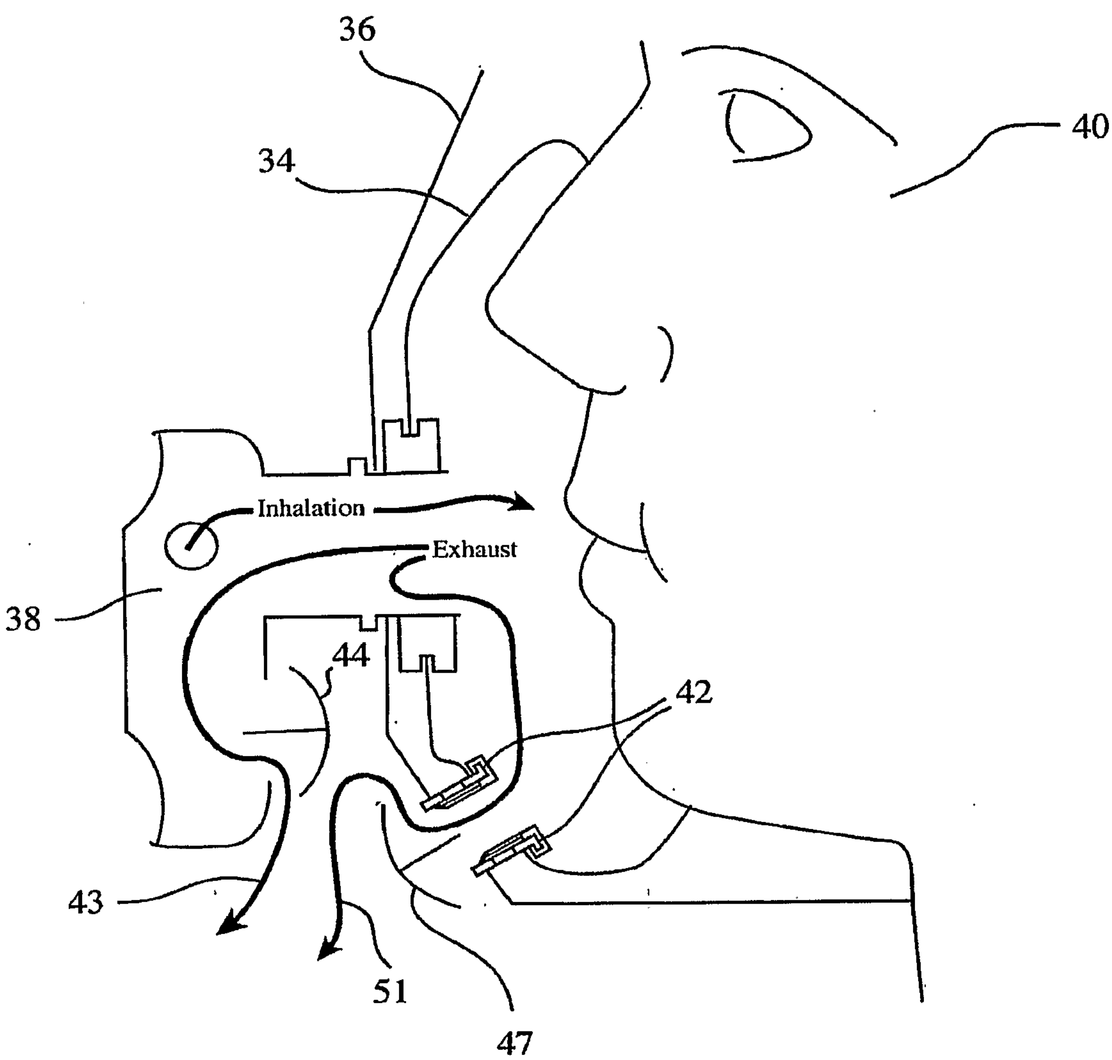
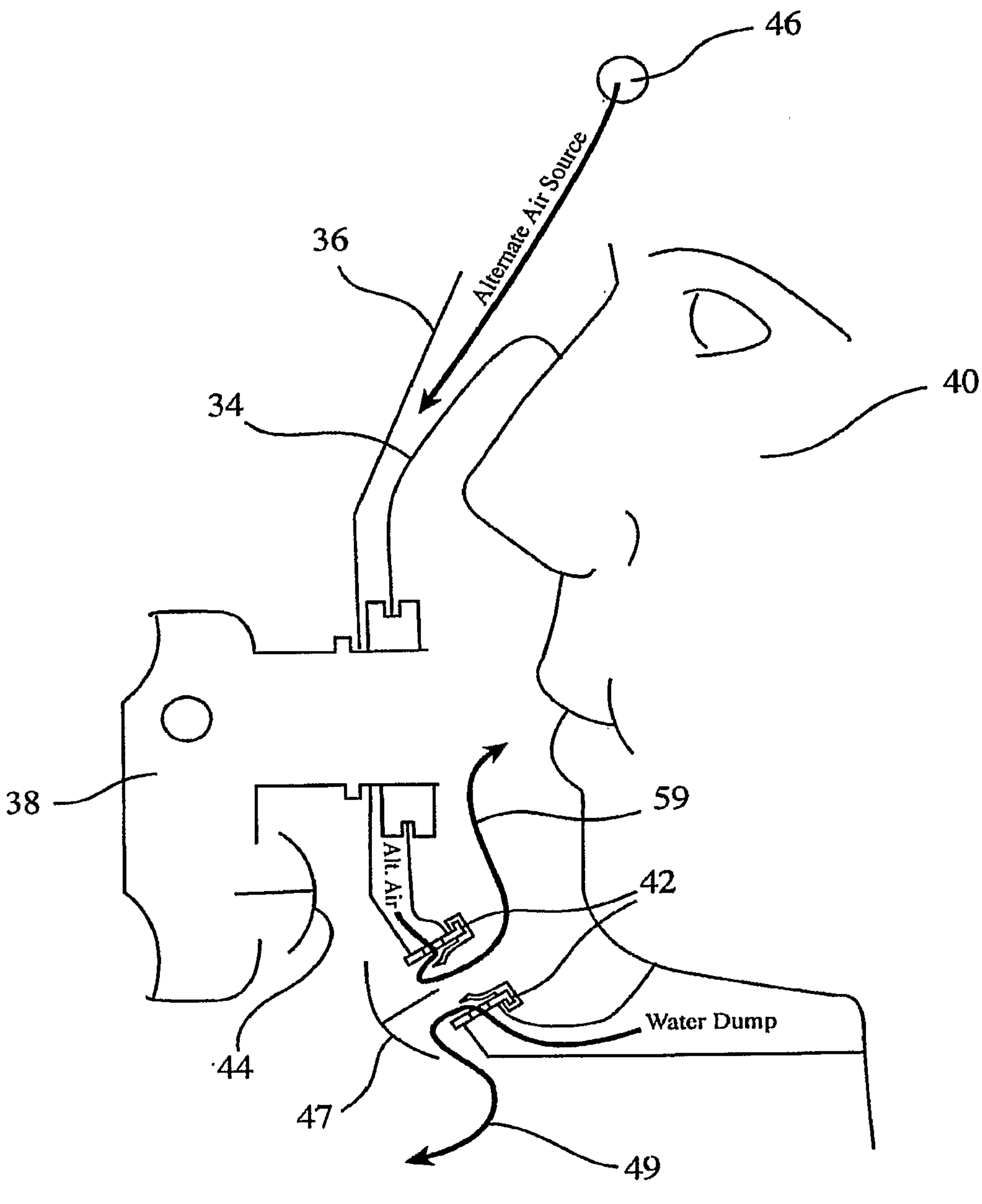


Fig. 4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Alternate Air Source
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40
34
38
59
42
Alt. Air
Water Dump
44
47
49

Fig. 5

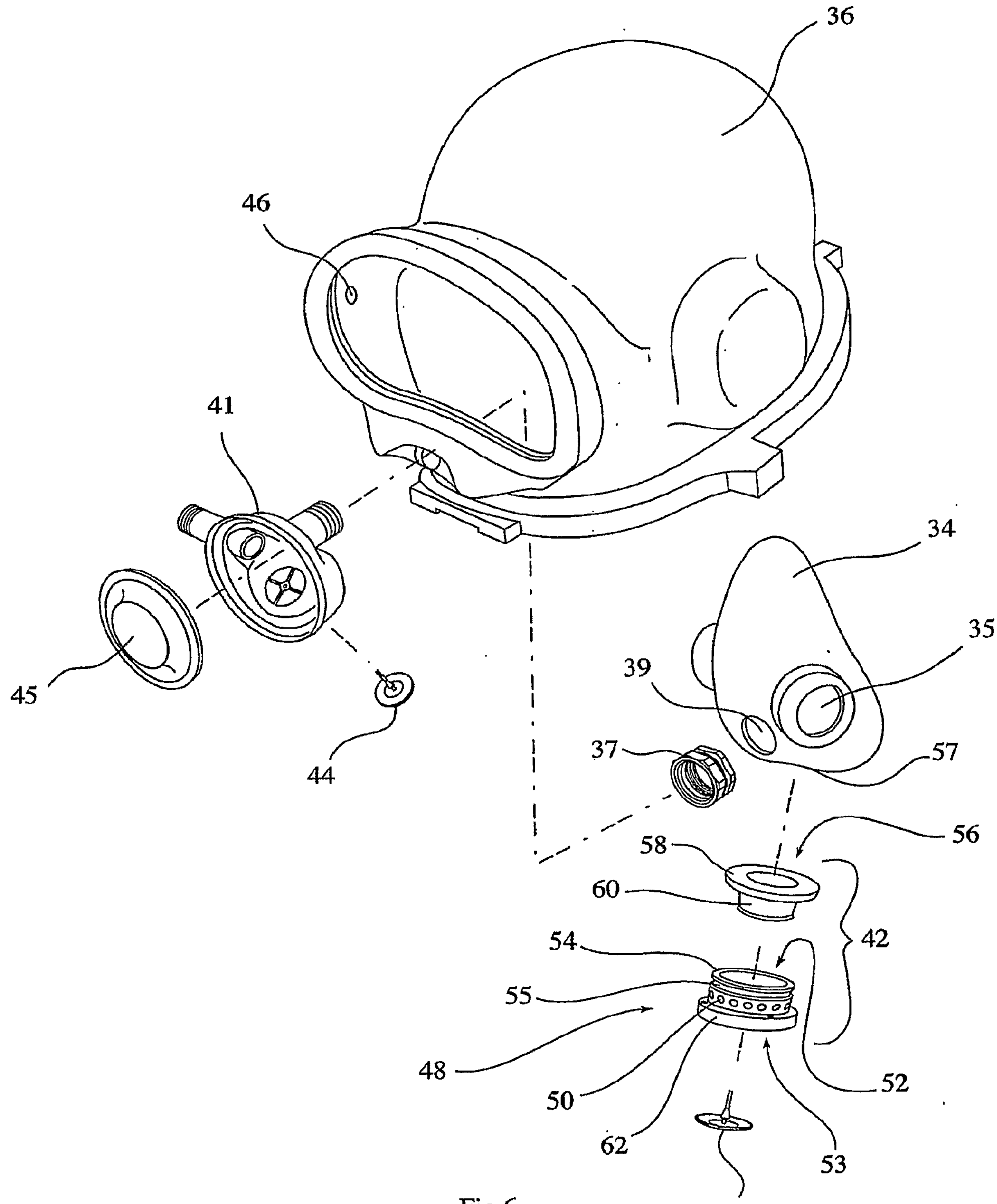


Fig 6

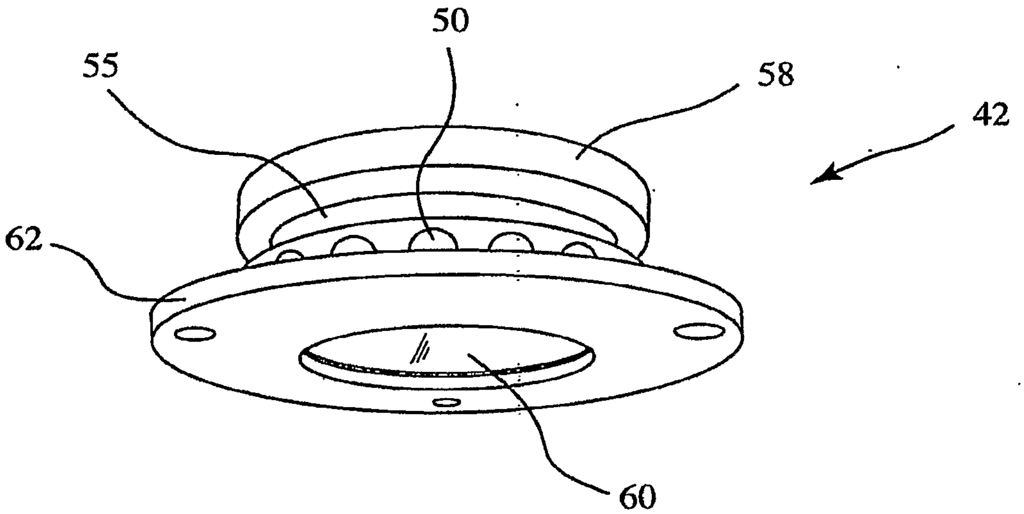


Fig. 7

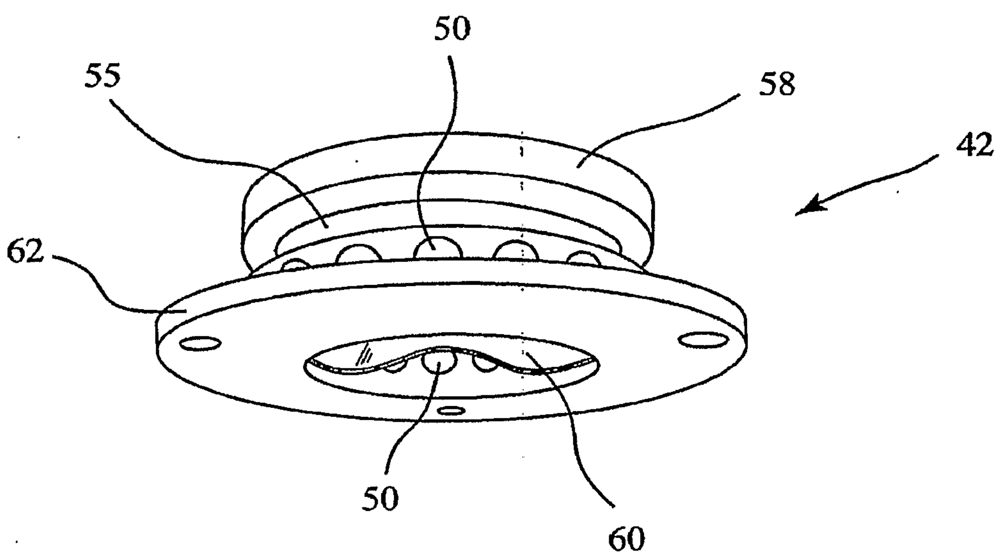


Fig. 8

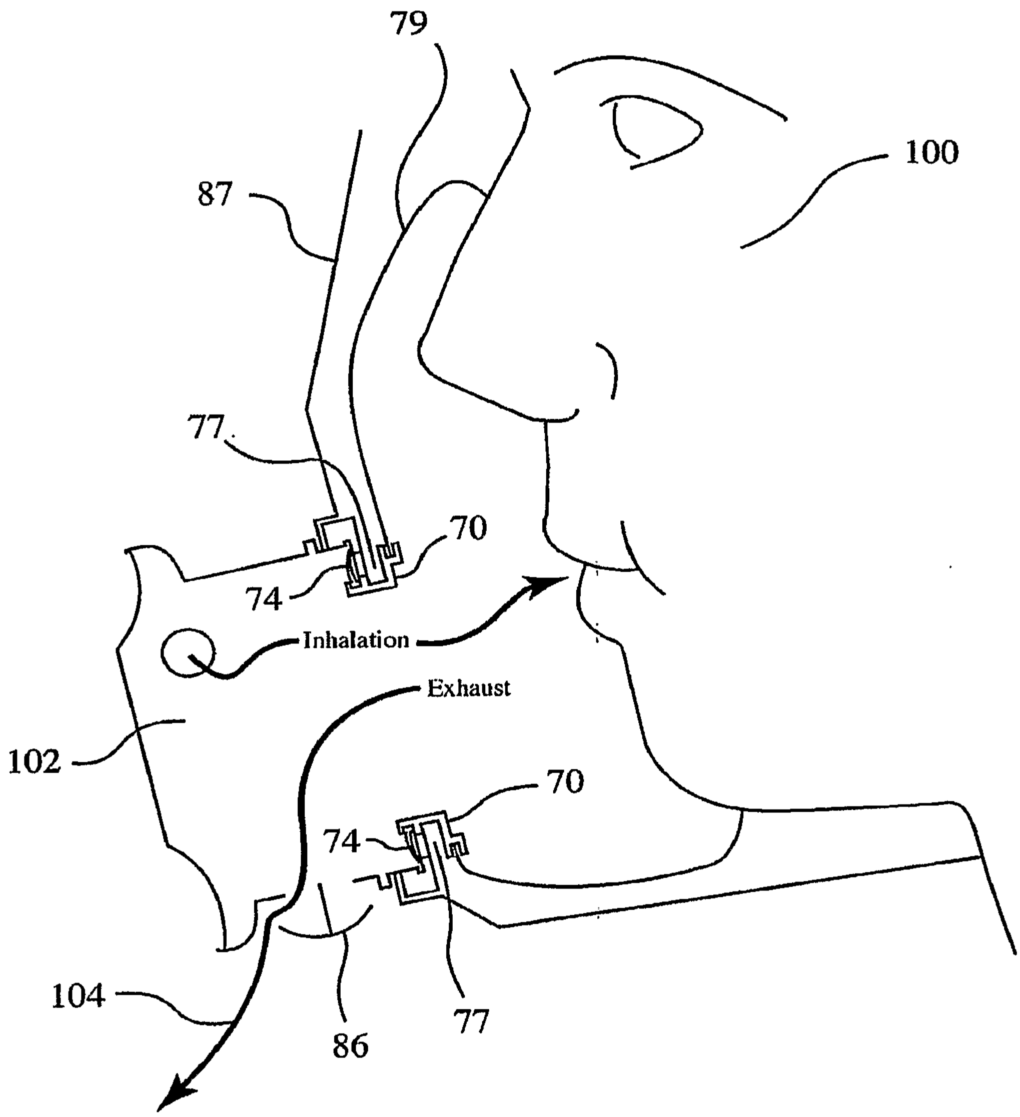
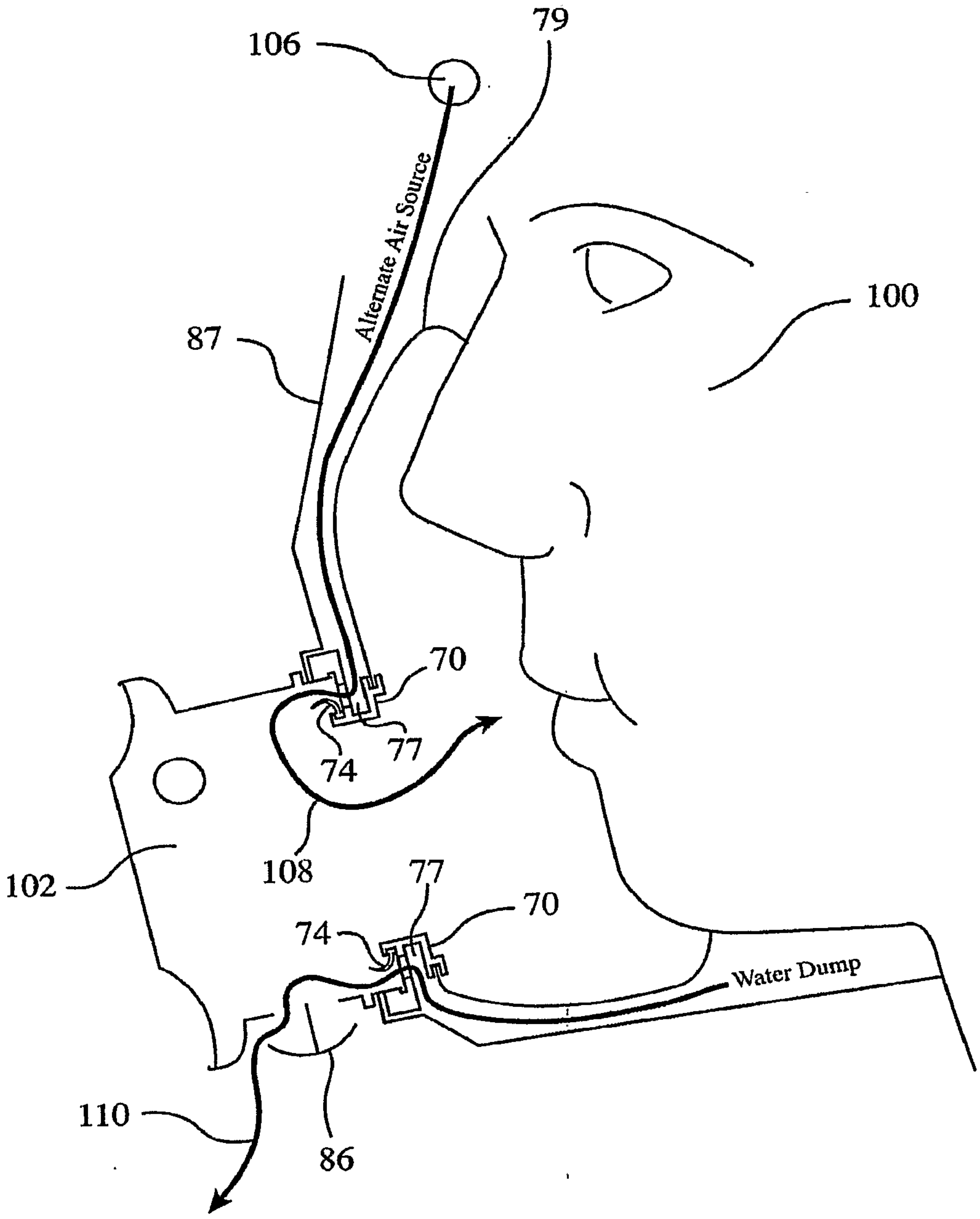


Fig. 9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102
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70
74
Water Dump
110
86

Fig. 10

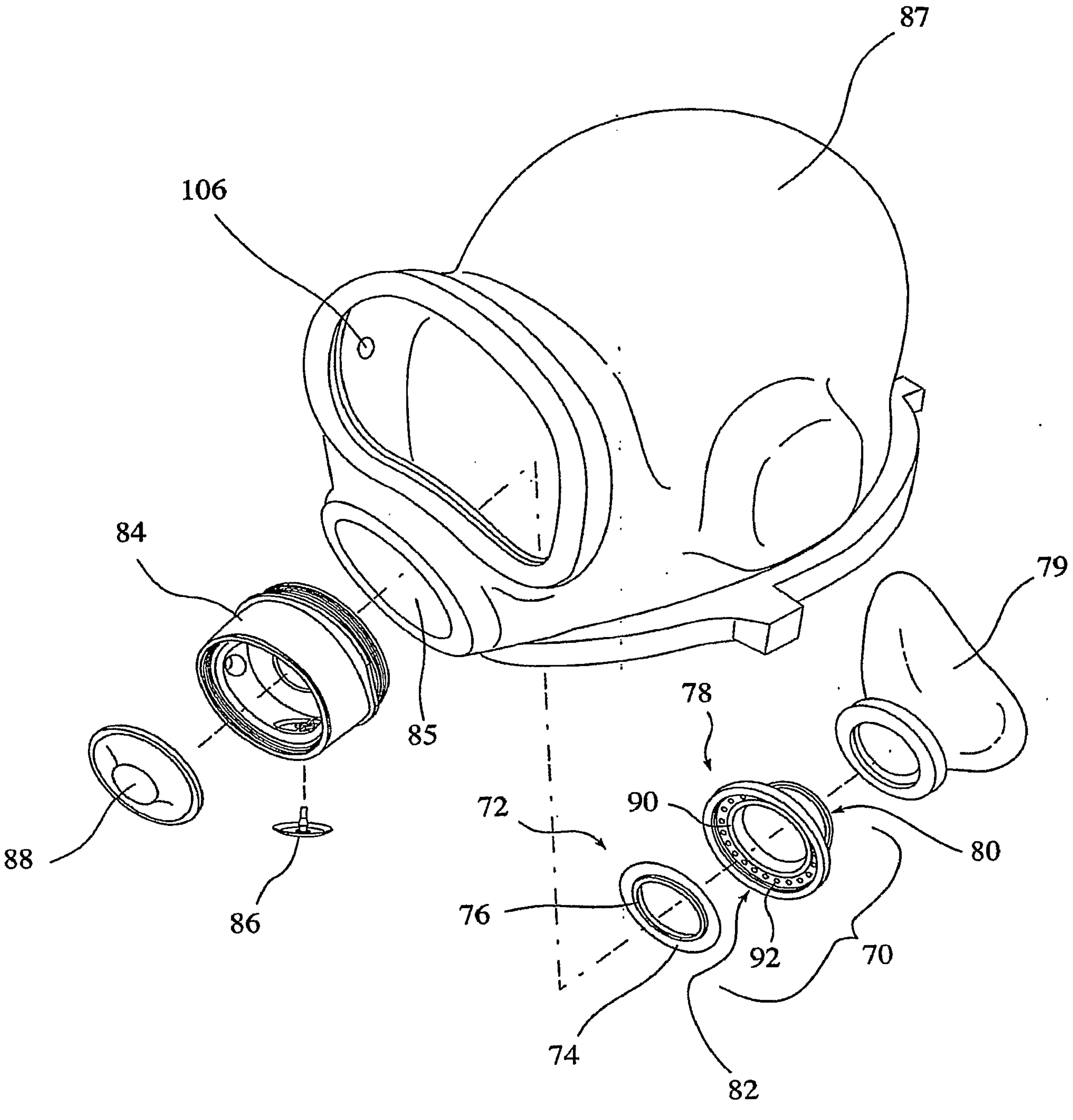

Fig. 11

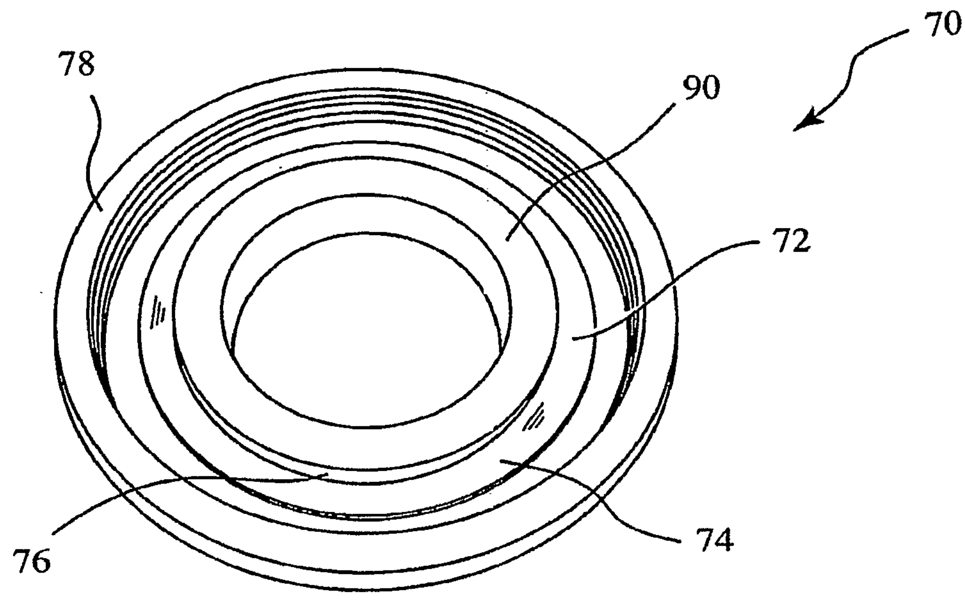

Fig. 12

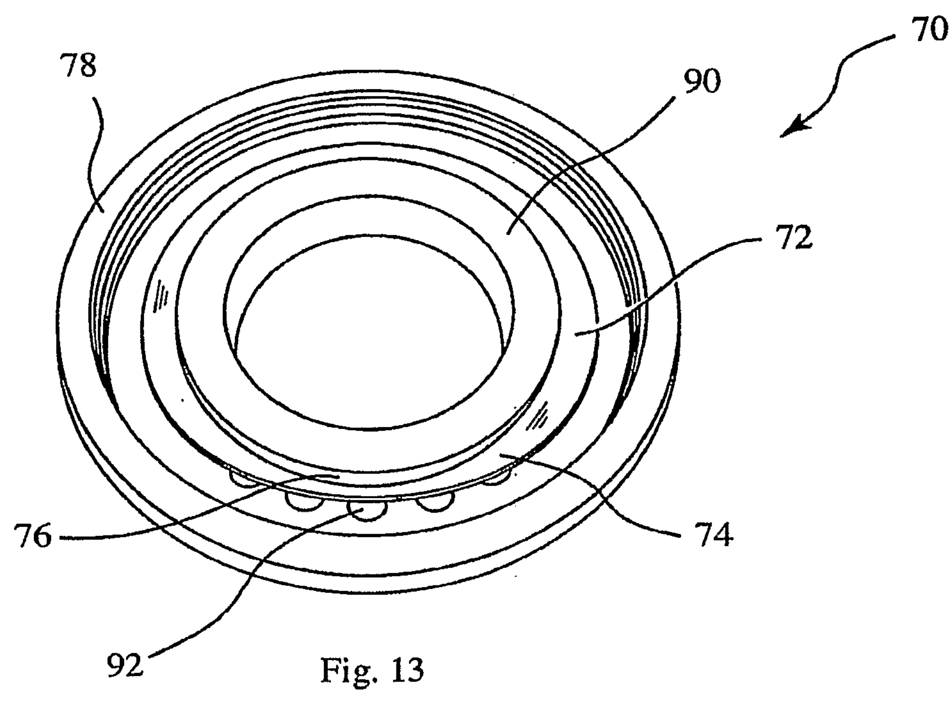

Fig. 13