

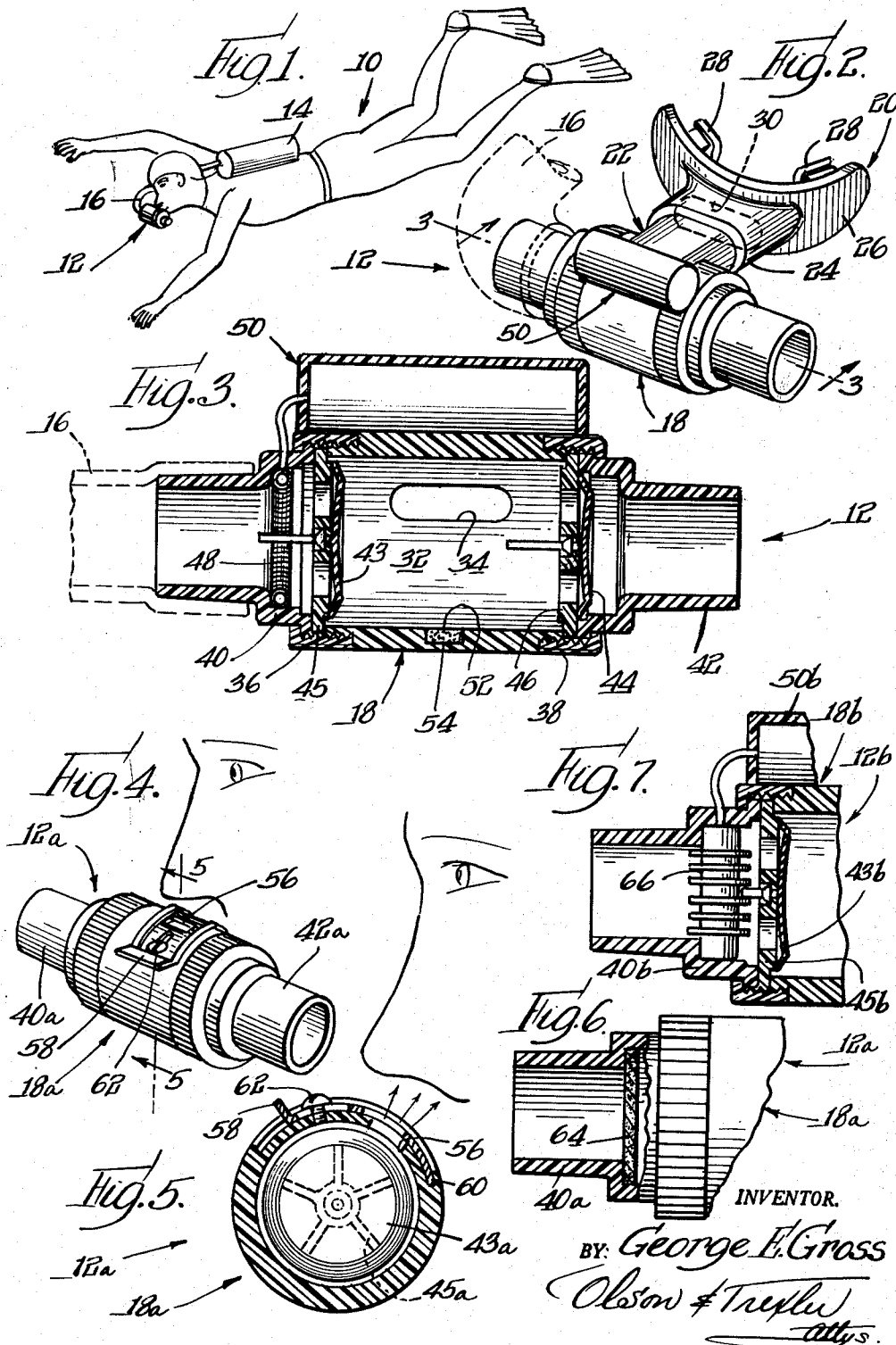
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APPARATUS FOR CONDITIONING INHALANT GASES AND VAPORS

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APPARATUS FOR CONDITIONING INHALANT GASES AND VAPORS

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1 Claim. (Cl. 128-142)

This invention relates generally to apparatus for conditioning inhalant gases and vapors and more particularly to such apparatus that is adapted for individual use.

In one specific aspect, the present invention relates to a respiratory heater for use by skin divers.

Modernly, a considerable number of underwater activities are conducted by skin divers, especially for commercial and governmental purposes; and numerous pieces of special equipment have been devised to facilitate the work of persons so employed. However, in water near the freezing point, heat loss from the body of a diver occurs so rapidly that he soon becomes too numb to work effectively. Accordingly, projects undertaken in such an environment proceed rather haltingly.

It is known that the human body, when actively engaged, as in swimming or in brisk walking, produces approximately 600 B.t.u./hour in the form of heat. If the environment is cold so that more than this amount of heat is transmitted from the body, discomfort and ultimately loss of efficiency occurs. If, under these conditions, heat is added from an external source to make up or prevent the excess loss, a person can continue to work effectively for reasonable periods of time. It has been found that as little as 150 B.t.u./hour of supplemental heat is effective in very cold water. Moreover, it has been found that supplemental heat energy can be efficiently added to the human body by way of heating the air to be inhaled into the lungs since in water at 40° F. about half the total heat produced by the body is normally lost through the lungs. The blood is so nearly in contact with the air in the lungs that heat transfer is readily affected. Blood which has taken heat from air in the lungs then can distribute this heat energy throughout the body. Conversely, cold air cools the blood very rapidly when breathed into the lungs.

Therefore, an important object of the present invention is to provide a novel respiratory heater for use by skin divers or the like.

A more general object of the invention is to provide novel means for conditioning inhalant gases and vapors.

Another object of the invention is to provide apparatus for conditioning inhalant gases and vapors, which apparatus is lightweight, portable and adapted for use as an individual air conditioning system.

Yet another object of the invention is to provide apparatus by the use of which a person's breathing comfort can be increased.

Still another object of the invention is to provide novel means for applying medication directly through the respiratory system.

A further object of the invention is to provide means for transferring heat to or from the human body by means of inhalant gases and vapors using the blood as a heat transfer medium.

A still further object of the invention is to provide apparatus which makes breathing easier under adverse conditions and circumstances.

And a still further object of the invention is to provide apparatus which enables skin divers to work for prolonged periods in near-freezing waters.

Additional objects and features of the invention pertain to the particular structure and arrangements whereby the above objects are attained.

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A structure in accord with the invention includes means defining an exchange chamber, means communicating the exchange chamber with a person's respiratory system, inlet means connecting the chamber with a source of an oxygen-containing inhalant, outlet means exhausting the chamber, and inhalant conditioning means including a heat transfer device within one of the first three mentioned means.

The invention, both to its structure and mode of operation, will be better understood by reference to the following disclosure and drawing forming a part thereof, wherein:

FIG. 1 is a schematic perspective view of a skin diver using apparatus constructed in accordance with the invention;

FIG. 2 is an enlarged perspective view of the apparatus employed by the skin diver in FIG. 1;

FIG. 3 is a further enlarged view taken through the section 3-3 of FIG. 2;

FIG. 4 is a perspective showing of apparatus constructed in accordance with the invention and adapted for ambulatory use;

FIG. 5 is an enlarged view taken through the section 5-5 of FIG. 4;

FIG. 6 is a fragmentary, cut-away, cross-sectional view of the inlet means of the embodiment of FIG. 4 showing the filter means; and

FIG. 7 is a fragmentary, cross-sectional view of yet another embodiment of the invention modified to incorporate a cooling device.

Referring now in detail to the drawing, specifically to FIG. 1, a skin diver indicated generally by the numeral 10 will be seen to be equipped with a breathing device 12 connected to an oxygen or air tank 14 by means of a flexible tube 16; and as is shown in FIG. 2, the device 12 comprises a cylindrical body member 18 which is connected to a rubber mouthpiece 20 by means of a hollow stem 22. The mouthpiece 20 is fashioned with an extended portion 24 adapted to fit resiliently over the stem 22, the mouthpiece 20 further including a flange 26 which is adapted to be disposed between a person's lips and teeth, headed elements 28 being arranged on the flange 26 for gripping by the teeth. Mouthpiece 20 is additionally provided with an aperture or breathing port 30 arranged in communication with the channel formed in the hollow stem 22.

As will be seen from an inspection of FIG. 3, the body member 18 defines an exchange chamber 32 which opens into the hollow stem 22 by means of an aperture 34. The body member 18 is also arranged to have centrally apertured end caps 36 and 38 threadably mounted over its opposite ends. The caps 36 and 38 advantageously confine valve means between the body member and, respectively, a hollow inlet element 40 and a hollow outlet element 42. The tubing 16 resiliently engages inlet element 40 as shown.

The valve means associated respectively with inlet element 40 and outlet element 42 include similarly configured but oppositely disposed flexible poppet valve elements 43 and 44. These valve elements cooperate respectively with valve discs 45 and 46 in selectively opening and sealing off the chamber 32. It will be recognized that, when a vacuum is drawn on chamber 32 as by the user inhaling, the inlet valve 43 will be drawn away from its cooperating disc 45 allowing oxygen to enter the chamber 32 from the tank 14 through the tubing 16. This vacuum will simultaneously insure seating of the outlet valve 44 against its cooperating disc 46.

In like manner, when a positive pressure is exerted in the chamber 32 as by the user exhaling, the inlet 40 will be closed off by its inlet poppet valve 43 whereas the outlet 42 will become opened as by the outlet valve 44

being urged away from its cooperating disc 46. It is recognized that other suitable valve means may be employed without departing from the scope of the invention. Moreover, valves may be dispensed within certain circumstances.

In accordance with a feature of the invention, inhalant conditioning means are disposed in the inlet element 40, in the exchange chamber 32, or in the stem 22. As shown in FIG. 3, one embodiment of inhalant conditioning means comprises a heat transfer device, and in the embodiment of FIG. 3, the heat transfer device specifically takes the form of an electrical heating coil 48. Advantageously, the coil 48 is supplied with electrical energy from a suitable source, such as a battery 50; and as will be recognized, the heating coil 48 may be continuously operated by the battery 50 or it may be selectively operated by means of a switch, as for example a switch opened and closed in conjunction with operation of the inlet valve 43, or a thermostatic switch which responds to the inlet air temperature to keep this temperature at the desired level, or a switch responsive to the outlet air temperature.

The capacity of the heat transfer device is preferably selected to prevent the total heat loss of the user's body from exceeding 660 B.t.u./hour. When skin losses alone exceed this rate, it is advantageous to provide sufficient capacity in the heat transfer device to warm the inhalant air above normal body temperature.

In further accord with the invention, the inhalant conditioning means may also comprise a quantity of vaporizable material 52 contained in a sump 54 of suitable size, sump 54 being fashioned in the body member 18 to communicate with chamber 32. The vaporizable material 52 may, for example, constitute a source of moisture such as a quantity of silica gel which is capable of absorbing moisture from exhaled breath and giving up this same moisture to subsequently inhaled air; and while moisteners are desirable in many circumstances, as for example in the case of divers, vaporizable medicaments and other like substances may also be inserted in the sump 54 for the physiological benefits to be derived from their use.

For purposes of affording an easy understanding of the invention, it is advantageous to provide at this juncture a functional description of the mode in which the component parts thus far identified cooperate. Assuming that a skin diver has been generally outfitted as shown in FIG. 1, he may submerge himself in water substantially at or near the freezing point; and he may supply himself with air or other oxygen-containing inhalant from the tank 14 by inhaling through the mouthpiece 26.

As the diver inhales, the vacuum drawn on chamber 32 will release the valve 43 from its contact with the valve disc 45 and oxygen-containing inhalant will be drawn in through the element 40 and the tube 16. With the heating coil 48 energized by means of the battery 50, this inhalant will take heat from the coil 48 and its temperature will be raised.

The heat content of the inhalant, if warmed above normal body temperature, will be taken up by the blood in the lungs to be thence distributed throughout the body, or if warmed to less than body temperature, will serve to reduce respiratory heat loss. It will become apparent that the diver will thereby be sustained in a reasonably comfortable condition and will be able to work effectively in the near freezing environment for reasonable periods of time. If desired, silica gel or any other suitable source of moisture or of a medicament may be utilized by means of the sump 54 to provide the correspondingly desirable results flowing therefrom.

Exhaled breath, of course, will build up pressure within the chamber 32 and close the valve 43 against the valve disc 45 while simultaneously opening the valve 44 to exhaust the chamber 32 through the outlet 42.

It is also to be realized that the embodiment of FIGS. 1-3 may be modified to heat a liquid or semi-solid material supplied in the sump 54; furthermore, coil 48 need

not heat the inhalant above body temperature; and in addition, the embodiment may be further modified for ambulatory use in the normal above-surface environment. Under the latter circumstances, inlet 40 need not communicate with a special tank of oxygen-containing inhalant, but rather it may communicate directly with the atmosphere. However, the heated and medicated or heated and moistened inhalant may be employed to advantage even in this situation, as by asthmatics in alleviating their susceptibilities.

Moreover, the battery 50 may be replaced by other sources of energy, as for example the six or twelve volt sources customarily available in automobiles, the 110 volt source customarily available in households, or by a chemical or any other suitable source. The embodiment of FIGS. 1-3, as modified for ambulatory use, may also be used to advantage in alleviating colds since it is a known medical fact that breathing warm, moist air can assist the body in combating a cold in its early stages.

When the invention is modified for ambulatory use, it has proved advantageous to aperture the body member 18 in the area beneath the user's nose. In FIGS. 4-6, a body member 18a is provided with an aperture 56 which is selectively closable by means of a hatch 58, hatch 58 being slidably received in slots 60. A screw 62 or other suitable fastener is advantageously included in order to fix the hatch 58 in position.

As is best shown in FIG. 6, the inhalant conditioning means comprises a pollen and dust filter element 64 disposed in the inlet 40a; and while a fibrous-type filter element is shown, it is recognized that a water-bath filter element may also be incorporated. Otherwise, the device 12a of FIGS. 4-6 is constructed and arranged similarly to the device 12 of FIGS. 1-3. Accordingly, like numerals have been used to designate like parts with the suffix "a" being employed to distinguish those elements associated with the embodiment of FIGS. 4-6.

The invention may also be constructed as is shown in FIG. 7 where a device 12b includes a thermo-electric cooling device 66 disposed in the inlet 40b and provided with electrical energy from the battery 50b. As will be recognized, when the invention is embodied as is shown in FIG. 7, quick, temporary, efficient cooling of the user's entire body can be achieved. Such cooling, of course, can be of pronounced advantage in extremely hot weather or under extremely hot working conditions, such as might be encountered in the vicinity of a blast furnace. Moreover, by means of the embodiment shown in FIG. 7, it is possible to chill one's entire body as might be desired in preparation for surgery; and in this latter situation, improved chilling would result since the natural insulation of the skin would be no barrier, cooling being achieved internally rather than externally.

Cooling means other than the junction cooling device 66 such as by ice or other refrigeration or any other suitable means may also be employed in the invention.

While particular embodiments of the invention have been shown, it should be understood, of course, that the invention is not to be limited thereto since many modifications may be made; and it is, therefore, contemplated to cover by the appended claim any such modifications as fall within the true spirit and scope of the invention.

The invention is claimed as follows:

In portable underwater breathing apparatus comprising tank means adapted to be secured to the body of a person and closed air passageway means therefrom, an air treating mouthpiece adapted to be held in the person's mouth, a device for conditioning inhalant gases and vapors comprising a lightweight structure having a hollow body with a pair of discrete openings therein, respectively comprising an inlet opening and outlet opening, and having a lateral stem intermediate the body ends, said stem having a bore therethrough communicating with the interior of said body and with said mouthpiece, one of said openings forming an outlet from said body

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communicating with the interior of said body, an outlet valve member at said outlet opening yielding to and passing air under pressure from said body through said outlet opening and held in closed sealing position when air in said body is at reduced pressure, an inlet tubular extension at one end of said body connected to said air passageway means and in air-tight relation therewith and communicating with the interior of said body through the inlet opening, an inlet valve member at the junction of said inlet tubular extension, opening in response to reduced pressure in said body and held in closed sealing position when air or the like in said body is under raised pressure, an air treating electric heating element sealingly disposed in said inlet tubular extension immediately adjacent said inlet valve member on the opposite side thereof from the interior of said hollow body, said air treating element characterized as being located, dimensioned and arranged as to provide relatively straight through unim-

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peded air flow therepast from said passageway with minimum back pressure for inhalation with small effort into said hollow body as air is inhaled through said stem and being unaffected by air exhaled through said stem and passing out through said hollow body, said outlet opening, and said outlet extension whereby carbon dioxide is not retained for reinhalation and a portable source of electric power sealingly extending to said electric heating element.

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