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PRINCIPLE FOR SAFEGUARDING THE POSSIBILITY FOR INDIVIDUAL PERSONS TO SWIM AND BREATHE IN WATER

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Fig. 1

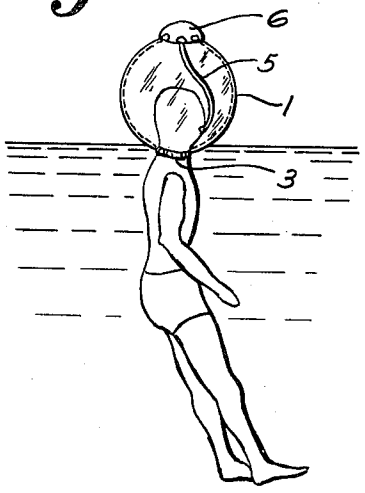


Fig. 2

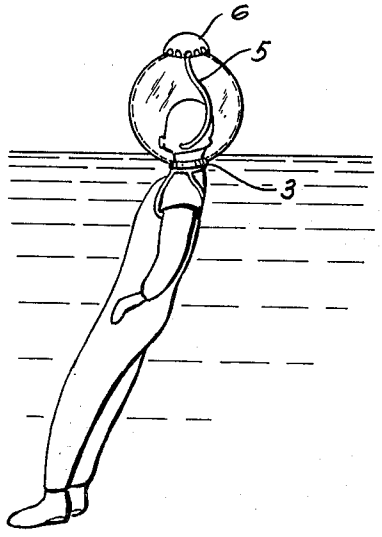
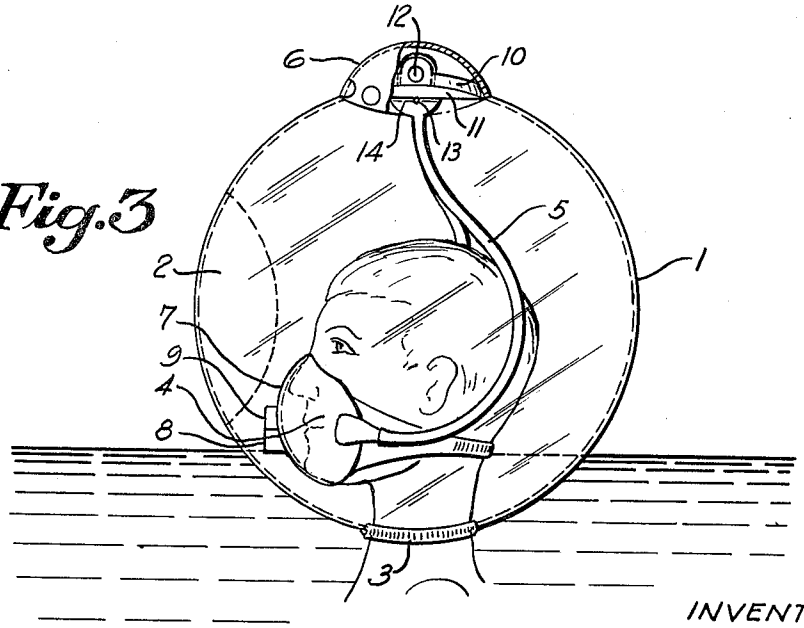


Fig. 3



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PRINCIPLE FOR SAFEGUARDING THE POSSIBILITY FOR INDIVIDUAL PERSONS TO SWIM AND BREATHE IN WATER

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2 Claims. (Cl. 9—313)

The invention is an exceptionally simple principle to provide an individual person intentionally or accidentally in the water with the necessary buoyancy for carrying out an activity or life-saving function and it also enables such an individual to breathe, so as to be able to stay on the surface safely for any length of time no matter what his overall weight and without requiring him to execute any systematic swimming motions.

A number of different expedients to help maintain the buoyancy of the human body have been known for ages. The most customary means to this end are probably the ringshaped life saver, a structure filled with cork or foam rubber, or the life jacket, which is worn directly on the body and consists of cork sections or is designed as a garment inflatable with human breath or automatically with compressed air and is worn by swimmers or shipwrecked persons in order to stay on the surface. In addition to these conventional lifesaving means in the form of cork rings or life jackets which are individualized safety devices that any sea vessel or aircraft is required to have on board in addition to other, more involved facilities, there are also more primitive models, notably the cork belt worn for buoyancy by persons learning to swim.

On the other hand, the only devices able to safeguard their wearers against the inhibiting effect of heavy seas and the associated danger due to water entering the respiratory system through the mouth or nose are either worn as separate items of equipment or, if combined with the buoyancy devices, represent complete clothing items with artificial fresh-air supply or costly supplementary equipment.

In view of this, the present invention proposes to assure buoyancy for individual persons in the water as well as an adequate supply of air by means of an exceptionally simple expedient characterized by providing continuous buoyancy of an order adequate to all demands as well as by providing a spare supply of enough fresh air to enable the swimmer to breathe from it until the normal fresh-air supply from atmosphere becomes available again.

This expedient essentially consists of the fact that the hydrostatic buoyancy of the person in the water is achieved exclusively by the expended air he breathes out. To this end, this air is collectced in a balloon-shaped envelope made of elastic material so that the head of the swimmer is enclosed and yet has adequate room. In accordance with the first procedural step of the invention fresh air is supplied to the swimmer from the atmosphere through a valve assembly placed on top of the balloon, whence an air hose leads to the mouth of the swimmer. The next procedural step is the process of breathing out, which causes the elastic balloon material to become more inflated with each breath until its elastic material is taut. The third and last procedural step deals with ejecting excess air after the balloon has been fully inflated. Each additional breath causes the superfluous air to be ejected via the retension strap around the neck into the water and thus to atmosphere because it cannot return upward through the hose due to the "one-way" valve at the top of the elastic enclosure.

This procedure as envisaged by the invention not only makes it possible to receive any amount of fresh air from the atmosphere under normal conditions, but it is also

advantageous in utilizing air breathed out to inflate the balloon to provide and constantly maintain additional buoyancy to warrant that the wearer can stay on the surface continuously no matter how he is clothed. Beyond this, it must be considered exceptionally vital that this device enables the swimmer to span brief interruptions of fresh-air supply by breathing from the contents of the balloon, whose oxygen/carbon-dioxide composition is regenerated again once the regular supply of fresh air from atmosphere sets in again and the used air is forced out by excess pressure.

To perform this function, the invention uses a balloon-shaped envelope made of elastic material which is transparent in its entirety. A number of polyvinylchloride films are known that are fit for such application because they are suitably soft and yet tear and puncture proof and not impaired by ageing. To assure that the requisite buoyancy will be provided and that the enclosed head will have sufficient freedom of motion, the balloon, which can be spherical or ellipsoidal in shape must have an approximate net volume of 65 dm^3. (about 1½ gal.), which would amount to a sphere diameter of 0.5 m. (about 20 in.). Such an elastic structure can readily be slipped over the head and it must then be fastened to the neck of the wearer. This fastening simultaneously has a sealing function permit excess used air to escape but keep water from entering. But to prevent the transparent balloon material from becoming foggy as a result of deposits of condensed water caused by the difference in temperatures, the balloon foil is kept transparent in the wearer's field of vision by appropriate measures designed to make this area immune to condensation. There should not be any need for such measures on the outside of the enclosure since the surrounding air is likely to always provide a sufficient drying effect.

A swimmer wearing the elastic balloon enclosure about his head receives an adequate fresh-air supply through the valve assembly at the top of the enclosure. This valve assembly is best mounted on the part of the balloon farthest from the water, bearing in mind the position of the balloon in its weighted state and its approximate stance while the wearer is swimming. This valve assembly functions as a so-called "one-way" gate which only permits air to be sucked in for breathing purposes and retains used air within the envelope. Moreover, the valve assembly must also as far as possible keep water from entering if the entire enclosure becomes flooded on the outside due to the movement of water or if splash-water comes in its vicinity. A sizeable assortment of devices that could more or less full meet this requirement can be assumed to be known and these could readily be chosen as alternatives if they should be found to be better suited than the design proposed under this invention in its basic outline.

Through a flexible hose of adequate diameter the valve assembly is connected to a mouthpiece shaped appropriately so as to facilitate its being held or to a breathing mask which, for the sake of absolute safety, is fastened "unbudgably" in front of the mouth and/or the nose of the swimmer by means of suitable retentive devices at the back of his head or neck. The above hose or set of hoses must have a diameter large enough to permit sufficient air for breathing to pass through and it must be formed and led so as to be unable to endanger breathing by tightening at bends or shifting out of position. For this purpose it is fastened to the valve assembly at the top in such a way that it can be rotated and at the bottom it terminates in one or two fittings on both sides of the mask or even on its neck portion. Depending on which position is deemed more appropriate, the breathing mask itself can be attached in front of the mouth and/or

nose of the swimmer and the area of the face covered is largely sealed off against the area within the balloon enclosure. For this purpose the edges of the mask have a peripheral sealing pad along the side facing the skin and by means of an elastic retentive binding the mask is fastened around the back of the head or neck. To connect the breathing area in front of the mouth and/or nose of the wearer to an adapter nozzle near or on the attachment device at the back of the head, the hose fittings on both sides have form-cast or attached hoses which can be kept in place by straps if such straps are worn. Another alternative is to have two separate hoses emerge from one hollow fitting each on the sides of the breathing mask and lead them to a double termination at the bottom of the valve assembly; for reasons of practicality this double termination should be capable of being rotated axially. If this solution were used, the safety factor of the air supply would be increased and the forming of the breathing mask itself and its retaining and fastening devices would be less costly to realize without the hose pattern interfering with the field of vision of the swimmer.

A further refinement of the invention is that the breathing mask mounted in front of the mouth and/or nose of the swimmer not only warrants a reliably functioning and water-free air-supply from the atmosphere through the valve assembly at the top of the balloon and the set of hoses so that the swimmer can breathe, but it also fulfills the additional function of permitting used air to be breathed out into the balloon interior without difficulty so that the balloon will be inflated and provide the additional buoyancy. If the swimmer is to be freed from the requirement consciously to breathe in through the mouth and out through the nose or vice versa, the balloon-inflating process can be accomplished with the aid of a valve arrangement through which the expanded mask chamber in front of the mouth and/or nose opens into the interior of the balloon. Using the familiar example of a gas mask, this valve system can be made to close automatically when the swimmer breathes in and opens only to let air escape into the balloon interior for inflating purposes, since the one-way valve assembly at the top of the envelope keeps it from leaving through that aperture.

Another refinement of the invention envisages designing this exit valve itself or a second, parallel system to enable air to be breathed in from the balloon interior if the swimmer applies a certain intensity of suction or by means of a certain mechanical prestressing of the valve system to provide for when the valve assembly at the top of the envelope is blocked by water, be it by total submersion or simply by a sizeable amount of splash-water, so that the swimmer's supply of fresh air from atmosphere is interrupted. If providing such a differential valve system with dual functions for various uses would prove too costly, the exit system and the "reserve breathing" system could be made to consist of separate valve arrangements and mounted side by side on the front of the breathing mask so that both would have access to the mask's expanded breathing chamber.

A breathing mask of this kind, namely one that encloses both the mouth and the nose of the swimmer and thus does not require him to adhere to any breathing instructions, is likely to be the better solution for life-saving applications, since shipwrecks and emergency landings at sea leave many of the affected persons without sufficient time for reflection, and excitement as well as fear usually lead those in such as predicament to ignore instructions completely. Such considerations show that the last-named variant of the breathing mask can be regarded as particularly panic-proof because there is practically nothing the swimmer can do wrong.

Along the same lines, the fact that the swimmer can always draw a temporary supply of air from the interior of the balloon if the supply of fresh air from atmosphere is blocked, represents a vital safety factor with favorable psychological as well as physiological effects because the swimmer knows that he can always continue breathing; the physiological advantage is that there is no spontaneous cramping such as could occur particularly if a person were cut off from his air supply immediately after he has breathed out.

Purely from a physiological point of view this breathing-alternative as provided for under the invention, enabling a swimmer to breathe used air stored in the balloon interior, is based on the fact that air when breathed out for the first time has such a low carbon dioxide volume that it can be breathed in again and safely a few more times before an excessive CO_2 volume can start damaging the blood circulation. But since the invention envisages that breathing from the balloon interior should and can only take place if access to the outside atmosphere is completely blocked and such a condition is generally of no more than a short duration, and in view of the fact that continued breathing and ejection of used air through the neck collar always keeps the air within the balloon at approximately the same CO_2-content level of a first or single breathing-out process and will be lowered to this level or "regenerated" quickly even after several breaths have been taken, it follows that the reserve breathing aspect of the invention represents an unquestionable safety factor inasmuch as any interruption of fresh-air supply from atmosphere can be spanned safely and the swimmer accordingly has the reassuring feeling that he can never be cut off from a source of air for breathing purposes.

Another provision of this invention is that the balloon envelope that encloses the head of the swimmer is fittingly attached at his neck in such a way that his only source of fresh air is through a breathing mask or mouthpiece from which a hose or hoses lead(s) to the valve assembly located at the top of the envelope. The function of this neck strap is adequately to seal the balloon interior off against the surrounding water and permit excess air to escape readily after the balloon has been inflated sufficiently. The neck strap can either have a peripheral sealing pad of sufficient elasticity or it can be executed as an elastic collar. It can additionally be provided with special sealing substances such as a pressure-reducing foam-rubber coating or something similiar. Since the retaining strap itself need not fulfill any sealing functions but must only prevent undesirable openings between the wearer's neck and the base of the envelope, it can be provided in various neck-sizes. Units designed for use as life-saving equipment on the high seas will appropriately have an added continuation of some sort encompassing the chest or extending beneath the wearer's armpits in order to safeguard against injuring the wearer or damaging the equipment on impact or submersion after having jumped from a higher location with the balloon already fully or partially inflated. There is no need for detailed comments on how this could be done since there are a number of solutions already in existence whose principles could be used.

An additional, vital advantage of the invention presently under discussion is that all of its parts are elastic except for the relatively small valve assemblies at the top of the envelope and at the front of the breathing mask, so that a prospective wearer can always carry with him the collapsed elastic balloon envelope along with its sealing and retaining apparatus and the fresh-air valves as connected through the hose system to the mouthpiece or complete breathing mask. When in a collapsed state, the equipment as envisaged under this invention would take up only a fraction of the space the life-saving means used heretofore require and yet would always be ready for use. The unit can accordingly be packed in a suitable casing and passed out at the start of a sea voyage or flight so that each passenger could always have it in his possession ready for use. This was not possible before because of the conventional life-saving equipment was too large and cumbersome always to be carried along by pas-

sengers aboard ships and all the more by flight passengers.

The enclosed drawings depict only two leading examples of how the invention could be realized. Primarily intended only as an illustration of the basic functioning principles of the invention, the two models sketched are chosen from among a multitude of possible models and modifications. In view of these considerations, all details that are not essential to the basic idea of the invention or its comprehension have been deleted. Another reason for this deletion is that there are a number of alternative solutions available for use which can be considered as being common engineering practice.

FIGURE 1 is a side view of a lifesaving device of the present invention when in use.

FIGURE 2 is a side view of a somewhat different construction.

FIGURE 3 shows the device of FIG. 2 on a larger scale.

FIGURE 1 presents the model of the invention that can be realized with the least amount of materials and accessories. This model could be used for, say, swimming instructions or as an aid to enable an accomplished swimmer to carry out certain functions in the water. In either case the wearer's breathing is unimpaired and he does not have to execute any additional, much less any systematic swimming motions in order to be "self-supporting" on the surface of the water.

This basic model uses a balloon-shaped envelope **1** made of a soft plastic foil which must be as transparent as possible, a polyvinylchloride product, for instance. The swimmer or person learning to swim slips this balloon over his head before entering the water and fastens it at his neck to seal the enclosure off. The balloon envelope, which is elastic itself, can have an adequately elastic collar for this purpose which can be stretched along with the balloon so as to fit over the person's head and then contracts again to the dimension required in order to make sufficiently tight contact with the wearer's neck. Indicated in FIGURE 1 by the numeral **3**, this device offers an additional, exceptional advantage in that it is largely irrelevant what neck size the individual user may have.

His head enclosed in the balloon envelope and sealed off at neck strap **3**, the swimmer is supplied fresh air via a short hose **5**, whose suitably shaped mouthpiece he holds and should always keep in his mouth (he can use his teeth to do this) and which terminates at the top of the balloon envelope in a valve assembly **6**. This valve assembly **6** only permits fresh air to be sucked in and its valves close automatically while the swimmer is breathing out. Moreover, the valve assembly can also be made splash-water or submersion-proof for special applications, as will be detailed in the comments on FIGURE 3. Since the air the swimmer breathes out through his mouth and/or nose cannot escape to atmosphere through the valve assembly, this used air will at first inflate the balloon breath by breath and as soon as it is fully inflated and an excess pressure has materialized, the excess air finally takes the only available route, it escapes into the water through neck collar **3**, which has been made elastic for this purpose. Water cannot enter the balloon against the internal pressure while used air is being ejected in this manner.

Application of this model of the invention is limited by the essential requirement that the swimmer always keeps the breathing hose or its mouthpiece in his mouth. He must furthermore not lose his head if the hose does happen to leave his mouth but return it immediately in order to keep the initial oxygen content of the air from being reduced too much and to avoid excessive CO_2 from accumulating. It follows that this simple model will be less suitable for life-saving applications at sea, since under such conditions the usually prevailing, unfavorable water situation is made even more dangerous by the state of excitement and insecurity of most shipwrecked persons or airplane passengers and the entire unit can accordingly become useless.

In order to eliminate such danger factors from the outset and make the equipment employing the invented principle completely equal to the requirements of emergency use at sea, no matter whether the user is an experienced crew member or a passenger whose life has never been in danger before and who moreover cannot swim, the model shown in FIGURE 1 has been refined or made easier to operate as shown in FIGURES 2 and 3. Just as in FIGURE 1, the general drifting position of a swimmer outfitted with the unit also appears in FIGURE 2 showing particularly the breathing mask **4**, **7** and **8**, **9** and the added retaining device beneath the armpits of the swimmer with the sealing closure collar of the balloon. While air is supplied just as in FIGURE 1 through valve assembly **6** at the top of the envelope and hose **5**, the transparency-protection on the inside of the balloon is shown more clearly in FIGURE 3 and designated with the numeral **2**.

FIGURE 3 is an enlarged view of the head area of a person equipped with the life-saving unit corresponding to the schematic sketch of FIGURE 2, the attachment apparel extended from the neck collar and encompassing the chest and/or arms of the swimmer being deleted, since it can be assumed that such accessories will be readily comprehended without detailed drawings.

As this picture clearly shows, there is a special breathing mask **4** in front of the nose and mouth of the swimmer. In the model illustrated this mask is held in place by a rubber strap around the base of the head, so that all the wearer must do is to pull this assembly over his head and see to it that it is firmly in position in front of his breathing organs. Breathing mask **4** has a valve assembly on its front which consists of the outlet system **8** and inlet system **9**, which open into the balloon interior from the chamber of the mask in front of mouth and nose. While outlet system **8** is designed to permit the swimmer to breathe into the balloon interior, inlet system **9** forces him to overcome a certain amount of resistance or generate a certain amount of suction power source of fresh air from atmosphere always has precinterior if the supply of fresh air from atmosphere via hose system **5** should temporarily be blocked. This source of fresh air from atmosphere always has precedence. Chamber **7** in front of the mouth and the nose of the swimmer opens on both sides of breathing mask **4** into one hose **5** each, which are led off toward the back of the head and up to valve assembly **6** at the top of the envelope, where they are terminated on fittings that can rotate in order to allow the hoses to assume the proper position when the device is slipped on.

Already mentioned above, the transparency-protected area in the field of vision of the swimmer can simply consist of an inner balloon coating that repels water condensations. It is also possible to have the envelope consist of a more rigid substance in the area in question or to make this section double-walled with the space between layers either suitably evacuated or filled with a medium that will largely keep the used air from being able to form condensation droplets. It need surely not be mentioned that condensation water or seawater which has managed to enter the balloon is automatically ejected along with the excess air which exits at each breath.

The fresh-air valve at the top of the envelope consists of a centrally located interior part **10** which opens toward the outside along several channels **11** which slope down slightly to permit water that may have entered to flow out again. Within this interior part there is a light, air-filled sphere **12** similar to a ping-pong ball, for example, which is lifted up by water that might enter and pressed against a valve aperture, which is then sealed closed. When no water has entered, this aperture opens a path for the air to pass from the outside to the chamber surrounding the centrally located interior part. This chamber

takes up the entire area of the valve assembly enclosure and opens into an aperture on which a standard reed valve **13** is mounted which does not resist air entering from the outside and leads to a fork-shaped adapter **14** fitting for the two hoses leading to the breathing mask. In the reverse direction this air route is blocked by the reed valve whose elastic membranes are pressed against the inlet aperture sealing the valve hermetically when the swimmer breathes out so that in this stage the air breathed out can only take the route leading into the balloon interior through outlet valve **8** of breathing mask **4**. Similarly, inlet valve **9** of breathing mask **4** is opened only if water blocks the fresh-air path leading from the outside to the breathing mask worn in front of the mouth and the nose of the swimmer.

However, the invention is by no means to be interpreted as being represented by the models illustrated in the appended figures exclusively. On the contrary, the sample models chosen for illustration and their corresponding explanation were expressly only selected as examples of how the basic idea underlying this invention could be realized.

I claim:

1. A life-saving device, comprising a balloon-shaped elastic envelope adapted to enclose the head of a wearer and to contain air breathed out by the wearer, said breathed out air serving as a reserve of breathing air and supplying hydrostatic buoyancy to the wearer in water, a breathing mask located in said envelope and adapted to enclose the breathing organs of the wearer, a suction hose connected to said breathing mask, a one-way valve located on top of said envelope and connected to said hose for transmitting air from the outside sucked in by the wearer through said hose and into said mask but preventing the escape of air from the interior of said envelope, and an elastic strap connected to said envelope and adapted to enclose the neck of the wearer, said elastic strap constituting an excess pressure valve permitting the escape of some of the air from the interior of said envelope.

2. A life-saving device in accordance with claim **1**, comprising an inner condensation repelling coating carried by said envelope and adapted to extend in front of the face of the wearer.

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