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SHOCK ABSORBING AND BUOYANT VEST

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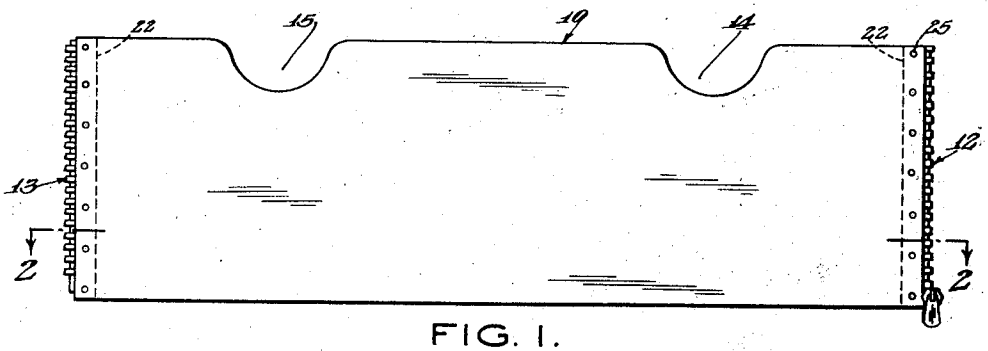


FIG. 1.

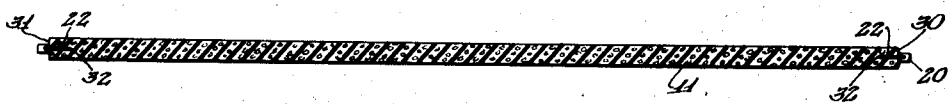


FIG. 2.

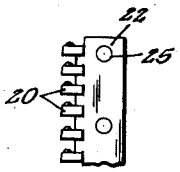


FIG. 3.

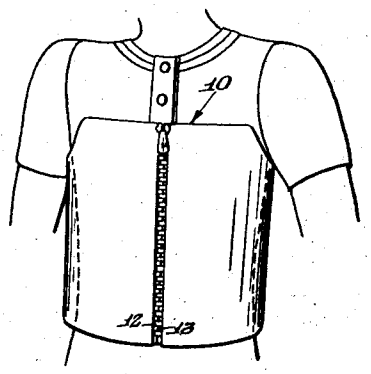


FIG. 4.

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SHOCK ABSORBING AND BUOYANT VEST

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4 Claims. (Cl. 9—20)

My invention relates to a shock absorbing and buoyant vest which has the double purpose of protecting the wearer against the shock which may occur in the case of bomb blasts and the like, and is also adapted by the nature of its construction for use as a life preserving vest.

Since underwater blasts frequently occur in marine disasters, a buoyant life preserving vest, which is also shock absorbing, may become of extreme importance.

Where high explosive blasts occur, injury to personnal is not confined to the immediate area of demolition, but, depending on the nature of the explosive charge, may occur, through the so-called blast effect, over an area having a radius of as much as a quarter of a mile. This blast effect arises from a compression wave immediately followed by a suction wave radiating from the center of the explosion. These two successive waves set up mechanical stresses about any object encountered within the radius of the blast effect, and cause their destruction.

When a person is subjected to these waves within the radius of the blast effect, the successive intense compression followed immediately by violent suction causes severe physical injury. These injuries occur for the most part in the thoracic portion of the body above the diaphragm. The diaphragm itself, and the abdominal walls and the viscera contained therein are usually sufficiently resilient to survive this series of successive mechanical shocks. The thorax however, above the diaphragm, is relatively rigid and contains the most vital and delicate organs. The blast effect, owing to the rigidity of the thorax, may actually have sufficient force to break the ribs, and most often has sufficient mechanical force upon the muscles of the chest to collapse the lungs as well as to injure the heart.

The collapse of the lung occurs both because of the compression waves and the suction waves. The compression wave tends to collapse the thorax and press the chest walls in upon the lungs, so that the air is expelled therefrom. This compression wave is immediately followed by the suction wave which draws out any air which may remain. The victim is immediately rendered unconscious and asphyxiated, and may suffer other physical injuries as above pointed out.

The most important force which causes physical damage, and the force which may most readily be counteracted is the compression wave, since it causes a physical injury as well as collapses the lungs.

Should a person survive the effect of the compression wave, he may most likely be sufficiently conscious at the end of the suction wave to be able to regain his breath. A combination of the two, however, is highly dangerous.

My shock absorbing vest is of a nature peculiarly appropriate for absorption of the shock of this compression wave. Essentially, it comprises a vest made of soft closed cell gas expanded rubber which closely surrounds the thorax.

Closed cell gas expanded rubber is distinguishable from sponge rubber in that it consists of a multiplicity of minute closed cells the majority of which do not communicate with adjacent cells, each of the minute cells having a small gas bubble enclosed therein. Each of the minute gas bubbles may, in fact, consist of a gas under pressure, thus increasing the shock absorbing effect. In the case of sponge rubber, instead of a multiplicity of minute sealed or closed cells, a multiplicity of communicating channels are formed so that a sponge rubber sheet or vest would be porous and thus permit the compression wave in blast effect to make itself felt.

In the case of soft closed cell gas expanded rubber, when it is used as a shock absorbing vest of this kind, the compression wave impinges on the outside of the vest and the force thereof is transmitted to the minute gas filled cells adjacent the outer surface of the vest.

These cells are compressed, and transmit the shock to the next inwardly adjacent closed cells through the elastic cell walls of the closed cell gas expanded rubber. The force of the shock thus transmitted through the first layer of cells has been diminished by the force necessary to compress the gas bubbles within the cells themselves. The shock is transmitted again and again through successive layers of the vest until it reaches the interior lining thereof, and the body of the wearer; but in each case, the shock must successively be transmitted through gas bubble after gas bubble so that in each case, the force of the shock is partially absorbed by compression of the successive gas bubbles.

In addition to this form of absorption, the successive gas bubbles, it must be noted, are compressed not merely inwardly, but also laterally by the force which is impinged on only one side thereof, so that the shock is transmitted not only inwardly, but also laterally through the sheet forming the vest itself, and thus around the body of the wearer instead of directly toward the body of the wearer.

Obviously, this transmission of the shock

through the vest, and the absorption of the force thereof, from gas bubble to gas bubble, occupies the merest fraction of a second. Nevertheless, the shock is appreciably diminished owing to the fact that the successive gas bubbles must be compressed before the force of the compression wave is transmitted onward, and this compression is not merely in an inward direction, but in all directions.

Since the soft closed cell gas expanded rubber sheet or vest has a multiplicity of extremely minute cells, the transmission of the shock from cell to cell will appreciably diminish the force thereof, as well as distribute the force so as to make the shock bearable when it finally reaches the person of wearer.

For optimum results, the sheet forming the vest should be at least one-half inch thick, although I prefer that it be as much as three-quarters of an inch or one inch thick.

Since the minute closed cells formed in the gas expanded closed cell rubber are of the order of $\frac{1}{32}$ to $\frac{1}{100}$ of an inch in diameter, it will be clear that the multiplicity of minute cells thus formed will act as an appropriate shock absorber for the compression waves.

This shock absorbing quality holds true whether the blast effect occurs in air or in water. The compression wave is transmitted in a similar manner through water or through air. But when the wave reaches the wearer of the vest, whether he is immersed in water or in air, the same absorptive effect will take place. Where the vest is to be utilized as a combintion buoyant vest and shock absorbing vest for use as a life preserver in water, then I have found that the optimum thickness thereof should be from three-quarters of an inch to one inch in order to provide appropriately for buoyancy of the body of the wearer. It is obviously peculiarly adapted to such life preserving purposes since the multiplicity of minute gas filled cells are individually sealed not only from each other but with respect to any outside fluid. The material of the vest is therefore impervious to water, and thus acts as an efficient buoyancy producing member. As a matter of fact, in the case of soft closed cell gas expanded rubber, the specific gravity of the material may be as low as .1 or less, so that an appropriate buoyant effect may be obtained with a minimum of material.

The primary object of my invention therefore, is the provision of a life preserving vest which is adapted to absorb the shock of an explosive blast.

As a corollary object of my invention, my life preserving vest is also water impervious and is sufficiently buoyant to support the wearer thereof in water.

Another object of my invention is to form a life preserving, shock absorbing, and buoyant vest from closed cell gas expanded rubber.

Still another object of my invention is the provision of simple fastening means in connection with the life preserving vest above set forth which will permit the user thereof quickly to secure the same to his body.

Still another object of my invention is the provision of a simplified slide fastener element vulcanized into the material of my life preserving vest.

These and many other objects of my invention will become apparent in the following description and drawing in which:

Figure 1 is a plan view of my shock absorbing buoyant vest.

Figure 2 is a cross-sectional view taken on line 2—2 of Figure 1 looking in the direction of the arrows.

Figure 3 is a view of a detail of the slide fastener construction.

Figure 4 is a view showing the manner in which my shock absorbing buoyant vest may be secured to the body of the user.

Referring now to Figures 1 and 2, I have here shown a shock absorbing buoyant vest 10 consisting of a body embracing member 11, and slide fastener element 12 and 13 at opposite edges thereof. One edge of the vest 10 may be notched at 14 and 15 in order to make the vest fit properly under the arms of the wearer.

The material 11 of the body portion of the vest 10 is formed of soft closed cell gas expanded rubber. Gas expanded rubber of this type has been described and the manner of manufacture thereof has been set forth in Denton Reissue Patent No. 21,245, as well as in Patent Nos. 2,086,513, and 2,110,400, all of which are assigned to the assignee of the present invention.

Essentially, the process of producing closed cell gas expanded rubber, consists in the preparation of a rubber mix containing sufficient sulphur to vulcanize the rubber when appropriate heat is applied; the subjection of the rubber mix to an external gas pressure which will cause impregnation of the gas, for instance nitrogen, thereinto; the expansion of the rubber within a confining mold, while at the same time partially curing or vulcanizing the same so that the inert gas impregnated therein may expand while the rubber cell walls may be given sufficient strength by the vulcanization to permit expansion, while at the same time preventing the bursting of the minute cells thus formed. When expansion has occurred, the expanded rubber is then subjected to a final vulcanizing process which sets the rubber in its fully expanded form with the minute cells sealed from each other, and containing gas therein.

Another way of forming the gas expanded soft cell rubber is by the utilization of gases generated from chemicals mixed intimately with the rubber in the rubber mix. In such cases, sufficient heat is applied to degenerate the chemicals mixed into the rubber thus forming an expanding gas, and thus causing expansion of the rubber while at the same time the heat is sufficient to partially vulcanize the rubber during expansion for the purposes above set forth.

Again, when the rubber is fully expanded, it is then fully vulcanized in order to set it in its gas expanded closed cell form.

In either case, by controlling the expansion and controlling the amount of sulphur included in the rubber mix, the softness of the rubber and the minuteness of the cells may be predetermined in accordance with the patent above mentioned.

The processes may follow the patents above mentioned or the processes may be the same as those described in connection with the application Serial No. 159,706, now Patent No. 2,299,593, dated October 20, 1942, assigned to the assignee of the present invention; or if it is desired to maintain the gas within the closed cells at an elevated pressure, then the processes may be that set forth in my application Serial No. 407,729.

The slide fastener may consist of elements 12 and 13 adapted to mesh with each other in a

manner which is well known in the art, and which are secured at opposite edges of the vest 10. As is seen in Figures 2 and 3, the slide fastener element consists of interengaging members 20 secured to a tape 22. The tape 22 is preferably approximately three-quarters of an inch in width, and is provided with a plurality of perforations 25 which are preferably of the order of three-eights of an inch in diameter, and approximately three-quarters of an inch apart.

After the material 11 forming the sheet or body of the vest 10 has been precured and before the final cure which has previously been described, the edges 30 and 31 of the vest may be split at 32, 32 and the tapes 22 inserted therein. Thereafter, when the final cure or vulcanization occurs, the rubber material of the sheet or body 11 of the vest 10 flows securely into adhesive contact with the tape 22, and flows also, through the perforation 25 and fixes the tape securely within the cellular sheet.

If desired, it may be possible to form the vest out of at least two plys of sheet material, which, after the precure, are laid together and then during the final curing stage vulcanized together. In such case, when the two sheets are laid together, the tape 22 of the slide fastener 12 may be inserted between the edges of the sheets to be vulcanized therein in the manner previously described.

By reason of the fact, that, during the final vulcanizing or curing stage, the rubber material flows through the perforations 25 in the tape 22 of the slide fasteners 12 and 13, the tapes are securely integrated with the body of the vest and the slide fastener elements 12 and 13 are secured thereto.

The slide fastening means or any other fastening means which may be used is, of course, sufficiently narrow so as not to provide a sufficient area over which a compression wave may be felt. In addition, the securement of the fastening means in the edge of the resilient vest provides for shock absorption at that area.

However, the fastening means may be covered by a flap of closed cell cellular rubber material; or the fastening may be so arranged that the edges of the vest abut flush against each other. Where a flap is used, it may be secured over one of the edges of the vest to extend beyond the edge over the opposite edge when the fastening is closed; or, in the case of a vest which is made of two or more plys of material, the inner ply may extend beyond the fastening securement on one side and the outer ply may extend beyond the fastening on the outer side to thus completely cover the fastening and make the vest, when worn, completely flush. This latter arrangement of a pair of flaps encasing the fastening means when it is closed is, of course, not necessarily limited to a vest which is made of plied material.

In Figure 4, I have shown the manner in which the vest 10 of my invention may be placed about the body of the wearer so that it protects the thoracic area of the person wearing it.

Preferably, when the vest is worn, it makes a good contact, fitting snugly around the body to prevent air or water from entering between the vest and body to provide a path for the compression wave. While it is thus desirable to have several sizes available, nevertheless, owing to the stretchable characteristics of my vest, it may fit rather tightly without substantial inconvenience. Further, since my vest encases the body tightly and fits under the arms, it is not subject to the objection (common in other life preservers) that it may be forced up violently against the chin and neck of the wearer when he strikes the water.

Since the buoyant quality of my vest is derived from a multiplicity of minute sealed cells, it is not subject to the objection, found in inflatable rubber members, that punctures or tears will interfere with its buoyancy.

My vest, when stored, is also not nearly as great a fire hazard as other life preserving media as for instance kapok. The rubber is not as inflammable; and the gas (which is preferably nitrogen) stored up in the multiplicity of cells does not support combustion.

My life preserving vest, as previously pointed out, is shock absorbing as well as buoyant. It is made of standard sheet material which in turn is formed of a standard and now well known product, and hence is simple to manufacture.

The multiplicity of minute sealed cells within the body of the material, acts to absorb the effect of the compression wave in the case of explosive blasts and also acts to preserve the buoyancy of the vest and hence of the person wearing it. Since the vest of my invention is made of ordinary sheet material, it may be stowed flat in order to save space, or it may be rolled up. When worn, it will not chafe the body, and it will permit free arm movement. Owing to its formation and the manner in which it is to be used, it is positive in fastening, and cannot come off; and furthermore, the vest is so arranged as to be worn in such manner that its buoyancy is fully used.

Many variations and modifications of my invention should now be obvious to those skilled in the art. I prefer therefore, to be bound not by the specific disclosures herein, but only by the appended claims.

I claim:

1. A shock absorbing buoyant vest adapted to be worn on and completely surround the thoracic portion of the body, said vest consisting entirely of a flat sheet of soft cell-tight cellular rubber material and having notches along one edge shaped to fit snugly under the armpits of the wearer, and slide fastening means secured to opposite edges of said flat sheet and adapted to interengage to connect said edges together. when said vest is to be worn, said slide fastening means each comprising elements mounted upon a tape, each tape being secured in an edge of the vest.

2. A shock absorbing buoyant vest adapted to be worn on and completely surround the thoracic portion of the body, said vest consisting entirely of a flat sheet of soft cell-tight cellular rubber material and having notches along one edge shaped to fit snugly under the armpits of the wearer, and slide fastening means secured to opposite edges of said flat sheet and adapted to interengage to connect said edges together when said vest is to be worn, said slide fastening means each comprising elements mounted upon a tape, each of said tapes on opposite sides being secured in a slit in the edge of the vest, the rubber material of the vest being vulcanized to hold said tapes in place.

3. A shock absorbing buoyant vest adapted to be worn on and completely surround the thoracic portion of the body, said vest consisting entirely of a flat sheet of soft cell-tight cellular rubber material and having notches along one edge shaped to fit snugly under the armpits of the

wearer, and slide fastening means secured to opposite edges of said flat sheet and adapted to interengage to connect said edges together when said vest is to be worn, said slide fastening means each comprising elements mounted upon a tape, each of said tapes on opposite sides being secured in a slit in the edge of the vest, the rubber material of the vest being then vulcanized to hold said tape in place; a plurality of openings in each tape, said rubber material on vulcanization flowing through said openings and anchoring said tapes in place.

4. A buoyant shock absorbing vest of soft cell-tight cellular rubber material formed from two plys of flat sheet material vulcanized together into a single laminar structure and having notches along one edge shaped to fit snugly under the ampits of the wearer; slide fastening means for said vest comprising elements secured to tapes at opposite edges of said vest, said tapes being originally placed at said edges between the said plys of material, vulcanization of said material causing the rubber at the edges to flow into intimate securing contact with said tapes.

HANS PFLEUMER.