Aug. 2, 1949. C. A. OSTBY, JR 2,478,126

DIVER'S SUIT

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Fig. 1

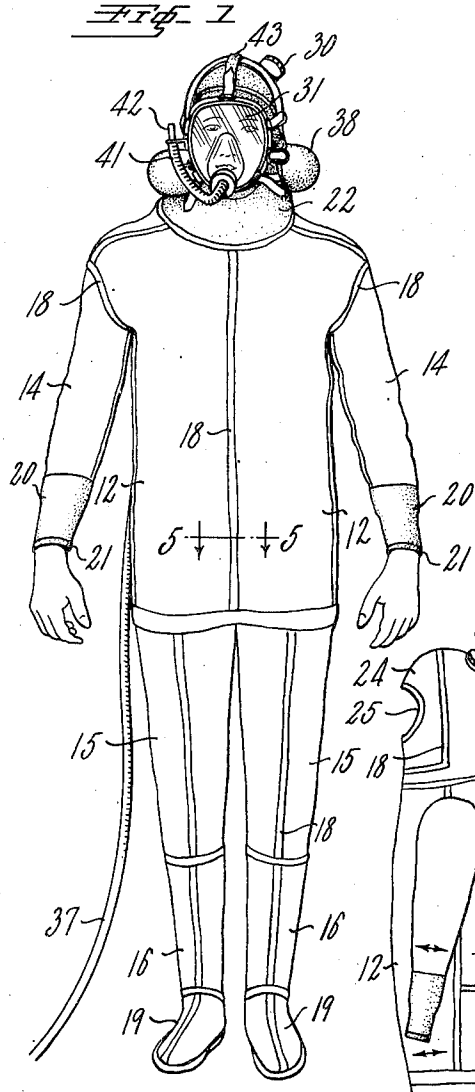
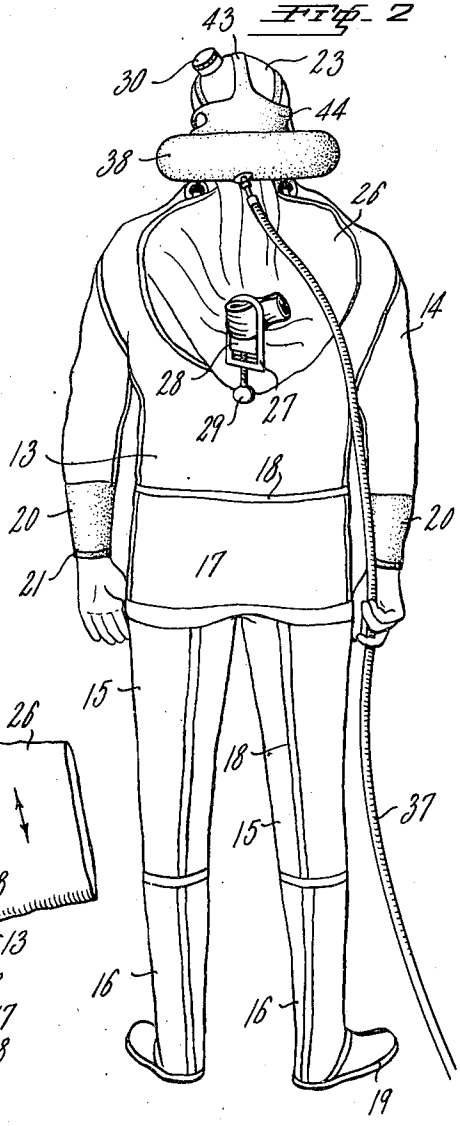


Fig. 2



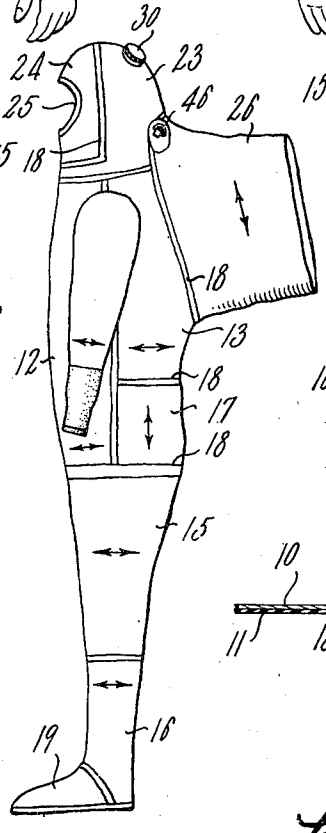


Fig. 3

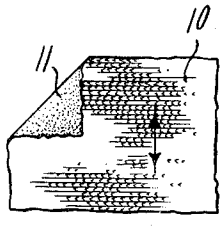


Fig. 4

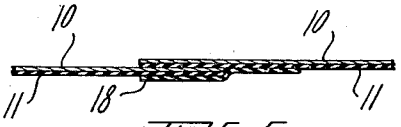


Fig. 5

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Fig. 6

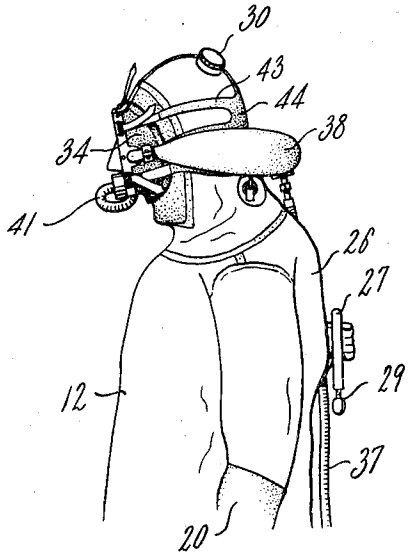


Fig. 7

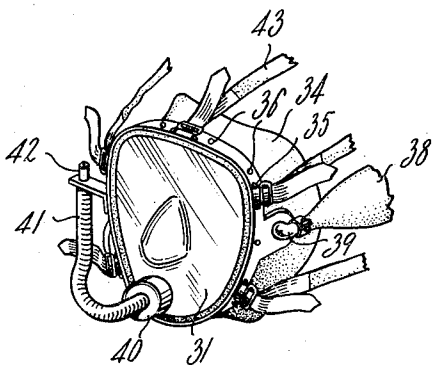


Fig. 8

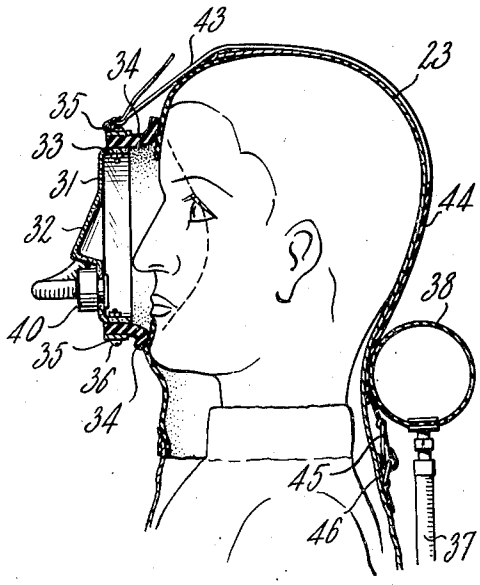
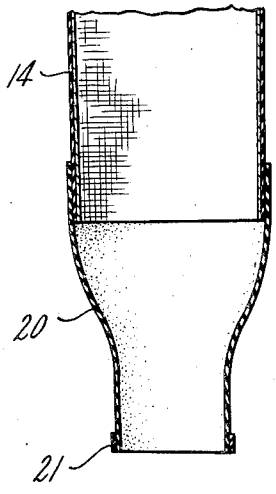


Fig. 9



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DIVER'S SUIT

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Application May 15, 1945, Serial No. 593,811

1 Claim. (Cl. 2—2.1)

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This invention relates to a snug fitting, light weight diving suit formed of stretchable waterproof material arranged in the suit to contract and stretch with the movement of the body and limbs of the person wearing the suit.

Diving suits as used heretofore have been large, bulky and heavy, resulting in discomfort to the wearer and a lowering of his efficiency. The primary reason why these prior suits were bulky was that they were made of heavy waterproof material that would not stretch to accommodate the insertion of the wearer's arms and legs into the suit or the freedom of his body movement, and therefore had to be made much larger than the person wearing the suit in order that he could get into the suit.

Another cause of the weight and bulkiness of the diving suits employed heretofore was due to the means employed for supplying air to the diver while submerged. Such diving suits were commonly provided with a heavy metal helmet bolted to a metal frame or receptacle enclosing the upper portion of the body of the diver. The air which the diver breathed was pumped into the diver's suit so that it partially inflated the suit and increased its resistance to the freedom of movement of the wearer, and since these suits were used to confine air under pressure they were made non-stretchable so that they would not expand and blow up like an elastic balloon.

The diving suit contemplated by the present invention differs radically from the prior diving suit above briefly described, in that the present diving suit is made stretchable so that it will fit the body of the wearer closely but will yield in the limb encircling direction to permit the diver's hands and feet to be fully inserted as he puts on the suit.

One important feature of the present suit resides in the construction whereby it is worn in a non-air-inflated condition. That is, the air which is supplied to the diver so that he may breathe when submerged does not enter the diving suit to inflate it but is supplied to a mask which fits snugly over the face of the diver and the air is confined to the interior of this mask. Since the present suit is not required to confine air that is pumped to the diver under pressure it does not have to resist the expansion caused by internal air pressure and therefore may be made of stretchable material. By making the present diving suit stretchable so that it may conform closely to the body and limbs of the wearer and by employing the construction whereby air is supplied to the face of the diver without inflating the suit, a light

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weight, stretchable, close-fitting suit is secured, which permits the diver wearing the same to work much more effectively in the water than heretofore.

A primary feature of the present invention therefore resides in a snug fitting diving suit that is worn in the water in a non-air-inflated condition and which is made largely of a stretchable waterproof material formed of a knitted fabric coated with rubber, and which material is so disposed in the suit that it will stretch a substantial amount in the limb encircling direction, so that although the suit is close-fitting the diver may get into and out of the same and move his limbs freely. Another important feature of the present invention resides in the construction of the lower back portion of the suit so that this portion of the suit will stretch in a vertical direction to accommodate the body movement of the wearer when he bends forward at the waist.

The above and other features of the present invention will be more fully understood from the following description when read in connection with the accompanying drawings; wherein

Fig. 1 is a front view of a diver wearing the suit contemplated by the present invention;

Fig. 2 is a rear view of Fig. 1;

Fig. 3 is a side view of the suit of Fig. 1 shown fully extended but without the diver therein, and with the face mask removed;

Fig. 4 is a plan view of a piece of knitted, waterproof, stretchable fabric such as is preferably used throughout the greater portion of the present suit;

Fig. 5 is an enlarged sectional view of a seam taken on line 5—5 of Fig. 1;

Fig. 6 is a side view of the upper portion of Fig. 1;

Fig. 7 is a perspective view of the mask as it appears when removed from the suit shown in Fig. 3;

Fig. 8 is a vertical sectional view through the helmet part of the suit and mask as worn by the diver in Fig. 1; and

Fig. 9 is an enlarged longitudinal section view through the lower portion of one of the sleeves of the diving suit.

The diving suit contemplated by the present invention is preferably made largely of knitted waterproof material such as shown in Fig. 4 of the drawing and which is capable of stretching at least 20% in the direction of the arrow in this view. This material consists of the knitted fabric 10 having the rubber layer 11 upon one face.

In making the diver's suit contemplated by the

present invention so that it will fit the diver snugly, it is important to embody the stretchable fabric shown in Fig. 4 in the suit so that the sleeves of the suit will stretch in the arm encircling direction and the trouser portion of the suit will stretch in the leg encircling direction as indicated by the arrows shown in Fig. 3 of the drawing. The front of the suit and the upper part of the back thereof should stretch in the body encircling direction as indicated by the arrows so as to encircle the diver's chest snugly but yieldingly. The lower back portion of the suit, however, should be constructed to stretch in a vertical direction as indicated by the arrow in Fig. 3 so that this portion of the suit may stretch longitudinally when the wearer bends forward at the waist. The knitted fabric 10 is of course disposed at the inner face of the suit.

The front portions 12 of the suit, upper rear portion 13, sleeves 14, upper leg enclosing portions 15 and lower leg enclosing portions 16 are all formed of the fabric shown in Fig. 4 of the drawing which is placed in the suit so that it will stretch in the horizontal direction or body and limb encircling directions as indicated by the arrows of Fig. 3. The lower back portion 17 of the suit has the fabric shown in Fig. 4 disposed so that it will stretch lengthwise of the suit as indicated by the arrow in Fig. 3 so that this portion of the suit may stretch lengthwise of the diver when he bends forward at the waist.

The various seams of the suit may be formed as shown in Fig. 5 by placing the marginal edge portions of two pieces of fabric in overlapping relation and cementing them together so as to bond the fabric face 10 of one to the rubber face 11 of the other as shown. The seam thus formed is preferably further strengthened and made watertight by securing along such seams a strip of trim tape 18.

The suit shown has attached thereto the light weight rubber shoes 19, but does not have gloves attached to the sleeves. It is therefore necessary to provide sleeves which will fit tightly around the wrists of the diver so as to prevent water from entering the suit at this point. It is desirable to make the lower portions 20 of the sleeves of rubber sheeting which is not reinforced with fabric so that these lower sleeve portions will have a greater range of stretch in the wrist encircling direction than the approximate 20% above-mentioned, and also so that rubber at the inner face of the sleeve portion 20 will engage directly the wrist portions of the diver's arms. The lower edge of each sleeve portion 20 is provided with the rubber reinforcing tape 21.

The suit so far described is provided with a helmet or head enclosing portion which is permanently secured to the neck portion 22 of the suit. The rear portion 23 of the helmet is preferably formed of the knitted waterproof fabric shown in Fig. 4 but the front portion of the helmet is preferably formed of rubber sheet material 24 which is not reinforced. This front portion 24 has the face opening 25, and the marginal portion of the material 24 adjacent the face opening is adapted to be snugly engaged by the rear portion of the mask shown in Fig. 7 of the drawing.

The upper back portion of the suit is provided with a large tubular extension 26 through which the diver enters and leaves the suit. This entrance tube 26 may be formed of the waterproof knitted fabric shown in Fig. 4 and arranged to stretch in the direction indicated by the arrow in Fig. 3, and this tubular member is secured to the back portion of the suit by the seam 18. After the diver has entered the suit, the tubular portion 26 is tightly closed so that water cannot enter the suit through this tube. This may be done by squeezing the tube until it forms a compact bar which may be folded upon itself to form a loop which is tightly clamped in the U-shape metal clamp 27 shown in Fig. 2 and which has the sliding clamping bar 28 that is forced into the clamping position by turning the threaded bolt 29.

After the diver has been tightly sealed in the suit by closing the tube 26 in the manner just described, and the mask shown in Fig. 7 has been secured in place, in a manner to be described, some air may be trapped in the body portion of the suit. As the diver enters the water the pressure of the water will force the suit into snug engagement with all portions of his body. This will cause the air which has been trapped in the suit to accumulate in the helmet. It is desirable to get rid of this trapped air and therefore the helmet is provided with the one-way valve 30 through which this trapped air may escape from the suit.

The face mask shown in Fig. 7 and other views of the drawings has a transparent face plate 31 which is shaped somewhat like a flat disk that is provided with a protruding nose portion 32 and an annular flange 33. This face plate is preferably made from plastic material such as Lucite. To the flange portions 33 of the face plate is secured a soft rubber ring 34 having a bevelled rear edge adapted to conform to the contour of the forehead and chin of the diver and the opposite sides of his face. This ring which engages the portion 24 of the suit so as to surround the opening 25 therein, serves to clamp the rubber sheet 24 against the diver's face and the mask should be secured so tightly against the face that air supplied to the interior of the mask will be confined between the face of the diver and the Lucite plate 31 without escaping to any appreciable extent from said area into the main portion of the diver's suit or between the sheet 24 and ring 34 into the water.

A metal strip 35 is preferably provided around the flange portion 33 of the face plate over the rubber ring 34 and is clamped to the flange 33 at short intervals by the bolts 36. The parts 33, 34 and 35 are preferably also cemented together so as to provide an absolutely watertight joint.

When the diver wearing the present suit is submerged, air under pressure is supplied by a hose 37 to the breather bag 38, which is a flexible waterproof fabric bag shaped to encircle the back of the neck of the wearer as shown. One end of this breather bag is secured to a curved metal tube 39 which leads to the interior of the mask and supplies air to the mask from the breather bag. The entrance to this tube 39 is preferably provided with a one-way valve so that air which enters the mask cannot return to the bag 38. The other end of the bag 38 is removably attached to the opposite side of the mask. The primary purpose of the breather bag is to act as a reservoir for the air supply.

Excess air supplied to the diver together with the exhaled air that exceeds the pressure of the water surrounding his helmet, will pass out of the one-way valve 40 and upwardly through the tube 41 to escape into the water at the end 42 of this tube.

The mask of Fig. 7 is not secured in place until after the diver has gotten into the suit shown in Fig. 3. It is then placed in position over the

rubber sheet 24 so that the soft rubber ring 34 clamps the sheet 24 firmly against the face, the mask is then firmly secured in place against the face of the diver by tightening the straps 43 which radiate from the member 44 that engages the back of the helmet. These straps 43 engage the metal ring 35 at spaced points as shown and can be tightened at will. When the breather bag 38 is inflated as shown it will be buoyant in the water and will tend to rise. In order to prevent it from rising, it is provided with fastening means 45 adapted to engage rings 46 secured to the rear portion of the suit in the collar area.

The knitted fabric 10 coated with rubber as shown in Fig. 4 of the drawing is preferably a fine rib knit fabric having a substantial stretch and having the threads close together so that the rubber layer 11 will adhere firmly to the fabric. The knitted fabric is preferably condensed in one direction while the coating material 11 is applied thereto to thereby produce a waterproof fabric having a stretch of at least 20%.

In practice good results have been secured by using a rib knit cotton fabric that weighs 3.5 ounces a square yard, and has 25 wales per inch and 35 courses at the face and 35 courses at the back of the fabric per inch. This fabric was stretched in one direction on a tentering machine to thereby contract the fabric in an opposite direction to increase its capacity to stretch, and while so stretched was coated with a solution of natural or synthetic rubber suitably compounded to give maximum adhesion of this coating to the fabric. Synthetic rubber such as Buna S, may be used, and if oil resisting properties are needed neoprene or Buna N may be used to form the layer 11. The weight of the rubber coating was approximately 24 ounces per square yard so that the waterproof fabric of Fig. 4 weighed about 27.5 ounces per square yard. This finished coated fabric withstood 100 pounds pressure on the Mullin hydrostatic tester.

A suit constructed as above described and shown in the drawings, which was worn by a diver 6 feet tall, weighed only 6 pounds without the mask shown in Fig. 7. This light weight, snug fitting, and highly flexible suit obviously permits the diver much greater freedom of movement when submerged than does the old type of heavy, stiff, bulky diving outfits.

Since the present suit is not inflated with air when the diver is submerged it is much less buoyant than the large, bulky inflated suits used heretofore, and the stretchable fabric does not need to confine a quantity of expanding air. The wearer of the present suit does not need a large amount of lead weight to enable him to remain submerged. A small amount of lead secured to a belt, not shown, and worn around the waist is all the added weight the diver will need.

Having thus described my invention, what I claim and desire to protect by Letters Patent is:

A one-piece, light-weight, water-tight diver's suit that snugly encloses the head, body and limbs of the wearer but has a face opening and a rear tubular entrance opening through which the wearer enters the suit and is worn in the water in a non-air-inflated condition; said suit being made for the most part of coated fabric capable of stretching at least 20% in one direction and to a less extent in a direction at right angles thereto, the coated fabric being formed of a stretchable knit fabric coated on its outer face with rubber, and the coated fabric being so disposed in the suit that its principal stretch is in the limb and chest encircling direction, while the rear seat covering portion of the suit has the principal fabric stretch extending longitudinally of the suit to stretch longitudinally at the rear of the suit when the wearer thereof bends forward at the waist.

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