March 9, 1971 W. J. O'NEILL ET AL 3,568,209

PROTECTIVE SUIT APPARATUS

Filed Sept. 14, 1966

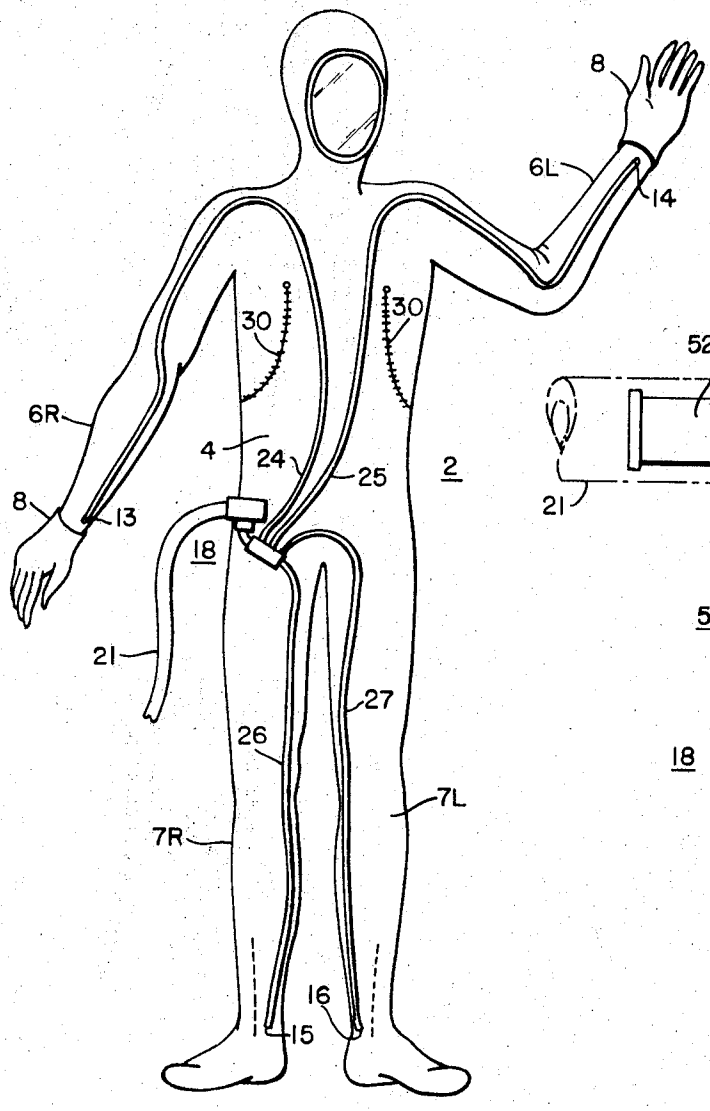



FIG. 1

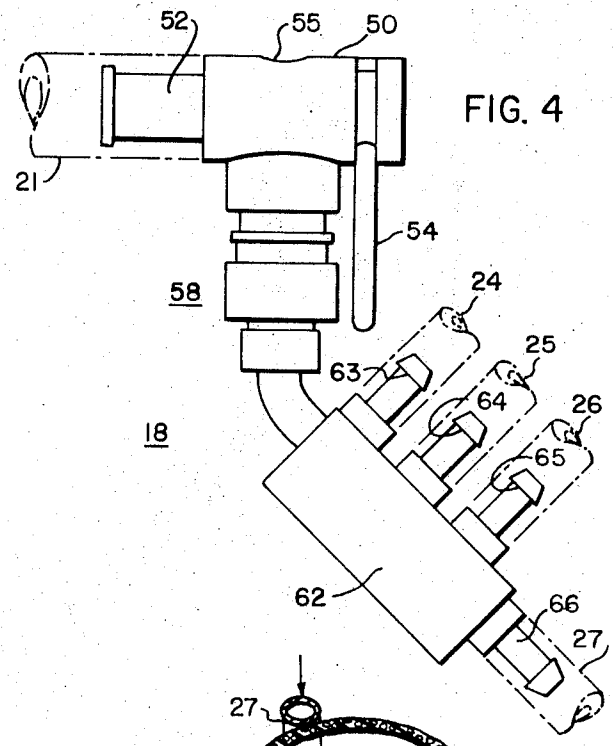



FIG. 4

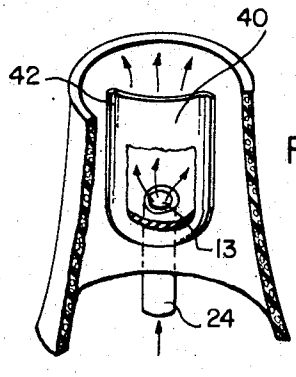



FIG. 3

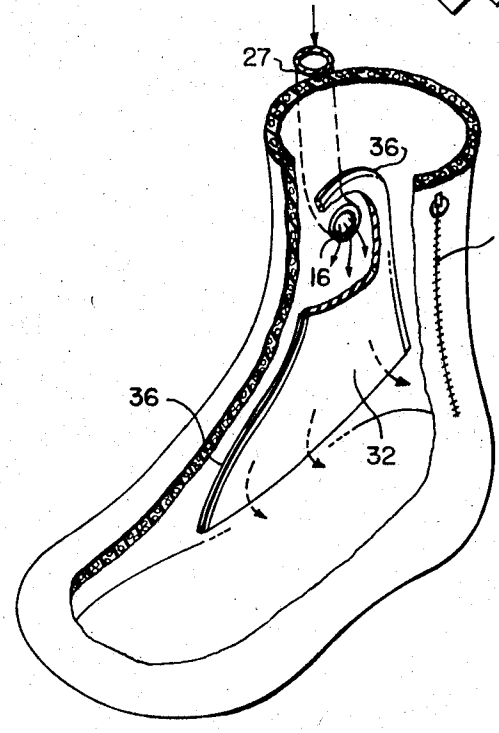



FIG. 2

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# PROTECTIVE SUIT APPARATUS

Wilber J. O'Neill, Severna Park, and Alan R. Krasberg, Crownsville, Md., assignors to Westinghouse Electric Corporation, Pittsburgh, Pa.

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U.S. Cl. 2—2.1 6 Claims

## ABSTRACT OF THE DISCLOSURE

Diver's wet suit includes apertures at the wrist and ankle portions thereof, with a baffle located behind each aperture. Warm water is supplied to a distributor including a manifold section having conduits connected thereto and to the respective apertures whereby heated water by virtue of the baffles is directed toward the hand and feet extremities of the diver. The distributor includes a quick disconnect feature for emergency situations and a valve section for diverting the heated water to the ambient medium in which the diver is working.

This invention in general relates to suit apparatus for protection in a hostile environment, and particularly to a protective suit system for divers.

Various methods are in use for keeping divers warm in cold water environments. In one method the diver wears a material between the body and an outer waterproof suit and the diver's heat loss is reduced by a gas or air trapped in the weave of the material. Another approach is the wet suit approach wherein the diver wears a suit of cellular material such as neoprene foam. The suit closely fits the form of the diver and a small amount of water enters between the suit and the diver's skin where the water is warmed by the diver's body heat to aid in keeping him comfortable.

The effective duration in water, of the wet suit approach, at about 10° above freezing is in the order of one hour or less.

Other attempts at keeping a diver comportable in a cold water environment has included the pumping of hot water to an aperture in the diver's suit for circulation around the diver's body. However, prior attempts at hot water heating systems have failed to adequately keep a diver warm for reasonable periods of time.

It is therefore a primary object of the present invention to provide an environmental suit system for keeping a diver in relative comfort at near freezing water temperatures.

Another object is to provide a system which effectively increases the period of time which a diver may spend under water.

A further object is to provide protective suit apparatus when a diver may be freed from the system with relative ease.

A further object is to provide protective suit apparatus wherein a heated fluid is supplied to the suit and wherein the diver may control the flow of the heated fluid into the system.

Briefly, in accordance with the above objects, there is provided protective suit apparatus, particularly well adapted to be used by divers, and which includes a garment such as a diver's wet suit having body, arm and leg portions. Apertures are provided in the arm and leg portions,



preferably in the vicinity of the wrist and ankle areas of the diver. Means are provided for conducting a conditioned fluid to the apertures, the conditioned fluid, for example, being hot water which is supplied to the diver via an insulated hose from a remote pumping station. Interiorly of the garment is a plurality of baffle members each located behind a respective one of the apertures for directing the conditioned fluid to the hand and foot extremities which tend to give up circulation first, to compensate for coldness.

Additional features of the apparatus include a distributing means for the conditioned fluid whereby the diver may with facility, control the fluid entering the suit, and in emergency situations disconnect himself from the fluid supply.

Special slide fastener arrangements not only allow the diver to get in and out of the suit easily but also provide for convenient fluid exits after completion of the dive.

The above stated as well as further objects and advantages of the present invention will become apparent upon a reading of the following detailed specification taken in conjunction with the drawings, in which:

FIG. 1 illustrates one embodiment of protective suit apparatus according to the present invention;

FIG. 2 is a perspective cut-away view partially in section of one ankle and foot area of the suit of FIG. 1;

FIG. 3 is a perspective cut-away view, partially in section of one wrist area of the suit of FIG. 1; and

FIG. 4 illustrates the fluid distributing means of FIG. 1 in more detail.

Referring now to FIG. 1, there is illustrated, on a wearer, a garment **2** which may be a neoprene foam wet suit and which includes body portion **4**, right and left arm portions **6**R and **6**L and right and left leg portions **7**R and **7**L. Protective gloves or mittens **8** may be worn by the diver and may be formed as part of, or may be tightly engaged with the suit **2**.

In a preferred embodiment, each arm and leg portion includes an aperture such as apertures **13**, **14**, **15** and **16** respectively located in the wrist area of the right arm portion **6**R, the wrist area of the left portion **6**L, the ankle area of the right leg portion **7**R and the ankle area of the left leg portion **7**L. Means are provided for conducting a conditioned fluid such as hot water to the apertures and includes a distributing means **18** into which is connected a thick insulated hose **21** through which is pumped the hot water from a remote station. A plurality of small diameter hoses **24** to **27** connect the distributing means **18** with a respective one of the apertures **13** to **16** whereby heated water entering the distributing means **18** is conducted directly to the wrist and ankle areas of the suit **2**. The hoses **24** to **27** may be secured to the garment **2** such as by gluing, sewing or by fasteners, or may actually be built into the suit **2** as conduits.

To allow the diver to get in and out of the suit **2** easily, there is provided a slide fastener **30** arrangement. The fastener **30** extends downwardly along the right and left sides of the front of the body portion **4** and extends across the back of the body portion in a continuous manner. Thusly, the upper part of the entire suit may be slid over the diver's chest, head and arms after which he may easily step out of the suit.

Since the diver's extremities tend to give up heat at a faster rate than the rest of his body, means are provided for directing the heated water initially to the diver's hand

and foot area and to this end reference should be made to FIGS. 2 and 3.

FIG. 2 is a cut-away partial cross section of an inside view of the lower leg portion 7L of suit 2. As was stated, means are provided for initially directing the heated fluid to the diver's extremities; this means takes the form of a baffle member 32 located behind the aperture 16. The baffle member 32 may be of a rubber composition and secured to the inside of the suit by means of, for example, glue as indicated by the ridge portion 36. The lower portion of the baffle member 32 is not glued to the inside of the suit and consequently the heated water entering at aperture 16 is forced downwardly where it emerges at the bottom of the baffle member 32 as indicated by the arrows. As shown in FIG. 2, the heated water is conducted via hose 27 to the aperture 16 where it is then forced toward the lower section of the suit leg. After heating of the diver's foot and toe extremities the water then flows up over the diver's legs into the body portion of the suit 2 to any convenient dump port (not shown).

At the termination of a dive and after the diver has emerged from the water, the suit 2 is filled with the heated water and to this end, as illustrated in FIG. 2, slide fastener 45 is located in the lower part of the foot portion of the suit 2 so that when opened, the remaining heated water within the suit may drain out. For convenience a slide fastener such as 45 may be located in the lower part of each leg portion of the suit 2.

In a manner similar to the baffle arrangement of FIG. 2, heated water entering the suit 2 at the wrist areas is forced toward the diver's hands and fingers and thence up the diver's arms to a convenient dump port. FIG. 3 illustrates in cut-away partial cross section a view looking inside the suit 2 in the vicinity of the wrist area of the right arm portion 6R of suit 2. Located behind the aperture 13 is a baffle member 40 which may be secured to the suit as indicated by the ridge portion 42 so that heated water entering the aperture 13 is forced toward the diver's extremities as indicated by the arrow. (The protective mitten or glove worn in conjunction with the suit is not shown.)

FIG. 4 illustrates in somewhat more detail one type of distributor means 18 which may be utilized. The distributing means 18 is preferably worn in the hip area and includes a valve section 50 having an inlet end 52 to which is connected the insulated hose 21. The valve section 50 is operable by means of diver operated lever 54 to direct the incoming heated water through the coupling section 58 to the manifold section 62, or to divert the incoming heated water directly out aperture 55 to the surrounding water medium. Intermediate these two extremities, the lever 54 may be manipulated so that a portion of the incoming heated water is diverted to the surrounding medium and the remainder is channeled through to the manifold section 62.

In some emergency situations it will be necessary that the diver disconnect himself from the system which supplies the heated water. In order to facilitate this maneuver, the coupling section 58 is preferably of the common two-part quick-disconnect variety.

The manifold sections 62 includes a plurality of outlets 63 to 66 to which are attached the small diameter hoses 24 to 27, respectively, so that the incoming heated water entering the manifold section 62 may be conducted to the apertures associated with the arm and leg portions of the suit 2.

Although the present invention has been described with a certain degree of particularity, it is obvious that various modifications may be made in the light of the above teachings. For example, the number or position of the various apertures serving as conditioned fluid inlets may be varied.

It has been mentioned that suitably located dump port or ports serve as an outlet means for the conditioned fluid; with a diving wet suit including a hood portion the conditioned fluid outlet may be effectively between the diver's face mask and the hood portion. It is also obvious that although the present invention has been described with respect to a diver in conjunction with heated water, the protective suit apparatus may be used in other hostile environments and the conditioned fluid may be a gas or liquid other than water, and may be supplied, where technology allows, by a diver associated portable unit.

Although dump ports have been indicated, suggesting an open circuit arrangement, a remote supplied, or self-contained closed circuit fluid arrangement may be provided.

What is claimed is:

1. Protective suit apparatus for use in a hostile environment comprising:
   (a) a garment adapted to be worn by a user and including body, arm and leg portions;
   (b) each said arm and leg portion including respective apertures located at the wrist and angle areas of said arm and leg portions;
   (c) distributing means having an inlet section for receiving a conditioned fluid and a manifold section for conducting said conditioned fluid to each said aperture; and
   (d) baffle means located behind a respective one of said apertures interiorly of said garment for directing said conditioned fluid to the hand and foot extremities of the user.

2. A diving suit as claimed in claim 1 and further comprising slide fastener means extending from one side of the chest of said torso portion downwardly and across the back and then upwardly to the other side of the chest of the torso portion.

3. Protective suit apparatus comprising:
   (a) a garment adapted to be worn by a user and including body, arm and leg portions;
   (b) fluid conducting means extending along said arm and leg portions;
   (c) said fluid conducting means being for conduction of a conditioned fluid;
   (d) fluid distributing means having an inlet section for receiving said conditioned fluid, and a plurality of outlets communicative with said fluid conducting means;
   (e) said fluid distributing means including a valve section for selectively diverting the incoming conditioned fluid to the surrounding ambient medium in which the user is immersed; and
   (f) each said fluid conducting means having a fluid discharge aperture in the vicinity of the extremities of said arm and leg portions and disposed relative to said suit and said user such that said conditioned fluid is discharged to flow between said suit and said user.

4. A diving suit comprising a body-enveloping garment of flexible material having neck, torso, arm and leg portions, a control unit adjacent said suit and connected to a source of warm fluid, first flexible conduit means extending from said control unit over the torso portion terminating adjacent the wrists thereof, second flexible conduit means extending from said control unit on the leg portions terminating adjacent the ankles thereof, the ends of said first and second conduit means being open into the suit and manually operable valve means on said control unit for regulating the flow of warm fluid from said source to said conduits, said valve having an inlet connected to said source of warm fluid, a first outlet connected to said conduit means and a second outlet for discharge from the valve, and manually operable means on said valve for selectively connecting said inlet and said outlets whereby the quantity of fluid flowing into said conduit means is controlled.

5. A one-piece body-enveloping garment as claimed in claim 4 wherein said slide fastener means has a continuous path downwardly from one side of the upper chest of the torso portion around one side in a generally

elliptical path, across the back, and around the other side of the torso portion in a generally elliptical path and upwardly to the other side of the upper chest.

6. A one-piece body-enveloping garment comprising flexible material providing neck, torso, arm and leg portions, and slide fastener means extending from one side of the chest of said torso portion downwardly and across the back and then upwardly to the other side of the chest of the torso portion.


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RICHARD J. SCANLAN, JR., Primary Examiner