March 17, 1970 M. F. MEAD 3,501,056

SELF-CONTAINED UNDERWATER SUIT HEATER

Filed May 6, 1968

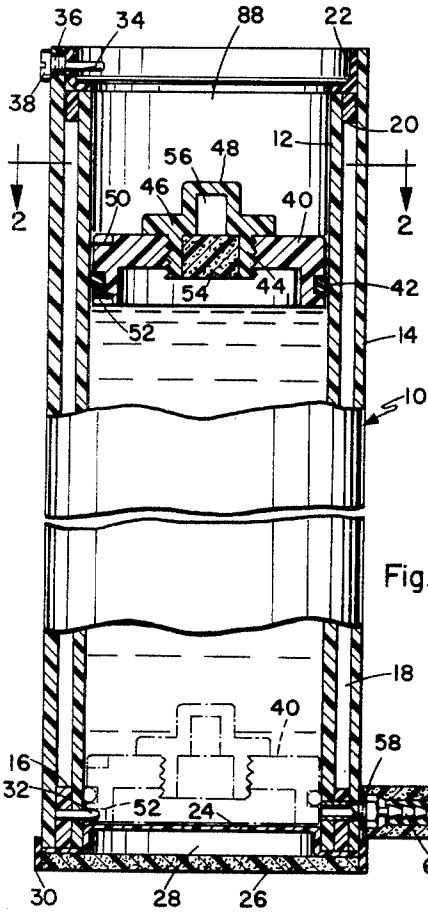



Fig. 1

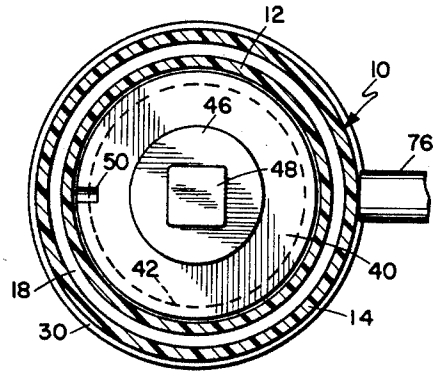
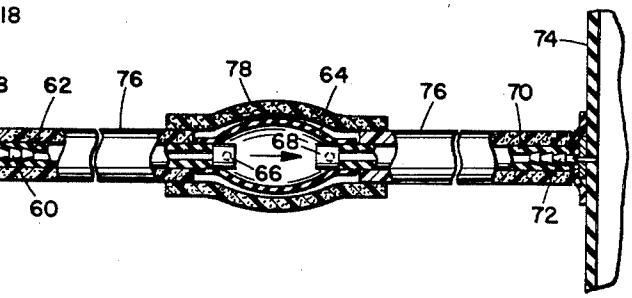



Fig. 2



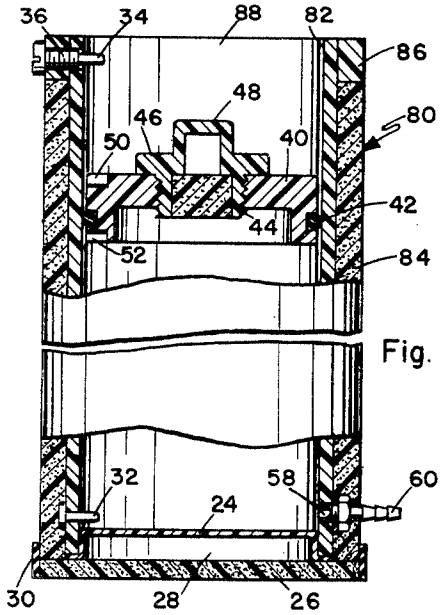




Fig. 3

*INVENTOR.*
MITCHELL F. MEAD
*BY* Knox & Knox

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# SELF-CONTAINED UNDERWATER SUIT HEATER

Mitchell F. Mead, 5527 Baltimore Drive, La Mesa, Calif. 92041

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U.S. Cl. 222—131 7 Claims

## ABSTRACT OF THE DISCLOSURE

The suit heater utilizes hot water carried in an insulated container which is readily attached to a diver, the hot water being transferred as needed by a small hand pump to the interior of the diver's wet suit. A piston-like follower in the container is drawn in as the hot water is removed, the follower being exposed to ambient pressure which thus maintains the ambient pressure on the hot water, so that the pump operates easily at any depth, the follower and container having co-acting stop means to facilitate opening, closing and refilling.

## BACKGROUND OF THE INVENTION

The present invention relates to diving apparatus and specifically to a self-contained underwater suit heater.

It is well known to heat diving suits electrically, which is practical only for a short duration unless power is supplied from the surface, with consequent limitation on mobility of the diver. Also the possibility of short circuiting makes the technique somewhat dangerous. Chemical heating has also been proposed, but this is usually continuous once initiated and not readily controllable. Since mobility is of prime importance in the type of diving performed in a wet suit with aqualung equipment, it is necessary for any added apparatus to be compact and easily carried.

## SUMMARY OF THE INVENTION

The suit heater described herein utilizes a compact insulated container which is easily attached to the diver or to the air tanks or harness of the breathing apparatus. A flexible hose leads from the container, through a small hand pump to an inlet in the wet suit. Prior to diving the container is filled with hot water, which can be pumped into the wet suit as needed. A follower sliding in the container is exposed on one side to the surrounding water, so that ambient pressure is maintained on the hot water and proper pump operation is ensured at any depth. The follower has a removable filler plug and the container incorporates stops on which the follower can be engaged at either end of its travel, to facilitate insertion or removal of the plug.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a cut-away side elevation view of the complete assembly;

FIGURE 2 is a sectional view taken on line 2—2 of FIGURE 1; and

FIGURE 3 is a cut-away view, similar to a portion of FIGURE 1, showing an alternative container structure.

Similar characters of reference indicate similar or identical elements and portions throughout the specification and throughout the views of the drawings.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the configuration shown in FIGURES 1 and 2, the container **10** is a double walled structure comprising an inner cylinder **12** and an outer cylinder **14**, separated at the lower end by a spacer ring **16** to leave an annular air



space **18** between the cylinders. The cylinders are preferably of plastic material for thermal insulation and resistance to water. At the upper end a spacer ring **20** is secured to inner cylinder **12**, but is slidable in outer cylinder **14** to allow for differential expansion and contraction of the two cylinders. Water is kept out of air space **18** by an annular seal **22**, of flexible material such as rubber or plastic, bonded between the inner and outer cylinders. The lower end is closed by a recessed plug **24** fitting tightly into inner cylinder **12** and sealed to the ends of the cylinders, with an insulated cap **26** secured over the recessed plug to enclose an insulating air chamber **28**, cap **26** being held by a retaining ring **30** suitably bonded in place.

Fixed in the lower end of container **10** is a stop pin **32** which protrudes a short distance into the interior of inner cylinder **12** adjacent plug **24**. At the upper end of the container is a stop pin **34** which projects over the opening of inner cylinder **12**, said stop pin having a threaded portion **36** which screws into the outer cylinder **14**, a head **38** on the threaded portion facilitating removal of the stop pin.

Slidably mounted in inner cylinder **12** is a piston-like follower **40** having an O-ring **42** for a seal against the cylinder wall. In the center of follower **40** is a threaded filler plug **44**, with a flange **46** which seats firmly against the top surface of the follower and having a raised, noncircular boss **48** for ease of removal. In the upper edge of follower **40** is a notch **50** to receive stop pin **34** and hold the follower against rotation at the upper end of its travel. The lower edge of follower **40** has a similar notch **52** to fit over stop pin **32** at the lower end of the cylinder. Filler plug **44** is hollow and has an insert of insulative material **54** in the lower end, leaving an air space **56** in the boss **48**.

At the lower end of container **10** is an outlet fitting **58** communicating with the interior of inner cylinder **12** and having an external tubular connector **60**. Secured on connector **60** is a flexible hose **62** leading to a pump **64** of the squeeze bulb type, which has been found most convenient in use. This type of pump is well known and has one way valves **66** and **68**, usuallly simple ball valves, at opposite ends to provide the pumping action when the bulb is squeezed and released. A further length of hose **70** connects the outlet side of pump **64** to an inlet fitting **72**, which is secured in any suitable manner to a wet suit, indicated fragmentarily at **74**. The inlet fitting **72** is preferably installed in the abdominal portion of the wet suit, since this is the area where cold is usually felt more noticeably and is a generally central point for distribution of the hot water. It will be obvious that multiple inlets could be used if required. To preserve the heat of the water as much as possible the hoses **62** and **70** are encased in insulated jackets **76** and a further jacket **78** is fitted over pump **64**. One suitable material having the necessary flexibility, as well as thermal insulating qualities, is nylon fabric coated Neoprene, which is commercially available. This is basically a foam material with closed cells and does not become permeated with water. However, other materials may be equally suitable.

An alternative construction for the container is shown in FIGURE 3. The container **80** has an inner cylinder **82**, similar to cylinder **12**, but the outer cylinder **84** is a thick layer of insulative material secured on the inner cylinder rather than spaced therefrom. At the lower end of container **80** is the same closure arrangement of a recessed plug **24**, cap **26** and retaining ring **30** as described above, and the same follower **40** is used. The lower stop pin **32** is secured in inner cylinder **82**, as is the outlet fitting **58** with its external connector **60**. At the upper end the inner cylinder **82** has an external reinforcing ring **86**, which provides support for

e threaded portion **36** of the removable upper stop n **34**.

Either form of the container can be attached to e diver in various ways, one suitable method being strap the container to the compressed air tank or supporting harness. The flexible hose will then exnd around one side of the diver to the wet suit in-, putting the pump **64** convenient to the diver's side ar the waist. Before diving the follower **40** is pulled the top of the container and the notch **50** engaged the upper stop pin **34** to prevent rotation. Filler ug **44** can then be unscrewed and the container filled th hot water.

During submersion, whenever the diver feels discomrt due to the cold water, a few squeezes of pump will transfer some of the hot water to the interior the wet suit, the amount being determined by the ver to suit particular conditions. As hot water is withawn from the container the follower **40** will be pulled to the inner cylinder, assisted by pressure of the surunding water entering the open end **88** of the conner, which thus maintains ambient pressure on the t water. This reduces the demand on pump **64** and sures a ready flow of hot water at any depth. A itable water resistant lubricant, such as petroleum ly, may be used to ensure smooth motion of the llower. The hot water is used only as needed and, der most conditions, a container roughly equal in e to a compressed air tank, will supply hot water r the normal operating period of the air supply. There ll, of course, be variations in tank sizes, air pressures, ter temperature and other related factors, but in neral the heating system is compatible in performance th conventional breathing apparatus.

To refill the container after use, the follower **40** pushed to the bottom to engage notch **52** on stop pin , as indicated in broken line in FIGURE 1. With the llower held against rotation the filler plug **44** can be screwed and removed. It is then possible to insert gers into the filler plug opening, to grip and pull follower to the upper end of the container ready r filling. For cleaning and servicing the upper stop **34** can be removed, allowing the follower **40** to taken completely out of the container.

The heating system is compact, completely self-conned, does not impede the diver and does not interfere th the breathing apparatus. The system is simple to e and very little maintenance is required.

It is understood that minor variation from the form the invention disclosed herein may be made without parture from the spirit and scope of the invention, d that the specification and drawings are to be conlered as merely illustrative rather than limiting.



I claim:

**1.** A self-contained heating system adapted to be carried by a diver and connected to a diver's wet suit, the system comprising:

a substantially cylindrical, thermally insulated hot water container having a closed end and an open end;

a piston-like follower slidably mounted in said container, said follower having a removable filler plug therein;

an outlet adjacent the closed end of said container;

an inlet fitting for connection to a wet suit;

and a one-way pump, connected between said outlet and inlet to pump hot water from said container to the wet suit.

**2.** The structure of claim **1**, wherein said container has an inwardly protruding stop pin adjacent said closed end, said follower having a notch for engagement on said stop pin to hold the follower against rotation.

**3.** The structure of claim **2**, wherein said container has a second inwardly protruding stop pin adjacent said open end, said follower having a notch for engagement on said second stop pin.

**4.** The structure of claim **3**, wherein said second stop pin is removable.

**5.** The structure of claim **1** and including thermally insulated flexible hoses connecting said pump to said outlet and inlet.

**6.** The structure of claim **1**, wherein said container comprises an inner cylinder and an outer cylinder concentrically spaced and fixed together at said closed end, said inner cylinder having a sealed sliding connection with said outer cylinder at said open end.

**7.** The structure of claim **1**, wherein said container comprises an inner cylinder, and an outer cylinder of thermally insulative material secured to the inner cylinder, said inner cylinder having an external reinforcing ring at said open end.

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SAMUEL F. COLEMAN, Primary Examiner

H. S. LANE, Assistant Examiner

U.S. Cl. X.R.

222—207, 386