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[45] Patented **May 11, 1971**

[73] Assignee **The United States of America as represented**
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[56] **References Cited**

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[54] **CARDIOVASCULAR CONDITIONING DEVICE**
AND PORTABLE RESPIRATOR
1 Claim, 7 Drawing Figs.

[52] U.S. Cl. **128/1,**
128/30.2

[51] Int. Cl. **A61b 19/00**

[50] Field of Search..... **128/1, 30.2,**
24, 299

ABSTRACT: A positive pressure vest and helmet assembly is pressurized by introducing gases thereinto to produce pooling of blood in the subject's extremities causing the vascular muscles to exercise in order to compensate for conditions resulting from body changes which occur under zero gravity conditions.

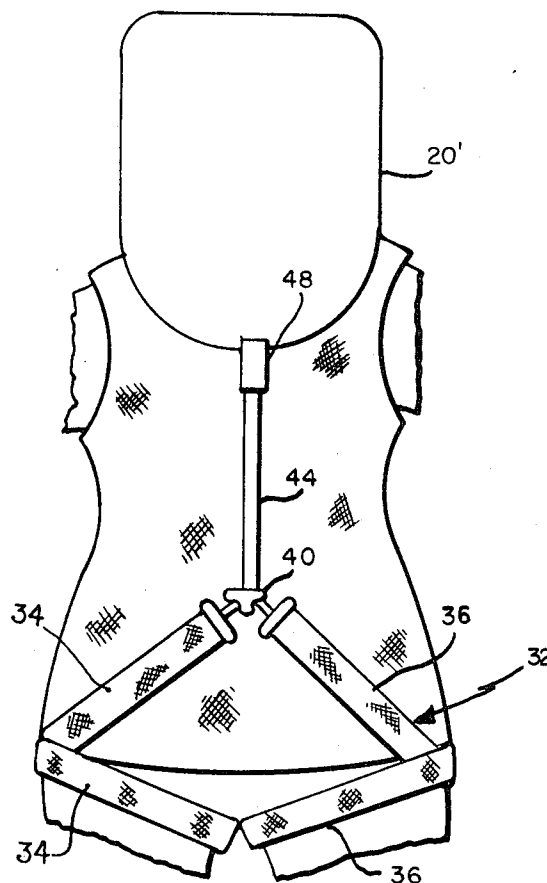


FIG. 2

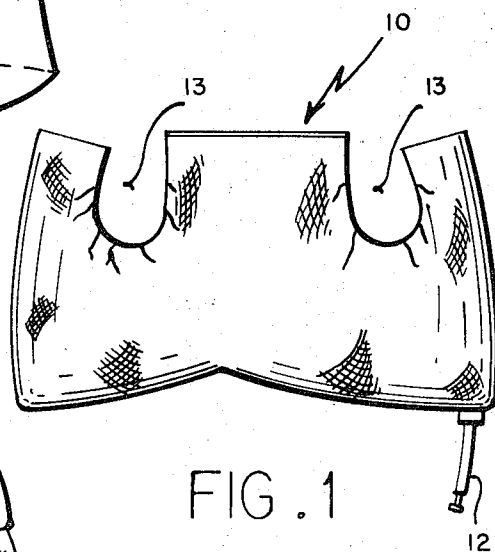
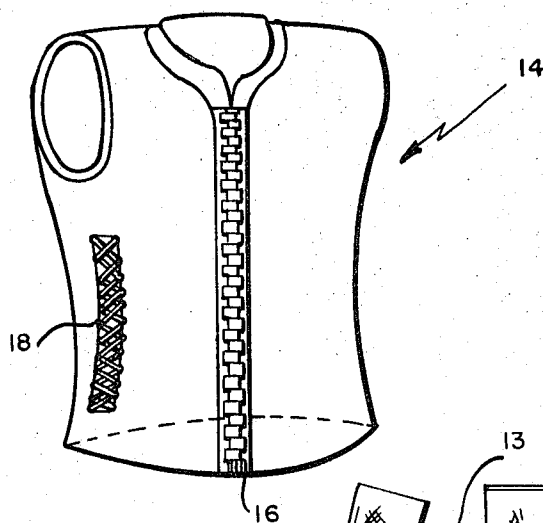


FIG. 3

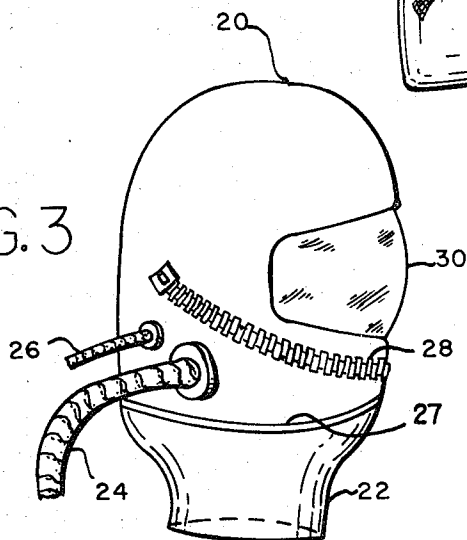


FIG. 1

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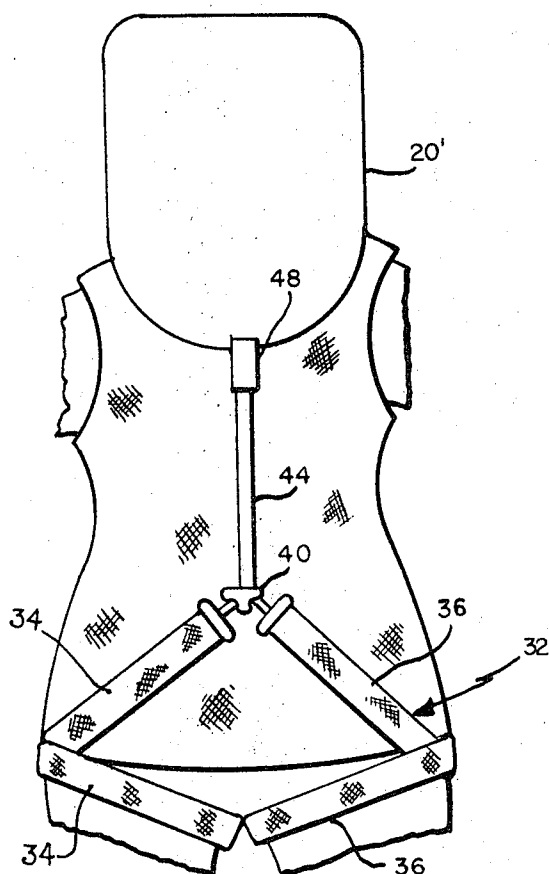


FIG. 4

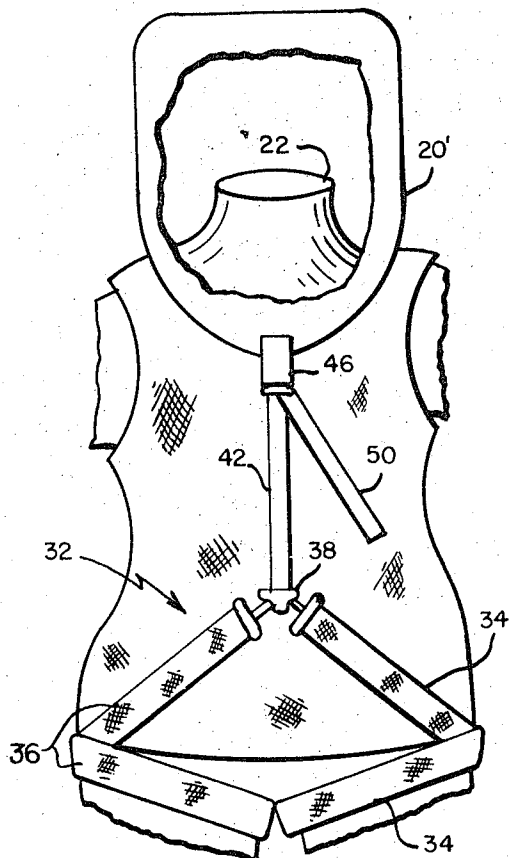


FIG. 5

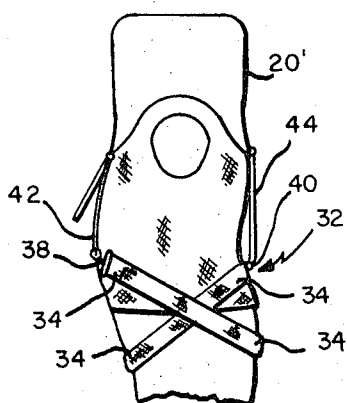


FIG. 6

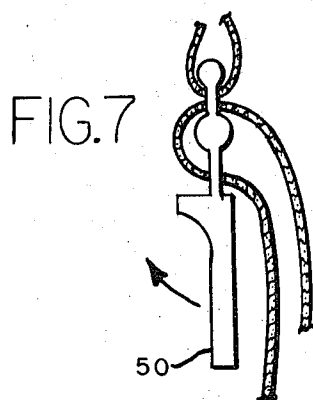


FIG. 7

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CARDIOVASCULAR CONDITIONING DEVICE AND PORTABLE RESPIRATOR

BACKGROUND OF THE INVENTION

In conditions of space flight when the aviator is subjected over long periods of time to zero gravity conditions and conditions of fast gravity changes, severe cardiovascular disturbances are experienced. The heart and vascular muscles become weakened from disuse. Under normal conditions of 1 g. the heart and blood vessels are continuously propelling the blood upward against gravity. When subjected for extended periods of time to zero gravity conditions, the heart and blood vessels become weakened and perhaps permanently damaged by lack of exercise, so that when returned to increased gravity conditions, the cardiovascular system cannot respond.

In attempts to make compensation for zero gravity conditions, devices have been contrived for encasing the lower extremities of the operator so that his legs and lower abdomen can be kept under negative pressure or in partial vacuum, creating a differential between upper and lower body portions in attempts to keep the heart and blood vessels active. Other devices have been tried, but all are cumbersome, consuming space and weight.

A great deal of research has been undertaken in attempts to understand, alleviate and compensate for these conditions. The aim is to keep the operator functioning normally for longer periods of time with no cardiovascular disturbance or damage.

SUMMARY OF THE INVENTION

The object of the present invention is to provide a pressure differential in selected body portions. This is done by an increase in positive pressures about the head and torso areas. The cardiovascular system is kept active by the greater energy required, thus compensating for the conditions above referred to.

In the device of the invention, a jacket without sleeves is made to be worn on the body. It is made of any suitable airtight, lightweight fabric, such as nylon coated with neoprene. The jacket is an inflatable bladder communicating with a controlled pressure source. The bladder is applied to the body, as a jacket above the waist. As found expedient a restraining jacket is applied over it to keep it in place and provide protection for it. The bladder and jacket are sleeveless; the arms, as well as the legs, are thus not included in the areas where increased pressure is being applied. The head, however, is included. The area within a helmet worn on the head of the subject is made airtight and is connected with a controlled pressure source. Pressure differentials are thus provided. Energy is required of the cardiovascular system to move pooled blood from one part of the body to another. The muscles are kept in tone and are thus enabled to compensate adequately for the unaccustomed conditions to which the astronaut is subjected. The damaging condition of orthostasis can thereby be prevented.

The device can also be used to provide artificial respiration. A portable respirator can be used to introduce intermittent pressure on the chest causing involuntary exhalation and inhalation of the subject.

The device can be manually operated by the subject, or it can be arranged to function automatically by using an inline cycling valve with a pressure cylinder or compressor or some other such expedient device. It will be seen that the device provides for applying positive pressure to the upper half of the body exclusive of the arms and this can be done without significantly affecting the normal breathing operation.

Adequate cardiovascular conditioning is thus provided by the present invention for the prevention and correction of the adverse effects of prolonged exposure of a subject to conditions of zero gravity. It will be seen also that the application of the present invention enables the physiological affects and stresses imposed on human subjects for long durations to be tolerated without ill effects.

The device is capable of fabrication from lightweight materials which do not add the impediment of greater weight in the subject's equipment. The design and material employed make the device procurable at low cost.

It will further aid in the research of physiological responses to stress associated with the cardiovascular system. Its use is not restricted to space conditions but has possibilities for use in the cardiovascular conditioning and treatment of hospital patients in both clinical and field applications.

These and other advantages, features and objects of the invention will become more apparent from the following description taken in connection with the illustrative embodiments in the accompanying drawings, wherein:

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of the vest portion of the assembly;

FIG. 2 is a view of the restraint jacket;

FIG. 3 is a side elevational view of the helmet portion of the assembly;

FIG. 4 is a back view of the vest and helmet showing the body harness for holding the helmet in place;

FIG. 5 is a front view of the device of FIG. 4;

FIG. 6 is a left side view of the same device; and

FIG. 7 is a view of the buckle which allows adjustment of the harness.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A vest or inner jacket 10 is constructed as shown, for example, in FIG. 1 of any lightweight, airtight material. It is made in the form of an inflatable bladder communicating through an inlet pipe 12 to a controllable pressure source (not shown). It is made of any expedient design which will be comfortable for the wearer. Arm holes 13 may be open or closed as desired. The inner jacket 10 is applied to the body of the operator. A restraint jacket 14, shown in FIG. 2, is worn over the inner inflatable jacket 10 and is provided with zipper 16 and lacings 18 for adjustment and fitting. These details are optional and subject to modification as expedience dictates. The outer jacket 14 may itself be made of double inflatable material, and serve the whole purpose by itself.

A helmet 20 fits over the head of the wearer, a flexible and elastomeric element 22 being attached to the helmet's lower portion, is turned upward as it is drawn on over the head and assumes the position shown in FIG. 5, forming an airtight closing about the neck of the wearer. A gas hose 24 communicates with the inside of the helmet 20 and provides a means for introducing breathing gas under pressure to the wearer. A flexible ring 27 fits over the shoulders of the operator. A cable 26 provides him with communication and a window 30 allows him vision and a zipper 28 allows him to open the helmet and bend it backward over his head.

FIGS. 4, 5, 6 and 7 show a body harness represented generally by the numeral 32 for securing the helmet to the body of the wearer. The helmet is shown schematically in these FIGS. at 20'. Leg straps 34 and 36 are secured by suitable fastenings 38 and 40 at front and back, respectively. Straps 42 and 44 connect fastenings 38 and 40 to the helmet at front and back by means of buckles 46 and 48 at front and rear. The buckle 46 is releasable by the operator by means of the strap 50 which is within reach of the hand of the operator.

The harness shown is exemplary only. The invention is not limited to the specific details shown.

Although the invention has been described with reference to particular embodiments, it will be understood to those skilled in the art that the invention is capable of a variety of alternative embodiments within the spirit and scope of the appended claims.

We claim:

1. A cardiovascular conditioning device for use under zero gravity conditions, said device comprising an inflatable jacket which permits normal breathing function while providing con-

trollable pressures about the upper body of the wearer, said inflatable jacket having free sleeve portions and being adjustable to fit the body of the wearer, a restricting jacket adjustable over said inflatable jacket to retain said inflatable jacket in position, a helmet adapted to be positioned over the head of the wearer for sustaining variable pressures thereon, sealing means between said helmet and said inflatable jacket, a body harness adjustable about the body of the wearer for maintaining said helmet in position over the head of the wearer, and a

controlled pressure source for inflating said inflatable jacket and pressurizing said helmet and amount sufficient to provide a constant pressure differential between the head and torso areas and the other body portions, thereby compensating for body changes occurring under zero gravity conditions by requiring increased cardiovascular activity which maintains the heart and vascular muscles in tone during relatively long periods of space flight under zero gravity conditions.

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