March 26, 1968 R. C. ARMSTRONG 3,374,792

NEGATIVE PRESSURE DEVICE

Filed Dec. 17, 1965 2 Sheets-Sheet 1

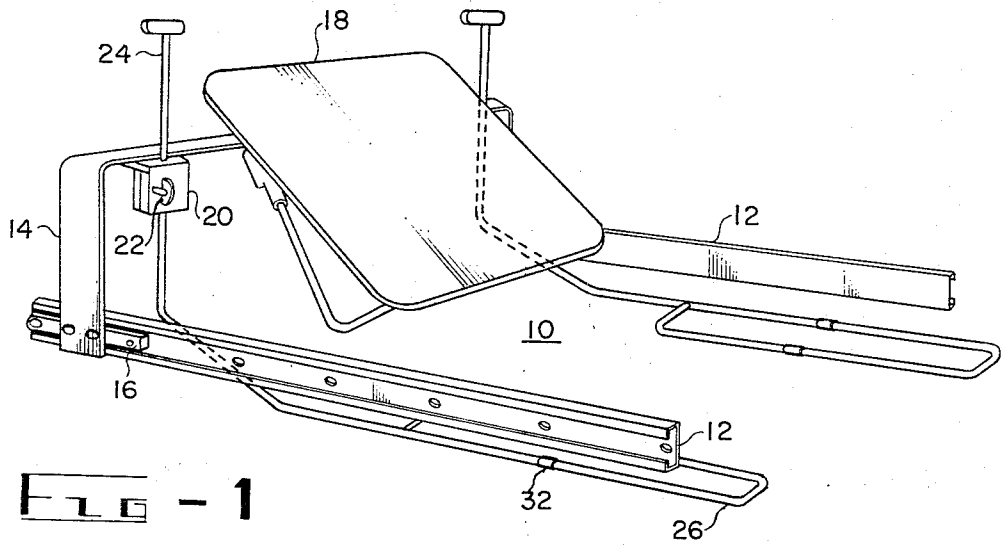

FIG - 1

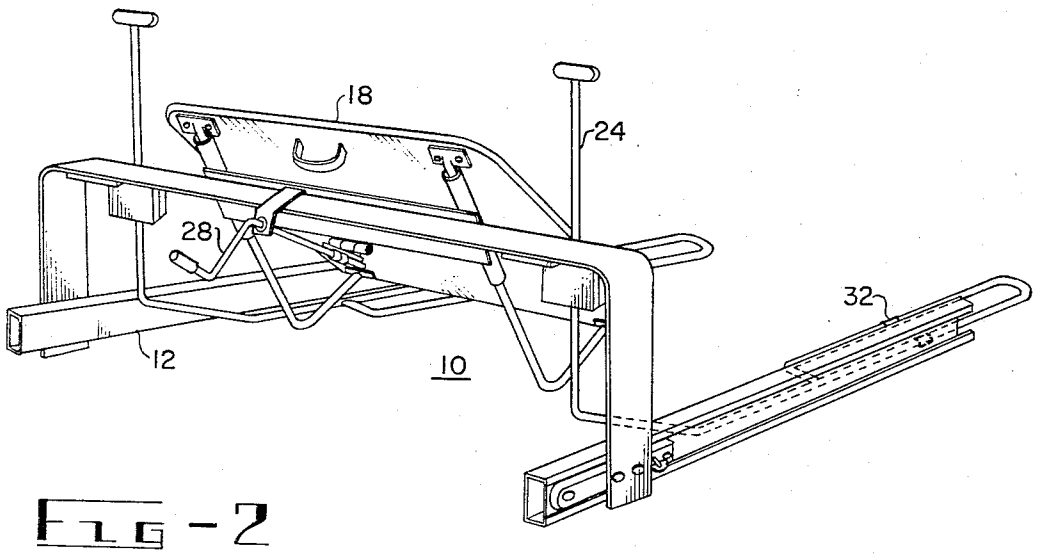

FIG - 2

INVENTOR.
ROBERT C. ARMSTRONG
BY
AGENT

March 26, 1968 R. C. ARMSTRONG 3,374,792

NEGATIVE PRESSURE DEVICE

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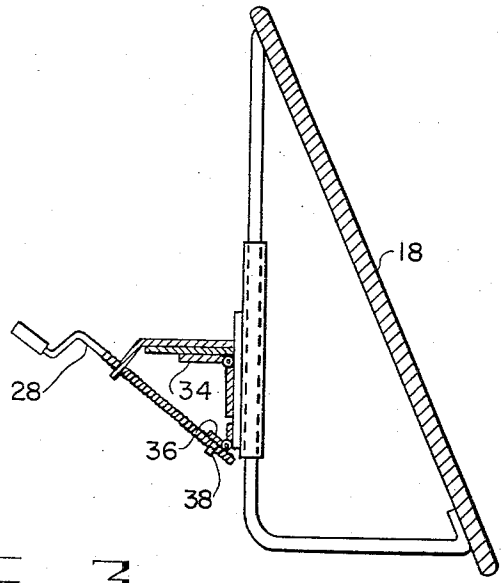

FIG - 3

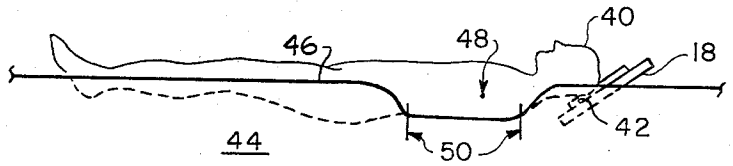

FIG - 4

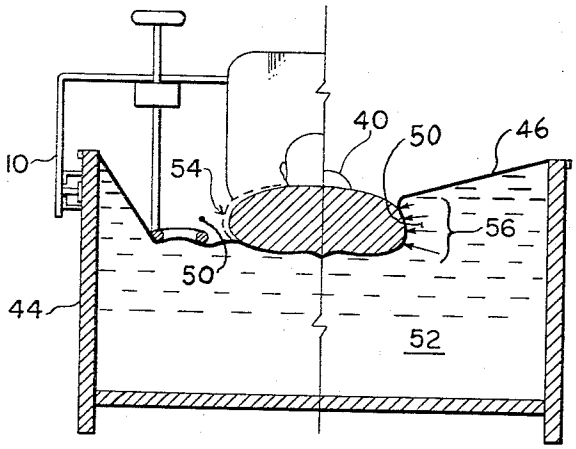

FIG - 5

INVENTOR.
ROBERT C. ARMSTRONG
BY
AGENT

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3,374,792

NEGATIVE PRESSURE DEVICE

Robert C. Armstrong, La Mesa, Calif., assignor to General Dynamics Corporation, San Diego, Calif., a corporation of Delaware

Filed Dec. 17, 1965, Ser. No. 514,622
10 Claims. (Cl. 128—376)

This device relates to a negative pressure breathing control device and more particularly to a device providing negative breathing pressure at an exact location from a head rest point in a dry immersion bed. The device is used on a dry immersion bed filed in a pending application Ser. No. 381,021 by the same inventor.

Briefly, the above application relates to a therapeutic device which enables a human or animal subject to be buoyantly supported in a fluid at a selected temperature, and maintained in a dry environment by flexible, fluid impervious means interposed between the subject and the immersion fluid. Thus, to obtain immersion therapy in the dry immersion bed, the patient is floated in fluid such as water while kept dry by a water-tight sheet interposed between the fluid and the patient's body. In this situation, the pressure against the occupant's body surfaces is optimally distributed and therefore minimized over conventional pressure points. However, although the maximum pressure points are relieved, the average pressure exerted against the immersed body surfaces exceeds by a few inches of water pressure that pressure that would be acting if the subject were lying in air.

This disparity between the pressure of the room air, which is transmitted to the intrathoracic structures of the patient's body and the fluid pressure applied to the external body surfaces creates a condition of negative pressure breathing. This negative breathing pressure causes an increase in the energy required to expand the chest and abdominal area during the inhalation phase of the respiratory cycle. This negative pressure breathing also tends to promote an increased return flow of venous blood from extrathoracic regions of the body toward the lower pressure obtained in the chest cavity. The increased inhalation energy requirement may be contra-indicated in patients with paresis and/or paralysis of respiratory muscles. Mobilization of extravascular fluid and correlated diuresis associated with the augmented venous return may be contra-indicated in certain patients and desirable in others. The utilization of the unbalanced fluid pressure to decrease tissue edema may be desired in specific instances.

The requirements for control of this negative breathing pressure and the correlated physiological responses is evident. The following described device is intended to allow regulation or control of the external fluid counterpressure exerted against the lateral and anterior surfaces of the chest and abdomen of a subject immersed in the "Dry Immersion Bed."

Accordingly, it is an object of the present invention to provide a device which prevents pressure against the chest and abdominal area of a supine occupant in a dry imersion bed by a pair of negative breathing pressure means mounted at a fixed distance from occupant's head resting point.

Another object of the present invention is to provide a device providing free respiration and which assures a control for attending physicians to correct eventual incorrect self-changes of the body position of an occupant in the dry immersion bed for therapeutic treatment.

Other objects and features of this invention will become apparent from the following specification and appended drawings wherein:

FIGURE 1 is a perspective front side view of the negative pressure breathing control device.

FIGURE 2 is a perspective illustration of the rear-

side view of the negative pressure breathing control device.

FIGURE 3 is a section showing the adjustable head rest features.

FIGURE 4 is a schematic side view showing the fixed distance controlled by the negative pressure breathing control device.

FIGURE 5 is a cross section of the dry immersion bed in which the occupant, in supine position, is shown with and without the negative pressure control device and in particular shows the pressure of the fluid against the chest and abdomen area and the relief of the same pressure by the use of the present device.

Referring now to the drawings, wherein like reference characters designate corresponding parts throughout the several views, there is shown in FIGURE 1, perspectively illustrated, a negative pressure breathing control device **10**. A pair of guide channels **12** to be mounted alongside the bed structure serve as part of the support means. A support beam **14** provided with sliding, adjustable locking devices **16** on each side guided through guide channel **12** offers an adjustable feature to the device **10**.

The head rest **18** is adjustably mounted to the support beam **14**. A pair of clamps **20** are mounted at each side of head rest **18** and provided with a set screw **22**. The clamps **20** are intended to hold at a required location the negative pressure control rods **24** which are provided with a substantially horizontally positioned surface area **26** formed by a loop of rod **24** for applying pressure against a dry immersion bed upper surface.

In FIGURE 2 in perspective fashion, is shown the rear view mechanism for adjusting head rest **18**. A crank **28** for positioning head rest **18** at the desired angle is mounted for rotation on support beam **14**.

Optional adjusting means **32** are provided halfway the surface areas **26**.

In FIGURE 3 there is shown a section of the head rest **18** which is provided with a pair of hinges **34** and **36**. A nut **38** is mounted to hinge **36** and provides the adjusting feature in combination with crank **28**.

In FIGURE 4 there is illustrated an outline of a supine occupant **40** for resting its head on head rest **18** at point **42** while partly immersed in the dry immersion bed **44** and partly enveloped by a water-tight sheet **46**. The chest and abdominal area **48** is permitted to expand by pushing water-tight sheet **46** in the outline illustrated at the desired area **50**.

In FIGURE 5 there is shown the dry immersion bed **44** filled with a fluid **52** and covered by a water-tight sheet **46**. The negative pressure control device **10** is mounted at one side of the supine occupant **40** thus providing chest expansion and abdominal expansion as shown by the phantom line **54**. Without the negative pressure breathing control device **10** the supine occupant **40** is immersed at the desired area **50** providing an unwanted pressure **56** which successively increases as shown by the arrows and prevents breathing or expansion of the chest and abdomen **48** for a weak or diseased supine occupant **40**.

Having thus indicated different parts by reference characters, the operation of the negative pressure breathing control device **10** is as follows:

The negative pressure control device **10** is mounted on each side of a dry immersion bed by guide channel means **12**. The support beam **14** is located at a desired position and locked by the adjustable locking device **16**. The head rest **18** is tilted at a desired angle by turning of crank **28** and a soft material is positioned on its surface for receiving the head of a supine occupant **40**.

As stated, the device **10** is specifically designed to prevent the water-tight sheet **46** from contacting the lateral and anterior surfaces of the chest and abdomen of a

supine occupant **40** of the bed **44**. Thus, after the device **10** is attached to the bed and positioned in the proper relationship to the supine occupant **40**, the desired area **50** is determined and negative pressure is avoided by positioning rods **24** in clamps **20** so that contact of the watertight sheet **46** is removed from the chest and abdominal area of the supine occupant **40**.

Thus, to insure this proper positioning of this negative pressure control device **10**, a head rest **18** is made an integral part of this attachment such that when a supine subject **40** uses the head rest **18** the pressure control device **10** is automatically positioned alongside of the desired area of the body **40**. The pressure control rod **24** which prevents the watertight sheet **46** from pressing against the body of the immersed subject **40** does not interfere with lateral or anterior motions of the upper extremities. The device **10** is adjustable in depth to accommodate a variety of body types as regards anterior-posterior dimensions of the chest and abdomen. The negative pressure control rod **24** is removable from the integral pressure control and head rest mechanism. The dimensions of the negative pressure control rod can be varied by sliding expanding means **30** or other rods to account for widely different body sizes of bed occupants.

It will be clearly apparent to those skilled in the art that the specific form of the present invention shown and described herein is subject to various changes and modifications, and it should be understood that these various changes and modifications may be made without departing from the spirit of the invention as set forth in the appended claims.

What I claim is:

1. A negative pressure control device for a dry immersion bed comprising in combination:

(a) support means,

(b) negative pressure control means adjustably mounted on said support means, and

(c) head rest means adjustably mounted on said support means.

2. A negative pressure control device as claimed in claim **1** wherein means are provided for positioning said support means at various locations on said bed.

3. A negative pressure control device as claimed in claim **2** wherein said positioning means comprises a pair of channel members mounted at each side of said bed with sliding means mounted on said support means provided with adjustable set screws.

4. A negative pressure control device as claimed in claim **1** wherein said negative pressure control means comprises a pair of members, each of said members provided with a widened, elongated surface area to be pressed into said dry immersion bed upper surface at required locations.

5. A negative pressure control device as claimed in claim **4** wherein said members are rods having a substantial L-shaped configuration and wherein each said elongated surface areas form a substantial loop-shaped configuration at said "L" horizontal portion.

6. A negative pressure control device for preventing contact pressure against chest and abdomen to a supine occupant in a dry immersion bed, and comprising in combination:

(a) a support means mounted with adjustable positioning mechanism at each side of said bed,

(b) a head rest including movably mounted adjusting means, mounted on said support means,

(c) a pair of adjusting clamps mounted on said support means at each side of said head rest, and

(d) a negative pressure control means disposed on each said adjusting clamps, for providing certain pressure at required locations on said dry bed at a predetermined distance from said head rest.

7. The device as claimed in claim **6** wherein said negative pressure control means comprises a member having an upper portion held at a required location in said adjustable clamp, and a lower portion forming an oblong surface area at a substantial horizontal plane.

8. The device as claimed in claim **7** wherein said oblong surface area is provided with means to adjust its oblong periphery dimension.

9. A chest and abdomen contact preventing device for a dry immersion bed comprising in combination:

(a) a support means adjustably mounted on said dry bed,

(b) a head rest having adjustable fitting means mounted to said support means,

(c) a pair of negative pressure members adjustably mounted on said support means at each side of said head rest, and

(d) each of said negative pressure members provided with substantial horizontal surfaces for positioning alongside an associated supine bed occupant's chest and abdomen whereby bed surface contact against said chest and abdomen is prevented.

10. A device for permitting free expansion of abdominal and lung areas during respiration of a supine subject in a dry immersion bed having a support means provided with a first means for removing immersion effect of said bed in said abdominal and lung areas of said supine subject and, said support means provided with a second means defining a head rest point for said supine subject and said second means located at a positive distance from said areas so that proper positioning of said device is assured.

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L. W. TRAPP, *Primary Examiner.*