United States Patent [19]

Dee

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[54] **BED SUPPORT**

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[52] **U.S. Cl.** **5/348**, 5/347, 128/134

[51] **Int. Cl.** **A47c 27/08**

[58] **Field of Search**...5/347, 348, 349, 350; 297/57; 198/220; 302/29; 128/33, 134; 5/347, 348

[56] **References Cited**

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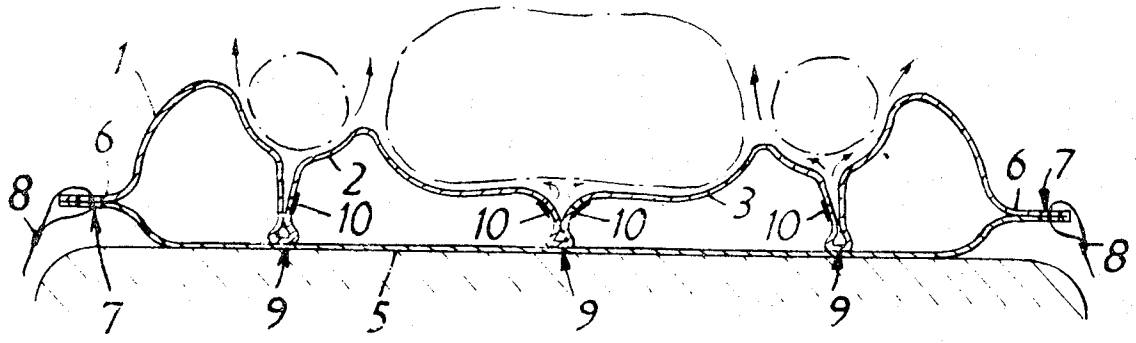
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Primary Examiner—Casmir A. Nunberg
Assistant Examiner—Andrew M. Calvert
Attorney—William Anthony Drucker

[57] **ABSTRACT**

Apparatus for supporting an item, and particularly all or part of the human body, includes a chamber having an upper wall at least part of which is of thin flexible sheet material, e.g. rubber film, adapted when supported by gas pressure in the chamber to define a trough in which the item may lie, means being provided for supplying at a position within the confines of the area of sheet material overlaid by the item an outward flow of gas selected to result in creation and maintenance of a substantially steady laminar flow of gas between the sheet material and the item, to exhaust subsequently to atmosphere.

8 Claims, 5 Drawing Figures



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SHEET 1 OF 3

FIG. 1.

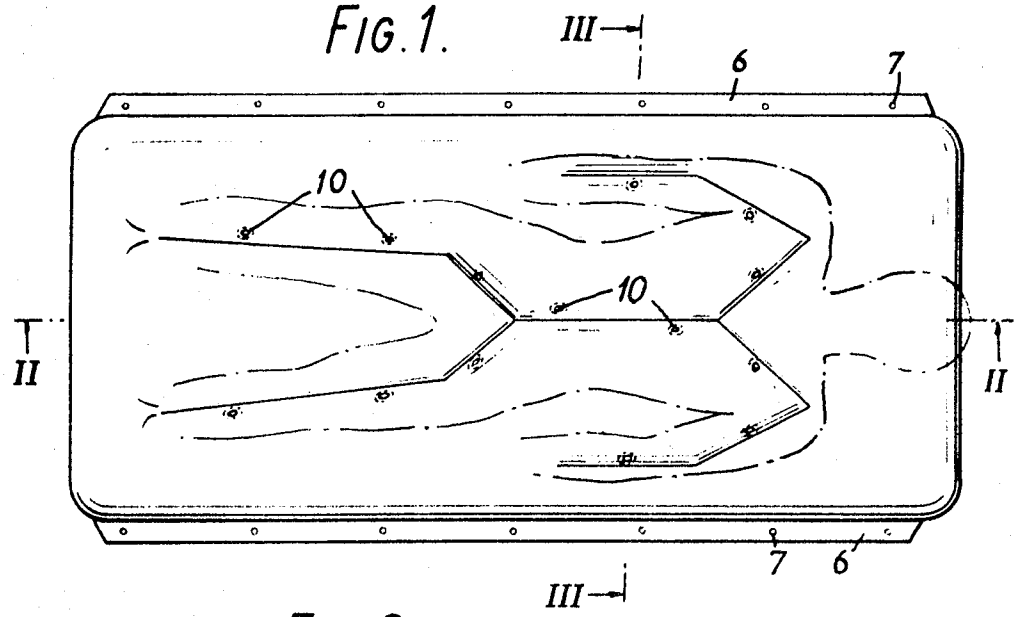


FIG. 2.

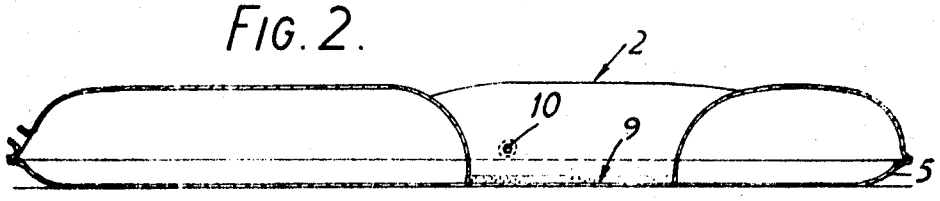
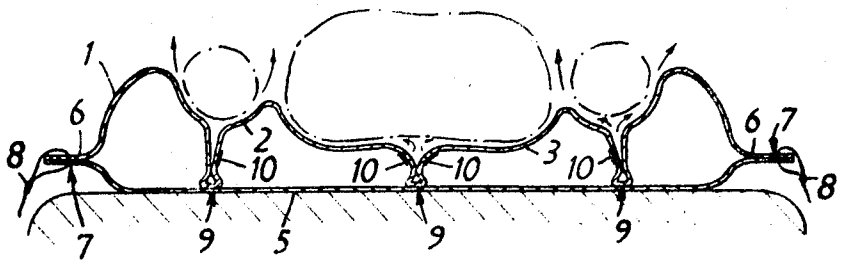


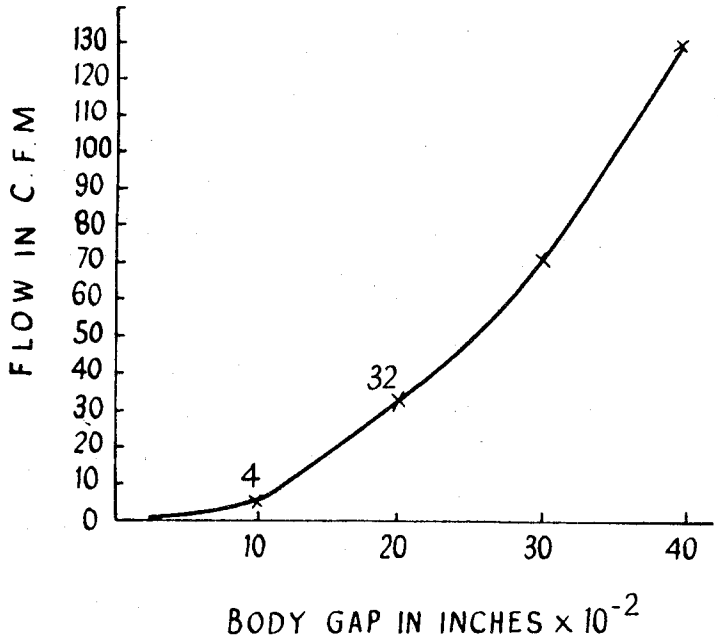
FIG. 3.



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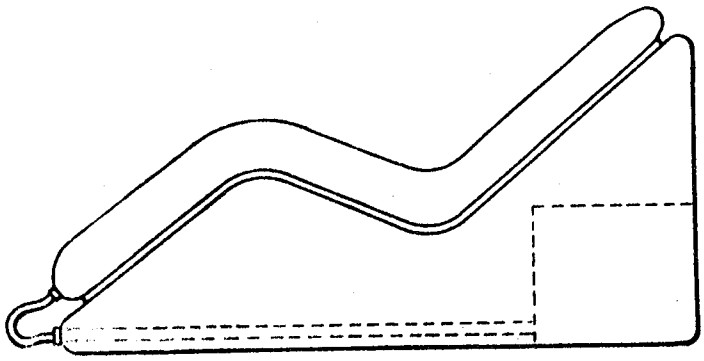
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FIG. 4.



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FIG. 5



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BED SUPPORT

The invention relates to a simplified method for supporting the irregular outline of a body such as a human body on a low pressure fluid film cushion, in an attitude such that a non-contacting support is provided.

It is already known to support a human body in a horizontal position on an air cushion in order to provide for support of a non-contacting nature where such support is desirable. However the present requirement necessitates the body to lie in a position where body extremities, i.e. legs and arms must lie both maintained together and adjacent to the trunk.

However there are areas of the body were fatty tissue is such as to set up a low frequency vibration of the surface flesh, resulting in rippling of the surface which may be detrimental to the condition of the skin in that area. Such areas are normally associated with the upper arm, the lower thighs, and the buttocks, and such rippling could give rise to considerable pain if allowed to develop.

A further problem encountered is that where normal bodily functions are performed, the support means has had to be interrupted to permit this, whereby the problems associated with the injuries, and necessitating the fluid film support, increase possible pain areas.

Again, in the known form it has been necessary to provide some fixed form of rigid construction to develop the support film, and this has necessitated a high-volume flow to support the body, resulting in the aforementioned surface rippling.

The first object of the present invention is to provide a pliable support surface for a human body, requiring a low-pressure supply but at reduced volume flow.

A further problem encountered is associated with the cleanliness of the air being supplied to the supporting means, in that it must be clean and uncontaminated, i.e. as sterile as possible.

It is accordingly a second object of the invention to provide means whereby metering of an air supply to the support area can also enhance filtration of the air supply.

Again, the equipment has of necessity been of an expensive nature, and therefore limited in its application to more critical cases rather than being available for more general use.

A further object is to provide a support means whereby normal bodily functions may be performed without disturbing the supporting means.

A further object is to ensure a smoother flow of fluid around the body form to attenuate the rippling or oscillating of those skin areas which may be susceptible thereto.

A further object is to provide a simple easily transportable flotation system which may be used under varying circumstances and conditions, e.g. on a standard bed, on the floor, on a stretcher in an ambulance, in an aircraft, on an operating table, etc.

A further object is to provide an inbuilt filter system to ensure the cleanliness of air escaping around the body, and at the same time to form the control orifice for the pressurized air.

A further object is to provide a cheap and economical support system to enable increased use to be made of the facility whereby the system could be employed in more general and everyday use.

According to the present invention, apparatus for supporting an item such as a portion of the human body

comprises chamber means having an upper wall at least part of which is of thin flexible sheet material adapted when supported by gas pressure in the chamber to define a trough within which the item may lie, and means for supplying at a position within the confines of the area of sheet material overlaid by the item an outward flow of gas selected to result in creation and maintenance of a substantially steady laminar flow of gas between the sheet material and the item, to exhaust to atmosphere.

The flexible material may also be resiliently extensible, thereby to assume according to the gas pressure in the chamber means such inflated dimensions as may be required to develop a trough capable of permitting the item to seat therein.

The chamber means may be wholly or partially of such flexible or resiliently extensible material. In a preferred construction, the chamber means is defined by a bounding wall which is mainly composed of resiliently extensible sheet material, the remainder being substantially non-extensible but resiliently flexible material such as a rubber, P.V.C. or like sheeting.

Preferably the means for supplying the outward flow of gas comprises filter means for the gas flow.

To permit the pressure gas supply for the outward laminar flow to be derived from the gas supply fed to the chamber means, the means for supplying said outward flow may comprise passage means providing a communication between the interior and the exterior of the chamber means.

For example a flow-metering means may be included in the wall of the chamber and an outlet opening within the requisite area of the sheet material, whereby an automatic compensation and balance is obtained between, on the one hand, the inflation of the chamber urging the sheet material towards the supported item, and on the other hand, the flow of gas between the sheet material and the item to create the laminar flow. This results in automatic adaptation of the sheet material, and the exhaust gap, to the contours of the supported item.

In a convenient arrangement, the outlet and the flow-metering means are combined in the form of portions of a porous material, such as porous P.T.F.E. or nylon, incorporated in the bounding wall of the chamber.

In a preferred arrangement, the chamber means for supporting an item comprises two chambers, the means for supplying the outward flow of gas then opening into a space defined between adjacent portions of the wall of the respective chambers.

The chamber means may advantageously be constituted by upper and lower sheets of compatible thermoplastics material heat-sealed together along contour lines, and a peripheral flange may be provided to receive means for securing the apparatus to a base. The two portions of the chamber are thus inherently ready to form themselves into a trough shape, with the metered openings disposed for example approximately centrally and longitudinally between them. Each of the chamber portions has porous outlets forming part of its bounding wall, and gas pressure supplied to the chamber is metered through the outlets and emerges at a central position below the item to be supported. The gas flow then distributes itself substantially equally at both sides towards a point of exhausting to atmosphere.

Such porous outlets may similarly serve as a filter for the gas under pressure, e.g. compressed air, which is allowed to escape about the supported item.

Two embodiments of support means for the human body, in accordance with the invention, are illustrated in the accompanying drawings, wherein:

FIG. 1 is a plan view of a bed support;

FIG. 2 is a central vertical longitudinal section taken on the line II—II of FIG. 1;

FIG. 3 is a vertical transverse section taken on the line III-III of FIG. 1;

FIG. 4 is a graph to show the relationship between compressed air flow in cubic-feet per minute, and the body gap in hundredths of an inch;

FIG. 5 is a side elevation of an embodiment of seat support.

CONSTRUCTION

For each portion of the body (see FIG. 3), there is provided chamber means constituted by pairs of chambers defined by respective neighboring upper wall portions 1, 2 (for the right arm), 2, 3 (for the truck) and 3, 4 for the left arm of the patient. These pairs of upper wall portions are heat-sealed to a base portion 5, and the seal between the outermost portions 1 and 4 and the base portion 5 is arranged to leave a peripheral flange 6 which is apertured at 7 and has eyelets to receive a cord 8 serving to tie the entire device down to a suitable structure such as a heavy base sheet or a mattress or a bed frame. The base portion 5 may advantageously be made of somewhat thicker material than the upper wall portions 1, 2, 3 and 4. The upper wall portions 1, 2, 3, and 4 may conveniently be constituted by a single sheet of material which is heat-sealed along contour lines 9 to the base portion 5, according to the outline of the body to be supported. Between each of the portions 1, 2, 3 and 4 and the base portion 5 there is defined a respective air chamber.

In the side wall area of each upper wall portions 1, 2, 3 and 4, adjacent to the side wall area of the neighboring portion or portions, there are inserted discs 10 of a porous material such as mesh formed of P.T.F.E., nylon, polyethylene or the like, and these discs form outlets which both control the flow of air outwardly from the chambers, and at the same timer filter the air which is emerging. Air is fed in under pressure at any convenient point of each chamber, e.g. through a flexible header tube or the like (not shown).

The upper portions 1, 2, 3 and 4 are in the form of a very thin membrane such as for example polyethylene film or fine rubber latex sheeting.

When air under pressure is supplied to the chambers, the respective upper wall portion is caused to balloon upwardly and air bleeds away through the outlet dics 10 to atmosphere. When a body is positioned on the membrane there may initially be contact between the body and the membrane, until such time as pressure develops between the body and the membrane downstream of the outlets 10, resulting in a line exhaust gap being formed about the outline of the body when flotation occurs.

If the human body is considered in a horizontal position, there is an average support area of about 400 square inches, varying according to body dimensions. For a small figure, the maximum weight may be of the order of 100 lbs., with a support area of 250 sq.ins. Alternatively, for a large figure, the weight may be of the order of 300 lbs., with a support area of in excess of 500 sq.ins. The support area is based on projected area, but it must be borne in mind that the membrane will contour to the curvature of the body, thereby enhancing or increasing the support area, hence the reference to the variable supply pressure of 0.5 to 2 p.s.i.

Assuming a peripheral outline of 20 ft. approximately, and a supply pressure of 2 p.s.i. with a pressure drop of 1 p.s.i. through the porous material resulting in a mean gap pressure between a body and membrane of 0.5 p.s.i. at a gap clearance of 0.020 ins., then the air flow per foot length of periphery would approximate to 1.6 c.f.m. or a total of 32 c.f.m. This would give a velocity in the gap clearance (body tomembrane) of 150 ft./sec.

A calculated relationship assuming constant supply pressure of 2 p.s.i. would be as shown in FIG. 4.

However in order to ensure a laminar flow condition between the body and the membrane, it is advisable to adjust the supply pressure, depending on the mass being supported, such that an average gap of 0.020 ins. results, because above this gap turbulent flow will result. This is advisable in view of those areas of the body which are susceptible to vibratory or rippling conditions.

SUPPLY

The air supply may take the form of a simple blower unit, e.g. comparable to a vacuum cleaner unit, having an inbuilt filtration system together with a simple sterilizing unit. To ensure warm air supply conditions, a heater unit of approximately a third of a kilowatt, dependent upon inherent motor heating characteristics and volume flow, is incorporated within the flow system, the whole being enclosed within a simple soundproofed cabinet and operating from the standard domestic power supply. The supply hose from the blower unit to the support system utilizes a simple flexible hose as used on domestic vacuum cleaners.

As indicated in FIG. 3 the depth of penetration of the supported body into the membrane will be a function of mass, supply pressure, and area, to maintain the recommended gap clearance.

Smaller sizes of support bed could be made for both children and babies where desirable.

The delta area located at the bed center is self-evident, in that an uninterrupted area is maintained.

There are many cases also where the support means may require to be in other forms than a simple horizontal position e.g. a reclining chair position, and the form of construction shown in FIG. 5 may be produced.

Other irregular outlines, embracing for example delicate glass configurations or instrument equipment may be supported in a similar way by a comparable method of support.

The principle involves a thin film support controlled by a series of orifices and involves principles of gas bearing technique as distinct from the hover principles encountered with other forms of support, such that an enclosed pressurized cushion meters the supporting fluid film through orifices.

The reduction of total volumetrics flow attenuates the most serious problem normally encountered with high volumetric flow rates, i.e. that of the rapid expansion and contraction of the compliant surfaces, which result in the ripple problems mentioned above.

The bed is such that it may be folded and sealed in sterile packs of a simple portable nature and disposable after use. It is also capable of use in an ambulance for use in cases of accident, since the necessary pressure and volumetric supply could be incorporated as an auxiliary unit on the ambulance, the support unit being incorporated in a stretcher frame.

It could also be utilized for emergency in a doctor's surgery, and also as a support where necessary in an operating theatre.

The apparatus is not limited to use with the human body and may be used to support any item requiring delicate handling, e.g. instruments.

I claim:

1. Apparatus for supporting an item such as a portion of the human body, comprising chamber means having an upper wall portion which is of thin flexible sheet material and which is adapted when supported by gas pressure in the chamber to define troughs within which the item may lie, and means for supplying gas through small openings, at a position within said troughs formed in said upper wall, to create between said upper wall and the item a substantially steady laminar flow of gas sufficient to maintain the item in a raised position out of contact with said wall.

2. Apparatus, as claimed in claim **10**, wherein said means for supplying the gas comprises means for filtering the gas flow.

3. Apparatus, as claimed in claim **1**, wherein the means for supplying the gas comprises flow-metering means.

4. Apparatus as claimed in claim **1**, wherein the openings comprise portions of porous material incorporated in said upper wall of the chamber.

5. Apparatus, as claimed in claim **1**, wherein said chamber means comprises two chambers, and wherein said means for supplying the gas opens into a space defined between adjacent portions of the wall of said two chambers.

6. Apparatus, as claimed in claim **1**, wherein said chamber means are constituted by upper and lower sheets of compatible thermoplastics material heat-sealed together along contour lines.

7. In combination, apparatus as claimed in claim **1**, and means for supplying air at greater than atmospheric pressure to said chamber means.

8. Apparatus, as claimed in claim **6**, comprising a peripheral flange adapted to receive means for securing the apparatus to a base.

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