

Nov. 28, 1967

J. T. SCALES ET AL

3,354,476

APPARATUS FOR SUPPORTING BODIES

Filed June 15, 1965

4 Sheets-Sheet 1

FIG. 1.

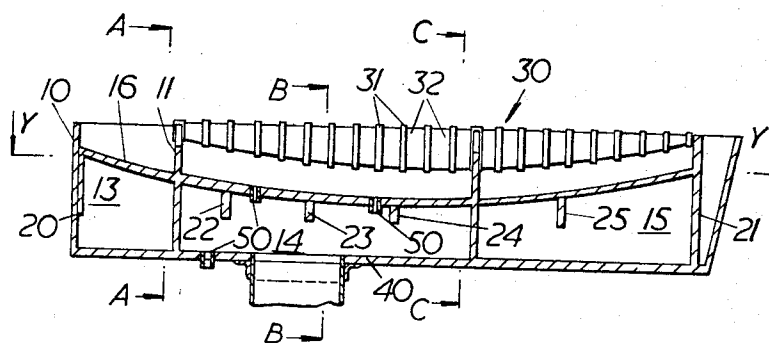
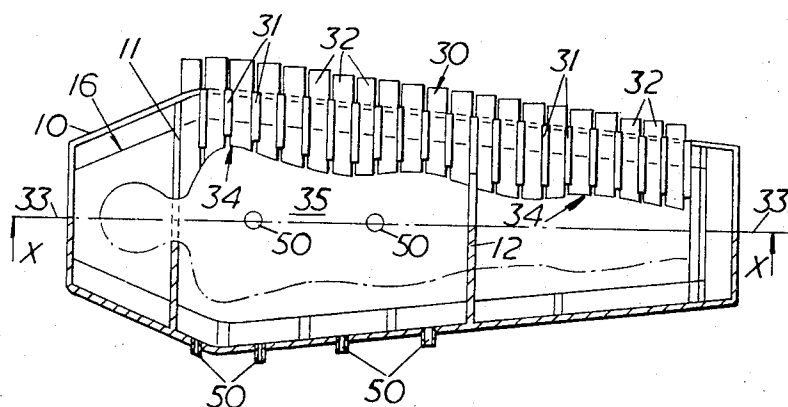


FIG.2.



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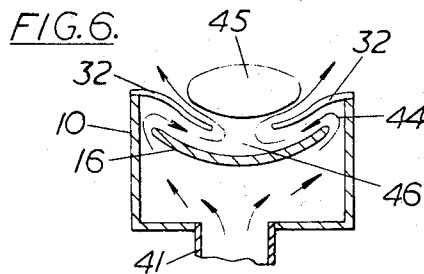
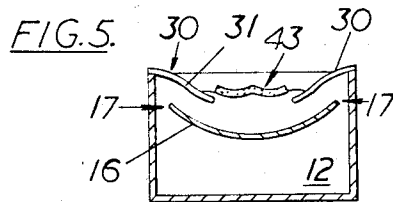
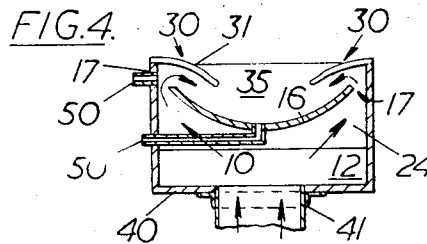
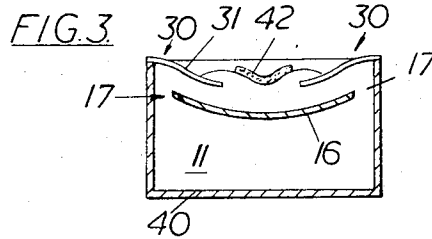
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APPARATUS FOR SUPPORTING BODIES

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4 Sheets-Sheet 2



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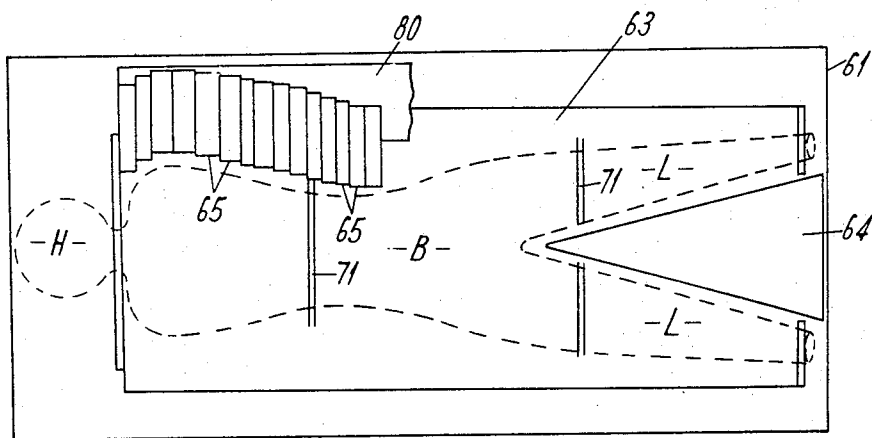
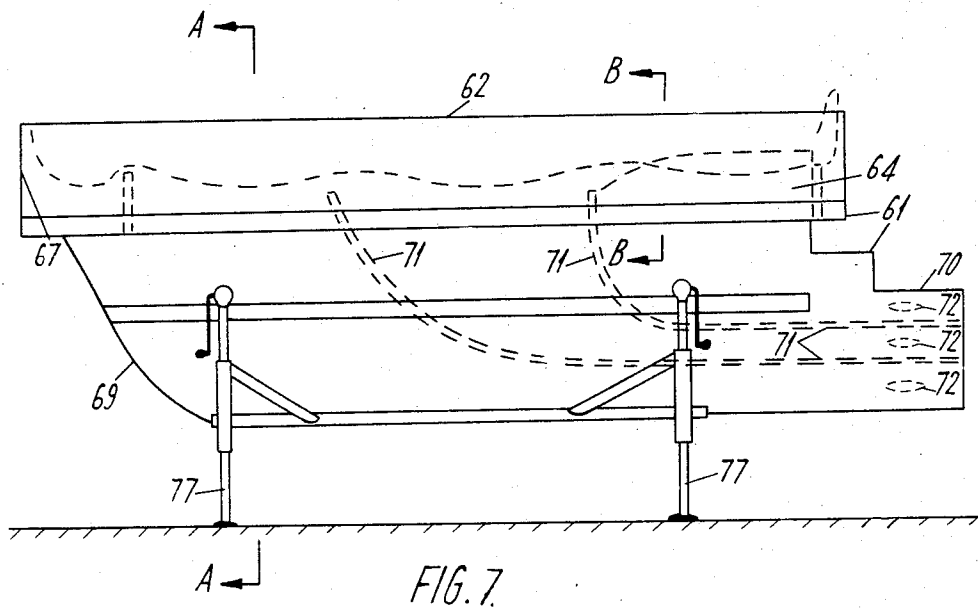
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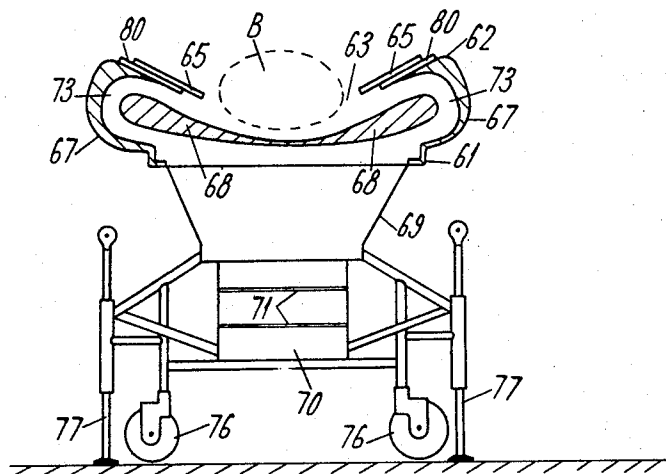


FIG. 9.

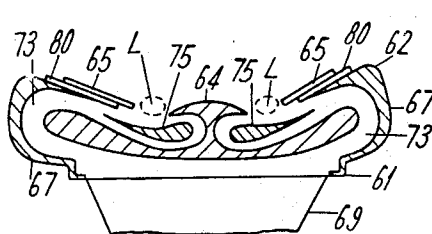


FIG. 10

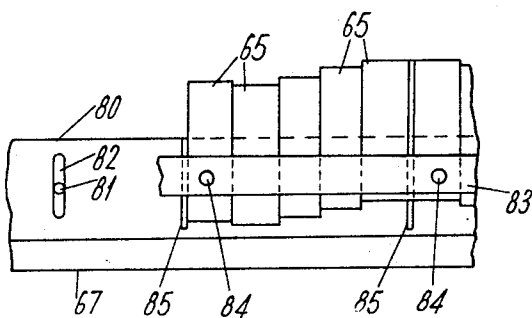


FIG. 11

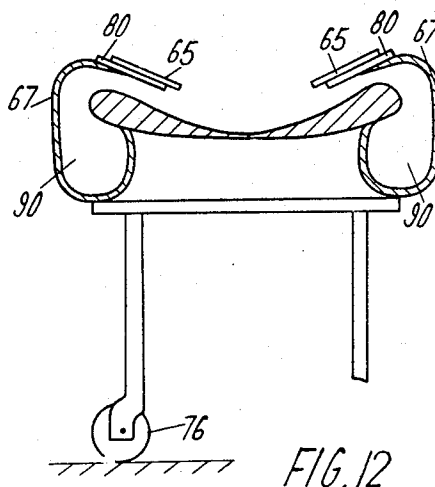


FIG. 12

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APPARATUS FOR SUPPORTING BODIES

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13 Claims. (5—348)

ABSTRACT OF THE DISCLOSURE

Apparatus for supporting a body, e.g. a human body, on a cushion of pressurized gas comprising a hollow housing having an aperture in its upper side, the aperture being variable in size and shape to accommodate bodies of various forms, and means for supplying pressurized gas to issue from the periphery of the aperture so as to form a gas cushion under the body and keep the body out of contact with the housing, and to form curtains of pressurized gas between the periphery of the aperture and the body to maintain the gas cushion.

This invention relates to apparatus for the support of a body, or part thereof, by one or more cushions of pressurized gas. Although not so restricted it will hereafter be described with reference to its use in supporting the human body.

According to the invention there is provided apparatus for supporting a body on a cushion of pressurized gas comprising a hollow housing defining at least part of the gas cushion space, an upper part of the housing defining an aperture for exposing at least part of the body to the said cushion space, members defining at least part of the periphery of the aperture, said members being movable so as to vary the shape and size of the aperture, and conduit means, connectable to a source of pressurized gas, for supplying pressurized gas to the housing to issue from at least part of the periphery of the aperture and form at least one curtain of pressurized gas between the periphery of the aperture and adjacent parts of the body, whereby at least one cushion of pressurized gas is formed and maintained beneath the body, and supports at least part thereof out of contact with the housing.

Preferably said upper part is concave-convex, said gas being directed generally radially inwardly along the convex surface and through said aperture to pass between the body to be supported and the periphery of the aperture.

The term "radially" where used throughout this specification is intended to mean "normal to the edge of said aperture." In the case of an elongate aperture, e.g. the aperture 35 or 63 illustrated in the accompanying drawings where the curvature of the sides of the aperture is not excessive, such direction is also normal to the longitudinal axis of the aperture.

Preferably a member having a substantially concave surface is disposed adjacent the convex surface of said upper side, defining therewith an arcuate channel through which gas may flow to said aperture, the member extending completely over and covering said aperture whereby the gas is urged through said aperture.

Preferably the housing is divided into a plurality of chambers each provided with a gas inlet, said aperture constituting the gas outlet therefrom.

The gas inlet to each chamber may be provided with a valve whereby selected chambers only may be used for providing respective sections only of said aperture with a supporting cushion of gas.

In a preferred embodiment, said upper part includes a

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plurality of slats individually mounted for radial movement, the innermost edges of said slats defining the periphery of said aperture. The slats may be mounted on a common support which is itself movably radially of said housing to move the slats simultaneously. Alternatively, the slats may be slidably mounted within radially disposed guides. Preferably the slats are flexible and the guides are curved to provide a substantially concavo-convex structure.

The preferred embodiment may preferably be adapted for use in supporting a human body, the portions of said upper part of the structure being relatively movable to provide an aperture of the general shape of the human form and variable to suit the particular human body to be supported. Part of the aperture may be divided into two portions to support individually the legs of a patient, each of said portions being provided with one of said members having a concave surface to define with the upper part of each portion, an arcuate channel through which the gas may flow. Supports may be provided upon which the patient's head and/or neck and/or ankles may rest.

The hollow housing is preferably mounted on a trolley for ease of movement.

The invention is illustrated, merely by way of example, in the accompanying drawings in which:

FIGURE 1 is an elevation of experimental apparatus in accordance with the present invention,

FIGURE 2 is a plan view of the apparatus shown in FIGURE 1, the lower half being a sectional view on line Y—Y of that figure,

FIGURES 3, 4 and 5 are part sectional end elevations of the apparatus of FIGURE 1 taken on lines A—A, B—B and C—C of that figure,

FIGURE 6 is a diagrammatic end elevation of the apparatus in use,

FIGURE 7 is a side view of an alternative form of apparatus according to the invention for supporting a human body,

FIGURE 8 is a plan view of the apparatus illustrated in FIGURE 7,

FIGURE 9 is a cross-section on the line A—A of FIGURE 7,

FIGURE 10 is a cross-section on the line B—B of FIGURE 7,

FIGURE 11 is a partial plan view of the apparatus of FIGURES 7 to 10 to a larger scale, and

FIGURE 12 is a cross-section, similar to that of FIGURE 9, illustrating an alternative embodiment of the invention.

Referring to FIGURES 1 to 6 of the drawings there is shown apparatus for supporting a body, e.g. the body of a human being, on a cushion of gas, e.g. air. The apparatus shown consists of a housing 10 divided by bulkheads 11 and 12 to provide three chambers 13, 14, 15. A main trough member 16 is supported from bulkheads 11 and 12 and is disposed within housing 10, being spaced from the side walls by air gaps 17. The member 16 is generally concavo-convex, having its concave surface uppermost. Additional end supports 20, 21 and intermediate supports 22, 23, 24 and 25 are provided to support the member 16 which is formed of ¼" thick polythene.

Forming the upper surface of housing 10 is a concavo-convex structure 30 comprising a plurality of spaced guide rails 31 in which are slidably mounted a plurality of flexible slats 32. Guide rails 31 are generally concavo-convex in shape—as clearly seen in FIGURES 3 to 5 and thus slats 32 assume this shape when forced through said guide rails. The guide rails are all disposed at 90° to the longitudinal axis 33 of the apparatus, and this is the direction referred to in this specification as "radial."

The innermost edges 34 of the slats 32 define the peripheral edge of an aperture 35 in the structure 30. By arranging the slats 32 within their guide rails 31, the aperture 35 is shaped to resemble the human form, as clearly seen in FIGURES 1 and 2.

The housing 10 is provided with a base 40 to which there is attached a duct 41 communicating with chamber 14. A source of compressed air (not shown) is connected to duct 41.

Bulkhead 11 is provided with a pad 42 (FIG. 3) disposed within a notch in its uppermost edge to provide support for the neck of the person to be supported. The head is supported by the section of member 16 disposed within chamber 13.

A support for the back of the knees, if the patient is lying on its back, or the front of the knees, if the patient is lying on its face, is provided by a pad 43 (FIG. 5) disposed within notches on the uppermost edge of bulkhead 12.

In operation, the patient lies with its head, neck and knees supported as described, and the slats 32 are then moved radially within guide rails 31 until they are all a predetermined distance from the patient's body, the peripheral gap between the edges 34 and the body then being substantially constant.

The source of compressed air is then switched on and this air flows into chamber 14, and through the bulkhead 12 (which is apertured) to chamber 15. The air flows through gaps 17 and then through the arcuate passages defined between the concave surface of member 16 and the convex surface of the structure 30. The radially inward flow of air, indicated by arrows 44 of FIGURE 6, flows out through aperture 35, flowing between the patient's body 45 and the slats 32. The space beneath the body 45, between the body and the member 16, becomes filled with compressed air, acting as an air cushion which acts upon body 45, urging it away from member 16 and thus lifting it clear of structure 30. Sufficient air at sufficient pressure is pumped through chambers 14, 15 and thus out through aperture 35 to maintain the body at the required distance from slats 32.

With apparatus along the lines of that illustrated, patients ranging from a six year old boy to an 18 stone adult have been successfully floated. It will be appreciated that, in each instance, the slats 32 must be adjusted to be disposed as close as possible to the body if the minimum power is to be used in lifting the body.

The apparatus shown in the figures is purely experimental. Thus no support is really required for the legs since sufficient lift can be obtained to support the whole body. Should it be required to support the head on air as well as the remainder of the body, air could also be supplied to chamber 13, and slats 32 could be extended around the head. The bulkhead 11 could thus be removed if the single duct 41 is used.

Instead of removing bulkheads 11, 12 and using a single inlet duct 41, the bulkheads could be retained, dividing the housing into three discrete compartments, and separate air ducts could communicate with these compartments in the manner described below with reference to FIGURES 7-12 of the drawings. Normally only certain parts of the body may require to be supported, and this may be effected by supplying air only to those chambers associated with the necessary parts of the body, the remainder of the body resting on slats 32.

To prevent excessive loss of air between adjacent slats when these are extended radially inwardly, the ends of the slats may be covered in a common sheet of material, thus covering the gaps. Alternative means for adjusting the size and shape of the aperture may be used, of course.

Referring now to FIGURES 7 to 12 of the drawings, the apparatus shown comprises an elongated hollow structure 61 having an upper side 62 in which an aperture 63 is formed. A movable central divider 64 is positioned at the end of the structure 61, at which are positioned the

legs L of a human body B to be supported by the apparatus. The periphery of the aperture 63 is defined along each side of the structure 61 by a series of rigid movable members in the form of aluminum sliding slats 65.

The slats 65 and means for moving the slats to vary the periphery of the aperture are described in more detail below in conjunction with FIGURE 11.

The structure 61 comprises an upper housing 67 provided with an internal member 68, having a concave upper surface, and a distribution unit 69. For convenience, the structure 61 can be made in separate parts attached together. For example the upper housing 67 can be made as a unit with the internal member 68, being then attached to the distribution unit 69. Alternatively, the whole structure can be made in one unit, such as by moulding.

The distribution unit 69 has an inlet 70 to which is fed pressurized air, or other gas. Dividers 71 extend from inlet 70 to member 68 and divide the length of the distribution unit into separate sections, the air flow being split up by the dividers. Valves 72 are provided to control air flow to each section. As will be seen in FIGURE 9, after the air has reached a particular section, it flows outwardly through a duct 73 formed between the wall of the upper housing 67 and the internal member 68. Duct 73 causes the air to be deflected around member 68, finally issuing radially inwardly in the form of a curtain of air which flows across the gap between the periphery of the aperture 63 and the body B. Thus a cushion of pressurized air is formed between the body B and the internal member 68.

At the leg-end of the structure 61 shown in cross section in FIGURE 10, the aperture 63 is divided into two portions, part of the air issuing from the duct 73 towards the outside of each leg L, whilst part of the air flow in the duct 73 is diverted by deflectors 75 towards the central divider 64 where the air is again deflected and directed outwardly to issue towards the inside of each leg L. Each leg L is thus supported independently.

The structure 61 is provided with wheels 76, for ease of movement, and with jacks 77 which can be used for levelling the structure or for tilting the structure if desired.

To obtain a variation in shape and size of the aperture, the sliding slats 65 may be moved radially relative to the upper housing 67. Referring to FIGURE 11, a large degree of variation is provided by mounting the slats 65 on a plate 80 which itself can slide in the same direction as the slats, i.e. radially or normal to the length of the structure 61. The plate 80 is fixed in position by screws 81 which co-operate with slots 82 formed in the plate 80. The slats 65 slide on top of the plate 80 and are held down by a pressure bar 83. The pressure bar is tightened down by knurled nuts 84 on bolts attached to the plate 80. A strip of rubber or similar flexible material can be positioned between the slats 65 and the pressure bar 83. At intervals, keys 85 are attached to the plate 80 to maintain the slats in the correct relationship.

In the illustrated embodiment, the head H of the body B is supported by a head-rest, with a seal round the neck. Alternatively, the head can be supported on an air or other gas cushion, in which case movable slats also extend round the end of the structure adjacent the area which supports the head. The feet of the body can extend outside the structure or be within the structure. In the illustrated embodiment the ankles are supported in suitably padded rests.

The provision of valves 72 enables only part of a body to be supported on a cushion of air or other gas. The rest of the body can be supported by padded supports. When a cushion of gas is to be formed in only one section, provision is made to supply air to a port extending transversely across the internal member 68, the air issuing upwards to form a curtain which seals the ends of the section to reduce the escape of air from the cushion. It may also be desirable to make provision for forming transverse curtains of air when cushions of air are formed

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in all sections, so as to be able to have the air cushions at different pressures.

Slats with square ends, as illustrated, give a stepped profile to the periphery of the aperture. This can be avoided if a length of flexible material is attached to the ends of the slats, the material overlapping the ends of the slats by an amount sufficient to prevent gaps being formed when the slats are moved in or out.

To enable observation to be maintained on the underneath part of the body, observation ports can be formed in the sides of the distribution unit 69. The centre portion of the internal member 68 is then made of transparent material. Mirrors are placed in the unit 69 so that observers looking through the observation ports can see through the transparent part of the internal member 68.

In an alternative arrangement, instead of the structure comprising an upper housing 67 on top of a distribution unit 69 through which the air is supplied, the structure can comprise only the upper housing 67, carried directly on a supporting structure of wheels and jacks, air or other gas being supplied through ducts on either side of the upper housing. Such an arrangement is illustrated, in cross-section, in FIGURE 12. Ducts 90 are formed along each side of the structure, air flowing from the ducts to form the curtains of air which flow across the gap between the periphery of the aperture and the body. Dividers can be positioned in the ducts 90 to divide the air flow, and valves may be positioned in each of the separate parts of the ducts to control the air flow.

All the pieces of apparatus described above are particularly suitable for supporting patients on their backs or faces. This can be most useful in treating badly burned patients where it is necessary to prevent the skin coming into contact with any bedding or support. By providing an air or other gas cushion to support the burned body, treatment may be accomplished more effectively. The arrangement may also be used to advantage in supporting patients suffering from certain orthopaedic disorders.

Depending on the use of the apparatus, so the gas used can differ. For orthopaedic use, normal air may be satisfactory, whilst for supporting patients suffering from burns, sterilised air is required. Other gases may also be used. Furthermore, provision can be made for injecting a liquid into the gas flow either continuously or otherwise.

The gas requirements are quite large and provision can be made, such as by covering at least part of the structure with a sheet of flexible material, such as polythene, to form an enclosure over the top of the structure and the body. The gas can then be led away to escape at some locality where no inconvenience will be caused. Further, there is likely to be some useful heat content in the gas and means can be provided for recovering some of this heat. In many cases it will not be acceptable, for clinical reasons, for the gas to be re-used, but in some cases it may be permissible for the enclosure to be connected to the gas pressurizing means.

As a further development, the whole structure can be covered with a "tent," in a similar manner to the forming of an "oxygen tent" over a bed, and the air or other gas fed to the structure can have oxygen added, the patient breathing the fortified air.

Where, for clinical or other reasons, it is desirable to prevent the body touching the structure at any time, such as when treating burns, the air flow can first be turned on, the body then slowly lowered into the aperture. The air flow will build up the cushion, or cushions, of a pressurized air as the body is lowered. The body will thus not touch the structure at any time.

It will be appreciated that the invention is not restricted to supporting human bodies on air. Thus any body may be so supported provided the structure is suitably constructed to provide an aperture of the correct shape and size to suit the body in question. Thus a sphere or similar curved object could be supported on a circular apparatus,

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the structure being annular and the slats employed being truly radially disposed. The aperture could then be circular, for example, and a single chamber supplied by a single centrally disposed air duct in the base may be used to provide an adequate supply of supporting air.

We claim:

1. Apparatus for supporting a body on a cushion of pressurized gas comprising a hollow structure defining at least part of the gas cushion space, a plurality of slats individually mounted for radial movement on the upper side of the structure, the innermost edges of said slats defining an aperture for exposing at least part of the body to the said cushion space, the shape and size of the aperture being variable by movement of said slats, and means for supplying gas to the structure to issue from at least part of the periphery of the aperture and form at least one curtain of moving gas between the periphery of the aperture and the body, whereby at least one cushion of pressurized gas is formed and maintained beneath the body, and within the structure, to support at least part thereof out of contact with the structure.

2. Apparatus as claimed in claim 1 including a common support on which said slats are mounted, the common support being itself movable radially of said structure to move the slats simultaneously.

3. Apparatus as claimed in claim 1 including radially disposed guides within which said slats are slidably mounted.

4. Apparatus as claimed in claim 3 wherein the slats are flexible and said guides are curved to provide a substantially concavo-convex structure.

5. Apparatus for supporting a human body on a cushion of pressurized gas comprising a hollow structure defining at least part of the gas cushion space, an upper side of the structure defining an aperture of the general form of the human body for exposing at least part of the human body to said cushion space, members defining at least part of the periphery of the aperture, said members being movable whereby the shape and size of the aperture can be varied to accommodate human bodies of various forms, and means for supplying gas to the structure to issue from at least part of the periphery of the aperture and form at least one curtain of moving gas between the periphery of the aperture and the body, whereby at least one cushion of pressurized gas is formed and maintained beneath the human body, and within the structure, to support at least part thereof out of contact with the structure.

6. Apparatus as claimed in claim 5 wherein part of said aperture is divided into two portions to support individually the legs of a patient, one of said members having a concave surface being provided for each of said portions to define with the upper side of each portion an arcuate channel through which the gas may flow.

7. Apparatus as claimed in claim 5 wherein supports are provided upon which may rest those parts of the patient's body which need not be supported on gas cushions.

8. Apparatus for supporting a body on a cushion of pressurized gas comprising a hollow housing defining at least part of the gas cushion space, an upper part of the housing defining an aperture for exposing at least part of the body to the said cushion space, members defining at least part of the periphery of the aperture, said members being movable in directions substantially normal to the periphery of said aperture so as to vary the shape and size of the aperture, inlet means, connectable to a source of pressurized gas, for admitting a flow of pressurized gas to the housing, and means for directing at least part of said flow to pass substantially in the direction of movement of said members so as to form at least one curtain of pressurized gas between the periphery of the aperture and adjacent parts of the body, whereby at least one cushion of pressurized gas is formed and main-

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tained beneath the body, and supports at least part thereof out of contact with the housing.

9. Apparatus for supporting a body on a cushion of pressurized gas comprising a hollow housing defining at least part of the gas cushion space, an upper concave-convex part of the housing defining an aperture for exposing at least part of the body to the said cushion space, members defining at least part of the periphery of the aperture, said members being movable so as to vary the shape and size of the aperture, and conduit means, connectable to a source of pressurized gas, for supplying pressurized gas to the housing and directing it generally radially inwardly along the convex surface of said upper part and through said aperture to pass between adjacent parts of the body to be supported and the concave surface of said upper part so as to form and maintain at least one cushion of pressurized gas beneath the body, and support at least part thereof out of contact with the housing.

10. Apparatus for supporting a body on a cushion of pressurized gas, comprising a hollow housing defining at least part of the gas cushion space, an upper concave-convex part of the housing defining an aperture for exposing at least part of the body to the said cushion space, members defining at least part of the periphery of the aperture, said members being movable so as to vary the shape and size of the aperture, a member having a substantially concave surface disposed adjacent the convex surface of said upper part and defining therewith an arcuate channel, and means for supplying gas to the structure and directing it generally radially inwardly through said arcuate channel and said aperture to pass between adjacent parts of the body to be supported and the concave surface so as to form and maintain at least one cushion of pressurized gas beneath the body, and support at least part thereof out of contact with the housing.

11. Apparatus for supporting a body on a cushion of pressurized gas comprising a hollow housing defining at least part of the gas cushion space, an upper concave-convex part of the housing defining an aperture for exposing at least part of the body to the said cushion space, members defining at least part of the periphery of the aperture, said members being movable so as to vary the shape and size of the aperture, dividing walls dividing

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said hollow housing into a plurality of chambers, a gas inlet for each of said chambers, and means for supplying gas to at least a selected one of the chambers of the housing to issue from at least part of the periphery of the aperture and form at least one curtain of pressurized gas between the periphery of the aperture and adjacent parts of the body so as to form and maintain at least one cushion of pressurized gas beneath the body and support at least part thereof out of contact with the housing.

12. Apparatus as claimed in claim 11 including a valve in the gas inlet to each chamber to enable selected chambers only to be used for providing respective sections only of said aperture with a supporting cushion of pressurized gas.

13. Apparatus for supporting a body on a cushion of pressurized gas comprising a hollow housing defining at least part of the gas cushion space, an upper concave-convex part of the housing defining an aperture for exposing at least part of the body to the said cushion space, members defining at least part of the periphery of the aperture, said members being movable in directions substantially normal to the periphery of said aperture so as to vary the shape and size of the aperture, dividing walls dividing said hollow housing into a plurality of chambers, a gas inlet for each of said chambers, and means for supplying gas to at least a selected one of the chambers of the housing to issue from at least part of the periphery of the aperture and form at least one curtain of pressurized gas between the periphery of the aperture and adjacent parts of the body so as to form and maintain at least one cushion of pressurized gas beneath the body and support at least part thereof out of contact with the housing.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,354,476

November 28, 1967

John Tracey Scales et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

In the heading to the printed specification, line 8, for "June 27, 1964" read -- June 22, 1964 --; column 5, line 15, for "intenal" read -- internal --.

Signed and sealed this 19th day of November 1968.

(SEAL)

Attest:

Edward M. Fletcher, Jr.

Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents