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(58) Field of search
A4L
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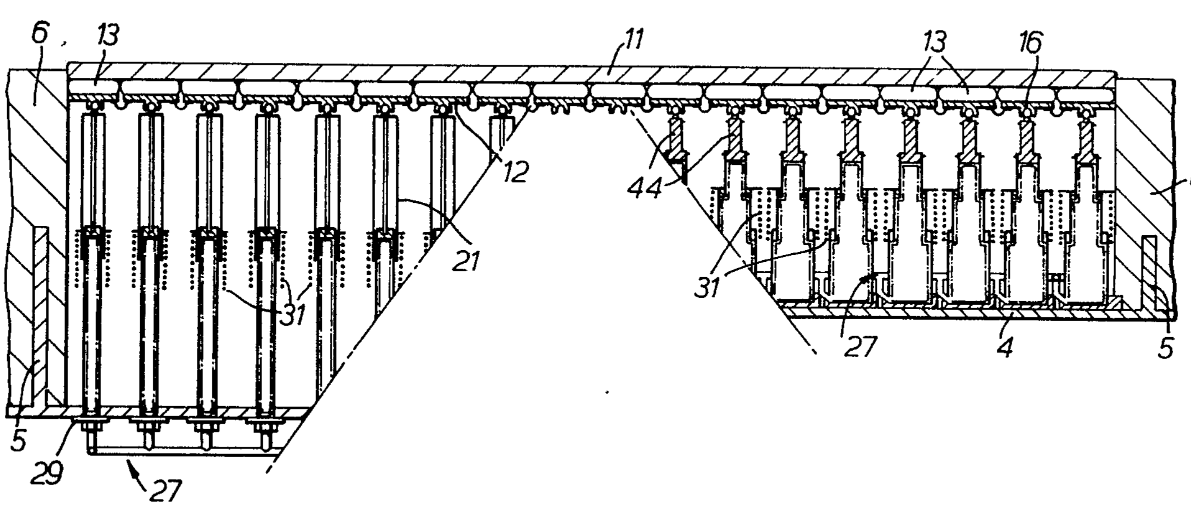
(54) **Body support device**

(57) A body support device, for example a bed, is formed from a plurality of swivel elements able to pivot in any direction by a limited amount and a grid system of interconnected fluidic cell units. Each cell unit comprises a connecting rod connected by a swivel joint to the swivel element, a piston which may be incorporated in the connecting rod or may be a separate element, and a fluid chamber fluidically connected to the grid. Application of body pressure to the device causes some swivel elements to depress which directly or indirectly activates the piston to expel fluid from the chamber into the grid, the fluid pressure in the grid being used to support the body when a position of equilibrium has been reached. "Bottoming out" resistors are provided to cater for excessive weights to prevent the pistons reaching the bottom of the fluid reservoir, and various means of absorbing shocks caused by sudden application of pressure on the device are disclosed.

Fig. 1.



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The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

Fig. 1.

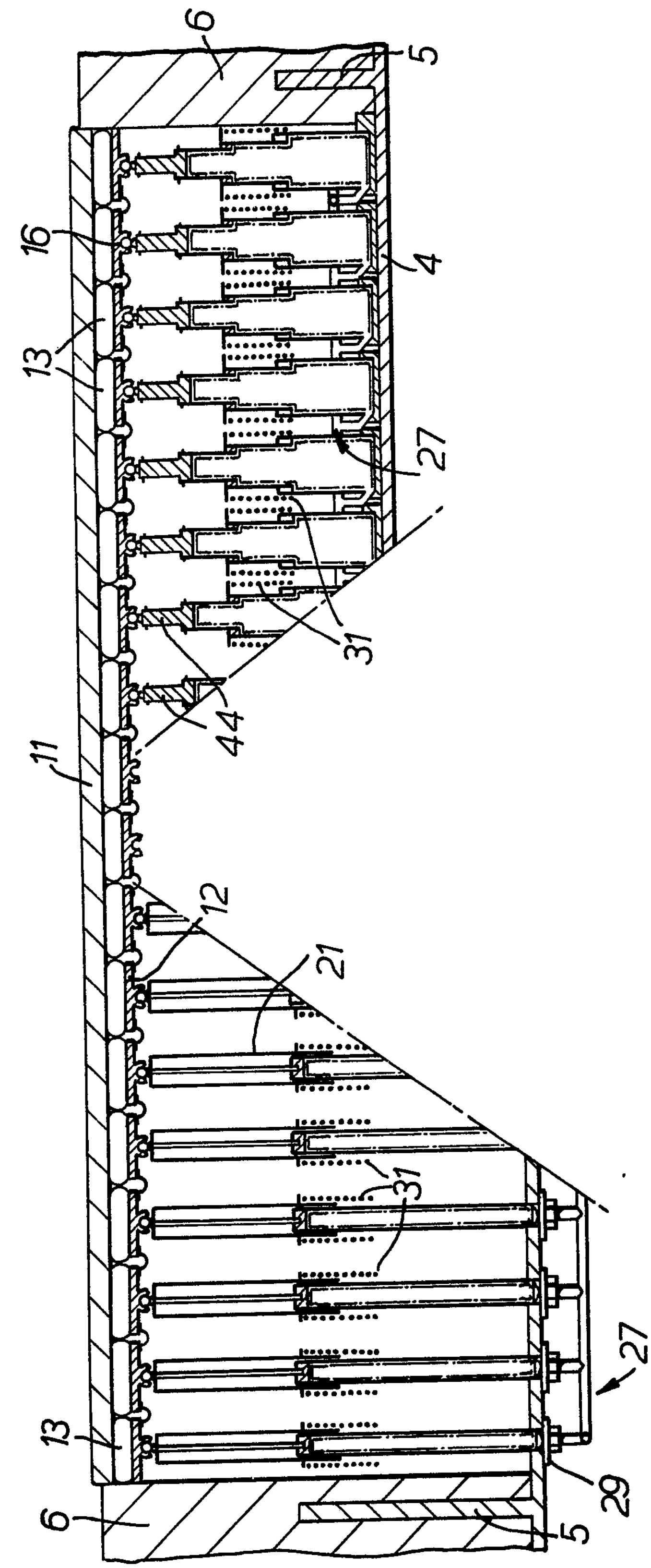

Fig. 2.

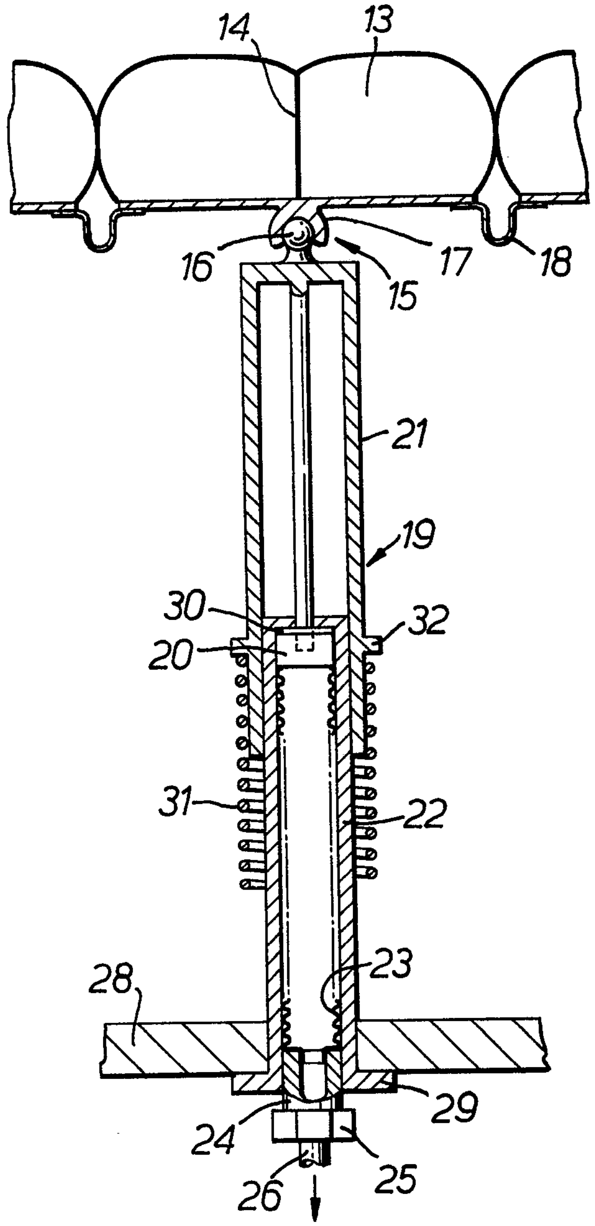
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Fig. 3.

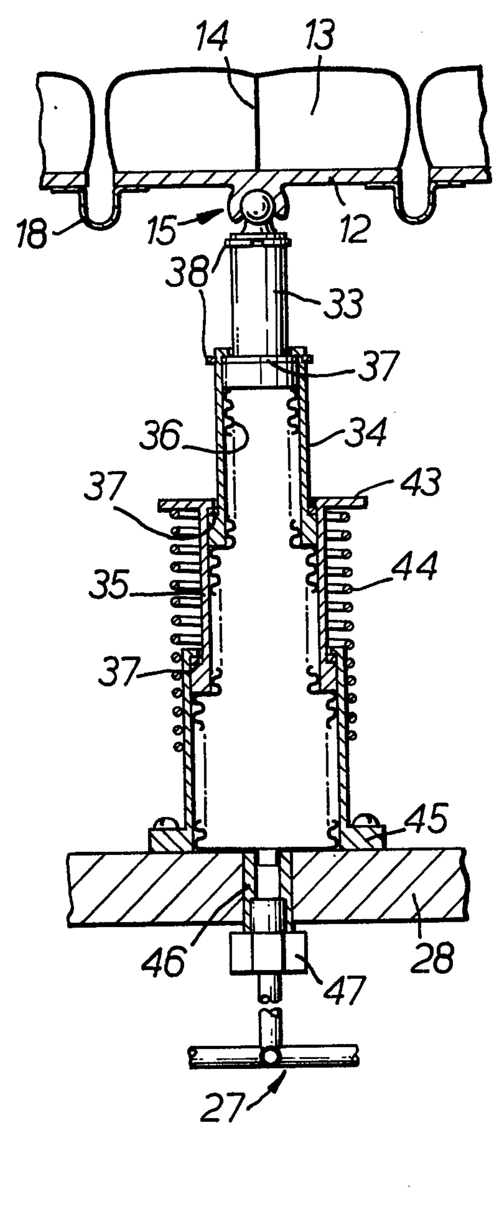
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Fig. 4.

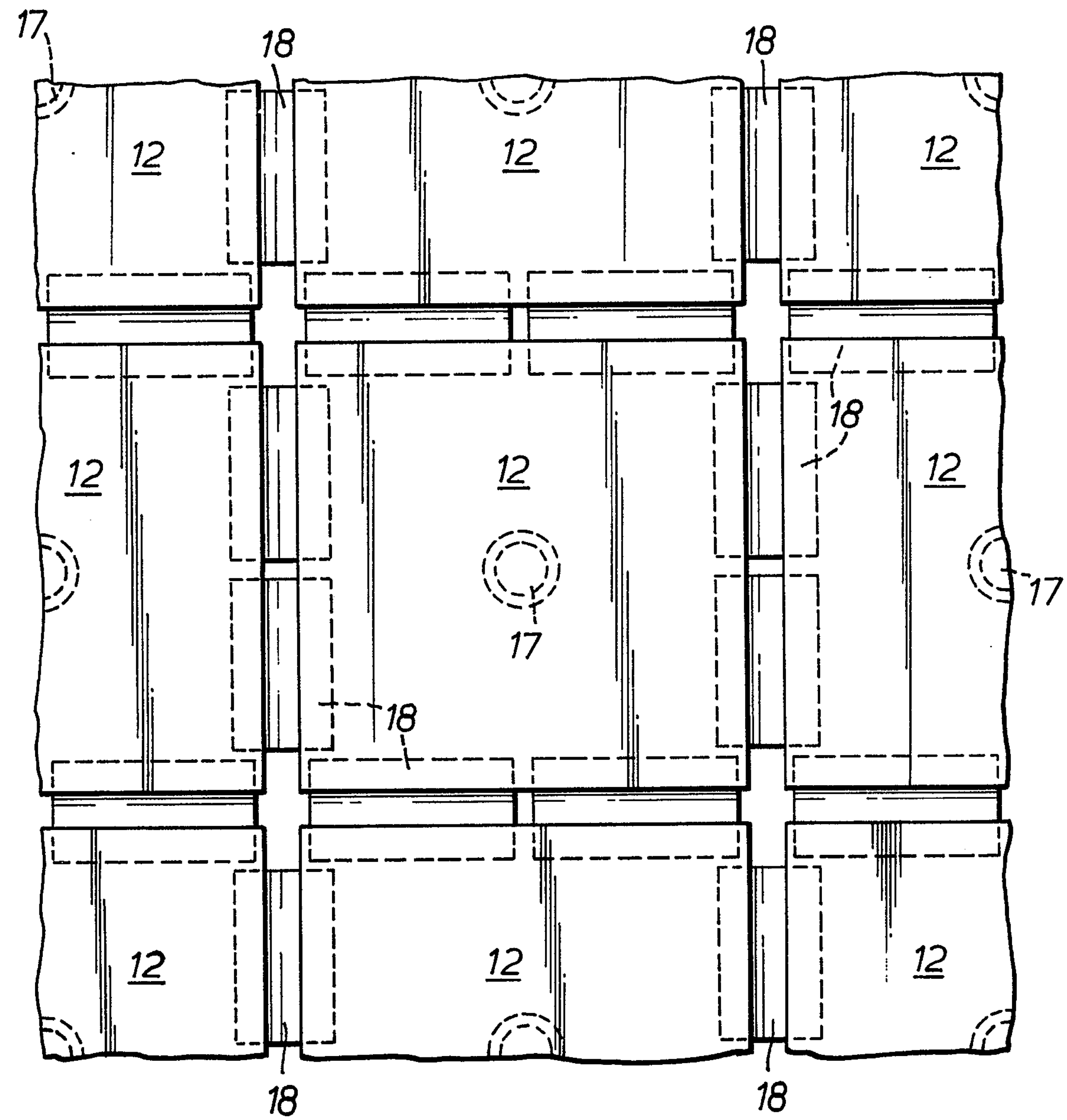


Fig.5.

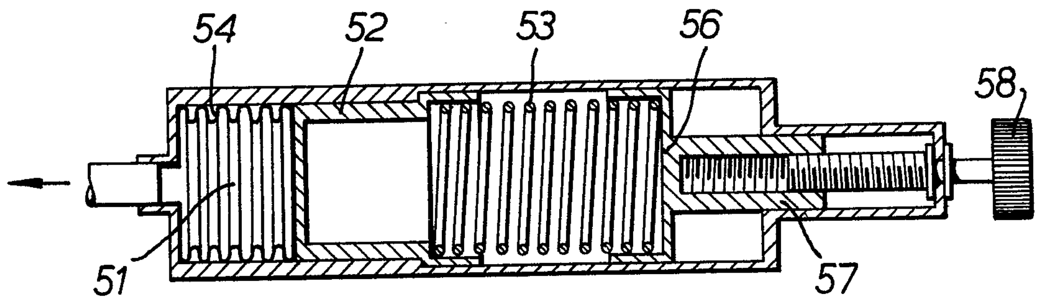


Fig.6.

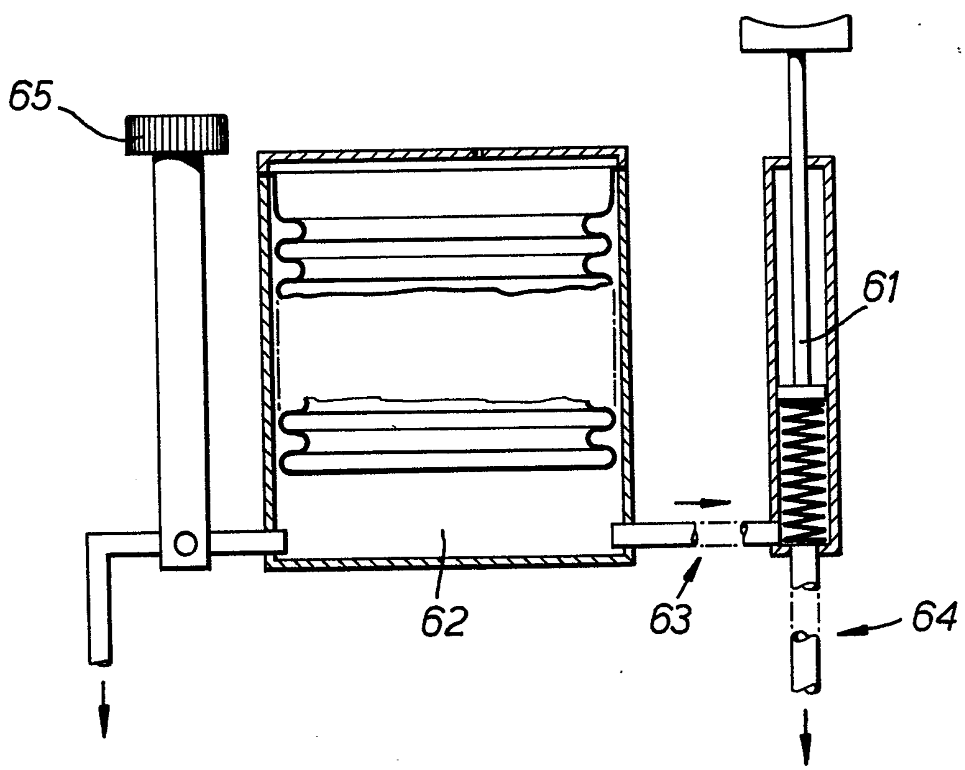


Fig. 7.

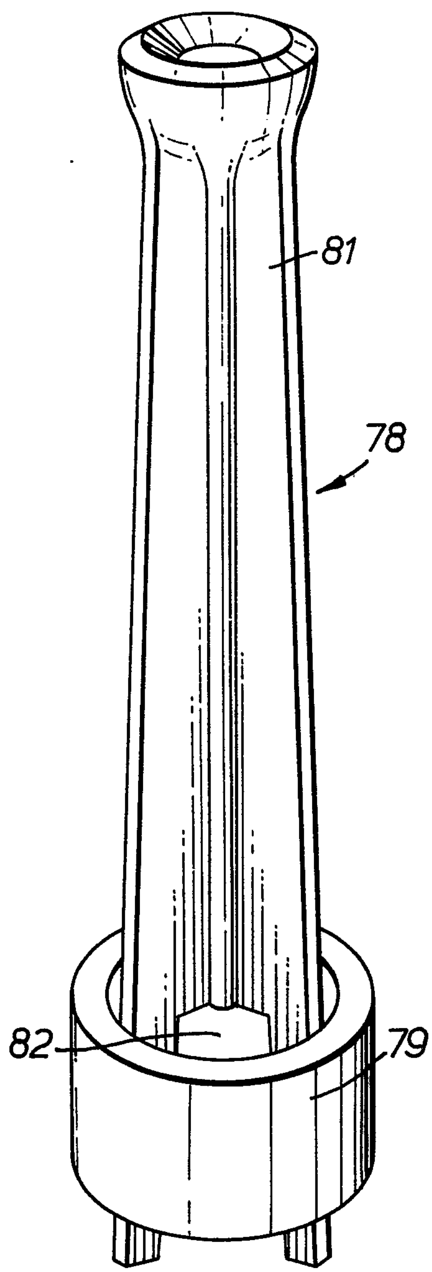


Fig. 8.

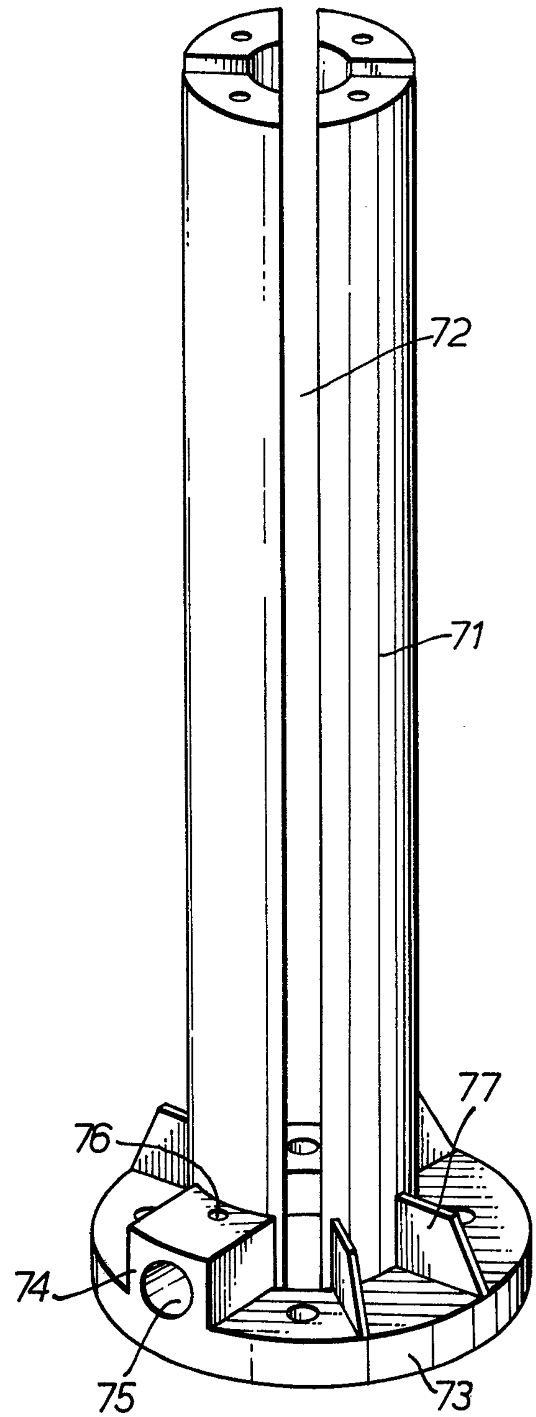


Fig.9.

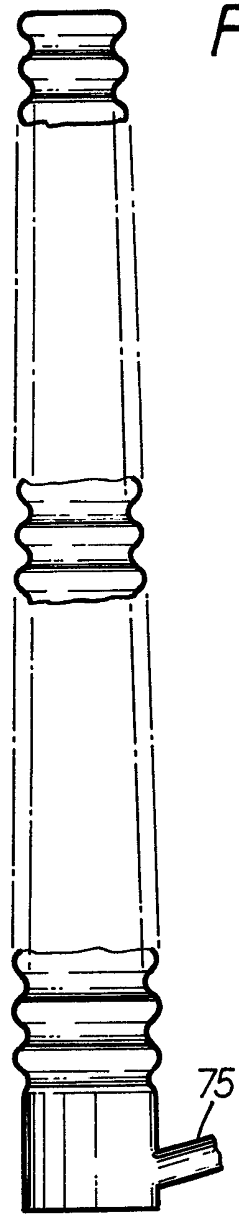
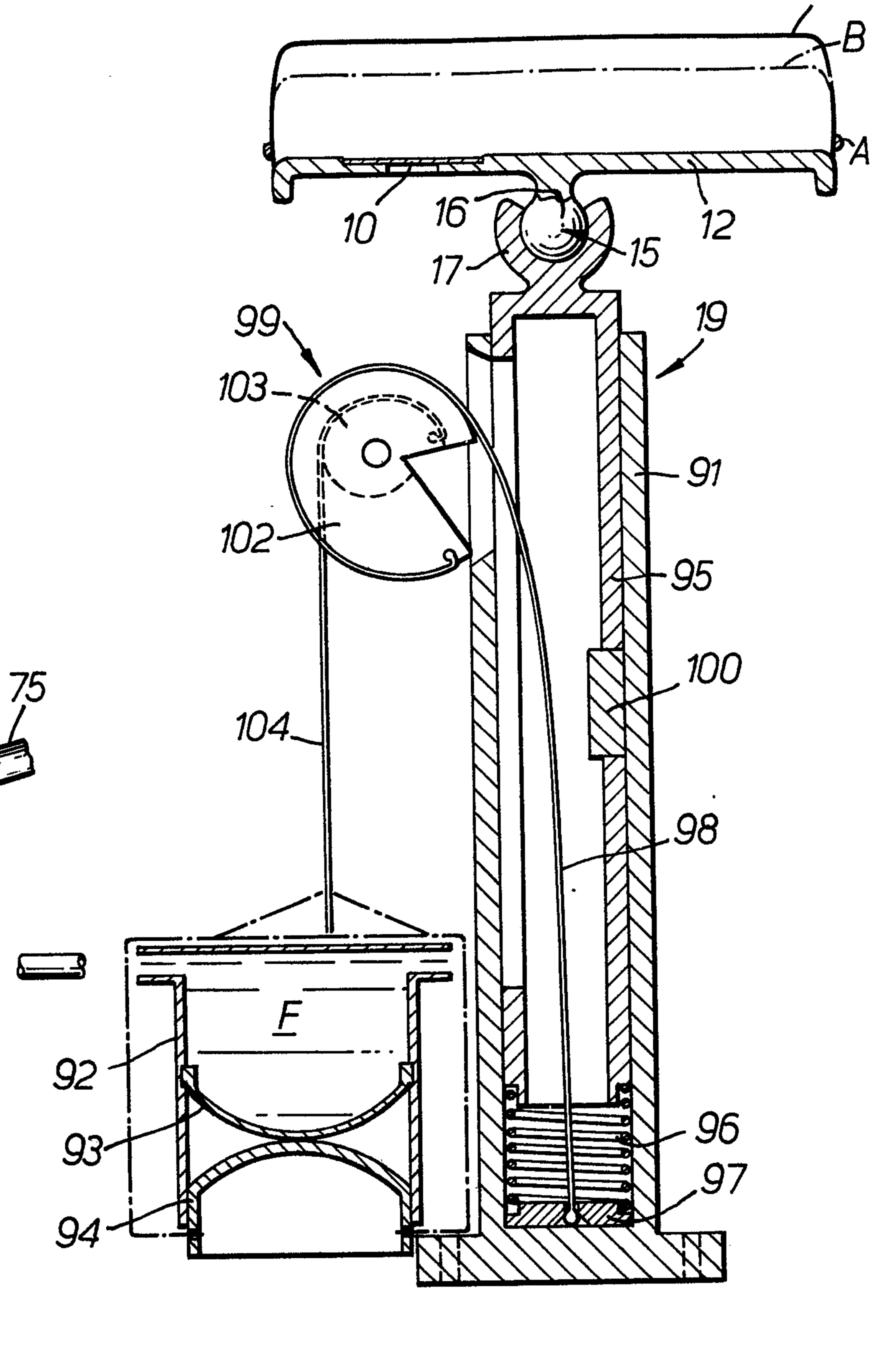


Fig.10.



SPECIFICATION

Body support device

The present invention relates to the support of a body and particularly to a body support device for supporting a body in a sitting or lying position, such as a bed, chair or seat.

We all spend a large part of our lives sitting or lying on man made support systems, at home, in offices, factory shop floors, during transportation, in hospitals, court rooms and on the beach. As far as is known all existing means of support designed for sitting or lying bodies have their drawbacks.

Elements relying primarily on springs or foam products can only exert an evenly distributed pressure against an object if that object itself exerts an evenly distributed pressure. Human bodies cannot do that as they are inherently uneven.

There are several reasons why it is desirable for such elements to provide an "even or mirrored" pressure type of support. Apart from the obvious comfort factor such a support does not restrict blood flow to the same extent, hence helping to avoid body tissue starved of oxygen — with subsequent cramp and stiffness or cold spots; it helps to preserve correct skeletal structure and, in the case of bed mattresses, from the physical standpoint ensures a refreshing night's sleep. The prevention of pressure points, often found with uneven support, is particularly useful in certain medical conditions such as late stages of pregnancy, burns, and bed ridden patients as it helps to guard against bed sores; also of course it would help back sufferers.

It is the object of the present invention to provide a support which applies a substantially mirrored pressure to all the parts of the body supported on a single support system, or interconnected support systems; and also to conform to the body shape without creating pressure points as a result.

Most conventional mattress or cushion covers are either elastic or do not totally conform to the body shape. This creates pressure points due to a "hammock" effect. Spring and foam support elements do not distribute pressure evenly within themselves; they rarely support the whole body and usually fail to provide an exact pressure match to the pressure of the body in contact with them. Water mattresses and certain air cushions do distribute pressure evenly within themselves, as they contain a single space or a series of interconnected spaces, and contain either liquid or a gas medium; all of which demonstrate mass flow properties. However their boundary in contact with the body, while being of necessity essentially inelastic, normally produces a "hammock" effect. Likewise the covers of spring or foam, mattresses are either elastic or else tend to demonstrate "hammock" effect.

It is the object of the present invention to achieve a surface, be it part of a bed mattress, lounge chair, sofa aeroplane or train seat or whatever, that gives true flotation support such that the surface exerts a substantially mirrored pressure against all that part of the body in contact with it without "hammock" effect and subsequent pressure points.

According to the present invention there is provided a body support device comprising a grid system of interconnected fluidic cell units, each unit comprising a piston, and a fluid reservoir fluidically connected to the grid, the units each carrying a swivel element attached for pivotal movement in any direction with respect thereto, the arrangement being such that on application of a body pressure to the device some swivel elements are depressed causing the piston to be actuated to expel fluid from the fluid reservoir in the cell unit to the grid, and each swivel element is able to take up its own optimum angle to support the body substantially without constraint from adjacent swivel elements. The force applied by the piston to the fluid in the fluid reservoir will compress the fluid and at a point of equilibrium the compressed fluid will exert an outward force on the piston which is transferred to an upward force at the swivel element and it is this upward force that supports the body weight.

In a preferred arrangement the swivel element is connected by a swivel joint to a connecting rod, which rod is slideable in a chamber. The connecting rod may also act as the said piston, which the chamber as the fluid reservoir. Alternatively the force applied to the connecting rod may be indirectly transmitted to a separate said piston operating in a separate fluid chamber. One way of transmitting this force is by a double pulley arrangement, the two pulley wheels having respective cords wrapped on them in opposite directions, one being connected to the connecting rod and the other to the piston.

It is preferred to incorporate a resistor on each cell unit to provide a resistance against the piston reaching the bottom of the fluid chamber. To cater for sudden movement, due for example to jumping, the device may include a shock absorber in the grid system which will take up excess fluid expelled from the cell units and return it to the system when required.

Preferably the swivel elements support cushioning means which may be in the form of sacs, for example one sac per element. These sacs may be filled with cushioning material such as fluid, air or small beads or foam rubber.

The layer which is adjacent the body, which may be an additional sheet or cover laid over the elements or sacs, should advantageously be able to stretch in area without elasticity so that pressure points are not created due to "hammock" effect.

The invention will now be described, by way of example with reference to the accompanying drawings, in which:—

Figure 1 is a vertical section longitudinally through a body support device showing two different embodiments of the invention, one to the left and one to the right of the central cut-away area,

Figure 2 is a partial section of a hydraulic cell, swivel element and sac being part of the embodiment shown on the left hand side of Figure 1,

Figure 3 is a partial section similar to Figure 2 but illustrating the multi-cell of the right hand side of Figure 1,

Figure 4 is a top view of a portion of the support device of Figure 1 illustrating the swivel plate ties,

Figure 5 is a cross-section of a shock absorber which is connected into the grid system of Figure 1,

Figure 6 is a schematic diagram illustrating an optional firmness control device which may be incorporated into the grid system of Figure 1,

Figure 7 is a perspectuve view of a tapered cell unit piston,

Figure 8 is a perspective view of the fluid chamber of a tapered cell unit,

Figure 9 is a longitudinal section of a tapered bellows seal and

Figure 10 is a schematic cross-section of a swivel plate and cushion attached to an indirect cell unit for use in a device according to the present invention.

The designs embodied in the accompanying illustrations are generalised forms of a concept that utilises some of the physical properties of fluids-mass flow-incompressibility — but in a markedly different way form the conventional water mattress.

It is envisaged that all cellular units described hereafter can be either liquid filled and function hydraulically, or gas filled and function pneumatically. There would be little structural or material difference between the two media. However the adjustment control would differ because of the different compressibility of the media. Additionally in the case of the pneumatic version, provision would have to be made to store a volume of compressed gas to supply the grid system and a means of inflating the system would be required. Indeed, the ability to alter the total volume of the interconnecting grid by opening up and shutting off gas storage units would be one form of adjustment control to control firmness.

Figure 1 illustrates simultaneously two embodiments which share some characteristics. The following description will treat the illustrations as representing a bed, although the structure applies equally to other support devices, such as cushioins, chairs, seats. A bed embodying the invention will comprise a base 4 to which are connected side supports 5. The side supports 5 are encased in a cushioning material 6 which extends above the level of the side supports 5, the solid supports preferably not extending above the depressed state of the bed for maximum comfort. The sprung part of the bed comprises a cover 11, which either due to its natural composition or its structure is able to stretch significantly while being inelastic. It is thought at the present time that a knitted fabric will be able to provide these properties.

Under the cover 11 are a large number of individual swivel elements 12. These may each be in the form of a square plate of between 2 and 6 inches in side length. Each element supports a partially filled and sealed sac 13 attached thereto. The attachment is preferably releasable, for example a "velcro" fastening. The sacs 13 may be air/gas filled, in which case a central sac tie 14 may be required to prevent a bulge.

Alternatively the sacs may be filled with liquid or contain small hollow beads in a fluid matrix. Obviously a combination of fillings may be used if this is found to be advantageous. The purpose of the sacs is to conform to the exact shape of the body.

In a preferred embodiment the sac itself is made from an essentially airtight flexible material; with the option of including ribs or swellings at specific places to limit material expansion. For example a rib A may be incorporated around the sac just above the place where it is attached to the swivel plate. With the exception of the ribs the sac material will be of substantially uniform thickness. It should be slightly elastic to allow for some expansion when a sudden load is applied to the sac, but resilient enough to minimise stretching under normal load.

The swivel plates 12 may each be constructed of one or more parts and are substantially rigid. Each swivel plate has a one way valve 10 which allows air into the sac but not out.

The space within the sac is partially filled with a low density foamed material B. When a body rests on the sac the material of the sac conforms to the shape of the body and cushions it, spreading the pressure evenly over the whole part of the body in contact with the sac. The air contained within the sac also acts as a shock absorber against sudden movements.

The foamed material insert is of low density and open texture. It is not required to provide support for the body, which is provided by the air. However if, over the course of time the sac has deflated because of escaped air, when the body leaves the sac the elasticity of the foamed material and the density is such that it returns the sac to its original shape thus drawing air into the sac through the one way valve.

The swivel element or plate 12 on which the sac is supported is mounted at its centre point on a swivel joint 15 comprising in this case a ball 16 and socket 17. This joint enables the element 12 to tilt about its centre point in any direction to a maximum pre-defined angle, which helps the sac to conform to the body shape. As the partially filled sac is "moulded" against the body, the sides of the sac, as illustrated, in effect become the extra area of boundary material that is needed in order to avoid "hammock" effect, as the total area of the top and sides of the sac is considerably greater than the surface area of the top of the sac alone. The sac may be made from a quilted material.

The swivel plates 12 are each joined to adjacent swivel plates by swivel plate ties 18. These are provided in order to provide sufficient independent movement of the swivel plates without actual gaps existing between the plates 12. The ties 18 may be of plastics material. A typical layout design for the ties 18 is shown in Figure 4. In a case of extreme depression of an individual swivel plate 12, the ties will pull adjacent plates 12 to a partially depressed state thereby preventing excessive billowing around the body.

Each swivel plate 12 is attached via its swivel joint 15 to a respective hydraulic cell unit 19. Each cell unit 19 comprises a piston 20 integral with a piston guide 21 and a fluid chamber 22 inside which the piston is slideably mounted. The piston guide 21 slides outside the chamber 22. A seal 23, for example a bellows seal of niltrile rubber, is contained in the chamber 22 to prevent fluid leakage. The fluid chamber 22 is connected via a connecting sleeve 24 and a union nut and olive 25 to a hydraulic small bore pipe 26 which forms part of a small bore fluid grid 27 by means of which grid all the fluid chambers in any one system are inter-connected so that equal fluid pressure is applied to every cell and piston in the system. The qualities that are desired of the hydraulic fluid is that it should have no smell, be non-toxic, non-corrosive and non-hygroscopic. It may be that a silicone based fluid will provide these properties. Any complete mattress or chair etc. may comprise just one such system of interconnecting cells, or two or more separate systems.

All the fluid chambers are mounted on a common base unit 4 by means of a respective flange 29 which may be above or below the base, and the interconnecting grid 27 of hydraulic pipes in this case is mounted below the base unit.

There is a damping washer 30 situated on top of the piston 20 of each cell to absorb shock and prevent noise on the rebound stroke. The cell also incorporates a bottoming out spring 31 which only becomes effective during the last stages of depression, preventing the piston from bottoming out. This spring 31 is a compression spring which is held against a flange 32 on the piston guide 21 and on complete depression of the piston compresses against the base unit 4. During normal use of the support device the spring will not be required; but it prevents damage to the cell and discomfort to the user during moments of shock, e.g., sitting down hard, jumping up and down, etc.

Figure 3 is an example of a more sophisticated hydraulic cell which would replace at least some of the cells 19. This is a multi-stage cell, the fluid chamber of which, in this case is composed of more than one sliding element. In Figure 3 there are three sliding elements, a piston 33 and two fluid chamber/pistons 34,35. The fluid chamber is again suitably sealed to prevent leakage by a bellows seal 36. Each sliding element has its own damping washer 37 and a bottoming out spring is incorporated. The multi-stage cell comprises four elements. The piston 33 carries the ball of the universal joint. A circlip 38 at the upper end of the element forms an abutment which limits the movement of the piston 33 by abutting the top of the second element 34. Once this position has been realised, the first and second sliding elements 33, 34 act as the piston depressing telescopically into the third element 35. The second element 34 also carries a circlip 38 around the top thereof to form an abutment limiting the movement of the second element 34 into the third element 35. The third element has a spring collar flange 43 at its upper end under which a compression spring 44 acts as a bottoming out resistor to prevent the combined first, second and third element piston bottoming out. The fourth element 37 acts as a fluid reservoir and is attached to the base plate 4 by means of screws which pass through a flange 45 on the fourth element into the base plate 4. On depression of the piston fluid leaves the cell through a pipe 46 which passes through the base plate and is connected to the small bore grid system by means of a union nut and olive 47.

This multi-stage design has two distinct advantages over the single stage cell. Firstly the multi-stage cell can accommodate the same amount of depression while having an overall shorter length than the single stage; secondly in the case of the multi-stage, with the depressing of each successive element the amount of fluid displacement increases. This progressive action means that while a small amount of depression is easily accommodated, increasing depression is increasingly resisted. By using the multi-stage cell in this hydraulic system, the cells can be designed with their sliding elements increasing in diameter in a suitable ratio so that a person lying on their side will only sink into the mattress slightly further than when lying on their back. The bulk of the support device is reduced still further by locating the grid above the base plate 4 as is illustrated in the right hand part of Figure 1. This could equally be done with the single stage system.

The hydraulic cell concept is similar to a water mattress in at least one way; namely both devices support weights by virtue of the incompressibility of the fluid. Air spring and foam units are all compressed by weight — the more weight the more compression. Of course this compression does act as a shock absorber which an incompressible fluid cannot do. The hydraulic cell system would be hard to sit on, like a water bed, if it were not for the incorporation of a shock absorber (see Figure 5). This works by allowing hydraulic fluid to be temporarily displaced from the grid into a chamber 51 due to the movement of a piston cup 52 which in turn compresses a spring 53 which absorbs the shock. This unit can, though it need not, include an adjuster to vary the spring rating. The shock absorber illustrated comprises the fluid chamber 51 which is fluidically connected at one end to the grid 27 and contains a fluid seal in the form of a nitrile bellows seal 54. The piston cup 52 encloses one end of the compression spring 53, the other end of the spring engaging a spring cup 56 within the chamber body 51. Connected to the rear end of the spring cup 56 is an internally threaded cylinder 57. An adjustment screw 58, the head of which is retained at a fixed location outside the body of the chamber 51 extends into the chamber and engages the inside of the cylinder 57. By rotating the screw the length of piston movement can be adjusted so adjusting the amount of shock absorption.

Another adjustment mechanism that may be provided is one that affects the firmness of the device. This firmness is controlled by adjusting the amount of hydraulic fluid in the system — the more there is, the firmer the support. Figure 6 represents diagrammatically one of many possible designs for this unit. There is a simple plunger type pump 61 which draws fluid from a reservoir 62 via a one-way valve 63 and forces it into the grid system 27, again via a one-way valve, 64. Fluid can be allowed back into the reservoir 62 to soften the support by opening a return valve 65 through which the grid is connected to the reservoir 62. The weight of the pistons, swivel plates, sacs, cover, bedding etc. will force the fluid back to the reservoir. Thus the adjustments for the general firmness of the bed and the firmness of the springing to absorb shock are independent of one another so that any combination can be selected. A double bed mattress could have two sets of control units; whereas a chair could have two or more separate systems each with their own adjusters.

Figures 7 and 8 illustrate the elements of a tapered side single cell unit which can be used in place of the parallel sided single cell unit or multi-stage cell unit already described.

The tapered side single cell unit comprises a chamber 71 comprising a cylindrical body with four vertical slots 72 arranged around the body at 90° spacing to receive respective ones of four fins 81 on the piston (Figure 7). At the bottom end of the chamber 71 the body is supported in a flange 73 by means of which it is attached to the base of the support device. An inlet and outlet conduit 74 is fitted to the flange 73 and contains a bore 75 angled at 12° to the horizontal by means of which air is passed between the chamber and the fluid grid, and a bleed hole 76 through which a hydraulic unit is filled during manufacture. A shock absorber spring (not shown) surrounds the chamber body 71 and abuts a set of fins 77 mounted on the flange. At its upper end the spring is located beneath a guide collar 79 on the piston and only becomes effective as the piston nears full compression.

The piston 78 comprises four elongate guide fins 81 arranged as spokes at 90° from one another around a vertical boss. The fins 81 are attached to a guide collar 79 which is located below the fins 81 and which collar 79 slides down the outside of the chamber 71 with the fins 81 located in the slots 72 of the chamber. A bellows seal (Figure 9) is located in the chamber 71 under the piston 78 and incorporates a taper over at least part of its length. The fluid that is to be compressed on action of the piston is contained within the bellows seal and compression of the seal pushes the fluid out of the chamber into the grid. The advantage of using a tapered bellows seal is that the resistance against depression of the piston is increased as the piston moves further into the chamber, i.e. as the bellows contracts. In order to avoid a sideways expansion of the seal, which could produce an undesirable frictional drag, the seal may comprise a retaining ring set into the root of each convolution of the seal. Alternatively the seal could be moulded with a continuous helical root and a continuous winding of a strong inelastic reinforcer applied to the helical root.

At the upepr end the piston is formed with means to form a swivel joint with the swivel plate. In this case the piston 78 carries a socket 80 to take a ball joint. At the base of the piston there is a recess 82 within the guide collar 79 which is designed to contain the bellows seal as it compresses during the downward travel of the piston. The recess 82 is tapered with the widest part at the mouth of the rcess. As the top of the seal has the smallest cross-sectional area it will naturally compress first — and so on down the seal. Thus it will be possible to gather the seal in the recess 82 as it compresses.

The unit illustrated in Figure 10 is a further cell unit which can replace any of the cell units already described. The other features of the support device are unchanged. While being more complex to manufacture and assemble this unit can be designed to give an optimum support. Indeed it has the advantage that by altering the designed shape of one component it is possible to provide a support surface to predetermined support characteristics.

The cell unit of Figure 10 comprises a first chamber body 91 which contains no fluid chamber, and a second chamber body 92 which is located close to the first chamber body. The second chamber body 92 contains a fluid F in the upper part, bounded on the lower side by a convex inelastic but flexible diaphragm 93. The shape of the diaphragm when there is no pressure on the support device is exactly matched in mirror image by the shape of a piston 94 which is moveable vertically within the chamber 92.

The swivel plate 12 is supported by a tubular moulded connecting rod 95 which slides within the first chamber body 91. Towards the bottom of the connecting rod 95 there is a spring or rubber bush 96 which acts as a shock absorber and "bottoming out" cushion. Attached to this spring or bush there is a collar 97 with a small central hole. A strong and flexible cord 98 is attached to the collar 97 through the hole, which cord 98 is threaded up through the centre of the connecting rod 95 and emerges through a longitudinal slot in the side of the rod 95. The cord 98 then passes onto a variable stage pulley 99 which rotates freely on a shaft 101 loacated in an extension of the chamber body 91. The cord 98 may incorporate an elastic section to absorb shock and provide a degree of springiness in the support surface. The connecting rod 95 may be split into two pieces transversely, joined together by a resilient bush 100. This bush would not only act as a spring and shock absorber, but when put under sudden load would deform outwardly by momentarily compressing, thus gripping the inner surface of the chamber body 91 and acting as a brake to sudden movement of the rod 95. Once the shock had passed the bush would resume its normal shape allowing the rod to travel freely within the chamber body.

The pulley 99 is a double pulley, with one diameter greater than the other. The cord from the bottom of the connecting rod 95 passes round the larger diameter pulley 102 and is secured to it. This means that a downward movement of the connecting rod 95 rotates the whole pulley 99. Attached to the smaller diameter pulley 103 is another length 104 of cord which is wrapped the opposite way round to the first cord 98. As the connecting rod 95 is depressed into the chamber body 91 unwrapping the first cord 98 from the larger diameter pulley, this in turn winds the second cord 104 up onto the smaller diameter pulley 103. The other end of the second 104 is attached via a suitable fastening to the piston 94 so that winding of the cord 104 onto the pulley 103 will raise the piston 94 in the chamber

92 so compressing the fluid F in the chamber 92 and pushing it out of the chamber into the fluid grid. Because the fluid is pressurised it exerts a counter force on the piston which in turn maintains a tension on the cord 104. This tension is transferred by the pulley to the other cord which exerts an upward pressure on the base of the connecting rod — thus providing the body support. Once again all the fluid chambers are interconnected. The nett result is similar to the single hydraulic cell, but here rather than the mechanical force of the body resting directly on the hydraulic system, it is applied indirectly through the chord and pulley system.

There are several advantages to merit the extra complexity. Firstly the overall depth of the complete support system can be minimised. Secondly by selecting the shape and size of the two pulleys a form of gearing can be introduced. This allows for much smaller piston movements. Thirdly both parts of the pulley can be designed with variable diameters — for example like a snail cam. Thus the leverage and amount of tension that the two chords have on the pulley at any one time can be altered as the pulley rotates. By careful design of the diameters a varying degree of upward pressure can be applied to the bottom of the connecting rod, dependent upon the amount of depression of the rod, to enable almost any desired support characteristic to be built into the system.

The fluid chamber 92, which may be a separate unit or integrally moulded with the main chamber body, can take a variety of formats. One embodiment consists of a parallel sided narrow bodied chamber with a conventional piston using either a bellows seal or an externally or internally active standard hydraulic piston seal. Another embodiment is that already described and illustrated in Figure 10. In this embodiment it is important that the curvatures of the seal and the piston are an exact match so that as the piston moves against the seal there is no wiping movement between the two parts. This match also allows the seal to be deformed by the piston without itself having to stretch to accommodate the deformity. It is important that the seal does not stretch as the convex part of the seal is completely unsupported by any solid part at zero compression and is only partially supported by the piston itself until full compression is reached.

There are two main advantages to this type of seal. Firstly there are no parts of the seal moving against hard parts in such a way as to cause frictional wear or compression set, so life expectancy of the seal is greatly enhanced. Secondly due to the shape of the curvature of the seal seal and matching piston, the cross-sectional area of the seal/piston interface increases with increasing compression; this implies an increasing resistance by the cell unit to a body resting on the swivel plate with increasing compression. By altering the designed curvature of the seal, while maintaining a match with the piston, different types of support can be achieved; this combined with the variable diameter pulleys helps facilitate achieving the desired support.

As an alternative to the cord acting between the connecting rod and the larger diameter pulley, a rack and pinion system could be used — the connecting rod 95 would be moulded with a toothed rack which would engage directly with a pinion moulded as part of the pulley.

In a further embodiment a system of one or more rigid levers would transmit the opposing forces of the connecting rod and the fluid chamber.

Where a hydraulic fluid is used in any design of support device a certain volume of gas, e.g. air may be deliberately left in each cell as its existence will provide an additional shock absorber. This would help prevent excessive stresses being applied to the seal by a sudden build up in hydraulic pressure.

All the embodiments described share the advantage that the whole system is completely self contained; needs no maintenance, no electricity supply. Furthermore the system is ideal for dividing into sub-elements which can be set at or adjusted to different angles to one another; e.g. mattresses with tilting top sections, reclining seats. Such sub-elements may, or may not have their grid systems connected together by a flexible pipe.

The present system has the further advantage that all interconnected cell units cooperate with one another. For this to be able to occur it follows that when the system is at rest and not supporting any weight all the cells will be in a position which intermediate the fully depressed and the fully raised. When a body lies or sits on the device the weight bearing cells are depressed. Fluid is displaced from these cells and flows via the grid 27 to enter cells which are not being depressed. In these cells the pistons will rise until they reach their limit, or the depressed cells bottom. Provided adjustment of the control for firmness is correct the non-weight-bearing cells should be in the fully raised position before the other cells bottom out. Not all the cells will be depressed to the same extent. In fact some of those beneath the body, for example under the small of the back, may actually rise. Thus the whole body receives support without any pressure points.

While it is agreed that the operation principle of the present invention shares advantages with the water bed, there are several further advantages over a water bed.

Firstly water mattresses suffer from a problem of weight. To contain the huge mass of water a substantial frame is required and the whole can weigh up to three quarters of a tonne. The large mass of water in a water bed presents other problems. The water naturally assumes room temperature and as such is cold to lie on. Hence these mattresses normally use electric heating pads to maintain the water nearer to body temperature. Moreover as the body on the mattress moves so does the water, but after the body has stopped moving there is some momentum left in the water. A complex baffle system is required to counter this effect. There is also the problem with such a large mass of water that the public remain nervous about the possibilities of leakage. Fungicides and algicides are required to prevent weed formation. Water cannot be used as a medium for support in any other than the horizontal plane and therefore the use cannot be extended to chairs, seats or mattresses with tilting sections.

CLAIMS

1. A body support device comprising a grid system of interconnected fluidic cell units, each unit comprising a piston, and a fluid reservoir fluidically connected to the grid, the units each carrying a swivel element attached for pivotal movement in any direction with respect thereto, the arrangement being such that on application of a body pressure to the device some swivel elements are depressed causing the piston to be actuated to expel fluid from the fluid reservoir in the cell unit to the grid, and each swivel element is able to take up its own optimum angle to support the body substantially without constraint from adjacent swivel elements.

2. A device according to claim 1 wherein at least some of the cell units each comprise a plurality of telescopically mounted sliding elements, the central element or elements of which first act as a fluid reservoir to receive the previously activated piston and then act themselves as a piston to expel fluid from the next adjacent element.

3. A device according to claim 1 wherein each unit comprises a fluid chamber, a piston slideable in the fluid chamber and a tapered bellows seal disposed in the said chamber so as to be compressed by downward movement of the piston, the diameter of the seal increasing from top to bottom so that the resistance provided by the fluid against further depression of the piston increases as the piston is depressed; the piston being recessed on the side adjacent the seal to receive the compressed part of the seal as it travels down the chamber.

4. A device according to claim 3 wherein the seal incorporates a continuous helical reinforcer to resist lateral expansion of the seal.

5. A device according to claim 1 wherein the swivel element is connected by a swivel joint to a connecting rod which rod is slideable in a chamber.

6. A device according to claim 5 wherein the connecting rod is in two or more parts, the parts being connected on the same axis and divided by one or more resilient bushes adapted to expand laterally to provide a braking force on sudden application of pressure to the swivel element.

7. A device according to claim 5 or 6 wherein the chamber is also the fluid reservoir and the connecting rod incorporates the said piston.

8. A device according to claim 7 wherein the cell unit comprises the said connecting rod slideably mounted in said chamber and a separate said piston slideably mounted in the said fluid reservoir; means being provided for transmitting movement of the connecting rod to activate the piston movement in the reservoir and for transmitting the fluid resistance in the reservoir back to the swivel element in the form of an upward force on the connecting rod.

9. A device according to claim 8 wherein the said means comprises a double pulley with respective cords oppositely wound, one connected to the connecting rod and the other to the piston.

10. A device according to claim 8 wherein the said means comprises a rack and pinion.

11. A device according to claim 9 wherein the double pulley comprises two contoured pulley wheels, the contours being designed to provide the required support characteristics.

12. A device according to any of the preceding claims wherein the swivel elements support cushioning means.

13. A device according to claim 12 wherein the cushioning means is in the form of one sac per element, the sacs being formed of a substantially inelastic material and being filled with cushioning material.

14. A device according to claim 13 wherein the sacs are air tight and are filled with an open textured foamed or elastic material.

15. A device according to claim 14 wherein the sac contains air in sufficient quantities to provide a cushioning effect, and including a one way valve allowing entry of air to the sac, the arrangement being such that on release of the pressure on a sac, the foamed material will return to its original shape drawing air into the sac if necessary to balance the air pressure in the sac with atmospheric air pressure.

16. A device according to any of the preceding claims including a shock absorber in the grid system adapted to take up excess fluid expelled from the cell units and return it to the system when required.

17. A device according to any of the preceding claims including a resistor on each cell unit to provide a resistance against the piston reaching the bottom of the fluid chamber.

18. A device according to claim 8 wherein the fluid reservoir has an internal boundary in the form of an inelastic but flexible convex diaphragm and the piston is formed with a convex surface matching the shape of the diaphragm and disposed in mirror image to the diaphragm, the arrangement being such that on movement of the piston into the fluid reservoir there is no expansion of the diaphragm and no frictional movement between the surface of the piston and the diaphragm.

19. A body support device substantially as herein described with respect the accompanying drawings.

20. A body support device substantially as herein described with reference to Figure 10 of the accompanying drawings.

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