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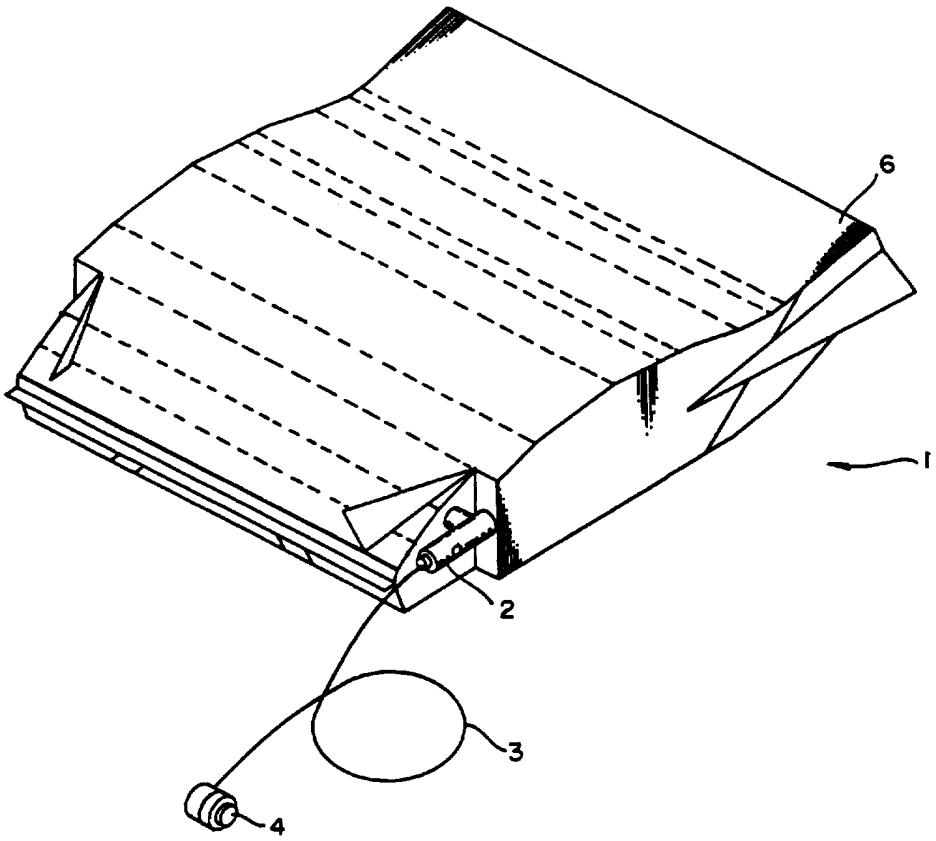
(57) Abstract

A self-inflating seat or modular seat insert (1) is disclosed as having a resilient core wholly surrounded by and bonded to an airtight outer skin, and a valve arrangement (2) that selectively permits air ingress to and egress from the internal space defined by the outer skin. The valve arrangement (2) is constructed to permit passive air ingress when ambient air pressure is greater than the internal air pressure in the space defined by the outer skin, and prevent air egress from the spaced defined by the outer skin when the internal air pressure is in excess of ambient air pressure. A user operated control (4) temporarily disables the valve arrangement (2), thereby allowing for deflation of the seat or seat insert when internal air pressure exceeds ambient air pressure, a feature of the valve assembly (2) permits automatic self-deflation should the internal pressure exceed a predetermined value relative to ambient pressure. Another feature is directed to a method of integrating the insert (1) into a seat back to permit user selection of the position of the insert (1).



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Self Inflating Modular Seat Insert

Technical Field

The present invention relates to seats or seat elements for long distance travel, for example seats or seat elements for aircraft or trains.

Background Art

It has been well known for many decades to provide a seat with a reclining back. As a result, the person sitting on the seat is not obligated to sit upright throughout the journey, but may instead sit in a reclined position. If the person is a passenger, the person may doze off.

A reclining seat back makes long distance travel significantly more comfortable. However, in general the seat back cannot be fully reclined to a horizontal position because of the limitations of space on board a train or aircraft. As a result, the traveler cannot lie down and sleep but instead is obligated to remain in a seated posture, albeit reclined, throughout the journey.

In a separate development, self-inflating cushions have recently been introduced for the pilot seats in long haul commercial aircraft. A cushion is placed on the pilot seat in the lumbar (lower back) region. The cushion comprises a resilient open cell foam core and an airtight outer skin surrounding the foam core. The open cell foam core is of the general size and shape of a conventional household seat cushion. The outer skin consists of a polyvinylchloride (PVC) cover. An air hose pipe leads from the cushion to the arm-rest of the pilot seat and a manually operable valve is provided at the free end (the pilot seat arm-rest end) of the hose pipe. Reflation of a compacted (deflated) cushion is effected by opening the valve. The compacted open cell foam, which is of resilient material expands and sucks air through the valve so that the cushion automatically reflates. Deflation is effected by opening the valve and at the same time squeezing the cushion so as to drive air out. The self-inflating cushions have found favour with pilots travelling on long journeys.

Nevertheless, the self-inflating cushions suffer from certain disadvantages which mitigate against wider use, for example use on passenger seats in aircraft, trains or other forms of mass transportation, or use in vehicles. The response

time (time to self-inflate) is relatively slow due to the thickness of the PVC skin. The hose and valve arrangement is quite large. The valve is located at the arm-rest so that the air exhausts at this point. The outer skin does not hold air well. The joint between the cushion and the rest of the seat (made of high density aircraft seat foam) may be uncomfortable. If used in mass transportation, considerable cost and inconvenience would arise if attendants on a train or aircraft were required to move along the narrow aisles in order to carry out the additional task of ensuring that the cushion on each seat was inflated to the correct degree. This would have to be done between flights in order to ensure that "business class" passengers would find their seats fully inflated when initially taking their seats. This might have to be done at the start of a flight or during a flight for travellers who may require assistance, for example infrequent travellers or invalid travellers. If used in vehicles, the slow response time might be unacceptable to the driver who is used to being able to make instant use of his vehicle.

Our earlier Irish Patent Application No. S940900 filed 16th November, 1994, from which the present application claims priority, proposes two improvements to the prior art self inflating cushions described above.

Summary of the Invention

In one aspect the invention provides a self-inflating seat or modular seat insert or element comprising a compactible resilient open cell foam core, an airtight outer skin surrounding the foam core, and a valve arrangement operable to allow airflow into and out of the airtight outer skin, characterised in that the valve arrangement includes automatic slow air bleed back means which operates automatically, in the absence of passenger weight against the seat or seat insert or element, to effect slow self-inflation.

In another aspect the invention provides a self-inflating seat or modular seat insert or element comprising a compactible resilient open cell foam core, an airtight outer skin surrounding the foam core, and a valve arrangement operable to allow airflow into and out of the airtight outer skin, characterised in that the outer skin is made of relatively flexible material and the inner surface of the outer skin is bonded to the outer surface of the resilient open cell foam core so that the

outer skin adopts the shape of the foam core and so that substantially no free air spaces exist within the outer skin.

Summary of the Invention

An object of the present invention is to provide still further improvements in seats or seat elements intended for long distance travel.

In another aspect the invention provides a self-inflating seat or modular seat insert or element particularly suited for use in aircraft, comprising a compactible resilient open cell foam core, an airtight outer skin surrounding the foam core, and a valve arrangement operable to allow airflow into and out of the airtight outer skin, characterised in that the seat or modular seat insert or element is constructed to withstand gradual or sudden decompression without bursting or exploding.

The advantage of construction to withstand gradual or sudden decompression is best explained by reference to what might happen in the absence of such construction. In the event of sudden decompression in the cabin of an aircraft, which may be a traumatic experience for a passenger, the passenger might also be faced with an expanding seat which pushes the passenger against the seat belt giving rise to considerable discomfort and further trauma. In a worst case scenario the passenger might experience a bursting or exploding seat.

Preferably, the valve arrangement incorporates a pressure relief feature which, in response to an appreciably higher pressure within the skin than outside the skin, operates so as to tend to equalize the pressures.

Alternatively, the outer skin may be expandable, thereby allowing air contained within the skin to expand, thus reducing the air pressure within the skin.

In another aspect the invention provides a passenger seat comprising:

a frame;

a seat element mounted on the frame;

a back element mounted on the frame;

the rear end of the seat element and the lower end of the back element being adjacent one another, characterised in that the seat is reconfigurable to

allow a passenger to rest or sleep on his side, for this purpose the upper end of the back element is movable downwardly on the frame and the lower end of the back element is moveable forwardly relative to the seat element, so that the back element may be configured to extend at an inclined angle upwardly and backwardly from part way along the seat element.

The advantage of a seat in accordance with this aspect of the invention is that a passenger is no longer obliged to remain in a sitting posture. Instead, with the seat reconfigured, the passenger may lie on his side, and the passenger's hip, side and shoulder may bear against the back element and the passenger is thus offered adequate and comfortable support. The reconfigured seat does not occupy any more space than a traditional reclining seat.

It will be appreciated that the various aspects of the invention described in our earlier patent application and in the present patent application may be combined with one another in various combinations. In accordance with a particularly preferred embodiment, all four aspects of the invention may be combined to provide a particularly safe, comfortable and convenient aircraft seat.

Brief Description of the Drawings

The invention will now be described more particularly with reference to the accompanying drawings which show, by way of example only, two embodiments according to the invention. The first embodiment is a seat back, this is illustrated in Figures 1 to 8. This first embodiment incorporates the first (automatic reflation when not in use), second (outer skin bonded to foam core) and third (automatic response to decompression) aspects of the invention. Figures 1 to 8 are identical to the corresponding Figures in our earlier patent application. The second embodiment is an aircraft seat, this is illustrated in Figures 9 and 10, and the seat incorporates the fourth (reconfigurable seat) aspect of the invention. In the drawings:

Figure 1 is a perspective view of the seat back;

Figure 2A, 2B, 2C and 2D show the manner in which the seat back (without valve arrangement) is assembled;

Figure 3 is an exploded perspective view of the valve arrangement;

Figures 4A, 4B, 4C, 5A, 5B, 5C, 6A, 6B, 7A, 7B and 8 illustrate various views of the various components of the valve arrangement;

Figure 9 is a side elevation of the seat of the second embodiment; and

Figure 10 is a similar view, but showing the seat reconfigured.

Modes for Carrying out the Invention

Referring initially to Figure 1, a seat back generally designated 1 is provided at a rear corner thereof with a valve housing 2 and a cable 3 leads to a button 4 operable by a passenger. The cable 3 is of the type conventionally used in a passenger aircraft seat to allow a passenger to control the rake of the seat. The button 4 is mounted on the arm-rest (not shown) of the passenger seat along side or opposite the other controls (not shown).

Referring now to Figures 2A, 2B, 2C and 2D, the seat back 1 comprises a foam core 5 contained within a nylon taffeta bag 6. Figure 2A shows the core 5 only. The core 5 is a composite structure, comprising a central core element 5a made of resilient, compactible open cell foam, and two end core elements 5b, 5c made of harder, less compactible foam. All of the core 5 is made of a composite of polyurethane low density open cell foam and graphite impregnated (for fire retardant purposes) high density open cell foam, and the elements of different texture are bonded seamlessly to one another to form the composite core 5. It will be noted that the composite core 5 has a contoured shape, suitable for use as a seat back. Figure 2B shows the core being inserted into the nylon taffeta bag 6. Figure 2C shows the core 5 contained within the bag 5, and at this stage in the assembly procedure heat is applied to the seat back 1 to bond the inner surface of the nylon taffeta bag 6 to the outer surface of the core 5, and to heat seal the bag 6. As a result of this stage in the assembly procedure, the seat back 1 comprises a core 5 which is flexible due to the open cell resilient structure of the central core element 5a, and which may therefore adopt different shapes, and an outer skin (the bag 6) which is bonded to the core 5 so that the outer skin adopts whatever shape is adopted by the core 5. In particular it will be appreciated that there are no dead spaces within the bag 6, that is to say no spaces between the bag 6 and the core 5. Figure 2D shows the completed seat back 1, sealed and provided with an airflow conduit 7.

The use of nylon taffeta has many advantages. Nylon taffeta is extremely flexible, and flexes easily with the changes in shape of the core 5. Nylon taffeta provides good airholding.

The use of the seat back 1 by a passenger will now be described. It will be assumed that when the passenger sits down the seat back 1 is fully inflated. If the passenger finds the fully inflated seat back 1 comfortable, then no action need be taken by the passenger. However, if the passenger finds the fully inflated seat back 1 to be uncomfortable, the passenger may allow some or all of the air to be released. Deflation is achieved by pressing on the button 4, while continuing to rest against the seat back 1. The seat back 1 deflates for as long as pressure is maintained on the button 4. Once the seat back 1 has reached the desired state of deflation, the passenger releases the pressure on the button 4. If the passenger over-deflates the seat back 1, or if at a later stage the passenger requires a higher level of inflation of the seat back 1, then reflation is effected by again pressing the button 4, but this time the passenger leans forward so as to remove his weight from the seat back 1.

The arrangement of bonding the inner surface of the outer skin 6 to the outer surface of the core 5 is particularly advantageous. There are no "free spaces" or "dead spaces" within the seat back 1. As a result, once the passenger leans back against any part of the seat back 1, irrespective of the shape of the passenger's back, or the shape of the seat back 1, the pressure applied by the passenger's weight is communicated throughout the seat back 1. Furthermore, any such pressure by the passenger immediately elevates the pressure within the seat back 1 to a pressure higher than the ambient pressure. As a result, once button 4 is depressed, deflation takes place quickly and predictably, with absolutely no effort required on the part of the passenger other than to lean back. Similarly, with reflation, because there are no free spaces or dead spaces, the internal pressure within the seat back 1 is communicated throughout the interior thereof, and once button 4 is depressed, air is sucked in. Thus the seat back reflates in a relatively quick and predictable manner. The passenger controlled operations of deflation and reflation occur relatively quickly, within a matter of ten to twenty seconds.

When the passenger leaves the aircraft, and assuming that the seat back 1 was partially deflated at the time of departure, then the seat back 1 automatically reflates slowly, so that after a period of time has elapsed, for example half an hour, the seat back 1 will have fully reflated. Thus the next arriving passenger will find the seat back 1 in the fully inflated condition, but it will not have been necessary for any attendant to ensure that reflation has taken place.

Referring now to Figure 3, the valve arrangement for passenger controlled deflation and reflation will now be described. The valve arrangement comprises a square section elongate valve housing 2, including a bore 11 extending axially along the housing 2, a projecting nozzle 12, and an aperture 13. A slide member 14 is slidably moveable along the bore 11 between a first (closed) position and a second (open) position. In the closed position the domed head 14a of the slide member 14 is located between the nozzle 12 and the aperture 13 and sealingly engages under the action of spring 15 against collar 16 located in the bore 11, thereby preventing airflow between the nozzle 12 and the aperture 13. In the open position the slide member 14 is located further to the right as seen in Figure 3, the head 14a of the slide member 14 is located between the aperture 13 and the right hand end of the housing 2 allowing uninterrupted airflow along the bore 11 between the aperture 13 and the nozzle 12. Slide member 14 includes a cable anchor recess 14b for receiving an anchor or spud 3a at the end of the cable 3 for pulling the slide member 14 to the right as shown in Figure 3 against the biassing action of the spring 15 to the open position. A plug 17 is provided for the right hand end of the bore 11. Plug 17 is provided for the right hand end of the bore 11. Plug 17 is held in position by means of a circlip 18 located within bore 11 near the right hand end thereof. Plug 17 includes a circumferential groove 17a which is a snap fit in the circlip 18. Plug 17 includes an end face 17b against which one end of the spring 15 is seated, the other end of the spring 15 being seated against the head 14a of the slide member 14. Plug 17 includes an axial bore 17c for slidingly receiving the shank 14c of the slide member 14. Finally, plug 17 includes a central aperture 17d not shown in Figure 3 through which cable 3 is guided from the interior of the valve housing 2 to the exterior thereof.

The valve arrangement for passenger controlled deflation and reflation is installed by connecting the nozzle 12 of the valve housing 2 to the conduit 7 of the seat back 1, while leaving the aperture 13 exposed to ambient air and mounting the button 4 on the passenger seat arm-rest.

In operation, normally the slide member 14 is in the closed position. However, if the button 4 is operated to pull the cable 3, the slide member 14 moves against the biassing action of the spring 15 to the open position, and airflow may take place in either direction along the airflow path from the interior of the seat back 1, through conduit 7, nozzle 12, bore 11 and aperture 13 to atmosphere or vice versa. If the weight of a passenger bears on the seat back 1, air is driven from the interior of the seat back 1 out to the atmosphere. If the passenger leans forward so that there is no weight on the seat back 1, and if the resilient open cell structure 5 is partly compacted, then the latter will expand, drawing air in the opposite direction along the flowpath from the atmosphere into the seat back 1.

Referring now to the left hand end of Figure 3, the valve arrangement for automatic slow reflation will now be described. A washer 20, a diaphragm 21 and a plug 22 are provided at the left hand end of the bore 11. It will be seen that the diaphragm 21 includes an eccentric air hole 23. The plug 22 includes a central air hole 24. It will be seen that the right hand face of the diaphragm 21 is subject to the air pressure prevailing in the interior of the seat cushion 1 communicated through conduit 7, nozzle 12 and bore 11. In the event of outward pressure the diaphragm 21 flexes outwardly, that is to say to the left as seen in Figure 3. The diaphragm 21 seats against the plug 22. Because the eccentric air hole 23 and the central air hole 24 are not in register, no outward airflow takes place. However, in the event of inward pressure (i.e. the compacted open cell foam core 5 tending to expand after removal of a passenger's weight), the diaphragm 21 flexes to the right as seen in Figure 3, that is to say away from the plug 22, and air can then flow through the central air hole 24 in the plug 22, through the gap between the plug 22 and diaphragm 21, and through the eccentric hole 23 in the diaphragm 21. The eccentric hole 21 is quite small and permits only a small flow of air.

Referring now to Figures 4A to 8;

Figure 4A is a side elevation of the valve housing 2;

Figure 4B is an end elevation thereof from the right hand end;

Figure 4C is an end elevation thereof from the left hand end;

Figure 5A is a top plan view of the slide member 14;

Figure 5B is a side elevation thereof;

Figure 5C is an end elevation thereof from the left hand end;

Figure 6A is a side elevation of the plug 17;

Figure 6B is an end elevation thereof from the right hand end;

Figure 7A is a side elevation of the circlip 18;

Figure 7B is an end elevation thereof from the left hand end; and

Figure 8 is a side elevation of the valve housing 2 shown partially cut away to reveal the slide member 14 and plug 17.

The valve arrangement includes an automatic decompression arrangement. Use is made of the above described valve arrangement for passenger controlled deflation and reflation. In the event of the pressure within the bag 6 significantly exceeding the pressure outside the bag 6, the slide member 14 moves against the biassing action of the spring 15, from left to right as shown in Figure 3, and allows air to flow out of the bag 6. For this purpose a number of modifications have been made relative to the arrangement as shown in our earlier patent application. Collar ring 16 has been changed from a square section to an O-section and is made of softer material. The head or nose 14a is made of silicon rubber instead of aluminum. The spring 15 is of particularly light construction and lower spring force. As with the embodiment described in our earlier patent application, if the air pressure within the bag 6 exceeds the air pressure outside the bag 6, there will be a tendency for the sliding member 14 to move and to release air. However, the slide member 14 has a certain inertia. As a result of the modified, sensitive, lightweight construction of the components, the slide member 14 will now commence opening if the pressure differential exceeds approximately 2 lbs per square inch (psi). The greater the pressure differential, the greater the extent to which the valve opens. In the event of gradual controlled decompression, the bag 6 will gradually lose air. In the event of sudden rapid decompression, with the air pressure in the cabin dropping form

(say) 12 psi to 2 psi, the valve will fully open and allow air to rush out of the bag 6.

Turning now to Figure 9, an aircraft seat comprises a frame 100, a seat element 101, a back element 102, and a headrest 103. These components are shown schematically.

Turning now to Figure 10, the seat has been reconfigured. The lower end of the back element 102 has been withdrawn from its position behind the rear end of the seat element 101, and has been pivoted forwardly. At the same time, the upper end of the back element 102 has been moved slidingly downwardly, for this purpose the upper end is slidably mounted to the frame 100. As a result, as shown by dashed lines, a passenger may lie on his side.

Referring back to Figure 9, for comparative purposes, the drawing shows a passenger lying on his side, and attention is drawn to the region 110 in which the passenger finds no support, thereby effectively preventing the passenger from comfortably lying on his side.

CLAIMS

What is claimed is:

1. A self-inflating seat or modular seat insert or element comprising:

an airtight outer skin defining a chamber;

a compactible resilient core disposed in the chamber; and

a valve arrangement fluidly coupled to the chamber and operable to allow airflow into and out of the chamber

wherein the valve arrangement has an automatic slow air bleed back means which operates automatically, in the absence of compression of the compactible resilient core, to effect slow self-inflation of the seat or modular seat insert or element after compression.

2. A self-inflating seat or modular seat insert or element according to claim 1 wherein the automatic slow air bleed back means comprises a one-way or check valve which permits ingress of air into the chamber when the air pressure in the chamber is less than ambient air pressure, and which prevents egress of air from the chamber when the air pressure in the chamber is greater than ambient air pressure.

3. A self-inflating seat or modular seat insert or element according to claim 2 wherein the one-way or check valve comprises a flexible diaphragm with an air hole and a diaphragm seat with an air passage wherein the air hole and air passage are out of mutual alignment whereby in a closed position, the air hold is proximately adjacent the seat so as to prevent transport of air through the air passage, and in an open position, the air hole is distant from the seat so as to enable transport of air through the air hole and the air passage.

4. A self-inflating seat or modular seat insert or element according to claim 1 wherein the valve arrangement is proximate to the outer skin.

5. A self-inflating seat or modular seat insert or element according to claim 1 wherein the valve arrangement is distant from the outer skin.

6. A self-inflating seat or modular seat insert or element according to claim 1 wherein the core is substantially adhered to the outer skin.

7. A self-inflating seat or modular seat insert or element according to claim 2 wherein the core is substantially adhered to the outer skin.

8. A self-inflating seat or modular seat insert or element according to claim 2 wherein the core is substantially adhered to the outer skin and wherein the valve assembly is proximate to the outer skin.

9. A self-inflating seat or modular seat insert or element according to claim 1 wherein the valve arrangement further comprises a primary valve and biassing means for biassing the valve to a closed position, and a user operated control means linked to and affecting the operation of the primary valve.

10. A self-inflating seat or modular seat insert or element according to claim 9 wherein the slow air bleed back means is integral with the primary valve.

11. A self-inflating seat or modular seat insert or element according to claim 9 wherein the primary valve comprises a housing and a slide member slidingly located therein and the biassing means comprises a spring which is in contact with the housing and the slide member, wherein the user operated control means comprises a cable linked to the slide member.

12. A self-inflating seat or modular seat insert or element according to claim 9 wherein the primary valve is proximate to the outer skin and the user operated control means is distant from the outer skin.

13. A self-inflating seat or modular seat insert or element according to claim 9 wherein the primary valve and the user operated control means are distant from the outer skin.

14. A self-inflating seat or modular seat insert or element according to claim 9

wherein the core is substantially adhered to the outer skin.

15. A self-inflating seat or modular seat insert or element according to claim 9 wherein the valve arrangement further comprises a primary valve and biassing means for biassing the valve to a closed position, and a user operated control means linked to and affecting the operation of the primary valve wherein the primary valve is proximate to the outer skin and the user operated control means is distant from the outer skin and wherein the core is substantially adhered to the outer skin.

16. A self-inflating seat or modular seat insert or element according to claim 1 further comprising a pressure relief means for permitting unattended egress of air in the chamber to the environment when the air pressure in the chamber exceeds a predetermined level to prevent bursting of the seat or modular seat insert or element.

17. A self-inflating seat or modular seat insert or element according to claim 16 wherein the predetermined level is substantially equal to or greater than 0.1379 bar.

18. A self-inflating seat or modular seat insert or element according to claim 16 wherein the pressure relief means is integral with the valve arrangement.

19. A self-inflating seat or modular seat insert or element according to claim 9 further comprising a pressure relief means for permitting unattended egress of air in the chamber to the environment when the air pressure in the chamber exceeds a predetermined level to prevent bursting of the seat or modular seat insert or element.

20. A seat comprising:

a frame;

a seat element mounted on the frame having a front end portion and a rear end portion;

a back element having an upper end portion slidingly and pivotally linked to the frame and having a lower end portion;

wherein the rear end portion of the seat element and the lower end portion of the back element are adjacent to one another and characterized in that the seat is reconfigurable to allow a user to rest or sleep on his side, for this purpose the upper end of the back element is movable downwardly on the frame and the lower end of the back element is movable forwardly relative to the seat element so that the back element may be configured to extend at an inclined angle upwardly and backwardly from part way along the seat element.

21. The seat according to claim 20 wherein the back element comprises the self-inflating element set forth in claim 1.

22. The seat according to claim 20 wherein the seat element comprises the self-inflating element set forth in claim 1.

23. The seat according to claim 20 wherein the back element comprises the self-inflating element set forth in claim 9.

24. The seat according to claim 20 wherein the seat element comprises the self-inflating element set forth in claim 9.

25. The seat according to claim 20 wherein the back element comprises the self-inflating element set forth in claim 16.

26. The seat according to claim 20 wherein the seat element comprises the self-inflating element set forth in claim 16.

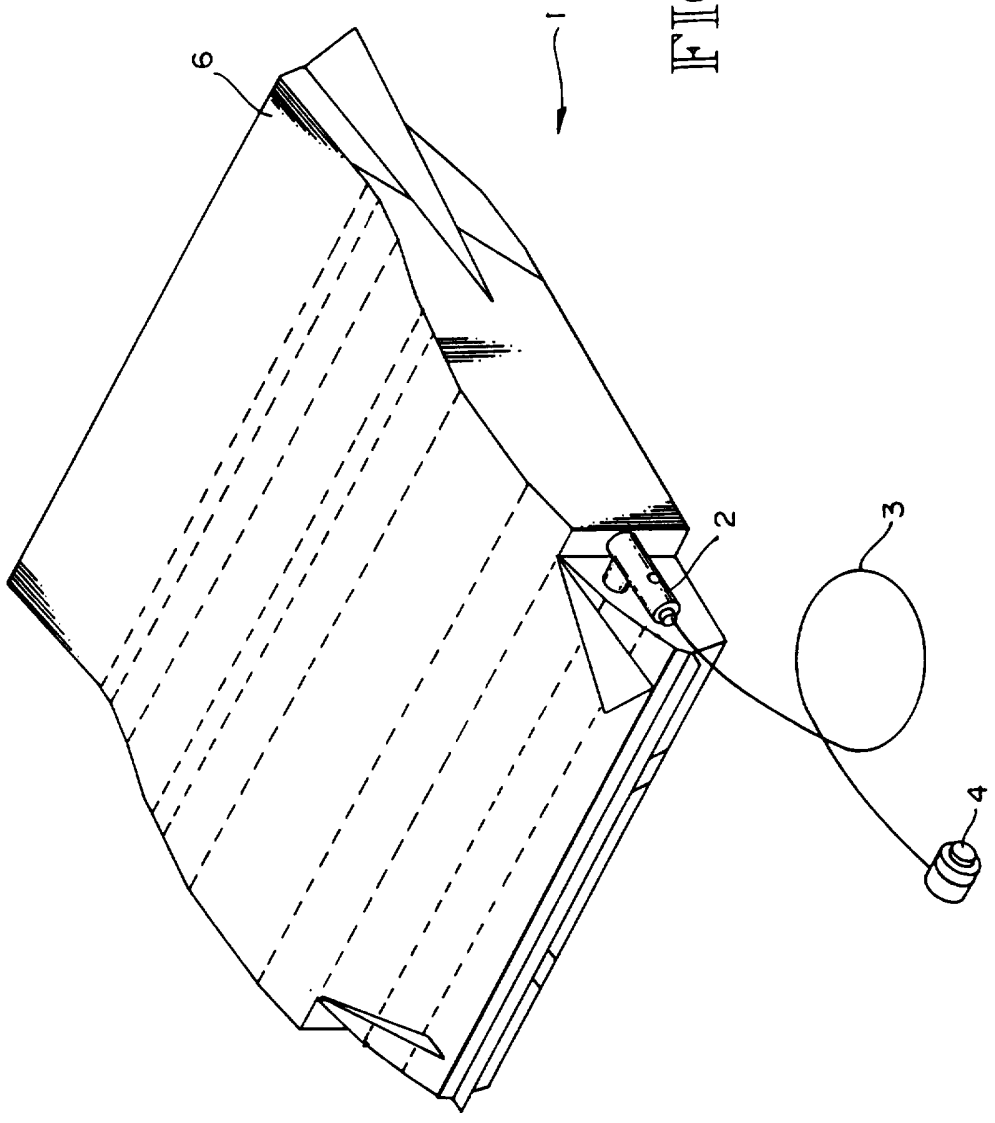

FIG. 1

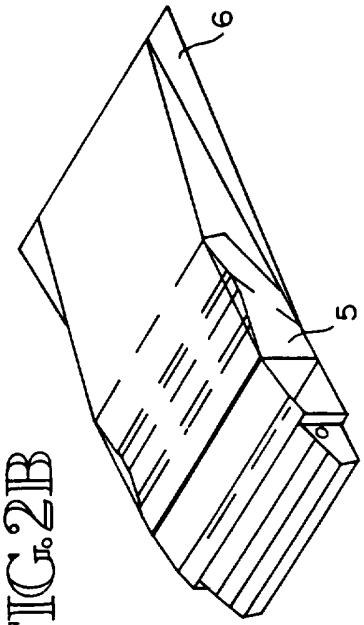

FIG. 2B

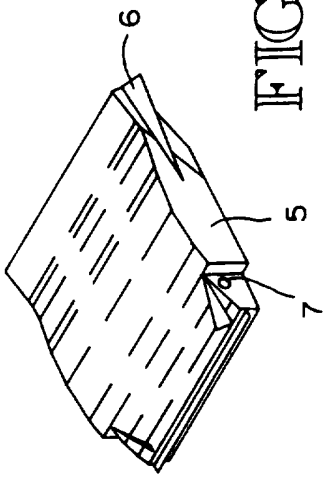

FIG. 2D

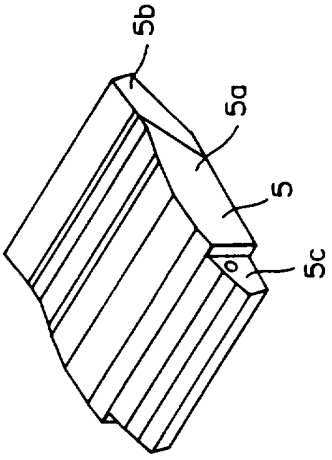

FIG. 2A

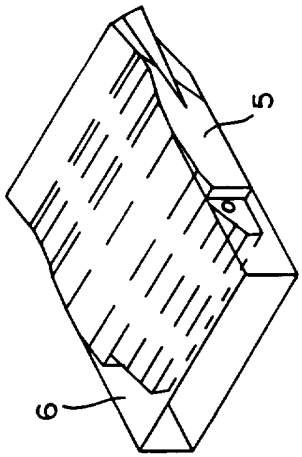

FIG. 2C

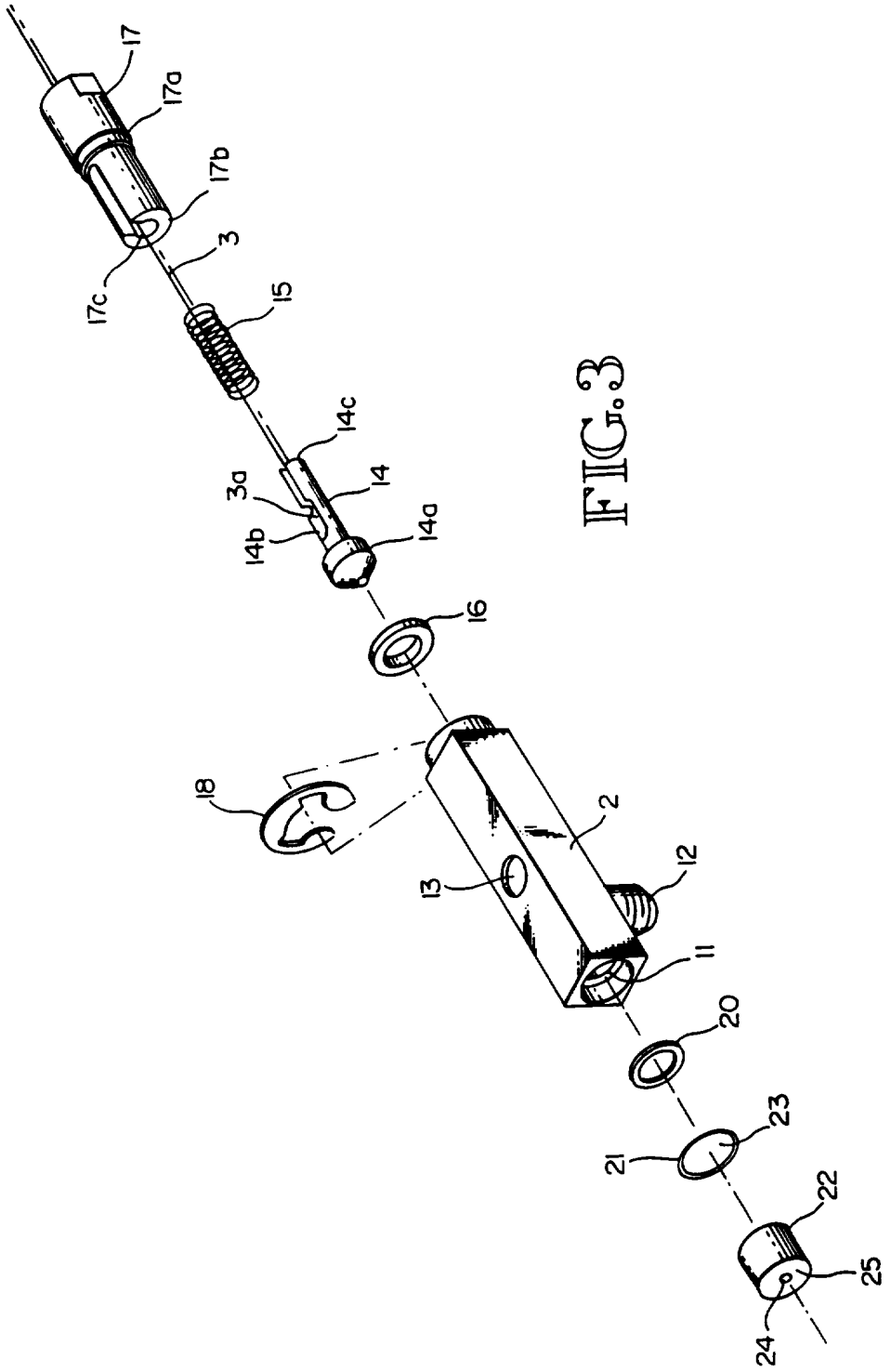
17
17a
17b
3
17c
15
14c
3a
14
14b
14a
16
18
2
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FIG. 3

FIG. 4A

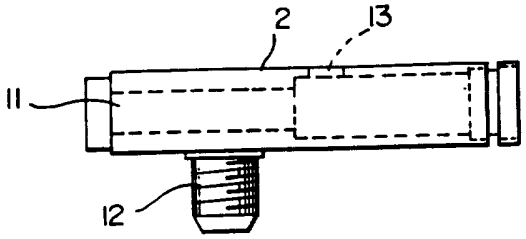


FIG. 4C

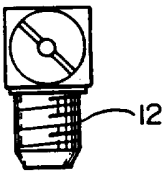
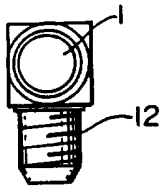


FIG. 4B



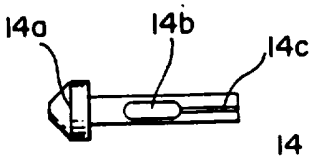


FIG. 5A

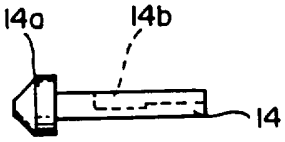


FIG. 5B

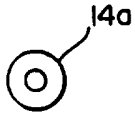


FIG. 5C

FIG. 6A

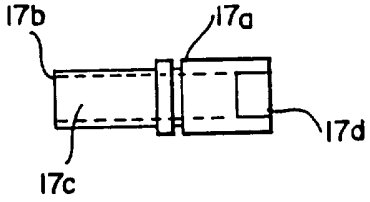


FIG. 6B

FIG. 7B

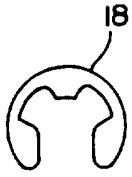


FIG. 7A

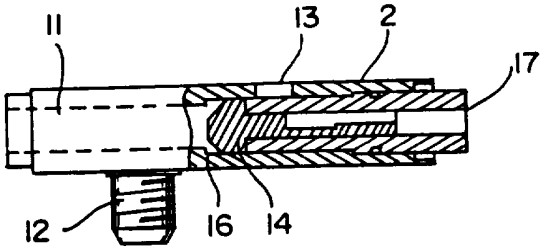


FIG. 8

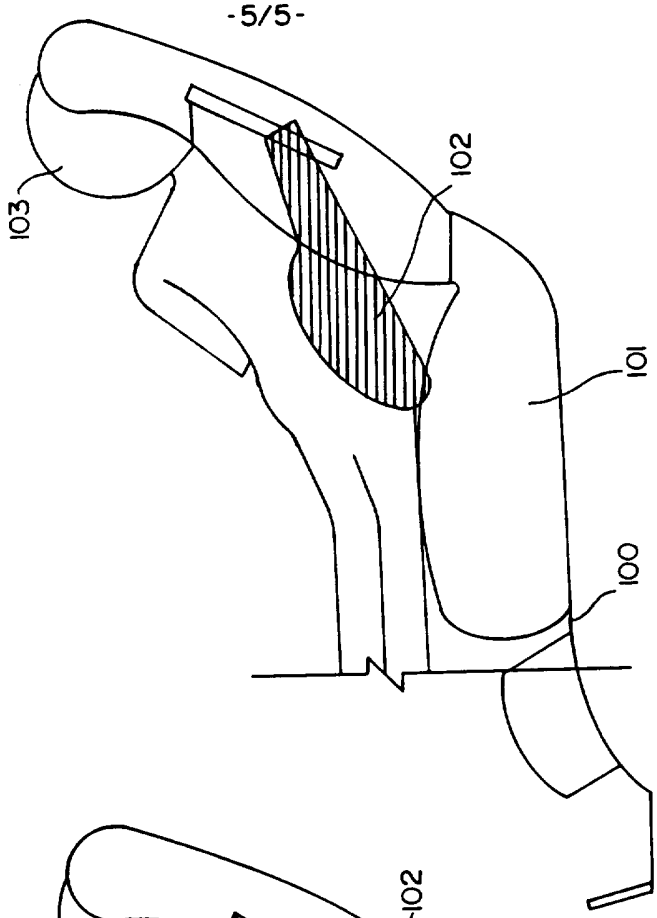


FIG. 10

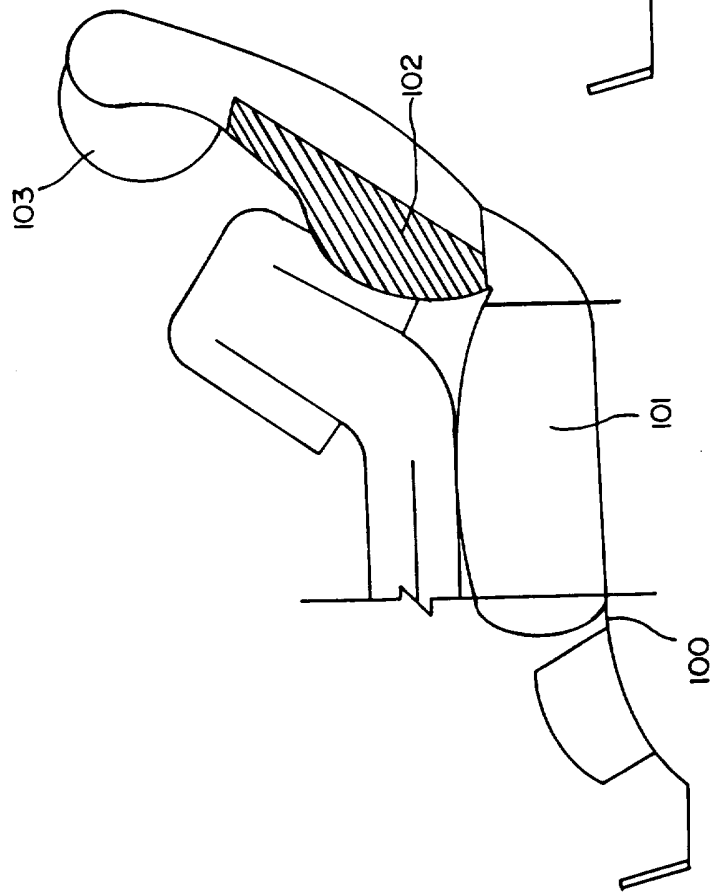


FIG. 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US95/14464

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :A47C 7/46
US CL :297/284.6
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 297/284.4, 284.6, 452.41

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US, A, 3,661,422 (SEMBER ET AL) 09 May 1972, See figure 4	1-10,13,14,16-19 ----- 11,12,15, and 21-26
Y	US, A, 4,514,010 (GONZALEZ) 30 April 1985, See figure 2	11,12,15
X ---- Y	US, A, 2,558,171 (CHESLEY) 26 June 1951, See figure 2	20 ---- 21-26
A	US, A, 3,652,126 (FOLLING) 28 March 1972, see figure 1	1-19

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search
04 MARCH 1996

Date of mailing of the international search report
13 MAR 1996

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US95/14464

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 3,770,315 (SMITTLE ET AL) 06 November 1973, fig. 1	1-19
A	US, A, 4,807,931 (ISHIDA ET AL) 28 February 1989, see fig. 1	1-19
A	US, A, 5,171,064 (BOUSSAROQUE) 15 December 1992, Fig.8	20