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B60R 22/12

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(54) Abstract Title: **Seat-belt arrangement**

(57) A seat belt arrangement is disclosed for restraining an occupant in a seat (1). The seat belt arrangement comprises a lap-belt (5) and a pair of shoulder-straps (6), one end (7) of each shoulder-strap (6) being secured to the lap-belt (5). Both ends of the lap-belt (5) are wound on a retractor (10), and each free end of the shoulder-straps (6) is also wound on a retractor (8). Each end of the lap-belt is connected to a mounting point on the seat (1), the mounting point being fixed in position. Withdrawal of the lap-belt (5) from its retractor (10) allows movement of the lap-belt (5) between an entry position and a restraining position, without movement of the retractor (10) relative to the mounting point to which it is secured.

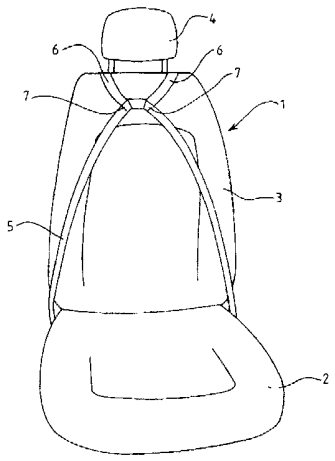

FIG 1

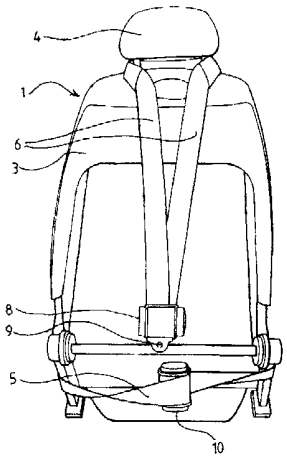

FIG 2

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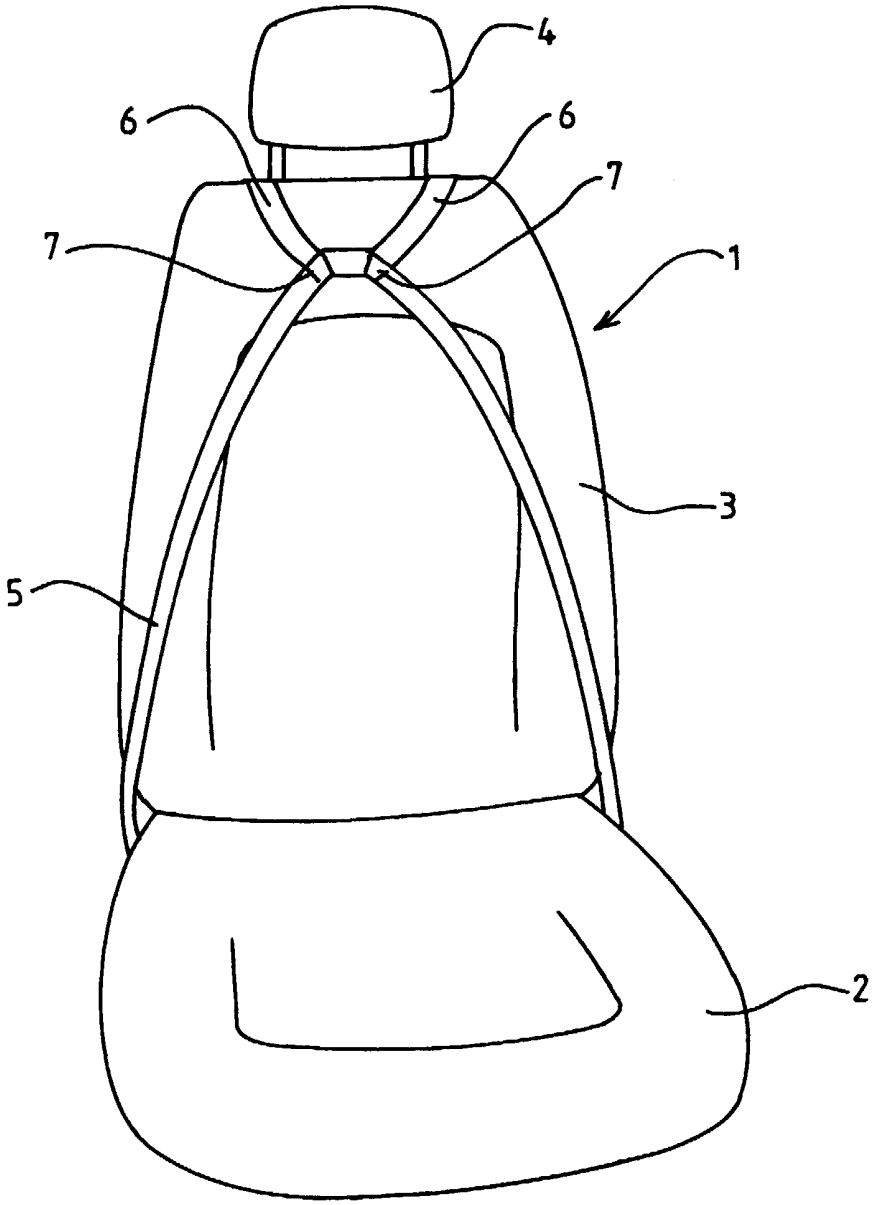


FIG 1

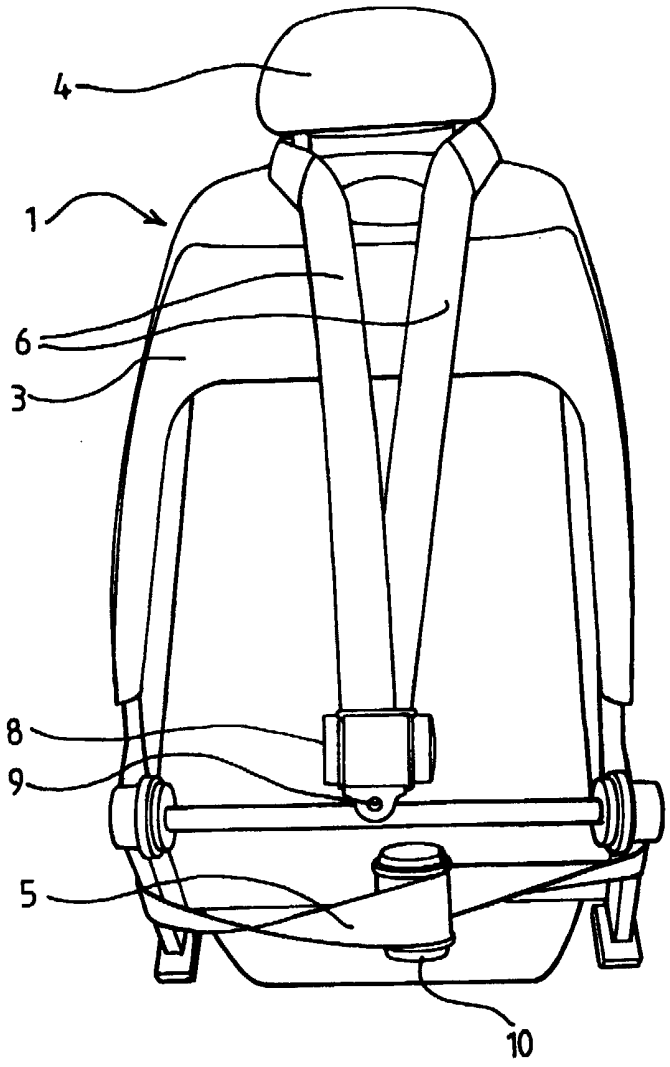
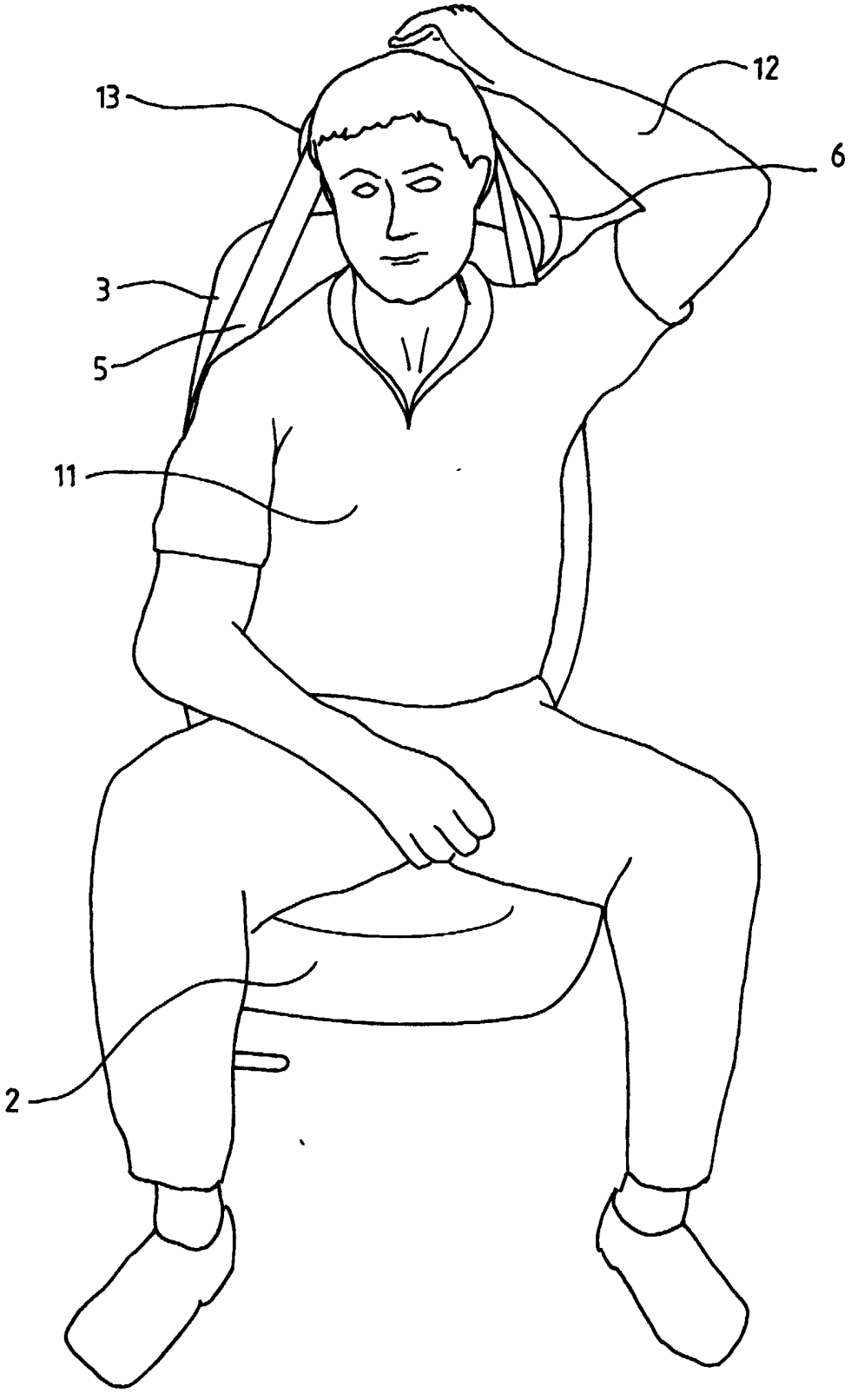


FIG 2

FIG 3



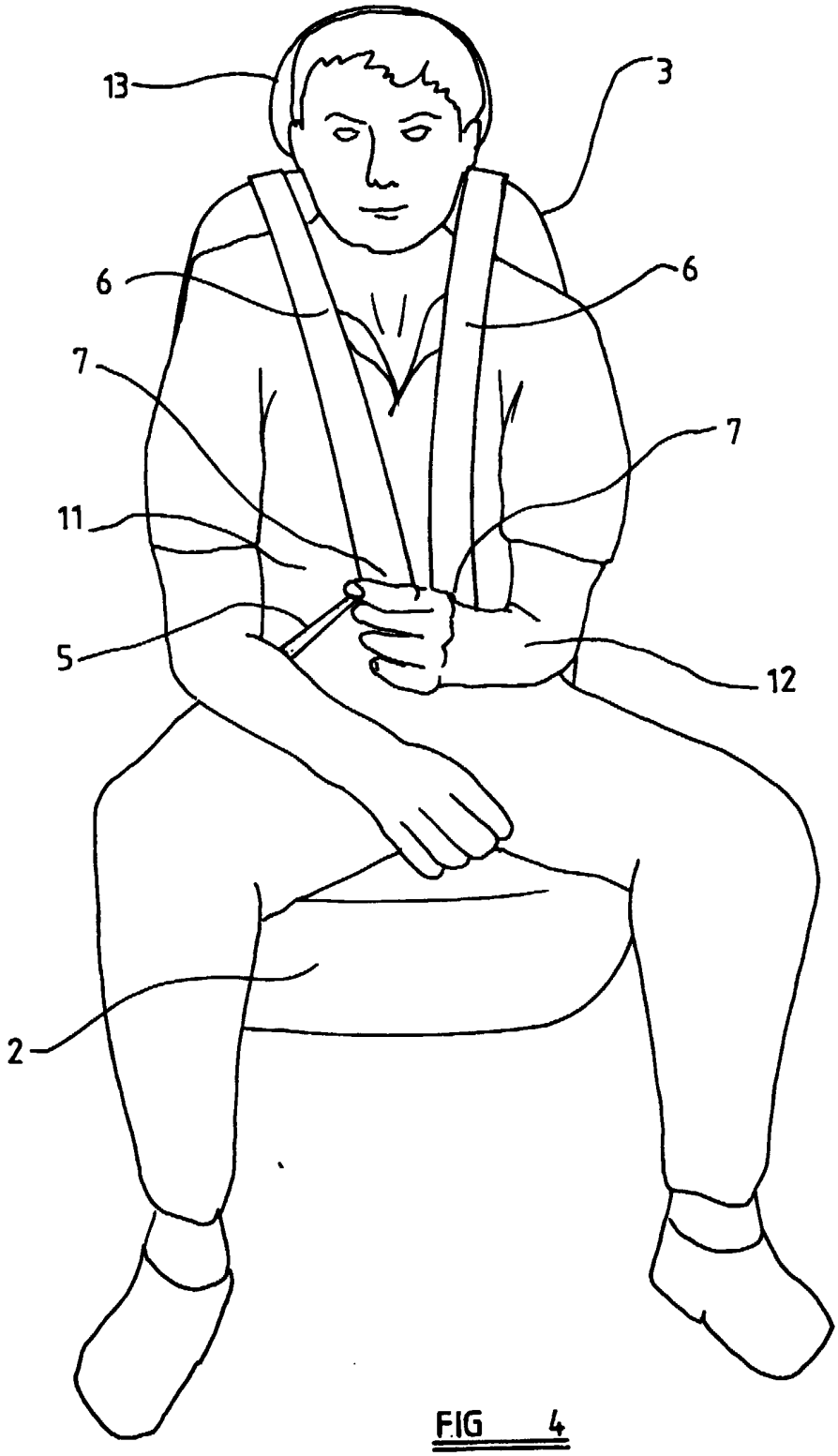


FIG 4

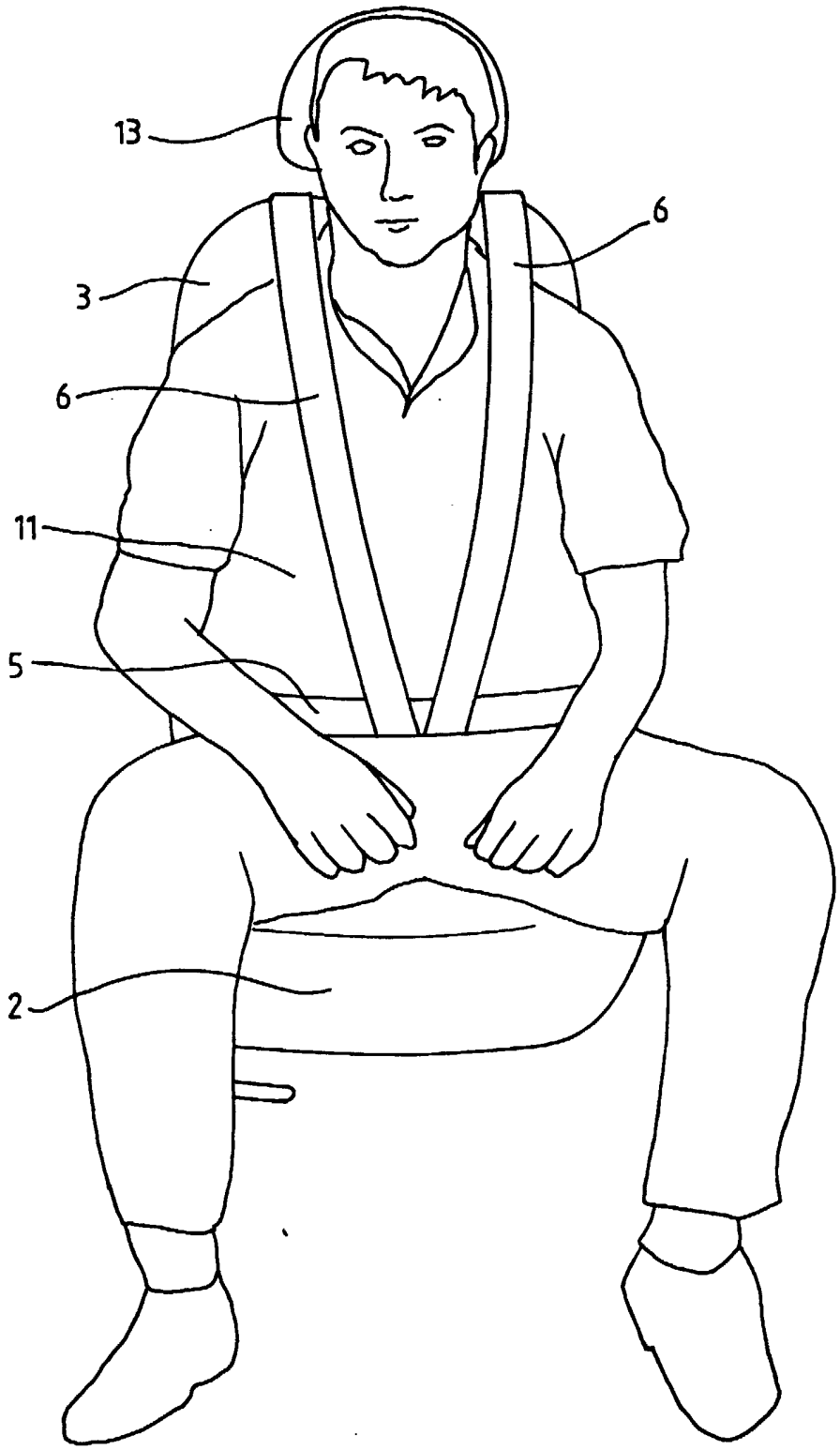


FIG 5

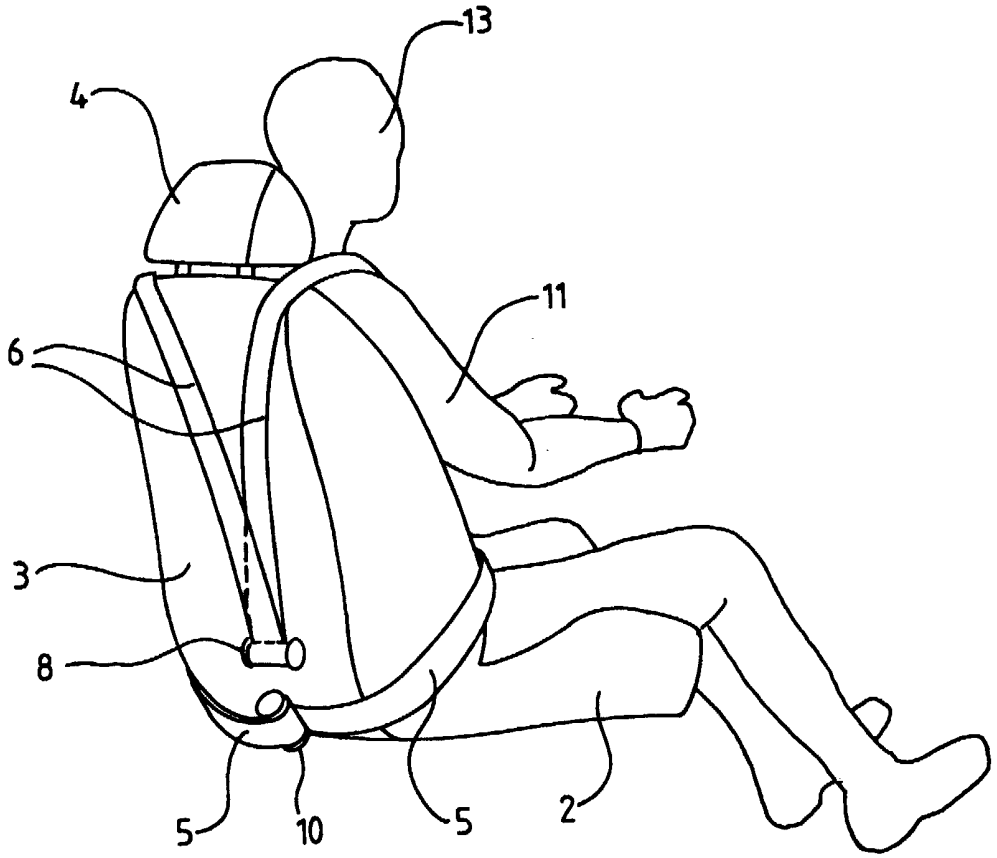


FIG 6

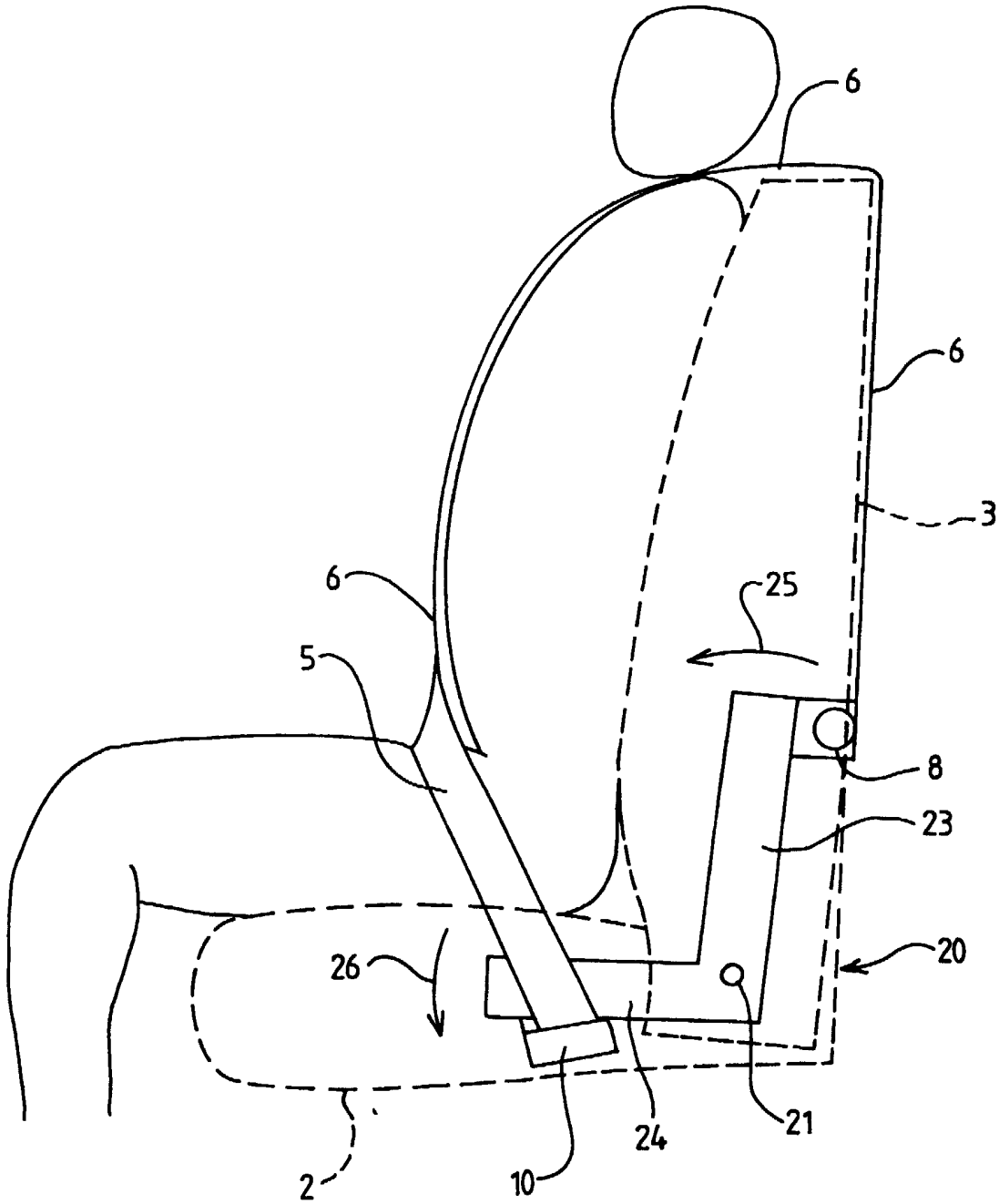


FIG 7a

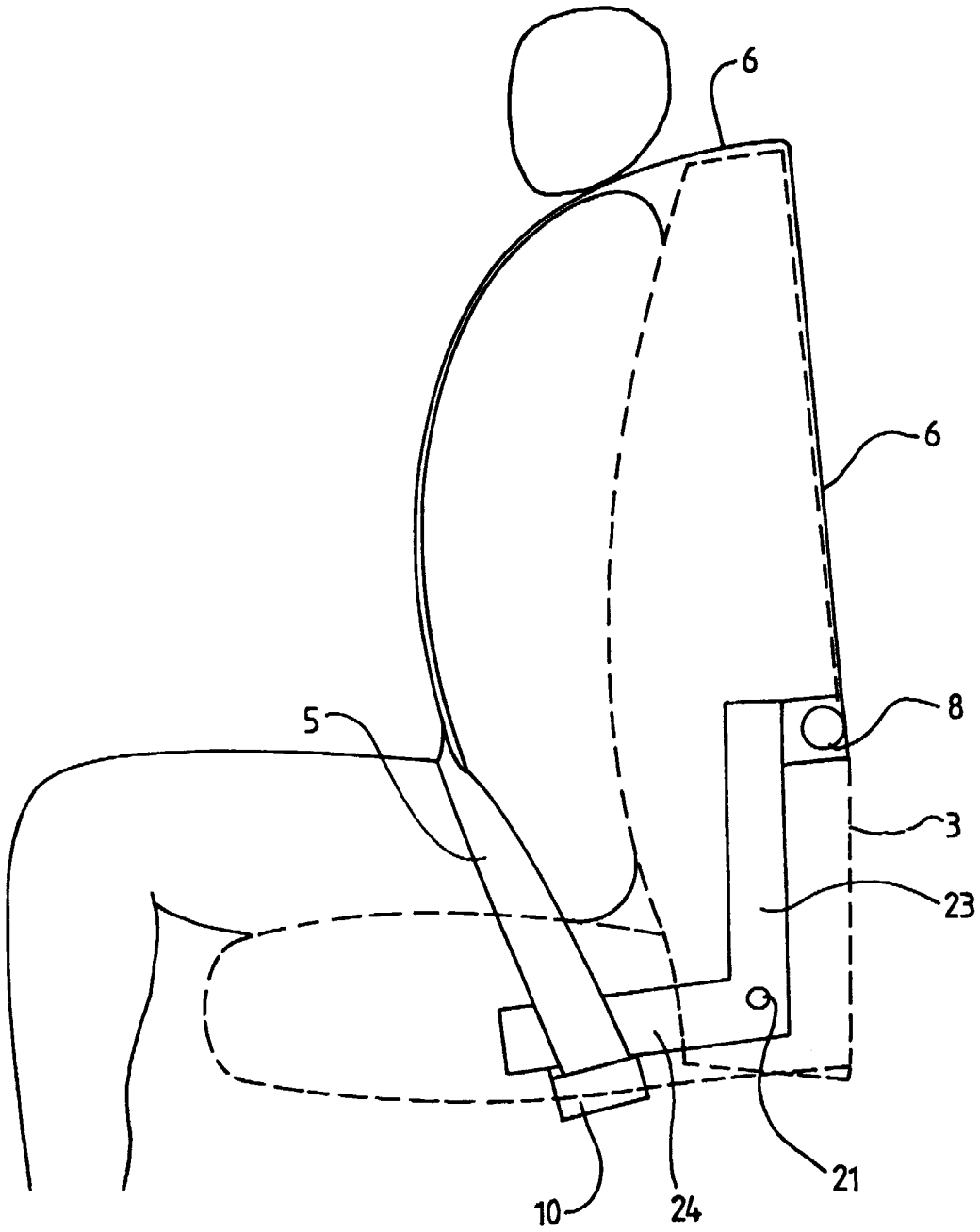


FIG 7b

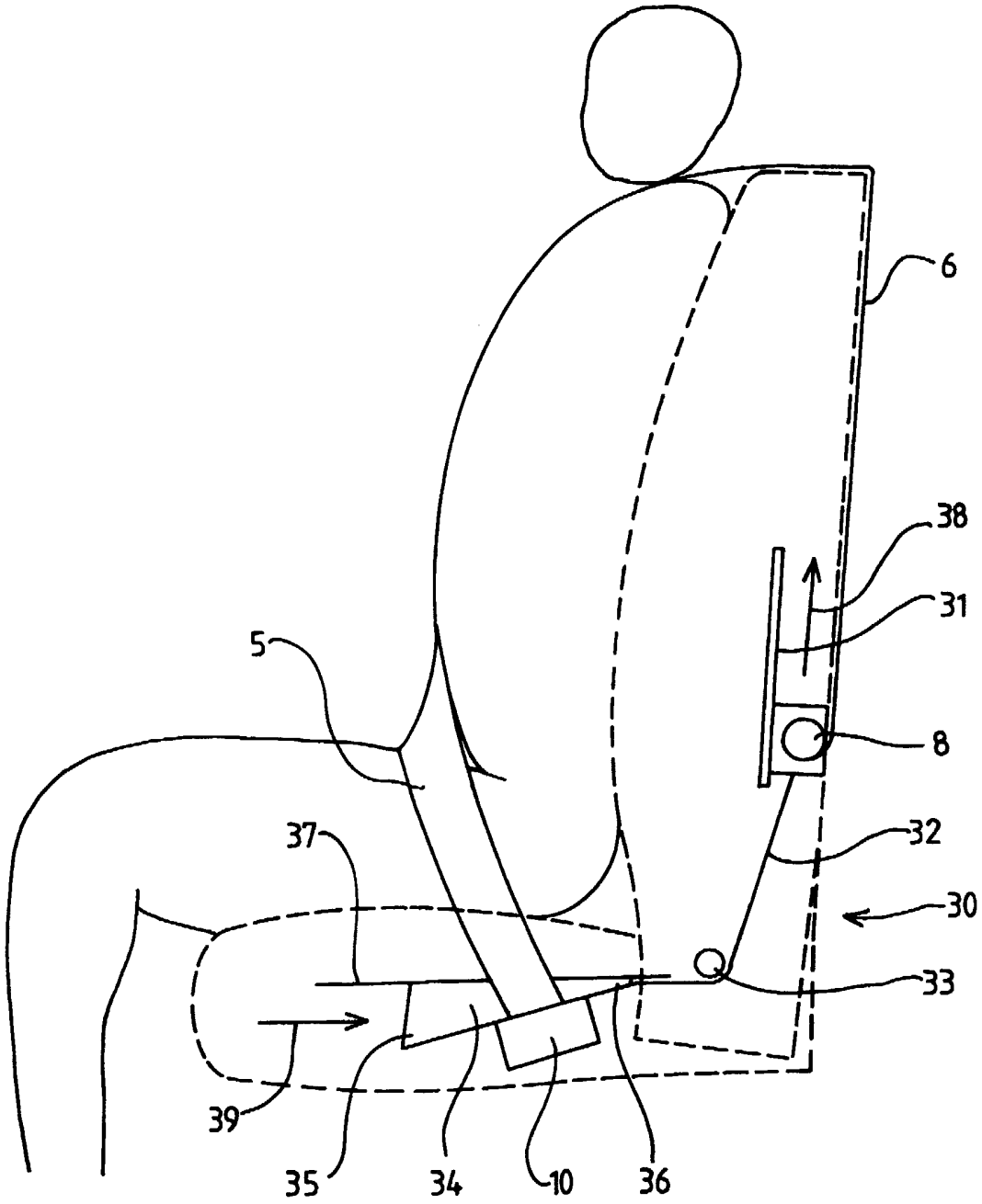


FIG 8a

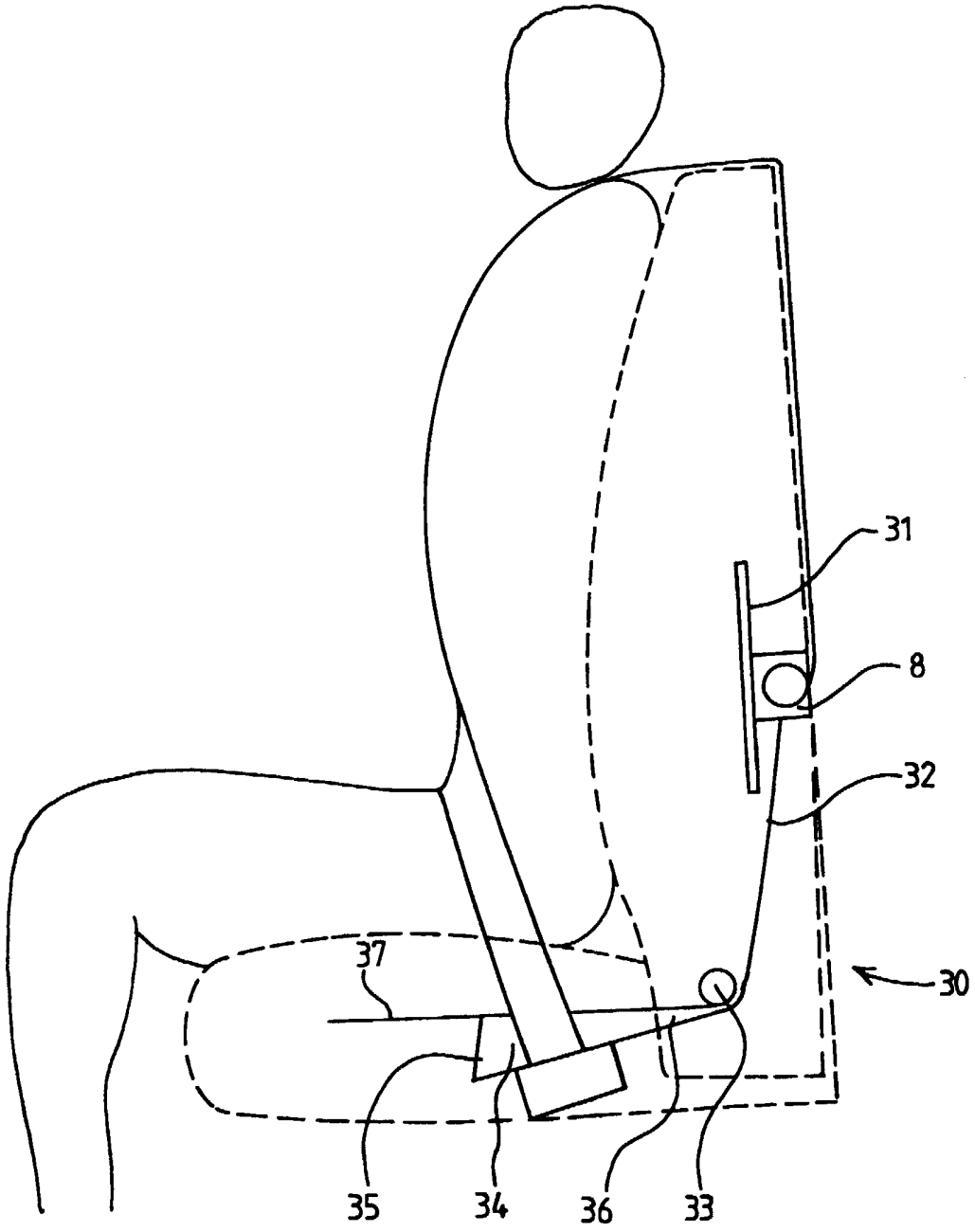


FIG 8b

"Improvements in or relating to a Seat-Belt Arrangement"

THE PRESENT INVENTION RELATES to a seat-belt arrangement and more particularly to a seat-belt arrangement for restraining an occupant sitting in a seat, for example in a motor vehicle.

Conventional seat-belt arrangements for restraining an occupant sitting in a motor vehicle seat typically comprise a single length of webbing strap which, when it adopts its restraining position, extends across the occupant's lap from one side of the occupant to the other side, with the strap then extending substantially diagonally across the torso of the occupant.

As will therefore be apparent, a conventional "three-point" seat-belt arrangement such as that described above, suffers from a significant disadvantage in that it only restrains one shoulder of the occupant. It is therefore possible for the other, un-restrained shoulder of the occupant still to

move forwardly with respect to the back rest of the seat under the inertia of the occupant's torso in the event of an accident. It will therefore be seen that conventional "three-point" seat-belt arrangements sometimes do not properly restrain an occupant in the seat, and an allow the occupant's torso to twist out of position with respect to the diagonal part of the seat belt.

Another common problem with conventional "three-point" seat belt arrangements is that it can sometimes be difficult for unusually small seat occupants to manipulate the seat-belt from its initial "open" position to its restraining position in which it extends across the occupant. This is because it is necessary for the occupant to reach across his or her body to grasp a tongue connector slidably provided on the seat-belt and then to move the seat-belt across his or her body to engage the tongue connector in a buckle. Particularly short occupants sometimes have to reach a significant distance behind their shoulder to grasp the tongue connector which can be difficult and inconvenient.

DE 2222251 B2 discloses an alternative type of seat-belt arrangement designed to eliminate some of the afore-mentioned problems of conventional seat-belt arrangements. The arrangement of DE 2222251 B2 comprises a pair of shoulder straps which, in use, extend over respective shoulders of the seat occupant and terminate at a position in the occupant's lap, where the ends of the shoulder straps are secured to a lap belt passing across the occupant's lap.

This arrangement therefore securely restrains both of the occupant's shoulders. However, this arrangement suffers from another problem also associated with the more conventional "three-point" seat-belt arrangements described above, in which it is necessary for the occupant to make-up a releasable connection between parts of the seat-belt arrangement to secure the seat-belt in position. Such a releasable connection, such as the tongue and buckle connection in the above mentioned conventional "three-point" seat-belt arrangement, represents a point of relative mechanical weakness in the seat-belt arrangement which increases the risk of failure of the seat-belt arrangement in the event of a serious accident.

Another problem with the arrangement of DE 2222251 B2, is that it provides no mechanism or arrangement configured to tension the lap-belt against the occupant of the seat, in the event that forward movement of the occupant's torso due to inertia tensions the shoulder-straps. In the event that a frontal impact occurs, it is desirable to provide a mechanism or arrangement to tension the lap-strap against the occupant's lap to prevent any tendency of the occupant's body to slip forwardly underneath the lap-strap.

It is therefore an object of the present invention to provide an improved seat-belt arrangement.

According to the present invention, there is provided a seat-belt arrangement for restraining an occupant sitting in a seat, the arrangement comprising:

a lap-belt having the opposed ends thereof connected to a mounting point or points on the seat, at least one said end being connected to the mounting point by being wound on a lap-retractor secured to the mounting point, the lap-belt being arranged to be moveable between an entry position in which the lap-belt is substantially clear of the squab of the seat and a restraining position in which the lap-belt extends across the lap of an occupant sitting in the seat;

a pair of shoulder-straps, each shoulder-strap being secured at one end thereof to the lap-belt and being wound at the other end thereof on a shoulder-retractor, the shoulder straps being configured to extend from the lap-belt and over respective shoulders of the occupant when the lap-belt adopts said restraining position; wherein

the mounting point or points are fixed in position, the lap-belt being withdrawn from the lap-retractor during movement of the lap-belt between said entry and restraining positions, without movement of the lap-retractor relative to the mounting point to which it is secured.

Preferably, each end of the lap-belt is wound on a respective lap-retractor.

Advantageously, both ends of the lap-belt are wound on the same lap-retractor.

Conveniently, each shoulder-strap is wound on the same shoulder-retractor.

Preferably, each shoulder-strap is fixedly secured at said one end to the lap-belt.

Advantageously, the seat-belt arrangement further comprises a mechanism configured to tension the lap-belt against the occupant when the lap-belt adopts said restraining position, in response to application of a predetermined tension to the shoulder straps.

According to a second aspect of the present invention, there is provided a seat-belt arrangement for restraining an occupant sitting in a seat, the arrangement comprising:

a lap-belt having the opposed ends thereof connected to a mounting point or points on the seat, at least one said end being connected to the mounting point by being wound on a lap-retractor secured to the mounting point, the lap-belt being arranged to be moveable between an entry position in which the lap-belt is substantially clear of the squab of the seat and a restraining position in which the lap-belt extends across the lap of an occupant sitting in the seat;

a pair of shoulder-straps, each shoulder-strap being secured at one end thereof to the lap-belt and being wound at the other end thereof on a shoulder-

retractor, the shoulder straps being configured to extend from the lap-belt and over respective shoulders of the occupant when the lap-belt adopts said restraining position; and

a mechanism configured to tension the lap-belt against the occupant when the lap-belt adopts said restraining position, in response to application of a predetermined tension to the shoulder-straps.

Preferably, said the or each shoulder-retractor is arranged to move relative to the squab of the seat upon application of said predetermined tension to the shoulder straps, and wherein said mechanism is configured to move at least one end of the lap-belt downwardly in response to said movement of the or each shoulder-retractor.

Advantageously, the or each shoulder-retractor is secured to a first arm of an element pivotally mounted to the seat, and said at least one moveable end of the lap-belt is anchored to a second arm of said element.

Conveniently, at least one said lap-retractor is secured to said second arm of the said element.

Preferably, the or each shoulder-retractor is arranged for sliding movement relative to the back-rest of the seat and is tethered to a wedge

element, the wedge element being arranged for movement relative to the squab of the seat to urge the or each said moveable end of the lap-belt downwardly.

Advantageously, the or each lap-retractor is arranged to be urged downwardly by movement of said wedge element.

Conveniently, each retractor comprises an inertia reel.

So that the invention may be more readily understood, and so that further features thereof may be appreciated, embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a front perspective view of a seat-belt arrangement installed upon a seat,

Figure 2 is a rear perspective view of the seat-belt arrangement illustrated in Figure 1,

Figure 3 is a front perspective view generally corresponding to that of Figure 1, illustrating an occupant manipulating the seat-belt arrangement in a first stage of operation towards a restraining position,

Figure 4 is a view corresponding generally to that of Figure 3, illustrating the occupant moving the seat-belt arrangement through a subsequent stage of operation towards the restraining position,

Figure 5 is a view corresponding generally to those of Figures 3 and 4, illustrating the seat-belt in its restraining position across the occupant,

Figure 6 is a perspective view from the rear and one side, illustrating the seat-belt arrangement in the restraining position illustrated in Figure 5,

Figure 7a is a schematic side view of a first embodiment of a mechanism of the seat-belt arrangement, illustrated in an initial position;

Figure 7b is a view corresponding to that of Figure 7a, illustrating the mechanism in a second position;

Figure 8a is a schematic side view illustrating a second embodiment of a mechanism of the seat-belt arrangement; and

Figure 8b is a view corresponding to that of Figure 8a, illustrating the mechanism in a second position.

Referring initially to figures 1 and 2, there is illustrated a seat-belt arrangement installed on a generally conventional motor vehicle seat 1, the seat 1 comprising a squab 2, a back-rest 3 and a head restraint 4. The seat-belt arrangement essentially comprises a lap-belt 5 and a pair of shoulder-straps 6. The lap-belt 5 and the shoulder-straps 6 are each formed from lengths of webbing strap as widely used for seat-belt arrangements.

As illustrated most clearly in Figure 1, the lap-belt 5, when viewed from the front of the seat 1, extends from one side of the seat in the general region where the squab 2 meets the back-rest 3, to the other side of the seat, in the general region where the squab 2 meets the back-rest 3. The seat-belt arrangement is illustrated in Figure 1 in its initial "entry" position ready for an occupant to sit upon the seat 1 and move the seat-belt arrangement towards a restraining position across the occupant. It will be seen that in this initial "entry" position, the lap-belt 5 extends upwardly in the middle, from the squab 2 towards the uppermost region of the back-rest 3.

The two shoulder straps 6 each extend over the uppermost end of the back-rest 3, around the outside of respective sides of the head-rest 4. As illustrated in Figure 1, the shoulder straps 6 extend from the rear of the back-rest 3, over the uppermost end of the back-rest 3 and downwardly to a position

at which the end 7 of each shoulder strap 6 is permanently and fixedly secured to the lap-belt 5 in a generally central region of the lap-belt. The end 7 of each shoulder strap 6 is secured to the lap-belt 5 by reinforced stitching in a manner known *per se*.

With particular reference to Figure 2, it will be seen that, at the rear of the back-rest 3, the shoulder straps 6 each extend downwardly towards a shoulder-retractor reel 8 which is permanently secured (at 9) to the seat structure, in the lower region of the back-rest 3. In the arrangement illustrated in Figure 2, each shoulder strap 6 is wound around the same shoulder-retractor reel 8, although it should be appreciated that in an alternative arrangement, each shoulder strap 6 could be wound upon a separate, respective shoulder-retractor reel 8 permanently secured to the seat structure.

Also having reference to Figure 2, it will be seen that the lap-belt 5 passes around the seat structure such that each end of the lap-belt 5 is wound, from opposite sides, on a single lap-retractor reel 10. The lap-retractor reel 10, is again permanently secured to the seat structure, at a mounting point slightly below the shoulder-retractor reel 8.

Because both the shoulder-retractor reel 8 and the lap-retractor reel 10 remain permanently secured to the seat structure throughout normal use of the

seat-belt arrangement, it should therefore be clear that each shoulder-strap 6 is effectively permanently secured at one end to the seat structure, and the lap-belt 5 is permanently secured at both ends to the seat structure.

Each retractor reel 8, 10 is configured, in a manner known *per se*, to be biased so as to reel in any slack in the respective shoulder-strap 6 and lap-belt 5. Also, as is commonly known in seat-belt arrangements, each retractor reel 8, 10 is of the inertia-reel type configured to lock up when a sudden tension is applied to the shoulder-straps 6 or the lap-belt 5, thereby preventing pay-out of the shoulder-straps 6 and lap-belt 5 respectively from the reels in the event of an accident.

It will therefore now be understood that, in the initial "entry" position illustrated in Figure 1, the lap-belt 5 and the shoulder-straps 6 are held against the forward-most surface of the back-rest 3 by virtue of the retractor reels 8, 10 taking up any slack in the lap-belt 5 and the shoulder-straps 6. Furthermore, due to the bias of the shoulder-retractor reel 8, the shoulder-straps 6 pull up the central region of the lap-belt 5 so that it adopts the position illustrated in Figure 1 in which it is slightly below the head-rest 4 at the top of the back-rest 3, and hence the lap-belt 5 and the shoulder-straps 6 are held substantially clear of the squab 2 to allow an occupant to sit on the squab 2 without fouling the seat-belt arrangement.

Turning now to consider Figure 3, an occupant 11 is illustrated sitting in the seat 1, and beginning to move the seat-belt arrangement from the initial "entry" position illustrated generally in Figure 1 towards a restraining position illustrated generally in Figures 5 and 6 in which the seat-belt is positioned across the occupant 11 to restrain the occupant in the seat 1. The occupant 11 is shown in Figure 3 reaching, with one arm 12, behind his or her head 13 to grasp the central region of the lap-belt 5 where it is secured to the ends 7 of the shoulder-straps 6. From this position, the occupant 11 moves his or her arm 12 forwardly, over his or her head 13 to a position in front of his or her torso, as generally indicated in Figure 4. During this movement, the shoulder-retractor reel 8 allows the shoulder straps 6 to be payed out, whilst the lap-retractor reel 10 begins to reel in the lap-belt 5 as the length of the lap-belt across the front of the occupant reduces.

Figure 5 illustrates the seat-belt arrangement of the present invention in its restraining position in which it restrains the occupant 11 in the seat 1. In this position, the occupant 11 has released the central region of the lap-belt 5 in the region of his or her groin, thereby allowing the lap-retractor reel 10 to reel in the lap-belt 5 to remove substantially all of its slack so that it bears against the occupant 11, adopting a restraining position in which it extends across the lap of the occupant. As will be seen, the shoulder-straps 6 each pass over the

uppermost end of the back-rest 3, and extend downwardly in front of the occupant's torso, passing to either side of the occupant's head 13 towards the central region of the occupant's waist.

It should therefore be appreciated that, throughout the entire procedure of manipulating the seat-belt arrangement of the present invention from its initial "entry" position illustrated in Figure 1, towards its final restraining position illustrated in Figures 5 and 6, it is never necessary for the occupant 11 releaseably to engage one component of the seat-belt arrangement with another. In this way, the above-described seat-belt arrangement eliminates the previously identified problem with conventional seat-belt arrangements, in which it is necessary to make up a releaseable connection between two components of the seat-belt arrangement which can represent a point of mechanical weakness. Also, because the seat-belt arrangement of the present invention comprises a pair of shoulder-straps 6 instead of just one, there is less of a tendency for the occupant's torso to twist or for a shoulder to slip from behind the seat-belt.

Turning now to consider Figure 7a, there is illustrated a mechanism 20 actuable upon the application of a predetermined tension to the shoulder-straps 6 to increase the tension in the lap-belt 5 passing over the occupant's lap, in the event of an accident. It is well known that, in the event of a forward impact,

the torso of an occupant within a motor vehicle is caused to move forwardly relative to the motor vehicle structure and the seat, due to the inertia of the occupant's torso. As will therefore be appreciated, the tension of each shoulder strap 6 of the seat-belt arrangement of the present invention will be increased as a result of such forwards movement of the torso of the occupant 11 relative to the back-rest 3 of the seat structure. The mechanism 20 illustrated in Figure 7 is configured to make use of this phenomenon.

Figure 7 illustrates the back-rest 3 and the squab 2 of the seat (both shown in phantom) being pivotally mounted with respect to one another via a recliner arrangement having a pivot point 21, in a manner known *per se*. The mechanism 20 comprises an element 22 which is pivotally mounted to the seat structure in the general region where the squab 2 meets the back-rest 3 via the pivot 21 between the back-rest 3 and the squab 2. The element 22 has a first arm 23 which extends upwardly from the pivot 21 in the general direction of the back-rest 3. The first arm 23 is fixedly secured to the back-rest 3. The element 22 also comprises a second arm 24 which rigidly connected to the first arm 23 and extends downwardly and forwardly from the pivot point 21, in the general direction of the squab 2. However, the second arm 24 is free to move with respect to the structure of the squab 2. The shoulder-retractor reel 8 is secured to the uppermost end of the first arm 23, whilst the lap-retractor reel 10 is secured to the second arm 24 of element 21.

In the event of a frontal impact, the tension within the shoulder-straps 6 is increased due to the above mentioned effect of inertia on the occupant's 11 torso. This increase in tension in the shoulder-straps 6, if it exceeds a predetermined level, will cause the shoulder-retractor reel 8 on which they are wound to lock-up, preventing pay-out of the should-straps, such that the first arm 23 of the element 22 and the back-rest 3 will then be caused to rotate slightly about pivot point 21, as indicated generally by arrow 25 to a position as illustrated in Figure 7b. Due to the rigid connection between the first arm 23 and the second arm 24 of the element 22, the second arm 24, and hence also the lap-retractor reel 10 secured thereto, are also caused to rotate, as indicated generally by arrow 26, in an anticlockwise direction about pivot point 21 to a position illustrated in Figure 7b. As will therefore be appreciated, this rotational movement of the lap-belt-retractor reel 10 about pivot point 21, causes the lap-retractor reel 10 to move away from the occupant's 11 lap, thereby increasing the tension in the lap-belt 5 extending over the occupant's lap and drawing the lap-belt 5 down more tightly over the occupant's lap. This increase in tension in the lap-belt 5 therefore serves to restrain the occupant 11 more securely, and in particular serves to reduce any tendency of the occupant's lap to slip forwardly in the seat 1, underneath the lap-belt 5.

Figure 8a illustrates an alternative mechanism 30 configured to achieve generally the same results as the mechanism 20 illustrated in Figures 7a and 7b. In this arrangement, the shoulder-retractor reel 8 is secured to the back-rest 3 of the seat structure (the seat being illustrated in phantom), by way of a guide 31, for sliding movement relative thereto. However, the shoulder-retractor 8 is initially fixed in position relative to the guide 31. The shoulder-retractor reel 8 is operatively connected by a flexible cable or wire 32, around a turning block 33 to a generally wedge-shaped element 34 located inside part of the squab 2 of the seat.

The wedge-shaped element 34 has its widest region 35 located towards the front of the squab 2, and its narrowest region 36 located towards the junction between the squab 2 and the back-rest 3.

As illustrated in Figure 8a, the wedge-shaped element 34 is located between a fixed bearing surface 37 inside the squab 2 and the lap-retractor reel 10. The wedge-shaped element 34 is moveable within the seat squab 2, relative to the fixed bearing surface 37 and the lap-retractor reel 10.

In the event of a frontal impact, the occupant's 11 torso moves generally forwardly relative to the seat structure (as shown in Figure 8b), due to its inertia, which results in an increase in tension in the shoulder-straps 6. This

increase in tension in the shoulder-straps 6 causes the should-retractor reel 8 to lock-up, thereby preventing pay-out of the shoulder-straps 6. When the tension in the shoulder-straps 6 exceeds a predetermined valve, the should-retractor reel 8 breaks free and slides upwardly along the guide 31 fixed to the back-rest 3, as indicated generally by arrow 38. This upwards movement of the shoulder-retractor reel 8, by virtue of wire or cable 31, pulls the wedge-shaped element 34 rearwardly relative to the seat squab 2 as generally indicated by arrow 39 towards the position illustrated in Figure 8b. As will therefore be appreciated, by virtue of the wedge-shaped configuration of element 34 and its sliding engagement with the fixed bearing surface 37 movement of the wedge-shaped element 34 in this way urges the lap-retractor downwardly relative to the squab 2. By virtue of the lap-retractor reel 10 becoming locked in the event of an accident to prevent pay out of the lap-belt 5, the tension within the lap-belt 5 is therefore increased, preventing the occupant 11 from moving forwardly underneath the lap-belt 5.

In the present specification "comprises" means "includes or consists of" and "comprising" means "including or consisting of".

The features disclosed in the foregoing description, or the following claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, as appropriate, may, separately, or in any

combination of such features, be utilised for realising the invention in diverse forms thereof.

CLAIMS:

1. A seat-belt arrangement for restraining an occupant sitting in a seat, the arrangement comprising:

a lap-belt having the opposed ends thereof connected to a mounting point or points on the seat, at least one said end being connected to the mounting point by being wound on a lap-retractor secured to the mounting point, the lap-belt being arranged to be moveable between an entry position in which the lap-belt is substantially clear of the squab of the seat and a restraining position in which the lap-belt extends across the lap of an occupant sitting in the seat;

a pair of shoulder-straps, each shoulder-strap being secured at one end thereof to the lap-belt and being wound at the other end thereof on a shoulder-retractor, the shoulder straps being configured to extend from the lap-belt and over respective shoulders of the occupant when the lap-belt adopts said restraining position; wherein

the mounting point or points are fixed in position, the lap-belt being withdrawn from the lap-retractor during movement of the lap-belt between said entry and restraining positions, without movement of the lap-retractor relative to the mounting point to which it is secured.

2. A seat-belt arrangement according to claim 1, wherein each end of the lap-belt is wound on a respective lap-retractor.

3. A seat-belt arrangement according to claim 2, wherein both ends of the lap-belt are wound on the same lap-retractor.

4. A seat-belt arrangement according to any preceding claim, wherein each shoulder-strap is wound on the same shoulder-retractor.

5. A seat-belt arrangement according to any preceding claim, wherein each shoulder-strap is fixedly secured at said one end to the lap-belt.

6. A seat-belt arrangement according to any preceding claim, further comprising a mechanism configured to tension the lap-belt against the occupant when the lap-belt adopts said restraining position, in response to application of a predetermined tension to the shoulder straps.

7. A seat-belt arrangement for restraining an occupant sitting in a seat, the arrangement comprising:

a lap-belt having the opposed ends thereof connected to a mounting point or points on the seat, at least one said end being connected to the mounting point by being wound on a lap-retractor secured to the mounting point, the lap-belt being arranged to be moveable between an entry position in which the lap-belt is substantially clear of the squab of the seat and a restraining position in which the lap-belt extends across the lap of an occupant sitting in the seat;

a pair of shoulder-straps, each shoulder-strap being secured at one end thereof to the lap-belt and being wound at the other end thereof on a shoulder-retractor, the shoulder straps being configured to extend from the lap-belt and over respective shoulders of the occupant when the lap-belt adopts said restraining position; and

a mechanism configured to tension the lap-belt against the occupant when the lap-belt adopts said restraining position, in response to application of a predetermined tension to the shoulder-straps.

8. A seat-belt arrangement according to claim 6 or 7, wherein said the or each shoulder-retractor is arranged to move relative to the squab of the seat upon application of said predetermined tension to the shoulder straps, and wherein said mechanism is configured to move at least one end of the lap-belt downwardly in response to said movement of the or each shoulder-retractor.

9. A seat belt arrangement according to claim 8, wherein the or each shoulder-retractor is secured to a first arm of an element pivotally mounted to the seat, and said at least one moveable end of the lap-belt is anchored to a second arm of said element.

10. A seat belt arrangement according to claim 9, wherein said at least one lap-retractor is secured to said second arm of said element.

11. A seat belt arrangement according to claim 8, wherein the or each shoulder-retractor is arranged for sliding movement relative to the back-rest of the seat and is tethered to a wedge element, the wedge element being arranged for movement relative to the squab of the seat to urge the or each said moveable end of the lap-belt downwardly.

12. A seat-belt arrangement according to claim 11, wherein the or each lap-retractor is arranged to be urged downwardly by movement of said wedge element.

13. A seat-belt arrangement according to any preceding claim, wherein each retractor comprises an inertia reel.

14. A seat-belt arrangement substantially as herein described with reference to and as shown in Figures 1 to 6 of the accompanying drawings.

15. A seat-belt arrangement substantially as herein described with reference to and as shown in Figures 1 to 7b of the accompanying drawings.

16. A seat-belt arrangement substantially as herein described with reference to and as shown in Figures 1 to 6 and 8a and 8b of the accompanying drawings.

Application No: GB 0214275.0 **Examiner:** Peter Macey
Claims searched: 1 - 6, 13 **Date of search:** 20 September 2002

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Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

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Other: Online: WPI, EPODOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	US 3822915	(ALFA ROMEO) see figures 1 - 3	-
A	US 3819197	(GENERAL MOTORS) see figure	-

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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