(57) Abstract: A device for tightening a three-point seat belt is located in the rear of a vehicle. A linear belttightener (1) is located in the region of the vehicle door sill (2) aligned essentially parallel to the vehicle door sill. The linear belttightener acts via a pulling element (6) on the belt webbing of a seat belt. The belt webbing is guided through a belt guide (4) anchored to the vehicle body.
DEVICE FOR TIGHTENING A REAR SEAT BELT

The present invention relates to a device for tensioning a three-point seat belt located in the rear of a vehicle.

DE 85 29 017 U1 teaches a device having anchoring points with a belt buckle of a seat belt retracted by an electrically activated linear belt tightener. The linear belt tightener, which can comprise a pyrotechnic piston driven in a cylinder, acts upon and retracts the seat belt buckle in the event of a crash to tighten the seat belt.

The three anchoring points of a three-point seat belt are the belt buckle, an end fitting located at the end of the belt webbing and fastened to the vehicle body, and a belt guide at approximately shoulder height or, if necessary, adjustable in height, around which the seat belt webbing is guided to a seat belt retractor.

There is provided in accordance with the present invention a device for tightening a three-point seat belt located in the rear of a vehicle comprising: a linear belt tightener located in the region of a vehicle door sill that extends between a B-column and a C-column of a vehicle, the linear belt tightener being aligned essentially parallel to the vehicle door sill, the linear belt tightener engaging a pulling element attached to a seat belt webbing that is guided through a belt guide anchored to a vehicle body, the pulling element is moved approximately parallel to the vehicle door sill during the tightening process.
Brief Description of the Drawings

Fig. 1 is a diagrammatic view of an embodiment of the invention.

Fig. 2 shows a belt guide that can be employed in the embodiment shown in Fig. 1.

Fig. 3 shows a further embodiment of the invention.
Detailed Description of the Invention

As used herein and in the claims terms such as front, back, above, below, top, bottom, forward, rearward, and the like should be understood to refer to directions in regards to a motor vehicle in which a device according to the invention disclosed herein has been installed.

The embodiment represented in Fig. 1 has a linear belt tightening 1 located in the region of a vehicle door sill 2 that extends between the B-column 9 and the C-column 10 of a vehicle body. The linear belt tightening is preferably secured to the vehicle door sill 2 and/or a floor panel 17, which shown only in part. The linear belt tightening 1 comprises a cylinder in which a piston, shown in broken lines, is pyrotechnically driven in a known manner. A linear belt tightening of this type is known for instance from US 6 186 549 or US 5 519 997 for tightening a seat belt. It is also possible, however, to design the linear belt tightening as an electrically operated actuator.

The linear belt tightening 1 has a pulling element 6 that is connected to one end of the belt webbing 5 of a seat belt. The belt webbing 5 is deflected by a belt guide 4. The belt guide 4 is located at approximately the end of the vehicle door sill 2, in particular at a location where the vehicle body 7 is angled in the region in where the vehicle door sill 2 and the C-column 10 coincide. This located concealed by the upholstery of the rear seat or the rear bench.

As shown in the figures, the belt guide 4 comprises a deflection bar 3, around which the belt webbing coming from above is deflected in a direction running approximately parallel to the vehicle door sill 2. The deflection bar 3 is oriented obliquely to the vehicle door sill, at a 90° deviating angle, preferably at an angle of approximately 45° to the longitudinal center line of the deflected belt webbing 5, as shown in Fig. 2.

In the figures, the belt webbing 5 is in a resting position, i.e. in a non-fastedened state. It has been removed and retracted by the seat belt.
retractor (not further represented). At the same time, the seat belt retractor forms the anchoring point of the seat belt, foreseen at approximately shoulder height, whereby the belt webbing can be guided in a known manner via another belt guide (not further represented), anchored to the car body at approximately shoulder height.

The angle adopted by the deflection bar ensures that the belt webbing 5 is guided to the upper anchoring point, located at approximately shoulder height of the vehicle occupant, while fitting closely and without folds or creases to the ascending rear back outline of the seat bench or the rear seat, and remaining crease-free. The angle of deflection of the belt webbing by the deflection bar 3 varies according to vehicle type. The belt webbing angle of deflection ensures that in the event of a crash, within a short period of time of approximately 4 milliseconds, approximately 120 millimeters of belt webbing can be drawn through the belt guide of the linear belt tightener 1 with a high expenditure of force. This period of time ensures that the tightening of the belt webbing can take place prior to the forward displacement of the seat belt wearing vehicle occupant. In addition, the belt guide 4 can be deformed during the tightening process and/or pivoted around its anchoring point 18, at which it is secured to the vehicle body 7, due to the forces arising during the tightening process. This ensures that due to the dynamic load during the tightening process the preferably triangular-shaped belt guide assumes the most favorable orientation according to seat belt fastening configurations. This ensures that the belt webbing 5 causes minimal friction, is deflected without causing injury, and is retracted through the belt guide 4 by the linear belt tightener 1.

During the initial phase of a crash, i.e. during the approximately first 15 milliseconds approximately 30 to 35 millimeters of chest belt webbing is retracted through the buckle tongue anchored in the belt buckle, via the lap belt to which the belt webbing 5 shown in the figures leads. Due to the direct belt webbing retraction at the lap belt, the belt force effects on the seat belt wearing vehicle occupant are favorably
affected in two respects. On one hand, the pressure exerted by the chest belt is reduced by as much as 10 to 20%. On the other hand, the peak restraint force on the lap belt that occurs during the crash is more even and reduced.

In the embodiment shown in Figs. 1 and 2, the pulling element 6 of the linear belt tightener 1 acts upon the end 19 of the belt webbing. This pulling element can be a pull bar, traction cable or the like. The pulling element 6 is firmly connected to a driving part driven in the linear belt tightener, for instance to a pyrotechnically driven piston, which is shown in broken lines. The movement of the pulling element 6 during the tightening process is directed towards the front of the vehicle. During the belt tightening process the belt webbing 5, which lies above the seat surface, is pulled downwards to the belt guide 4.

Since the linear belt tightener 1 can only move in one direction, namely in the belt tightening direction, and is blocked in the opposite direction by a blocking element, the linear belt tightener, along with the belt guide 4, functions during normal driving conditions as an end fitting with which the end 19 of the belt webbing is anchored to the vehicle body. At the same time, this arrangement creates a final fittingtightener, through which the seat belt, for instance in the event of a crash, is tightened. Here traction is exerted on the belt webbing 5 from below. When fastening a child’s safety seat with the help of the seat belt of the rear seat or bench of the vehicle, the child’s safety seat is drawn into the seat upholstery.

An electrical cable 8 extends between a front end 15 of the linear belt tightener 1, and an electrical connection or junction point. Preferably the electrical connection or junction point is a plug-in connection 11 in the region of the B-column 9 of the vehicle provided with plugs and plug sockets or other suitable connection means. The electrical cable 8 conducts a current to an igniter which ignites a propellant in the cylinder or in a working area of the cylinder of the linear belt tightener 1.
This propellant can alternatively be located in the drive piston of the linear drive 1. At the front end 15 of the linear belt tightener 1 a plug socket 16 is provided to ensure the conductive integrity of the cable 8 with the igniter in the linear belt tightener 1. A line (not further represented) can run in the linear belt tightener 1 from the plug socket 16 to the igniter. At the electrical plug-in connection 11, which is located in the region of the B-column 9, a further plug socket can be provided to ensure the conductive integrity of the cable 8. An igniter of a second tightening drive 13 can be connected to the electrical plug-in connection 11 via a further cable 12.

The second tightening drive 13 serves as a tightening drive for a belt reel of a seat belt retractor 14 that is secured to the B-column 9. Therefore a common electrical connection or junction point, in particular a plug-in connection 11 for the current supply of the igniter of both these tightening drives, is provided for the linear belt tightener 1 and the tightening drive 13. The cables 8, 12 may be current supply cables if both tightening drives 1, 13 are electrical actuators, i.e. as electrical tightening drives.

Due to the arrangement shown in Fig. 1, a reduction in the length of the electrical cable 8 can be achieved. This cable merely requires a length that corresponds to the distance from the front end 15 of the linear belt tightener 1 to the B-column 9.

In the embodiment shown in Fig. 3, the pulling element 6 acts upon a belt web loop 22 of the belt webbing 5 retracted through the belt guide 4. The other components are the same as in the embodiment shown in Figs. 1 and 2. The belt web loop comprises two strands that are guided through a second belt guide 21 foreseen on the pulling element 6. The pulling element 6 acts upon the web loop 22 by this second belt guide 21. The end 19 of the belt webbing on the one strand of the web loop 22 is secured to a second anchoring point 20 on the vehicle body 7. In the embodiment shown in Fig. 3 two anchoring points 18, 20 are provided.

Alternatively, both anchoring points 18, 20 can be joined to form a common anchoring point. In the embodiment shown in Fig. 3, similarly to a pulley block, a double belt webbing retraction length is achieved through
the belt guide 4 during the movement of the pulling element 6 by the linear belt tightener 1. The deflection bar 3 of all the embodiments and the deflection bar of the second belt guide 21 of Fig. 3 preferably provide at the deflection areas surfaces that cause little friction.

Due to the arrangement of the linear tightening drive in the door sill region and the normally present carpet, the loud noise when a pyrotechnically driven tightener is activated is further away from the head of the vehicle occupant. A force limitation action can be integrated in the linear belt tightener.
We claim:

1. A device for tightening a three-point seat belt located in the rear of a vehicle comprising: a linear belt tightener (1) located in the region of a vehicle door sill that extends between a B-column (9) and a C-column (10) of a vehicle, the linear belt tightener being aligned essentially parallel to the vehicle door sill (2), the linear belt tightener engaging a pulling element (6) attached to a seat belt webbing (5) that is guided through a belt guide (4) anchored to a vehicle body, the pulling element is moved approximately parallel to the vehicle door sill during the tightening process.

2. The device according to claim 1 wherein during the tightening process the pulling element (6) is moved toward the front of the vehicle.

3. The device according to claim 1 wherein the pulling element (6) is connected to an end of the belt webbing (5).

4. The device according to claim 1 wherein the pulling element (6) acts upon a belt web loop of the belt webbing guided through the belt guide such (4) that the belt webbing (5) is anchored to the vehicle body.

5. The device according to any of claims 1 to 4 wherein the belt guide (4) is located at approximately a rear end of the vehicle door sill.

6. The device according to any of claims 1 to 4 wherein the belt guide (4) is located in a region where the vehicle door sill (2) and the C-column (10) coincide.
7. The device according to any of the preceding claims wherein the belt guide (4) comprises a deflection bar (3) that extends obliquely to a longitudinal center line of the of the belt webbing (5) guided through the belt guide.

8. The device according to any of the preceding claims wherein the belt guide (4) pivots around an anchor.

9. The device according to any of the preceding claims further comprising an electrical cable (8) for providing a current to the linear belt tightener (1), and an electrical connection (11) is provided for the cable in the region of the B-column (9) for an electrical cable (12) for the activation of an additional tightening drive (13) that is located in the region of the B-column.
# INTERNATIONAL SEARCH REPORT

## A. CLASSIFICATION OF SUBJECT MATTER

**IPC(?)** : B60R 28/56; A47C 51/00  
**US CL** : 260/801.1, 806, 807, 808; 207/468, 480, 483  
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.** : 260/801.1, 806, 807, 808; 207/468, 480, 483  

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)

- East, West, APS

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>US 5,873,599 A (BAUER et al.) 23 February 1999, see entire document.</td>
<td>1-3</td>
</tr>
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<td>US 5,609,367 A (EUSEBI et al.) 11 March 1997, see entire document.</td>
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<td>X</td>
<td>US 4,350,369 A (CHIKA) 21 September 1982, see entire document.</td>
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<td>A</td>
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<td>1-9</td>
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- Further documents are listed in the continuation of Box C.  
- See patent family annex.