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(54) **ELECTRIC BUCKLE FOR A SAFETY BELT DEVICE OF A VEHICLE**

(57) The invention relates to an electric buckle comprising
-a frame (14) with an insertion slit (5) for a tongue, and
-a latch (6), which is moveable from a latched to a de-latched position and vice versa, wherein
-an electric actuator (1) is provided, which initiates the movement of the latch (6) when activated.

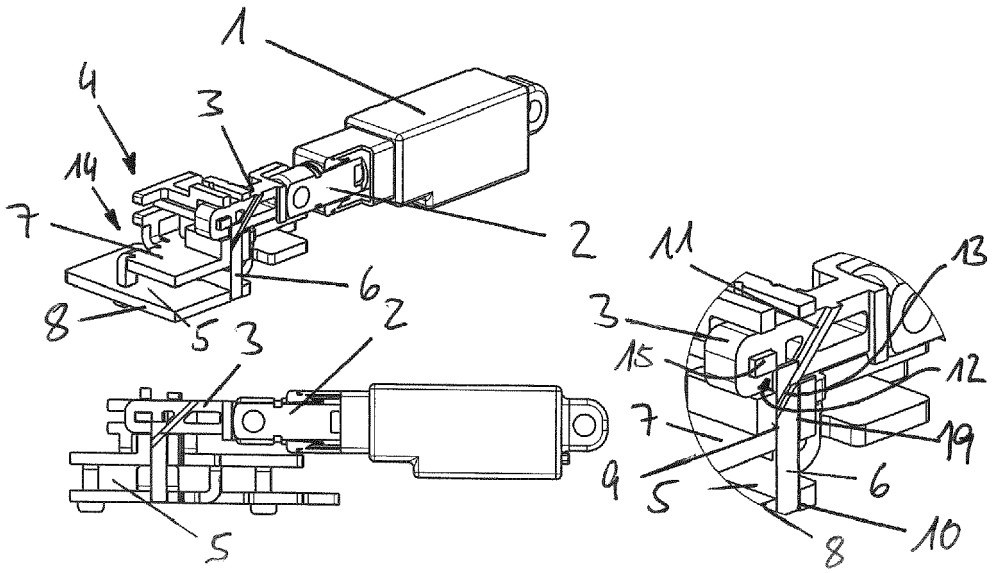

Fig. 1

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Description

[0001] The invention relates to an electric buckle for a safety belt device of a vehicle comprising the features of the preamble of claim 1.

[0002] Safety belt devices for vehicles comprise as basic components a safety belt and a retractor on which the safety belt may be wound on with a first end.

[0003] If the safety belt device is designed as a 3-point belt it does further comprise a bracket, which is attached at a second end of the safety belt, a tongue which is slidably hold on the safety belt and finally a buckle, in which the tongue is lockable. The bracket and the retractor are mounted at the vehicle structure or directly at a seat on one side with respect of the occupant sitting on the seat, and the buckle is mounted on the other side at the vehicle structure or directly at the seat. The seat belt device is fastened by retracting the safety belt from the retractor and locking the tongue in the buckle, wherein the locked tongue subdivides the safety belt in a diagonal shoulder belt section crossing the shoulder of the occupant from the retractor to the locked tongue and a pelvis belt section crossing the pelvis from the locked tongue to the bracket.

[0004] If the safety belt device is designed as a 2-point belt it does comprise instead a tongue which is attached at the second end of the safety belt and a buckle, in which the tongue is lockable. If the safety belt is designed to restrain the occupant via the pelvis the retractor is mounted at on side of the seat at the vehicle structure or directly at the seat, while the buckle is mounted at the vehicle structure or directly at the seat on the other side of the seat. If the safety belt is designed to restrain the occupant via the shoulder, for example as a part of a 4-point belt, the retractor is mounted above the shoulder of the occupant at the vehicle structure or directly at the seat while the buckle is mounted below the shoulder directly at the seat or at the vehicle structure. The seat belt device is fastened in both embodiments by retracting the safety belt from the retractor and locking the tongue in the buckle, wherein the safety belt crosses the pelvis or the shoulder of the occupant.

[0005] In all different embodiments a buckle is used to lock the tongue, which comprises a mechanical locking mechanism having a frame, a latch, which is moveable from a latched to a de-latched position in the frame, and a push button, which enables an easy manual operation of the buckle by the occupant to release the tongue with a movement of the latch to the de-latched position as well as a self-actuated locking movement of the latch to the latched position when inserting the tongue into the buckle.

[0006] One problem of these buckles is that the locking mechanism is based on a complex mechanical interaction of the different parts of the locking mechanism and specially to transfer the movement of the push button to the latch. As the tongue needs to be kept locked also under extreme conditions, and the tongue need to be releasable afterwards to unfasten the safety belt, this mechanical locking mechanism affords a very precise interacting of all parts of the locking mechanism. Furthermore, the buckle is subjected in an accident to extreme accelerations in all directions especially when a reversible or irreversible pretensioner is activated to tension the safety belt. These accelerations are especially high when the pretensioner is arranged at the buckle itself and when the safety belt is tensioned via the tongue by pulling the buckle.

[0007] Starting from this background it is the object of the invention to provide a buckle which is easier to handle and which enables an improved reliable locking of the tongue also when the buckle is subjected to accelerations.

[0008] According to the invention it is suggested an electric buckle comprising the features of claim 1. Further preferred embodiment may be obtained from the subclaims, the figures and the related description.

[0009] According to the basic idea of the invention it is suggested that an electric actuator is provided, which initiates the movement of the latch when activated. The movement of the latch is therefore initiated by an activation of an electric actuator which is independent from any external forces and accelerations and may be operated by an external signal. The suggested solution enables further an integration of the buckle in an electric control circuit. Therefore, the latching movement as well as the de-latching movement of the buckle may be initiated dependent from a signal of a sensor device or dependent from a signal generated by an electric button or a touch surface. Moreover, the electric actuator enables an active starting of the latching or de-latching movement of the latch without the need to apply any forces from external like for example the pressing of a push button.

[0010] Furthermore, it is suggested that the electric actuator performs a linear movement when activated. The advantage of the linear movement can be seen therein that the movement can be very simple transferred to the latch, wherein the movement of the actuator may be also transferred to a movement of the latch in another direction. Electric actuators with a linear movement may be for example piezo stacks or linear drives in general. Another advantage of the suggested movement can be seen therein, that the movement of the actuator can be guided very precisely.

[0011] Furthermore, a link element may be provided, which transfers the movement of the electric actuator to the latch. The link element is used here to provide a connection between the actuator and the latch which enables an arrangement of the actuator more distanced to the latch without the need of a direct connection. This could be advantageous for example with respect to the electric connection or the attachment of the actuator.

[0012] Furthermore, it is suggested that the link element comprises an abutment surface at which the latch abuts at least sectionally, wherein the abutment surface control the movement of the latch because of its contour.

The link element is therefore not only used to transfer the movement from the actuator to the latch but additionally also to control the movement of the latch according to a predefined course.

[0013] In this case the abutment surface may be designed as an oblique plane surface with respect to the movement of the electric actuator, so that the movement may be turned to an angled movement of the latch according to a preferred direction to lock the tongue.

[0014] Furthermore, the latch may comprise a clearance through which the link element is moved by the electric actuator. The latch and the link element are therefore coupled and/or guided in their movements versus each other wherein the clearance in the latch enables additionally a very compact design of the buckle.

[0015] Furthermore, it is suggested that the clearance is limited sidewise at least by one side wall of the latch and the abutment surface abuts at least sectionally at a recess arranged in the side wall. The clearance and the side wall are used thereby for guiding the link element as well as for transferring the movement of the link element to the latch.

[0016] Furthermore, it is suggested that a locking bar is provided, which is moved by the activation of the electric actuator to a locking position in which the locking bar secures the latch in the latched position. The movement of the electric actuator is thereby used not only to operate the movement of the latch itself but also additionally to operate a movement of a locking bar to a locking position to secure the latch against unintended release when it is positioned in the latched position.

[0017] Furthermore, it is suggested that the locking bar is arranged at the link element, so that a very compact design may be realized. Furthermore, the movement of the latch and the movement of the locking bar are directly connected via the movement of the link element.

[0018] Furthermore, it is suggested that the insertion slit is limited by two frame walls, wherein in each of the frame walls are provided openings, which are aligned to each other and in which the latch engages in the latched position.

[0019] In the following the invention shall be illustrated on the basis of preferred embodiments with reference to the accompanying drawings, wherein:

Fig. 1 shows an electric buckle according to the invention with an electric actuator and a locking mechanism in a latched position;

Fig. 2 shows the electric buckle from Fig. 1 with the electric actuator and the locking mechanism in a first intermediate position;

Fig. 3 shows the electric buckle from Fig. 1 with the electric actuator and the locking mechanism in a second intermediate position;

Fig. 4 shows the electric buckle from Fig. 1 with the electric actuator and the locking mechanism in the delatched position.

[0020] In Fig. 1 it is shown an electric buckle according to the invention comprising an electric actuator 1 and a locking mechanism 4 in the latched position. The electric actuator 1 may be realized by a linear drive, a piezo stack or the like, and comprise a piston 2 which is driven to a lateral linear movement when the electric actuator 1 is activated.

[0021] The locking mechanism 4 comprise a frame 14 and a latch 6, wherein the frame 14 is only shown with these parts which are essential for the locking mechanism, while it may comprise further parts like a channel which is designed to be attached at the vehicle structure or at a seat. Furthermore, the electric buckle may comprise a not shown cover to protect the frame 14, locking mechanism 4 and the electric actuator 1 to the outside. Furthermore, the electric buckle may comprise a reversible or irreversible pretensioner, a buckle presenter and a cable to attach the electric buckle at the vehicle structure.

[0022] The frame 14 comprises several parts, wherein two frame walls 7 and 8 are provided, which are arranged parallel and in a distance to each other, so that they are providing an insertion slit 5. The insertion slit 5 is dimensioned according to the dimensions of a not shown tongue and especially to the dimensions of the locking section of the tongue to be inserted therein.

[0023] Each of the frame walls 7 and 8 is provided with an opening 9 and 10, wherein the openings 9 and 10 are aligned to each other, so that the latch 6 may engage in the latched position shown in Fig. 1 both openings 9 and 10. If the not shown tongue would be added in Fig. 1 it would be arranged between the frame walls 7 and 8 and the latch 6 would engage a locking opening of the tongue, so that pulling forces acting on the seatbelt and thereby on the tongue are hold by the latch 6, which is supported by the frame walls 7 and 8, which can be seen as vehicle fixed by the attachment of the buckle at the vehicle structure or at the seat.

[0024] The electric actuator 1 is activated in condition to a signal of a sensor detecting a release procedure of the safety belt, and/or in condition to a signal generated by operating of a button by the occupant or by rescue people in case of an accident or in condition to any other external signal.

[0025] The electric actuator 1 is abutting with the front side of the piston 2 at a slidable link element 3. The latch 6 comprise a clearance 12 through which the link element 3 is extended. The link element 3 further comprises at the side an extending oblique plane abutment surface 11, which is arranged in an angled between 30 to 60 degrees preferably in an angle of 45 degrees with respect to the lateral movement of the piston 2 and the link element 3 itself. Furthermore, the latch 6 is provide with a side wall 19 limiting the clearance 12 with a recess 13 at which the link element 3 is abutting with the front side of

its abutment surface 11. In the front side of the link element 3 is arranged a locking bar 15 which is arranged perpendicular to the lateral movement of the link element 3 and parallel to the top side of the latch 6. The locking bar 15 is further guided in a channel of a part of the frame 14, wherein the channel extends in lateral direction of the movement of the link element 3 while the later explained release of the tongue.

[0026] In the latched position of the latch 6 the locking bar 15 is in a position, in which the locking bar 15 overlaps the topside of the latch 6 and secures thereby the latch 6 in the latched position.

[0027] If the electric buckle receives a signal to release the tongue the electric actuator 1 is activated and the piston 2 is pushed out in the direction of arrow A. Because the piston 2 is abutting with its frontside at the link element 3, the link element 3 is driven also in direction of arrow A. The movements of the piston 2 and the link element 3 are therefore identical. As the link element 3 is abutting with its abutment surface 11 at the recess 13 of the latch 6, the latch 6 is pulled upwards in direction of arrow B. The lateral movement of the link element 3 is transferred by the orientation of the abutment surface 11 and the recess 13 to a lateral movement of the latch 6, which is oriented perpendicular to the lateral movement of the link element 3, which can be seen also by the different orientations of the arrows A and B in the Fig. 2 and 3.

[0028] Fig. 2 and 3 show the positions of the latch 6 in two different intermediate positions during the movement in direction of arrow B in the release procedure. The release movement of the latch 6 is enabled in a first step by moving the link element 3 so far in lateral direction, that the locking bar 15 do not overlap the latch 6 at the topside anymore. Afterwards the latch 6 may be pulled upwards like described above in the direction of arrow B.

[0029] In the first intermediate position the latch 6 is pulled out of the opening 10 of the lower frame wall 8. In the second intermediate position the latch 6 is pulled further to a position in which it does not extend into the insertion slit 5 anymore. Finally, the latch is pulled in a final de-latched position shown in Fig. 4. The insertion slit 5 is released completely and the tongue may be pulled out of the insertion slit 5.

[0030] The latching movement of the latch 6 is realized according to the same principle by pulling the piston 2 against the direction of arrow A and by pushing the latch 6 upwards against direction of arrow B into the insertion slit 5 and the opening 10 of the frame wall 8.

[0031] To support and tension all parts during the movements additional springs may be provided. Furthermore the return movement of all parts may be supported by the springs.

[0032] The latching and de-latching movement of the latch 6 is controlled by the movement of the link element 3, which is driven by the piston 2 of the electric actuator 1. Therefore, the latching and de-latching is controlled independent from external forces and accelerations of the latch 6 and the link element 3. Furthermore, the latch 6 is secured additionally by the locking bar 15 in the latched position, wherein the locking bar 15 is also moved together with the link element 3. Therefore, also the securing of the latch 6 is also controlled by the electric actuator 1 independent from external forces.

Claims

1. Electric buckle comprising

   - a frame (14) with an insertion slit (5) for a tongue, and
   - a latch (6), which is moveable from a latched to a de-latched position and vice versa,
   characterized in that,
   - an electric actuator (1) is provided, which initiates the movement of the latch (6) when activated.

2. Electric buckle according to claim 1, **characterized in that**,

   - the electric actuator (1) performs a linear movement when activated.

3. Electric buckle according to claim 1 or 2, **characterized in that**,

   - a link element (3) is provided, which transfers the movement of the electric actuator (1) to the latch (6).

4. Electric buckle according to claim 3, **characterized in that**,

   - the link element (3) comprises an abutment surface (11) at which the latch (6) abuts at least sectionally, wherein the abutment surface (11) controls the movement of the latch (6) because of its contour.

5. Electric buckle according to claim 4, **characterized in that**,

   - the abutment surface (11) is designed as an oblique plane surface with respect to the movement of the electric actuator (1).

6. Electric buckle according to one of the claims 3 to 5, **characterized in that**

   - the latch (6) comprises a clearance (12) through which the link element (3) is moved by the electric actuator (1) .

7. Electric buckle according to one of the claims 4 or 5 and according to claim 6, **characterized in that**

- the clearance (12) is limited sidewise at least by one side wall (19) of the latch (6) and the abutment surface (11) abuts at least sectionally at a recess (13) arranged in the side wall (19).

8. Electric buckle according to one of the claims 1 to 7, **characterized in that**

- a locking bar (15) is provided, which is moved by the activation of the electric actuator (1) to a locking position, in which the locking bar (15) secures the latch (6) in the latched position.

9. Electric buckle according to claim 8 and one of the claims 3 to 7, **characterized in that**

- the locking bar (15) is arranged at the link element (3) .

10. Electric buckle according to one of the claims 1 to 9, **characterized in that**

- the insertion slit (5) is limited by two frame walls (7,8), wherein in each of the frame walls (7,8) are provided openings (9,10), which are aligned and in which the latch (6) engages in the latched position.

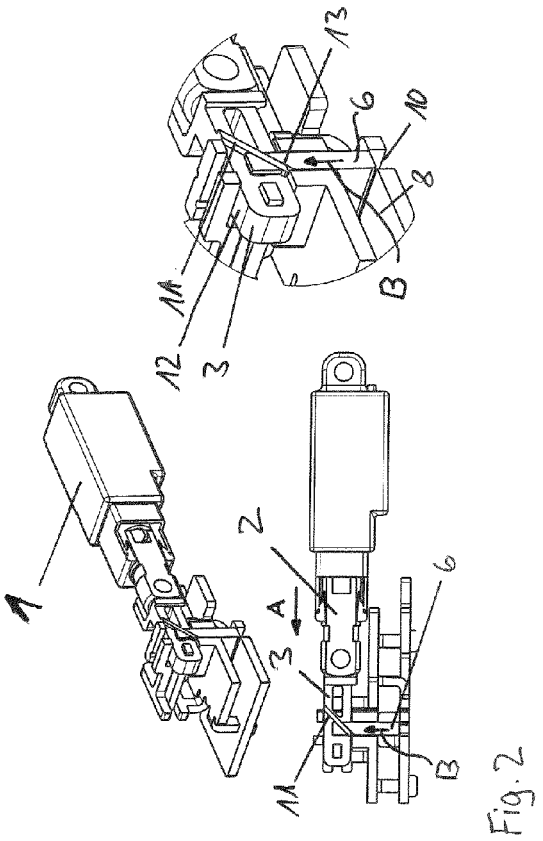

Fig.2

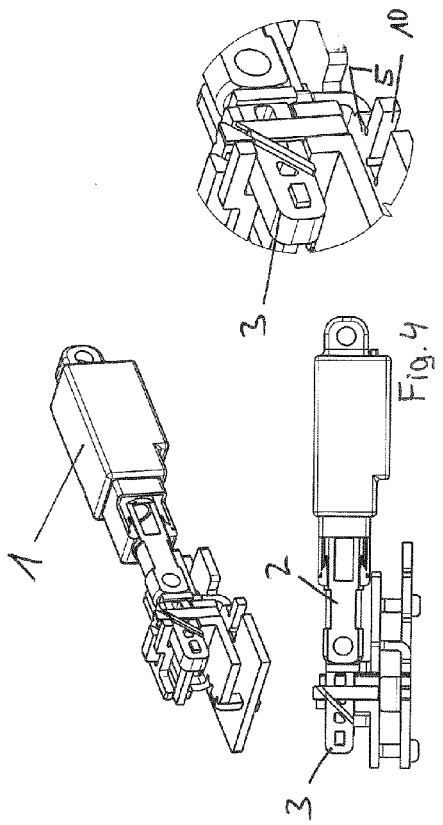

Fig.4

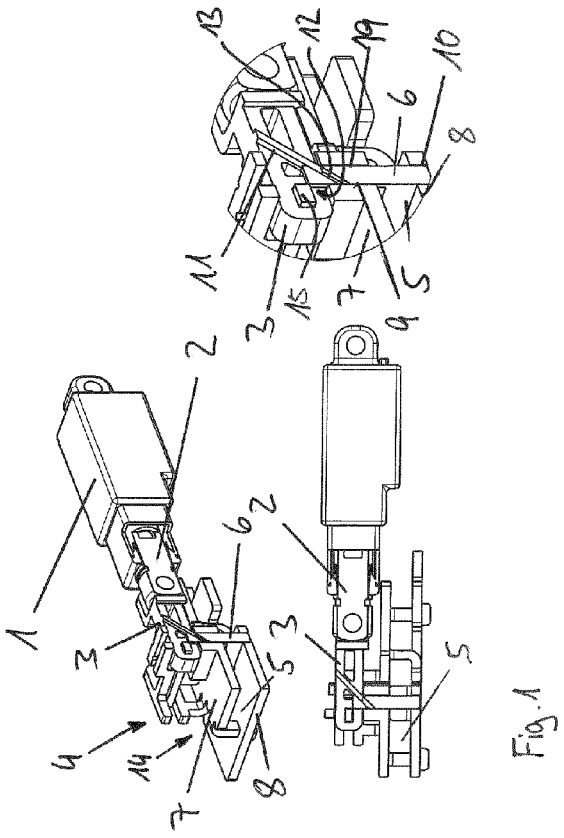

Fig.1

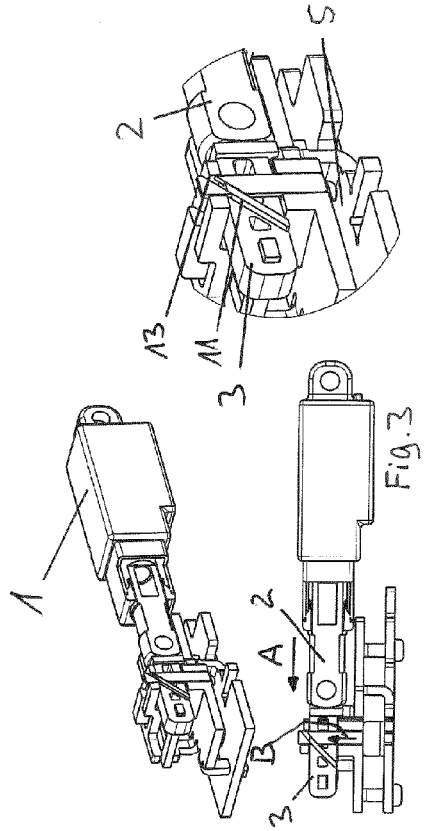

Fig.3

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EUROPEAN SEARCH REPORT

Application Number
EP 22 17 1323

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 5 359 756 A (MIYAUCHI KIYOTAKA [JP] ET AL) 1 November 1994 (1994-11-01) * column 5, lines 6-62; figures *	1-5,8-10	INV. A44B11/25
X	JP H05 185902 A (TAKATA CORP) 27 July 1993 (1993-07-27) * Description; figures *	1-7,10	
A	US 5 280 669 A (NANBU YUICHI [JP] ET AL) 25 January 1994 (1994-01-25) * figures 5a,5b *	10	
X	US 5 907 892 A (TODD MAUREEN [GB]) 1 June 1999 (1999-06-01) * column 2, lines 4-60; figures 1-4 *	1-7	
			TECHNICAL FIELDS SEARCHED (IPC) A44B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	14 September 2022	Gallego, Adoración

CATEGORY OF CITED DOCUMENTS

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