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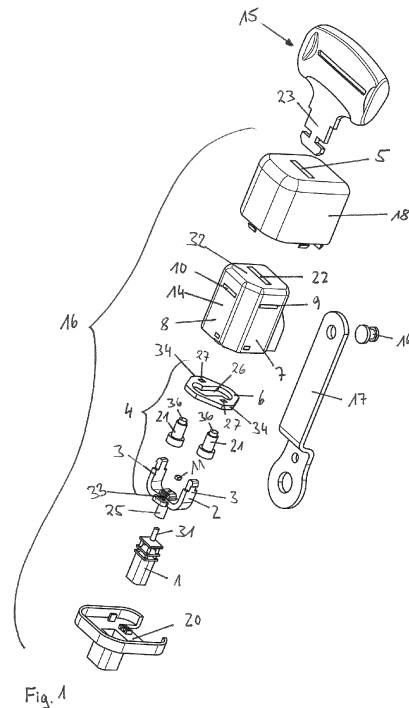
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(54) **ELECTRIC BUCKLE FOR A SAFETY BELT DEVICE OF A VEHICLE**

(57) The invention relates to an electric buckle (16) comprising a frame (14) with an insertion slit (22) for inserting a tongue (15) of a safety belt device, and a locking element (6), which is moveable from a locking position, in which the tongue (15) is locked, to a releasing position, in which the tongue (15) is released, and vice versa, wherein the locking element (6) engages in the locking position into a recess of the frame (14) and a recess (24) of a locking section (23) of the tongue (15), wherein an electric actuator (1) is provided, which initiates the movement of the locking element (6) when activated. The locking element (6) is designed to be ring-shaped with a central opening (26) through which the tongue (15) extends with its locking section (23), wherein a connecting element (2) is provided, which transfers the driving movement of the electric actuator (1) to a rotational movement of the locking element (6) around a rotation axis running in parallel to the insertion direction of the tongue (15) with moving the locking element (6) from the released position to the locked position and vice versa.



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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 held 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 to 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 safety 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 one 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 safety 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 locking element, which is moveable from a locking position in which the tongue is locked to a releasing position in which the tongue is released with respect to the frame, and a push button, which enables an easy manual operation of the buckle by the occupant to release the tongue. If the occupant presses the push button the locking element is moved to the releasing position, while the locking element is moved to the locking position when the occupant inserts the tongue into the buckle automatically.

[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 locking element and to initiate the movement to the locking position when inserting the tongue. As the tongue needs to be kept locked also under extreme conditions, and the tongue needs 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 different directions and preferably to lateral accelerations in different directions especially if a reversible or irreversible pretensioner is activated to tension the safety belt. These accelerations are especially high in a design in which the pretensioner is arranged at the buckle itself and when the safety belt is tensioned via the tongue by pulling the buckle and the locked tongue.

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

[0008] According to the invention it is suggested an electric buckle comprising the features of claim 1. Further preferred embodiments 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 the locking element is designed to be ring-shaped with a central opening through which the tongue extends with its locking section, wherein a connecting element is provided, which transfers the driving movement of the electric actuator to a rotational movement of the locking element around a rotation axis running in parallel to the insertion direction of the tongue with moving the locking element from the releasing position to the locking position and vice versa.

[0010] The suggested solution enables an easy locking and releasing of the tongue with an electric drive which can be triggered preferably via a manually actuable push button for example at the buckle itself, at an instrument panel or in a door trim. Alternatively, the electric drive of the buckle may also be triggered automatically by a signal of a sensor device detecting different driving situations, the presence of an occupant or also different emergency situations. The locking and releasing movement of the locking element is realized by the suggested design by a rotational movement of the locking element, so that the locking mechanism may not be released under high lateral accelerations in an accident and especially during the tensioning of the safety belt. Furthermore, the rotational movement of the locking element may be actuated very easily by an electric drive realized by an electric motor having a rotational driven shaft or by an electric actuator with a longitudinal driven element and a gear mechanism to transmit the longitudinal movement of the longitudinal driven element to the rotational movement of the locking element. The locking element is designed to be ring-shaped with a central opening through which the tongue extends with its locking section, so that the locking element and the locking section of the tongue are overlapping each other, wherein

the locking element with the central opening and the inserted locking section provide a more equal and preferably a symmetric mass distribution of the locking element and the locking section with respect to the rotational axis of the locking element and with respect to the insertion direction of the locking section of the tongue. Therefore, the probability of unintended opening of the locking mechanism due to inertia forces caused by extreme acceleration may be reduced. Furthermore, the suggested design of the locking element and the locking movement enable a very compact design of the buckle by the ring-shaped locking element and the inserted tongue in the locked state. This compact design can be reduced to a minimum of parts if the electric actuator is designed as an electric motor with a rotatable driven shaft and a direct connection of the shaft with the connecting element.

[0011] Furthermore, it is suggested that the central opening of the locking element comprises at least one locking wall with which the locking element engages into the recess of the locking section of the tongue in the locked position. The locking wall enables a positive connection of the locking element and the locking section of the tongue to retain the tongue when pulling forces are acting in the safety belt.

[0012] Furthermore, it is suggested that the central opening of the locking element comprises at least one arc-shaped guiding section, and that a frame fixed bolt is provided, which engages the guiding section. The frame fixed bolt engaging into the arc-shaped guiding section enables a guidance of the locking element during the movement from the locked to the released position and vice versa.

[0013] Furthermore, it is suggested that the locking element comprises at least one opening and the connecting element comprises at least one extending arm, wherein the connecting element engages with the arm into the opening. The locking element and the connecting element are connected via the arm of the connecting element engaging into the opening of the locking element to transmit the driving movement of the electric drive via the connecting element to the locking element.

[0014] Furthermore, it is suggested that the recess in the frame is designed as an opening in a side wall of the frame, and the locking element is provided with at least one outwardly extending protrusion, with which the locking element engages into the recess of the frame. The protrusion engaging into the opening enables a positive connection of the locking element to the frame and therefore, a vehicle fixed connection of the locking element in the locked position. Because of the design as an opening the locking element is fixed in at least two directions defined by the side walls of the opening.

[0015] Furthermore, it is suggested that the locking element is designed as a flat disc which is arranged perpendicular to the insertion direction of the tongue. The locking element is rotated from the locking position to the releasing direction around an axis running parallel to the insertion direction of the locking section of the tongue.

Because of the design of the locking element as a flat disc and the arrangement of the locking element perpendicular to the insertion direction the locking element is rotated in a plane, which is oriented perpendicular to the insertion direction, without performing a movement in the insertion direction of the locking section of the tongue. Therefore, the necessary installation space for the locking element may be reduced to a minimum.

[0016] Furthermore, it is suggested that the electric actuator is realized by an electric motor with a rotationally driven shaft, and the connecting element comprises a tube-shaped projection in which the shaft is rotationally fixed connected. The connecting element is therefore directly connected with the shaft of the electric motor, so that the connection and transmission of the rotary movement from the electric drive to the connecting element is realized with a minimum of parts and a minimum of costs.

[0017] Furthermore, it is suggested that the locking element is rotated in a rotational angle of 20 to 70, preferably 30 to 60 and most preferably 45 degrees from the locked to the released position and vice versa.

[0018] In the following the invention shall be illustrated on the basis of preferred embodiments with reference to the accompanying drawings, wherein:

Fig. 1 shows the electric buckle with a tongue and with the single parts before the assembling; and

Fig. 2 shows the electric buckle with and without the tongue in one position with and without a cover and a frame; and

Fig. 3 a connecting element with a locking element and an electric actuator in different perspectives; and

Fig. 4 the locking element with two bolts and a bolt in single view;

Fig. 5 the electric buckle without the cover in perspective view and in view to a cross section from the bottom with the locking element in the locking and in the releasing position.

[0019] In Fig. 1 it is shown an electric buckle 16 according to the invention of a not shown safety belt device with a tongue 15 and a bracket 17 for mounting the buckle 16 at a not shown vehicle structure or at a not shown seat structure. The electric buckle 16 comprises an electric actuator 1, a locking mechanism 4 with a frame 14, a housing 18 and a bottom housing 20.

[0020] The electric actuator 1 may be realized by a linear drive, a piezo stack or the like, or by an electric motor with a rotational driven shaft 31. The electric actuator 1 is driving a locking mechanism 4 like described afterwards when actuated based on a rotational movement of a locking element 6. As far as an electric actuator 1 with a lateral movement is provided the lateral move-

ment is transferred preferably by an additional gear mechanism to the rotational movement.

[0021] The locking mechanism 4 comprises a frame 14 and the ring-shaped locking element 6, wherein the frame 14 is designed as a load bearing rigid part connected via a rivet 19 with a bracket 17, which is mounted with its free end at the vehicle structure or at the seat structure. Therefore, the frame 14 is fixed at the vehicle structure or at the seat structure via the bracket 17 in a vehicle fixed and load bearing manner. The frame 14 itself may be designed as a metal stamped or pressed part or as a reinforced composite material. The frame 14 is realized with at least two opposing side frame walls 7 and 8, wherein each of the frame walls 7 and 8 is provided with an opening 9 and 10. In the present embodiment the frame 14 is realized with four side frame walls 7 and 8 and a front surface 32 which are connected to a closed cavity with a rectangular cross-section.

[0022] Furthermore, the electric buckle 16 comprises a cover 18 and a bottom cover 20 covering the frame 14, the locking mechanism 4 and the electric actuator 1 to the outside. Furthermore, the electric buckle 16 may comprise a reversible or irreversible pretensioner, a buckle presenter and/or a cable to attach the electric buckle 16 at the vehicle structure.

[0023] The frame 14 comprises several parts, wherein the frame 14 comprises two pairs of frame walls 7 and 8, which are arranged in parallel and in a distance to each other, and an upper front surface 32 with an insertion slit 22. The housing 18 covering the frame 14 is provided also with an insertion slit 5, which is aligned to the insertion slit 22 of the frame 14, when the buckle 16 is assembled. Both insertion slits 5 and 22 are dimensioned according to the dimensions of a locking section 23 of the tongue 15 and especially regarding to the dimensions of the locking section 23 in the cross section plus an additional clearance to enable an easy insertion of the tongue 15 with the locking section 23 into the buckle 16.

[0024] The frame walls 7 and 8 are provided with openings 9 and 10, wherein the openings 9 and 10 are arranged at predefined positions, so that the locking element 6 explained hereafter may engage in the locking position shown in Fig. 5 in both openings 9 and 10. The upper front surface 32 is provided with two circular openings 35 arranged adjacent to the slit 22 like shown in Fig. 5.

[0025] If the tongue 15 is inserted into the insertion slits 5 and 22 and the locking section 23 is locked like described hereafter the pulling forces acting on the safety belt and thereby on the tongue 15 are retained by the locking element 6, which is retained by the frame walls 7 and 8, which can be seen as vehicle fixed by the attachment of the buckle 16 at the vehicle structure or at the seat by the attachment via the bracket 17.

[0026] The electric actuator 1 may be 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 the operation of a button by the occupant

or by rescue people in case of an accident or in condition to any other external signal. The button to operate the buckle 16 may be placed at the buckle 16 directly or at any other part of the interior vehicle structure like for example at an instrument panel, at a door trim, at a seat cover or the like.

[0027] The locking mechanism 4 of the buckle 16 comprises the ring-shaped locking element 6, two bolts 21 and a connecting element 2 connecting the locking element 6 with the electric actuator 1.

[0028] The connecting element 2 itself comprises at the bottom side a tube-shaped projection 25 which extends downwardly from a base plate 33. Furthermore, the connecting element 2 comprises two arms 3 extending from the end sides of the base plate 33 upwardly to a U-shaped geometry of the connecting element 2 like also shown in the figures 2 and 3. Furthermore, a sensor 11 is attached at the base plate 33 which is directed with the sensor surface in the direction of the upwardly extending arms 3 and in the direction of the front surface of the locking section 23 of the tongue 15 when the tongue is locked. The tube-shaped projection 25 comprises a central bore 30, with a not round or polygon cross-section in which the shaft 31 of the electric actuator 1 engages.

The projection 25 provides a rotationally fixed connection of the connecting element 2 with the shaft 31 of the electric actuator 1.

[0029] The ring-shaped locking element 6 comprises a central opening 26 and two smaller openings 27 arranged at opposite sides of the central opening 26 like shown in figure 1 and 4. The central opening 26 comprises further two opposing parallel arranged locking walls 28 and two opposing arc-shaped end-sections 29 connecting the locking walls 28 at their ends. The bolts 21 each comprise a central cylindrical section 38, a head 37 with a bigger diameter and at their free ends a cylindrical section 36 with a smaller diameter.

[0030] The bolts 21 are fixed with their end sections 36 in the circular openings 35 of the front surface 32 of the frame 14. Furthermore, the bolts 21 are engaging the arc-shaped sections 29 of the central opening 26 of the locking element 6 with their central sections 38 and are exceeding further with their heads 37 the side rim of the arc-shaped sections 29 at the side facing towards the base plate 33.

[0031] The extending arms 3 are provided at their free ends with pins 40 which are sectioned by steps 39 to smaller outer dimensions from the arms 3. The arms 3 engage with the pins 40 into the openings 27 of the locking element 6 and provide thereby a positive connection of the connecting element 2 with the locking element 6. The locking element 6 is fixed by the pins 40 and the steps 39 in a predefined position in a plane which is arranged perpendicular to the insertion direction of the locking section 23.

[0032] The locking section 23 of the tongue 15 is provided with two recesses 24 in the side rims in form of cut-out sections, which are arranged in a distance to the free

end of the locking section 23 which corresponds to the distance or is smaller than the distance between the front surface of the sensor 11 and the steps 39 of the arms 3, so that the recesses 24 are arranged opposite to the pins 40 and in the plane in which the locking element 6 is arranged when the tongue 15 is inserted with its locking section 23 into the buckle 16, like shown in the bottom right figure of figure 2.

[0033] In the left figure of the figure 5 it is shown the buckle 16 with the frame 14 without a tongue 15. Each of the opposing frame walls 7 and 8 are provided with an opening 9 and 10, which are designed as slits, which are arranged with their longer sides perpendicular to the insertion direction of the locking section 23 of the tongue 15 shown in figure 2. Furthermore, the slits are arranged in the plane in which the locking element 6 is arranged.

[0034] In the middle figures of figure 5 it is shown the buckle 16 in a cross section from the bottom with the locking element 6 in the releasing position without the bolts 21 and with the bolts 21. The locking element 6 got an outer shape which is adapted to the inner shape of the frame 14, with two opposing protrusions 34 and 31 extending radially to the outside. The outer dimensions of the locking element 6 are smaller than the inner dimensions of the frame 14, so that the locking mechanism 4 with the locking element 6 and the connecting element 2 may be inserted into the frame 14 in the assembly process.

[0035] When the electric actuator 1 is activated to lock an inserted tongue 15 the locking element 6 is rotated in an angle of 45 degrees in the direction of the arrow shown in the right figure of figure 5 to the locking position. The locking element 6 may be also rotated instead in an angle between 20 to 70, preferably 30 to 60 degrees, as far as the tongue 15 may be inserted and released in the releasing position of the locking element 6 and is locked in the locking position of the locking element 6. During this movement the locking element 6 gets into engagement with the opposing protrusions 34 and 41 into the opposing openings 9 and 10 in the side frame walls 7 and 8 of the frame 14. At the same time the locking element 6 gets into engagement with the locking walls 28 into the recesses 24 of the locking section 23 of the tongue 15. Therefore, the locking element 6 provides of force-fitting connection to the tongue 15 and to the frame 14 in the locking position, so that the tongue 15 is locked also in a vehicle fixed manner via the locking element 6, the frame 14 and the bracket 17. To release the tongue 15 the locking element 6 is rotated backwards wherein protrusions 34 and 41 get out of the openings 9 and 10 and the locking walls 28 get out of the recesses 24 of the tongue 15 in the releasing position.

Claims

1. Electric buckle (16) comprising

- a frame (14) with an insertion slit (22) for inserting a tongue (15) of a safety belt device, and
- a locking element (6), which is moveable from a locking position, in which the tongue (15) is locked, to a releasing position, in which the tongue (15) is released, and vice versa, wherein
- the locking element (6) engages in the locking position into a recess of the frame (14) and a recess (24) of a locking section (23) of the tongue (15), wherein
- an electric actuator (1) is provided, which initiates the movement of the locking element (6) when activated **characterized in that**,
- the locking element (6) is designed to be ring-shaped with a central opening (26) through which the tongue (15) extends with its locking section (23), wherein
- a connecting element (2) is provided, which transfers the driving movement of the electric actuator (1) to a rotational movement of the locking element (6) around a rotation axis running in parallel to the insertion direction of the tongue (15) with moving the locking element (6) from the released position to the locked position and vice versa.

2. Electric buckle (16) according to claim 1, **characterized in that**

- the central opening (26) of the locking element (6) comprises at least one locking wall (28) with which the locking element (6) engages into the recess (24) of the locking section (23) of the tongue (15) in the locking position.

3. Electric buckle (16) according to claim 1 or 2, **characterized in that**

- the central opening (26) of the locking element (6) comprises at least one arc-shaped guiding section (29) and a frame fixed bolt (21) is provided, which engages the guiding section (29).

4. Electric buckle (16) according to anyone of the claims 1 to 3, **characterized in that**

- the locking element (26) comprises at least one opening (27) and the connecting element (2) comprises at least one extending arm (3), wherein
- the connecting element (2) engages with the arm (3) into the opening (27).

5. Electric buckle (16) according to anyone of the claims 1 to 4, **characterized in that**

- the recess in the frame (14) is designed as an opening (9,10) in a side frame wall (7,8) of the

frame (14), and

- the locking element (6) is provided with at least one outwardly extending protrusion (34,41), with which the locking element (6) engages into the recess of the frame (14) .

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6. Electric buckle (16) according to anyone of the claims 1 to 5, **characterized in that**

- the locking element (6) is designed as a flat disc which is arranged perpendicular to the insertion direction of the tongue (15).

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7. Electric buckle (16) according to anyone of the claims 1 to 6, **characterized in that**

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- the electric actuator (1) is realized by an electric motor with a rotationally driven shaft (31), and
- the connecting element (2) comprises a tube-shaped projection (25) in which the shaft (31) is rotationally fixed connected.

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8. Electric buckle (16) according to anyone of the claims 1 to 7, **characterized in that**

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- the locking element (6) is rotated in a rotational angle of 20 to 70, preferably 30 to 60 and most preferably 45 degrees from the locked to the released position and vice versa.

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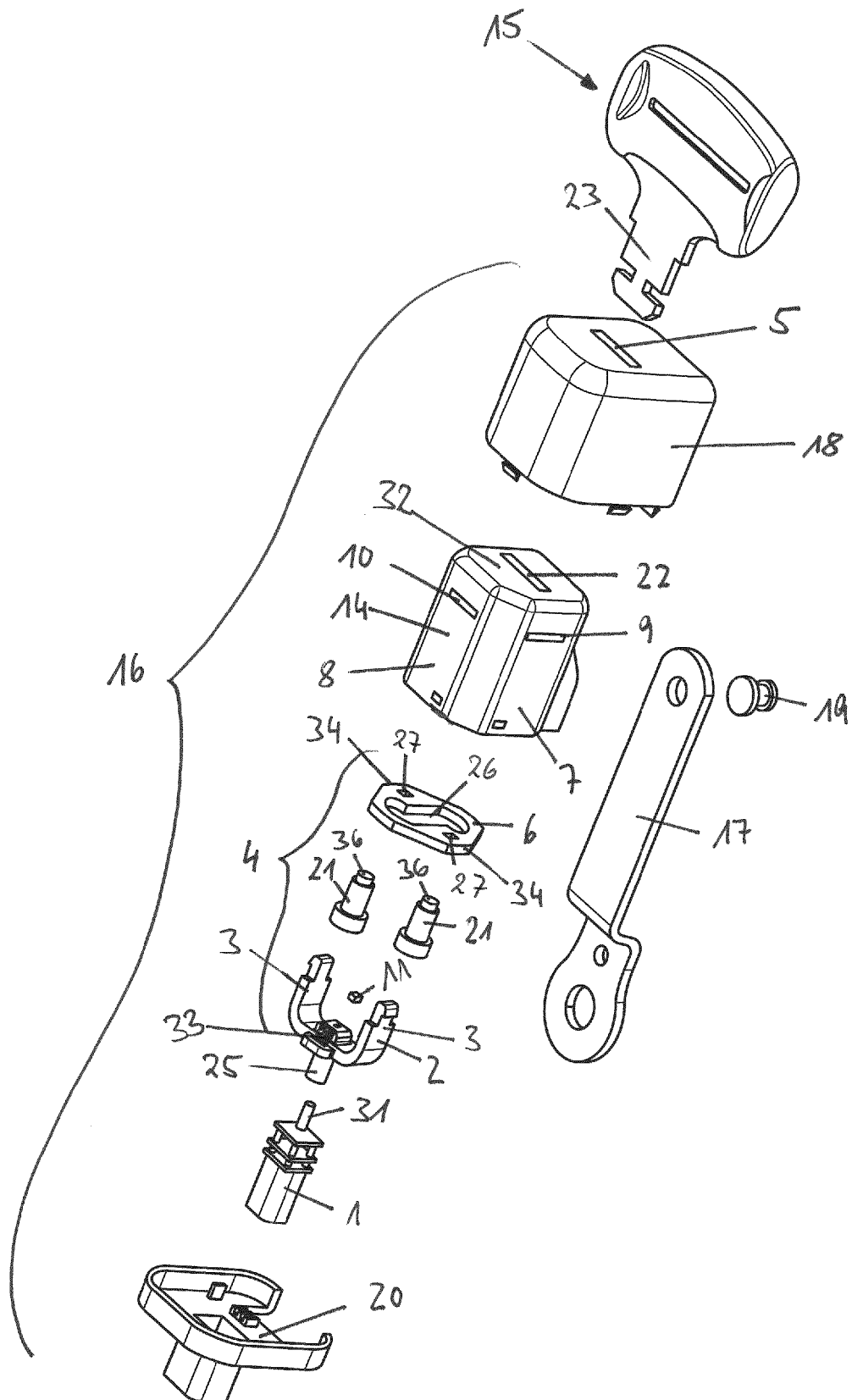


Fig. 1

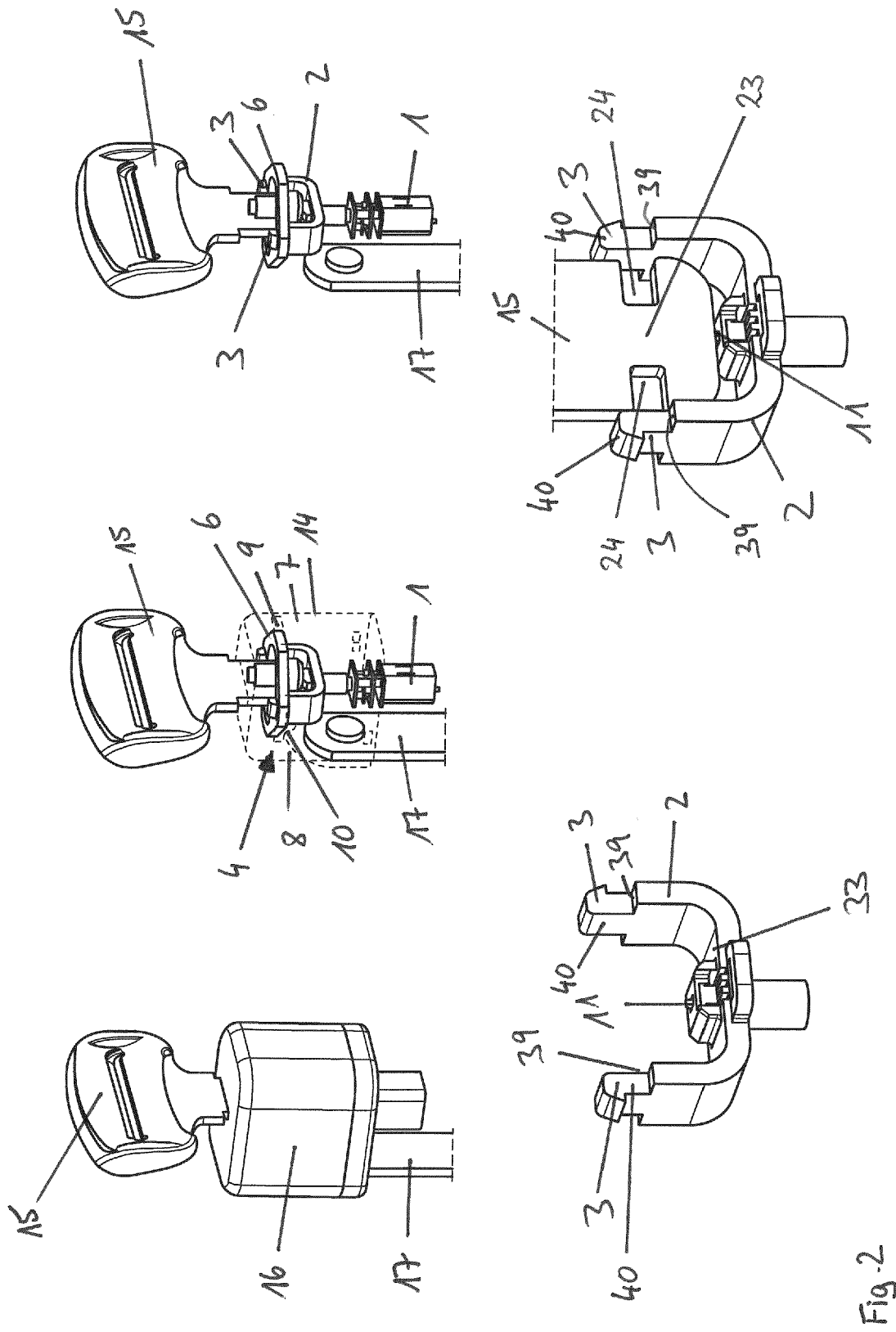
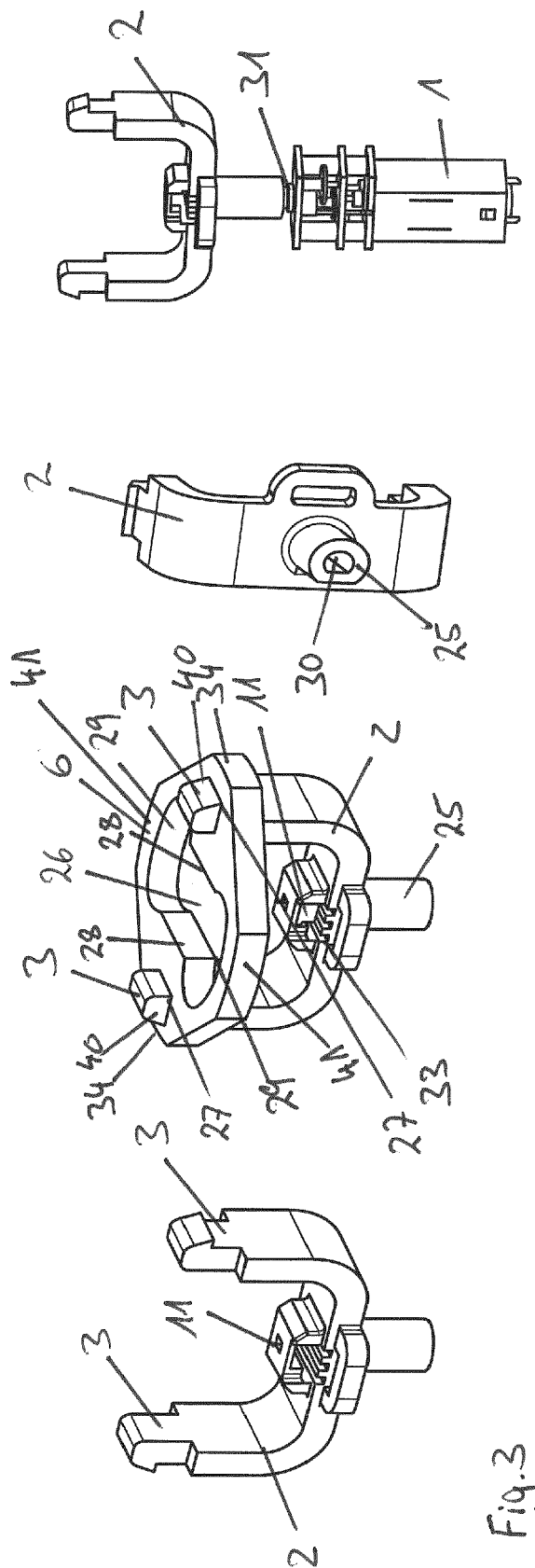
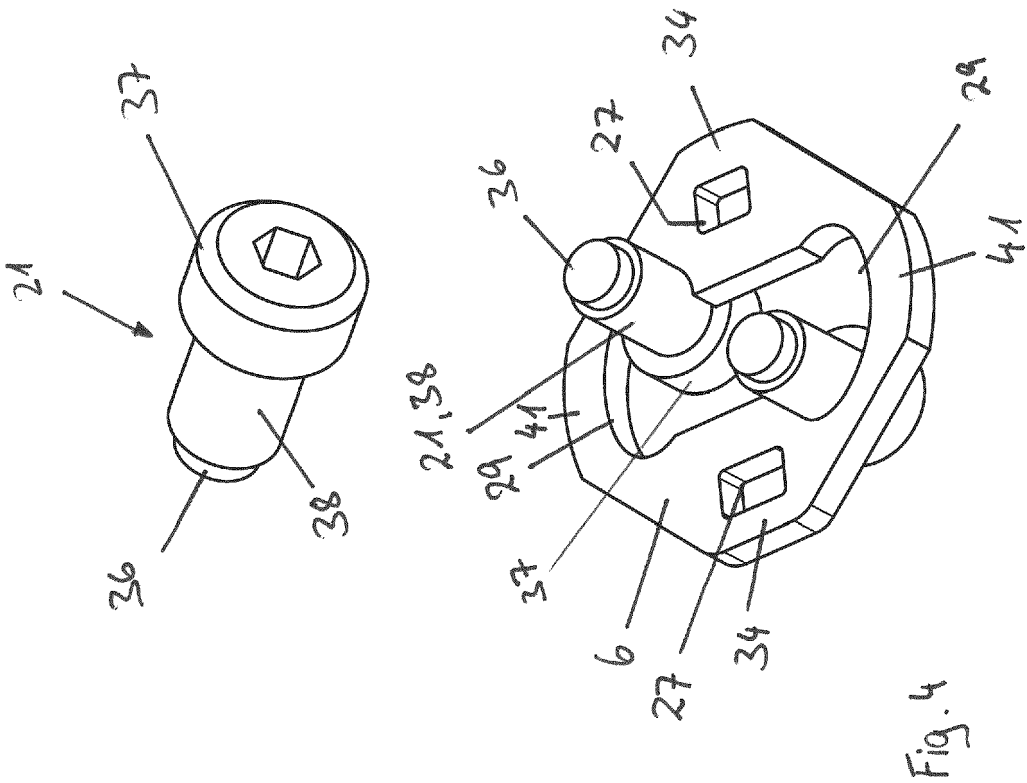


Fig. 2





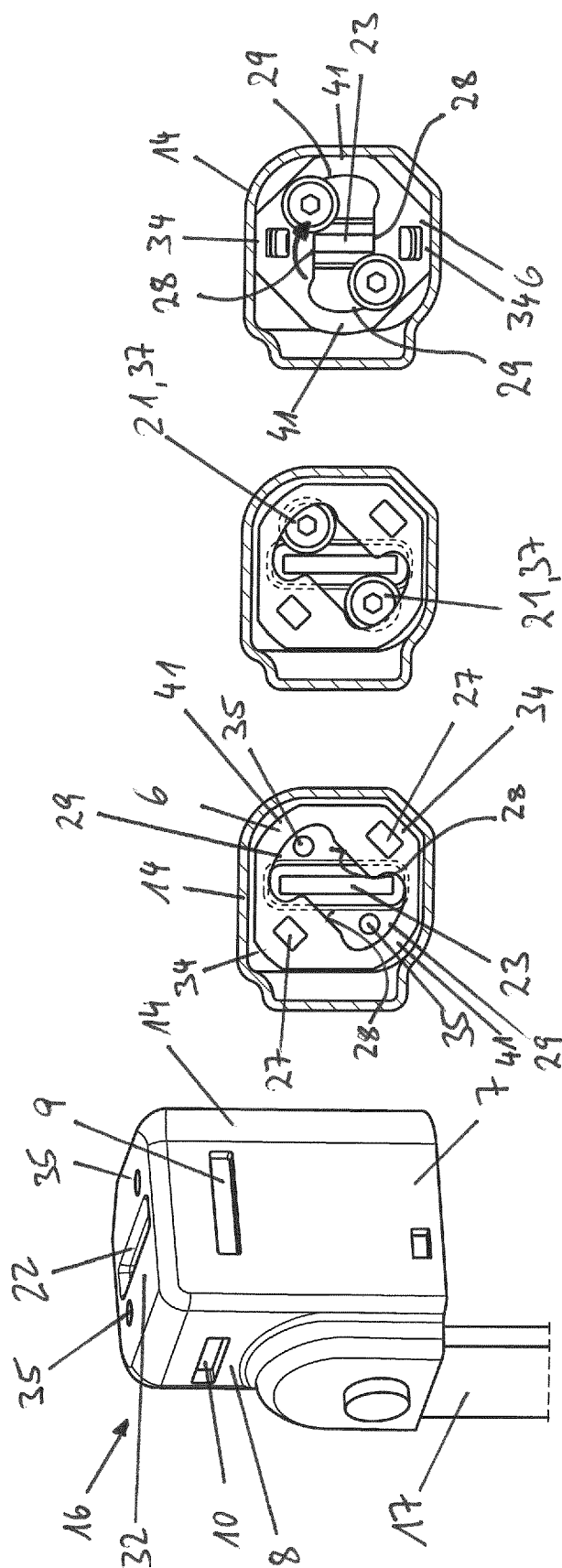


Fig. 5



EUROPEAN SEARCH REPORT

Application Number

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EPO FORM 1503 03.82 (P04C01)

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A	KR 200 386 214 Y1 (NN) 13 June 2005 (2005-06-13) * figures 2,3 *	1-8	INV. A44B11/25
A	TW I 776 642 B (BROGENT TECH INC [TW]) 1 September 2022 (2022-09-01) * figure 1 *	1-8	
			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		2 June 2023	van Voorst, Frank
CATEGORY OF CITED DOCUMENTS			
T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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02-06-2023

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