



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
10.04.2024 Bulletin 2024/15

(51) International Patent Classification (IPC):
A44B 11/25 (2006.01)

(21) Application number: **22199990.7**

(52) Cooperative Patent Classification (CPC):
A44B 11/2523; A44B 11/2573

(22) Date of filing: **06.10.2022**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

(72) Inventors:
• **Atwadkar, Abhijeet**
562 114 Bangalore (IN)
• **Swain, Abhijit**
562 114 Bangalore (IN)
• **Shetty, Rakshith**
562 114 Bangalore (IN)

(71) Applicant: **Autoliv Development AB**
447 83 Vårgårda (SE)

(74) Representative: **Müller Verweyen**
Patentanwälte
Friedensallee 290
22763 Hamburg (DE)

(54) **SEAT BELT BUCKLE FOR A RESTRAINING SYSTEM AND RESTRAINING SYSTEM**

(57) The invention relates to a seat belt buckle (10) for a restraining system of a motor vehicle, comprising a housing (11), an insertion slot (12) for the insertion of a belt tongue (13), and a push button (14) displaceable between a default position (15) and a releasing position (16) for releasing the belt tongue (13). The seat belt buckle (10) comprises an electric actuator (17), which is adapted to move the push button (14) from the default position

(15) to the releasing position (16), and/or to move a locking element (35) of the seat belt buckle (10) from a latched state to an unlatched state, and/or to lock and unlock the push button (14) in the default position (15), and/or to lock and unlock the locking element (35) in a latched state. The invention further relates to a restraining system (27) with such a seat belt buckle (10) and a corresponding method to control said restraining system (27).

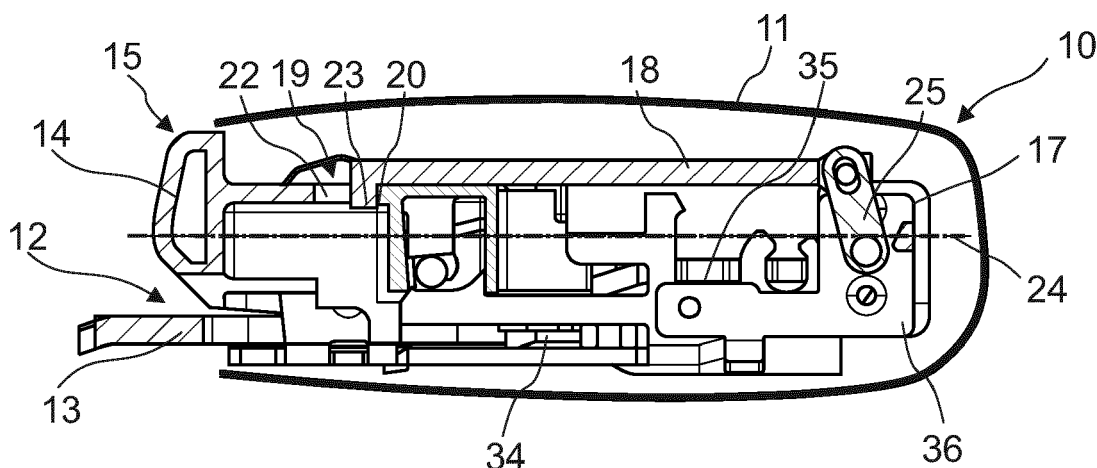


Fig. 1

Description

[0001] The invention relates to a seat belt buckle for a restraining system of a motor vehicle, comprising a housing, an insertion slot for the insertion of a belt tongue, and a push button displaceable in the housing between a default position and a releasing position for releasing the belt tongue. It further relates to a restraining system for a motor vehicle with at least one seat belt buckle. The invention further relates to a method for controlling a restraining system.

[0002] In general, seatbelt usage reduces the probability of injury to occupants in a motor vehicle in the event of an accident. Nonetheless, there are occupants who do not wear a seat belt when traveling in a motor vehicle. Therein, two groups of occupants could be identified, which tend to be more likely not wear seat belts. One of these groups is children in a certain range of ages who are able to unbuckle themselves, but still act irrationally. The other group is obese occupants, wherein some of the factors contributing to a lower rate of usage are discomfort reaching the buckle and latch as well as discomfort reaching the seat belt buckle in order to unbuckle.

[0003] In order to overcome these disadvantages, buckle presenters are known which are able to move the buckle head temporarily in a more favorable position to insert the belt tongue. As a drawback, said buckle presenters are associated with high costs.

[0004] Further on, belt extenders are known. Occupants can insert these belt extenders as a second seat belt buckle at the top of the seat belt buckle. Thereby, a higher position of the seat belt buckle is achieved which is more comfortable for obese occupants. To prevent children from unbuckling themselves, belt extenders having a second seat belt buckle are known, which do not provide an easy-to-use push button to eject the seat tongue. These belt extenders are difficult to take into account in a design of the restraining system and therefore may prevent the restraining system from working as intended.

[0005] Considering this background, it is the task of the invention to provide an improved seat belt buckle, an improved restraining system and a method to control the restraining system which overcome the aforementioned disadvantages and are cost-efficient.

[0006] To solve the task of the invention, a seat belt buckle comprising the features of claim 1 is proposed. Further preferred embodiments may be obtained from the sub-claims, the figures, and the related description.

[0007] A seat belt buckle for a restraining system of a motor vehicle is proposed that comprises a housing, an insertion slot for the insertion of a belt tongue, and a push button. The push button is displaceable, preferably along a displacement axis, in the housing between a default position and a releasing position for releasing the belt tongue. It is proposed that the seat belt buckle comprises an electric actuator, which is adapted to move the push button from the default position to the releasing position, and/or to move a locking element of the seat belt buckle

from a latched state to an unlatched state, and/or to lock and unlock the push button in the default position, and/or to lock and unlock the locking element in a latched state.

[0008] The electric actuator of the seat belt buckle is preferably able to move the push button so that a locked belt tongue is unlocked and/or ejected. In general, releasing a belt tongue in the seat belt buckle has the same effect as ejecting or unlatching a belt tongue from the seat belt buckle.

[0009] In a preferred embodiment, the push button is coupled to a locking element and/or a lock of the seat belt buckle so that the movement of the push button into a releasing position actuates the locking element and/or the lock in a position that unlocks a belt tongue.

[0010] In another embodiment, it is possible that the electric actuator directly actuates a locking element and/or a lock of seat belt buckle. In this case, the push button may stay in the default position or be moved into the releasing position when a seat tongue is unlocked and ejected by the electric actuator. It is also possible that the push button may be moved indirectly by the movement of the locking element when a seat tongue is unlocked by the electric actuator.

[0011] The seat belt buckle preferably comprises a frame or buckle channel, preferably made of metal, on which all or a share of the parts of the seat belt buckle are mounted. The electric actuator is preferably mounted on one or more motor mounts which motor mount(s) is preferably attached to the frame or buckle channel. The seat belt buckle is preferably enclosed by the housing, wherein the housing may have primarily a covering function. In possible embodiments, the housing can also have structural functions, in which all or a share of the parts of the seat belt buckle are mounted.

[0012] The electric actuator allows the belt tongue in the seat belt buckle to be released without the seat belt buckle having to be touched or reached by an occupant. This increases the comfort and ease of use of the seat belt buckle.

[0013] A locking element preferably engages with a belt tongue in a latched state so that the belt tongue is secured in the seat belt buckle. Further, the locking element can be another part of a locking mechanism in a seat belt buckle that directly or indirectly effects the releasing or locking of a belt tongue. In order to release a belt tongue, it is necessary to move the locking element out of the latched state into an unlatched state. In the unlatched state of the locking element the belt tongue is not fixed in the seat belt buckle. In general, the push button in the release position directly or indirectly moves a locking element to an unlatched state, and a locking element is preferably in a latched state when the push button is in a default position. Locking a locking element in a latched state inhibits the function of the push button so that a belt tongue cannot be released, not even with the push button. The locking element has to be unlocked first before the locking element can be actuate to an unlatched state.

[0014] Additionally or alternatively, the electric actuator in the seat belt buckle allows to lock and unlock the push button in the default position. Thereby, the push button can be blocked or held in the default position. As a result, a child, for example, is not able to de-latch the seat belt or to release a belt tongue from the seat belt buckle.

[0015] It is further proposed that the seat belt buckle comprises a control rod, which is connected to the push button via a sliding connection, wherein the control rod can be actuated by the electric actuator.

[0016] The control rod and the sliding connection enable a favorable mounting position of the electric actuator and a good utilization of the given space in the seat belt buckle. The electric actuator is preferably mounted at the bottom of the seat belt buckle opposite the push button. This allows a small width of the seat belt buckle and is also favorable for the electrical connection of the electric actuator. The control rod can transmit a push and/or preferably pull from the electric actuator to the push button, resulting in a movement of the push button from the default position to the release position which leads to the release or ejection of a buckled belt tongue.

[0017] Preferably, the sliding connection has a first limit stop, wherein the control rod is adapted to move the push button from the default position to a releasing position when the push button and the control rod engage at the first limit stop.

[0018] The sliding connection enables a movement of the push button relative to the control rod and the electric actuator without moving the electric actuator. Thus, the push button can be pushed from the default position to the releasing position by an occupant without having to move the control rod and the electric actuator. The first limit stop of the sliding connection enables the control rod to engage the push button and to pull the push button towards the releasing position, while a manual push on the push button does not necessarily cause the actuator to move.

[0019] In further development, it is proposed that the sliding connection has a second limit stop, wherein the control rod is adapted to lock the push button in the default position when the push button and the control rod engage at the second limit stop.

[0020] The second limit stop of the sliding connection can block the moveability of the push button and lock it in the default position when the control rod is moved to a position engaging with the second limit stop of the sliding connection. Actuating the control rod to abut at the second limit stop by the electric actuator allows to easily switch between a locked and unlocked state of the push button.

[0021] The combination of the sliding connection with the first and second limit stop allows to incorporate both functions, releasing the belt tongue and locking the push button, in single mechanism using a single electric actuator.

[0022] Blocking in the sense of the present invention

also refers to significantly increasing the resistance or generating holding forces in the default position so that the push button can only be pressed towards the release position by applying a higher force than normal.

[0023] Preferably, the sliding connection comprises an elongated slot in the push button and the control rod comprises a control pin engaging in this elongated slot.

[0024] The control pin can be easily guided in the elongated slot and preferably interact at the first limit stop and/or second limit stop with the push button.

[0025] In preferred embodiments, it is proposed that the sliding connection extends parallel to the displacement axis. Thereby, any loads between the electric actuator and the push button can be transferred efficiently.

[0026] In an advantageous embodiment, the electric actuator is arranged in the housing. Thereby, the electric actuator is protected from the environment and the seat belt buckle can be mounted in a vehicle more easily.

[0027] In a further advantageous embodiment, the actuator is a rotational motor which is adapted to turn a lever which is connected to the control rod. A rotational motor as an actuator offers a cost-efficient and easy-to-control actuator. Preferably, the seat belt buckle comprises a gearbox arranged on the drive side of the actuator, preferably the rotational motor. Thus, smaller rotational motors with lower torque can be used in the seat belt buckle. A lever is preferably attached to the actuator, wherein further preferably a gearbox is arranged between the actuator, in particular rotational motor, and the lever.

[0028] Preferably, the control rod and the lever are rotatably connected, preferably by a connector pin. This allows an efficient assembly process while resulting in a sufficient bearing of the lever and the control rod.

[0029] Further, to solve the task of the invention, a restraining system for a motor vehicle with the features of claim 10 is proposed. The proposed restraining system comprises at least one seat belt buckle as described above and at least one seat belt with a belt tongue.

[0030] The proposed restraining system can provide multiple functions like electronically controlled releasing of a belt tongue out of seat belt buckle and/or locking the manual releasing to avoid misuse, for example by children.

[0031] According to a further development, it is proposed that the restraining system comprises an input means for receiving user input, preferably a switch and/or a sensor, and a control means for controlling the electric actuator, wherein the restraining system is adapted to eject the belt tongue out of the seat belt buckle and/or lock the belt tongue in the seat belt buckle based on the user input.

[0032] There are two groups of input means, contact type and noncontact type input means. Contact type inputs means can be switches of any kind and contact sensors, for example. Noncontact type input means can be contact-less sensors that capture voice input or gesture input, for example. The received user input is preferably

processed by an electronic control means which controls the electric actuator of the seat belt buckle to operate according to the user input. Accordingly, the de-latch function can be actuated from any remote input means, for example a switch or sensor that can be installed in an ergonomic location to the occupant.

[0033] It is further proposed that the restraining system comprises a crash sensor for detecting a crash and a control means for controlling the electric actuator, wherein the restraining system is adapted to lock the belt tongue in the seat belt buckle based on a detected crash.

[0034] Thereby, any unintended release or unlatching of the seat belt, in particular the seat belt buckle, can be electronically avoided by the control means. In further developments, it is proposed to omit the inertia mass countering the mass of the push button to avoid unintended movement of the push button due to high accelerations, especially accelerations caused by a seat belt pretensioner. Thereby, an inertial de-latch lock can be created with the electric actuator.

[0035] Further, a method for controlling a restraining system comprising the features of claim 13 is proposed to solve the task of the invention. A method for controlling a restraining system as described above is proposed, characterized by the steps:

- controlling the electric actuator to move the push button from the default position to the releasing position, and/or to move a locking element of the seat belt buckle from a latched state to an unlatched state,

and/or

- controlling the electric actuator to lock and unlock the push button in the default position, and/or to lock and unlock the locking element in a latched state.

[0036] In a preferred development, the following steps are proposed:

- reading a user input from an input means, and
- reading a vehicle condition input from a vehicle condition sensor or a control means, wherein
- the seat belt buckle is controlled to release the belt tongue when the user input and the vehicle condition input are in agreement to eject the belt tongue out of the seat belt buckle,
- or reading a vehicle emergency input from a vehicle emergency sensor, wherein
- the seat belt buckle is controlled to eject the belt tongue when a vehicle emergency is detected.

[0037] A user input can be an input via switches or sensors which are comfortable for the user to operate. The switches or sensors can be arranged on a steering wheel, on a dashboard and/or door. Further, it is possible to detect a gesture as user input in a contactless manner or to detect any suitable voice command.

[0038] A vehicle condition sensor may be a crash sensor, for example. Further, a vehicle condition sensor preferably detects the ignition of the vehicle or the current speed of the vehicle as vehicle condition input.

[0039] As a safety measure, the seat belt buckle is preferably controlled to eject the belt tongue only when the user input and the vehicle condition input are in agreement. Thus, a release of the seat belt due to user input can be prevented in case a crash scenario is ongoing or the vehicle speed or vehicle acceleration are not favorable for ejecting the seat belt, for example. In these cases, the user input and the vehicle condition input would not be in agreement and the control means would not control the electric actuator to eject the belt tongue. In preferred embodiments, the vehicle condition input can be used to check the user input.

[0040] A vehicle emergency sensor can be a fire or heat sensor which generates a vehicle emergency input in case fire or extreme heat is detected. Further, a vehicle emergency sensor can be a water or pressure sensor detecting the ingress of water, resulting in respective vehicle emergency input. It also possible that the vehicle emergency sensor may detect any medical emergency of an occupant. Accordingly, the vehicle emergency sensor can be a vital sign sensor and/or a health monitoring sensor sensing the condition of an occupant. In case such a vehicle emergency input is detected the belt tongue can be released automatically, for example.

[0041] In another preferred development, the following steps are proposed:

- reading a crash sensor input from a crash sensor,
- wherein a control means controls the electric actuator to lock the press button in the default position and/or the belt tongue in the seat belt buckle when a crash scenario is detected, and to unlock the press button in the default position and/or the belt tongue in the seat belt buckle when an end of the crash scenario is detected.

[0042] Once the crash is completed, the belt tongue in the seat belt buckle can preferably be unlocked again by the electric actuator. Thereafter, the seat belt buckle is ready for manual release or remote release with the electronic actuator.

[0043] In the following the invention shall be illustrated on the basis of preferred embodiments with reference to the accompanying drawings, therein shows:

Fig. 1 a cross-section of a seat belt buckle;

Fig. 2 parts of a seat belt buckle with an electronic actuator;

Fig. 3 a detail view of a push button with an elongated hole;

Fig. 4 a cross-section of a seat belt buckle with a

pressed push button;

Fig. 5 a cross-section of a seat belt buckle with an electric actuator releasing a belt tongue;

Fig. 6 a cross-section of a seat belt buckle with a push button locked in a default position; and

Fig. 7 a schematic view of restraining system.

[0044] Figure 1 shows a cross-section of an embodiment of a seat belt buckle 10 and a belt tongue 13. The seat belt buckle 10 comprises a housing 11 and an insertion slot 12, wherein the seat belt tongue 13 is inserted and locked in the latched state shown in Figure 1. The seat belt buckle 10 comprises a push button 14 that allows to release and eject the belt tongue 13. The push button 14 is spring loaded and therefore remains in a default position 15 as shown in Figure 1. An occupant can de-latch and release the belt tongue 13 by pressing the push button 14 and moving the push button 14 from the default position 15 into a releasing position 16, see also Figure 4. Accordingly, the push button 14 is displaced from the default position 15 along a displacement axis 24 to the release position 16.

[0045] Various release mechanisms are well known in the art that result in release of the belt tongue 13 when the push button 14 is displaced to a release position 16. The push button 14 may interact with an ejector 34 and a locking element 35 of the seat belt buckle 10 to release and eject the belt tongue 13.

[0046] The seat belt buckle 10 comprises an electric actuator 17 that is mounted on two actuator mounts 36. The electric actuator 17 is connected to a lever 25, which is rotatably within a range preferably smaller than 135°, further preferably smaller than 90° by the electric actuator 17. The lever 25 is rotatably connected to a control rod 18 which is arranged in parallel to the displacement axis 24. The control rod 18 and the lever 25 are connected via a connector pin 26, wherein the connector pin 26 extends through a hole of the control rod 18 and through an elongated hole of the lever 25. Thereby, the control rod 18 can be kept in parallel to the displacement axis 24 over the range of motion of the electric actuator 17. The control rod 18 extends towards the push button 14, wherein a control pin 23 at the end of the control rod 18 and an elongated slot of the push button 14 form a sliding connection 19.

[0047] The parts of the seat belt buckle 10 which enable a release of a belt tongue 13 based on an electric command to the electric actuator 17 are shown in Figure 2 in an isometric view. As can be seen in Figure 2, a gearbox 37 is arranged between the electric actuator 17 and the lever 25, so that the lever 25 can be provided with a higher torque in order to apply higher forces to the push button 14 via the control rod 18. The electric actuator 17 is an electric motor in this embodiment. The push button 14 has an elongated slot 22 with a first limit stop

20 and with a second limit 21. The first and second limit stop 20, 21 are adapted to interact with the control pin 23 of the control rod 18 and provide limits to the sliding connection 19 in the directions parallel to the displacement axis 24.

[0048] Figure 3 shows a detail view of the push button 14, wherein the first limit stop 20 is oriented towards the releasing position 16 and the second limit stop 21 is oriented towards the default position 15.

[0049] Figure 1, 4, 5 and 6 show different positions of the push button 14 and the control rod 18.

[0050] In Figure 1, the push button 14 is in the default position 16 and a belt tongue 13 is locked in the seat belt buckle 10 by the locking element 35. The control pin 23 rests against the first limit stop 20 of the elongated slot 22. In this state, the push button 14 is held in the default position 15 by a spring (not shown) of the seat belt buckle 10 and the electric actuator 17 does not apply any forces. The push button 14 can be pressed by an occupant to the release position 16 of the seat belt buckle 10, wherein the sliding connection 19 and the control rod 18 do not provide any significant resistance since the control rod 18 can be held stationary without engaging with a limit stop 20, 21. Thus, in this state the common functionality of the seat belt buckle 10 is unchanged.

[0051] Figure 4 shows a cross-section of a seat belt buckle 10 with the push button 14 manually pushed towards the releasing position 16. Thus, the electric actuator 17 is not active and the control pin 23 travels along the elongated slot 22 of the push button 14. Accordingly, the push button 14 is not locked in this position of the control rod 18 and can be moved freely between the default position 15 and the releasing position 16.

[0052] Figure 5 shows a cross-section of a seat belt buckle 10 with the electric actuator 17 releasing a belt tongue 13. The electric actuator 17 turns the lever 25 clock-wise and pulls the control rod 18. The control pin 23 of the control rod 18 engages with the first limit stop 20 and displaces the push button 14 along the displacement axis 24 to the releasing position 16. In the releasing position 16 the locking element 35 or latch is lifted and the ejector 34 pushes the belt tongue 13 out of the insertion slot 12.

[0053] Further, in this preferred embodiment, it can be seen that an inertia mass 38 is lifted allowing the locking bar 39 to unlock the locking element 35 or latch and thereby releasing the belt tongue 13.

[0054] Figure 6 shows the cross-section of the seat belt buckle 10, wherein the push button 14 is locked in the default position 15. The electric actuator 17 and the control rod 18 block any movement of the push button 14 completely or provide significant resistance against the displacement of the push button 14 out of the default position 15. As shown in Figure 6, the control pin 23 abuts the second limit stop 21 so that any movement of the push button 14 towards the releasing position 16 has to overcome the resistance of the electric actuator 17 and/or the gearbox 37.

[0055] In other embodiments, the electric actuator 17 may be attached to other parts of the locking mechanism, for example the locking element 35, of the seat belt buckle 10 in order to lock or disable the function of the push button 14 and/or the release a belt tongue 13 locked in the seat belt buckle 10.

[0056] Figure 7 shows a schematic view of a restraining system 27 for a motor vehicle. The restraining system 27 comprises a seat belt buckle 10 as described above and a corresponding belt tongue 13 attached to a seat belt 33.

[0057] The restraining system 27 comprises an electronic control means 28 that controls the electric actuator 17 of the seat belt buckle 10. Further, the restraining system 27 has an input means 29, for example, switches. These switches can be operated by an occupant in order to electrically release the belt tongue 13 and/or to lock and unlock the push button 14 in the default position 15 to provide a child lock, for example. The same applies to other input means 29 like ultrasonic sensors, microphones, and/or touch sensitive sensors, for example.

[0058] Further, the restraining system 27 comprises a crash sensor 30 in this preferred embodiment. The control means 28 may command to lock or unlock the belt tongue 13 in the seat belt buckle 10 based on the input of the crash sensor 30. When a crash is imminent or detected by the crash sensor 30 the control means 28 controls the electric actuator 17 to lock the push button 14 in the default position 15. Further on, the crash sensor 30 may detect the end of the crash scenario and the control means 28 controls the electric actuator 17 to unlock the push button 14.

[0059] In preferred embodiments, the restraining system 27 comprises a vehicle condition sensor 31. The vehicle condition sensor 31 may detect the status of the ignition or a comparable status of a motor vehicle, and/or the speed of the vehicle.

[0060] Further on, the restraining system 27 illustrated in Figure 7 comprises a vehicle emergency sensor 32, which may detect fire, a similar hazard or water, i.e., drowning of the motor vehicle, and/or any medical emergency of an occupant.

[0061] The restraining system 27 of Figure 7 may be controlled and operated in the following manner.

[0062] The control means 28 reads a user input from a user input means 29, like a switch. The user input may be a command to activate or deactivate the locking of the push button 14 in the default position 15, which can be used as a child lock of the seat belt buckle 10. The activation or deactivation or the position of the control rod 18 may be controlled based on user input from the input means 29.

[0063] Other user inputs like a command to release a belt tongue 13 may be cross-checked with input from a crash sensor 30 or a vehicle condition sensor 32 in order to avoid releasing the belt tongue 13 based on a false or unintentional input from an input means 29 during a phase of high acceleration or a crash. Accordingly, the

seat belt buckle 10 is only de-latched when predefined conditions are fulfilled.

[0064] Further on, the control means 28 can be adapted to control the electric actuator 17 to release a belt tongue 13 from the seat belt buckle 10 without a user input from the input means 28. Preferably, the restraining system 27 comprises a vehicle emergency sensor 32 adapted to detect emergency situations like fire or ingress of water, for example, which may trigger an emergency de-latching without a dedicated user input.

[0065] In other emergencies like a crash, the restraining system 27 or the control means 28 may control the electric actuator 17 to lock the seat belt buckle 10 when high accelerations and/or deformation of the car occur or any impact is detected. Here, the electric actuator 17 may move the control rod 18 into a locking position and thereby locking the push button 14 in the default position 15. After the completion of a crash is detected by the crash sensor 30, the control means 28 may control the electric actuator 17 to unlock the seat belt buckle 10.

Claims

1. Seat belt buckle (10) for a restraining system of a motor vehicle, comprising
 - a housing (11),
 - an insertion slot (12) for the insertion of a belt tongue (13), and
 - a push button (14) displaceable between a default position (15) and a releasing position (16) for releasing the belt tongue (13), **characterized in that**
 - the seat belt buckle (10) comprises an electric actuator (17), which is adapted
 - to move the push button (14) from the default position (15) to the releasing position (16), and/or to move a locking element (35) of the seat belt buckle (10) from a latched state to an unlatched state, and/or
 - to lock and unlock the push button (14) in the default position (15), and/or to lock and unlock the locking element (35) in a latched state.
2. Seat belt buckle (10) according to claim 1, wherein
 - the seat belt buckle (10) comprises a control rod (18), which is connected to the push button (14) via a sliding connection (19), wherein the control rod (18) can be actuated by the electric actuator (17).
3. Seat belt buckle (10) according to claim 2, wherein
 - the sliding connection (19) has a first limit stop (20), wherein the control rod (18) is adapted to

- move the push button (14) from the default position (15) to a releasing position (16) when the push button (14) and the control rod (18) engage at the first limit stop (20).
4. Seat belt buckle (10) according to any one of claims 2 or 3, wherein
- the sliding connection (19) has a second limit stop (21), wherein the control rod (18) is adapted to lock the push button (14) in the default position (15) when the push button (14) and the control rod (18) engage at the second limit stop (21).
5. Seat belt buckle (10) according to any one of claims 2 to 4, wherein
- the sliding connection (19) comprises an elongated slot (22) in the push button (14) and the control rod (18) comprises a control pin (23) engaging in this elongated slot (22).
6. Seat belt buckle (10) according to any one of claims 2 to 5, wherein
- the push button (14) is displaceable along a displacement axis (24) between a default position (15) and a releasing position (16), and
 - sliding connection (19) extends parallel to the displacement axis (24).
7. Seat belt buckle (10) according to any one of claims 1 to 6, wherein
- electric actuator (17) is arranged in the housing (11).
8. Seat belt buckle (10) according to any one of claims 1 to 7, wherein
- the actuator (17) is a rotational motor which is adapted to turn a lever (25) which is connected to the control rod (18).
9. Seat belt buckle (10) according to any one of claims 1 to 8, wherein
- the control rod (18) and the lever (25) are rotatably connected, preferably by a connector pin (26).
10. Restraining system (27) for a motor vehicle with at least one seat belt buckle (10) according to any one of claims 1 to 9, **characterized in that**
- the restraining system (27) comprises at least one seat belt (33) with a belt tongue (13).
11. Restraining system (27) according to claim 10, wherein
- the restraining system (27) comprises an input means (29) for receiving user input, preferably a switch and/or a sensor, and a control means (28) for controlling the electric actuator (17), wherein the restraining system (27) is adapted to eject out the belt tongue (13) of the seat belt buckle (10) and/or lock the belt tongue (13) in the seat belt buckle (10) based on the user input.
12. Restraining system (27) according to claim 10 or 11, wherein
- the restraining system (27) comprises a crash sensor (30) for detecting a crash and a control means (28) for controlling the electric actuator (17), wherein the restraining system (27) is adapted to lock the belt tongue (13) in the seat belt buckle (10) based on a detected crash.
13. Method for controlling a restraining system (27) according to any one of claims 10 to 12, **characterized by the steps:**
- controlling the electric actuator (13) to move the push button (14) from the default position (15) to the releasing position (16), and/or to move a locking element (35) of the seat belt buckle (10) from a latched state to an unlatched state, and/or
 - controlling the electric actuator (13) to lock and unlock the push button (14) in the default position (15), and/or to lock and unlock the locking element (35) in a latched state.
14. Method according to claim 13, comprising the following steps:
- reading a user input from an input means (29), and
 - reading a vehicle condition input from a vehicle condition sensor (31) or a control means (28), wherein
 - the seat belt buckle (10) is controlled to eject the belt tongue (13) when the user input and the vehicle condition input are in agreement to eject the belt tongue (13) out of the seat belt buckle (10),
 - or reading a vehicle emergency input from a vehicle emergency sensor (32), wherein
 - the seat belt buckle (10) is controlled to release the belt tongue (13) when a vehicle emergency is detected.
15. Method according to claim 13 or 14, comprising the

following the steps:

- reading a crash sensor input from a crash sensor (30),
- wherein a control means (28) controls the electric actuator (17) to lock the press button (14) in the default position (15) and/or the belt tongue (13) in the seat belt buckle (10) when a crash scenario is detected, and to unlock the press button (14) in the default position (15) and/or the belt tongue (3) in the seat belt buckle (10) when an end of the crash scenario is detected.

5

10

15

20

25

30

35

40

45

50

55

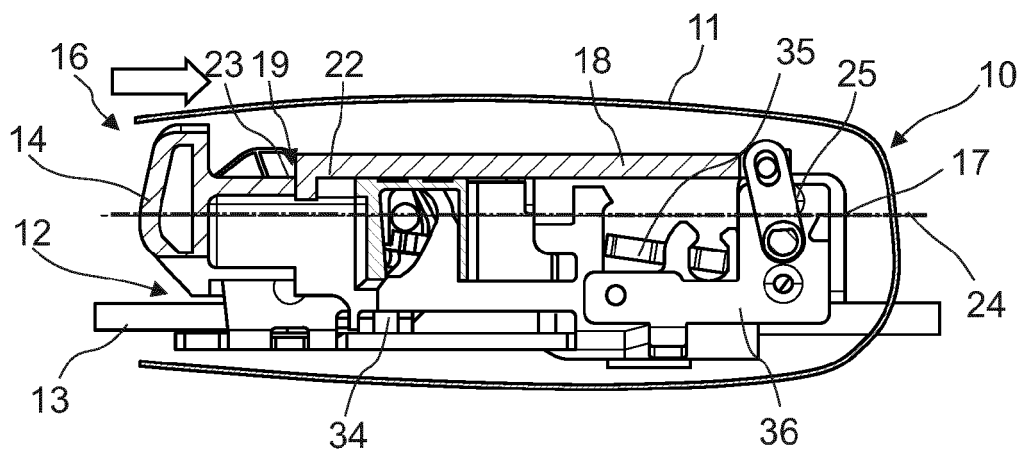


Fig. 4

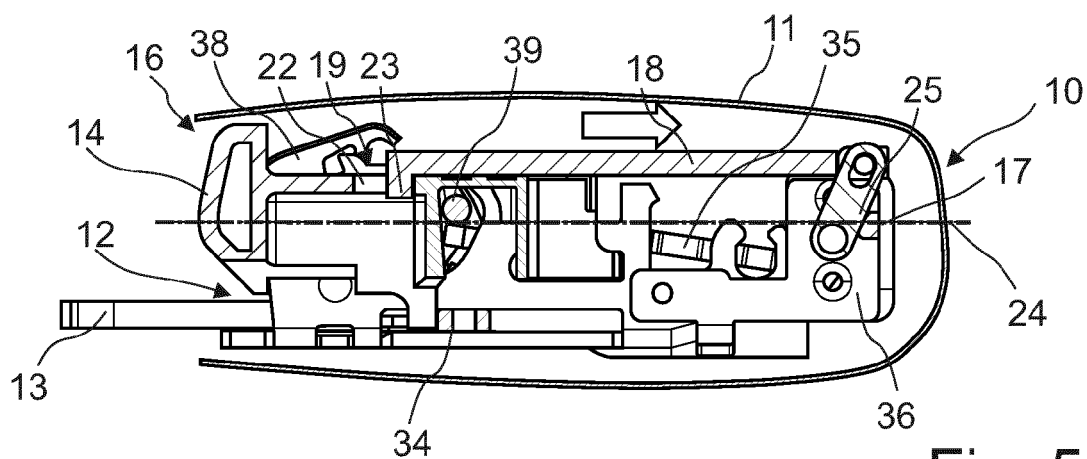


Fig. 5

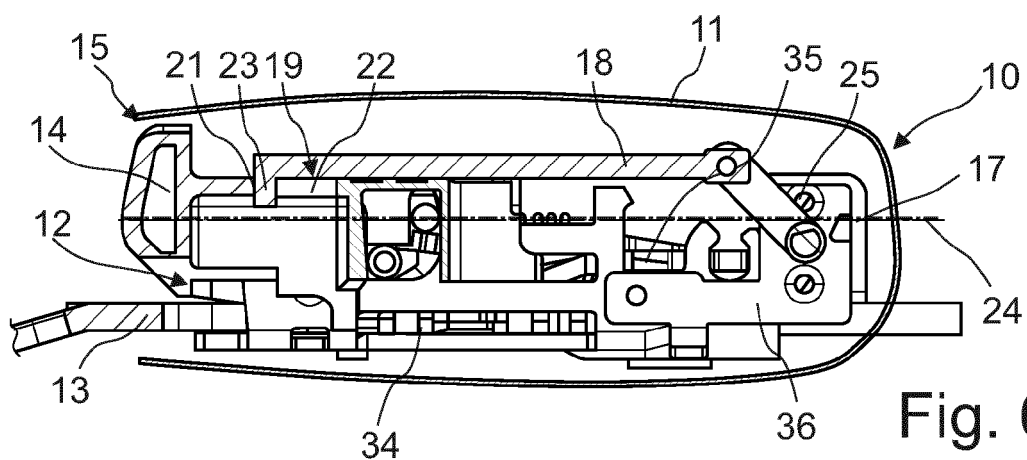
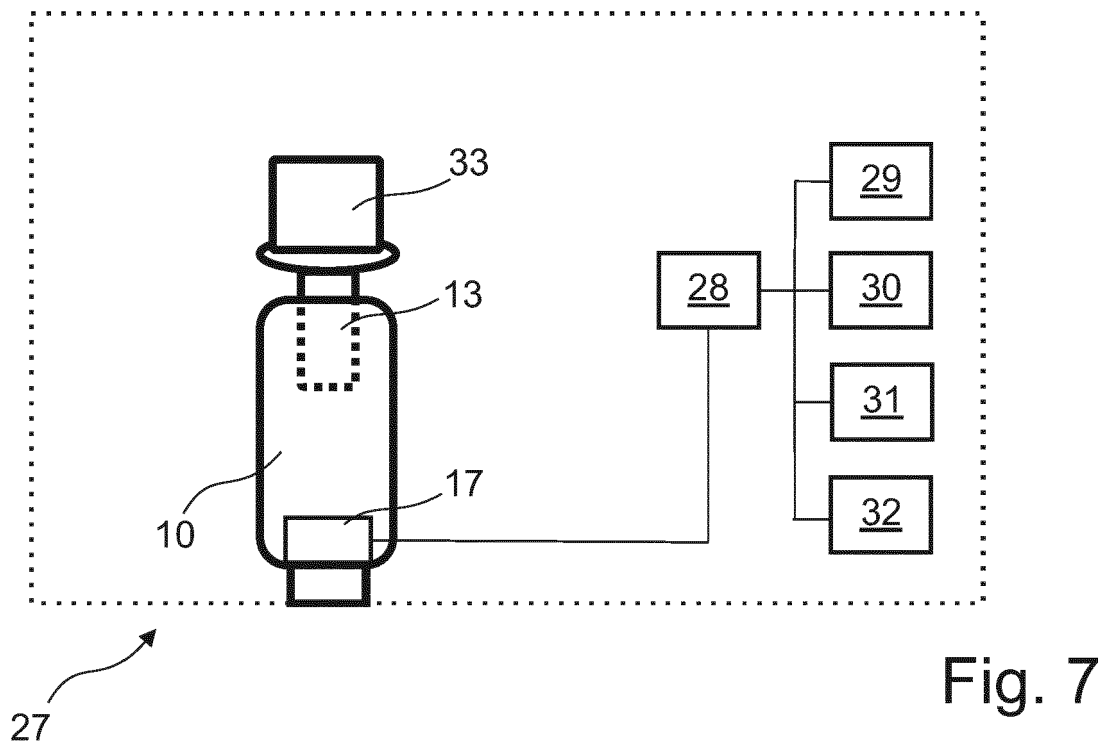


Fig. 6





EUROPEAN SEARCH REPORT

Application Number

EP 22 19 9990

5

10

15

20

25

30

35

40

45

50

55

1

EPO FORM 1503 03.82 (P04C01)

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 2007/204442 A1 (FALB MARGO B [US] ET AL) 6 September 2007 (2007-09-06) * paragraph [0012] - paragraph [0078]; figures 1-18 *	1-15	INV. A44B11/25
X	WO 2021/037024 A1 (INDIANA MILLS & MFG [US]; ZHANG WEI X [CN]) 4 March 2021 (2021-03-04) * paragraph [0024] - paragraph [0058]; figures 1-18 *	1-15	
X	US 2012/279028 A1 (WALEGA FRANK GLENN [US] ET AL) 8 November 2012 (2012-11-08) * paragraphs [0025] - [0048]; figures 3-11 *	1, 7-15 2-6	
			TECHNICAL FIELDS SEARCHED (IPC)
			A44B
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 23 February 2023	Examiner Breuil, Paul
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		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	

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

EP 22 19 9990

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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

23-02-2023

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2007204442 A1	06-09-2007	NONE	
WO 2021037024 A1	04-03-2021	US 2022338599 A1	27-10-2022
		WO 2021037024 A1	04-03-2021
US 2012279028 A1	08-11-2012	US 2010101060 A1	29-04-2010
		US 2012279028 A1	08-11-2012