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Rotatable seatbelt buckle

Abstract

A vehicle includes a vehicle seat and a plate fixed relative to the vehicle seat. A seatbelt buckle is rotatably supported by the vehicle seat and is rotatable relative to the plate to one of a first or second position. A first and second slot are both in one of the plate or the seatbelt buckle. A pin supported by and movable to an extended position relative to one of the plate or the seatbelt buckle. The pin is spaced from the first and second slot when the seatbelt buckle is in a stowed position and is positioned to extend into the first or second slot when the seatbelt buckle is in the first or second position. A computer executes instructions to rotate the seatbelt buckle to one of the first or second position based on a size of an occupant and, then, move the pin to the extended position.

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Background/Summary

BACKGROUND
(1) A vehicle includes a seatbelt assembly. The seatbelt assembly may include a seatbelt retractor and a webbing retractably payable from the seatbelt retractor. The seatbelt assembly includes an anchor coupled to the webbing, and a latch plate that engages a seatbelt buckle. The seatbelt assembly is disposed adjacent to a seat of the vehicle. The webbing extends continuously from the seatbelt retractor to the anchor. For example, one end of the webbing feeds into the seatbelt retractor, and the other end of the webbing is fixed to the anchor.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) FIG. **1** is a perspective view of a vehicle.
(2) FIG. **2** is a first side view of a vehicle seat having a seatbelt buckle in a stowed position.
(3) FIG. **2**A is a side view of the seatbelt buckle in the stowed position.
(4) FIG. **3** is a second side view of the vehicle seat having a hook assembly in an extended position.
(5) FIG. **3**A is a side view of the hook assembly in the extended position.
(6) FIG. **4** is a side view of the vehicle seat having the seatbelt buckle in a first position.
(7) FIG. **4**A is a side view of the seatbelt buckle in the first position.
(8) FIG. **5** is a side view of the vehicle seat having the seatbelt buckle in a second position.
(9) FIG. **5**A is a side view of the seatbelt buckle in the second position.
(10) FIG. **6** is a side view of the vehicle seat having the seatbelt buckle in a third position.
(11) FIG. **6**A is a side view of the seatbelt buckle in the third position.
(12) FIG. **7** is a side view of the vehicle seat having the hook assembly in a retracted position.
(13) FIG. **7**A is a side view of the hook assembly in the retracted position.
(14) FIG. **8**A is a frontal view of the seatbelt buckle in the first position and a pin supported by the seatbelt buckle in a retracted position.
(15) FIG. **8**B is a frontal view of the seatbelt buckle in the second position and the pin in an extended position.
(16) FIG. **9** is a block diagram of a vehicle communication network of the vehicle.

(17) FIG. **10** is a flow chart of a method executable by a vehicle computer.

DETAILED DESCRIPTION

(18) A vehicle including a vehicle seat and a plate fixed relative to the vehicle seat. The vehicle includes a seatbelt buckle rotatably supported by the vehicle seat. The seatbelt buckle is rotatable relative to the plate from a stowed position to one of a first position or a second position. The vehicle includes a first slot and a second slot both in one of the plate or the seatbelt buckle. The vehicle includes a pin supported by the other of the plate or the seatbelt buckle. The pin is moveable relative to the other of the plate or the seatbelt buckle from a retracted position to an extended position. The pin is spaced from the first slot and the second slot when the seatbelt buckle is in the stowed position. The pin being positioned to extend from the retracted position to the extended position into the first slot when the seatbelt buckle is in the first position. The pin is positioned to extend from the retracted position to the extended position into the second slot when the seatbelt buckle is in the second position. The vehicle includes a computer including a processor and a memory storing instructions executable by the processor to rotate the seatbelt buckle to one of the first position or the second position based on a size of an occupant of the vehicle seat and then, move the pin to the extended position.

(19) The vehicle may include a third slot in the same of the plate and the seatbelt buckle, the seatbelt buckle is rotatable to one of the first position, the second position, or a third position, and the pin being in the extended position and extending into the third slot when the seatbelt buckle is in the third position.

(20) The seatbelt buckle may rotate about a rotational axis parallel to a cross-seat axis.

(21) The pin may be spaced from the rotational axis.

(22) The vehicle seat may include a seatback with the seatbelt buckle being rotatable away from the seatback from the stowed position to the first position and the second position.

(23) The vehicle seat may include a seat bottom with the plate being fixed relative to the seat bottom and the seatbelt buckle is rotatable relative to the seat bottom.

(24) The seatbelt buckle may be rotatable relative to the vehicle seat in a seat-forward direction.

(25) The pin may move in a cross-seat direction from the retracted position to the extended position.

(26) The seatbelt buckle may be rotatable about a rotational axis with the pin, the first slot, and the second slot being spaced from the rotational axis.

(27) The vehicle may include a solenoid including the pin.

(28) The pin may be biased toward one of the first slot or the second slot in the extended position.

(29) The vehicle may include a latch plate engageable with the seatbelt buckle with the seatbelt buckle rotating away from the stowed position when the latch plate is engaged with the seatbelt buckle.

(30) The pin may be moveable from the retracted position to the extended position when the latch plate is engaged with the seatbelt buckle.

(31) The vehicle may include a webbing with the latch plate being moveable along the webbing to define a lap portion and the lap portion being moveable in a seat-forward direction as the seatbelt buckle moves from the stowed position toward the first position and the second position.

(32) The vehicle may include a latch plate engageable with the seatbelt buckle and an actuator biasing the pin toward the extended position in response to detected engagement of the latch plate with the seatbelt buckle.

(33) The instructions may include to detect engagement of a latch plate with the seatbelt buckle.

(34) The instructions may include to detect disengagement of the latch plate with the seatbelt buckle.

(35) The instructions may include to, based on detection of disengagement of the latch plate, move the pin from the extended position to the retracted position and rotate the seatbelt buckle to the stowed position.

(36) With reference to the Figures, wherein like numerals indicate like parts throughout the several views, a vehicle **10** includes a vehicle seat **12** and a plate **14** fixed relative to the vehicle seat **12**. A seatbelt buckle **16** is rotatably supported by the vehicle seat **12**. The seatbelt buckle **16** is rotatable relative to the plate **14** from a stowed position to one of a first position or a second position. A first slot **18** and a second slot **20** are both in one of the plate **14** or the seatbelt buckle **16**. A pin **22** is supported by the other of the plate **14** or the seatbelt buckle **16**. The pin **22** is moveable relative to the other of the plate **14** or the seatbelt buckle **16** from a retracted position to an extended position. The pin **22** is spaced from the first slot **18** and the second slot **20** when the seatbelt buckle **16** is in the stowed position. The pin **22** is positioned to extend from the retracted position to the extended position into the first slot **18** when the seatbelt buckle **16** is in the first position. The pin **22** is positioned to extend from the retracted position to the extended position into the second slot **20** when the seatbelt buckle **16** is in the second position. A computer **24**, hereinafter referred to as the "vehicle computer **24**," includes a processor and a memory storing instructions executable by the processor to rotate the seatbelt buckle **16** to one of the first position or the second position based on a size of an occupant of the vehicle seat **12** and, then, move the pin **22** to the extended position.
(37) Prior to the vehicle impact, the vehicle computer **24** determines the size of the occupant of the seat **12** and rotates the seatbelt buckle **16** to one of the first position or the second position corresponding to the size of the occupant. Sizes of occupants may be stored in the vehicle computer **24** and the sizes may correspond to the first position and the second position as described further below. After the seatbelt buckle **16** rotates to the first position or the second position, the pin **22** engages with one of the first slot **18** and the second slot **20** to maintain the seatbelt buckle **16** in the first position or the second position in the event of certain vehicle impacts. The pin **22** maintains the seatbelt buckle **16** in the first position or the second position to position a lap portion **26** of a seatbelt webbing **28**, hereinafter referred to as "webbing **28**," such that the webbing **28** may control the kinematics of the occupant of the vehicle seat **12**.
(38) With reference to FIG. **1**, the vehicle **10** may be any suitable type of ground vehicle, e.g., a passenger or commercial automobile such as a sedan, a coupe, a truck, a sport utility, a crossover, a van, a minivan, a taxi, a bus, etc. Operations, systems, and methods described herein should always be implemented and/or performed in accordance with an applicable owner's/user's manual and/or safety guidelines.
(39) The vehicle **10** defines a vehicle-longitudinal axis L extending between a front vehicle end (not numbered) and a rear vehicle end (not numbered) of the vehicle **10**. The vehicle **10** defines a cross-vehicle axis C extending cross-vehicle from one side to the other side of the vehicle **10**. The vehicle **10** defines a vertical axis V. The vehicle-longitudinal axis L, the cross-vehicle axis C, and the vertical axis V are perpendicular relative to each other.
(40) As described further below, the vehicle **10** includes a vehicle body **30** including rockers (not numbered), roof rails (not shown), roof beams (not shown), pillars (not numbered), body panels (not numbered), vehicle floor **32**, vehicle roof **34**, etc. The vehicle **10** includes a passenger compartment **36** to house occupants, if any, of the vehicle **10**. The passenger compartment **36** may extend across the vehicle **10**, i.e., from one side to the other side of the vehicle **10**. The passenger compartment **36** includes a front end (not numbered) and a rear end (not shown) with the front end being in front of the rear end during forward movement of the vehicle **10**.
(41) The vehicle roof **34** and the vehicle floor **32** are spaced from each other. Specifically, the vehicle floor **32** is spaced downwardly from the vehicle roof **34**. The vehicle roof **34** defines the upper boundary of the passenger compartment **36** and may extend from the front end of the passenger compartment **36** to the rear end of the passenger compartment **36**. The vehicle roof **34** may include a roof panel (not numbered) extending from one side of the vehicle **10** to the other. As an example, the roof panel may be attached to roof rails, e.g., by welding, fasteners, etc.
(42) The vehicle **10** includes the vehicle floor **32** defining the lower boundary of the passenger compartment **36** and may extend from the front end of the passenger compartment **36** to the rear

end of the passenger compartment **36**. The vehicle floor **32** may include upholstery, for example, carpet, and may have a class-A surface facing the passenger compartment **36**, i.e., a surface specifically manufactured to have a high quality, finished, aesthetic appearance free of blemishes.
(43) With continued reference to Figures, the vehicle **10** may include one or more vehicle seats **12**, hereinafter referred to as "seat **12**." Specifically, the vehicle **10** may include any suitable number of seats **12**. The seats **12** are supported by the vehicle floor **32**. The seats **12** may be arranged in any suitable arrangement in the passenger compartment **36**. As in the example shown in the Figures, one or more of the seats **12** may be at the front end of the passenger compartment **36**, e.g., a driver seat and/or a passenger seat. In other examples, one or more of the seats **12** may be behind the front end of the passenger compartment **36**, e.g., at the rear end of the passenger compartment **36**. The seats **12** may be movable relative to the vehicle floor **32** to various positions, e.g., movable fore-and-aft and/or cross-vehicle. The seat **12** may be of any suitable type, e.g., a bucket seat.
(44) With reference to FIGS. **1**-**7**A, the seats **12** include a seatback **38**, a seat bottom **40**, and a head restraint **42**. The head restraint **42** may be supported by and extend upwardly from the seatback **38**. The head restraint **42** may be stationary or movable relative to the seatback **38**. The seatback **38** may be supported by the seat bottom **40** and may be stationary or movable relative to the seat bottom **40**. The seatback **38**, the seat bottom **40**, and the head restraint **42** may be adjustable in multiple degrees of freedom. Specifically, the seatback **38**, the seat bottom **40**, and the head restraint **42** may themselves be adjustable. In other words, adjustable components within the seatback **38**, the seat bottom **40**, and the head restraint **42** may be adjustable relative to each other.
(45) The seats **12** includes a first side **44** and a second side **46** spaced cross-seat from the first side **44**. In the example shown in the Figures, the first side **44** and the second side **46** are spaced cross-vehicle from each other. For example, the first side **44** is vehicle-inboard of the second side **46** and the second side **46** is vehicle-outboard of the first side **44**. The second side **46** may be adjacent a door (not numbered) of the vehicle **10** and the first side **44** may be spaced vehicle-inboard from the door of the vehicle **10**.
(46) The seatback **38** and/or the seat bottom **40** includes a seat frame **48** and a covering (not numbered) supported on the seat frame **48**. The seat frame **48** may include tubes, beams, etc. Specifically, the seat frame **48** includes a pair of upright frame members (not shown). The upright frame members are elongated, and specifically, are elongated in a generally upright direction when the seatback **38** is in a generally upright position. The upright frame members are spaced from each other and the seat frame **48** includes one or more cross-members extending between the upright frame members. The seat frame **48**, including the upright frame members, may be of any suitable plastic material, e.g., carbon fiber reinforced plastic (CFRP), glass fiber-reinforced semi-finished thermoplastic composite (organosheet), etc. As another example, some or all components of the seat frame **48** may be formed of a suitable metal, e.g., steel, aluminum, etc.
(47) The covering may include upholstery, padding, and/or plastic portions. The upholstery may be cloth, leather, faux leather, or any other suitable material. The upholstery may be stitched in panels around the seat frame **48**. The padding may be between the covering and the seat frame **48** and may be foam or any other suitable material.
(48) The seatback **38** and the seat bottom **40** define an occupant-seating area **52** of the seat **12**. The occupant-seating area **52** is the area occupied by an occupant when properly seated on the seat bottom **40** and the seatback **38**. The occupant-seating area **52** is in a seat-forward direction F of the seatback **38** and above the seat bottom **40**. In the example shown in the Figures, the occupant-seating area **52** faces the front end of the passenger compartment **36** when the seat **12** is in the forward-facing position.
(49) The vehicle **10** includes a seatbelt assembly **50** that includes a retractor (not shown), the webbing **28**, and a latch plate **90**. The webbing **28** is retractably payable from the retractor. The seatbelt assembly **50** may include an anchor (not shown) fixed relative to the seat **12**. In some examples, the anchor may be fixed to the seat **12**, e.g., the seat bottom **40**. In other examples, the

anchor may be fixed to other components of the vehicle **10**, e.g., the vehicle floor **32**, pillars, etc. The anchor is coupled to the webbing **28** and the anchor fixes at least one end of the webbing **28** relative to the seat **12**. The latch plate **90** is engageable with the seatbelt buckle **16**. In other words, the webbing **28** is engageable with the seatbelt buckle **16**. The seatbelt buckle **16** is fixed to the first side **44** of the seat **12**. In other words, the seatbelt buckle **16** is fixed to the side of the seat **12** that is opposite the seatbelt assembly **50**. The latch plate **90** may be movable from an unbelted position to a belted position. In other words, the latch plate **90** may be engaged with the seatbelt buckle **16** in the belted position and the latch plate **90** may be disengaged with the seatbelt buckle **16** in the unbelted position.

(50) With continued reference to FIGS. **1**-**7**A, the seatbelt assembly **50** may control the kinematics of the occupant of the seat **12**, e.g., during sudden decelerations of the vehicle **10**. The webbing **28** may extend continuously from the retractor to the anchor. For example, one end of the webbing **28** feeds into the retractor and the other end of the webbing **28** is fixed to the anchor. The webbing **28** may be fabric, e.g., woven polyester. The webbing **28** is dividable into the lap portion **26** and a shoulder portion **54**. Specifically, the latch plate **90** is moveable along the webbing **28** to divide the webbing **28** into the lap portion **26** and the shoulder portion **54**. The lap portion **26** and the shoulder portion **54** are defined by the latch plate **90** when the latch plate **90** is engaged with the seatbelt buckle **16**. In the belted position, the lap portion **26** may extend along a lap of an occupant of the seat **12** and the shoulder portion **54** may extend along a shoulder of the occupant of the seat **12**. Specifically, the latch plate **90** divides the webbing **28** into the lap portion **26** and the shoulder portion **54** and the latch plate **90** may move freely along the webbing **28**. The lap portion **26** extends from the retractor to the seatbelt buckle **16** and the shoulder portion **54** extends from the seatbelt buckle **16** to the anchor.

(51) The seatbelt buckle **16** and the plate **14** are each supported by the seat **12**. Specifically, the seatbelt buckle **16** and the plate **14** are each supported by the first side **44** of the seat **12**. The plate **14** is fixed relative to the seat **12**. Specifically, the plate **14** is fixed relative to the seat bottom **40**, e.g., the seat frame **48** of the seat bottom **40**. In the example shown in the Figures, the plate **14** is fixed to the seat frame **48** of the seat bottom **40**. The plate **14** may be fixed to the seat frame **48** of the seat bottom **40**. The plate **14** may be concealed from view inside the passenger compartment **36**. For example, the plate **14** may be between the seat frame **48** of the seat bottom **40** and the covering of the seat **12**. The plate **14** may be fixed in any suitable way, e.g., fasteners, welding, unitary formation, etc. The plate **14** may be of any suitable shape. In the example shown in the Figures, the plate **14** is circular, however, the plate **14** may be of any other suitable shape, e.g., rectangular, etc. The plate **14** may be of any suitable material, e.g., steel, rigid plastic, other suitable metals, etc.

(52) The seatbelt buckle **16** includes a buckle portion **56** and a bar portion **58**. The bar portion **58** extends upwardly from the seat bottom **40** to the buckle portion **56**. Specifically, the bar portion **58** includes a proximal end **60** and the bar portion **58** extends from the proximal end **60** to the buckle portion **56**. The latch plate **90** engages with the buckle portion **56** when the latch plate **90** is in the belted position. The bar portion **58** may be rigid relative to the webbing **28** of the seatbelt assembly **50** between the proximal end **60** and the buckle portion **56**. In other words, the bar portion **58** is not bendable relative to the webbing **28** between the proximal end **60** and the buckle portion **56**.

(53) The seatbelt buckle **16** is rotatable relative to the seat **12**. The seatbelt buckle **16** is rotatably supported by the seat **12**. Specifically, the seatbelt buckle **16** is rotatably supported by the seat bottom **40**. The bar portion **58** of the seatbelt buckle **16** is rotatably supported by the seat bottom **40**. The seatbelt buckle **16** is rotatable about a rotational axis A that is parallel to a cross-seat axis B. The cross-seat axis B is elongated from one side of the seat **12** to the other side of the seat **12**. In the example shown in the Figures, the cross-seat axis B and the rotational axis A are elongated along a cross-seat direction S. The cross-seat direction S is elongated cross-vehicle. The bar portion **58** is rotatably supported by the seat bottom **40** at the proximal end **60**. The seatbelt buckle **16** is

rotatable relative to the seat bottom **40** and the seatbelt buckle **16** is rotatable relative to the plate **14**. In other words, the seatbelt buckle **16** is rotatable relative to the seat bottom **40** and the plate **14** from the stowed position to one of the first position and the second position. Specifically, the bar portion **58** of the seatbelt buckle **16** rotates from the stowed position one of the first position and to the second position. The proximal end **60** is centered on the plate **14** and the rotational axis A. In other words, the bar portion **58** rotates about the proximal end **60** at the center of the plate **14**. The seatbelt buckle **16** of any one of the seats **12** of the vehicle **10**, e.g., driver seat, passenger seat, etc., may be rotatable in the event of certain vehicle impacts.

(54) As the seatbelt buckle **16** rotates from the stowed position to one of a plurality of other positions. For example, in the example shown in the Figures, the seatbelt buckle **16** rotates from the stowed position to the first position, the second position, and a third position. The seatbelt buckle **16** may rotate to any suitable number of positions. As the seatbelt buckle **16** rotates from the stowed position to the other positions, the seatbelt buckle **16** is rotatable away from the seatback **38**. In other words, as the seatbelt buckle **16** rotates from the stowed position to the other positions, the buckle portion **56** moves in the seat-forward direction F. The buckle portion **56** moves adjacent the occupant-seating area **52** and in the seat-forward direction F. The lap portion **26** of the webbing **28** is moveable in the seat-forward direction F as the seatbelt buckle **16** moves from the stowed position toward one of the other positions. When the seatbelt buckle **16** is in the first position, the seatbelt buckle **16** is rotated farther from the seatback **38** relative to the stowed position. When the seatbelt buckle **16** is in the second position, the seatbelt buckle **16** is rotated farther from the seatback **38** relative to the first position. When the seatbelt buckle **16** is in the third position, the seatbelt buckle **16** is rotated farther from the seatback **38** relative to the second position.

(55) With reference to FIGS. **2**-**2**A, when no occupant is in the seat **12** of the vehicle **10** or when an occupant has just seated in the seat **12**, the seatbelt buckle **16** is in the stowed position. When an occupant is seated in the seat **12** and the latch plate **90** is engaged with the seatbelt buckle **16**, the vehicle computer **24** may receive a signal from an occupancy sensor **62** (described further below) indicating the size of the occupant in the seat **12**. The seatbelt buckle **16** rotates away from the stowed position when the latch plate **90** is engaged with the seatbelt buckle **16**. The vehicle computer **24** may store predetermined ranges of size of occupants that may be seated in the seat **12**. Depending on the size of the occupant, the seatbelt buckle **16** rotates to a different position. For example, a smaller occupant may indicate the seatbelt buckle **16** to rotate to the first position, a medium occupant may indicate the seatbelt buckle **16** to rotate to the second position, and a larger occupant may indicate the seatbelt buckle **16** to rotate to the third position. In other words, the larger the occupant, the farther from the seatbelt buckle **16** is rotated from the seatback **38**.

(56) A motor **64** may be operatively coupled to the seatbelt buckle **16** to rotate the seatbelt buckle **16** to the various positions. A shaft **66** may extend in the cross-seat direction S between the motor **64** and the seatbelt buckle **16**. Specifically, the shaft **66** may extend along the rotational axis A from the motor **64** to the bar portion **58** of the seatbelt buckle **16**. The shaft **66** may be coupled to the proximal end **60** of the seatbelt buckle **16**. The shaft **66** may be connected to the seatbelt buckle **16** to rotate the seatbelt buckle **16** from the stowed position to the other positions spaced from the stowed position.

(57) With reference to FIGS. **4**-**7**A, two or more slots are in one of the plate **14** and the seatbelt buckle **16** and the pin **22** is supported by the other of the plate **14** and the seatbelt buckle **16**. In the example shown in the Figures, the slots **18**, **20**, **68** are in the plate **14**. Specifically, the example in the Figures includes three slots in the plate, e.g., the first slot, the second slot, and a third slot **68**. In other words, the plate **14** defines the slots **18**, **20**, **68**. In such an example, the pin **22** is supported by the seatbelt buckle **16**. The pin **22** is spaced from the rotational axis A. The pin **22** is spaced from the rotational axis A along the seatbelt buckle **16** and the slot **18**, **20**, **68** is spaced from the rotational axis A along the plate **14**. In other words, the pin **22** and the slot **18**, **20**, **68** are each spaced from the proximal end **60** of the bar portion **58** of the seatbelt buckle **16**. In other examples

not shown in the Figures, the slots **18**, **20**, **68** may be in the seatbelt buckle **16**, e.g., the bar portion **58** of the seatbelt buckle **16**. In other words, the bar portion **58** of the seatbelt buckle **16** may define the slots **18**, **20**, **68**. In such an example, the pin **22** is supported by the plate **14**.

(58) The slots **18**, **20**, **68** are aligned radially around the rotational axis A. Specifically, the slots **18**, **20**, **68** are each spaced equidistantly from the rotational axis A. The slots **18**, **20**, **68** and the pin **22** are both spaced from the rotational axis A. In both examples discussed above, the pin **22** is radially aligned with the slots **18**, **20**, **68** along the plate **14** and the seatbelt buckle **16**. In other words, the pin **22** and the slots **18**, **20**, **68** spaced an equal distance from the rotational axis A. The number of slots in one of the plate **14** and the seatbelt buckle **16** is equal to the number of positions to which the seatbelt buckle **16** may rotate. For example, in the example shown in the Figures, the seatbelt buckle **16** may rotate to three different positions after the stowed position and, therefore, there are three different slots. The number of slots and number of seatbelt buckle **16** positions may be of any suitable number.

(59) The pin **22** is moveable relative to one of the plate **14** and the seatbelt buckle **16** from the retracted position to the extended position. In the example shown in the Figures, the pin **22** is moveable relative to the seatbelt buckle **16**. The pin **22** may be moveable into and out of the bar portion **58** of the seatbelt buckle **16**. Specifically, the pin **22** is moveable in the cross-seat direction S. The pin **22** moves in the cross-seat direction S from the retracted position to the extended position. The pin **22** is in the retracted position when the seatbelt buckle **16** is in the stowed position and the latch plate **90** is disengaged from the seatbelt buckle **16**. After the latch plate **90** is engaged with the seatbelt buckle **16** and once the seatbelt buckle **16** reaches one of the other positions spaced from the stowed position, the pin **22** moves to the extended position. In other examples, e.g., examples wherein the pin **22** is supported by the plate **14**, the pin **22** is moveable relative to the plate **14**.

(60) The pin **22** is in the retracted position when the seatbelt buckle **16** is in the stowed position. In other words, the pin **22** is spaced from the slots **18**, **20**, **68** when the seatbelt buckle **16** is in the stowed position. Specifically, the pin **22** is spaced from the slots **18**, **20**, **68** along the rotational axis A when the seatbelt buckle **16** is in the stowed position. Once the latch plate **90** is engaged with the seatbelt buckle **16**, the motor **64** rotates the seatbelt buckle **16** to the slot **18**, **20**, **68** corresponding to the size of the occupant in the seat **12**. As described further below, the pin **22** moves to the extended position and into the associated slot **18**, **20**, **68**.

(61) The pin **22** is receivable by the slots **18**, **20**, **68**. With reference to FIGS. **4** and **4**A, the pin **22** is receivable by the first slot **18** when the seatbelt buckle **16** is in the first position. With reference to FIGS. **5** and **5**A, the pin **22** is receivable by the second slot **20** when the seatbelt buckle **16** is in the second position. With reference to FIGS. **6** and **6**A, the pin **22** is receivable by the third slot **68** when the seatbelt buckle **16** is in the third position. In other words, the pin **22** is positioned to extend from the retracted position to the extended position into the first slot **18** when the seatbelt buckle **16** is in the first position, the pin **22** is positioned to extend from the retracted position to the extended position into the second slot **20** when the seatbelt buckle **16** is in the second position, and the pin **22** is in the extended position and extending into the third slot **68** when the seatbelt buckle **16** is in the third position. The pin **22** being in one of the slots **18**, **20**, **68** maintains the seatbelt buckle **16** in the respective position in the event of certain vehicle impacts such that the lap portion **26** of the webbing **28** moves in the seat-forward direction F. FIGS. **4**A, **5**A, and **6**A all show in hidden lines the original position, i.e., the stowed position of the seatbelt buckle **16**.

(62) The pin **22** is biased toward one of the slots **18**, **20**, **68** when the seatbelt buckle **16** is in one of the other positions. An actuator **70** may bias the pin **22** toward the second retracted position and the extended position in response to detected engagement of the latch plate **90** with the seatbelt buckle **16**. The actuator **70** may be any suitable type of actuator **70**, e.g., a solenoid including the pin **22**, a motor, etc. The actuator **70** may be supported by one of the plate **14** and the seatbelt buckle **16**. In the example shown in the Figures, the pin **22** moves from the seatbelt buckle **16** and toward the

plate **14**, i.e., the actuator **70** is supported by the seatbelt buckle **16** to bias the pin **22** toward the plate **14**. In other examples, e.g., when the pin **22** is supported by the plate **14**, the pin **22** moves toward the seatbelt buckle **16** as the pin **22** moves to the retracted position, i.e., the actuator **70** is supported by the plate **14** to bias the pin **22** toward the seatbelt buckle **16**.

(63) With reference to FIGS. **3**, **3**A, **7**, and **7**A, the vehicle **10** includes a hook assembly **72**. The hook assembly **72** includes a hook **74**, a lock **76**, a pyrotechnic device **78**, and may include a track **80**. In the event of certain vehicle impacts, the pyrotechnic device **78** may be activated to allow the hook **74** to move from an extended position to a retracted position. As the hook **74** moves to the retracted position, the hook **74** engages the lap portion **26** of the webbing **28** to move the lap portion of the webbing **28** downwardly along the torso of the occupant simultaneously with the rotation of the seatbelt buckle **16**. In other words, the seatbelt buckle **16** and the hook assembly **72** may move the lap portion **26** down along the torso of the occupant of the seat **12**.

(64) The hook assembly **72** is supported by the seat **12**. The hook assembly **72** is fixed relative to the seat **12**, e.g., the hook assembly **72** is fixed to the seat **12**. In some examples, such as shown in the Figures, the hook assembly **72** is supported by the seatback **38**. In such an example, the hook assembly **72** is fixed to the seat frame **48** of the seatback **38** between the seat frame **48** and the covering of the seat **12**. In other examples, the hook assembly **72** may be supported by the seat bottom **40**. In such an example, the hook assembly **72** is fixed to the seat frame **48** of the seat bottom **40** between the seat frame **48** and the covering of the seat **12**. In yet further examples, the hook assembly **72** may be supported by any suitable portion of the seat **12**. In either example discussed above, the covering of the seat **12** may include a cavity **82** surrounding the hook assembly **72** to allow movement of the seat **12** around the hook assembly **72** and the covering may include a releasable seam **84**, e.g., a tear seam, adjacent the hook assembly **72**.

(65) As discussed above, the hook assembly **72** is supported by the seat **12**. In other words, the hook **74** is supported by the seat **12**. The track **80** is fixed to the seat **12** and the hook **74** is movable relative to the track **80** from the extended position to the retracted position. Specifically, the hook **74** is retractable relative to the track **80**. When the hook **74** moves to the retracted position, the hook **74** may release the releasable seam **84** to allow the hook **74** to engage the lap portion **26** of the webbing **28**. The hook **74** and the track **80** are supported by the second side **46** of the seat **12**. In other words, the track **80** and hook **74** are supported by an opposite side of the seat **12** from the seatbelt buckle **16**. The occupant-seating area **52** of the seat **12** is between the hook **74** and the track **80** and the seatbelt buckle **16**. In other words, the occupant of the seat **12** is seated between the hook **74** and the track **80** and the seatbelt buckle **16**.

(66) With reference to FIGS. **3**, **3**A, **7**, and **7**A, the hook assembly **72** includes the lock **76** engageable with the hook **74**. The lock **76** engages with the hook **74** to maintain the hook **74** in the extended position during operation of the vehicle **10**, e.g., in the absence of certain vehicle impacts. In the event of certain vehicle impacts, the lock **76** disengages the hook **74** to allow the hook **74** to retract to the retracted position. After the hook **74** reaches the retracted position, the lock **76** re-engages the hook **74** to maintain the hook **74** in the retracted position.

(67) The lock **76** includes a pin (not shown), a first spring (not shown), and a housing (not numbered). The pin of the lock **76** is slidable relative to the housing. In the example shown in the Figures, the pin of the lock **76** is slidable relative to the housing from a first extended position to a retracted position and from the retracted position to a second extended position to disengage the hook **74** and to reengage the hook **74**.

(68) The hook assembly **72** includes the pyrotechnic device **78** operatively coupled to the lock **76** to disengage the pin of the lock **76** from the hook **74**. In the example shown in the Figures, the pyrotechnic device **78** is operatively coupled to the pin of the lock **76** to retract the pin of the lock **76** from the hook **74**. In the event of certain vehicle impacts, the pyrotechnic device **78** activates to retract the pin of the lock **76** away from the hook **74** to allow hook **74** to move to the retracted position. In the event of certain vehicle impacts, the pyrotechnic device **78** includes a pyrotechnic

charge that activates to move the pin of the lock **76** from the first extended position to the retracted position. The pyrotechnic charge overcomes force of the first spring to move the pin of the lock **76** to the retracted position. The pyrotechnic charge may be combustible to produce a gas. The pyrotechnic charge may be formed of a solid mixture of substances that, when ignited, react to produce the gas. For example, the pyrotechnic charge may be formed of sodium azide (NaNO3), potassium nitrate (KNO3), and silicon dioxide (SiO2), which react to form nitrogen gas (N2).

(69) With reference to FIG. **9**, the vehicle computer **24** includes a processor and a memory storing instructions executable by the processor. The memory includes one or more forms of computer readable media, and stores instructions executable by the vehicle computer **24** for performing various operations, including as disclosed herein. The vehicle computer **24** may be a restraints control module. The vehicle computer **24** can be a generic computer with the processor and the memory as described above and/or may include an electronic control unit ECU or controller for a specific function or set of functions, and/or a dedicated electronic circuit including an ASIC (application specific integrated circuit) that is manufactured for a particular operation, e.g., an ASIC for processing sensor data and/or communicating the sensor data. In another example, the vehicle computer **24** may include an FPGA (Field-Programmable Gate Array) which is an integrated circuit manufactured to be configurable by a user. Typically, a hardware description language such as VHDL (Very High-Speed Integrated Circuit Hardware Description Language) is used in electronic design automation to describe digital and mixed-signal systems such as FPGA and ASIC. For example, an ASIC is manufactured based on VHDL programming provided pre-manufacturing, whereas logical components inside an FPGA may be configured based on VHDL programming, e.g. stored in a memory electrically connected to the FPGA circuit. In some examples, a combination of processor(s), ASIC(s), and/or FPGA circuits may be included in the vehicle computer **24**.

(70) The vehicle computer **24** is generally arranged for communications on a vehicle communication network **86** that can include a bus in the vehicle **10** such as a controller area network CAN or the like, and/or other wired and/or wireless mechanisms. Alternatively or additionally, in cases where the vehicle computer **24** actually comprises a plurality of devices, the vehicle communication network **86** may be used for communications between devices represented as the vehicle computer **24** in this disclosure. Further, as mentioned below, various controllers and/or sensors may provide data to the vehicle computer **24** via the vehicle communication network **86**.

(71) The vehicle **10** may include at least one impact sensor **88** for sensing certain vehicle impacts (e.g., impacts of a certain magnitude, direction, etc.). The impact sensor **88** may be configured to sense certain vehicle impacts prior to impact, i.e., pre-impact sensing. The impact sensor **88** may be in communication with the vehicle computer **24**. The impact sensor **88** is configured to detect certain vehicle impacts. In other words, a “certain vehicle impact” is an impact of a specific type and/or magnitude, i.e., “certain” indicates the type and/or magnitude of the impact. The type and/or magnitude of such “certain vehicle impacts” may be prestored in the vehicle computer **24**, e.g., a restraints control module. The impact sensor **88** may be of any suitable type, for example, post contact sensors such as accelerometers, pressure sensors, and contact switches; and pre-impact sensors such as radar, LIDAR, and vision sensing systems. The vision sensing systems may include one or more cameras, CCD image sensors, CMOS image sensors, etc. The impact sensor **88** may be located at numerous points in or on the vehicle **10**.

(72) The vehicle **10** may include at least one occupancy sensor **62**. The occupancy sensor **62** is configured to detect occupancy of the seats **12**, e.g., detect an occupant in the occupant-seating area **52**. The occupancy sensor **62** may include visible-light or infrared cameras directed at the seat **12**, weight sensors supported by the seat bottom **40**, sensors detecting whether latch plate **90** is engaged with the seatbelt buckle **16**, or other suitable sensors. The occupancy sensor **62** provides data to the vehicle computer **24** specifying whether the seat **12** is occupied or unoccupied and

information regarding the type of occupant. As one example, the vehicle **10** may include one occupancy sensor **62** for each occupant-seating area **52**. As another example, the vehicle **10** may include one occupancy sensor **62** that is designed to individually detect occupancy of each occupant-seating area **52**.

(73) With reference to FIG. **10**, the vehicle computer **24** stores instructions to control components of the vehicle **10** according to the method. Specifically, the vehicle computer **24** identifies the size of an occupant seated in the seat **12** and rotates the seatbelt buckle **16** to a position corresponding to the size of the occupant. Use of "in response to," "based on," and "upon determining" herein, including with reference to method, indicates a causal relationship, not merely a temporal relationship.

(74) With reference to decision block **1005**, the method includes determining whether an occupant is seated in the seat **12**. The determination of whether an occupant is seated in the seat **12** includes determining that the latch plate **90** of the seatbelt assembly **50** is engaged with the seatbelt buckle **16**. The occupancy sensor **62** for the seat **12** may send a signal to the vehicle computer **24** that the latch plate **90** is engaged with the seatbelt buckle **16**. In other words, the engagement of the latch plate **90** with the seatbelt buckle **16** is detected to determine an occupant is seated in the seat **12**. If an occupant is determined to be in the seat **12**, the method continues to block **1010**. If no occupant is determined to be in the seat **12**, the method returns to its start.

(75) With reference to block **1010**, the method includes determining the size of the occupant of the seat **12**. The occupancy sensor **62** may send a signal to the vehicle computer **24** indicating the size of the occupant of the seat **12**.

(76) With reference to block **1015**, based on determining the size of the occupant of the seat **12**, the method includes rotating the seatbelt buckle **16** to one of the first position, the second position, or the third position corresponding to the size of the occupant identified. The vehicle computer **24** may send a signal to the motor **64** to rotate the seatbelt buckle **16** to a position corresponding to the slot **18**, **20**, **68** corresponding to the size of the occupant.

(77) With reference to block **1020**, based on identifying an occupant is in the seat **12** and that the seatbelt buckle **16** is moved to one of the first position, the second position, or the third position, the method includes moving the pin **22** to the extended position. The vehicle computer **24** may send a signal to the actuator **70** to bias the pin **22** toward the extended position and move to the extended position.

(78) With reference to decision block **1025**, the method includes detecting certain vehicle impacts. The impact sensors **88** may send a signal to the vehicle computer **24** that certain vehicle impacts have or will occur. If certain vehicle impacts are detected, the method continues to block **1030**. If certain vehicle impacts are not detected, the method continues to decision block **1035**.

(79) With reference to block **1030**, in response to detecting certain vehicle impacts, the method includes activating the pyrotechnic device **78**. In response to activation of the pyrotechnic device **78**, the pin of the lock disengages the hook **74** and the hook **74** moves to the retracted position. After the pyrotechnic device **78** is activated, the method ends.

(80) With reference to decision block **1035**, in response to no certain vehicle impacts being detected, the method includes detecting that the latch plate **90** is disengaged with the seatbelt buckle **16**, e.g., for determining an occupant is exiting the vehicle. If an occupant is exiting the vehicle **10**, the occupant may disengage the latch plate **90** from the seatbelt buckle **16**. If the latch plate **90** remains engaged, the method returns to decision block **1025**.

(81) With reference to block **1040**, based on detecting the latch plate **90** is disengaged with the seatbelt buckle **16**, the method includes activating the actuator **70** to move the pin **22** from the extended position to the retracted position. The vehicle computer **24** may send a signal to the actuator **70** to move the pin **22** toward the retracted position.

(82) With reference to block **1045**, based on the pin **22** moving to the retracted position, the method includes rotating the seatbelt buckle **16** to the stowed position. The vehicle computer **24** may send a

signal to the motor **64** to rotate the seatbelt buckle **16** to the stowed position. After the seatbelt buckle **16** rotates to the stowed position, the method returns to decision block **1005** to determine if another occupant is seated in the seat **12**.

(83) The disclosure has been described in an illustrative manner, and it is to be understood that the terminology which has been used is intended to be in the nature of words of description rather than of limitation. The numerical adjectives “first,” “second,” and “third” are used herein merely as identifiers, do not signify order or importance, and may be used interchangeably Many modifications and variations of the present disclosure are possible in light of the above teachings, and the disclosure may be practiced otherwise than as specifically described.

Claims

1. A vehicle comprising: a vehicle seat; a plate fixed relative to the vehicle seat; a seatbelt buckle rotatably supported by the vehicle seat, the seatbelt buckle being rotatable relative to the plate from a stowed position to one of a first position or a second position; a first slot and a second slot both in one of the plate or the seatbelt buckle; a pin supported by the other of the plate or the seatbelt buckle, the pin being moveable relative to the other of the plate or the seatbelt buckle from a retracted position to an extended position; the pin being spaced from the first slot and the second slot when the seatbelt buckle is in the stowed position; the pin being positioned to extend from the retracted position to the extended position into the first slot when the seatbelt buckle is in the first position; the pin being positioned to extend from the retracted position to the extended position into the second slot when the seatbelt buckle is in the second position; and a computer including a processor and a memory storing instructions executable by the processor to: rotate the seatbelt buckle to one of the first position or the second position based on a size of an occupant of the vehicle seat; and then, move the pin to the extended position.

2. The vehicle of claim 1, further comprising: a third slot in the one of the plate and the seatbelt buckle; the seatbelt buckle is rotatable to one of the first position, the second position, or a third position; and the pin being in the extended position and extending into the third slot when the seatbelt buckle is in the third position.

3. The vehicle of claim 1, wherein the seatbelt buckle rotates about a rotational axis parallel to a cross-seat axis.

4. The vehicle of claim 3, wherein the pin is spaced from the rotational axis.

5. The vehicle of claim 1, wherein the vehicle seat includes a seatback, the seatbelt buckle being rotatable away from the seatback from the stowed position to the first position and the second position.

6. The vehicle of claim 1, wherein the vehicle seat includes a seat bottom, the plate being fixed relative to the seat bottom and the seatbelt buckle is rotatable relative to the seat bottom.

7. The vehicle of claim 1, wherein the seatbelt buckle is rotatable relative to the vehicle seat in a seat-forward direction.

8. The vehicle of claim 1, wherein the pin moves in a cross-seat direction from the retracted position to the extended position.

9. The vehicle of claim 1, wherein the seatbelt buckle is rotatable about a rotational axis; the pin, the first slot, and the second slot being spaced from the rotational axis.

10. The vehicle of claim 1, further comprising a solenoid including the pin.

11. The vehicle of claim 1, wherein the pin is biased toward one of the first slot or the second slot in the extended position.

12. The vehicle of claim 1, further comprising a latch plate engageable with the seatbelt buckle, the seatbelt buckle rotating away from the stowed position when the latch plate is engaged with the seatbelt buckle.

13. The vehicle of claim 12, wherein the pin is moveable from the retracted position to the

extended position when the latch plate is engaged with the seatbelt buckle.
14. The vehicle of claim 12, further comprising a webbing, the latch plate being moveable along the webbing to define a lap portion, the lap portion being moveable in a seat-forward direction as the seatbelt buckle moves from the stowed position toward the first position and the second position.
15. The vehicle of claim 1, further comprising: a latch plate engageable with the seatbelt buckle; and an actuator biasing the pin toward the extended position in response to detected engagement of the latch plate with the seatbelt buckle.
16. The vehicle of claim 1, wherein the instructions include to detect engagement of a latch plate with the seatbelt buckle.
17. The vehicle of claim 16, wherein the instructions include to detect disengagement of the latch plate with the seatbelt buckle.
18. The vehicle of claim 17, wherein the instructions include to, based on detection of disengagement of the latch plate, move the pin from the extended position to the retracted position and rotate the seatbelt buckle to the stowed position.