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### Safety belt retracting and locking apparatus and automobile seat

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#### Abstract

A seat belt retracting and locking apparatus and an automotive seat including a seat belt retractor, a sensor having a sensing seat and a sensing ball, and a locking mechanism. When the locking mechanism is in a locking state, the sensing seat is fixed in an initial position. When the locking mechanism is in an unlocking state, the sensing seat is rotatable. When the seat belt retracting and locking apparatus and the automotive seat are in a normal state, the sensing seat is locked in the initial position by the locking mechanism, and the angle and the position of the sensing seat are not affected by a change in the speed of a vehicle, so that relative positions between the sensing ball, a pawl, and a ratchet do not change, thereby improving the stability of the performance of the apparatus and seat.

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## Background/Summary

(1) The present application claims the priority of Chinese Patent Application No. 202111067644.9 filed on 13 Sep. 2021, which is incorporated herein by reference in its entirety.

### TECHNICAL FIELD

(2) The present invention relates to the technical field of sensing instruments for seat belts, and in particular to a seat belt retracting and locking apparatus and an automotive seat.

### BACKGROUND

(3) As shown in FIGS. 1-2, for some vehicle models, a seat belt retracting and locking apparatus 4' is mounted in a seat back 2', and is specifically mounted on a backrest frame of the seat back 2'. The seat back 2' is connected to a seat cushion 1' by means of a rotary shaft 3'. The seat back 2' may rotate relative to the seat cushion 1' to adjust an angle.

(4) The seat belt retracting and locking apparatus 4' includes a seat belt retractor 41' and a sensor 42'. The seat belt retractor 41' includes a reel housing 411', a core shaft 412', a seat belt reel 413', a ratchet 414', and a pawl 415'. The core shaft 412' is mounted on the reel housing 411'. The seat belt reel 413' is sleeved on the core shaft 412'. The ratchet 414' is located outside of the reel housing 411'. The ratchet 414' is sleeved on the core shaft 412'. The ratchet 414' is connected to one end of the seat belt reel 413'. The ratchet 414' and the seat belt reel 413' can rotate synchronously on the core shaft 412'. The pawl 415' is located outside of the reel housing 411', and is connected to the reel housing 411' by means of a pawl pivot shaft. After the pawl 415' is triggered, the pawl 415' can rotate about the pawl pivot shaft, so as to engage with the ratchet 414' to prevent the ratchet 414' from rotating, thereby preventing the seat belt reel 413' from rotating.

(5) The sensor 42' includes a sensing seat and a sensing ball located in a recessed cavity of the sensing seat. The sensing seat is connected to the reel housing 411' by means of a sensing seat pivot shaft. The sensor 42' may be mounted by means of a support. The sensing seat can rotate back and forth on the sensing seat pivot shaft.

(6) In a normal state, the sensor 42' naturally sags, and the pawl 415' rests on the sensing ball. The pawl 415' is separated from the ratchet 414'. The seat belt reel 413' can rotate normally.

(7) In emergency situations such as when a vehicle suddenly slows down or tilts, the sensing ball leaves an initial position due to inertia and pushes up the pawl 415'. The pawl 415' rotates about the pawl pivot shaft. One end of the pawl 415' having teeth turns upwards and engages with the ratchet 414', so that the seat belt reel 413' cannot continue to rotate, so as to prevent the seat belt from being pulled out, thereby better protecting an occupant.

(8) The sensor 42' in the prior art is connected to the rotary shaft 3' of the seat back 2' by means of a synchronizer, and the angle of the sensor 42' changes accordingly as the angle of the seat back 2' is adjusted.

(9) When the angle of the seat back 2' is adjusted, the angle and/or the position of the sensor 42' may change due to an error of the synchronizer, thereby affecting normal performance of the sensor 42'.

### SUMMARY

(10) An objective of the present invention is to provide a seat belt retracting and locking apparatus and an automotive seat. In a normal state, a sensing seat is locked in an initial position by a locking

mechanism, so that the angle or the position thereof are not affected by a change in the speed of a vehicle. When the angle of a seat back is adjusted, the locking mechanism unlocks the sensing seat, and the vehicle sensing seat always remains in the initial position, so that relative positions between a sensing ball, a pawl, and a ratchet do not change, thereby ensuring the stability of the performance of the product.

(11) Provided in the technical solution of the present invention is a seat belt retracting and locking apparatus for being mounted in a seat back, comprising a seat belt retractor, a sensor having a sensing seat and a sensing ball, and a locking mechanism for locking the sensing seat, the seat belt retractor comprising a retractor housing for being connected to a backrest frame of the seat back, a core shaft mounted on the retractor housing, a seat belt reel sleeved on the core shaft, a ratchet located outside of the retractor housing and synchronously rotating with the seat belt reel, and a pawl pivotally mounted outside of the retractor housing and capable of being triggered by the sensing ball to lock the ratchet, the sensing seat being connected to the retractor housing by means of a first pivot shaft, the sensing seat having an accommodating recess, the sensing ball being at least partially located in the accommodating recess, an abutting portion of the pawl resting on the sensing ball, the sensing seat having an initial position, the center of gravity of the sensing seat in the initial position being located directly below the axis of the first pivot shaft, the locking mechanism being mounted on the retractor housing, and being located on one side of the sensor, the locking mechanism having a locking state of locking the sensing seat when the seat back is locked and an unlocking state of unlocking the sensing seat when the angle of the seat back is adjusted, when the locking mechanism is in the locking state, the sensing seat being fixed in the initial position, and when the locking mechanism is in the unlocking state, the sensing seat being rotatable relative to the axis of the first pivot shaft, and the sensing seat remaining in the initial position.

(12) In an optional technical solution, a counterweight block is mounted in the sensing seat, and the counterweight block is located directly below the axis of the first pivot shaft, and when the locking mechanism is in the unlocking state, the counterweight block causing the sensing seat to remain in the initial position.

(13) In an optional technical solution, when the sensing ball is in a static state in the accommodating recess, the center of gravity of the sensing ball is located directly above the counterweight block.

(14) In an optional technical solution, a side of the sensing seat facing away from the accommodating recess is provided with a curved rack, and the counterweight block is located between two ends of the curved rack, the locking mechanism being located on one side of the sensing seat, the locking mechanism comprising an extensible locking pin and a driving member for driving the locking pin to move towards a side of the sensing seat, an end portion of the locking pin facing the curved rack having locking pin teeth, when the locking pin teeth engage with the curved rack, the locking mechanism locking the sensing seat, and when the locking pin teeth are separated from the curved rack, the locking mechanism unlocking the sensing seat.

(15) In an optional technical solution, the driving member is an elastic element, when the elastic element is in a compressed state, the locking pin being separated from the curved rack, and when the elastic element is in a released state, the locking pin mating with the curved rack.

(16) In an optional technical solution, the seat belt retracting and locking apparatus further comprises an electromagnetic actuator for driving the elastic element to switch between the compressed state and the released state, the electromagnetic actuator comprising an electromagnet capable of compressing the elastic element when powered on and a controller for being connected to a vehicle computer and capable of controlling the electromagnet to be powered on and off, in a normal state, the electromagnet being in a powered-off state, and the elastic element being in the released state, and when the controller receives an angle adjustment signal of the seat back transmitted by the vehicle computer, the controller controlling the electromagnet to be powered on,

and causing the elastic element to be in the compressed state.

(17) In an optional technical solution, the seat belt retracting and locking apparatus further comprises a pulling cord for being connected between a rotation shaft of a seat adjuster and the locking pin, when the seat adjuster is in a locked state, the elastic element being in the released state, and the locking pin mating with the curved rack, and when the seat adjuster is in an unlocked state, the pulling cord pulling the locking pin to leave the curved rack, and causing the elastic element to be in the compressed state.

(18) In an optional technical solution, the curved rack has a first end and a second end arranged opposite each other, the distance between the counterweight block and the first end being less than the distance between the counterweight block and the second end, when the seat back is in a vertical state, the locking pin being located below the curved rack and facing the counterweight block, and when the seat back is in a state of being laid down backwards to be horizontal, the locking pin being located at a front side of the curved rack and facing the second end.

(19) In an optional technical solution, the pawl is connected to the retractor housing by means of a second pivot shaft, the first pivot shaft being parallel to a rotary shaft of the seat back, and the second pivot shaft and the core shaft being respectively parallel to the first pivot shaft.

(20) Further provided in a technical solution of the present invention is an automotive seat, comprising a seat back and the seat belt retracting and locking apparatus according to any one of the foregoing technical solutions, the retractor housing being fixedly connected to a backrest frame of the seat back, when the seat back is locked, the locking mechanism locking the sensing seat, and when the angle of the seat back is adjusted, the locking mechanism unlocking the sensing seat.

(21) By using the above technical solutions, the following beneficial effects are achieved: in the seat belt retracting and locking apparatus and the automotive seat provided by the present invention, in a normal state, the sensing seat is locked in the initial position by the locking mechanism, so that the angle and the position of the sensing seat are not affected by a change in the speed of a vehicle.

(22) When the vehicle operates normally, the pawl is separated from the ratchet, and the seat belt retractor can operate normally. In emergency situations such as when the vehicle brakes sharply or tilts, the sensing ball moves forwards and upwards along a recess wall of the accommodating recess due to inertia, thereby triggering the pawl and causing the pawl to engage with the ratchet, so that the seat belt reel cannot continue to rotate, so as to prevent the seat belt from being pulled out, thereby providing a protective effect.

(23) When the angle of the seat back is adjusted, the seat belt retractor and the locking mechanism rotate together with the seat back. However, the sensing seat always remains in the initial position, and the sensing ball is substantially still, so that relative positions between the sensing ball, the pawl, and the ratchet do not change, thereby improving the stability of the performance of the product.

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## Description

### BRIEF DESCRIPTION OF THE DRAWINGS

(1) FIG. 1 is a schematic diagram of a seat belt retracting and locking apparatus mounted in a seat back in the prior art;

(2) FIG. 2 is a schematic structural diagram of a seat belt retracting and locking apparatus in the prior art;

(3) FIG. 3 is a schematic diagram of the relative positions of a locking mechanism, a sensor, a pawl, and a ratchet when a seat back is in a vertical state and the locking mechanism locks a sensing seat;

(4) FIG. 4 is a schematic diagram of the relative positions of a locking mechanism, a sensor, a

- pawl, and a ratchet when a seat back is in a vertical state and the locking mechanism unlocks a sensing seat;
- (5) FIG. 5 is a schematic diagram of the relative positions of a locking mechanism, a sensor, a pawl, and a ratchet when a seat back is in a state of tilting backwards and the locking mechanism locks a sensing seat;
- (6) FIG. 6 is a schematic diagram of the relative positions of a locking mechanism, a sensor, a pawl, and a ratchet when a seat back is in a state of tilting backwards and the locking mechanism unlocks a sensing seat;
- (7) FIG. 7 is a schematic diagram of the relative positions of a locking mechanism, a sensor, a pawl, and a ratchet when a seat back is in a state of being laid down backwards to be horizontal and the locking mechanism locks a sensing seat;
- (8) FIG. 8 is a schematic diagram of the relative positions of a locking mechanism, a sensor, a pawl, and a ratchet when a seat back is in a state of being laid down backwards to be horizontal and the locking mechanism unlocks a sensing seat;
- (9) FIG. 9 is a schematic structural diagram of a sensor;
- (10) FIG. 10 is a schematic diagram of an electromagnetic actuator, a locking pin, and an elastic element;
- (11) FIG. 11 is a schematic diagram of a locking pin mated with a curved rack when a seat adjuster is in a locked state and an elastic element is in a released state;
- (12) FIG. 12 is a schematic diagram of a pulling cord pulling a locking pin to leave a curved rack and causing an elastic element to be compressed when a seat adjuster is in an unlocked state;
- (13) FIG. 13 is a schematic diagram of a seat belt retracting and locking apparatus mounted in a seat back;
- (14) FIG. 14 is a schematic diagram of a seat back in a vertical state;
- (15) FIG. 15 is a schematic diagram of a seat back in a state of tilting backwards; and
- (16) FIG. 16 is a schematic diagram of a seat back in a state of being laid down backwards to be horizontal.

#### DETAILED DESCRIPTION

- (17) Specific embodiments of the present invention are described further below with reference to the accompanying drawings. The same parts are denoted by the same reference numerals. It should be noted that the words “front,” “rear,” “left,” “right,” “upper” and “lower” used in the following description refer to directions in the accompanying drawings, and the words “inner” and “outer” each refer to a direction towards or away from the geometric center of a particular component.
- (18) As shown in FIGS. 2-9 in conjunction with FIGS. 13-16, a seat belt retracting and locking apparatus **100** for being mounted in a seat back **301** provided by an embodiment of the present invention includes a seat belt retractor **1**, a sensor **2** having a sensing seat **21** and a sensing ball **22**, and a locking mechanism **3** for locking the sensing seat **21**.
- (19) The seat belt retractor **1** includes a retractor housing **11** for being connected to a backrest frame of the seat back **301**, a core shaft **12** mounted on the retractor housing **11**, a seat belt reel (not shown in the drawings) sleeved on the core shaft **12**, a ratchet **13** located outside of the retractor housing **11** and synchronously rotating with the seat belt reel, and a pawl **14** pivotally mounted outside the retractor housing **11** and capable of being triggered by the sensing ball **22** to lock the ratchet **13**.
- (20) The sensing seat **21** is connected to the retractor housing **11** by means of a first pivot shaft **212**.
- (21) The sensing seat **21** is provided with an accommodating recess **211**, and the sensing ball **22** is at least partially located in the accommodating recess **211**.
- (22) An abutting portion **141** of the pawl **14** rests on the sensing ball **22**.
- (23) The sensing seat **21** has an initial position, and the center of gravity of the sensing seat **21** in the initial position is located directly below the axis of the first pivot shaft **212**.
- (24) The locking mechanism **3** is mounted on the retractor housing **11**, and is located on one side of

the sensor **2**. The locking mechanism **3** has a locking state of locking the sensing seat **21** when the seat back **301** is locked and an unlocking state of unlocking the sensing seat **21** when the angle of the seat back **301** is adjusted.

(25) When the locking mechanism **3** is in the locking state, the sensing seat **21** is fixed in the initial position.

(26) When the locking mechanism **3** is in the unlocking state, the sensing seat **21** is rotatable relative to the axis of the first pivot shaft **212**, and the sensing seat **21** remains in the initial position.

(27) The seat belt retracting and locking apparatus **100** provided by the present invention is used for being mounted in the seat back **301** of an automotive seat **300**. The seat belt retracting and locking apparatus **100** includes the seat belt retractor **1**, the normally-locked sensor **2**, and the locking mechanism **3** for normally locking the sensing seat **21**.

(28) The seat belt retractor **1** includes the retractor housing **11**, the core shaft **12**, the seat belt reel, the ratchet **13**, and the pawl **14**. The core shaft **12** is mounted on the retractor housing **11**. The seat belt reel is sleeved on the core shaft **12**. For the mounting means of the seat belt reel, reference may be made to the description of the seat belt reel in the background. When the seat belt reel rotates normally on the core shaft **12**, a seat belt may be pulled out normally. When the seat belt reel is restricted to be unable to rotate on the core shaft **12**, the seat belt is locked, and can no longer be pulled out.

(29) The ratchet **13** is located outside of the retractor housing **11**. The ratchet **13** is sleeved on the core shaft **12**. The ratchet **13** is fixedly connected to one end of the seat belt reel. The ratchet **13** and the seat belt reel may synchronously rotate on the core shaft **12**. The pawl **14** and the ratchet **13** are located on the same side of the retractor housing **11**. The pawl **14** is connected to the retractor housing **11** by means of a second pivot shaft **142**. The pawl **14** has the abutting portion **141** extending towards the sensing ball **22**. One end of the pawl **14** has teeth for engaging with the ratchet **13**.

(30) The normally-locked sensor **2** includes the sensing seat **21** and the sensing ball **22**.

(31) The sensor **2**, the ratchet **13**, and the pawl **14** are located on the same side of the retractor housing **11**. The pawl **14** is located between the sensor **2** and the ratchet **13**.

(32) The first pivot shaft **212** is connected to the sensing seat **21**, and extends in the width direction of the seat back **301** (a vehicle width direction). The sensing seat **21** is connected to the retractor housing **11** by means of a first pivot shaft **212**.

(33) The sensing seat **21** has the accommodating recess **211**. A portion of the sensing ball **22** is located in the accommodating recess **211**, and a portion of the sensing ball **22** protrudes from the accommodating recess **211**. In a normal state, the abutting portion **141** of the pawl **14** rests on the sensing ball **22**.

(34) The locking mechanism **3** is mounted outside of the retractor housing **11**, and the locking mechanism **3** and the sensor **2** are located on the same side of the retractor housing **11**. In the normal state, the locking mechanism **3** locks the sensing seat **21**. When the angle of the seat back **301** is adjusted, the seat belt retractor **1** and the locking mechanism **3** both rotate about a rotary shaft **303** along with the seat back **301**.

(35) The sensing seat **21** has the following two means of connection to the first pivot shaft **212**: a first connecting means: the sensing seat **21** is fixed to the first pivot shaft **212**, and the first pivot shaft **212** is pivotally connected to the retractor housing **11**. When the locking mechanism **3** unlocks the sensing seat **21**, the sensing seat **21** and the first pivot shaft **212** rotate as a whole relative to the retractor housing **11**.

(36) A second connecting means: the sensing seat **21** is rotatably mounted on the first pivot shaft **212**, and the first pivot shaft **212** is fixed on the retractor housing **11**. When the locking mechanism **3** unlocks the sensing seat **21**, the sensing seat **21** can rotate relative to the first pivot shaft **212**.

(37) Regardless of whether the sensing seat **21** is fixedly or rotatably (pivotally) connected to the

first pivot shaft **212**, when the locking mechanism **3** unlocks the sensing seat **21**, the sensing seat **21** can rotate relative to the axis of the first pivot shaft **212**.

(38) When the sensor **2** is mounted on the retractor housing **11**, the sensing seat **21** has the initial position, and the center of gravity of the sensing seat **21** located in the initial position is located directly below the axis of the first pivot shaft **212**, so that the sensing seat **21** remains in a vertical state.

(39) The locking state and the unlocking state of the locking mechanism **3** correspond to a locked state and an adjustable state of the seat back **301**. When the seat back **301** is locked, the locking mechanism **3** is in the locking state, and the locking mechanism **3** locks the sensing seat **21**. When the angle of the seat back **301** is adjusted, the locking mechanism **3** is in the unlocking state, and the locking mechanism **3** unlocks the sensing seat **21**.

(40) A mechanism such as a locking pin, a latch bolt, a bolt, a pushing rod, and a stopping arm may be selected as the locking mechanism **3**. Any mechanism capable of locking and unlocking the sensing seat **21** can be considered the locking mechanism **3**.

(41) The locking state and the unlocking state of the locking mechanism **3** may be configured to be manual operations as desired, or may be configured to be automatic operations as desired.

(42) When the locking mechanism **3** locks the sensing seat **21**, the sensing seat **21** is located in the initial position. In situations such as when a vehicle brakes sharply or tilts, under the action of inertial force, the sensing ball **22** rolls forwards in the accommodating recess **211**, and moves upwards along a recess wall on a front side of the accommodating recess **211**, thereby pushing up the abutting portion **141** of the pawl **14**, so that the pawl **14** rotates about the second pivot shaft **142**. A front end of the pawl **14** having teeth turns upwards and engages with the ratchet **13** to lock the ratchet **13**, so that the seat belt reel no longer rotates, thereby preventing the seat belt from being pulled out.

(43) Therefore, for the normally-locked sensor apparatus provided by the present invention, the sensing seat **21** is locked in the initial position by the locking mechanism **3** as long as the angle of the seat back **301** is not adjusted, so that the angle and the position of the sensing seat **21** are not affected by a change in the speed of the vehicle.

(44) When the angle of the seat back **301** is adjusted, the seat belt retractor **1** and the locking mechanism **3** rotate about the rotary shaft **303** together with the seat back **301**. However, the sensing seat **21** only rotates relative to the axis of the first pivot shaft **212** and always remains in the initial position, and the sensing ball **22** also remains substantially still, so that relative positions between the sensing ball **22**, the pawl **14**, and the ratchet **13** do not change, thereby improving the stability of the performance of the product.

(45) In one embodiment, as shown in FIGS. **1-6**, a counterweight block **213** is mounted in the sensing seat **21**, and the counterweight block **213** is located directly below the axis of the first pivot shaft **212**.

(46) When the locking mechanism **3** is in the unlocking state, the counterweight block **213** causes the sensing seat **21** to remain in the initial position.

(47) In the present embodiment, the counterweight block **213** is provided in the sensing seat **21**, and the counterweight block **213** is located directly below the axis of the first pivot shaft **212**, thereby facilitating maintaining the location of the center of gravity of the combination of the sensing seat **21** and the counterweight block **213** directly below the axis of the first pivot shaft **212**, helping the sensing seat **21** to remain in the initial position when the locking mechanism **3** is in the unlocking state.

(48) In one embodiment, when the sensing ball **22** is in a static state in the accommodating recess **211**, the center of gravity of the sensing ball **22** is located directly above the counterweight block **213**, so that the center of gravity of the sensing ball **22** and the center of gravity of the combination of the sensing seat **21** and the counterweight block **213** are located on the same vertical line, facilitating the sensor **2** remaining in a vertical state.



(49) In one embodiment, as shown in FIGS. 2-9, a side of the sensing seat **21** facing away from the accommodating recess **211** is provided with a curved rack **214**, and the counterweight block **213** is located between two ends of the curved rack **214**.

(50) The locking mechanism **3** is located on one side of the sensing seat **21**.

(51) The locking mechanism **3** includes an extensible locking pin **31** and a driving member **32** for driving the locking pin **31** to move towards a side of the sensing seat **21**.

(52) An end portion of the locking pin **31** facing the curved rack **214** has locking pin teeth **311**.

(53) When the locking pin teeth **311** engage with the curved rack **214**, the locking mechanism **3** locks the sensing seat **21**.

(54) When the locking pin teeth **311** are separated from the curved rack **214**, the locking mechanism **3** unlocks the sensing seat **21**.

(55) In the present embodiment, the bottom of the sensing seat **21** is provided with the curved rack **214**, and the curved rack **214** and the sensing seat **21** may be integrally formed. The counterweight block **213** is located between the two ends of the curved rack **214**. That is, the center of gravity of the combination of the sensing seat **21** and the counterweight block **213** is located between the two ends of the curved rack **214**.

(56) The locking mechanism **3** is located on one side of the sensing seat **21** facing away from the sensing ball **22**. The locking mechanism **3** includes the extensible locking pin **31** and the driving member **32**. The locking pin **31** extends towards the curved rack **214**, and the end portion of the locking pin **31** has the locking pin teeth **311**. The driving member **32** is used for driving the locking pin **31** to move towards the side of the sensing seat **21**, so as to cause the locking pin teeth **311** to engage with the curved rack **214**. The driving member **32** may be a member capable of driving the locking pin **31** to move rectilinearly, such as an elastic member, a cylinder, and a motor.

(57) The locking mechanism **3** includes a support **33**. The locking pin **31** traverses a through hole on the support **33**, and can slide relative to the support **33**. The locking pin **31** has a connecting plate **34**, and the driving member **32** is connected between the support **33** and the connecting plate **34**.

(58) In the normal state, the seat back **301** is locked. The driving member **32** drives the locking pin **31** to move towards a side of the curved rack **214**, and causes the locking pin teeth **311** to engage with the curved rack **214**, and at such time, the locking mechanism **3** locks the sensing seat **21**.

(59) When the angle of the seat back **301** needs to be adjusted, an operation may be performed to cause the locking pin **31** to leave the curved rack **214**. At such time, the locking mechanism **3** unlocks the sensing seat **21**. Specifically, the locking pin **31** may be caused to leave the curved rack **214** by means of turning off the driving member, or resetting the driving member, or manually pulling the locking pin **31**, or the like.

(60) When the locking pin **31** rotates along with the seat back **301**, the distance between the locking pin **31** and the curved rack **214** does not change, thereby facilitating control of mating or separation between the locking pin **31** and the curved rack **214**.

(61) In one embodiment, the driving member **32** is an elastic element **321**.

(62) When the elastic element **321** is in a compressed state, the locking pin **31** is separated from the curved rack **214**.

(63) When the elastic element **321** is in a released state, the locking pin **31** mates with the curved rack **214**.

(64) In the present embodiment, the driving member **32** is the elastic element **321**, such as an expansion spring, or an elastic piece, or the like, thereby facilitating operation.

(65) In the normal state, the elastic element **321** is released or spread to push up the connecting plate **24**, thereby driving the locking pin **31** to mate with the curved rack **214**.

(66) When the angle of the seat back **301** needs to be adjusted, the locking pin **31** is pulled to overcome an acting force of the elastic element **321**, or the elastic element **321** is compressed by means of an electromagnetic mechanism, so that the locking pin **31** is separated from the curved

rack **214**.

(67) In one embodiment, as shown in FIG. **10**, the seat belt retracting and locking apparatus **100** further includes an electromagnetic actuator **4** for driving the elastic element **321** to switch between the compressed state and the released state.

(68) The electromagnetic actuator **4** includes an electromagnet **41** capable of compressing the elastic element **321** when powered on and a controller **42** for being connected to a vehicle computer **200** and capable of controlling the electromagnet **41** to be powered on and off.

(69) In the normal state, the electromagnet **41** is in a powered-off state, and the elastic element **321** is in the released state.

(70) When the controller **42** receives an angle adjustment signal of the seat back transmitted by the vehicle computer **200**, the controller **42** controls the electromagnet **41** to be powered on, and causes the elastic element **321** to be in the compressed state.

(71) The electromagnetic actuator **4** in the present embodiment is applicable to a button-type, key-type, or touch-type seat back adjustment switch. The electromagnetic actuator **4** includes the electromagnet **41**, the controller **42**, and a circuit board **43**. The electromagnet **41** and the controller **42** are respectively connected to the circuit board **43**. The electromagnet **41** may be mounted in the support **33**. The circuit board **43** is used for supplying power to the electromagnet **41**. The controller **42** may the electromagnet **41** to be powered on and off by means of controlling a circuit to be powered on and off. The vehicle computer **200** can monitor the operating state of a motor in an electrically adjustable seat, the state of a seat locking pin, user operations, and the like by means of sensors. Generally, when a user does not choose to adjust the seat back **301**, the seat back **301** is always considered by default to be in the locked state (the normal state). The controller **42** may control the circuit to be powered off, and the electromagnet **41** is powered off. The electromagnet **41** in the normal state is in the powered-off state. At such time, the electromagnet **41** does not exert an attraction force on the elastic element **321**, and the elastic element **211** is in a released or spread or expanded state, and can drive the locking pin **31** to extend out and mate with the curved rack **214**. When the user chooses to adjust the seat back **301**, the vehicle computer **200** transmits to the controller **42** an angle adjustment signal of the seat back. The controller **42** controls the circuit to be closed, and the electromagnet **41** is powered on. The electromagnet **41** that is powered on generates a magnetic field to attract the elastic element **321**, so that the elastic element **321** is compressed, and the locking pin **31** can be pulled to be separated from the curved rack **214**.

(72) In one embodiment, as shown in FIGS. **11-12**, the seat belt retracting and locking apparatus **100** further includes a pulling cord **5** for being connected between a rotation shaft **61** of a seat adjuster **6** and the locking pin **31**.

(73) When the seat adjuster **6** is in a locked state, the elastic element **321** is in the released state, and the locking pin **31** mates with the curved rack **214**.

(74) When the seat adjuster **6** is in an unlocked state, the pulling cord **5** pulls the locking pin **31** to leave the curved rack **214** and causes the elastic element **321** to be in the compressed state.

(75) The pulling cord **5** in the present embodiment is applicable to a handle-type seat back adjustment switch having a rotation shaft.

(76) The seat adjuster **6** may be a handle, a rocker, or the like, and has the rotation shaft **61**. One end of the pulling cord **5** is connected to the locking pin **31**, and the other end thereof is wound around the rotation shaft **61**. The rotation shaft **61** may be mounted on the rotary shaft **303** of the seat back **301** and a seat cushion **302**.

(77) When the seat adjuster **6** is in the locked state or a locked position (the normal state), the seat back **301** is locked, and the pulling cord **5** does not act on the locking pin **31**. The elastic element **211** is in the released or spread or expanded state, and can drive the locking pin **31** to extend out and mate with the curved rack **214**. When the seat adjuster **6** is rotated to the unlocked state or an unlocked position, the rotation shaft **61** rotates accordingly and winds the pulling cord **5**, and the pulling cord **5** pulls the locking pin **31** and compresses the elastic element **321**, so that the locking

pin **31** is separated from the curved rack **214**.

(78) In one embodiment, as shown in FIGS. **3-8**, the curved rack **214** has a first end **2141** and a second end **2142** arranged opposite each other.

(79) The distance between the counterweight block **213** and the first end **2141** is less than the distance between the counterweight block **213** and the second end **2142**.

(80) When the seat back **301** is in a vertical state, the locking pin **31** is located below the curved rack **214** and faces the counterweight block **213**.

(81) When the seat back **301** is in a state of being laid down backwards to be horizontal, the locking pin **31** is located on a front side of the curved rack **214** and faces the second end **2142**.

(82) The first end **2141** is a rear end of the curved rack **214**, and the second end **2142** is a front end of the curved rack **214**. The closer the counterweight block **213** is to the first end **2141**, the smaller the length of the curved rack **214** may be.

(83) Assuming that the radius of the curved rack **214** is  $r$ , the seat back **301** is enabled to be adjusted backwards by  $90^\circ$  from the vertical state as long as the curved rack **214** is slightly longer than the arc of  $\frac{1}{2}\pi r$ .

(84) In one embodiment, the pawl **14** is connected to the retractor housing **11** by means of the second pivot shaft **142**. The first pivot shaft **212** is parallel to the rotary shaft **303** of the seat back **301**, and the second pivot shaft **142** and the core shaft **12** are respectively parallel to the first pivot shaft **212**, thereby facilitating product structure arrangement and causing the sensing seat **21** to remain perpendicular to the vehicle width direction, and not oscillate in the vehicle width direction, facilitating the sensor **2** remaining in the vertical state.

(85) As shown in FIGS. **13-16**, an automotive seat **300** provided by an embodiment of the present invention includes a seat back **301** and the seat belt retracting and locking apparatus **100** according to any one of the foregoing embodiments.

(86) The retractor housing **11** is fixedly connected to a backrest frame of the seat back **301**.

(87) When the seat back **301** is locked, the locking mechanism **3** locks the sensing seat **21**.

(88) When the angle of the seat back **301** is adjusted, the locking mechanism **3** unlocks the sensing seat **21**.

(89) The automotive seat **300** provided by the present invention includes the seat back **301**, the seat cushion **302**, the rotary shaft **303**, and the seat belt retracting and locking apparatus **100**.

(90) For the structure, configurations, and working principle of the seat belt retracting and locking apparatus **100**, please refer to the foregoing description of the seat belt retracting and locking apparatus **100**. Details will not be described herein again.

(91) The seat back **301** is connected to the seat cushion **302** by means of the rotary shaft **303**. The seat back **301** can rotate about the rotary shaft **303** relative to the seat cushion **302** so as to be adjusted. For the adjustment means and the adjustment mechanism of the seat back **301**, reference may be made to content in the prior art.

(92) The locking state and the unlocking state of the locking mechanism **3** correspond to a locked state and an adjustable state of the seat back **301**. When the seat back **301** is locked, the locking mechanism **3** is in the locking state, and the locking mechanism **3** locks the sensing seat **21**. When the angle of the seat back **301** needs to be or is adjusted, the locking mechanism **3** is in the unlocking state, and the locking mechanism **3** unlocks the sensing seat **21**.

(93) Therefore, for the automotive seat **300** provided by the present invention, the sensing seat **21** is locked in the initial position by the locking mechanism **3** as long as the angle of the seat back **301** is not adjusted, so that the angle and the position of the sensing seat **21** are not affected by a change in the speed of the vehicle.

(94) When the angle of the seat back **301** is adjusted, the seat belt retractor **1** and the locking mechanism **3** rotate together with the seat back **301**. However, the sensing seat **21** only rotates relative to the axis of the first pivot shaft **212**, and always remains in the initial position, and the sensing ball **22** also remains substantially still, so that relative positions between the sensing ball

22, the pawl 14, and the ratchet 13 do not change, thereby improving the stability of the performance of the product.

(95) Depending on the requirements, the above technical solutions can be combined to achieve an optimal technical effect.

(96) The above description is merely illustrative of the principles and preferred examples of the present invention. It should be noted that other variations can be made by those of ordinary skill in the art on the basis of the principles of the present invention, and such variations should be construed as falling within the scope of protection of the present invention.

## Claims

1. A seat belt retracting and locking apparatus for being mounted in a seat back, comprising: a seat belt retractor, a sensor having a sensing seat and a sensing ball, and a locking mechanism for locking the sensing seat, the seat belt retractor comprising a retractor housing for being connected to a backrest frame of the seat back, a core shaft mounted on the retractor housing, a seat belt reel sleeved on the core shaft, a ratchet located outside of the retractor housing and synchronously rotating with the seat belt reel, and a pawl pivotally mounted outside of the retractor housing and capable of being triggered by the sensing ball to lock the ratchet, the sensing seat being connected to the retractor housing by means of a first pivot shaft, the sensing seat having an accommodating recess, the sensing ball being at least partially located in the accommodating recess, an abutting portion of the pawl resting on the sensing ball, the sensing seat having an initial position, the center of gravity of the sensing seat in the initial position being located directly below the axis of the first pivot shaft, a counterweight block is mounted in the sensing seat, the counterweight block being located directly below the axis of the first pivot shaft, wherein one side of the sensing seat facing away from the accommodating recess is provided with a curved rack, and the counterweight block is located between two ends of the curved rack, and the locking mechanism being mounted on the retractor housing, and being located on one side of the sensor, the locking mechanism being located on one side of the sensing seat, the locking mechanism comprising an extensible locking pin and a driving member for driving the locking pin to move towards one side of the sensing seat configured for engaging the curved rack, wherein the locking mechanism has a locking state of locking the sensing seat when the seat back is locked and an unlocking state of unlocking the sensing seat when the angle of the seat back is adjusted, when the locking mechanism is in the locking state, the sensing seat being fixed in the initial position, and when the locking mechanism is in the unlocking state, the sensing seat being rotatable relative to the axis of the first pivot shaft, and the sensing seat remaining in the initial position.

2. The seat belt retracting and locking apparatus according to claim 1, wherein when the locking mechanism is in the unlocking state, the counterweight block causes the sensing seat to remain in the initial position.

3. The seat belt retracting and locking apparatus according to claim 2, wherein when the sensing ball is in a static state in the accommodating recess, the center of gravity of the sensing ball is located directly above the counterweight block.

4. The seat belt retracting and locking apparatus according to claim 1, wherein an end portion of the locking pin is formed with locking pin teeth and faces the curved rack, when the locking pin teeth engage with the curved rack, the locking mechanism locks the sensing seat, and when the locking pin teeth are separated from the curved rack, the locking mechanism unlocks the sensing seat.

5. The seat belt retracting and locking apparatus according to claim 4, wherein the driving member is an elastic element, when the elastic element is in a compressed state, the locking pin being separated from the curved rack, and when the elastic element is in a released state, the locking pin mating with the curved rack.

6. The seat belt retracting and locking apparatus according to claim 5, wherein the seat belt retracting and locking apparatus further comprises an electromagnetic actuator for driving the elastic element to switch between the compressed state and the released state, the electromagnetic actuator comprising an electromagnet capable of compressing the elastic element when powered on and a controller for being connected to a vehicle computer and capable of controlling the electromagnet to be powered on and off, in a normal state, the electromagnet being in a powered-off state, and the elastic element being in the released state, and when the controller receives an angle adjustment signal of the seat back transmitted by the vehicle computer, the controller controlling the electromagnet to be powered on, and causing the elastic element to be in the compressed state.

7. The seat belt retracting and locking apparatus according to claim 5, wherein the seat belt retracting and locking apparatus further comprises a pulling cord for being connected between a rotation shaft of a seat adjuster and the locking pin, when the seat adjuster is in a locked state, the elastic element being in the released state, and the locking pin mating with the curved rack, and when the seat adjuster is in an unlocked state, the pulling cord pulling the locking pin to leave the curved rack, and causing the elastic element to be in the compressed state.

8. The seat belt retracting and locking apparatus according to claim 4, wherein the curved rack has a first end and a second end arranged opposite each other, the distance between the counterweight block and the first end being less than the distance between the counterweight block and the second end, when the seat back is in a vertical state, the locking pin being located below the curved rack and facing the counterweight block, and when the seat back is in a state of being laid down backwards to be horizontal, the locking pin being located on a front side of the curved rack and facing the second end.

9. The seat belt retracting and locking apparatus according to claim 1, wherein the pawl is connected to the retractor housing by means of a second pivot shaft, the first pivot shaft being parallel to a rotary shaft of the seat back, and the second pivot shaft and the core shaft being respectively parallel to the first pivot shaft.

10. An automotive seat, comprising the seat back and the seat belt retracting and locking apparatus according to claim 1, the retractor housing being fixedly connected to a backrest frame of the seat back, when the seat back is locked, the locking mechanism locking the sensing seat, and when the angle of the seat back is adjusted, the locking mechanism unlocking the sensing seat.

11. An automotive seat, comprising the seat back and the seat belt retracting and locking apparatus according to claim 2, the retractor housing being fixedly connected to a backrest frame of the seat back, when the seat back is locked, the locking mechanism locking the sensing seat, and when the angle of the seat back is adjusted, the locking mechanism unlocking the sensing seat.

12. An automotive seat, comprising the seat back and the seat belt retracting and locking apparatus according to claim 3, the retractor housing being fixedly connected to a backrest frame of the seat back, when the seat back is locked, the locking mechanism locking the sensing seat, and when the angle of the seat back is adjusted, the locking mechanism unlocking the sensing seat.

13. An automotive seat, comprising the seat back and the seat belt retracting and locking apparatus according to claim 4, the retractor housing being fixedly connected to a backrest frame of the seat back, when the seat back is locked, the locking mechanism locking the sensing seat, and when the angle of the seat back is adjusted, the locking mechanism unlocking the sensing seat.

14. An automotive seat, comprising the seat back and the seat belt retracting and locking apparatus according to claim 5, the retractor housing being fixedly connected to a backrest frame of the seat back, when the seat back is locked, the locking mechanism locking the sensing seat, and when the angle of the seat back is adjusted, the locking mechanism unlocking the sensing seat.

15. An automotive seat, comprising the seat back and the seat belt retracting and locking apparatus according to claim 6, the retractor housing being fixedly connected to a backrest frame of the seat back, when the seat back is locked, the locking mechanism locking the sensing seat, and when the

angle of the seat back is adjusted, the locking mechanism unlocking the sensing seat.

16. An automotive seat, comprising the seat back and the seat belt retracting and locking apparatus according to claim 7, the retractor housing being fixedly connected to a backrest frame of the seat back, when the seat back is locked, the locking mechanism locking the sensing seat, and when the angle of the seat back is adjusted, the locking mechanism unlocking the sensing seat.

17. An automotive seat, comprising the seat back and the seat belt retracting and locking apparatus according to claim 8, the retractor housing being fixedly connected to a backrest frame of the seat back, when the seat back is locked, the locking mechanism locking the sensing seat, and when the angle of the seat back is adjusted, the locking mechanism unlocking the sensing seat.

18. An automotive seat, comprising the seat back and the seat belt retracting and locking apparatus according to claim 9, the retractor housing being fixedly connected to a backrest frame of the seat back, when the seat back is locked, the locking mechanism locking the sensing seat, and when the angle of the seat back is adjusted, the locking mechanism unlocking the sensing seat.

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