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(54) **QUICK-ACTING BELT TENSIONER FOR A CHILD SAFETY SEAT**

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(60) Provisional application No. 63/321,382, filed on Mar. 18, 2022.

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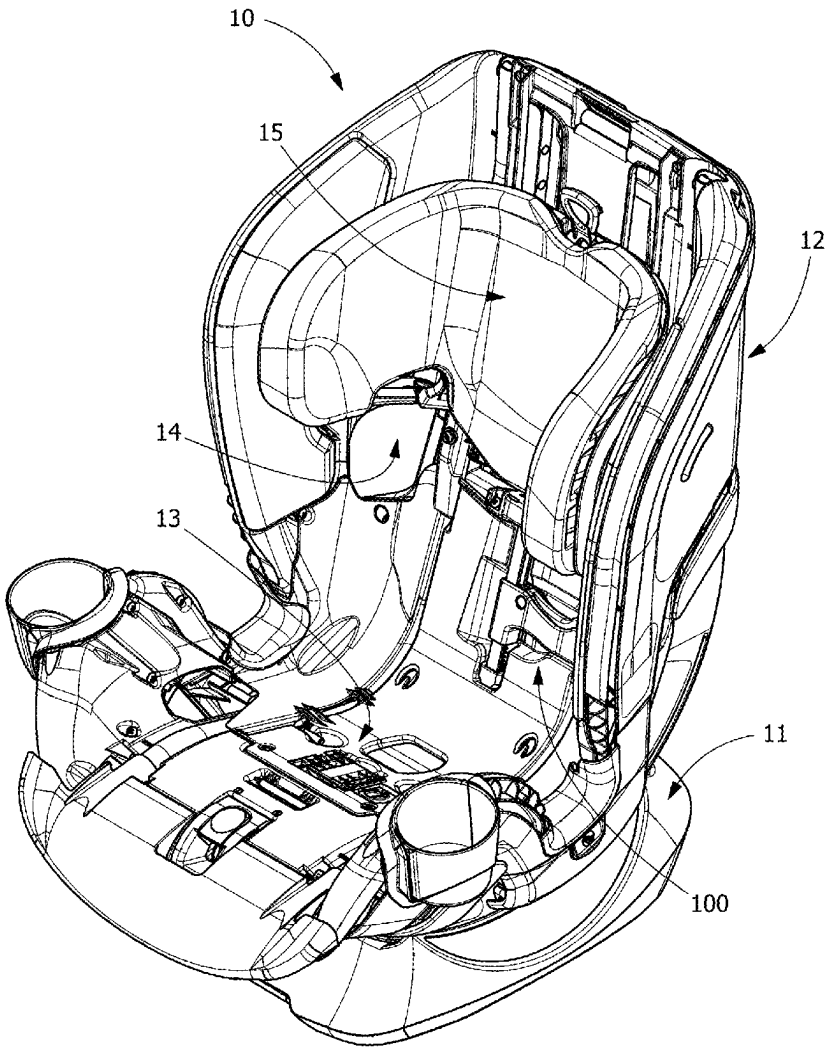
(57) **ABSTRACT**

A belt tensioning mechanism for securing a child safety seat into a vehicle includes a tensioning member with a hook-like engagement structure rotatably mounted on the safety seat adjacent to a belt path for a vehicle seat belt. Engaging the seat belt in the engagement structure and rotating the tensioning member by movement of the lever tensions the seat belt by wrapping the seat belt around the tensioning member. The lever is slideably disposed on the tensioning member to selectively close an opening of the hook-like structure and prevent disengagement of the seat belt therefrom, and to inhibit tensioning rotation of the tensioning member unless the lever is properly positioned. A latching mechanism is provided to restrain the tensioning member and lever in the tensioned and closed position. The seat shell and lever may include structures to further constrain seat belt tensioning unless the lever is properly positioned.



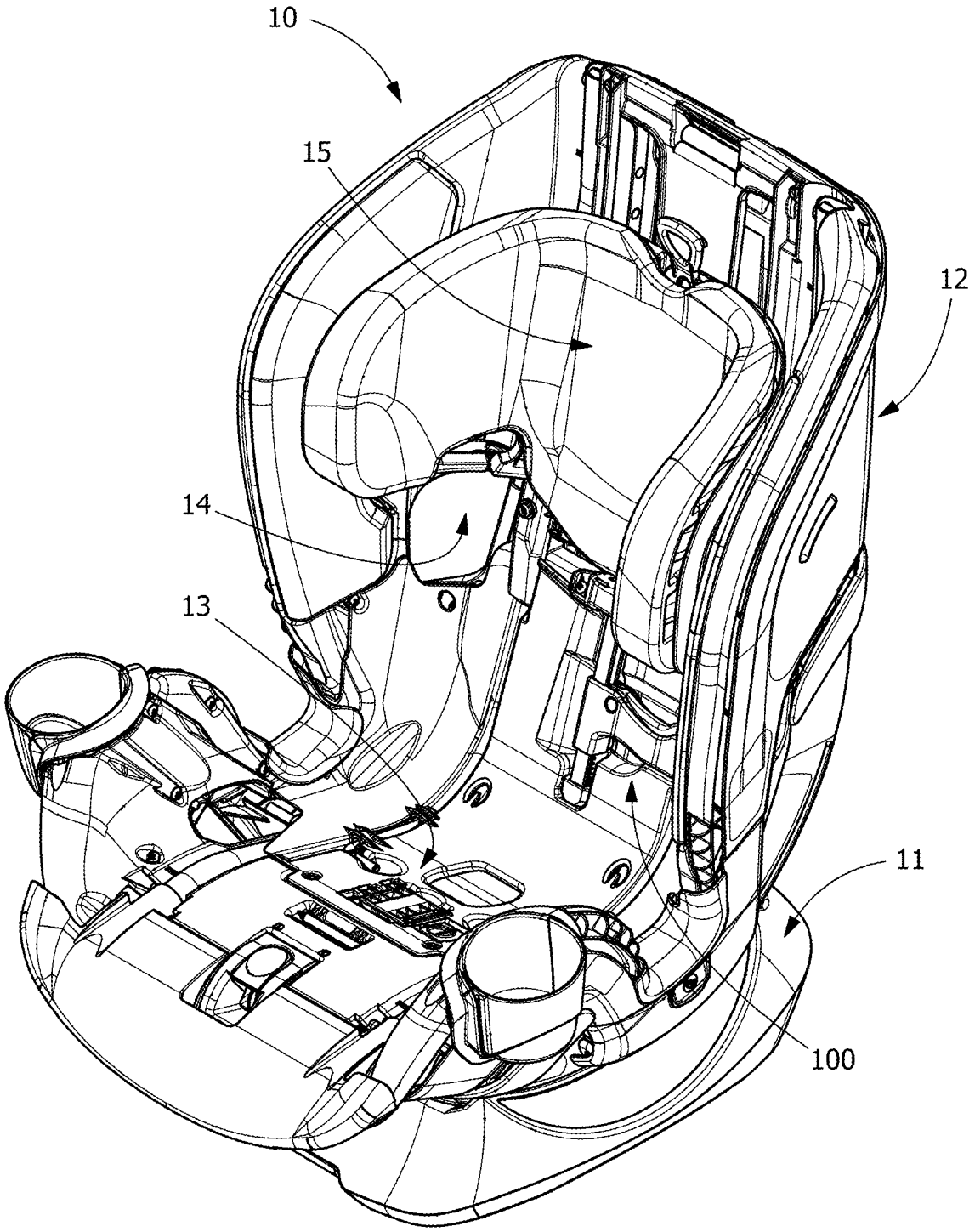


FIG. 1

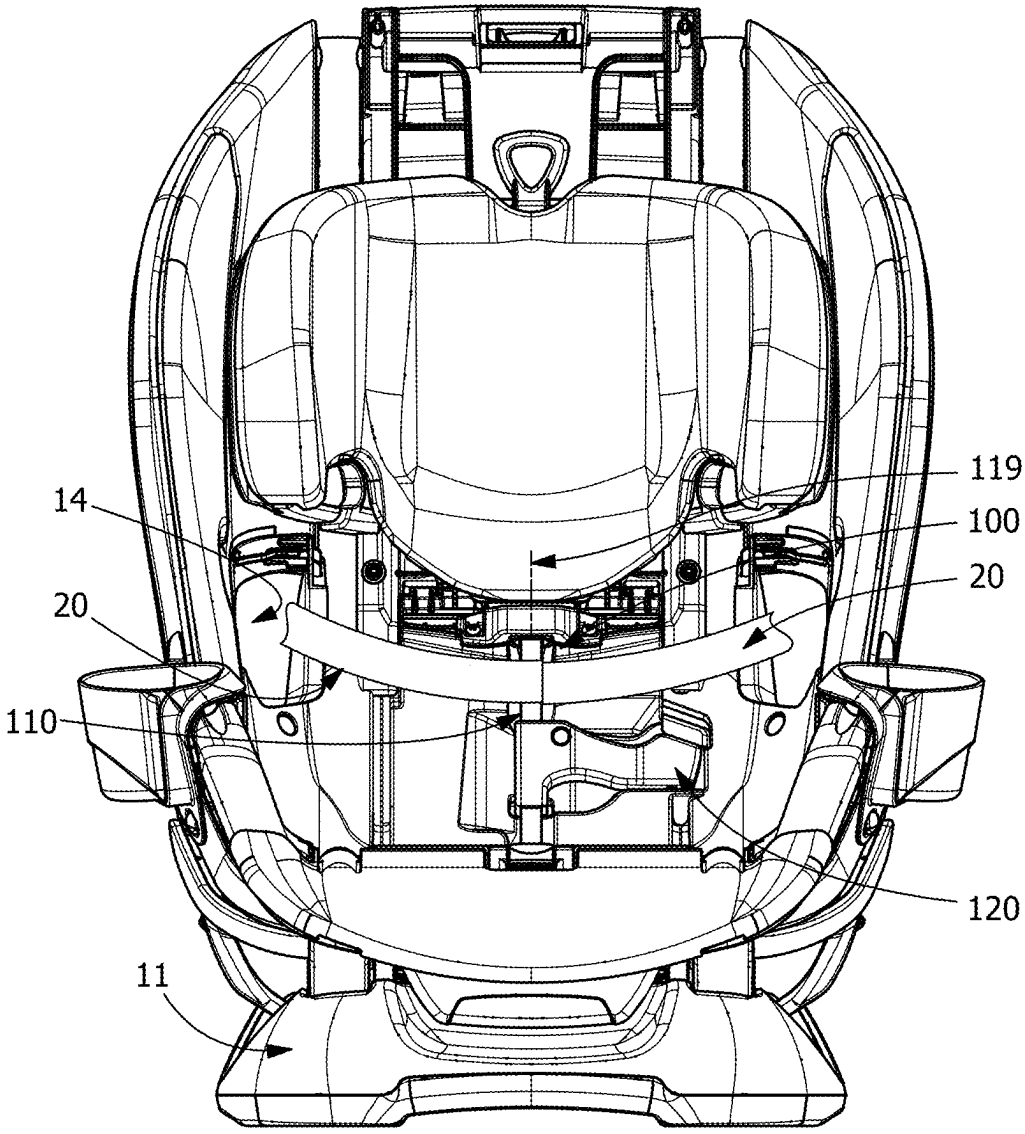


FIG. 2

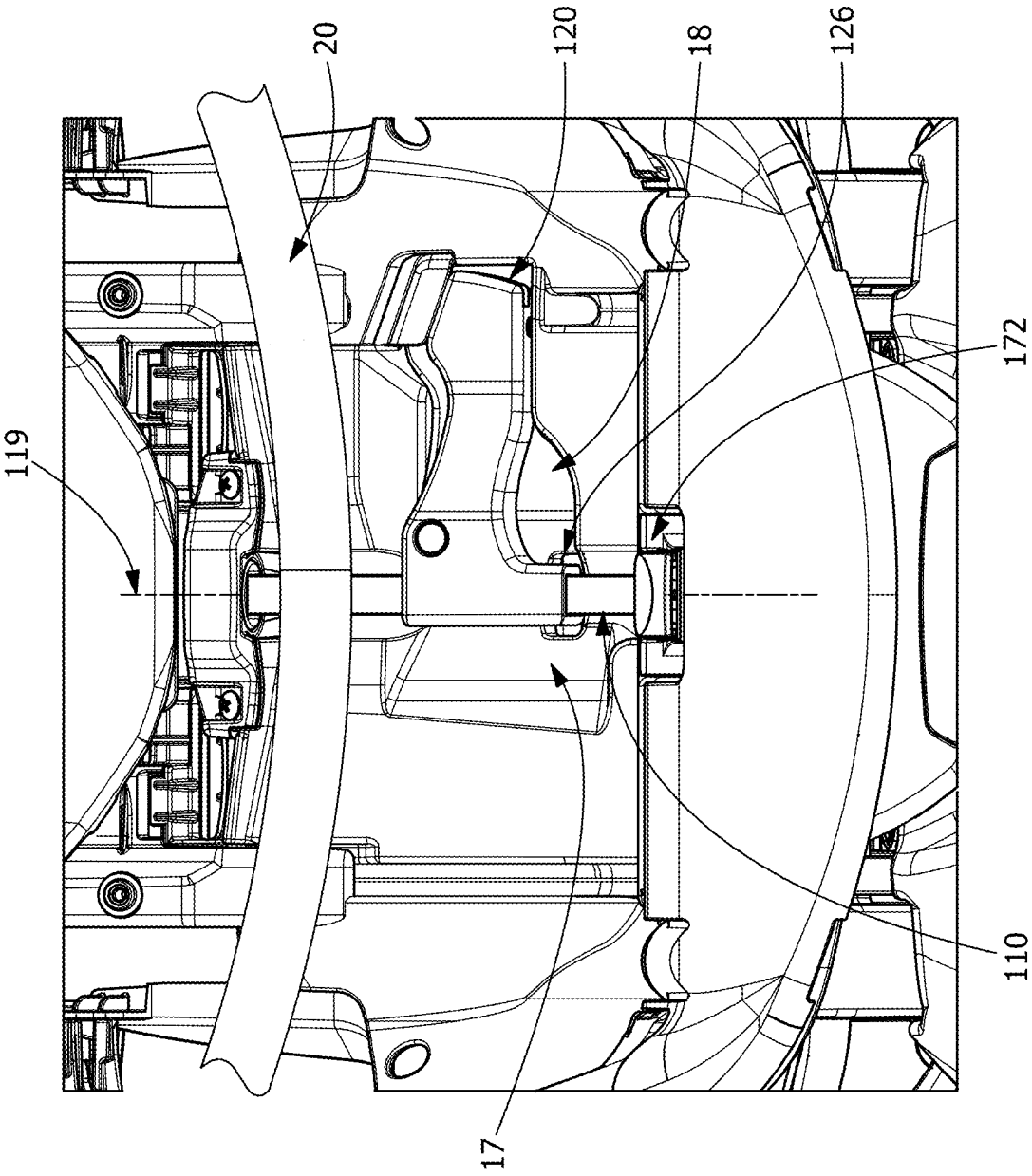


FIG. 3

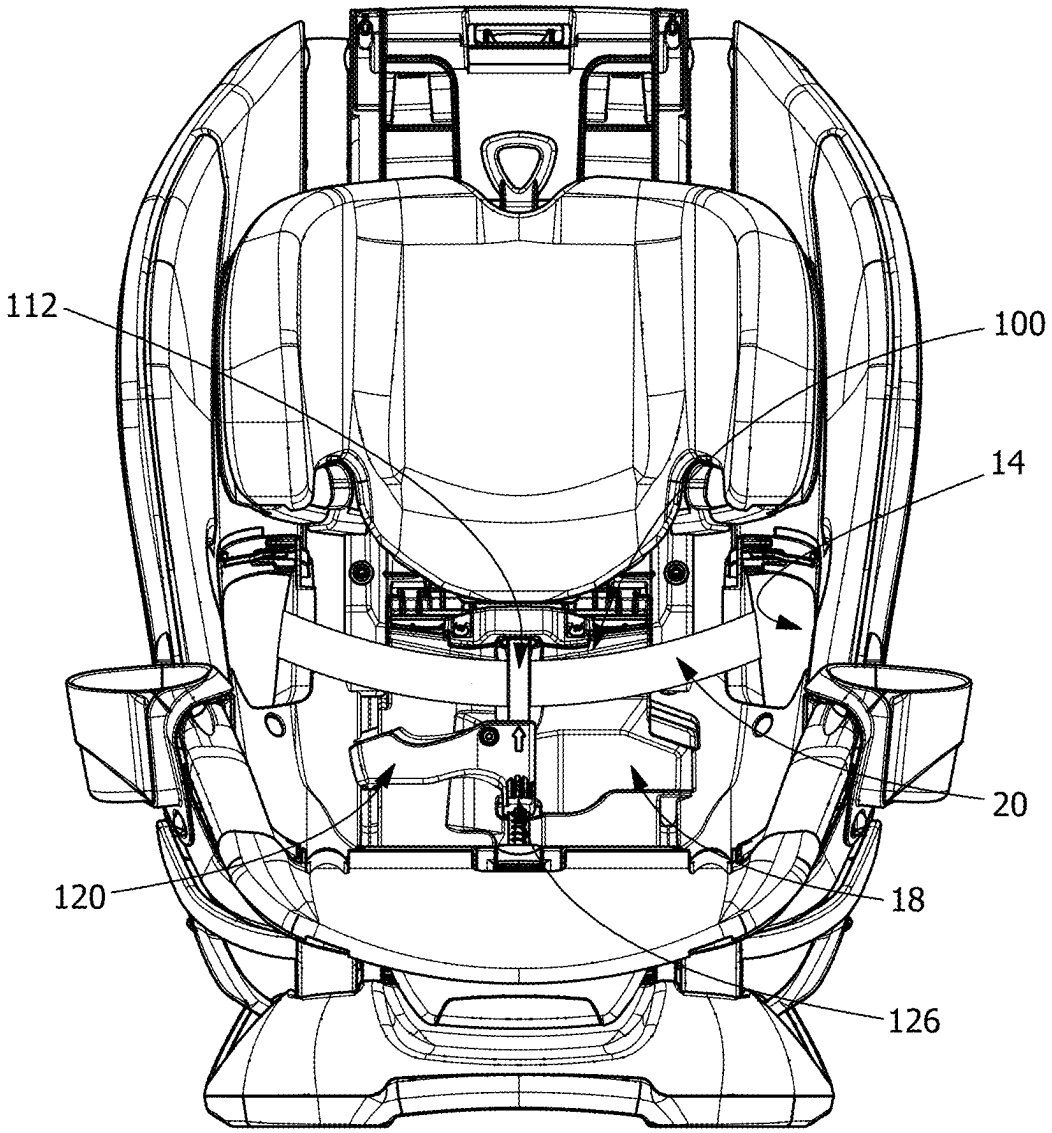


FIG. 4

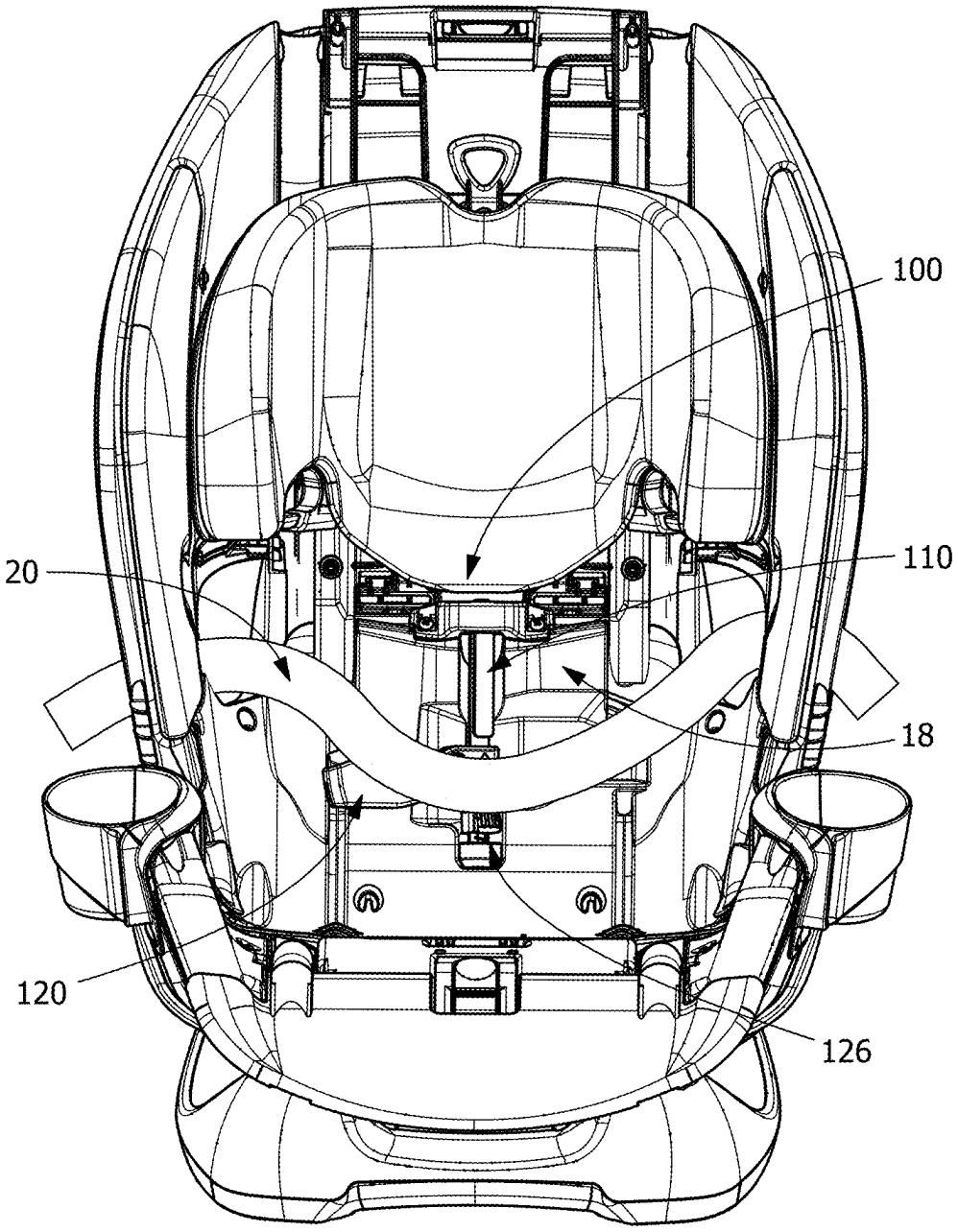


FIG. 5

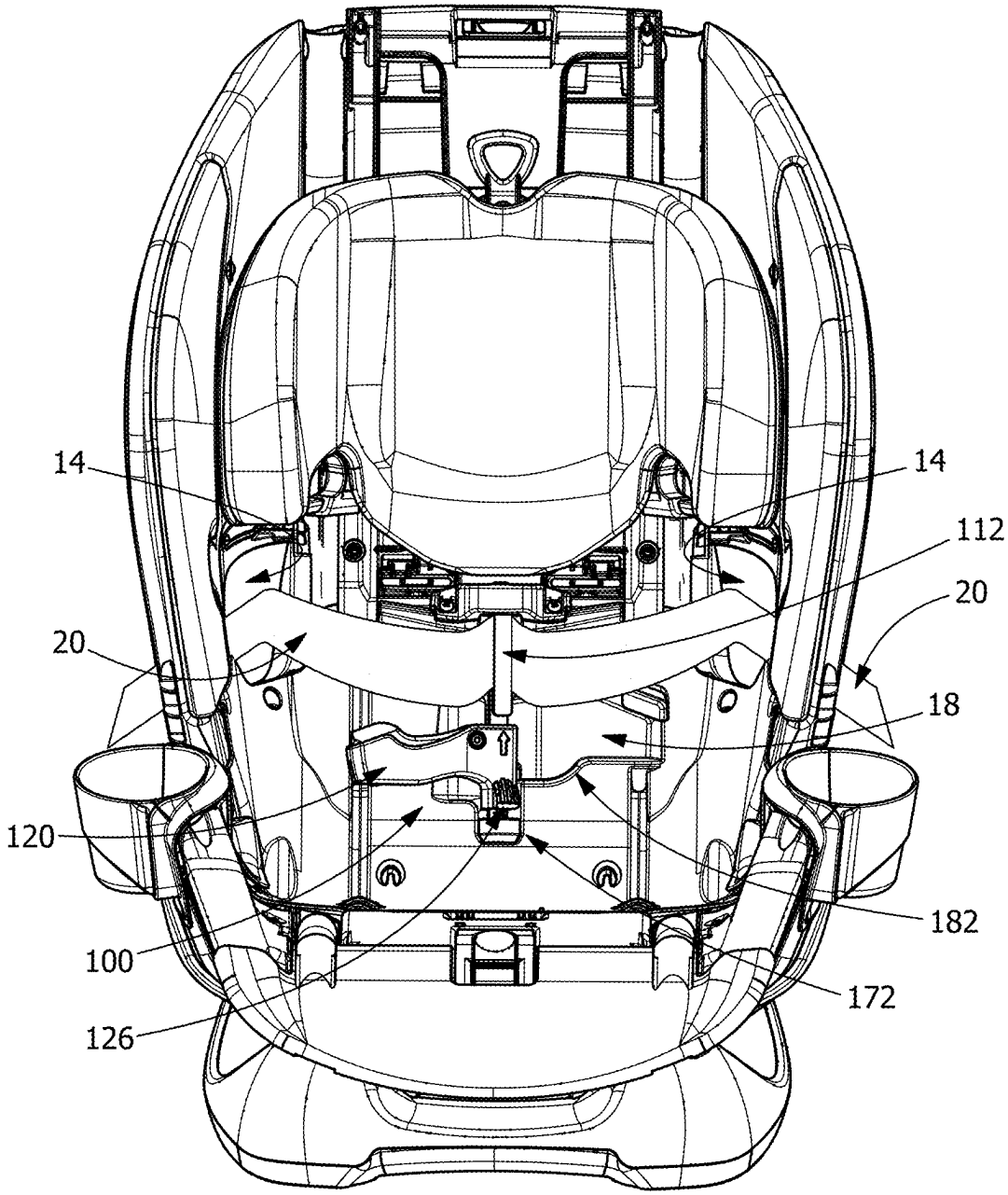


FIG. 6

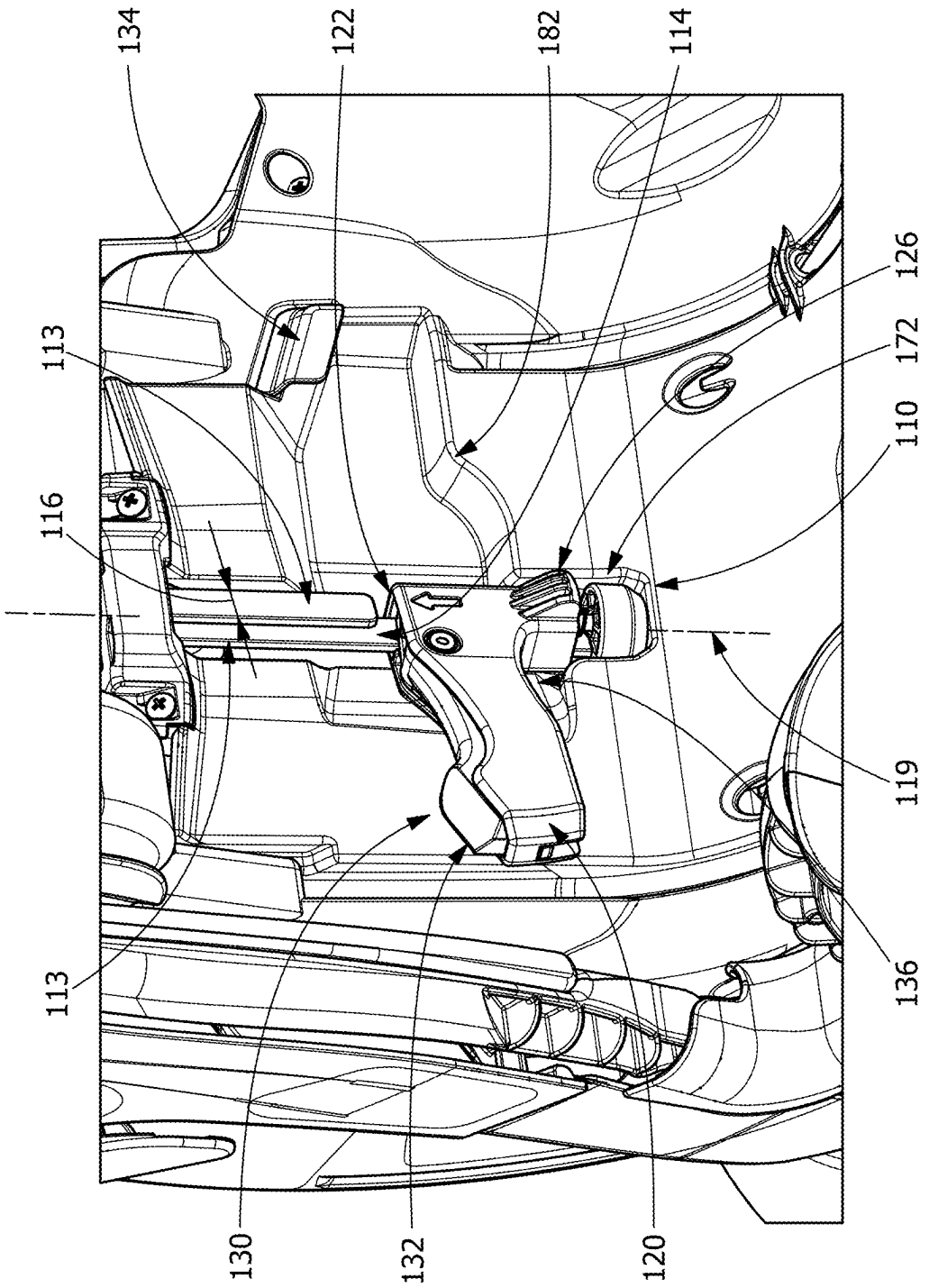


FIG. 7

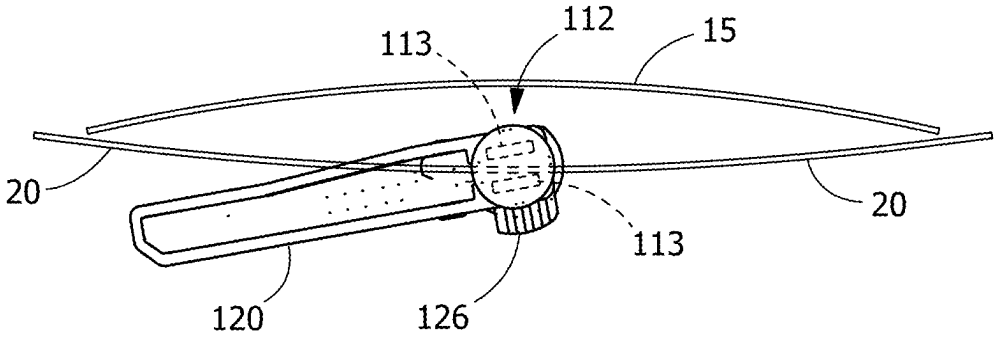


FIG. 8

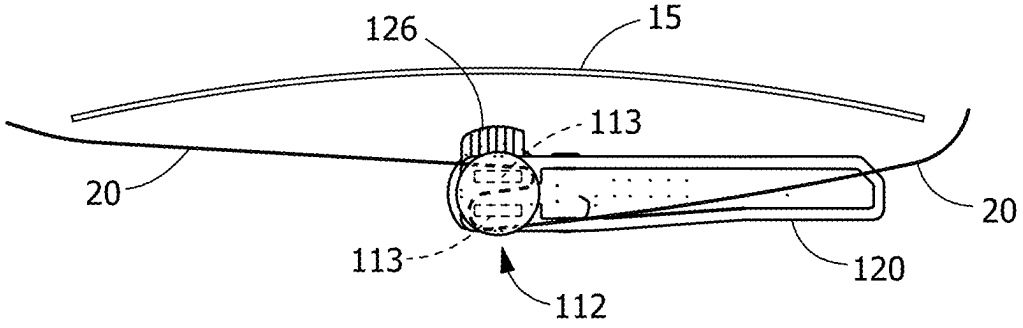


FIG. 9

QUICK-ACTING BELT TENSIONER FOR A CHILD SAFETY SEAT

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to U.S. application Ser. No. 18/181,855, entitled "QUICK-ACTING BELT TENSIONER FOR A CHILD SAFETY SEAT" filed Mar. 10, 2023, and U.S. Provisional Application No. 63/321,382, entitled "QUICK-ACTING BELT TENSIONER FOR A CHILD SAFETY SEAT" filed Mar. 18, 2022, the disclosures of both which are incorporated herein by reference in their entirety.

FIELD OF THE INVENTION

[0002] The present disclosure is generally directed to the field of child safety seats for use in vehicles, and, more particularly to a quick acting belt tensioning mechanism that tensions the vehicle safety belts to properly anchor the safety seat in the vehicle.

BACKGROUND OF THE INVENTION

[0003] Children's safety seats installed in vehicles have made automobile travel substantially safer for children. Realization of these safety benefits relies on proper installation and tensioning of the vehicle seat belts to securely anchor the safety seat in the vehicle. Many parents discover the process of properly installing child safety seats to be difficult and often. Vehicle seat belts typically comprise lap and shoulder belt portions with routing optimized to restrain an adult or larger child siting in the vehicle seat. Belt routing adapted to secure a safety seat in the vehicle seat generally complicates the belt installation and tensioning process.

[0004] What is needed is a quick acting belt tensioning mechanism for a child safety that simplifies the process of anchoring the seat into the vehicle while providing a simple and reliable mechanism to properly tension the vehicle seat belt and properly secure the safety seat into the vehicle. Other features and advantages will be made apparent from the present specification. The teachings disclosed extend to those embodiments that fall within the scope of the claims, regardless of whether they accomplish one or more of the aforementioned needs.

SUMMARY OF THE INVENTION

[0005] Accordingly, the present invention, in any of the embodiments described herein, may provide one or more of the following advantages:

[0006] It is an object of the present invention to provide a quick acting belt tensioning mechanism for securing a child safety seat into a vehicle comprising a tensioning member with a hook-like engagement structure rotatably disposed on a shell of the safety seat and rotatable between generally opposing tensioned and released positions, and a lever slidably disposed on the engagement structure between generally opposing open and closed position and operably connected to the engagement structure to effect rotational movement thereof. Securing the safety seat to the vehicle requires directing the vehicle seat belt through openings in the safety seat shell allowing the vehicle seat belt to be directed through the seat shell adjacent to the tensioning member and engaged in the hook-like engagement structure of the tensioning member while the tensioning member is release and the lever opened. Once the vehicle seat belt is attached to a latching connector in the vehicle, the tensioning mechanism is operated by sliding the lever to the closed position and then rotating the tensioning member from the released position to the tensioned position by moving the lever. Slack in the vehicle seat belt is reduced as the seat belt is wrapped around the engagement structure as the tensioning member is rotated.

[0007] It is a further object of the present invention to provide a quick-acting belt tensioning mechanism for securing a child safety seat into a vehicle having a rotatable tensioning member with a hook-like engagement structure and a lever with slidably disposed for axial movement on the tensioning member. The engagement structure includes a belt engagement path substantially surrounded by the structure and an engagement opening created by the open mouth of the hook. The lever may be moved so the engagement opening is unimpeded, allowing insertion of the vehicle safety belt through the engagement opening or to block the engagement opening thereby preventing removal of the vehicle safety belt from the engagement path dependent upon the axial position of the lever. The lever when in the closed position blocks the engagement opening of the engagement structure thereby retaining the vehicle belt within the engagement structure.

[0008] It is a further object of the present invention to provide a quick acting belt tensioning mechanism for securing a child safety seat into a vehicle having a rotatable tensioning member rotated by a lever and further comprising a latching mechanism with a moveable latch member engageable with a fixed latch plate when the lever tensioning member is rotated to the tensioned position while the lever is in the closed position to restrain the tensioning member in the tensioned position.

[0009] It is a still further object of the present invention to provide a quick acting belt tensioning mechanism for securing a child safety seat into a vehicle having a position limiting structure configured to receive the lever when rotating the tensioning member toward the tensioned position only when the lever is in the closed position. The positioning limiting structure may take the form of a recessed portion in the shell of the safety seat in which the tensioning member and lever are partially disposed. Blocking structures may also be provided on the lever to limit lever movement to a desired sequence for tensioning the vehicle seat belt.

[0010] It is another object of the present invention to provide a quick acting belt tensioning mechanism for securing a child safety seat into a vehicle having a latching mechanism to maintain the tensioning member and lever in at least one preferred position. The at least one preferred position maintains the tensioning mechanism in the tensioned configuration thereby precluding unintentional release and subsequent loosening of the seat connection to the vehicle.

[0011] It is a still further object of the present invention to provide a quick acting belt tensioning mechanism for securing a child safety seat into a vehicle that is durable in construction, inexpensive of manufacture, carefree of maintenance, easily assembled, and simple and effective to use.

[0012] These and other objects are achieved in accordance with the present invention by providing a quick acting belt tensioning mechanism for securing a child safety seat into a vehicle having a tensioning member with a hook-like

engagement structure rotatably mounted on the safety seat adjacent to a belt path for a vehicle seat belt. The engagement structure includes a belt engagement path substantially surrounded by the structure and an engagement opening created by the open mouth of the hook. Engaging the seat belt in the engagement structure and rotating the tensioning member by movement of the lever tensions the seat belt by wrapping the seat belt around the tensioning member. The lever is slideably disposed on the tensioning member to close the engagement opening of the hook-like structure and trap the belt within the engagement path to prevent disengagement of the seat belt therefrom and to inhibit rotation of the tensioning member to the tensioned position unless the lever is properly positioned. A latching mechanism is provided to restrain the tensioning member and lever in the tensioned and closed position. The seat shell and lever may include structures to further constrain seat belt tensioning unless the lever is properly positioned.

[0013] Other features and advantages of the present invention will be apparent from the following more detailed description of the preferred embodiment, taken in conjunction with the accompanying drawings which illustrate, by way of example, the principles of the invention.

BRIEF DESCRIPTION OF DRAWINGS

[0014] The advantages of this invention will be apparent upon consideration of the following detailed disclosure of the invention, especially when taken in conjunction with the accompanying drawings wherein:

[0015] FIG. **1** is a perspective view of a child safety seat of the type in which the present invention is useful;

[0016] FIG. **2** is a front elevation view of the safety seat of FIG. **1** showing one embodiment of a quick acting belt tensioning mechanism as it would be positioned when in use securing the safety seat into the vehicle;

[0017] FIG. **3** is a partial view of the quick acting belt tensioning mechanism of FIG. **2** showing a latching mechanism in a released configuration in preparation for repositioning the belt tensioning mechanism to the released position;

[0018] FIG. **4** is a front elevation view of the interior of the quick acting belt tensioning mechanism of FIG. **2** showing the mechanism in the released position;

[0019] FIG. **5** is a front elevation view of the interior of the quick acting belt tensioning mechanism of FIG. **2** showing the mechanism in the release position and the operating lever in the open position to allow disengagement of the vehicle seat belt from the tensioning mechanism;

[0020] FIG. **6** is a front elevation view of the interior of the quick acting belt tensioning mechanism of FIG. **5** showing the routing of the vehicle seat belt engaged with the tensioning mechanism;

[0021] FIG. **7** is an expanded partial view of the belt tensioning mechanism as shown in FIG. **5** showing the seat shell and lever configurations used to limit mechanism movement;

[0022] FIG. **8** is a partial view of the belt tensioning mechanism shown viewed from above and in the detensioned position; and

[0023] FIG. **9** is a partial view of the belt tensioning mechanism shown viewed from above and in the tensioned position.

[0024] Wherever possible, the same reference numbers will be used throughout the drawings to represent the same parts.

DETAILED DESCRIPTION OF THE INVENTION

[0025] Many of the fastening, connection, processes and other means and components utilized in this invention are widely known and used in the field of the invention described, and their exact nature or type is not necessary for an understanding and use of the invention by a person skilled in the art, and they will not therefore be discussed in significant detail. Also, any reference herein to the terms "up" or "down," or "top" or "bottom" are used as a matter of mere convenience and are determined as the seat would normally be positioned in a vehicle for use by a child. Furthermore, the various components shown or described herein for any specific application of this invention can be varied or altered as anticipated by this invention and the practice of a specific application of any element may already be widely known or used in the art by persons skilled in the art and each will likewise not therefore be discussed in significant detail.

[0026] Referring to the figures, an exemplary child safety seat **10** incorporating principles of the present invention is shown comprising a shell structure **12** configured to contain a child occupant therein and a base structure **11** suitable for resting upon a vehicle seat and support the shell structure. The shell structure includes a seating portion **13** and a backrest portion **15** that is angled in relation to the seating portion and extends generally upwardly therefrom. Shell structure **12** may be moveable in relation to base structure **11** to allow the recline angle of the shell structure and backrest portion to be adjusted for optimal orientation of the child occupant in relation to the vehicle seat when safety seat **10** is installed in a vehicle. Shell structure **12** may further be selectively detachable from base structure **11** allowing the shell structure to be used to carry a child occupant, typically an infant. A carry handle connected to the shell structure may be provided to that end.

[0027] Safety seats of the type illustrated are typically secured to the vehicle seat by directing the vehicle seat belt **20** through a belt pathway **14** formed in and defined by the shell structure. Directing the vehicle seat belt though the belt pathway and connecting the seat belt to a seat belt anchor connector provided in the vehicle on the laterally opposite side of the safety seat anchors the safety seat to the vehicle. Vehicle seat belt **20** may comprise a lap portion and a shoulder portion, or may comprise only a lap portion, and have a first end anchored to the vehicle and a second, free end that may be selectively anchored to the vehicle by a belt connector at a location distant from the first end belt anchor location so the belt extends across the lap and/or torso of a seat occupant. Some safety seats include a more substantial base structure that is anchored by the vehicle seat belts in the vehicle. The seat shell is subsequently connected to the base assembly. The connection of the shell structure to the base structure in such embodiments is more robust as it must withstand crash forces and maintain the seat shell securely connected to the base structure and hence the vehicle. The instant invention may also find utility in securing such base structures into vehicles.

[0028] The quick acting belt tensioning mechanism **100** comprises a tensioning member **110** with a hook-like belt

engagement structure **112** disposed on the shell of the safety seat and rotatable about a rotational axis **119**. The hook-like arrangement of belt engagement structure **112** defines a belt engagement path **113** through which vehicle seat belt **20** may pass when operably engaged and an engagement opening **114** which allows easy movement of belt **20** to laterally (in a direction parallel to rotational axis **119**) into an operably engaged position wherein vehicle seat belt **20** passes through the belt engagement path **113** of the engagement structure **112**. In the embodiment illustrated, rotational axis **119** is generally aligned parallel to the slope of the backrest portion and rotatable between generally opposing tensioned position (FIGS. **1-3**) and released or detensioned position (FIGS. **4-6**).

[0029] The belt tensioning mechanism **100** further includes a lever **120** moveably disposed on engagement structure **112** and bi-directionally moveable in a direction parallel to the rotational axis between generally opposing open (FIG. **5**) and closed (FIG. **4**) positions. Belt access to engagement opening **114** is uninhibited by lever **120** when the lever is in the open position. Sliding lever **120** (upwardly as illustrated) to the closed position blocks engagement opening **114** and prevents disengagement of the belt from belt engagement path **113** when passing therethrough. The shell structure includes a recessed portion **17** into which the belt tensioning mechanism is positioned so that soft goods covering the backrest portion provide a smooth surface for the child occupant. The recessed portion preferably includes a lever recess **18** configured to preclude lever movement toward the tensioned and latched orientation (FIG. **2**) unless the lever is first moved to the closed position (FIG. **4**). A lever block **126** may be provided on the lever to aid in limiting rotational movement of the lever when it is not in the fully closed position.

[0030] The lever **120** includes a sleeve **122** which engages tensioning member **110** in a manner enabling lever **120** to move bi-directionally along tensioning member **110** in line with rotational axis **119**. The sleeve **122** is configured to engage tensioning member **110** in a manner enabling rotational torque to be applied to the tensioning member so that the tensioning member **110** may be rotated between the tensioned and detensioned positions. The sleeve **122** also allow bi-directional displacement of the lever in the direction of the rotational axis **119** between the open and closed positions. When shifted to the closed position, the sleeve encircles the engagement opening **114** portion of tensioning member engagement structure **112** (FIG. **4**) to close the opening and trap the engaged vehicle seat belt therein.

[0031] Lever **120** movement is controlled by interaction with the seat shell structure **12**. Lever **120** rotates about fixed rotational axis, but a blocking member **126** attached to lever **120** for movement therewith interacting with a blocking structure **172** to limit the axial locations along tensioning member **110** that lever **120** may be rotated. Blocking structure **172** is configured to inhibit lever **120** rotation toward the tensioned position unless lever **120** is moved upwardly into the closed position. Once so positioned, interference between blocking member **126** and blocking structure **172** no longer occurs, allowing the lever to be rotated. Similarly, lever **120** is inhibited from downward axial movement while in the tensioned position by interaction between the lever and/or blocking member and the blocking structure **172** and/or confines of lever recess **18**, defined by peripheral end **182**.

[0032] Moving lever **20** from a left pointing orientation (FIG. **4**) to a right pointing orientation (FIG. **3**) moves tensioning member **110** from the released position to the tensioned position, approximately one-half of a rotation of the tensioning member. The configuration of the recessed portion **17** of the backrest and the lever recess **18** may limit lever **120** rotation to slightly less than a one-half of a full rotation (180 degrees reversed) orientation of the lever. In the illustrated embodiment, the lever and tensioning member are limited to approximately 170 degrees of rotation between the tensioned and released positions due to the relationship between the lever and the recessed spaces. For purposes of this disclosure, approximately one-half rotation is defined as rotation of the tensioning member ranging between 160 degrees and 200 degrees.

[0033] A latching mechanism **130** is provided to maintain lever **120** in at least the tensioned position. Latching mechanism **130** may include a moveable latch member **132** engageable with a fixed latch member **134** when lever **120** is oriented in the tensioned position. The moveable latch member is moveable between generally opposing latched and unlatched positions. The moveable latch member may include a resilient member to bias the latch member toward the latched position and an actuator **136** to allow selective movement of the latch member toward the unlatched position. The latching mechanism is engaged when the lever and tensioning member are rotated to the tensioned position while the lever is in the closed position, the latch member being restrained by the fixed latch member to prevent reverse rotation of the tensioning member and lever out of the tensioned position. Moveable latch member **132** may be selectively moved to allow disengagement of the moveble latching member **132** from the fixed latch member **134** and movement of the lever and tensioning member from the tensioned position. The moveable latch member may be disposed on the lever and the fixed plate on the shell structure, or the relative positions may be reversed. The latch members may be reinforced to withstand anticipated forces and/or to improve operation of durability of the latching mechanism.

[0034] The engagement structure has a width **116** transverse to the rotational axis. As the tensioning member is rotated from the released to the tensioned position, the vehicle seat belt is wrapped around the tensioning member, reducing the effective belt length to effectively tension the seat belt. The width of the tensioning member may be varied during production to optimize the degree of belt tensioning applied to the seat belt by the belt tensioning mechanism.

[0035] The process of securing the safety seat into the vehicle requires positioning the seat in a desired position in the vehicle, preferably in a rear seat. The lap and shoulder portions of the vehicle seat belt **20** are directed through the belt pathway and connected to the seat belt latch on the opposite of the safety seat. When so installed, the vehicle seat belt passes adjacent to the belt tensioning mechanism **100**. When the mechanism **100** is positioned as shown in FIG. **5**. the seat belt may be directed through the engagement structure. The vehicle seat belt should be tightened to snug tight. The tensioning mechanism is operated by sliding the lever upwardly to the closed position as illustrated in the FIGS. **5** and **4**. The lever is then moved to the opposite side which rotates the tensioning member from the released position to the tensioned position. Moving the lever fully to

the tensioned position engages the latching mechanism to prevent reverse movement of the lever and tensioning member.

[0036] While the exemplary embodiments illustrated in the figures and described herein are presently preferred, it should be understood that these embodiments are offered by way of example only. Accordingly, the present application is not limited to a particular embodiment, but extends to various modifications that nevertheless fall within the scope of the appended claims. The order or sequence of any processes or method steps may be varied or re-sequenced according to alternative embodiments.

[0037] It is important to note that the construction and arrangement of the various exemplary embodiments is illustrative only. Although only a few embodiments have been described in detail in this disclosure, those skilled in the art who review this disclosure will readily appreciate that many modifications are possible (e.g., variations in sizes, dimensions, structures, shapes and proportions of the various elements, values of parameters, mounting arrangements, use of materials, colors, orientations, etc.) without materially departing from the novel teachings and advantages of the subject matter recited in the claims. For example, elements shown as integrally formed may be constructed of multiple parts or elements, the position of elements may be reversed or otherwise varied, and the nature or number of discrete elements or positions may be altered or varied. Accordingly, all such modifications are intended to be included within the scope of the present application. The order or sequence of any process or method steps may be varied or re-sequenced according to alternative embodiments. In the claims, any means-plus-function clause is intended to cover the structures described herein as performing the recited function and not only structural equivalents but also equivalent structures. Other substitutions, modifications, changes and omissions may be made in the design, operating conditions and arrangement of the exemplary embodiments without departing from the scope of the present application.

1. A tensioning mechanism for a safety belt comprising:
- a tensioning member rotatable about an axis;
- a belt engagement structure on the tensioning member structure having a belt path and an opening; and
- a lever operably connected to the tensioning member and configured to rotate the tensioning member about the axis between tensioned and detensioned positions, and to bi-directionally slide along the axis between generally opposing open and closed positions,
- wherein the lever blocks the opening when in the closed position and permits the safety belt to be moved into the belt path via the opening when in the open position.

2. The tensioning mechanism of claim **1**, wherein the lever further comprises a sleeve engaged on the tensioning member.

3. The tensioning mechanism of claim **1**, further comprising a position limiter configured to inhibit rotation of the lever and tensioning member toward the tensioned position unless the lever is in the closed position.

4. The tensioning mechanism of claim **1**, further comprising a latching mechanism configured to restrain the lever and tensioning member in at least the tensioned position.

5. The tensioning mechanism of claim **1**, wherein the tensioning mechanism is disposed on a child safety seat and arranged to apply tension a vehicle safety belt thereby securing the child safety seat in the vehicle.

6. A belt tensioning mechanism for a safety belt comprising:
- a tensioning member rotatable about an axis between generally opposing tensioned and detensioned positions;
- a hook-like belt engagement structure on the tensioning member structure having a belt path and an opening; and
- a lever operably connected to the tensioning member and configured to rotate the tensioning member about the axis, the lever further being moveable along the axis between generally opposing open and closed positions,
- wherein the lever blocks the opening when in the closed position and permits the safety belt to be moved into the belt path via the opening when in the open position.

7. The belt tensioning mechanism of claim **6**, wherein the tensioning member is rotated approximately one-half of a full revolution when moving between the detensioned and tensioned positions.

8. The belt tensioning mechanism of claim **6**, further comprising a position limiter configured to inhibit rotation of the lever and tensioning member toward the tensioned position unless the lever is in the closed position.

9. The belt tensioning mechanism of claim **6**, further comprising a latching mechanism configured to restrain the lever and tensioning member in at least the tensioned position.

10. The belt tensioning mechanism of claim **6** wherein the lever further comprises a sleeve engaged on the tensioning member.

11. The belt tensioning mechanism of claim **10**, wherein the sleeve is configured to limit movement in relation to the tensioning member to sliding movement bi-directionally along the axis.

12. A belt tensioning mechanism for applying tension to a vehicle safety belt to secure a child safety seat in the vehicle, the belt tensioning mechanism comprising:
- a tensioning member connected to the safety seat and rotatable about an axis between generally opposing tensioned and detensioned positions;
- a belt engagement structure on the tensioning member structure, the belt engagement structure having a belt path and an opening; and
- a lever operably connected to the tensioning member and configured to rotate the tensioning member about the axis, the lever further being bi-directionally moveable along the axis between generally opposing open and closed positions,
- wherein the lever blocks the opening when in the closed position preventing movement of a vehicle safety belt through the opening and permits a vehicle safety belt to be moved into the belt path via the opening when in the open position.

13. The belt tensioning mechanism of claim **12**, wherein the tensioning member is rotated approximately one-half of a full revolution when moving between the detensioned and tensioned positions.

14. The belt tensioning mechanism of claim **12**, further comprising a latching mechanism configured to restrain the lever and tensioning member in at least the tensioned position.

15. The belt tensioning mechanism of claim **12**, wherein the lever further comprises a sleeve engaging the tensioning member.

16. The belt tensioning mechanism of claim **15**, wherein the sleeve is configured to limit movement in relation to the tensioning member to sliding movement bi-directionally along the axis.

17. The belt tensioning mechanism of claim **12**, further comprising a position limiter configured to inhibit rotation of the lever and tensioning member toward the tensioned position unless the lever is in the closed position.

18. The belt tensioning mechanism of claim **17**, wherein the position limiter includes a blocking member disposed on the lever, contact between the blocking and the seat shell in certain axial positions of the lever inhibiting lever and tensioning member rotation.

19. The belt tensioning mechanism of claim **18**, wherein the position limiter is further configured to inhibit movement of the lever from the closed position toward the open position when the belt tensioning member is in the tensioned position.

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