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Tolerance compensation fastening assembly

Abstract

The present disclosure provides a tolerance compensation fastening assembly for fastening a first component to a second component which comprises a first compensation element and a second compensation element. The first compensation element comprises a first support portion which is provided with a first receiving hole that receives a shank of a fastener, and is connectable to the first component and movable relative to the first component in a longitudinal direction. The second compensation element comprises a second support portion which is provided with a second receiving hole that receives the shank of the fastener and is connectable to the first component and movable relative to the first component in at least one transverse direction perpendicular to the longitudinal direction. The first support portion and the second support portion are subjected to an axial fastening force applied by the fastener, and are at least partially made of metal.

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Background/Summary

CROSS-REFERENCE

(1) The present application claims the benefit of Chinese Patent Application Nos. 202111638397.3, filed Dec. 29, 2021, and 202211626847.1, filed Dec. 16, 2022, each titled “Tolerance Compensation Fastening Assembly,” the contents of which are hereby incorporated by reference.

TECHNICAL FIELD

(2) Embodiments of the present disclosure relate generally to a tolerance compensation fastening assembly, and more particularly to a fastening assembly capable of compensating for a tolerance and configured to fasten a first component to a second component.

BACKGROUND

(3) A fastening assembly with a tolerance compensating function can compensate for tolerances caused by manufacturing and mounting while fastening two components. Such a fastening assembly generally includes threaded fastening elements, and the fastening between the components is achieved by the torque of the threaded fastening elements. In the existing fastening assemblies, components other than the threaded fastening elements are generally made of plastic.

SUMMARY

(4) The present disclosure provides a tolerance compensation fastening assembly for fastening a first component to a second component. The tolerance compensation fastening assembly comprises a first compensation element and a second compensation element. The first compensation element comprises a first support portion. The first support portion is provided with a first receiving hole. The first receiving hole is configured to receive a shank of a fastener. The first compensation element is configured to be connectable to the first component and movable relative to the first component in a longitudinal direction. The second compensation element comprises a second support portion. The second support portion is provided with a second receiving hole. The second receiving hole is configured to receive the shank of the fastener. The second support portion is configured to be connectable to the first component and movable relative to the first component in at least one transverse direction perpendicular to the longitudinal direction. The first support portion and the second support portion are configured to be subjected to an axial fastening force applied by the fastener, and the first support portion and the second support portion are at least partially made of metal.

(5) The tolerance compensation fastening assembly according to the above further comprises the fastener. The fastener comprises a bolt and a nut. The bolt comprises the shank and a radial bolt extension radially extending from the shank. The nut comprises a threaded connection and a radial nut extension radially extending from the threaded connection, and the threaded connection being threadedly connected to the shank. The first support portion and the second support portion are located between the radial bolt extension and the radial nut extension, and parts of the first support portion and the second support portion that overlap with the radial bolt extension and the radial nut extension in the longitudinal direction are at least partially made of metal.

(6) In the tolerance compensation fastening assembly according to the above, the first support portion comprises a first metal ring part and a first plastic part. The first metal ring part is connected to the first plastic part. The second support portion comprises a second metal ring part and a second plastic part. The second metal ring part is connected to the second plastic part. The first metal ring part and the second metal ring part at least partially overlap with the radial bolt extension and the radial nut extension in the longitudinal direction.

(7) In the tolerance compensation fastening assembly according to the above, the first metal ring part of the first support portion is integrally formed with the first plastic part through an insert injection molding process, or is connected to the first plastic part through an assembly process. The second metal ring part of the second support portion is integrally formed with the second plastic part through an insert injection molding process, or is connected to the second plastic part through an assembly process.

(8) The tolerance compensation fastening assembly according to the above further comprises an insertion end configured to be inserted into the first component and an operation end opposite to the insertion end, and limiting means. The insertion end is formed by one of the bolt and the nut, and the operation end is formed by the other of the bolt and the nut. The one of the bolt and the nut that forms the insertion end comprises an introduction position and a locked position and is configured to be rotatable between the introduction position and the locked position. The one of the bolt and the nut that forms the insertion end comprises a mating portion. The limiting means are structures provided on the second support portion around the second receiving hole, and the limiting means are configured to mate with the mating portion to define the introduction position and the locked position.
(9) In the tolerance compensation fastening assembly according to the above, the limiting means comprises a first-direction limiting edge and a second-direction limiting edge opposite to each other, and a rotation space defined between the first-direction limiting edge and the second-direction limiting edge and in communication with the second receiving hole. The first-direction limiting edge corresponds to the introduction position, and the second-direction limiting edge corresponds to the locked position. The one of the bolt and the nut that forms the insertion end is rotatable in the rotation space.
(10) The tolerance compensation fastening assembly according to the above further comprises retaining means. The retaining means are configured to mate with the mating portion such that the one of the bolt and the nut that forms the insertion end is retained in the introduction position when the operation end is subjected to a rotational force that is less than a preset threshold.
(11) In the tolerance compensation fastening assembly according to the above, the retaining means comprise a retainer arranged between the first support portion and the second support portion, and the second support portion mates with the retainer to limit the rotation of the retainer relative to the second support portion. Part of the retainer that overlaps with the first support portion, the second support portion, the radial bolt extension and the radial nut extension in the longitudinal direction is at least partially made of metal.
(12) In the tolerance compensation fastening assembly according to the above, the retaining means comprise structures provided on the second support portion around the second receiving hole.
(13) In the tolerance compensation fastening assembly according to the above, the retaining means and the limiting means are arranged at different axial positions of the tolerance compensation fastening assembly, and the retaining means comprise at least two retaining ribs. The at least two retaining ribs are made of plastic and configured to be deformable when subjected to a certain rotational force. The mating portion comprises at least one edge, and the at least one edge is retainable between the at least two retaining ribs.
(14) In the tolerance compensation fastening assembly according to the above, the retaining means and the limiting means are arranged at the same axial position of the tolerance compensation fastening assembly, and the retaining means comprises a retaining protrusion located between the opposite first-direction limiting edge and second-direction limiting edge. The retaining protrusion is made of plastic and configured to be deformable when subjected to a certain rotational force. The mating portion comprises at least one edge, and the at least one edge is retained between the first-direction limiting edge and the retaining protrusion.
(15) In the tolerance compensation fastening assembly according to the above, the first compensation element comprises a tubular main body portion, and the first support portion is an annular flange arranged at one end of the tubular main body portion. The tubular main body portion is provided with a threaded portion on an outer surface thereof, and the first compensation element is connected to the first component via the threaded portion of the tubular main body portion. The second compensation element further comprises a pair of elastic connecting arms respectively located on opposite sides of the second support portion, and the second support portion is connected to the first component via the pair of elastic connecting arms.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) FIG. **1**A is a perspective view of a tolerance compensation fastening assembly according to an embodiment of the present disclosure.

(2) FIG. **1**B is an exploded view of the tolerance compensation fastening assembly shown in FIG. **1**A.

(3) FIG. **2**A is a perspective view of a first compensation element of the tolerance compensation fastening assembly shown in FIG. **1**B.

(4) FIG. **2**B is an exploded view of the first compensation element shown in FIG. **2**A.

(5) FIG. **3**A is a perspective view of a second compensation element of the tolerance compensation fastening assembly shown in FIG. **1**B.

(6) FIG. **3**B is an exploded view of the second compensation element shown in FIG. **3**A.

(7) FIG. **4**A is a perspective view of a bolt of the tolerance compensation fastening assembly shown in FIG. **1**B from one perspective.

(8) FIG. **4**B is a perspective view of the bolt shown in FIG. **4**A from another perspective.

(9) FIG. **5** is a perspective view of the tolerance compensation fastening assembly shown in FIG. **1**A with its insertion end in an introduction position.

(10) FIG. **6** is an exploded view of a retainer of the tolerance compensation fastening assembly shown in FIG. **1**B.

(11) FIG. **7** is an axial cross-sectional view of the tolerance compensation fastening assembly shown in FIG. **1**A.

(12) FIG. **8**A is a partial perspective view of a first component using the tolerance compensation fastening assembly in FIG. **1**A.

(13) FIG. **8**B is a partially enlarged view of FIG. **8**A.

(14) FIG. **8**C is a perspective view of the tolerance compensation fastening assembly shown in FIG. **1**A and the first component shown in FIG. **8**A in a pre-assembled state.

(15) FIG. **8**D is a partial perspective view of a second component using the fastener assembly in FIG. **1**A.

(16) FIG. **9**A is a cross-sectional view of a first step in a mounting process for fastening the tolerance compensation fastening assembly and the first component in the pre-assembled state shown in FIG. **8**C to the second component.

(17) FIG. **9**B is a cross-sectional view of a second step in the mounting process for fastening the tolerance compensation fastening assembly and the first component in the pre-assembled state shown in FIG. **8**C to the second component shown in FIG. **8**D.

(18) FIG. **9**C is a cross-sectional view of a third step in the mounting process for fastening the tolerance compensation fastening assembly and the first component in the pre-assembled state shown in FIG. **8**C to the second component shown in FIG. **8**D.

(19) FIG. **9**D is a cross-sectional view of a fourth step in the mounting process for fastening the tolerance compensation fastening assembly and the first component in the pre-assembled state shown in FIG. **8**C to the second component shown in FIG. **8**D.

(20) FIG. **9**E is a cross-sectional view of a fifth step in the mounting process for fastening the tolerance compensation fastening assembly and the first component in the pre-assembled state shown in FIG. **8**C to the second component shown in FIG. **8**D.

(21) FIG. **10** is an exploded view of a tolerance compensation fastening assembly according to another embodiment of the present disclosure.

(22) FIG. **11**A is an exploded view of a second compensation element of the tolerance compensation fastening assembly shown in FIG. **10**.

(23) FIG. **11**B is a perspective view of the second compensation element shown in FIG. **11**A with a

second metal ring part removed.
(24) FIG. **12**A is an exploded view of a first compensation element of the tolerance compensation fastening assembly shown in FIG. **10** from a first perspective.
(25) FIG. **12**B is an exploded view of the first compensation element of the tolerance compensation fastening assembly shown in FIG. **10** from a second perspective.
(26) FIG. **13** is a side view of the tolerance compensation fastening assembly shown in FIG. **10** with a bolt in the introduction position and a nut removed.
DETAILED DESCRIPTION
(27) Various specific embodiments of the present disclosure are described below with reference to the accompanying drawings which constitute part of this description. It is to be understood that although the terms indicating orientations, such as “front”, “rear”, “upper”, “lower”, “left”, “right”, “top” and “bottom”, are used in the present disclosure to describe structural parts and elements in various examples of the present disclosure, these terms are used herein only for ease of illustration and are determined based on the exemplary orientations shown in the accompanying drawings. Since the embodiments disclosed in the present disclosure can be arranged in different directions, these terms indicating directions are only illustrative and should not be considered as limitations.
(28) Embodiments of the present disclosure provide a tolerance compensation fastening assembly for fastening a first component (e.g., a hidden door handle module of a vehicle) to a second component (e.g., a vehicle door). The tolerance compensation fastening assembly also has a tolerance compensating function and thus can compensate for tolerances caused by the manufacturing and mounting of components.
(29) FIGS. **1**A and **1**B show the overall structure of a tolerance compensation fastening assembly **100** according to an embodiment of the present disclosure. FIG. **1**A is a perspective view of the tolerance compensation fastening assembly **100**, and FIG. **1**B is an exploded view of the tolerance compensation fastening assembly **100**. As shown in FIGS. **1**A and **1**B, the tolerance compensation fastening assembly **100** includes a fastener formed by a bolt **110** and a nut **120** mating with each other, a first compensation element **130**, a second compensation element **140**, and a retainer **150** forming retaining means. The bolt **110** includes a shank **114** having an external thread and a radial bolt extension **112** radially extending from the shank **114**. The nut **120** includes a threaded connection **124** in the form of an internal thread and a radial nut extension **122** radially extending from the threaded connection **124**. The first compensation element **130** includes a first support portion **132**, and the second compensation element **140** includes a second support portion **142**. Through the threaded engagement of the shank **114** of the bolt **110** and the threaded connection **124** of the nut **120**, the first support portion **132** of the first compensation element **130**, the second support portion **142** of the second compensation element **140** and the retainer **150** are retained between the radial bolt extension **112** and the radial nut extension **122**, with the retainer **150** being located between the first support portion **132** and the second support portion **142**. For the assembled tolerance compensation fastening assembly **100** (shown in FIG. **1**A), the first compensation element **130** and the second compensation element **140** are first connected to a first component **820** (shown in FIG. **8**A) so as to be pre-assembled to the first component **820**, the radial bolt extension **112** is then inserted into a second component **840** (as shown in FIG. **8**A), and finally the first component **820** is fastened to the second component **840** by tightening the nut **120** and the bolt **110**. When the tolerance compensation fastening assembly **100** is in a state where the first component **820** and the second component **840** are fastened, the first support portion **132** of the first compensation element **130**, the second support portion **142** of the second compensation element **140** and the retainer **150** are subjected to an axial fastening force exerted by the fastener. The tolerance compensation fastening assembly **100** can compensate for tolerances in a longitudinal direction Y and in at least one transverse direction X, Z perpendicular to the longitudinal direction Y. The shank **114** of the bolt **110** extends in the longitudinal direction Y.
(30) Still as shown in FIGS. **1**A and **1**B, the end of the tolerance compensation fastening assembly

100 for insertion into the second component **840** is an insertion end **102**, and the end opposite to the insertion end **102** is an operation end **104**. In the embodiment shown in FIGS. **1**A and **1**B, the insertion end **102** of the fastening element **100** is formed by the bolt **110**, more particularly by the radial bolt extension **112**, and the operation end **104** is formed by the nut **120**. By performing a rotating operation on the operation end **104**, the bolt **110** and the nut **120** can be tightened to each other after the insertion end **102** is inserted into the second component **840**, thereby fastening the first component **820** to the second component **840**. It should be noted that, although in the embodiment shown in FIGS. **1**A and **1**B, the bolt **110** forms the insertion end **102** of the tolerance compensation fastening assembly **100** and the nut **120** forms the operation end **104** of the tolerance compensation fastening assembly **100**, according to the present disclosure, the positions of the bolt **110** and the nut **120** can be interchanged so that the insertion end **102** of the tolerance compensation fastening assembly **100** is formed by the nut **120** and the operation end **104** of the tolerance compensation fastening assembly **100** is formed by the bolt **110**. They are both within the scope of protection of the present disclosure.

(31) FIGS. **2**A and **2**B show the specific structures of the first compensation element **130**. FIG. **2**A is a perspective view of the first compensation element **130**, and FIG. **2**B is an exploded view of the first compensation element **130**. As shown in FIGS. **2**A and **2**B, the first compensation element **130** includes a tubular main body portion **230** and a first support portion **132** arranged at one end of the tubular main body portion **230**, and the first support portion **132** is an annular flange protruding and extending inwardly from one end of the tubular main body portion **230**. The first support portion **132** is provided with a first receiving hole **210** for receiving the shank **114** of the bolt **110**. The tubular main body portion **230** is provided with an external thread **231** on an outer surface thereof. The external thread **231** is configured to engage with an internal thread on the first component **820**, so as to connect the first compensation element **130** to the first component **820**, and enable the first compensation element **130** to move relative to the first component **820** in the longitudinal direction Y.

(32) At least a part of the first support portion **132** of the first compensation element **130** is made of metal, while the other part is made of plastic together with the tubular main body portion **230**. In some embodiments, for example, as shown in FIG. **2**B, the first support portion **132** includes a first metal ring part **222** and a first plastic part **221**. The first metal ring part **222** is surrounded by the first plastic part **221**, and the first plastic part **221** is connected to the end of tubular main body portion **230**. The first metal ring part **222** may be connected to the first plastic part **221** in various ways, such as being integrally formed with the first plastic part through an insert injection molding process, or being connected to the first plastic part through an assembly process. The first metal ring part **222** has an outer periphery **227** connected to the first plastic part **221**, and end surfaces **228** of the first metal ring part on two opposite sides of the outer periphery **227** are exposed without being covered by the first plastic part **221**, so that in the fastened state of the tolerance compensation fastening assembly **100**, the first metal ring part **222** can be in contact with the components (i.e., the radial nut extension **122** and the retainer **150**, as shown in FIG. **7**) adjacent to the first support portion **132** in the longitudinal direction Y.

(33) FIGS. **3**A and **3**B show the specific structures of the second compensation element **140**. FIG. **3**A is a perspective view of the second compensation element **140**, and FIG. **3**B is an exploded view of the second compensation element **140**. As shown in FIGS. **3**A and **3**B, the second compensation element **140** includes a second support portion **142** and a pair of elastic connecting arms **331**. The second support portion **142** is generally disc-shaped, and the pair of elastic connecting arms **331** are respectively located on two opposite sides of the second support portion **142**. The pair of elastic connecting arms **331** are configured to connect the second support portion **142** to the first component **820**.

(34) The second support portion **142** is provided with a second receiving hole **310** for receiving the shank **114** of the bolt **110**. The second support portion **142** includes a front side surface **342** and a

rear side surface **344** opposite to each other. The second receiving hole **310** extends through the front side surface **342** and the rear side surface **344** in the longitudinal direction Y. The second support portion **142** includes an accommodation cavity **325** formed by inwardly recessing the rear side surface **344** toward the front side surface **342**. The accommodation cavity **325** can accommodate the retainer **150**, and limit the rotation of the retainer **150** relative to the second support portion **142** by means of a form fit. The retainer **150** can limit the rotation of the bolt **110** when the nut **120** is subjected to a rotational force that is less than a preset threshold so as to retain the bolt **110** in its introduction position, and release the bolt **110** when the nut **120** is subjected to a rotational force that is greater than a preset threshold so that the bolt can be rotated from the introduction position to a locked position, which will be illustrated with reference to FIG. **6**.

(35) The second support portion **142** further includes limiting means **360** arranged at the second receiving hole **310**. The limiting means **360** can mate with a mating portion **415** (as shown in FIG. **4**B) of the bolt **110** to define the introduction position and the locked position of the bolt **110**. The number of the limiting means **360** matches the number of mating structures on the mating portion **415**, and is four in the embodiment shown in the figures. The four limiting means **360** are arranged rotationally symmetrically around the center of the second receiving hole **310**. Each limiting means **360** includes a first-direction limiting edge **363** and a second-direction limiting edge **367** opposite to each other, and a rotation space **365** defined between the first-direction limiting edge **363** and the second-direction limiting edge **367** and in communication with the second receiving hole **310**. The first-direction limiting edge **363** and the second-direction limiting edge **367** respectively correspond to the locked position and the introduction position of the bolt **110**, and the mating portion **415** (shown in FIG. **4**B) of the bolt **110** can rotate in the rotation space **365**. When the bolt **110** is in the introduction position, the mating portion **415** of the bolt **110** abuts against the first-direction limiting edge **363**, thereby blocking the bolt **110** from leaving the introduction position in a first direction from the locked position to the introduction position; and when the bolt **110** is in the locked position, the mating portion **415** of the bolt **110** abuts against the second-direction limiting edge **367**, thereby blocking the bolt **110** from leaving the locked position in a second direction from the introduction position to the locked position.

(36) The second support portion **142** further includes a position indicator **350** arranged on the front side surface **342** for providing a visual indication of whether the bolt **110** is in the introduction position. The position indicator **350** is shaped to indicate the position in which the radial bolt extension **112** of the bolt **110** needs to be located when inserted into the second component **840**. In some embodiments (e.g., shown in FIGS. **4**A and **4**B), the radial bolt extension **112** includes four corners **411**. The four corners **411** are uniformly arranged around the radial bolt extension **112**. The position indicator **350** includes four protrusion portions **351** arranged around the second receiving hole **310**. The four protrusion portions **351** are arranged to be respectively aligned with the four corners **411** of the radial bolt extension **112** when the radial bolt extension **112** is in the introduction position. The protrusion portion **351** also has the shape of a corner. When the four corners **411** of the radial bolt extension **112** are respectively aligned with the four protrusion portions **351** of the position indicator **350**, it can be determined that the radial bolt extension **112** is in the introduction position.

(37) In some embodiments, each of the pair of elastic connecting arms **331** forms a hanging ear-like shape, and has a proximal end connected to the second support portion **142** and a distal end configured to hang on a protrusion **823** of the first component **820** (see FIG. **8**B). Specifically, each elastic connecting arm **331** includes two support arms **352** parallel to each other and spaced apart from each other, and the distance between the two support arms **352** is set such that the protrusion **823** of the first component **820** can be accommodated. Each support arm **352** first extends from the second support portion **142**, and then generally extends in the longitudinal direction Y in a direction away from the front side surface **342** of the second support portion **142**. In this way, each elastic connecting arm **331** has a retaining section **335** extending generally in the longitudinal direction Y,

and the distance between the retaining sections **335** of the two elastic connecting arms **331** is set such that a mounting tab **825** (see FIG. **8**B) of the first component **820** can be accommodated. The elastic connecting arm **331** is elastic and can be deformed when being stressed, so that the second support portion **142** is movable in the transverse directions X, Z relative to the first component **820**.

(38) At least a part of the second support portion **142** of the second compensation element **140** is made of metal, while the other part is made of plastic together with the elastic connecting arms **331**. In some embodiments, for example, as shown in FIG. **3**B, the second support portion **142** includes a second metal ring part **322** and a second plastic part **321**. The second metal ring part **322** is surrounded by the second plastic part **321**. The second metal ring part **322** may be connected to the second plastic part **321** in various ways, such as being integrally formed with the second plastic part through an insert injection molding process, or being connected to the second plastic part through an assembly process. The second metal ring part **322** has an outer periphery **327** connected to the second plastic part **321**, and end surfaces **328** of the second metal ring part on two opposite sides of the outer periphery **327** are exposed without being covered by the second plastic part **321**, so that in the fastened state of the tolerance compensation fastening assembly **100**, the end surfaces **328** of the second metal ring part **322** can be in contact with adjacent components.

(39) FIGS. **4**A and **4**B show the specific structures of the bolt **110**. FIG. **4**A is a perspective view of the bolt **110** from one perspective, and FIG. **4**B is a perspective view of the bolt **110** from another perspective. As shown in FIGS. **4**A and **4**B, the bolt **110** further includes a mating portion **415** arranged on the shank **114**. The mating portion **415** is configured to mate with the retainer **150** to retain the radial bolt extension **112** in the introduction position, and to mate with the limiting means **360** to define the introduction position and the locked position of the bolt **110**. Specifically, the shank **114** extends in the longitudinal direction Y and is generally cylindrical. The shank **114** has a central axis A and an external thread arranged on its outer surface. The mating portion **415** protrudes outwardly from the shank **114**. The mating portion **415** is generally prism-shaped, and its cross-section perpendicular to the central axis A is not a circle, but a polygon with corners, such as a square as shown in FIGS. **4**A and **4**B. The mating portion **415** therefore has several edges **417** arranged around the central axis A. The diameter of the shank **114** is substantially equal to the minimum side length of the cross-section of the mating portion **415**. The radial bolt extension **112** is generally in the shape of a truncated cone, with a smaller top dimension and a larger bottom dimension, and its bottom side edge is cut away in the direction of the central axis A, so that the radial bolt extension **112** has four corners **411**, and its bottom surface **418** is substantially in the form of a square perpendicular to the central axis A. That is to say, the cross-section of the radial bolt extension **112** in the direction perpendicular to the central axis A is largest at the bottom surface **418**. The bottom surface **418** is not circular but polygonal, so that the bottom surface has multiple dimensions. Its minimum dimension is the side length and its maximum dimension is the diagonal. The bolt **110** has the introduction position and the locked position according to the orientation of the radial bolt extension **112**, and can be rotated between the introduction position and the locked position. In the introduction position, the radial bolt extension **112** can be inserted into a hole **845** (see FIG. **8**D) of the second component **840**, while in the locked position, the radial bolt extension **112** cannot be withdrawn from the hole **845** of the second component **840**, thereby locking the bolt **110** relative to the second component **840**.

(40) FIG. **5** is a perspective view of the tolerance compensation fastening assembly **100** with the bolt **110** in the introduction position. As shown in FIG. **5**, the four corners **411** of the radial bolt extension **112** are respectively aligned with the four protrusion portions **351** of the position indicator **350** of the second compensation element **140**. This indicates that the bolt **110** is in the introduction position, and its radial bolt extension **112** can be inserted into the hole **845** of the second component **840**. After the bolt **110** is rotated about the central axis A in the first direction, the bolt **110** leaves its introduction position and reaches the locked position. Since the radial bolt extension **112** is inserted into the hole **845** of the second component **840** and rotated, the corners

411 of the radial bolt extension **112** will make it impossible for the radial bolt extension **112** to be withdrawn from the hole **845**.

(41) FIG. **6** is a partially exploded view of the retainer **150** shown in FIG. **1**B. As shown in FIG. **6**, the retainer **150** forms the retaining means for retaining the bolt **110** in its introduction position. At least a part of the retainer **150** is made of metal, while the other part is made of plastic. As shown in FIGS. **1**B and **6**, the retainer **150** has a receiving hole **650** for receiving the shank **114** of the bolt **110**. The retainer **150** includes a metal ring part **610** surrounding the receiving hole **650**, and a plastic part **620**. The plastic part **620** is surrounded by the metal ring part **610**. The metal ring part **610** may be connected to the plastic part **620** in various ways, such as being integrally formed with the plastic part through an insert injection molding process, or being connected to the plastic part through an assembly process.

(42) As shown in FIG. **6**, the retainer **150** further includes an engagement ring **630** mounted in the plastic part **620**. The engagement ring **630** has an inside engagement surface **635**. The inside engagement surface **635** defines the receiving hole **650**. The inside engagement surface **635** is provided with several retaining ribs **638**. The number of retaining ribs **638** are arranged around the receiving hole **650**. Each retaining rib **638** protrudes toward a central axis of the receiving hole **650** and extends in the longitudinal direction Y. The engagement ring **630** is made of plastic so that the retaining ribs **638** can be deformed when subjected to a certain rotational force. The distance between adjacent retaining ribs **638** is set such that the edge **417** of the mating portion **415** of the bolt **110** can be retained between adjacent ribs **638**, so that the bolt **110** is retained in the introduction position when the bolt **110** is subjected to a rotational force that is less than a preset threshold, and the bolt **110** can be released when the bolt **110** is subjected to a rotational force that is greater than a preset threshold so that the bolt can be rotated to the locked position.

(43) In addition, as shown in FIG. **6**, the retainer **150** further has an outside engagement surface **615**. The outside engagement surface **615** is configured to engage with the accommodation cavity **325** of the second compensation element **140** to limit the rotation of the retainer **150** relative to the second compensation element **140**. The outside engagement surface **615** is formed on the metal ring part **610** of the retainer **150** as an outside annular surface of the metal ring part **610**. The outside engagement surface **615** is formed in a prism shape, a side wall of the accommodation cavity **325** is also formed in a matching prism shape, and the two mate with each other to limit the rotational movement of the retainer **150**.

(44) FIG. **7** is an axial cross-sectional view of the tolerance compensation fastening assembly **100** shown in FIG. **1**A, for showing the mating relationship between the components in the tolerance compensation fastening assembly **100**. As shown in FIG. **7**, the shank **114** of the bolt **110** of the tolerance compensation fastening assembly **100** passes through the first support portion **132** of the first compensation element **130**, the retainer **150** and the second support portion **142** of the second compensation element **140** in sequence, and is inserted into the threaded connection **124** of the nut **120**. The first metal ring part **222** of the first support portion **132** of the first compensation element **130**, the metal ring part **610** of the retainer **150**, and the second metal ring part **322** of the second support portion **142** of the second compensation element **140** at least partially overlap in the longitudinal direction Y, and they at least partially overlap with the radial bolt extension **112** and the radial nut extension **122** in the longitudinal direction Y. Thus, parts of the first support portion **132** of the first compensation element **130**, the retainer **150**, and the second support portion **142** of the second compensation element **140** that overlap with the radial bolt extension **112** and the radial nut extension **122** in the longitudinal direction Y are at least partially made of metal. In addition, the diameter of the first receiving hole **210** in the first support portion **132** of the first compensation element **130** of the tolerance compensation fastening assembly **100** is larger than the outer diameter of the shank **114** of the bolt **110**, so the shank **114** of the bolt **110** is movable along the radial direction of the receiving hole **210**.

(45) FIGS. **8**A-**8**D show the specific structures of an exemplary first component **820** and second

component **840** using the fastener assembly **100**, and show a pre-assembled state of the tolerance compensation fastening assembly **100** on the first component **820**. FIG. **8**A is a partial perspective view of the first component **820**, FIG. **8**B is a partially enlarged view of FIG. **8**A, FIG. **8**C is a perspective view of the tolerance compensation fastening assembly **100** and the first component **820** in the pre-assembled state, and FIG. **8**D is a partial perspective view of the second component **840** using the fastener assembly in FIG. **1**A.

(46) As shown in FIGS. **8**A and **8**D, the first component **820** is, for example, a hidden door handle module of a vehicle, and the second component **840** is, for example, a door. The first component **820** is fastened to the second component **840** via the tolerance compensation fastening assembly **100**. The second component **840** has an inside element (inner sheet metal) **843** and an outside element (outer sheet metal) **841**. The inside element **843** is provided with a hole **845** for receiving the insertion end **102** of the tolerance compensation fastening assembly **100**. There are several (e.g., three) mounting tabs **825** on the first component **820**, and each mounting tab **825** is mounted to one hole **845** of the second component **840** via one tolerance compensation fastening assembly **100**.

(47) As shown in FIG. **8**B, the mounting tab **825** of the first component **820** includes a hole **821** penetrating the mounting tab **825** in the longitudinal direction Y, and a pair of side surfaces **822** located on two opposite sides of the hole **821**. The mounting tab **825** further includes a pair of protrusions **823** respectively arranged on the pair of side surfaces **822** for mating with the pair of elastic connecting arms **331** of the second compensation element **140** to limit the rotation of the second compensation element **140** relative to the first component **820** and limit the movement distance of the second compensation element **140** relative to the first component **820** in the longitudinal direction Y. The protrusion **823** protrudes outwardly from the respective side surface **822** of the mounting tab **825**, and is sized to be smaller than the distance between the two support arms **352** of the elastic connecting arm **331**, so the protrusion can not only be accommodated between the two support arms **352** of the elastic connecting arm **331** but can also move therebetween. The distance between the pair of side surfaces **822** is set such that the mounting tab **825** can be accommodated between the retaining sections **335** of the pair of elastic connecting arms **331** of the second compensation element **140**, and the pair of side surfaces **822** are in contact with the retaining sections **335** of the pair of elastic connecting arms **331**. An internal thread **828** is provided on an inner surface of the hole **821** for threaded connection with the external thread **231** on the first compensation element **130**.

(48) As shown in FIG. **8**C, the tolerance compensation fastening assembly **100** can be pre-assembled to the first component **820**. Specifically, to achieve the pre-assembled state, the tolerance compensation fastening assembly **100** is inserted, from its operation end **104** (see FIG. **1**A), into the hole **821** in the mounting tab **825** of the first component **820** such that the external thread **231** of the first compensation element **130** is threadedly connected to the internal thread **828** on the inner surface of the hole **821**, and the pair of elastic connecting arms **331** of the second compensation element **140** are respectively hung on the pair of protrusions **823** on the mounting tab **825**. In the pre-assembled state, the retaining sections **335** of the pair of elastic connecting arms **331** of the second compensation element **140** are respectively in contact with the pair of side surfaces **822** of the mounting tab **825** of the first component **820**, the radial bolt extension **112** is located outside the mounting tab **825** of the first component **820**, and the bolt **110** is located in its introduction position.

(49) Since the first compensation element **130** is threadedly connected to the mounting tab **825** of the first component **820**, the first compensation element **130** can move relative to the first component **820** in the longitudinal direction Y. Since the shank **114** of the bolt **110** can radially move in the first receiving hole **210** of the first compensation element **130**, and the elastic connecting arms **331** of the second compensation element **140** have elasticity, the second support portion **142** of the second compensation element **140** can move together with the bolt **110** relative

to the first component **820** in the transverse directions X, Z.

(50) As shown in FIG. **8**D, the hole **845** in the inside element **843** of the second component **840** has a width of W, and the side length of the bottom surface **418** of the radial bolt extension **112** is smaller than the width W of the hole **845**, but the diagonal of the bottom surface **418** is larger than the width W of the hole **845**. Therefore, when a side of the bottom surface **418** of the radial bolt extension **112** is aligned with the width of the hole **845**, the radial bolt extension **112** can be inserted into the hole **845**, and after insertion, the radial bolt extension **112** is rotated so that the radial bolt extension **112** cannot be withdrawn from the hole **845** once the side of the bottom surface **418** of the radial bolt extension **112** is out of alignment with the width of the hole **845**.

(51) The hidden door handle module (first component **820**) of the vehicle has a support body (not shown in the figures) in a simulated shape of a door handle cover plate. The support body is configured for the mounting of the door handle cover plate to ensure a consistent gap between the door handle cover plate and an edge of a handle hole (not shown) in the outer sheet metal (outside element **841**) of the vehicle door. During mounting, the door handle module needs to be first mounted to the inner sheet metal of the vehicle door (the inside element **843** of the second component **840**) from the inner side of the vehicle door by means of the tolerance compensation fastening assembly **100**, such that the support body of the door handle module extends into the handle hole in the outer sheet metal of the vehicle door (the outside element **841** of the second component **840**), and the gap between the peripheral edge of the support body and the edge of the handle hole is consistent, so that when the handle cover plate is mounted on the support body later, the gap between the peripheral edge of the handle cover plate and the edge of the handle hole is consistent.

(52) The inner sheet metal (inside element **843**) of the vehicle door is connected to the outer sheet metal (outside element **841**) of the vehicle door, and the inner sheet metal (inside element **843**) of the vehicle door is provided with holes **845** corresponding in number to the mounting tabs **825** of the door handle module (first component **820**). Ideally, each hole **845** in the inner sheet metal (inside element **843**) of the vehicle door is precisely positioned relative to the outer sheet metal (outside element **841**) of the vehicle door so that the support body of the door handle module (first component **820**) can be precisely positioned relative to the outer sheet metal (outside element **841**) of the vehicle door. However, due to manufacturing and mounting tolerances, the hole **845** in the inner sheet metal (inside element **843**) of the vehicle door often cannot be precisely positioned relative to the outer sheet metal (outside element **841**) of the vehicle door, so that there may be tolerances in the longitudinal direction Y, or in the transverse directions X, Z relative to the ideal mounting position. The tolerance compensation fastening assembly **100** of the present disclosure can compensate for the tolerances in the longitudinal direction Y and in the transverse directions X, Z while fastening the first component **820** to the second component **840**.

(53) FIGS. **9**A-**9**E show an exemplary process for fastening the first component **820** to the second component **840** by the tolerance compensation fastening assembly **100** pre-assembled to the first component **820**. As shown in FIG. **9**A, in a first step, the radial bolt extension **112** of the bolt **110** (which is now in the introduction position) of the tolerance compensation fastening assembly **100** that is pre-assembled to each mounting tab **825** of the first component **820** is substantially aligned with the corresponding hole **845** of the inside element **843** of the second component **840**. As shown in FIG. **9**B, in a second step, the first component **820** is moved such that the radial bolt extension **112** is inserted into the hole **845** of the inside element **843**. As shown in FIG. **9**C, in a third step, the tolerance compensation fastening assembly **100** is pushed toward the inside element **843** of the second component **840** until the front side surface **342** of the second compensation element **140** abuts against the inside element **843** of the second component **840**. As shown in FIG. **9**D, in a fourth step, the nut **120** is rotated, so as to drive the bolt **110** to rotate by the nut **120**, such that the radial bolt extension **112** is rotated away from its introduction position and reaches the locked position. As shown in FIG. **9**E, in a fifth step, the nut **120** is continued to be rotated, such that the

nut **120** drives the first compensation element **130** to move toward the inside element **843** of the second component **840** until the first support portion **132** of the first compensation element **130** abuts against the adjacent retainer **150** and cannot be moved further, the assembly process is completed.

(54) In the second step above, since the shank **114** of the bolt **110** can radially move in the first receiving hole **210** of the first compensation element **130**, and the elastic connecting arms **331** of the second compensation element **140** have elasticity, the second support portion **142** of the second compensation element **140** and the bolt **110** can move together in the transverse directions X, Z relative to the first component **820**, so that even if multiple holes **845** in the second component **840** are not in the ideal mounting positions, the radial bolt extension **112** of the bolt **110** of the tolerance compensation fastening assembly **100** that is pre-assembled to each mounting tab **825** of the first component **820** can also be inserted into the corresponding hole **845** of the inside element **843** of the second component **840**, thereby enabling the tolerances in the transverse directions X, Z to be compensated by the fastening device **100**. In the fifth step above, since the first compensation element **130** can move relative to the first component **820** in the longitudinal direction Y, the amount of movement of the first compensation element **130** can be adjusted according to the tolerance of the longitudinal direction Y, thereby compensating for the tolerance in the longitudinal direction Y.

(55) FIG. **10** is an exploded view of a tolerance compensation fastening assembly **1000** according to another embodiment of the present disclosure. The tolerance compensation fastening assembly **1000** of the embodiment shown in FIG. **10** is similar to the tolerance compensation fastening assembly **100** of the embodiment shown in FIGS. **1**A and **1**B, mainly except that the retaining means of the tolerance compensation fastening assembly **1000** is not formed by a separate retainer, but by structures on the second support portion of the second compensation element. In addition, the tolerance compensation fastening assembly **1000** is different from the tolerance compensation fastening assembly **100** in terms of the structures of the parts of the first support portion and the second support portion that are made of metal.

(56) Specifically, as shown in FIG. **10**, the tolerance compensation fastening assembly **1000** includes a fastener formed by a bolt **1100** and a nut **1200** mating with each other, a first compensation element **1300** and a second compensation element **1400**. The bolt **1100** includes a shank **1140** having an external thread and a radial bolt extension **1120** radially extending from the shank **1140**. The nut **1200** includes a threaded connection **1240** in the form of an internal thread and a radial nut extension **1220** radially extending from the threaded connection **1240**. The first compensation element **1300** includes a first support portion **1320**, and the second compensation element **1400** includes a second support portion **1420**. The first support portion **1320** is provided with a first receiving hole **2100**, and the second support portion **1420** is provided with a second receiving hole **3100**. The first receiving hole **2100** and the second receiving hole **3100** are configured to receive the shank **1140** of the bolt **1100**. Through the threaded engagement of the shank **1140** of the bolt **1100** and the threaded connection **1240** of the nut **1200**, the first support portion **1320** of the first compensation element **1300** and the second support portion **1420** of the second compensation element **1400** are retained between the radial bolt extension **1120** and the radial nut extension **1220**. In the fastened state, the first support portion **1320** and the second support portion **1420** are subjected to the axial fastening force exerted by the bolt **1100** and the nut **1200**. The nut **1200** forms an operation end **1040** of the tolerance compensation fastening assembly **1000**, and the bolt **1100** forms an insertion end **1020** of the tolerance compensation fastening assembly **1000**.

(57) Still as shown in FIG. **10**, the bolt **1100** further includes a mating portion **4150** arranged on the shank **1140** of the bolt **1100**. The mating portion also has a square cross-sectional shape which is similar to the mating portion **415** of the bolt **110** in the embodiment shown in FIGS. **1**A and **1**B, and also has several edges **4170**. The difference is that the mating portion **415** of the bolt **110** in the

embodiment shown in FIGS. **1**A and **1**B extends all the way to the radial bolt extension **112**, while the mating portion **4150** of the bolt **1100** in FIG. **10** is separated from the radial bolt extension **1120** by a distance. An avoidance portion **1150** is formed at the part of the shank between the mating portion **4150** and the radial bolt extension **1120**.

(58) FIGS. **11**A and **11**B show the specific structures of the first compensation element **1300**. FIGS. **11**A and **11**B are exploded views of the first compensation element **1300** respectively from two different perspectives. As shown in FIGS. **11**A and **11**B, the structure of the first compensation element **1300** is similar to that of the first compensation element **130** in the embodiment shown in FIGS. **1**A and **1**B, and also includes a tubular main body portion **2300** and a first support portion **1320** in the shape of an annular flange arranged at one end of the tubular main body portion **2300**. An external thread **2310** is provided on an outer surface of the tubular main body portion **2300** for engaging with the internal thread **828** on the first component **820**. The first support portion **1320** includes a first metal ring part **2220** and a first plastic part **2210**. The first plastic part **2210** is connected to the end of the tubular main body portion **2300**. The first metal ring part **2220** includes a radial extension ring **2223** and an axial extension ring **2225**. The axial extension ring **2225** extends into the first plastic part **2210** and defines the first receiving hole **2100**. The radial extension ring **2223** covers a radially-extending outer surface of the first plastic part **2210**. The axial extension ring **2225** extends for a certain length and reaches at least a radially-extending inner surface of the first plastic part **2210**, so as to be able to be in contact with the radial nut extension **1220** in the fastened state of the tolerance compensation fastening assembly **1000**. In this way, in the fastened state of the tolerance compensation fastening assembly **1000**, the first metal ring part **2220** can be in contact with the components (i.e., the radial nut extension **1220** and the second support portion **1420**) adjacent to the first support portion **1320** in the longitudinal direction Y. The first metal ring part **2220** may be connected to the first plastic part **2210** in various ways, such as being integrally formed with the first plastic part through an insert injection molding process, or being connected to the first plastic part through an assembly process (e.g., interference fit).

(59) FIGS. **12**A and **12**B show the specific structures of the second compensation element **1400**. FIG. **12**A is an exploded view of the second compensation element **1400**, and FIG. **12**B is a perspective view of the second compensation element **1400** with a second metal ring part removed. As shown in FIGS. **12**A and **12**B, the second compensation element **1400** includes a second support portion **1420** and a pair of elastic connecting arms **3310**. The second support portion **1420** is generally disc-shaped, and the pair of elastic connecting arms **3310** are respectively located on two opposite sides of the second support portion **1420** and are configured to connect the second support portion **1420** to the first component **820**. The second support portion **1420** includes a second metal ring part **3220** and a second plastic part **3210**. The second metal ring part **3220** is accommodated in an accommodation cavity **3211** defined by the second plastic part **3210**. A part of the second plastic part **3210** extends into the second metal ring part **3220**, and the second plastic part **3210** defines the second receiving hole **3100**. Several connection protrusions **3225** are provided on the side of the second metal ring part **3220** facing the second plastic part **3210**, and the second plastic part **3210** is provided with several connection holes **3215** for respectively receiving the number of connection protrusions **3225**, so as to connect the second metal ring part **3220** to the second plastic part **3210**. The second metal ring part **3220** may be integrally formed with the second plastic part **3210** through an insert injection molding process, or be connected to the second plastic part **3210** through an assembly process (e.g., interference fit). In the fastened state of the tolerance compensation fastening assembly **1000**, the second metal ring part **3220** can be in contact with the first metal ring part **2220** of the first support portion **1320**.

(60) The second plastic part **3210** of the second support portion **1420** is provided with a guide section **3700**, limiting means **3600** and retaining means **1500** around the second receiving hole **3100**. In the embodiment shown in FIGS. **1**A and **1**B, the limiting means **360** and the retaining means **150** are arranged in different axial positions relative to the bolt **110**. However, in the

embodiment shown in FIG. **10**, the limiting means **3600** and the retaining means **1500** are arranged in the same axial position relative to the bolt **1100**. Furthermore, the guide section **3700** is arranged in a different axial position than the limiting means **3600** and the retaining means **1500**.

(61) Still as shown in FIGS. **12**A and **12**B, the guide section **3700** is arranged closer to the radial bolt extension **1120** than the limiting means **3600** and the retaining means **1500**, and is configured to mate with the mating portion **4150** of the bolt **1100** (as shown in FIG. **10**), so as to guide the insertion of the bolt **1100** into the second receiving hole **3100** in a desired orientation (an orientation corresponding to the locked position). To this end, the guide section **3700** defines a guide channel having a cross-section matching that of the mating portion **4150**. The guide channel forms part of the second receiving hole **3100**. When the mating portion **4150** of the bolt **1100** is inserted through the guide section **3700**, by rotating the bolt **1100**, the bolt **1100** can be rotated to the introduction position. During this process, the avoidance portion **1150** on the bolt **1100** mates with the guide section **3700**, allowing the bolt **1100** to rotate. In addition, steps **3218** are formed between the guide section **3700** and the limiting means **3600**/the retaining means **1500**, for limiting the bolt **1100** from being withdrawn from the second receiving hole **3100** after being rotated to the introduction position.

(62) The limiting means **3600** can mate with the mating portion **4150** of the bolt **1100** to define the introduction position and the locked position of the bolt **1100**. The number of limiting means **3600** matches the number of mating structures on the mating portion **4150**, and is four in the embodiment shown in the figures. The four limiting means **3600** are arranged rotationally symmetrically around the center of the second receiving hole **3100**. Each limiting means **3600** includes a first-direction limiting edge **3630** and a second-direction limiting edge **3670** opposite to each other, and a rotation space **3650** defined between the first-direction limiting edge **3630** and the second-direction limiting edge **3670** and in communication with the second receiving hole **3100**. The first-direction limiting edge **3630** and the second-direction limiting edge **3670** respectively correspond to the locked position and the introduction position of the bolt **1100**, and the mating portion **4150** of the bolt **1100** can rotate in the rotation space **3650**. When the bolt **1100** is in the introduction position, the mating portion **4150** of the bolt **1100** abuts against the first-direction limiting edge **3630**, thereby blocking the bolt **1100** from leaving the introduction position in a first direction from the locked position to the introduction position; and when the bolt **1100** is in the locked position, the mating portion **4150** of the bolt **1100** abuts against the second-direction limiting edge **3670**, thereby blocking the bolt **1100** from leaving the locked position in a second direction from the introduction position to the locked position.

(63) The retaining means **1500** includes a retaining protrusion **6380** arranged between the first-direction limiting edge **3630** and the second-direction limiting edge **3670**, and the first-direction limiting edge **3630**. The retaining protrusion **6380** is provided on an inside engagement surface **6350** connected to the first-direction limiting edge **3630** and the second-direction limiting edge **3670**. When the nut **1200** is subjected to a rotational force that is less than a preset threshold, the edge **4170** of the mating portion **4150** of the bolt **1100** can be retained between the first-direction limiting edge **3630** and the retaining protrusion **6380** to limit the rotation of the bolt **1100**, thereby retaining the bolt **1100** in its introduction position.

(64) FIG. **13** is a side view of the tolerance compensation fastening assembly **1000** with the bolt in the introduction position and the nut removed. As shown in FIG. **13**A, when the bolt **1100** is in the introduction position, the edge **4170** of the mating portion **4150** of the bolt **1100** is retained between the first-direction limiting edge **3630** and the retaining protrusion **6380**. When the nut **1200** is screwed with a force exceeding a preset threshold and thus the bolt **1100** is rotated in a clockwise direction in FIG. **13**A, the mating portion **4150** of the bolt **1100** can deform the retaining protrusion **6380** so as to pass over the retaining protrusion **6380**, so that the bolt **1100** can be rotated to the locked position. In the locked position, the mating portion **4150** of the bolt **1100** abuts against the second-direction limiting edge **3670**.

(65) After the first component is fastened to the second component via the tolerance compensation fastening assembly, the first support portion of the first compensation element and the second support portion of the second compensation element of the tolerance compensation fastening assembly are clamped between the radial nut extension and the radial bolt extension; therefore, the first support portion of the first compensation element, the retainer and the second support portion of the second compensation element are components that are subjected to the axial fastening force of the fastener, and their durability will affect the fastening effect of the tolerance compensation fastening assembly. If the first support portion of the first compensation element and the second support portion of the second compensation element are both made of plastic, the plastic material will creep under a high-temperature environment to create a gap between these components, so that the tolerance compensation fastening assembly will suffer from torque attenuation after prolonged use and it is no longer possible to clamp these components by means of the bolt and the nut. In the present disclosure, parts of the first support portion of the first compensation element and the second support portion of the second compensation element that overlap with the radial nut extension and the radial bolt extension in the longitudinal direction Y are at least partially made of metal; therefore, the tolerance compensation fastening assembly of the present disclosure has a relatively slow torque attenuation, and can adapt to relatively harsh use environments. Furthermore, the tolerance compensation fastening assembly of the present disclosure can define the introduction position and the locked position of the insertion end with a simple structure. The tolerance compensation fastening assembly of the present disclosure can also retain the insertion end in the introduction position with a simple structure, thereby facilitating transportation and assembly of the tolerance compensation fastening assembly.

(66) Although the present disclosure is described in conjunction with the examples of embodiments outlined above, various alternatives, modifications, variations, improvements, and/or substantial equivalents that are known or current or to be anticipated before long may be obvious to those of at least ordinary skill in the art. Furthermore, the technical effects and/or technical problems described in this description are exemplary rather than limiting; therefore, the disclosure in this description may be used to solve other technical problems and have other technical effects and/or may solve other technical problems. Accordingly, the examples of the embodiments of the present disclosure as set forth above are intended to be illustrative rather than limiting. Various changes may be made without departing from the spirit or scope of the present disclosure. Therefore, the present disclosure is intended to embrace all known or earlier disclosed alternatives, modifications, variations, improvements, and/or substantial equivalents.

Claims

1. A tolerance compensation fastening assembly for fastening a first component having an opening with an internal thread provided on an inner surface thereof to a second component, the tolerance compensation fastening assembly comprising: a first compensation element comprising a first support portion having a first metal ring part connected to a first plastic part, the first support portion being provided with a first receiving hole, the first receiving hole being configured to receive a shank of a fastener, wherein the fastener comprises a bolt defining the shank and a radial bolt extension radially extending from the shank, and a nut defining a threaded connection and a radial nut extension radially extending from the threaded connection, and the threaded connection being threadedly connectable to the shank, and wherein the first compensation element comprises a threaded portion on an outer surface thereof that is configured to threadedly engage the internal thread of the first component and movable relative to the first component in a longitudinal direction; and a second compensation element comprising a second support portion having a second metal ring part connected to a second plastic part, the second support portion being provided with a second receiving hole, the second receiving hole being configured to receive the

shank of the fastener, wherein the second support portion is configured to be connectable to the first component and movable relative to the first component in at least one transverse direction perpendicular to the longitudinal direction, wherein the first support portion and the second support portion are configured to be subjected to an axial fastening force applied by the fastener, wherein the first metal ring part and the second metal ring part at least partially overlap with the radial bolt extension and the radial nut extension in the longitudinal direction, wherein the first support portion and the second support portion are located between the radial bolt extension and the radial nut extension, and wherein parts of the first support portion and the second support portion that overlap with the radial bolt extension and the radial nut extension in the longitudinal direction are at least partially made of metal.

2. The tolerance compensation fastening assembly according to claim 1, wherein: the first metal ring part of the first support portion is integrally formed with the first plastic part through an insert injection molding process, or is connected to the first plastic part through an assembly process; and the second metal ring part of the second support portion is integrally formed with the second plastic part through an insert injection molding process, or is connected to the second plastic part through an assembly process.

3. The tolerance compensation fastening assembly according to claim 1, further comprising: an insertion end configured to be inserted into the first component and an operation end opposite to the insertion end, the insertion end being formed by one of the bolt and the nut, and the operation end being formed by the other of the bolt and the nut, wherein the one of the bolt and the nut that forms the insertion end comprises an introduction position and a locked position and is configured to be rotatable between the introduction position and the locked position, and wherein the one of the bolt and the nut that forms the insertion end comprises a mating portion; and a limiting structure provided on the second support portion around the second receiving hole, and the limiting structure being configured to mate with the mating portion to define the introduction position and the locked position.

4. The tolerance compensation fastening assembly according to claim 1, wherein: the first compensation element comprises a tubular main body portion, and the first support portion is an annular flange arranged at one end of the tubular main body portion, wherein the tubular main body portion is provided with the threaded portion; wherein the second compensation element further comprises a pair of elastic connecting arms respectively located on opposite sides of the second support portion, and the second support portion is connected to the first component via the pair of elastic connecting arms.

5. The tolerance compensation fastening assembly according to claim 1, wherein the second compensation element further comprises a pair of elastic connecting arms respectively located on opposite sides of the second support portion, and the second support portion is connected to the first component via the pair of elastic connecting arms.

6. A tolerance compensation fastening assembly for fastening a first component to a second component, the tolerance compensation fastening assembly comprising: a first compensation element comprising a first support portion, the first support portion being provided with a first receiving hole, the first receiving hole being configured to receive a shank of a fastener, wherein the first compensation element is configured to be connectable to the first component and movable relative to the first component in a longitudinal direction; and a second compensation element comprising a second support portion, the second support portion being provided with a second receiving hole, the second receiving hole being configured to receive the shank of the fastener, wherein the second support portion is configured to be connectable to the first component and movable relative to the first component in at least one transverse direction perpendicular to the longitudinal direction, wherein the first support portion and the second support portion are configured to be subjected to an axial fastening force applied by the fastener, and wherein the first support portion and the second support portion are at least partially made of metal, a limiting

structure provided on the second support portion around the second receiving hole, and the limiting structure being configured to mate with a mating portion to define an introduction position and a locked position, wherein the limiting structure comprises a first-direction limiting edge and a second-direction limiting edge opposite to each other, and a rotation space defined between the first-direction limiting edge and the second-direction limiting edge and in communication with the second receiving hole, the first-direction limiting edge corresponding to the introduction position, and the second-direction limiting edge corresponding to the locked position, wherein the one of a bolt and a nut that forms an insertion end is rotatable in the rotation space.

7. The tolerance compensation fastening assembly according to claim 6, further comprising: retaining means being configured to mate with the mating portion such that the one of the bolt and the nut that forms the insertion end is retained in the introduction position when an operation end is subjected to a rotational force that is less than a preset threshold.

8. The tolerance compensation fastening assembly according to claim 7, wherein: the retaining means comprise a retainer arranged between the first support portion and the second support portion, and the second support portion mates with the retainer to limit the rotation of the retainer relative to the second support portion; wherein part of the retainer that overlaps with the first support portion, and the second support portion in the longitudinal direction is at least partially made of metal.

9. The tolerance compensation fastening assembly according to claim 7, wherein: the retaining means comprise structures provided on the second support portion around the second receiving hole.

10. The tolerance compensation fastening assembly according to claim 7, wherein: the retaining means and the limiting structure are arranged at different axial positions of the tolerance compensation fastening assembly, and the retaining means comprise at least two retaining ribs, the at least two retaining ribs being made of plastic and configured to be deformable when subjected to a certain rotational force; and the mating portion comprises at least one edge, the at least one edge being retainable between the at least two retaining ribs.

11. The tolerance compensation fastening assembly according to claim 7, wherein: the retaining means and the limiting structure are arranged at the same axial position of the tolerance compensation fastening assembly, and the retaining means comprises a retaining protrusion located between the opposite first-direction limiting edge and second-direction limiting edge, the retaining protrusion being made of plastic and configured to be deformable when subjected to a certain rotational force; and the mating portion comprises at least one edge, the at least one edge being retained between the first-direction limiting edge and the retaining protrusion.