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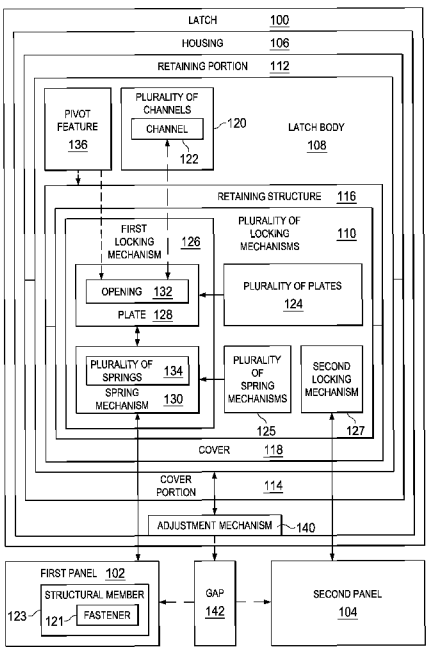
FIG. 1



(57) Abstract: An apparatus comprising a latch body (108) and a plurality of locking mechanisms (126,127). The latch body has a plurality of channels (122) that extend through the latch body. The plurality of locking mechanisms is housed within the latch body. A locking mechanism in the plurality of locking mechanisms comprises a plate (128) and a spring mechanism (130). The plate has an opening (132) positioned relative to a corresponding channel in the plurality of channels. The spring mechanism is configured to hold the plate in a locked position within the latch body.

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LATCH WITH A BUILT-IN ADJUSTMENT MECHANISM

BACKGROUND INFORMATION

1. Field:

The present disclosure relates generally to a latch and, in particular, to a latch for joining panels without using any additional tools. Still more particularly, the present disclosure relates to a latch that allows two panels to be joined and the width of the gap formed between the two panels to be adjusted.

2. Background:

Typically, the sidewalls of an aircraft interior are formed by installing panels that are joined together using mechanical fasteners. These panels may be referred to as, for example, "wall panels" or "sidewall panels". With some currently available techniques for joining panels, a bracket having multiple slots is used to join two panels together. Each of these slots has an elongate shape such as, for example, an oval shape. A nut plate is located within each of these slots and is allowed to move freely within the corresponding slot of the bracket. Each of the nut plates is configured to receive the threaded end of a screw.

These screws are used to fasten the panels to the bracket. In particular, each panel may have an attachment feature, such as, for example, without limitation, a loop, configured to receive the threaded end of a screw. When the bracket and the nut plates located in the slots of the bracket are positioned relative to the panels, screws are driven through the loops and into the nut plates to fasten the panels to the bracket. In this manner, the two panels are joined together by the bracket.

However, joining panels using these types of brackets, nut plates, and screws may take more time and/or effort than desired. Additionally, tools may be needed to drive the screws into the nut plates. For example, screwdrivers, screw guns, and/or other types of tools may be needed.

Further, with these types of currently available techniques, the panels may be joined outside of selected tolerances. In particular, the width of the gap formed between the panels after the panels are joined together may be greater than desired. Consequently, the installation of these panels may need to be reworked multiple times

to achieve an installation of panels that are within selected tolerances. This reworking may take more time and/or effort than desired. Further, the reworking may be more expensive than desired. Therefore, it would be desirable to have a method and apparatus that takes into account at least some of the issues discussed above, as well as other possible issues.

SUMMARY

In one illustrative embodiment, an apparatus comprises a latch body and a plurality of locking mechanisms. The latch body has a plurality of channels that extend through the latch body. The plurality of locking mechanisms is housed within the latch body. A locking mechanism in the plurality of locking mechanisms comprises a plate and a spring mechanism. The plate has an opening positioned relative to a corresponding channel in the plurality of channels. The spring mechanism is configured to hold the plate in a locked position within the latch body.

In another illustrative embodiment, a latch comprises a housing, a latch body, a plurality of locking mechanisms, and an adjustment mechanism. The latch body is housed within the housing and has a plurality of channels that extend through the latch body. The plurality of locking mechanisms is housed within the latch body. A locking mechanism in the plurality of locking mechanisms comprises a plate and a spring mechanism. The plate has an opening positioned relative to a corresponding channel in the plurality of channels. The spring mechanism comprises a plurality of compression springs configured to hold the plate in a locked position within the latch body. The adjustment mechanism is configured to move the latch body and the plurality of locking mechanisms housed within the latch body in a direction along an axis independently of the housing.

In yet another illustrative embodiment, a method for attaching a latch to a number of panels is provided. A load is applied to a spring mechanism in the latch to move a plate in the latch into an unlocked position. The unlocked position is configured to allow a fastener to pass through an opening in the plate. The spring mechanism and the plate form a locking mechanism that is housed within a latch body. The load applied to the spring mechanism is removed after a selected portion of the fastener has passed through the opening in the plate such that the plate moves into a locked position.

According to an aspect of the invention there is provided an apparatus comprising a latch body having a plurality of channels that extend through the latch body, and a plurality of locking mechanisms housed within the latch body, wherein a locking mechanism in the plurality of locking mechanisms comprises a plate having an opening positioned relative to a corresponding channel in the plurality of channels; and a spring mechanism configured to hold the plate in a locked position within the latch body.

Advantageously, the latch body further comprises a retaining structure configured to hold the plurality of locking mechanisms, and a cover. Preferably the locking mechanism further comprises a pivot feature, wherein the plate is configured to be rotated about the pivot feature. Preferably the spring mechanism comprises a plurality of springs, wherein rotation of the plate about the pivot feature applies a load to at least one spring in the plurality of springs. Preferably, the plate is configured to be rotated about the pivot feature into an unlocked position such that the opening in the plate is aligned with the corresponding channel through the latch body within selected tolerances. Preferably, a fastener is configured to freely move within the corresponding channel through the latch body when the plate is in the unlocked position and the opening in the plate is aligned with the corresponding channel within the selected tolerances. Preferably, the pivot feature is associated with at least one of the plate and the retaining structure of the latch body.

Advantageously, a fastener that has at least partially passed through the opening in the plate is locked in place when the plate is in the locked position.

Advantageously, the locking mechanism is configured to receive a fastener attached to a structural member. Preferably, the structural member is attached to a panel for use in forming a sidewall for an interior of an aircraft.

Advantageously, the locking mechanism is a first mechanism and further comprising an adjustment mechanism configured to move the latch body and the plurality of locking mechanisms housed within the latch body in a direction along an axis of the latch body. Preferably, the opening in the plate and the corresponding channel are elongated with respect to the axis.

Advantageously, a housing is configured to house the latch body.

Advantageously, the opening has a shape selected from one of a circular shape, an elongated shape, an oval shape, a square shape, and a rectangular shape and

wherein the corresponding channel has a shape selected from one of a circular cylindrical shape, an elongated cylindrical shape, an elliptic cylindrical shape, a hyperbolic cylindrical shape, a parabolic cylindrical shape, and a prism shape.

According to a further aspect of the present disclosure there is provided a latch comprising a housing, a latch body housed within the housing and having a plurality of channels that extend through the latch body, and a plurality of locking mechanisms housed within the latch body, wherein a locking mechanism in the plurality of locking mechanisms comprises, a plate having an opening positioned relative to a corresponding channel in the plurality of channels, a spring mechanism comprising a plurality of compression springs configured to hold the plate in a locked position within the latch body; and an adjustment mechanism configured to move the latch body and the plurality of locking mechanisms housed within the latch body in a direction along an axis of the latch body independently of the housing.

According to a yet further aspect of the present disclosure there is provided a method for attaching a latch to a number of panels, the method comprising applying a load to a spring mechanism in the latch to move a plate in the latch into an unlocked position such that a fastener is allowed to pass through an opening in the plate, wherein the spring mechanism and the plate form a locking mechanism that is housed within a latch body, and removing the load applied to the spring mechanism after a selected portion of the fastener has passed through the opening in the plate such that the plate moves into a locked position.

Advantageously, the step of applying the load to the spring mechanism comprises inserting the fastener through a channel in the latch body corresponding to the opening in the plate, wherein the fastener is associated with a panel, and applying a force to the fastener at the opening of the plate that causes the load to be applied to the spring mechanism in the latch and move the plate in the latch into the unlocked position. Preferably, the step of removing the load applied to the spring mechanism comprises removing the load applied to the spring mechanism after the selected portion of the fastener has passed through the opening in the plate such that the plate moves into the locked position and locks the fastener in place with respect to an axis of the latch body, wherein locking the fastener in place attaches the latch to the panel with which the fastener is associated.

Advantageously, the latch body is moved in a direction along an axis of the latch body using an adjustment mechanism in the latch. Preferably, the step of moving the latch body comprises moving the latch body in the direction along the axis using the adjustment mechanism in the latch, wherein the opening in the plate and a corresponding channel through the latch body are elongated with respect to the axis to allow the fastener to move freely within the corresponding channel independently of movement of the latch body.

The features and functions can be achieved independently in various embodiments of the present disclosure or may be combined in yet other embodiments in which further details can be seen with reference to the following description and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features believed characteristic of the illustrative embodiments are set forth in the appended claims. The illustrative embodiments, however, as well as a preferred mode of use, further objectives and features thereof, will best be understood by reference to the following detailed description of an illustrative embodiment of the present disclosure when read in conjunction with the accompanying drawings, wherein:

Figure 1 is an illustration of a latch in the form of a block diagram in accordance with an illustrative embodiment;

Figure 2 is an illustration of a portion of a sidewall for an interior of an aircraft in accordance with an illustrative embodiment;

Figure 3 is an illustration of an enlarged view of a portion of a sidewall for an interior of an aircraft with a latch in accordance with an illustrative embodiment;

Figure 4 is an illustration of another view of a latch attached to two structural members in accordance with an illustrative embodiment;

Figure 5 is another illustration of a latch in accordance with an illustrative embodiment;

Figure 6 is an illustration of another view of a latch in accordance with an illustrative embodiment;

Figure 7 is an illustration of a latch body in accordance with an illustrative embodiment;

Figure 8 is an illustration of a first locking mechanism and a second locking mechanism held within a retaining structure in accordance with an illustrative embodiment;

Figure 9 is an illustration of two plates in unlocked positions in accordance with an illustrative embodiment;

Figure 10 is an illustration of an adjusted latch body in accordance with an illustrative embodiment;

Figure 11 is an illustration of an adjusted latch body in accordance with an illustrative embodiment;

Figure 12 is an isometric view of a structural member and a fastener in accordance with an illustrative embodiment;

Figure 13 is an illustration of a cross-sectional view of a latch attached to a structural member in accordance with an illustrative embodiment;

Figure 14 is another illustration of a cross-sectional view of a latch attached to a structural member in accordance with an illustrative embodiment;

Figure 15 is an illustration of a process for attaching a latch to a panel in the form of a flowchart in accordance with an illustrative embodiment;

Figure 16 is an illustration of an aircraft manufacturing and service method in the form of a block diagram in accordance with an illustrative embodiment; and

Figure 17 is an illustration of an aircraft in the form of a block diagram in accordance with an illustrative embodiment.

DETAILED DESCRIPTION

The illustrative embodiments recognize and take into account different considerations. For example, the illustrative embodiments recognize and take into account that a latch that is capable of joining together wall panels without requiring any additional tools may reduce the time and/or effort needed to join and install these wall panels. Further, the illustrative embodiments recognize and take into account that it may be desirable to have a latch that allows the width of the gap formed between joined wall panels to be adjusted without requiring that the wall panels be disengaged and rejoining one or more times.

Thus, the illustrative embodiments provide a method and apparatus for joining panels using a latch that has a built-in adjustment mechanism. Further, the illustrative embodiments provide a latch that does not require any additional tools to lock fasteners received in the latch in fixed positions.

With reference now to **Figure 1**, an illustration of a latch in the form of a block diagram is depicted in accordance with an illustrative embodiment. In **Figure 1**, latch **100** may be used to join first panel **102** and second panel **104**. First panel **102** and second panel **104** may be, for example, without limitation, sidewall panels for the interior of an aircraft.

In these illustrative examples, latch **100** includes housing **106**, latch body **108** , and a plurality of locking mechanisms **110**. As depicted, housing **106** is configured to house latch body **108** and plurality of locking mechanisms **110**. In one illustrative example, housing **106** comprises retaining portion **112** and cover portion **114**. In this example, retaining portion **112** is configured to hold latch body **108**, while cover portion **114** is configured to cover latch body **108**. In particular, retaining portion **112** forms a first side of housing **106**, and cover portion **114** forms a second side of housing **106.** Depending on the implementation, retaining portion **112** and cover portion **114** may be two portions of a same structure or two different pieces.

Within housing **106**, latch body **108** houses a plurality of locking mechanisms **110**. In one illustrative example, latch body **108** comprises retaining structure **116** and cover **118**. Retaining structure **116** is configured to hold a plurality of locking mechanisms **110,** while cover **118** is configured to cover a plurality of locking mechanisms **110.** Depending on the implementation, retaining structure **116** and cover **118** may be two portions of a same structure or two different pieces.

Retaining structure **116** forms a first side of latch body **108**, and cover **118** forms a second side of latch body **108**. Latch body **108** has a plurality of channels **120** that extend from the first side of latch body **108** to the second side of latch body **108**. In particular, each channel in plurality of channels **120** is formed by the volume of space located inside latch body **108** between an opening in retaining structure **116** and a corresponding opening in cover **118**.

In this manner, each channel in the plurality of channels **120** is open at both ends. The sizes of these openings are selected such that each channel in the plurality

of channels **120** is capable of receiving a fastener and allowing the fastener to pass through the channel. The fastener may be, for example, a screw.

Channel **122** is an example of one of the plurality of channels **120**. Channel **122** may be configured to receive a fastener, such as, for example, fastener **121**. Fastener **121** may be associated with first panel **102**.

When one component is "associated" with another component, the association is a physical association in the depicted examples. For example, a first component, such as fastener **121** may be considered to be associated with a second component, first panel **102**, by being secured to the second component, bonded to the second component, mounted to the second component, welded to the second component, fastened to the second component, and/or connected to the second component in some other suitable manner. The first component also may be connected to the second component using a third component. The first component may also be considered to be associated with the second component by being formed as part of and/or an extension of the second component.

In one illustrative example, fastener **121** is associated with first panel **102** through structural member **123**. In particular, fastener **121** is attached to structural member **123,** which in turn, is attached to first panel **102.** Fastener **121** may be, for example, a screw.

As depicted, the plurality of locking mechanisms **110** is formed by a plurality of plates **124** and a plurality of spring mechanisms **125**. More specifically, each locking mechanism in the plurality of locking mechanisms **110** is formed by a plate in the plurality of plates **124** and a corresponding spring mechanism 130 in the plurality of spring mechanisms **125**.

First locking mechanism **126** and second locking mechanism **127** are examples of locking mechanisms in the plurality of locking mechanisms **110**. First locking mechanism **126** is configured to be connected to first panel **102**, while second locking mechanism **127** is configured to be connected to second panel **104**.

As depicted, first locking mechanism **126** is formed by plate **128** from the plurality of plates **124** and spring mechanism **130** from the plurality of spring mechanisms **125**. In this illustrative example, plate **128** has opening **132**. When opening **132** of plate **128** is aligned with channel **122** within selected tolerances, fastener **121** may be inserted into channel **122** and moved through channel **122**. However, when opening **132** of

plate **128** is not aligned with channel **122** within selected tolerances, fastener **121** located within channel **122** may be held in a fixed or locked position. In other words, fastener **121** may be unable to move through channel **122** when opening **132** of plate **128** is not aligned with channel **122** within selected tolerances.

Spring mechanism **130** is configured to hold plate **128** in a position in which opening **132** is unaligned with channel **122** within selected tolerances. In one illustrative example, spring mechanism **130** comprises a plurality of springs **134**. The plurality of springs **134** may be compression springs in this example. As used herein, a "compression spring" is a spring configured to compress or shorten in length when a load is applied to the spring.

The plurality of springs **134** may be positioned relative to plate **128** and latch body **108** in a manner such that plate **128** is held in a fixed position when no loads are applied to any of the plurality of springs **134**. This fixed position is referred to as a locked position. When plate **128** is in the locked position, opening **132** of plate **128** is not aligned with channel **122** within selected tolerances.

However, an external load may be applied to plate **128** to cause plate **128** to rotate about pivot feature **136**. This rotation causes a load to be applied to at least one of the plurality of springs **134**, which in turn, causes the at least one of the plurality of springs **134** to compress. In this manner, the position of plate **128** within latch body **108** may be changed, thereby changing the alignment of opening **132** with respect to channel **122**.

In one illustrative example, the external load may be applied to plate **128** when fastener **121** is inserted into channel **122** of latch body **108**. For example, fastener **121** may be inserted into channel **122** such that at least a portion of fastener **121** is received within opening **132** in plate **128**.

Force may be applied to fastener **121** along an axis of the latch body 108 through opening **132** in the direction in which fastener **121** is being inserted into channel **122**. In other words, fastener **121** may be pushed through opening **132**. The axis through opening **132** may be substantially perpendicular to plate **128**. The force applied to fastener **121** applies a load to plate **128,** which in turn, applies a load to at least one of the plurality of springs **134** that causes the at least one of the plurality of springs **134** to compress. In this manner, pushing fastener **121** through opening **132** causes the position of plate **128** to change.

Fastener **121** may be pushed through opening **132** until plate **128** is moved into an unlocked position. When plate **128** is in an unlocked position, opening **132** of plate **128** is substantially aligned with channel **122** within selected tolerances. With plate **128** in an unlocked position, a selected portion of fastener **121** may be moved through opening **132**.

Once the selected portion of fastener **121** has passed through opening **132,** the force being applied to fastener **121** may be removed. Removing the force applied to fastener **121** in turn, removes the load applied to the at least one of the plurality of springs **134**. In particular, fastener **121** is no longer being pushed, the load applied to plate **128** is removed, which in turn, removes the load applied to the at least one of the plurality of springs **134**.

Removing these load causes plate **128** to move back into a locked position. In particular, plate **128** moves such that plate **128** locks fastener **121** in place with respect to the axis through opening **132**. Fastener **121** is locked in place by the misalignment between opening **132** and channel **122.** Once fastener **121** is locked in place, fastener **121** may not be pulled out through opening **132** without applying a load to at least one of plurality of springs **134**.

Pivot feature **136** may be associated with plate **128** and/or retaining structure **116.** For example, pivot feature **136** may be part of retaining structure **116** in the form of a protrusion on an inner surface of retaining structure **116**. In another example, pivot feature **136** may be a rivet attached to the inner surface of retaining structure **116**. In yet another example, pivot feature **136** may be a structural feature considered part of plate **128**. In still another example, pivot feature **136** may be a part connected to plate **128** and retaining structure **116**.

When fastener **121** is locked in a fixed position within channel **122** by first locking mechanism **126**, latch body **108** is considered fastened or attached to first panel **102**. Second locking mechanism **127** may be used to fasten or attach latch body **108** to second panel **104** in a similar manner. In this manner, first locking mechanism **126** and second locking mechanism **127** are used to join first panel **102** to second panel **104**.

In these illustrative examples, latch **100** includes adjustment mechanism **140** configured to adjust the width of gap **142** formed between first panel **102** and second panel **104**. Adjustment mechanism **140** may be considered a “built-in” adjustment mechanism.

Adjustment mechanism **140** is configured to move latch body **108** along an axis relative to housing **106**. In some cases, movement of latch body **108** causes fastener **121** and thereby first panel **102** to be moved along with latch body **108**. However, in other cases, latch body **108** may move without moving fastener **121** or first panel **102**.

In one illustrative example, opening **132** and the openings in retaining structure **116** and cover **118** that form channel **122** may have sizes and/or shapes based on the size and/or shape, respectively, of fastener **121**. In some illustrative examples, opening **132** and the openings in retaining structure **116** and cover **118** that form channel **122** may be configured to form an interference fit with fastener **121** when the fastener 121 is inserted into channel **122**. In this example, movement of latch body **108** causes fastener **121** and thereby first panel **102** to be moved along with latch body **108**.

However, in other illustrative examples, opening **132** and channel **122** may be elongated with respect to the axis along which latch body **108** is moved. In other words, opening **132** and the openings in retaining structure **116** and cover **118** that form channel **122** may be slotted.

In these examples, the shape of opening **132** and the openings in retaining structure **116** and cover **118** that form channel **122** allow adjustment mechanism **140** to move latch body **108** without moving fastener **121** located within channel **122** and opening **132**. The shape of opening **132** may be, for example, a circular shape, an elongated circular shape, an oval shape, a square shape, a rectangular shape, and/or other shapes. The distance by which latch body **108** may be moved along the axis is limited by the length of retaining portion **112** of housing **106** and/or the length of opening **132** and the lengths of the openings in retaining structure **116** and cover **118** that form channel **122**.

In some cases, adjustment mechanism **140** may be used to move latch body **108** and second panel **104** fastened to latch body **108** without moving fastener **121** or first panel **102**. In this manner, the width of gap **142** between first panel **102** and second panel **104** may be adjusted using adjustment mechanism **140**.

The illustration of latch **100** in **Figure 1** is not meant to imply physical or architectural limitations to the manner in which an illustrative embodiment may be implemented. Other components in addition to or in place of the ones illustrated may be used. Some components may be unnecessary. Also, the blocks are presented to illustrate some functional components. One or more of these blocks may be combined,

divided, or combined and divided into different blocks when implemented in an illustrative embodiment.

For example, in some cases, only one end of channel **122** in the plurality of channels **120** may be open. For example, in some cases, channel **122** may extend from an opening in cover **118** to the inside surface of retaining structure **116** within latch body **108**. As another example, channel **122** may extend from an opening in retaining structure **116** to the inside surface of cover **118** within latch body **108**.

In other illustrative examples, more than two locking mechanisms may be present in the plurality of locking mechanisms **110**. For example, two locking mechanisms in plurality of locking mechanisms **110** may be used to attach latch body **108** to first panel **102**.

Turning now to **Figure 2**, an illustration of a portion of a sidewall for an interior of an aircraft is depicted in accordance with an illustrative embodiment. As depicted in **Figure 2**, a portion of sidewall **200** for an interior of an aircraft is depicted. This portion of sidewall **200** is formed by first panel **202** and second panel **204**. First panel **202** and second panel **204** are examples of implementations for first panel **102** and second panel **104**, respectively, in **Figure 1**.

As depicted, first panel **202** and second panel **204** are joined using latch **206** and latch **208**. Latch **206** and latch **208** are implemented in a manner similar to the manner in which latch **100** in **Figure 1** is implemented. Latch **206** is described in greater detail in **Figures 3-14** below. In particular, portion **210** of sidewall **200** is shown in an enlarged view in **Figure 3**.

With reference now to **Figure 3**, an illustration of an enlarged view of portion **210** of sidewall **200** with latch **206** from **Figure 2** is depicted in accordance with an illustrative embodiment. In this illustrative example, latch **206** is attached to first panel **202** using structural member **300** and to second panel **204** using structural member **302**. Structural member **300** and structural member **302** take the form of plates in this illustrative example.

Fastener **304** and fastener **306** have been used to attach structural member **300** to first panel **202**. Fastener **308** and fastener **310** have been used to attach structural member **302** to second panel **204**. Further, latch **206** has been attached to structural member **300** using fastener **312**. Latch **206** has been attached to structural member **302** using fastener **314**.

Turning now to **Figure 4**, an illustration of another view of latch **206** attached to structural member **300** and structural member **302** from **Figure 3** is depicted in accordance with an illustrative embodiment. In **Figure 4**, an opposite view of latch **206** attached to structural member **300** and structural member **302** from **Figure 3** is depicted. First panel **202** and second panel **204** are not shown in this view.

With reference now to **Figure 5**, an illustration of latch **206** from **Figure 4** is depicted in accordance with an illustrative embodiment. In this illustrative example, latch **206** is depicted without structural member **300** and structural member **302** in **Figure 4** attached to latch **206**.

As depicted, latch **206** includes housing **500**. Housing **500** is an example of one implementation for housing **106** for latch **100** in **Figure 1**. In this illustrative example, housing **500** includes retaining portion **502** and cover portion **504**. Cover portion **504** has opening **506** and opening **508**. In this illustrative example, opening **506** has a circular shape, while opening **508** has an elongated shape. Opening **508** may be referred to as a slotted opening.

Opening **506** is configured to receive fastener **314** from **Figure 3**, while opening **508** is configured to receive fastener **312** from **Figure 3**. Retaining portion **502** also has two openings (not shown in this view).

Housing **500** houses latch body **510**, first locking mechanism **512**, and second locking mechanism **514**. In particular, retaining portion **502** of housing **500** holds latch body **510,** first locking mechanism **512**, and second locking mechanism **514**. Cover portion **504** of housing **500** covers latch body **510,** first locking mechanism **512**, and second locking mechanism **514**.

Latch body **510** is an example of one implementation for latch body **108** in **Figure 1**. First locking mechanism **512** and second locking mechanism **514** are examples of implementations for first locking mechanism **126** and second locking mechanism **127** in **Figure 1**. Latch body **510,** first locking mechanism **512**, and second locking mechanism **514** are described in greater detail in **Figures 7-11** below.

Additionally, latch **206** includes adjustment mechanism **516**. Adjustment mechanism **516** is associated with latch body **510** and is configured to move latch body **510** within housing **500**. Adjustment mechanism **516** is described in greater detail in **Figures 7-11** below.

With reference now to **Figure 6**, an illustration of another view of latch **206** is depicted in accordance with an illustrative embodiment. In this illustrative example, retaining portion **502** of housing **500** is seen more clearly. As depicted, retaining portion **502** has opening **600** and opening **602**.

Opening **600** and 602 have an elongated shape. Openings **600** and 602 may be referred to as slotted openings. Opening **600** is configured to receive fastener **312** from **Figure 3**, while opening **602** is configured to receive fastener **314** from **Figure 3**.

Turning now to **Figure 7**, an illustration of latch body **510** from **Figure 5** is depicted in accordance with an illustrative embodiment. In this illustrative example, housing **500** from **Figure 5** is not shown in this view such that latch body **510** housed within housing **500** may be seen. Latch body **510** houses first locking mechanism **512** and second locking mechanism **514**.

As depicted, latch body **510** comprises retaining structure **700** and cover **702**. Retaining structure **700** of latch body **510** holds first locking mechanism **512** and second locking mechanism **514**. Cover **702** covers first locking mechanism **512** and second locking mechanism **514**.

Additionally, latch body **510** has channel **704** and channel **706**. Channel **704** extends through latch body **510** between opening **708** in cover **702** and an opening (not shown in this view) in retaining structure **700**. These openings have elongated shapes in this illustrative example. Consequently, channel **704** has an elongated cylindrical shape. In other illustrative examples, channel **704** may have a circular cylindrical shape, an elliptic cylindrical shape, a hyperbolic cylindrical shape, a parabolic cylindrical shape, a prism shape, and/or other shapes. Channel **704** is configured to receive fastener **314** from **Figure 3**.

Further, channel **706** extends through latch body **510** between opening **710** in cover **702** and an opening (not shown in this view) in retaining structure **700**. These openings have elongated shapes in this illustrative example. Consequently, channel **706** has an elongated cylindrical shape. Channel **706** is configured to receive fastener **312** from **Figure 3**.

In this illustrative example, adjustment mechanism **516** may be rotated in the direction of arrow **712** to move latch body **510** in a direction along axis **714 of latch body 510**. Adjustment mechanism **516** is configured to move latch body **510** independently of housing **500** in **Figure 5**. Further, when adjustment mechanism **516**

moves latch body **510**, first locking mechanism **512** and second locking mechanism **514** held within latch body **510** are also moved.

With reference now to **Figure 8**, an illustration of first locking mechanism **512** and second locking mechanism **514** held within retaining structure **700** from **Figure 7** is depicted in accordance with an illustrative embodiment. In this illustrative example, cover **702** of latch body **510** from **Figure 7** has been removed such that first locking mechanism **512** and second locking mechanism **514** may be seen. As depicted, first locking mechanism **512** and second locking mechanism **514** are positioned within edge **804** of retaining structure **700**.

With cover **702** from **Figure 7** removed, opening **800** and opening **802** in retaining structure **700** are seen. Opening **800** has a circular shape, while opening **802** has an elongated shape. Channel **704** extends out through opening **800** in retaining structure **700**, while channel **706** extends out through opening **802** in retaining structure **700**.

As depicted, first locking mechanism **512** includes plate **806** and spring mechanism **808**. Spring mechanism **808** comprises compression spring **810** and compression spring **812**. Further, plate **806** has opening **814** and opening **816**. Opening **814** and opening **816** both have circular shapes in this illustrative example.

Compression spring **810** and compression spring **812** are positioned between plate **806** and edge **804** of retaining structure **700** in a manner that keeps plate **806** in locked position **815** relative to retaining structure **700**. When plate **806** is in locked position **815**, first locking mechanism **512** is considered locked.

In locked position **815**, opening **814** in plate **806** is not aligned with channel **704** through latch body **510** within selected tolerances. Consequently, channel **704** is partially occluded. In other words, when opening **814** is not aligned with channel **704** within selected tolerances, the size of channel **704** is reduced such that all portions of fastener **314** from **Figure 3** may be unable to pass through the entirety of channel **704**.

Opening **816** in plate **806** may be used to move plate **806** such that opening **814** can be aligned with channel **704**. In particular, opening **816** in plate **806** may be used to rotate plate **806** about pivot feature **818**. In this illustrative example, pivot feature **818** is a rivet attached to retaining structure **700**. However, in other illustrative examples, pivot feature **818** may be a structural feature that is part of retaining structure **700** about

which plate **806** may rotate. Plate **806** may be rotated about pivot feature **818** in the direction of arrow **820** to align opening **814** with channel **704** within selected tolerances.

In a similar manner, second locking mechanism **514** includes plate **822** and spring mechanism **824**. Spring mechanism **824** comprises compression spring **826** and compression spring **828**. Further, plate **822** has opening **830** and opening **832**. Opening **830** has an elongated shape, while opening **832** has a circular shape in this illustrative example. Opening **830** may be referred to as a slotted opening.

Compression spring **826** and compression spring **828** are positioned between plate **822** and edge **804** of retaining structure **700** in a manner that keeps plate **822** in locked position **831** relative to retaining structure **700**. When plate **822** is in locked position **831**, second locking mechanism **514** is considered locked.

In locked position **831**, opening **830** in plate **822** is not aligned with channel **706** through latch body **510** within selected tolerances. Consequently, channel **706** is partially occluded. In other words, when opening **830** is not aligned with channel **706** within selected tolerances, the size of channel **706** is reduced such that all portions of fastener **312** from **Figure 3** may be unable to pass through the entirety of channel **706**.

However, opening **832** in plate **822** may be used to move plate **822** such that opening **830** can be aligned with channel **706**. In particular, opening **832** in plate **822** may be used to rotate plate **822** about pivot feature **834**. In this illustrative example, pivot feature **834** is a rivet attached to retaining structure **700**. However, in other illustrative examples, pivot feature **834** may be a structural feature that is part of retaining structure **700** about which plate **822** may rotate. Plate **822** may be rotated about pivot feature **834** in the direction of arrow **836** to align opening **830** with channel **706** within selected tolerances.

With reference now to **Figure 9**, an illustration of plate **806** and plate **822** from **Figure 8** in unlocked positions is depicted in accordance with an illustrative embodiment. In **Figure 9**, plate **806** and plate **822** have been moved by applying force to plate **806** and plate **822** in the direction of arrow **900** through opening **816** in plate **806** and opening **832** in plate **822**.

When force is applied to plate **806** in the direction of arrow **900**, plate **806** rotates about pivot feature **818** in the direction of arrow **902**. Further, this force applies a load to compression spring **810** and compression spring **812** such that both of these compression springs contract or shorten in length. Plate **806** has been rotated about

pivot feature **818** into unlocked position **906** such that opening **814** in plate **806** is aligned with channel **704** through latch body **510** within selected tolerances. In other words, the rotation of plate **806** into unlocked position **906** unlocks first locking mechanism **512**.

Similarly, when force is applied to plate **822** in the direction of arrow **900**, plate **822** rotates about pivot feature **834** in the direction of arrow **904**. Further, this force applies a load to compression spring **826** and compression spring **828** such that both of these compression springs contract or shorten in length. Plate **822** has been rotated about pivot feature **834** into unlocked position **908** such that opening **830** in plate **822** is aligned with channel **706** through latch body **510** within selected tolerances. In other words, the rotation of plate **822** into unlocked position **908** unlocks second locking mechanism **514**.

When the force applied to opening **816** in plate **806** and the force applied to opening **832** in plate **822** to load compression spring **810,** compression spring **812**, compression spring **826**, and compression spring **828**, respectively, are removed, these compression springs lengthen such that plate **806** and plate **822**, respectively, are moved back into locked position **815** and locked position **831**, respectively, from **Figure 8**. In other words, when compression spring **810** and compression spring **826** are not loaded, first locking mechanism **512** and second locking mechanism **514** remain locked.

With reference now to **Figure 10**, an illustration of an adjusted latch body 510 is depicted in accordance with an illustrative embodiment. In **Figure 10**, adjustment mechanism **516** has been rotated in the direction of arrow **1000**. As depicted, this rotation causes latch body **510** along with first locking mechanism **512** and second locking mechanism **514** held within latch body **510** to move in the direction of arrow **1002**.

The elongated r shape of channel **706** and opening **830** in plate **822** allow a fastener, such as fastener **312** from **Figure 3**, to move independently of latch body **510** in a direction along axis **714** in **Figure 7** within the length of the opening **830**. In other words, movement of latch body **510** in the direction of arrow **1002** may or may not cause a fastener located within channel **706** to move, depending on the starting location of the fastener within channel **706**.

With reference now to **Figure 11**, an illustration of an adjusted latch body 510 is depicted in accordance with an illustrative embodiment. In **Figure 11**, adjustment

mechanism **516** has been rotated in the direction of arrow **1100** along axis **714** in **Figure 7**. As depicted, this rotation causes latch body **510** along with first locking mechanism **512** and second locking mechanism **514** held within latch body **510** to move in the direction of arrow **1102** along axis **714**.

Turning now to **Figure 12**, an isometric view of structural member **302** and fastener **314** from **Figure 3** is depicted in accordance with an illustrative embodiment. As illustrated, fastener **314** is attached to structural member **302**. Structural member **302** has opening **1200** and opening **1202**. Opening **1200** and opening **1202** may be configured to receive fastener **308** and fastener **310**, respectively, from **Figure 3** when structural member **302** is attached to second panel **204** in **Figures 2-3.**

Fastener **314** attached to structural member **302** has body **1204** and head **1206**. Portion **1208** of body **1204** is smaller in diameter than portion **1210** of body **1204**. This difference in diameter along body **1204** of fastener **314** may be used to lock fastener **314** in a fixed position within first locking mechanism **512** in **Figures 5-11** described above.

With reference now to **Figure 13**, an illustration of a cross-sectional view of latch **206** attached to structural member **302** is depicted in accordance with an illustrative embodiment. In **Figure 13**, a cross-sectional view of latch **206** attached to structural member **302** is depicted taken along lines **13-13** in **Figure 4**.

In this illustrative example, first locking mechanism **512** is locked, which in turn, locks fastener **314** in a fixed position with channel **704** through latch body **510**. In particular, when first locking mechanism **512** is locked, opening **814** in plate **806** is positioned relative to portion **1208** of body **1204** of fastener **314** in a manner that substantially prevents fastener **314** from moving through channel **704**.

With reference now to **Figure 14**, an illustration of a cross-sectional view of latch **206** attached to structural member **302** is depicted in accordance with an illustrative embodiment. In **Figure 14**, first locking mechanism **512** from **Figure 13** has been unlocked such that fastener **314** may freely move through channel **704**.

The illustrations of latch **206** in **Figures 2-11** and **Figures 12-14** and structural member **302** in **Figure 12** are not meant to imply physical or architectural limitations to the manner in which an illustrative embodiment may be implemented. Other components in addition to or in place of the ones illustrated may be used. Some components may be optional.

Additionally, some of the components in **Figures 2-14** may be illustrative examples of how components shown in block form in **Figure 1** can be implemented as physical structures. The different components shown in **Figures 2-14** may be combined with components in **Figure 1**, used with components in **Figure 1**, or as a combination of the two.

With reference now to **Figure 15**, an illustration of a process for attaching a latch to a panel in the form of a flowchart is depicted in accordance with an illustrative embodiment. The process illustrated in **Figure 15** may be implemented using latch **100** in **Figure 1** and/or latch **206** in **Figures 2-11** and **Figures 12-14**.

The process begins by applying a load to a spring mechanism in the latch to move a plate in the latch into an unlocked position such that a fastener is allowed to pass through an opening in the plate (operation **1500**). The spring mechanism and the plate form a locking mechanism that is housed within a latch body of the latch. The plate has an opening positioned relative to a corresponding channel that extends through the latch body.

Operation **1500** may be performed by, for example, without limitation, inserting the fastener through a channel in the latch body corresponding to the opening in the plate. The fastener may be associated with a panel. Applying a force to the fastener at the opening of the plate causes the load to be applied to the spring mechanism in the latch and the plate in the latch to move into the unlocked position.

Next, the load applied to the spring mechanism is removed after a selected portion of the fastener has passed through the opening in the plate such that the plate moves into a locked position (operation **1502**), with the process terminating thereafter. In operation **1502**, with no external loads are applied to the spring mechanism, the fastener is locked in place when the plate is in the locked position.

The flowcharts and block diagrams in the different depicted embodiments illustrate the architecture, functionality, and operation of some possible implementations of apparatus and methods in an illustrative embodiment. In this regard, each block in the flowcharts or block diagrams may represent a module, a segment, a function, and/or a portion of an operation or step.

In some alternative implementations of an illustrative embodiment, the function or functions noted in the blocks may occur out of the order noted in the figures. For example, in some cases, two blocks shown in succession may be executed

substantially concurrently, or the blocks may sometimes be performed in the reverse order, depending upon the functionality involved. Also, other blocks may be added in addition to the illustrated blocks in a flowchart or block diagram.

For example, in some illustrative examples, the panel described in **Figure 15** may be a first panel and the locking mechanism used to attach the latch to the first panel may be a first locking mechanism. The latch may also be attached to a second panel using a second locking mechanism housed in the latch body. In this manner, the first and second panels may be joined by the latch.

An adjustment mechanism in the latch may be used to adjust the width of the gap formed between the two panels. The adjustment mechanism may be used to move the latch body in a directional along an axis. The opening in the plate in the first locking mechanism and the corresponding channel may be elongate with respect to the axis along which the latch body is capable of moving.

Consequently, the fastener located within this corresponding channel may be able to move within the channel in a direction along the axis. This movement may be independent of the movement of the latch body. Depending on the location of the fastener within the corresponding channel, movement of the latch body by the adjustment mechanism may or may not move the fastener or the panel with which the fastener is associated when the latch body moves.

Illustrative embodiments of the disclosure may be described in the context of aircraft manufacturing and service method **1600** as shown in **Figure 16** and aircraft **1700** as shown in **Figure 17**. Turning first to **Figure 16**, an illustration of an aircraft manufacturing and service method in the form of a block diagram is depicted in accordance with an illustrative embodiment. During pre-production, aircraft manufacturing and service method **1600** may include specification and design **1602** of aircraft **1700** in **Figure 17** and material procurement **1604**.

During production, component and subassembly manufacturing **1606** and system integration **1608** of aircraft **1700** in **Figure 17** takes place. Thereafter, aircraft **1700** in **Figure 17** may go through certification and delivery **1610** in order to be placed in service **1612**. While in service **1612** by a customer, aircraft **1700** in **Figure 17** is scheduled for routine maintenance and service **1614**, which may include modification, reconfiguration, refurbishment, and other maintenance or service.

Each of the processes of aircraft manufacturing and service method **1600** may be performed or carried out by a system integrator, a third party, and/or an operator. In these examples, the operator may be a customer. For the purposes of this description, a system integrator may include, without limitation, any number of aircraft manufacturers and major-system subcontractors; a third party may include, without limitation, any number of vendors, subcontractors, and suppliers; and an operator may be an airline, a leasing company, a military entity, a service organization, and so on.

With reference now to **Figure 17**, an illustration of an aircraft in the form of a block diagram is depicted in which an illustrative embodiment may be implemented. In this example, aircraft **1700** is produced by aircraft manufacturing and service method **1600** in **Figure 16** and may include airframe **1702** with plurality of systems **1704** and interior **1706**. Examples of systems **1704** include one or more of propulsion system **1708**, electrical system **1710**, hydraulic system **1712**, and environmental system **1714**. Any number of other systems may be included. Although an aerospace example is shown, different illustrative embodiments may be applied to other industries, such as the automotive industry.

Apparatuses and methods embodied herein may be employed during at least one of the stages of aircraft manufacturing and service method **1600** in **Figure 16**. For example, latches implemented in a manner similar to latch **100** from **Figure 1** and/or latch **206** from **Figures 2-11** and **Figures 13-14** may be used to install the sidewall for interior of aircraft **1700**. These latches may be used during component and subassembly manufacturing **1606**, system integration **1608**, and/or maintenance and service **1614**. Further, the different components that make up these latches may be manufactured and/or assembled during at least one of material procurement **1604** and component and subassembly manufacturing **1606**.

In one illustrative example, components or subassemblies produced in component and subassembly manufacturing **1606** in **Figure 16** may be fabricated or manufactured in a manner similar to components or subassemblies produced while aircraft **1700** is in service **1612** in **Figure 16**. As yet another example, one or more apparatus embodiments, method embodiments, or a combination thereof may be utilized during production stages, such as component and subassembly manufacturing **1606** and system integration **1608** in **Figure 16**. One or more apparatus embodiments, method embodiments, or a combination thereof may be utilized while aircraft **1700** is in

service **1612** and/or during maintenance and service **1614** in **Figure 16**. The use of a number of the different illustrative embodiments may substantially expedite the assembly of and/or reduce the cost of aircraft **1700**.

The description of the different illustrative embodiments has been presented for purposes of illustration and description, and is not intended to be exhaustive or limited to the embodiments in the form disclosed. Many modifications and variations will be apparent to those of ordinary skill in the art. Further, different illustrative embodiments may provide different features as compared to other illustrative embodiments. The embodiment or embodiments selected are chosen and described in order to best explain the principles of the embodiments, the practical application, and to enable others of ordinary skill in the art to understand the disclosure for various embodiments with various modifications as are suited to the particular use contemplated.

CLAIMS:

What is claimed is:

1. An apparatus comprising:

a latch body (108, 510) having a plurality of channels (120, 122, 704,706) that extend through the latch body (108,510); and

a plurality of locking mechanisms (110,126,127,512,514) housed within the latch body (108,510), wherein a locking mechanism (126) in the plurality of locking mechanisms (110,126, 127,512,514) comprises:

a plate (128, 806,822) having an opening (132, 800, 802, 814, 830) positioned relative to a corresponding channel (122,704, 706) in the plurality of channels (120,122,704,706); and

a spring mechanism (130, 808, 812, 824, 828) configured to hold the plate (128,806, 822) in a locked position within the latch body (108,510).

2. The apparatus of claim 1, wherein the latch body (108,510) further comprises:

a retaining structure (116) configured to hold the plurality of locking mechanisms (110,126,127,512,514); and

a cover (118).

3. The apparatus of claim 2 further comprising:

a pivot feature (136, 818), wherein the plate (128, 806, 822) is configured to be rotated about the pivot feature (136, 818) and the pivot feature (136, 818) is associated with at least one of the plate (128, 806, 822) and the retaining structure (116) of the latch body (108,510).

4. The apparatus of claim 1, 2 or 3, wherein the spring mechanism (130, 134, 808, 812, 824, 828) comprises:

a plurality of springs (134, 808, 812, 824,828), wherein rotation of the plate (128,806, 822) about the pivot feature (136, 818) applies a load to at least one spring in the plurality of springs (134, 808, 812, 824, 828) .

5. The apparatus of claim 1, 2 or 3, wherein the plate (128, 806, 822) is configured to be rotated about the pivot feature (136, 818) into an unlocked position such that the opening in the plate (128, 806, 822) is aligned with the corresponding channel (122, 704, 706) through the latch body (108,510) within selected tolerances.

6. The apparatus of claim 4 or 5, wherein a fastener (121, 312, 314) is configured to freely move within the corresponding channel (122,704,706) through the latch body (108,510) when the plate (128,806,822) is in the unlocked position and the opening (132, 800, 802, 814, 830) in the plate (128,806,822) is aligned with the corresponding channel (122,704,706) within the selected tolerances.

7. The apparatus of claims 1 - 6, wherein a fastener (121,312,314) that has at least partially passed through the opening (132, 800, 802, 814, 830) in the plate (128,806,822) is locked in place when the plate (128,806,822) is in the locked position and the locking mechanism (110,126,127,512,514) is configured to receive a fastener (121,312,314) attached to a structural member (123,300,302) that is attached to a panel (102,202,204) for use in forming a sidewall (200) for an interior of an aircraft.

8. The apparatus of any of claims 1 to 7, wherein the locking mechanism (110,126,127,512,514) is a first mechanism (126) and further comprising an adjustment mechanism (140, 516) configured to move the latch body (108,510) and the plurality of locking mechanisms (110, 126,127,512,514) housed within the latch body (108,510) in a direction along an axis independently of the housing (106).

9. The apparatus of any of the preceding claims 1 to 8, wherein the opening (132, 800, 802, 814, 830) in the plate (128,806,822) and the corresponding channel (122,704,706) are elongated with respect to the axis.

10. The apparatus of claims 1 to 9 further comprising a housing (106) configured to house the latch body (108,510).

11. A method for attaching a latch (100) to a number of panels, the method comprising:

applying a load to a spring mechanism (130, 808, 812, 824, 828) in the latch (100) to move a plate (128, 806, 822) in the latch (100) into an unlocked position such that a fastener (121, 312, 314) is allowed to pass through an opening (132, 800, 802, 814, 830) in the plate (128,806,822), wherein the spring mechanism (130,808,812,824,828) and the plate (128,806,822) form a locking mechanism (110, 126,127,512,514) that is housed within a latch body (108,510); and

removing the load applied to the spring mechanism (130,808,812,824,828) after a selected portion of the fastener (121,312,314) has passed through the opening (132, 800, 802, 814, 830) in the plate (128,806,822) such that the plate (128,806,822) moves into a locked position.

12. The method of claim 11, wherein the step of applying the load to the spring mechanism (130,808,812,824,828) comprises:

inserting the fastener (121,312,314) through a channel (122, 704, 706) in the latch body (108) corresponding to the opening (132, 800, 802, 814, 830) in the plate (128,806,822), wherein the fastener (121,312,314) is associated with a panel (102); and

applying a force to the fastener (121,312,314) at the opening (132, 800, 802, 814, 830) of the plate (128,802,822) that causes the load to be applied to the spring mechanism (130,808,812,824,828) in the latch (100) and move the plate (128,802,822) in the latch (100) into the unlocked position.

13. The method of claims 11 or 12, wherein the step of removing the load applied to the spring mechanism (130) comprises:

removing the load applied to the spring mechanism (130,808,812,824,828) after the selected portion of the fastener (121,312,314) has passed through the opening (132, 800, 802, 814, 830) in the plate (128,802,822) such that the plate (128,802,822) moves into the locked position and locks the fastener (121,312,314) in place with respect to an axis (714) of the latch body (510), wherein locking the fastener (121,312,314) in place attaches the latch (100) to the panel with which the fastener (121,312,314) is associated.

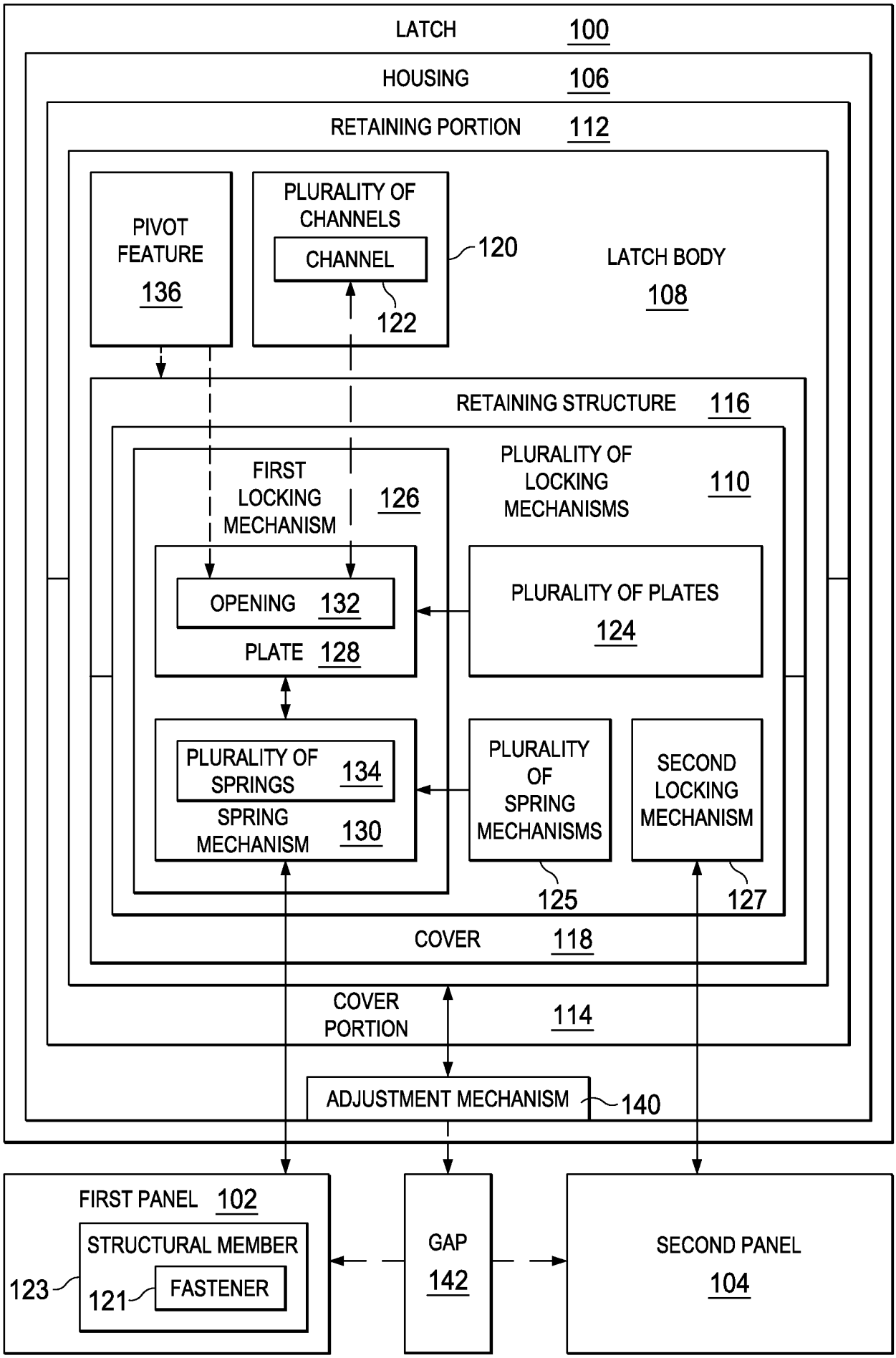
14. The method of claims 11 to 13 further comprising:

moving the latch body (108,510) in a direction along an axis (714) using an adjustment mechanism (140,516) in the latch (100).

15. The method of any of claims 11 to 14, wherein the step of moving the latch body (108) comprises:

moving the latch body (108,510) in the direction along the axis (714) using the adjustment mechanism (140,516) in the latch (100) , wherein the opening (132, 800, 802, 814, 830) in the plate (128,128,802,822) and a corresponding channel (122,704,706) through the latch body (108,510) are elongated with respect to the axis to allow the fastener (121,312,314) to move freely within the corresponding channel (122,704,706) independently of movement of the latch body (108,510).

FIG. 1


LATCH 100
HOUSING 106
RETAINING PORTION 112
PIVOT FEATURE 136
PLURALITY OF CHANNELS
CHANNEL
120
122
LATCH BODY 108
RETAINING STRUCTURE 116
FIRST LOCKING MECHANISM 126
PLURALITY OF LOCKING MECHANISMS 110
OPENING 132
PLATE 128
PLURALITY OF PLATES 124
PLURALITY OF SPRINGS 134
SPRING MECHANISM 130
PLURALITY OF SPRING MECHANISMS
125
SECOND LOCKING MECHANISM
127
COVER 118
COVER PORTION 114
ADJUSTMENT MECHANISM
140
FIRST PANEL 102
STRUCTURAL MEMBER
123
121
FASTENER
GAP 142
SECOND PANEL 104

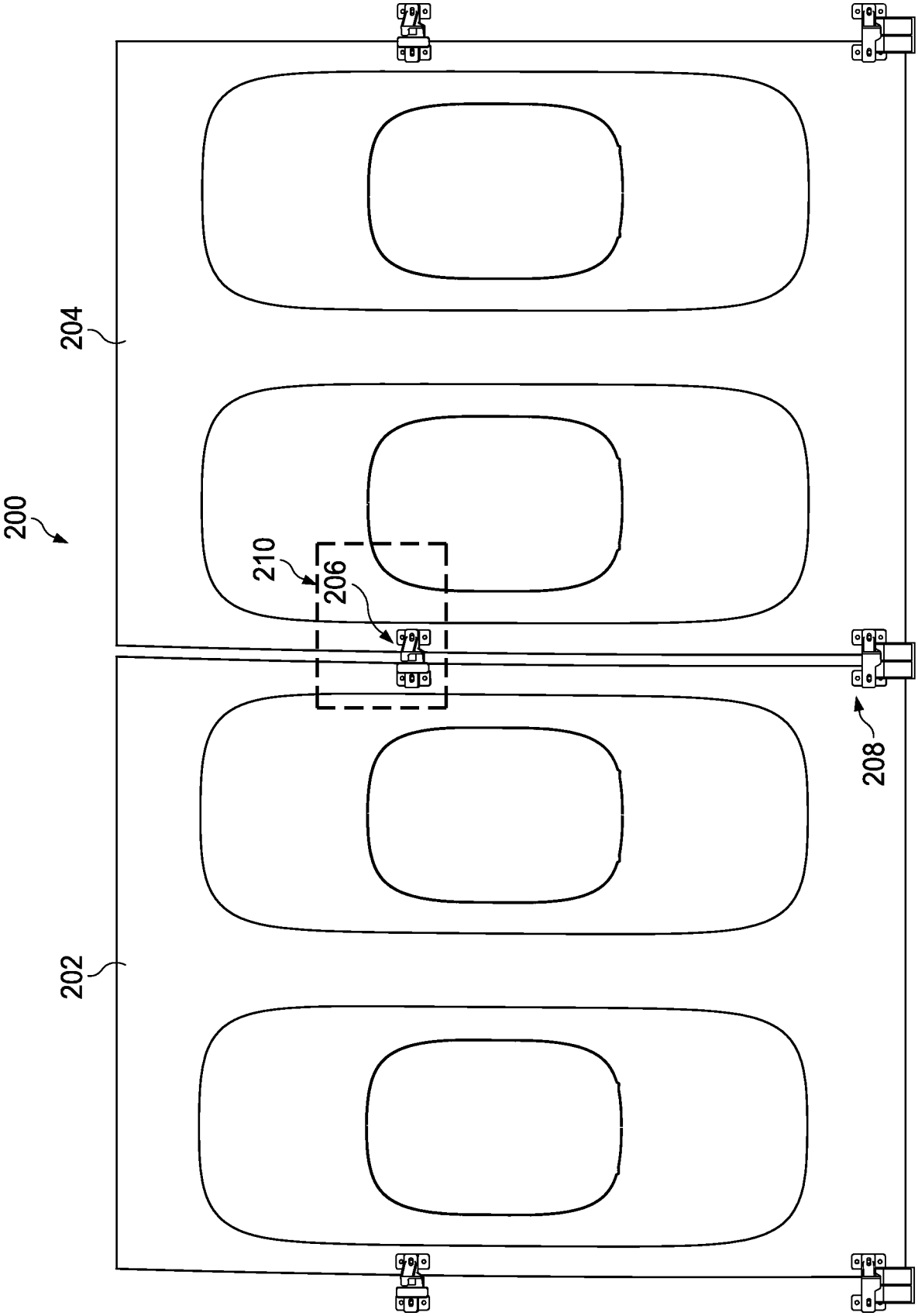


FIG. 2

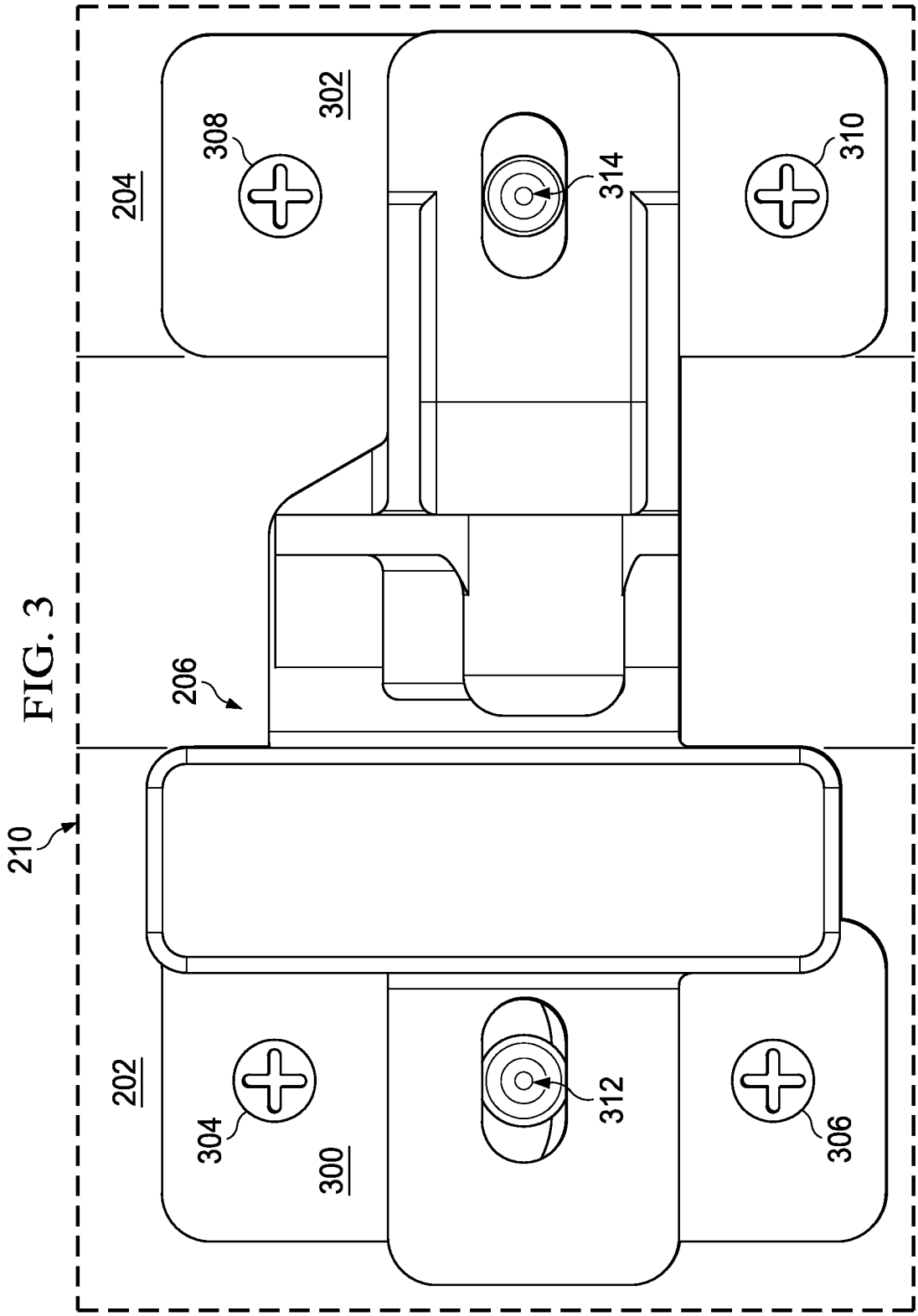
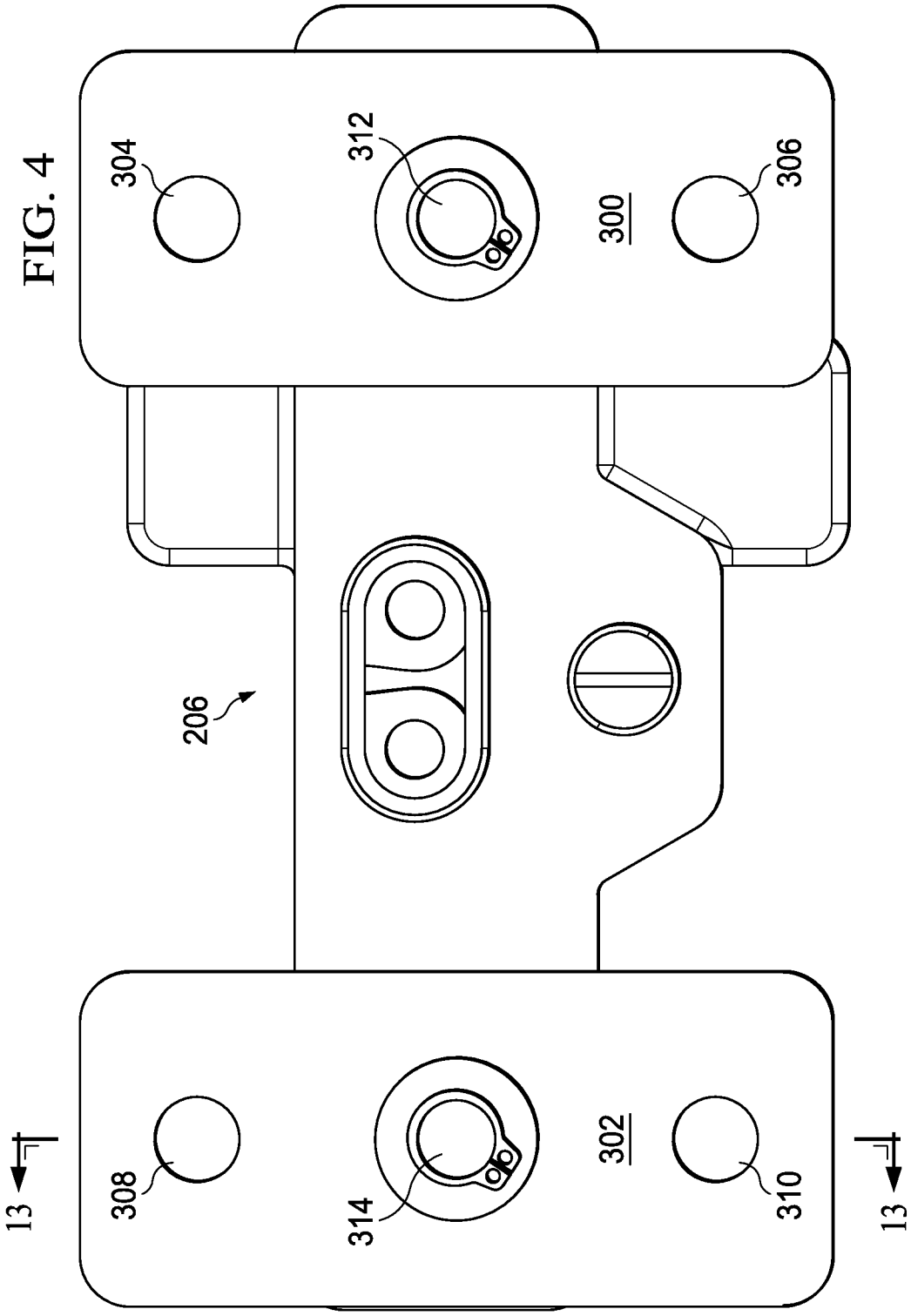


FIG. 3

FIG. 4



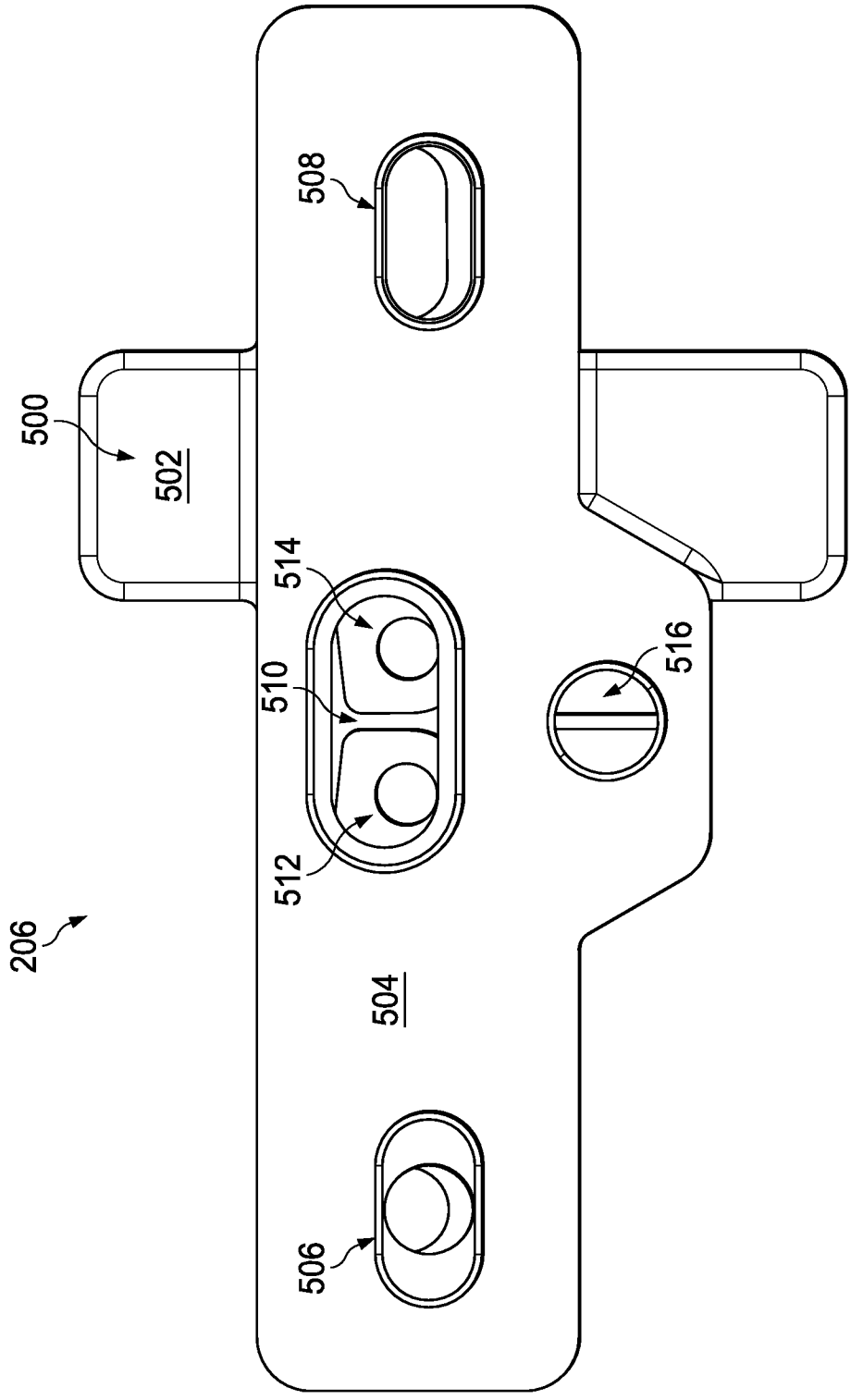


FIG. 5

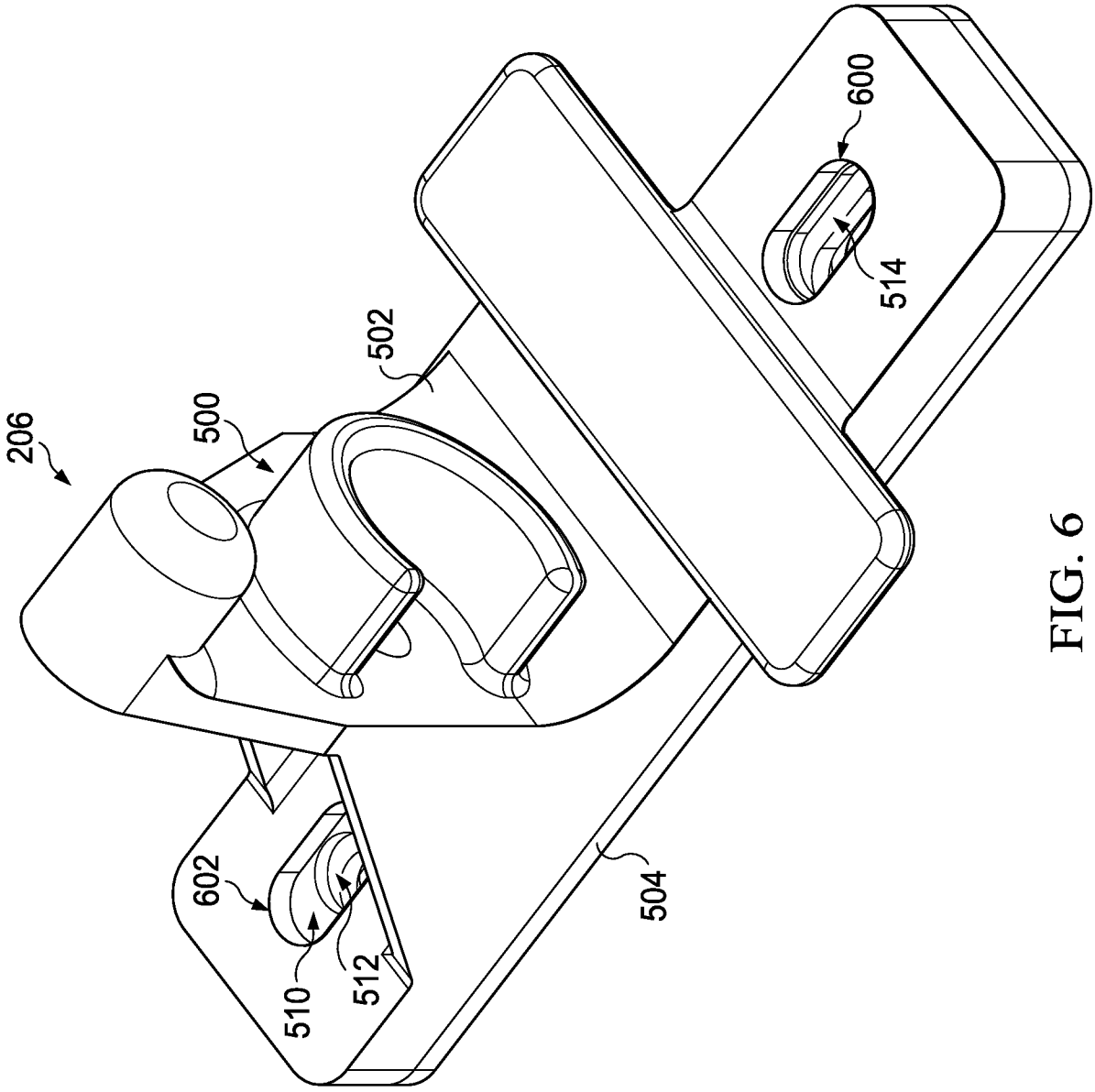


FIG. 6

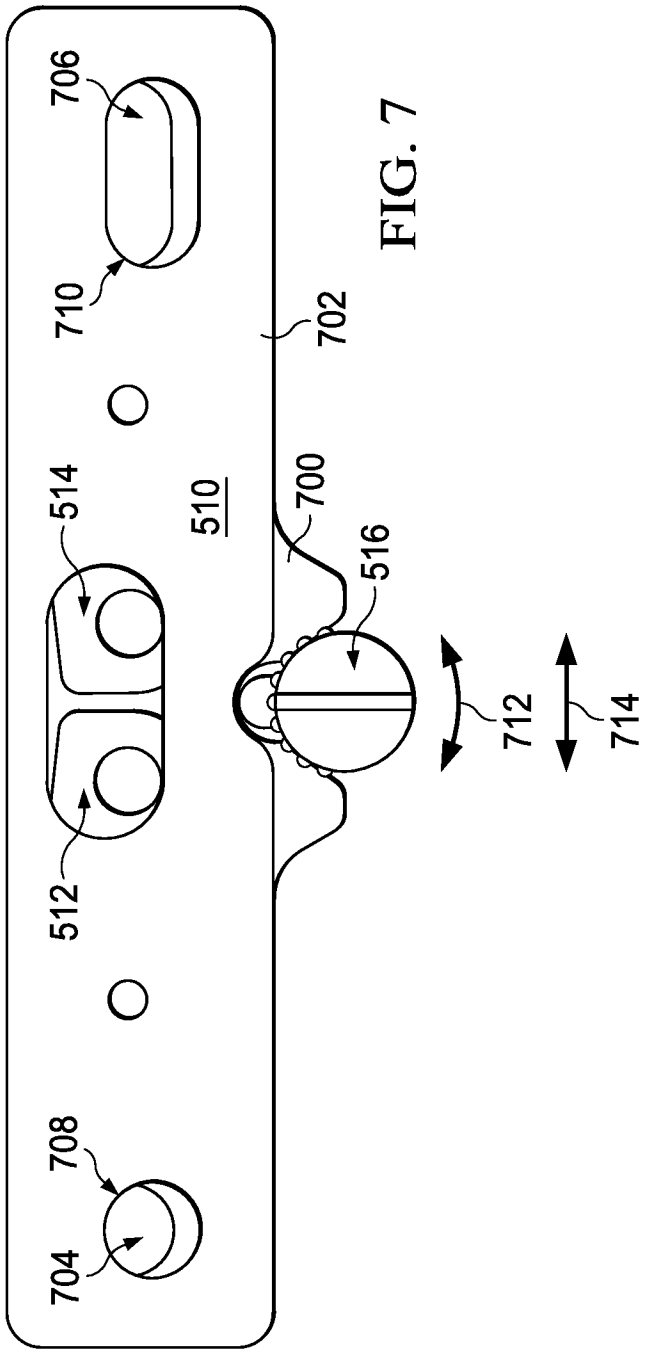


FIG. 7

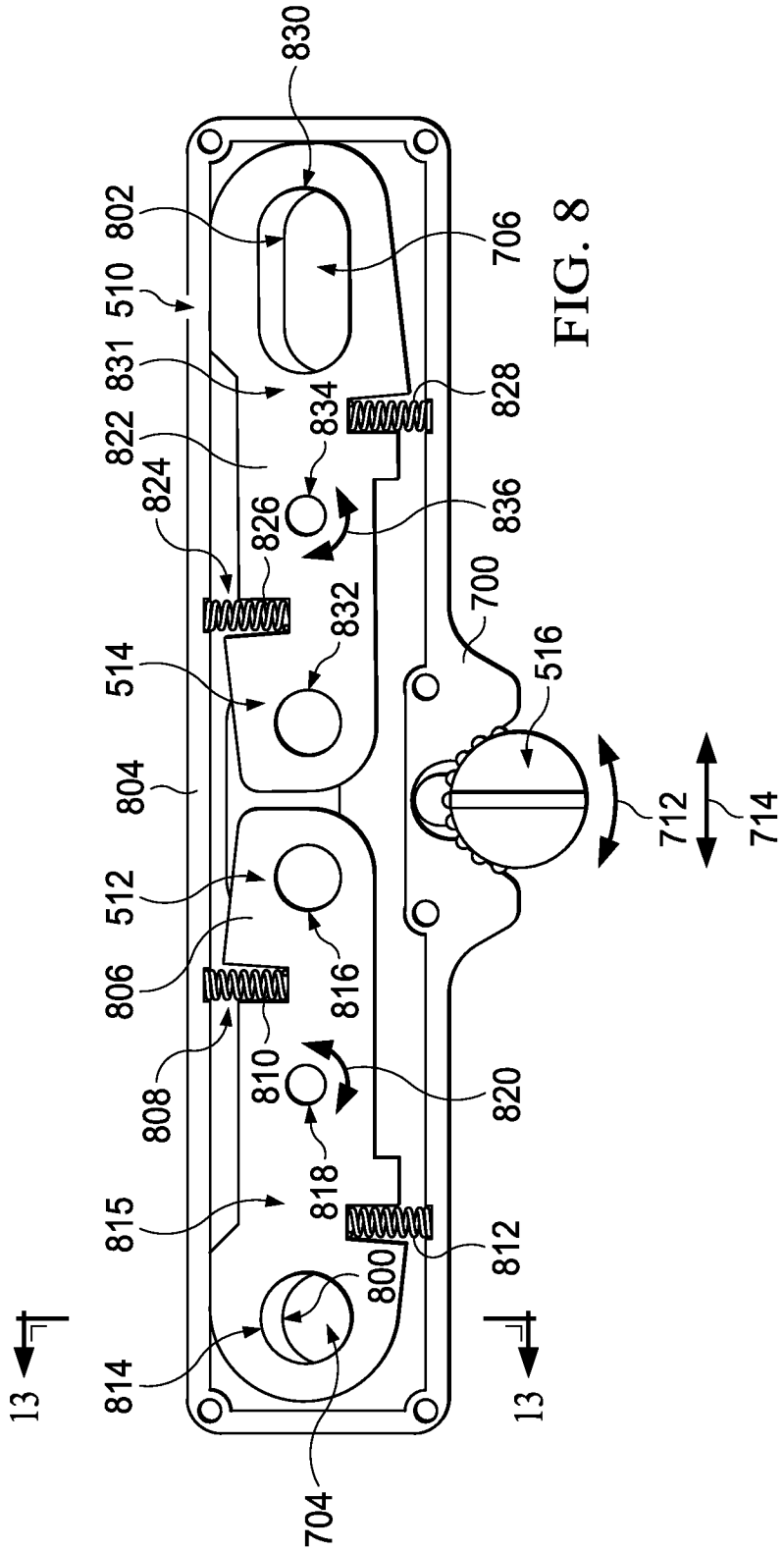
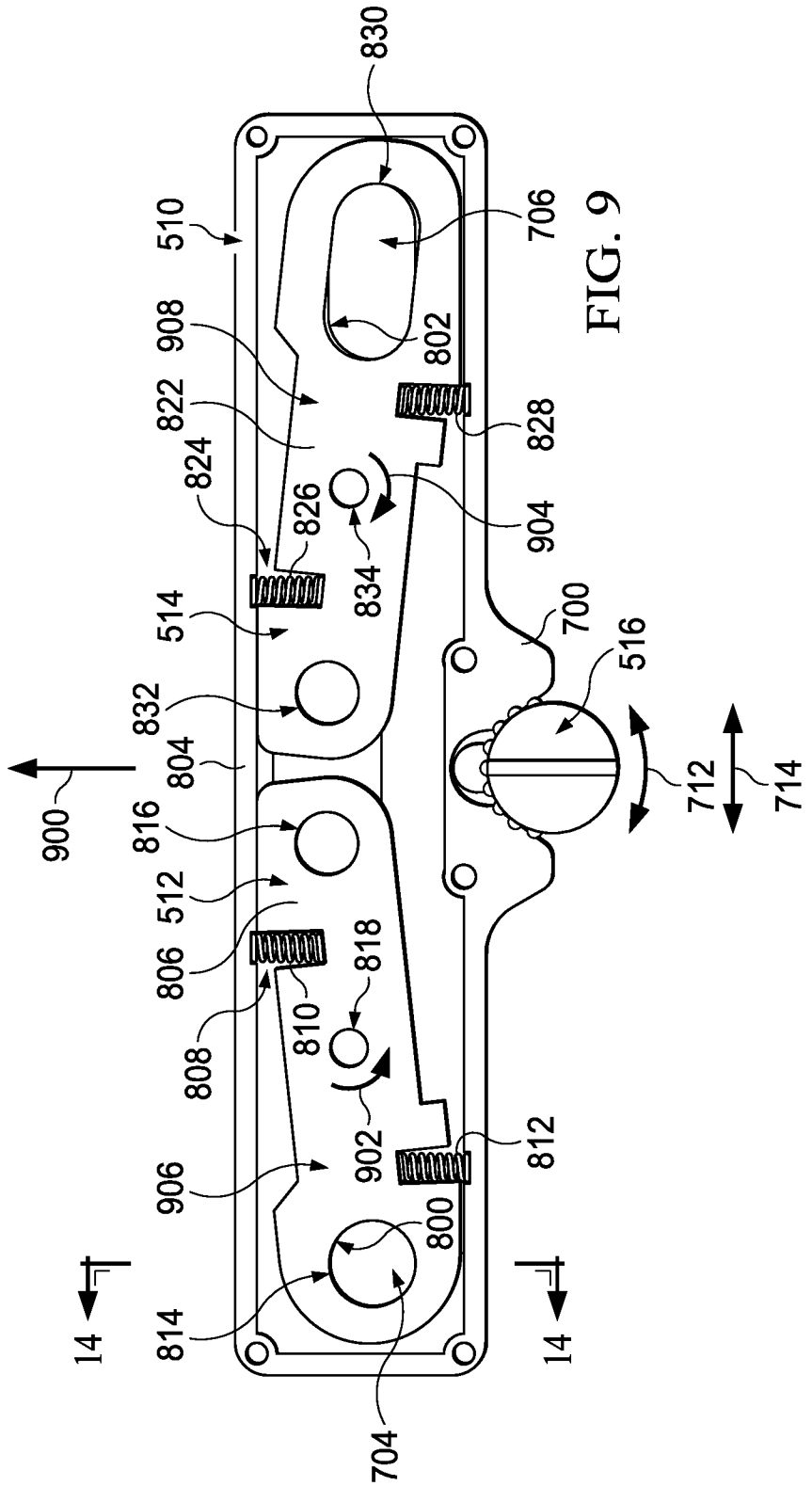

830
802
706
510
831
828
834
822
824
826
836
832
700
514
516
804
712
714
512
806
816
808
810
820
818
815
812
800
814
704
13
13

FIG. 8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512
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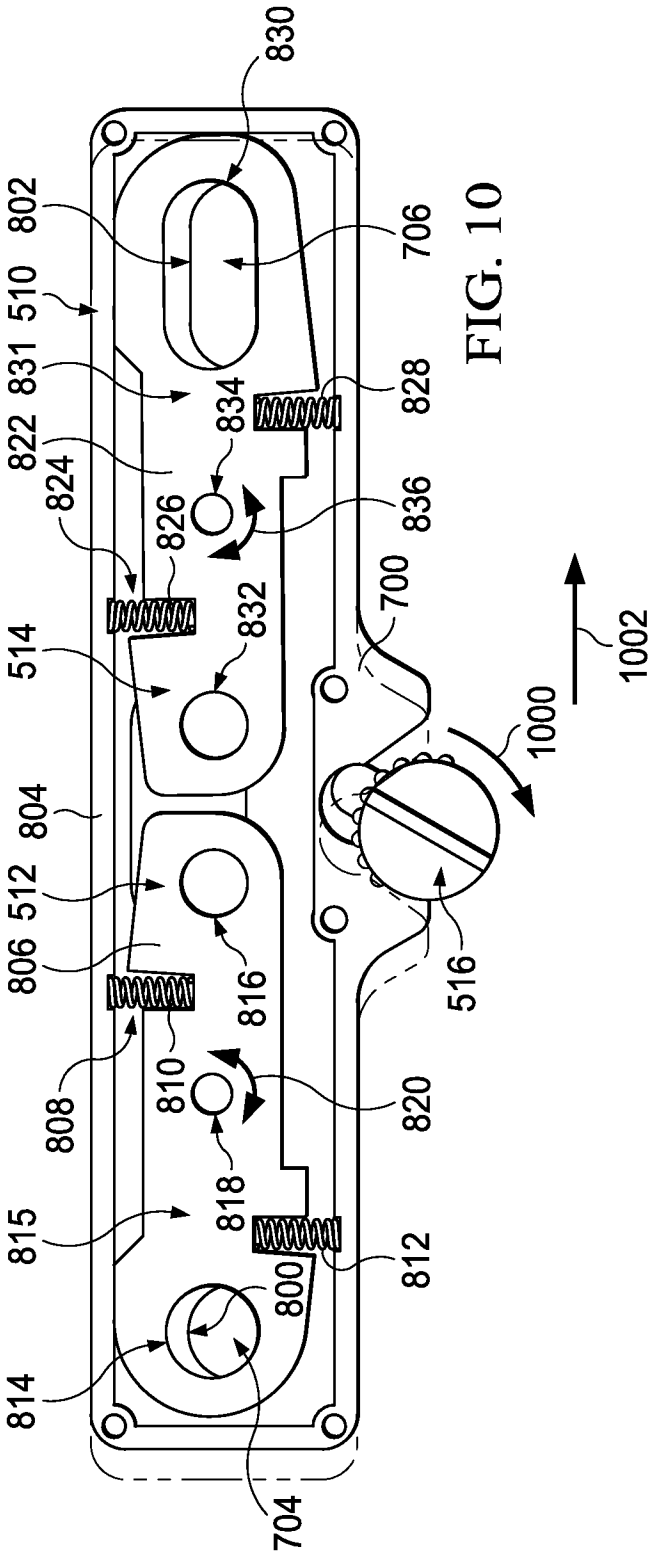
902
812
906
800
814
14
14
704

FIG. 9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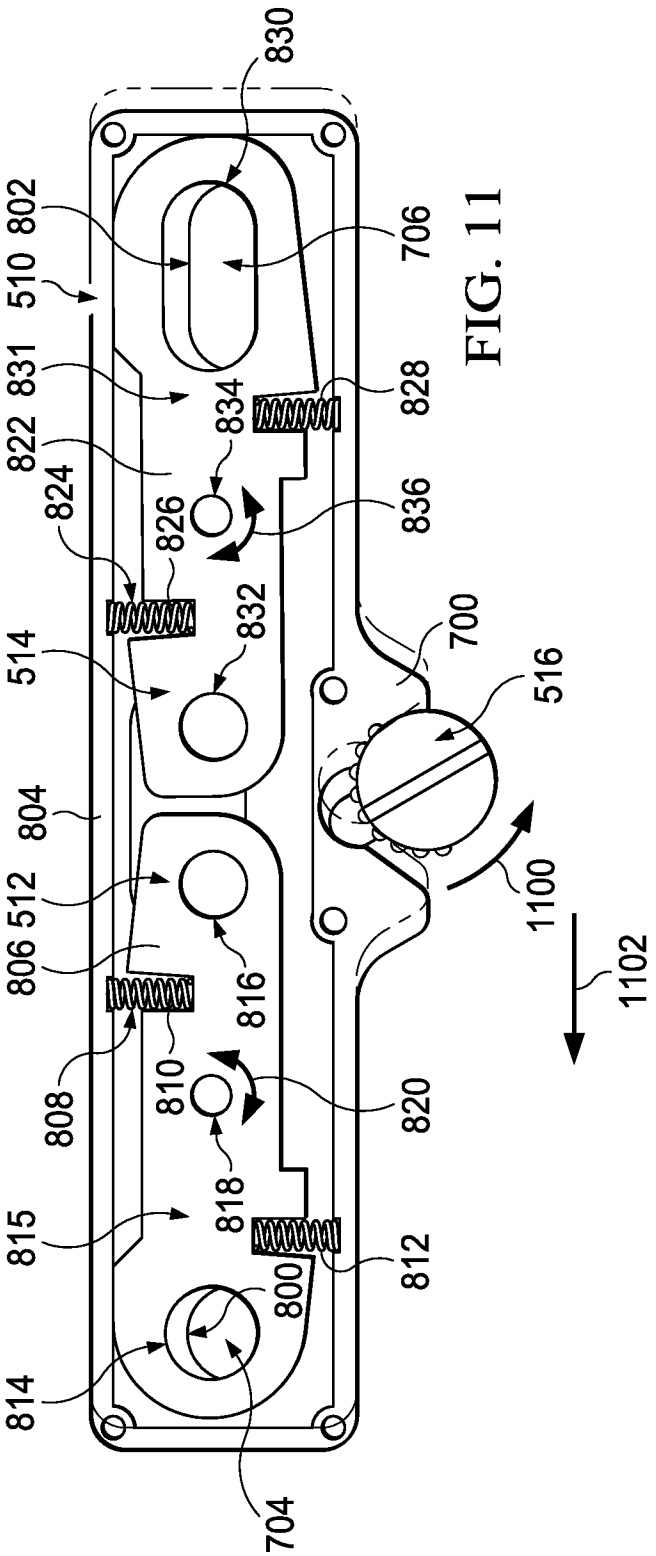
704

FIG. 10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812
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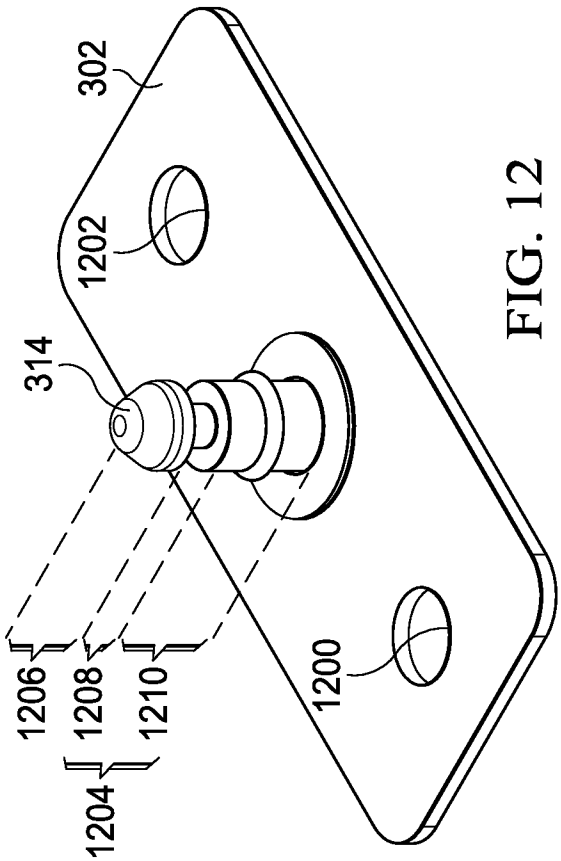
814
704

FIG. 11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1206
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1204
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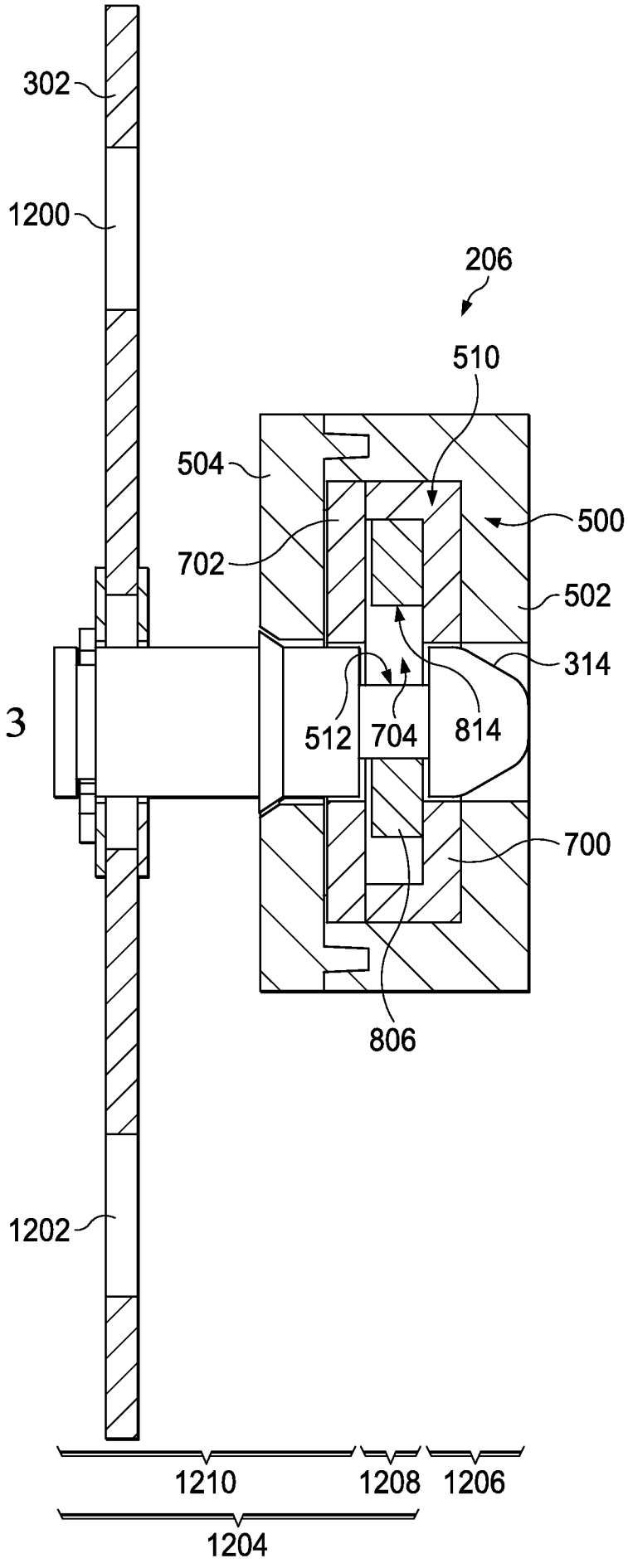
FIG. 12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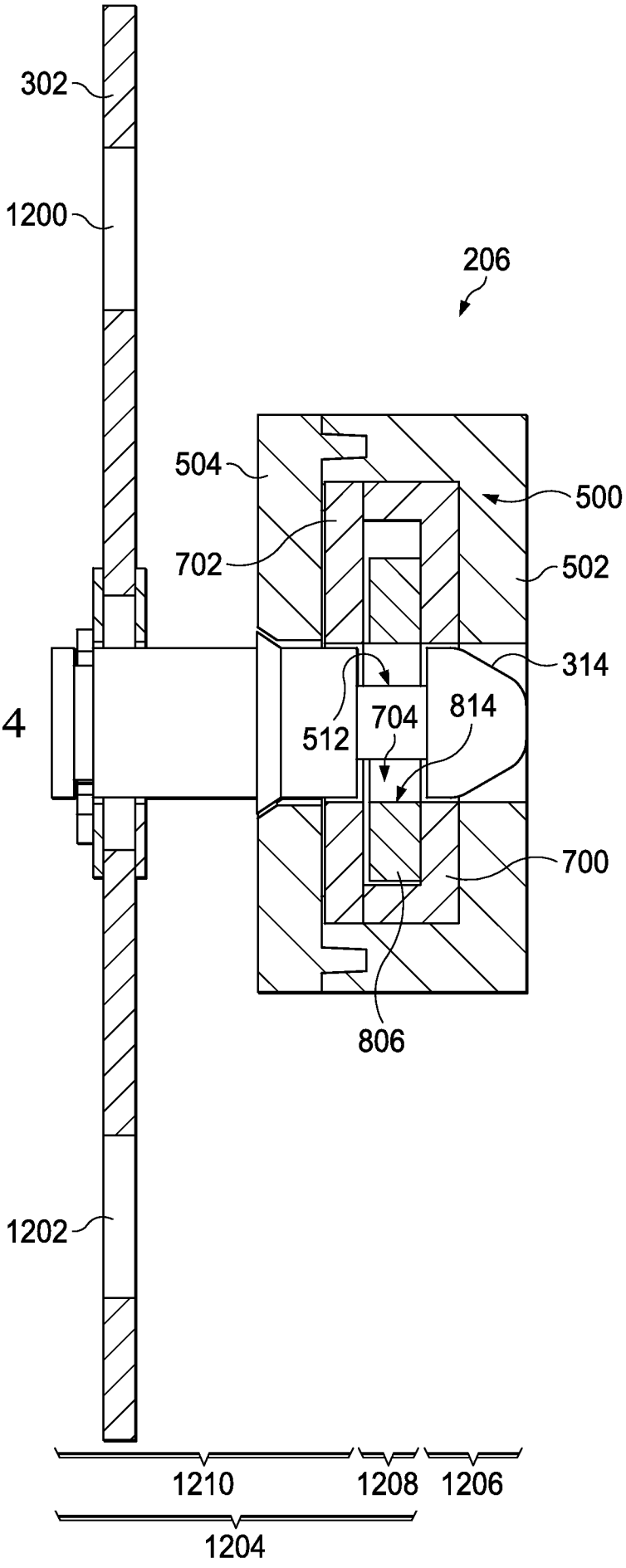
1204

FIG. 13

FIG. 14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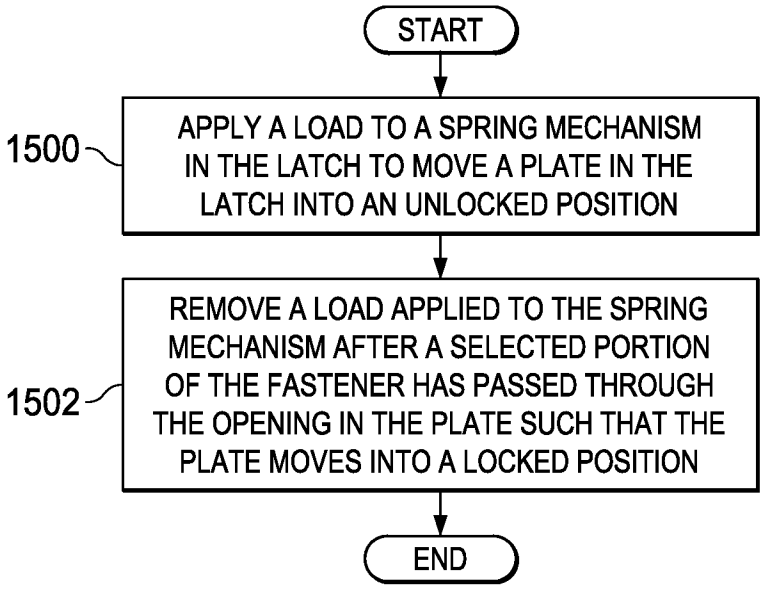

START
1500
APPLY A LOAD TO A SPRING MECHANISM IN THE LATCH TO MOVE A PLATE IN THE LATCH INTO AN UNLOCKED POSITION
1502
REMOVE A LOAD APPLIED TO THE SPRING MECHANISM AFTER A SELECTED PORTION OF THE FASTENER HAS PASSED THROUGH THE OPENING IN THE PLATE SUCH THAT THE PLATE MOVES INTO A LOCKED POSITION
END

FIG. 15

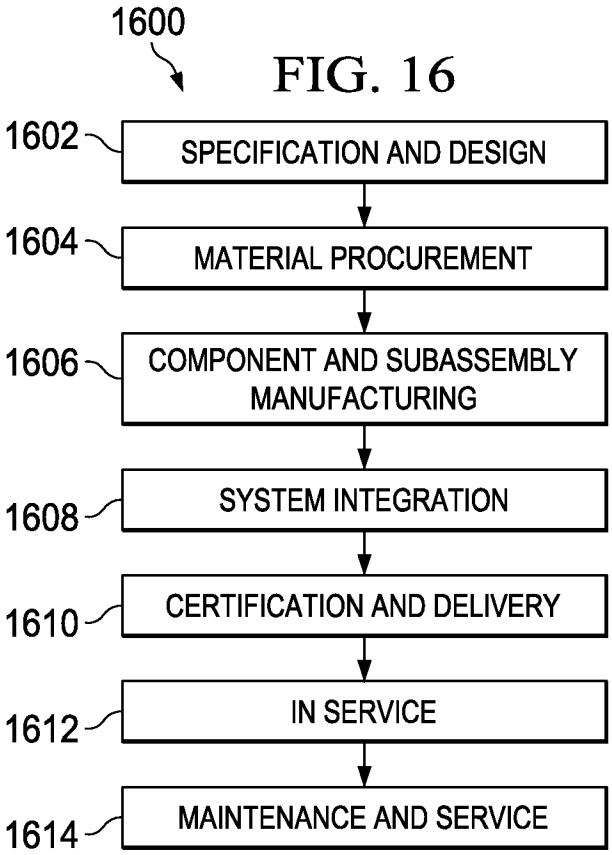
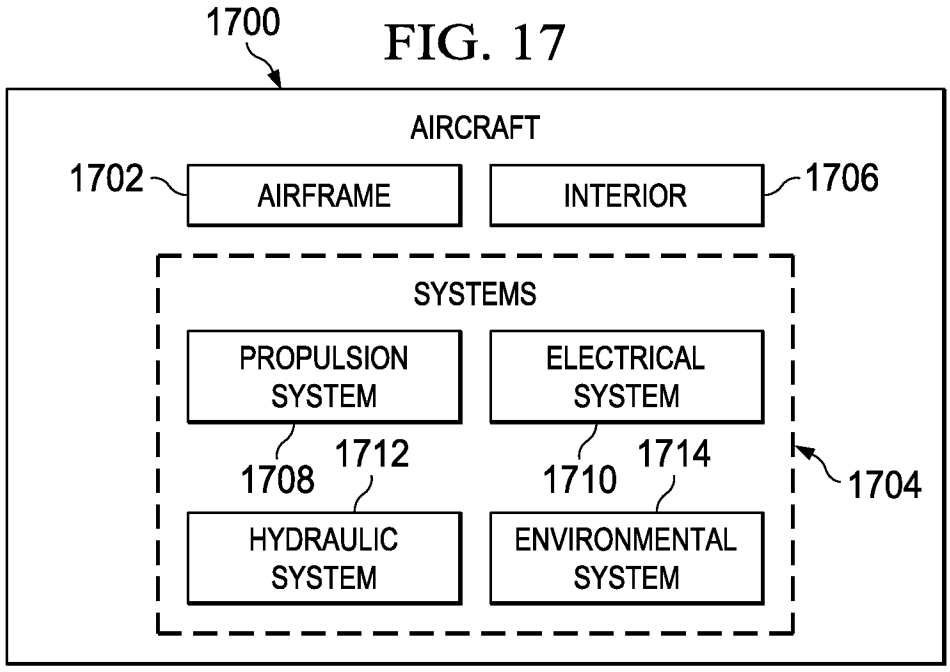

1600
1602
SPECIFICATION AND DESIGN
1604
MATERIAL PROCUREMENT
1606
COMPONENT AND SUBASSEMBLY MANUFACTURING
1608
SYSTEM INTEGRATION
1610
CERTIFICATION AND DELIVERY
1612
IN SERVICE
1614
MAINTENANCE AND SERVICE

FIG. 16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AIRCRAFT
1702
AIRFRAME
INTERIOR
1706
SYSTEMS
PROPULSION SYSTEM
ELECTRICAL SYSTEM
1708
1712
1710
1714
1704
HYDRAULIC SYSTEM
ENVIRONMENTAL SYSTEM

FIG. 17

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2013/057160

A. CLASSIFICATION OF SUBJECT MATTER
INV. F16B5/00 B64D11/00 F16B12/26
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F16B B64D E05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	US 3 638 285 A (GIRALDEZ JOSE HUMBERTO SANCHEZ) 1 February 1972 (1972-02-01) column 3, lines 42-62 column 4, line 67 - column 5, line 18 figures 1,2,10,11	1-3,7, 9-13 4-6 8,14,15
X	DE 89 614 C (JOHANN LÖWISCH) 5 May 1896 (1896-05-05) figures 1-3	1,7,9, 11-13
Y	US 2 286 739 A (KRAUSE WALTER H) 16 June 1942 (1942-06-16) page 1 - page 2; figures 1-4	4-6
A	DE 20 2009 014811 U1 (BLUM GMBH JULIUS [AT]) 18 February 2010 (2010-02-18) abstract; figures 1-3	1,11

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28 January 2014	04/02/2014

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Fritzen, Claas

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2013/057160

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US 2286739 A	16-06-1942	NONE	
DE 202009014811 U1	18-02-2010	AT 507577 A1	15-06-2010
		CN 201539473 U	04-08-2010
		DE 202009014811 U1	18-02-2010