



- (51) International Patent Classification:
H02G 3/32 (2006.01)
- (21) International Application Number:
PCT/US2013/045036
- (22) International Filing Date:
10 June 2013 (10.06.2013)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
13/546,630 11 July 2012 (11.07.2012) US
- (71) Applicant: **THE BOEING COMPANY** [US/US]; 100 North Riverside Plaza, Chicago, Illinois 60606-2016 (US).
- (72) Inventors: **LUTHI, Benjamin**; P.O. Box 3707, Seattle, Washington 98123 (US). **GERHART, Wayne Frederick**; P.O. Box 3707, Seattle, Washington 98123 (US).
- (74) Agents: **WOO, Euclid** et al.; The Boeing Company, PO Box 2515, MC 110-SD54, Seal Beach, California 90740-1515 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: LINE MOUNTING SYSTEM

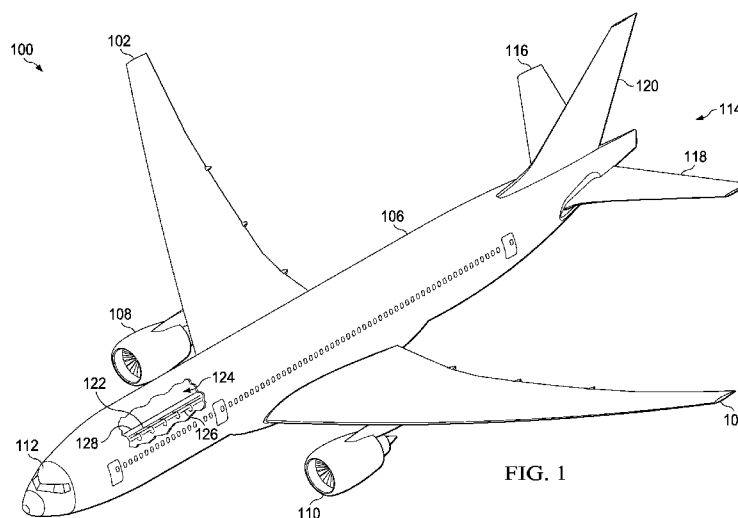


FIG. 1

(57) Abstract: A method and apparatus for mounting lines in an aircraft. A line mounting system for the aircraft comprises support structures and spacers. The support structures are configured to slide into positions relative to attachment structures in the aircraft and connect to the attachment structures in the positions. The spacers are associated with the support structures. A number of lines is configured to be connected to the spacers. The number of lines is held in a desired configuration in the aircraft when the support structures are secured to the attachment structures.

LINE MOUNTING SYSTEM

BACKGROUND INFORMATION

1. Field:

5 The present disclosure relates generally to line systems for platforms and, in particular, to line mounting systems for platforms. Still more particularly, the present disclosure relates to a method and apparatus for mounting wire bundles in an aircraft.

2. Background:

10 An aircraft has many wires that extend through different parts of the fuselage, wing, and other sections of the aircraft. These wires may be used to distribute power, exchange data, or a combination of the two.

 These wires may extend through the entire length of the aircraft or through a portion of an aircraft structure. When installed in an aircraft, these wires may be in
15 the form of bundles that provide power or data to the aircraft. When many wire bundles are present, these wire bundles are bound together by fasteners. These fasteners may be, for example, straps, cable ties, cable lacing, sleeves, or a combination thereof to form a wiring assembly.

 This wiring assembly is connected to the aircraft structure using a bracket,
20 clamp, or some other type of fastener system. For example, a sponge clamp may be used to support a bundle of wires in the aircraft. The sponge clamp is a rigid structure that may have a U-shape with a sponge material. The sponge material in the sponge clamp may press the wires in the wire bundle together when the clamp is connected to a structure in the aircraft.

25 Connecting these wire bundles to a sponge clamp may take more time and effort than desired. For example, operators may use tools to secure these wire bundles to the sponge clamp. Further, different numbers of wire bundles may be connected to an aircraft structure at different times during the installation of wiring in the aircraft. For example, operators may manually connect a first number of wire
30 bundles to the sponge clamps along the entire length of the fuselage before connecting a second number of wire bundles at the same locations as the first number of wire bundles.

In this instance, more work is performed to add the second number of wire bundles. When additional wires are to be added to the bundle, or if additional wire bundles are to be added, the clamp is removed and the new wires are placed in. As part of this process, a operator may replace or modify the cable ties around a wire bundle, or the operator may secure new cable ties around the wire bundles in the wiring assembly. These operations may be more time-consuming, expensive, and/or tedious than desired.

Thus, current techniques for mounting lines, such as wire bundles, in an aircraft may increase the time needed to complete manufacturing of an aircraft more 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, a line mounting system for an aircraft comprises support structures and spacers. The support structures are configured to slide into positions relative to attachment structures in the aircraft and connect to the attachment structures in the positions. The spacers are associated with the support structures. A number of lines is configured to be connected to the spacers. The number of lines is held in a desired configuration in the aircraft when the support structures are secured to the attachment structures.

In another illustrative embodiment, a method for mounting lines in an aircraft is present. Attachment structures are associated with an interior of a fuselage of the aircraft. Support structures are moved to positions relative to the attachment structures. The support structures are connected to the attachment structures when the support structures are in the positions relative to the attachment structures such that a number of lines has a desired configuration in the fuselage of the aircraft when connected to spacers.

In yet another illustrative embodiment, a method for mounting lines in a platform is provided. Support structures are positioned relative to attachment structures associated with the platform. Spacers are associated with the support structures and the spacers are configured to be connected to a number of lines. The

support structures are connected to the attachment structures such that the number of lines has a desired configuration when connected to the spacers.

According to an aspect of the present disclosure there is provided a line mounting system for an aircraft, the line mounting system comprising a support
5 structures configured to slide into positions relative to attachment structures in the aircraft and connect to the attachment structures in the positions and spacers associated with the support structures, wherein a number of lines is configured to be connected to the spacers, wherein the number of lines is held in a desired configuration in the aircraft when the support structures are secured to the
10 attachment structures. Advantageously a support structure in the support structures comprises an elongate structure having a channel configured to receive a portion of an attachment structure in the attachment structures when the support structure is in a position in the positions. Advantageously the number of lines is connected to the spacers prior to the support structures being slid into the positions relative to the
15 attachment structures in the aircraft. Preferably the number of lines is a first number of lines and further comprising a second number of lines configured to be connected to the spacers after the support structures are secured to the attachment structures in the aircraft. Advantageously the system further comprises fasteners configured to secure the support structures to the attachment structures in the positions relative to
20 the attachment structures in the aircraft. Preferably the fasteners are configured to secure the support structures to the attachment structures in the positions relative to the attachment structures without a tool. Preferably the fasteners comprise scriveners.

According to an aspect of the present disclosure there is provided a method for mounting lines in an aircraft, the method comprising associating attachment
25 structures with an interior of a fuselage of the aircraft, moving support structures to positions relative to the attachment structures, and connecting the support structures to the attachment structures when the support structures are in the positions relative to the attachment structures such that a number of lines has a desired configuration in the fuselage of the aircraft when connected to spacers. Advantageously the
30 number of lines is a first number of lines and further comprising connecting a second number of lines to the spacers with the support structures after connecting the support structures to the attachment structures. Advantageously the method further comprises connecting the number of lines to the spacers prior to connecting the

support structures to the attachment structures. Advantageously the method further comprises connecting the number of lines to the spacers after connecting the support structures relative to the attachment structures. Advantageously, connecting the support structures to the attachment structures such that the number of lines has the desired configuration when connected to the spacers comprises connecting the support structures to the attachment structures such that the number of lines has the desired configuration when connected to the spacers without using a tool. Advantageously a support structure in the support structures is connected to an attachment structure in the attachment structures with a fastener. Advantageously a spacer in the spacers has a number of locations in which a location in the number of locations is configured to receive a portion of the number of lines and hold the portion of the number of lines when a fastener connects the portion of the number of lines to the spacer in the location. Advantageously the desired configuration is a desired minimum distance between the lines in the number of lines. Advantageously a support structure in the support structures comprises an elongate structure having a channel configured to receive a portion of an attachment structure in the attachment structures when the support structure is moved to a position in the positions for the support structures relative to the attachment structure.

According to an aspect of the present disclosure there is provided a method for mounting lines in a platform, the method comprising positioning support structures relative to attachment structures associated with the platform, wherein spacers are associated with the support structures and the spacers are configured to be connected to a number of lines, and connecting the support structures to the attachment structures such that the number of lines has a desired configuration when connected to the spacers. Advantageously the method further comprises connecting a second number of lines to the spacers with the support structures after connecting the support structures to the attachment structures. Advantageously the method further comprises connecting the number of lines to the spacers prior to positioning the support structures relative to the attachment structures. Advantageously the method further comprises connecting the number of lines to the spacers after positioning the support structures relative to the attachment structures. Preferably the method further comprises rolling the number of lines connected to the

spacers onto a reel prior to positioning the support structures relative to the attachment structures.

The features and functions can be achieved independently in various embodiments of the present disclosure or may be combined in yet other
5 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
10 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 an aircraft in accordance with an illustrative
15 embodiment;

Figure 2 is an illustration of a block diagram of a platform in accordance with an illustrative embodiment;

Figure 3 is an illustration of a block diagram of a support structure with a number of spacers and an attachment structure in accordance with an illustrative
20 embodiment;

Figure 4 is an illustration of components in a line mounting system in accordance with an illustrative embodiment;

Figure 5 is an illustration of an exploded view of a support structure with spacers and an attachment structure in accordance with an illustrative embodiment;

Figure 6 is an illustration of a partially assembled view of a support structure with spacers and an attachment structure in accordance with an illustrative
25 embodiment;

Figure 7 is another illustration of a partially assembled view of a support structure with spacers and an attachment structure in accordance with an illustrative
30 embodiment;

Figures 8-12 are illustrations of an installation of a line mounting system for wire bundles in accordance with an illustrative embodiment;

Figure 13 is an illustration of a wire bundle connected to a support structure in accordance with an illustrative embodiment;

Figure 14 is an illustration of wire bundles connected to spacers in a support structure in accordance with an illustrative embodiment;

5 **Figure 15** is an illustration of an assembly of wire bundles with a line mounting system in accordance with an illustrative embodiment;

Figure 16 is an illustration of the installation of a line mounting system in accordance with an illustrative embodiment;

10 **Figure 17** is an illustration of a portion of a line mounting system installed in a platform in accordance with an illustrative embodiment;

Figure 18 is an illustration of a portion of a line mounting system installed in a platform in accordance with an illustrative embodiment;

Figure 19 is an illustration of a perspective view of a spacer in accordance with an illustrative embodiment;

15 **Figure 20** is another illustration of a perspective view of a spacer in accordance with an illustrative embodiment;

Figure 21 is an illustration of a side view of a spacer in accordance with an illustrative embodiment;

20 **Figure 22** is an illustration of a flowchart of a process for securing lines to a platform in accordance with an illustrative embodiment;

Figure 23 is a more detailed illustration of a flowchart of a process for securing lines to a platform in accordance with an illustrative embodiment;

Figure 24 is an illustration of an aircraft manufacturing and service method in accordance with an illustrative embodiment; and

25 **Figure 25** is an illustration of an aircraft in which an illustrative embodiment may be implemented.

DETAILED DESCRIPTION

30 The illustrative embodiments recognize and take into account that a first set of wire bundles may be mounted along the entire surface of the aircraft before a second set of wire bundles is installed at the same locations as the first set of wire bundles. With the current process, modifications must be made to accommodate the second

set of wire bundles. These modifications may take more time and effort than desired to perform.

The illustrative embodiments also recognize and take into account that the installation of wire bundles may include having to see whether the support structures to be installed line up with channels in the body of the aircraft. For example, during installation, an operator may have to visually confirm that the support structure being installed is aligned with a channel to connect the support structure to the aircraft. This may be time-consuming and tedious.

The illustrative embodiments also recognize and take into account that a minimum desired distance may be maintained between wire bundles. For example, a minimum distance between a first set of wire bundles and a second set of wire bundles may need to be present for the wiring assembly to function as desired. The minimum distance may, for example, reduce interference between wires.

The illustrative embodiments also recognize and take into account that the process for installation of these wire bundles in an aircraft may require the use of tools. The use of tools may be more expensive than desired. Further, operators may have to wait for tools and/or find particular tools to complete the mounting process. Additionally, during maintenance and rework, tools may be needed to modify wire bundles and other components in the wiring assembly. The need for tools during maintenance and rework may increase the time an aircraft is out of service.

Thus, the illustrative embodiments provide a method and apparatus for mounting lines in an aircraft. A line mounting system comprises support structures and spacers. The support structures are configured to slide into positions relative to attachment structures in the aircraft and connect to the attachment structures in the positions. The spacers are associated with the support structures and a number of lines is configured to be connected to the spacers. The number of lines is held in a desired configuration in the aircraft when the support structures are secured to the attachment structures.

With reference now to the figures, and in particular, with reference to **Figure 1**, an illustration of an aircraft is depicted in accordance with an illustrative embodiment. In this illustrative example, aircraft **100** has wing **102** and wing **104**

attached to body **106**. Aircraft **100** includes engine **108** attached to wing **102** and engine **110** attached to wing **104**.

Body **106** has nose section **112** and tail section **114**. Horizontal stabilizer **116**, horizontal stabilizer **118**, and vertical stabilizer **120** are attached to tail section **114** of body **106**.

Aircraft **100** is an example of an aircraft in which line mounting system **122** may be implemented. In this illustrative example, line mounting system **122** is located in interior **124** of aircraft **100** in this exposed view. Line mounting system **122** is configured to mount wire bundles **126**. As depicted, wire bundles **126** are shown in phantom as being mounted under floor **128** within interior **124** of aircraft **100** using line mounting system **122**.

Turning now to **Figure 2**, an illustration of a block diagram of a platform is depicted in accordance with an illustrative embodiment. In this illustrative example, aircraft **100** is an example of one implementation for platform **200** in **Figure 2**.

Line mounting system **202** may be used to mount a number of lines **204** to platform **200**. As used herein, a “number of” when used with reference to items means one or more items. For example, the number of lines **204** is one or more lines. Lines **204** may be grouped into wire bundles **206** in these illustrative examples.

As depicted, lines **204** may take various forms. For example, lines **204** may be any type of transport element. A transport element is a structure that is configured to transport items such as a fluid, light, an electrical signal, and other suitable items. Lines **204** may be selected from, for example, without limitation, at least one of a wire, an optical fiber, a fluid line, and other suitable types of lines. In these illustrative examples, lines **204** are flexible lines **208**.

As used herein, the phrase “at least one of”, when used with a list of items, means different combinations of one or more of the listed items may be used and only one of each item in the list may be needed. For example, “at least one of item A, item B, and item C” may include, without limitation, item A or item A and item B.

This example also may include item A, item B, and item C, or item B and item C. In other examples, “at least one of” may be, for example, without limitation, two of item A, one of item B, and ten of item C; four of item B and seven of item C; and other suitable combinations.

In this illustrative example, line mounting system **202** is comprised of support structures **210** and spacers **212**. Spacers **212** are structures that are associated with support structures **210**. In some illustrative examples, spacers **212** may be considered features of support structures **210**.

5 When one component is “associated” with another component, the association is a physical association in these depicted examples. For example, a first component, a spacer in spacers **212**, may be considered to be associated with a second component, a support structure in support structures **210**, 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.

15 Spacers **212** are configured to hold a number of lines **204**. In these illustrative examples, spacers **212** may be configured to hold multiple wire bundles in wire bundles **206**.

20 Support structures **210** are configured to be connected to attachment structures **214**. As used herein, a first component “connected to” a second component means that the first component can be connected directly or indirectly to the second component. In other words, additional components may be present between the first component and the second component. The first component is considered to be indirectly connected to the second component when one or more additional components are present between the two components. When the first component is directly connected to the second component, no additional components are present between the two components.

30 Support structures **210** are configured to be moved into positions **216** relative to attachment structures **214**. Attachment structures **214** are also part of line mounting system **202** in this illustrative example.

When support structures **210** are in positions **216** relative to attachment structures **214**, support structures **210** may be connected to attachment structures

214. In these illustrative examples, support structures **210** may be connected to attachment structures **214** without needing tool **218**.

In these illustrative examples, support structures **210** may be connected to attachment structures **214** using fasteners **220**. Fasteners **220** may be selected as ones that do not require tool **218**. For example, fasteners **220** may take the form of scriveners that do not require the use of tools such as tool **218**. In these illustrative examples, lines **204** may be connected to spacers **212** using a number of different types of connection systems. In these illustrative examples, line fasteners **224** may be used to connect lines **204** to spacers **212**.

Line fasteners **224** may take a number of different forms. For example, line fasteners **224** may take the form of ties **226**. As an example, ties **226** may be cables ties, zip ties, and other suitable types of ties.

In these illustrative examples, when lines **204** are connected to spacers **212** and support structures **210** are connected to attachment structures **214**, lines **204** may have desired configuration **228**. Desired configuration **228** may be described using a number of different parameters. For example, desired configuration **228** may be spacing **229** between one or more of lines **204** within line mounting system **202**.

Spacing **229** may be desirable when lines **204** take the form of wires **230**. The value for spacing **229** between wires **230** may be selected such that a desired minimum distance is maintained between lines **204**. This desired minimum distance may reduce interference between wires **230**. In particular, the spacing may be between bundles **231** of wires **230**. Spacing **229** may be specified by various regulations, rules, and other factors. In other illustrative examples, desired configuration **228** may be a location of lines **204** relative to other components in platform **200**. For example, desired configuration **228** may be located in an interior of a fuselage of aircraft **100** in **Figure 1**.

In these illustrative examples, first number of wire bundles **232** may be connected to spacers **212** prior to support structures **210** being connected to attachment structures **214**. In these illustrative examples, after support structures **210** have been connected to attachment structures **214** in platform **200**, second number of wire bundles **233** may be connected to spacers **212**. With line mounting system **202**, removing ties **226** that secure first number of wire bundles **232** to each other and to spacers **212** may be unnecessary. Additional ties in ties **226** may be

used to connect second number of wire bundles **233** to spacers **212**. In this manner, less time and effort is needed to attach lines **204** in desired configuration **228** in platform **200** as compared to currently used techniques and systems.

Turning now to **Figure 3**, an illustration of a block diagram of a support structure with a number of spacers and an attachment structure is depicted in accordance with an illustrative embodiment. In this illustrative example, support structure **300** is an example of a support structure in support structures **210** in **Figure 2**. Number of spacers **302** is an example of one or more spacers in spacers **212** in **Figure 2**. Attachment structure **304** is an example of an attachment structure in attachment structures **214** in **Figure 2**.

In this illustrative example, support structure **300** is associated with number of spacers **302**. In other words, one or more spacers may be connected to, formed as part of, or otherwise associated with support structure **300**.

In this illustrative example, support structure **300** takes the form of elongate structure **308**. Additionally, support structure **300** also may include channel **310** within elongate structure **308**.

In these illustrative examples, support structure **300** is configured to be moved relative to attachment structure **304**. In particular, elongate structure **308** may be slid relative to attachment structure **304** with number of spacers **302**. The sliding of elongate structure **308** may be such that channel **310** receives portion **312** of attachment structure **304**.

Once elongate structure **308** is in position **314** relative to attachment structure **304**, opening **316** in elongate structure **308** of support structure **300** and opening **318** in attachment structure **304** may be aligned with each other. With the alignment of opening **316** and opening **318**, fastener **320** may be used to maintain support structure **300** in position **314** relative to attachment structure **304**.

In particular, fastener **320** may be installed through opening **316** and opening **318**. In this manner, fastener **320** may be used to secure or lock elongate structure **308** in position **314** with portion **312** within channel **310**. In these illustrative examples, fastener **320** will take the form of scrivet **322**. Scrivet **322** may be installed by an operator without the need for tool **324**. In this manner, lines, such as wire bundles, may be installed more quickly and with less effort by an operator.

Further, in these illustrative examples, channel **310** may be configured such that portion **312** of attachment structure **304** halts movement of elongate structure **308** by an operator when position **314** is reached. As a result, the operator does not need to view opening **316** and opening **318** to verify that these openings are aligned with each other. This configuration of channel **310** and portion **312** may further reduce the amount of time and effort needed by an operator to install wire bundles using support structure **300**.

The illustration of platform **200** with line mounting system **202** and the different components in **Figure 2** and **Figure 3** 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, elongate structure **308** may be connected to attachment structure **304** using other mechanisms other than installing fastener **320** into opening **316** in support structure **300** and opening **318** in attachment structure **304**. For example, a fastening mechanism may be present in channel **310** that is configured to hold support structure **300** relative to attachment structure **304** in position **314**.

For example, a first fastening component may be located in channel **310**. This fastening component may engage another fastening component in portion **312** of attachment structure **304**. When support structure **300** is in position **314** relative to attachment structure **304**, these two fastening components may engage each other to hold support structure **300** in position **314** relative to attachment structure **304**.

More specifically, the first fastening component may be an opening or slot formed in the wall of channel **310**. The second fastening component may be a tab or other structure on attachment structure **304** that is configured to enter the opening or slot such that support structure **300** is held in a position relative to attachment structure **304** and does not move.

As another example, although platform **200** in **Figure 2** has been described as taking the form of an aircraft, in some illustrative examples, platform **200** may take

other forms. For example, platform **200** may be selected from one of a mobile platform, a stationary platform, a land-based structure, an aquatic-based structure, a space-based structure, a surface ship, a tank, a personnel carrier, a train, a spacecraft, a space station, a satellite, a submarine, an automobile, a power plant, a bridge, a dam, a manufacturing facility, and a building.

Turning now to **Figure 4**, an illustration of components in a line mounting system is depicted in accordance with an illustrative embodiment. In this depicted example, support structure **400** is associated with spacer **402** and spacer **404**. These components are illustrative examples of physical implementations for the components in shown in block form in **Figure 3**.

As depicted, spacer **402** and spacer **404** are separate components that are connected to support structure **400**. In this example, support structure **400** takes the form of elongate member **406**. Spacer **402** and spacer **404** are structures configured to be connected to one or more lines. In these illustrative examples, spacer **402** and spacer **404** are associated with elongate member **406** by being connected to elongate member **406**. Clip **407** connects spacer **402** to elongate member **406** and clip **409** connects spacer **404** to elongate member **406**.

Elongate member **406** may be moved to a position relative to attachment structure **408**. Elongate member **406** is connected to bracket **414** in attachment structure **408** using scrivet **418**.

In this illustrative example, attachment structure **408** is comprised of three components. As depicted, attachment structure **408** includes post **410**, post **412**, and bracket **414**. Bracket **414** is associated with post **410** and post **412**. Attachment structure **408** may be connected to a platform, such as aircraft **100** in **Figure 1**, in this illustrative example.

In this example, spacer **402** and spacer **404** have shapes configured to allow for more efficient connection of lines to the spacers. For instance, a wire bundle may be attached to location **420** and location **422** for spacer **402**. Additionally, a wire bundle may be attached to location **424** and another wire bundle may be attached to location **426** on spacer **404**. These wire bundles may be attached to locations **420**, **422**, **424**, and **426** prior to elongate member **406** being attached to attachment structure **408**.

After elongate member **406** has been attached to attachment structure **408**, additional wire bundles may be attached to location **428** and location **430** for spacer **402**. Additional wire bundles also may be attached to location **434** and location **436** for spacer **404**. The attachment of these additional wire bundles may be performed
5 after elongate member **406** has been attached to attachment structure **408**. The attachment of the additional wire bundles may be performed without having to reconfigure already attached wire bundles through the use of spacer **402** and spacer **404**.

Spacer **402** and spacer **404** may maintain wire bundles in a desired
10 configuration with respect to each other. In particular, the desired configuration may be a desired spacing between wire bundles.

Turning now to **Figure 5**, an illustration of an exploded view of a support structure with spacers and an attachment structure is depicted in accordance with an illustrative embodiment. In this view of support structure **400**, elongate member **406**
15 has channel **500**. Channel **500** is configured to receive portion **502** and portion **503** of attachment structure **408**. In this illustrative example, portion **502** and portion **503** of attachment structure **408** are part of bracket **414**.

Additionally, opening **504** in elongate member **406** and opening **506** in bracket **414** in attachment structure **408** is seen. Scrivet **418** is configured to secure
20 elongate member **406** to bracket **414** in attachment structure **408** when these two components are in a desired position relative to each other.

In this depicted example, bracket **414** is associated with post **410** and post **412** by being connected to post **410** and post **412** using fastener **507** and fastener **508**. In other illustrative examples, post **410** and post **412** may be formed as part of
25 bracket **414**.

In this illustrative example, spacer **402** is associated with elongate member **406** by being connected to elongate member **406** by clip **509**. In a similar fashion, spacer **404** is associated with elongate member **406** by being connected to elongate member **406** using clip **510**.

Turning now to **Figure 6**, an illustration of a partially assembled view of a support structure with spacers and an attachment structure is depicted in accordance with an illustrative embodiment. As can be seen in this view, clip **509** and clip **510** also may function to stop movement of elongate member **406** relative to attachment
30

structure **408** when portion **502** within channel **500** moves in the direction of arrow **600** to a position where opening **504** in elongate member **406** is aligned with opening **506** in bracket **414** of attachment structure **408**. More specifically, post **410** may contact clip **509** and post **412** may contact clip **510** to stop movement of elongate member **406** in the direction of arrow **600**.

In these illustrative examples, clip **509** and clip **510** may be considered part of a configuration for channel **500** that allows for the movement of elongate member **406** in the direction of arrow **600** to be halted.

Turning now to **Figure 7**, another illustration of a partially assembled view of a support structure with spacers and an attachment structure is depicted in accordance with an illustrative embodiment.

Turning next to **Figures 8-12**, illustrations of an installation of a line mounting system for wire bundles are depicted in accordance with an illustrative embodiment. In **Figure 8**, elongate member **406** with spacer **402** and spacer **404** is moved in the direction of arrow **800** relative to attachment structure **408**. Next, in **Figure 9**, portion **503** of bracket **414** is received in channel **500** of elongate member **406**. Elongate member **406** is moved or rotated in the direction of arrow **900** such that portion **502** of bracket **414** also may be received in channel **500**.

In **Figure 10**, both portion **502** and portion **503** are in channel **500**. In this view, elongate member **406** may be moved in the direction of arrow **1000**. With reference next to **Figure 11**, movement of elongate member **406** halts when opening **506** in bracket **414** is aligned with opening **504** in elongate member **406**. In these illustrative examples, movement in the direction of arrow **1000** no longer occurs because of the configuration of channel **500**.

Scrivet **418** may be installed in opening **504** and opening **506** to secure elongate member **406** with bracket **414** in a desired position. Scrivet **418** prevents movement in the direction of arrow **1000**. In **Figure 12**, elongate member **406** with spacer **402** and spacer **404** are shown connected to bracket **414** of attachment structure **408**.

Turning now to **Figure 13**, an illustration of a wire bundle connected to a support structure is depicted in accordance with an illustrative embodiment. In this illustrative example, wire bundle **1300** is an example of a line bundle that may be connected to elongate member **406**.

In this illustrative example, wire bundle **1300** is connected to elongate member **406** through spacer **404**. As depicted, wire bundle **1300** is connected to spacer **404** using tie **1302**. In a similar fashion, wire bundle **1304** may be connected to elongate member **406** through spacer **402**. As depicted, wire bundle **1304** is connected to spacer **402** using tie **1306**. In the different illustrative examples, wire bundle **1300** may be connected to spacer **402** and wire bundle **1304** may be connected to spacer **404** after or prior to the connection of elongate member **406** to bracket **414** in these illustrative examples.

With reference now to **Figure 14**, an illustration of wire bundles connected to spacers in a support structure is depicted in accordance with an illustrative embodiment. In this illustrative example, wire bundle **1300** and wire bundle **1304** are connected to spacer **404** and spacer **402** prior to elongate member **406** being connected to bracket **414** in attachment structure **408**.

In these illustrative examples, additional wire bundles may be connected to spacer **402** and spacer **404** after elongate member **406** has been connected to attachment structure **408**. In this example, wire bundle **1400** is connected to spacer **402** after installation of elongate member **406**. As depicted, wire bundle **1400** is connected to spacer **402** using tie **1402**. In this example, removal of tie **1306** is not needed to connect wire bundle **1400** to spacer **402** based on the shape of spacer **402**.

The connection of elongate member **406** to attachment structure **408** may be performed more easily due to the configuration to the channel **500**. In other words, an operator does not have to look to see whether opening **504** is aligned to opening **506**. Instead, when support structure **400** is no longer able to move in the direction of arrow **1000**, these two openings are aligned with each other and ready to receive scrivet **418**. Scrivet **418** is configured to be installed by an operator without needing a tool.

As a result, an operator may connect elongate member **406** to attachment structure **408** without seeing these components. In other word, the operator may perform the connection through the sense of touch. This capability may increase the speed at which wire bundles may be installed in a platform.

Turning now to **Figure 15**, an illustration of an assembly of wire bundles with a line mounting system is depicted in accordance with an illustrative embodiment. In

this illustrative example, line mounting system **1500** may be connected to wire bundles **1502** on table **1504**. This connection of wire bundles **1502** to line mounting system **1500** occurs prior to the installation of line mounting system **1500** in a platform such as aircraft **100** in **Figure 1**.

5 As depicted, support structures **1506** are connected to wire bundle **1508** and wire bundle **1510** in wire bundles **1502** on table **1504**. Wire bundles **1502** connected to support structures **1506** in line mounting system **1500** may be rolled onto reel **1512**. Reel **1512** may be moved to an interior of an aircraft and line mounting system **1500** with wire bundles **1502** may be installed into the aircraft.

10 Turning now to **Figure 16**, an illustration of the installation of a line mounting system is depicted in accordance with an illustrative embodiment. In this illustrative example, line mounting system **1500** may be installed into interior **1600** of platform **1602**.

15 As depicted, line mounting system **1500** with wire bundles **1502** may be unrolled from reel **1512** for installation. In this illustrative example, support structures **1506** in line mounting system **1500** are connected to attachment structures such as attachment structures **1604** in interior **1600** of platform **1602**. A more detailed illustration of section **1610** is shown in **Figure 17** below.

20 With reference now to **Figure 17**, an illustration of a portion of a line mounting system installed in a platform is depicted in accordance with an illustrative embodiment. In this illustrative example, support structure **1700** in support structures **1506** in line mounting system **1500** is illustrated. As can be seen, wire bundle **1508** is connected to spacer **1702** using tie **1704** and wire bundle **1510** is connected to spacer **1706** using tie **1708**.

25 Support structures **1506** take the form of elongate member **1710** and is connected to bracket **1712** in attachment structure **1714**. Scrivet **1716** holds elongate member **1710** in a desired position relative to bracket **1712**.

30 Turning now to **Figure 18**, an illustration of a portion of a line mounting system installed in a platform is depicted in accordance with an illustrative embodiment. A portion of line mounting system **1800** is shown in this view.

As depicted, line mounting system **1800** is configured to mount wire bundle **1802** and wire bundle **1804** to structure **1806** in platform **1808**. In these illustrative

examples, structure **1806** may be, for example, the bottom of floor **128** in aircraft **100** in **Figure 1**.

In this illustrative example, line mounting system **1800** includes support structure **1810** and support structure **1812**. Spacer **1814** and spacer **1816** are associated with support structure **1810**. Spacer **1818** and spacer **1820** are associated with support structure **1812**. Support structure **1810** is connected to attachment structure **1822**, and support structure **1812** is connected to attachment structure **1824**.

In this illustrative example, wire bundle **1802** and wire bundle **1804** are held in a desired configuration by line mounting system **1800**. In particular, space **1826** may be maintained with a minimum desired value between wire bundle **1802** and wire bundle **1804** in this illustrative example. Space **1826** may be maintained using spacer **1814** and spacer **1816** associated with support structure **1812** and spacer **1818** and spacer **1820** associated with support structure **1810**.

Additionally, space **1826** may be maintained between wire bundle **1802** and wire bundle **1804** using spacer **1828**. Spacer **1828** is not connected to another structure in this illustrative example.

In these illustrative examples, space **1826** may be desired for a number of different reasons. For example, space **1826** may vary for different types of wires or numbers of wires in wire bundle **1802** and wire bundle **1804**. If space **1826** is less than a desired value, interference may occur between signals sent through wires in wire bundle **1802** and wire bundle **1804**. This interference may negatively affect the operation of systems sending and receiving signals using wire bundle **1802** and wire bundle **1804**.

As a result, the use of spacer **1828** in addition to spacer **1818** and spacer **1820** associated with support structure **1812** and spacer **1818** and spacer **1820** associated with support structure **1810** may provide a desired configuration for space **1826** along the length of wire bundle **1802** and wire bundle **1804**. The installation of spacers or additional brackets may be more time-consuming and costly than desired. Moreover, the installation of these structures may add more weight to the aircraft than desired.

Turning now to **Figure 19**, an illustration of a perspective view of a spacer is depicted in accordance with an illustrative embodiment. In this illustrative example, spacer **1900** is an example of one implementation of spacer **1828** in **Figure 18**.

As can be seen, spacer **1900** includes base **1902**. Connecting structure **1904** extends from side **1906** of base **1902**. Connecting structure **1908** extends from side **1910** of base **1902**. These connecting structures may be used to connect wire bundles to spacer **1900** using fasteners, such as ties.

Turning now to **Figure 20**, another illustration of a perspective view of a spacer is depicted in accordance with an illustrative embodiment.

With reference now to **Figure 21**, an illustration of a side view of a spacer is depicted in accordance with an illustrative embodiment. In this figure, a view of side **1910** is illustrated. As can be seen from this view, wire bundles may be connected to connecting structure **1908** and connecting structure **1904** (not shown) at locations **2100**, **2102**, **2104**, and **2106**.

The illustrations of the different physical implementations for a line mounting system, such as line mounting system **202**, and for different components in the line mounting system and aircraft **100** in **Figure 1** and **Figures 4-21** are not meant to imply limitations to the manner in which other illustrative examples may be implemented. For example, although attachment structure **408** in **Figure 4** has been shown as three pieces that are connected to each other, attachment structure **408** may take other forms. For example, attachment structure **408** may be formed as a single piece in other illustrative examples.

In still another illustrative example, support structure **400** may take other forms other than elongate member **406** in **Figure 4**. For example, support structure **400** may be oval or circular in shape. In still other illustrative examples, support structure **400** may be a square or hexagonal in shape. In the different possible embodiments, support structure **400** is configured to be connected to attachment structure **408** in **Figure 4**. Even with the different shapes, support structure **400** may still include channel **500** in **Figure 5**.

The different components shown in **Figure 1** and **Figures 4-21** may be combined with components in **Figure 2** and **Figure 3**, used with components in **Figure 2** and **Figure 3**, or a combination of the two. Additionally, some of the components in **Figure 1** and **Figures 4-21** may be illustrative examples of how

components shown in block form in **Figure 2** and **Figure 3** can be implemented as physical structures.

With reference now to **Figure 22**, an illustration of a flowchart of a process for securing lines to a platform is depicted in accordance with an illustrative embodiment. The process illustrated in **Figure 22** may be implemented using line mounting system **202** in **Figure 2**.

The process begins by positioning support structures relative to attachment structures associated with a platform (operation **2200**). Spacers may be associated with the support structures. These spacers are configured to be connected to the number of lines. Next, the support structures are connected to the attachment structures such that a number of lines has a desired configuration when connected to spacers (operation **2202**).

In operation **2200** and operation **2202**, the number of lines may already be connected to the spacers prior to the support structures being connected to the attachment structures. In other illustrative examples, the number of lines may be connected to the spacers after the support structures have been connected to the attachment structures. Additionally, the number of lines may be grouped as one or more bundles.

When the number of lines are a first number of lines attached to the spacers, a second number of lines may be connected to the spacers associated with the support structures after connecting the support structures to the attachment structures (operation **2204**) with the process terminating thereafter.

With reference now to **Figure 23**, a more detailed illustration of a flowchart of a process for securing lines to a platform is depicted in accordance with an illustrative embodiment. The process illustrated in **Figure 23** may be implemented using line mounting system **202** in **Figure 2**.

The process begins by associating attachment structures with a platform (operation **2300**). In operation **2300**, the attachment structures are connected to the platform in locations where lines, such as wires or other transport elements, are to be located.

The process then connects a number of lines to spacers associated with support structures (operation **2302**). The assembly of the number of lines connected

to the spacers associated with the support structures are rolled onto a reel (operation **2304**).

Within the platform, a portion of the assembly of the number of lines connected to spacers associated with support structures is unrolled from the reel for
5 installation in the platform (operation **2306**). Support structures are positioned relative to the attachment structures associated with the platform (operation **2308**). The support structures positioned in operation **2308** are support structures that have been unrolled from the reel with the number of lines connected to spacers associated with the support structures.

10 The process then connects the support structures to the attachment structures such that the number of lines has a desired configuration (operation **2310**). The connection may be made using fasteners that do not require the use of a tool. Further, the alignment of the support structures to the attachment structures also may not require visual inspection by the operator.

15 In this illustrative example, the desired configuration may be where the number of lines are located and spacing between the number of lines. In particular, the spacing may be spacing between two or more wire bundles.

A determination is made as to whether additional support structures with spacers connected to the number of lines are still present on the reel that have not
20 been connected to the attachment structures (operation **2312**). If additional support structures are present, the process returns to operation **2306**. Otherwise, the process terminates.

This process allows for the installation of additional lines after the initial installation of the number of lines connected to spacers associated with the support
25 structures on the reel. The installation of additional lines may be made without removing fasteners such as ties from the already installed number of lines in these illustrative examples.

The flowcharts and block diagrams in the different depicted embodiments illustrate the architecture, functionality, and operation of some possible
30 implementations of apparatus and methods in an illustrative embodiment. In this regard, each block in the flowcharts or block diagrams may represent a module, segment, function, and/or a portion of an operation or step. For example, one or more of the blocks may be implemented as program code, in hardware, or a

combination of the program code and hardware. When implemented in hardware, the hardware may, for example, take the form of integrated circuits that are manufactured or configured to perform one or more operations in the flowcharts or block diagrams.

5 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
10 be added in addition to the illustrated blocks in a flowchart or block diagram.

In one illustrative example, operation **2204** in **Figure 22** is an optional operation. In other words, the attachment of additional line bundles may not be needed and operation **2204** may be omitted.

In another illustrative example, operation **2300** and operation **2302** in **Figure**
15 **23** may be performed at the same time or may be performed in a different order. In still other illustrative examples, the support structures may be connected to the attachment structures first. The number of lines may then be connected to the spacers associated with the support structures afterwards depending on the particular implementation.

20 Illustrative embodiments of the disclosure may be described in the context of aircraft manufacturing and service method **2400** as shown in **Figure 24** and aircraft **2500** as shown in **Figure 25**. Turning first to **Figure 24**, an illustration of an aircraft manufacturing and service method is depicted in accordance with an illustrative embodiment. The process depicted in **Figure 24** may be used during manufacturing
25 and service of aircraft **100** in Figure 1. During pre-production, aircraft manufacturing and service method **2400** may include specification and design **2402** of aircraft **2500** in **Figure 25** and material procurement **2404**.

During production, component and subassembly manufacturing **2406** and system integration **2408** of aircraft **2500** in **Figure 25** takes place. Thereafter,
30 aircraft **2500** in **Figure 25** may go through certification and delivery **2410** in order to be placed in service **2412**. While in service **2412** by a customer, aircraft **2500** in **Figure 25** is scheduled for routine maintenance and service **2414**, which may

include modification, reconfiguration, refurbishment, and other maintenance or service.

Each of the processes of aircraft manufacturing and service method **2400** may be performed or carried out by a system integrator, a third party, and/or an operator.

5 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
10 organization, and so on.

With reference now to **Figure 25**, an illustration of an aircraft is depicted in which an illustrative embodiment may be implemented. In this example, aircraft **2500** is produced by aircraft manufacturing and service method **2400** in **Figure 24** and may include airframe **2502** with plurality of systems **2504** and interior **2506**.
15 Examples of systems **2504** include one or more of propulsion system **2508**, electrical system **2510**, hydraulic system **2512**, and environmental system **2514**. 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.

20 Apparatuses and methods embodied herein may be employed during at least one of the stages of aircraft manufacturing and service method **2400** in **Figure 24**. In one illustrative example, components for a line mounting system may be assembled during components and subassembly manufacturing **2406**. Wire bundles or other groupings of lines may be connected to the line mounting system
25 prior to installation in aircraft **2500** as part of system integration **2408**.

In still other illustrative examples, the line mounting system in accordance with an illustrative embodiment may be manufactured and installed during maintenance and service **2414**. The use of a number of the different illustrative embodiments may substantially expedite the assembly of and/or reduce the cost of
30 aircraft **2500**.

Thus, one or more illustrative embodiments provide a method and apparatus for mounting lines in a desired configuration. In these illustrative examples, different

types of lines may be mounted within a platform using a line mounting system, such as line mounting system **202** in **Figure 2**.

With the use of line mounting system **202** in **Figure 2**, the installation of lines, such as wires, air hoses, fluid lines, and other types of lines may be performed with less effort and less time. With line mounting system **202**, the use of tools by an operator may be avoided. Further, the operator also may not need to see the different components in line mounting system **202** to install the lines. For example, an operator may not need to look to see whether a hull in a support structure lines up with a hull in an attachment structure before installing a fastener in the hulls to maintain a desired position between the support structure and the attachment structure.

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:

- 5 1. A line mounting system (202) for an aircraft (100), the line mounting system (202) comprising:
- support structures (210) configured to slide into positions (216) relative to attachment structures (214) in the aircraft (100) and connect to the attachment structures (214) in the positions (216); and
- 10 spacers (212) associated with the support structures (210), wherein a number of lines (204) is configured to be connected to the spacers (212), wherein the number of lines (204) is held in a desired configuration (228) in the aircraft (100) when the support structures (210) are secured to the attachment structures (214).
- 15 2. The line mounting system (202) of claim 1, wherein a support structure (300) in the support structures (210) comprises an elongate structure (308) having a channel (310) configured to receive a portion (312) of an attachment structure (304) in the attachment structures (214) when the support structure (300) is in a position (314) in the positions (216).
- 20 3. The line mounting system (202) of claim 1, wherein the number of lines (204) is connected to the spacers (212) prior to the support structures (210) being slid into the positions (216) relative to the attachment structures (214) in the aircraft (100).
- 25 4. The line mounting system (202) of claim 3, wherein the number of lines (204) is a first number of lines and further comprising:
- a second number of lines configured to be connected to the spacers (212) after the support structures (210) are secured to the attachment structures (214) in the aircraft (100).
- 30 5. The line mounting system (202) of claim 1 further comprising:
- fasteners (220) configured to secure the support structures (210) to the attachment structures (214) in the positions (216) relative to the attachment

structures (214) in the aircraft (100) and the fasteners (220) are configured to secure the support structures (210) to the attachment structures (214) in the positions (216) relative to the attachment structures (214) without a tool (218).

5 6. A method for mounting lines (204) in an aircraft (100), the method comprising:
associating attachment structures (214) with an interior (124) of a fuselage of
the aircraft (100);

moving support structures (210) to positions (216) relative to the attachment
structures (214); and

10 connecting the support structures (210) to the attachment structures (214)
when the support structures (210) are in the positions (216) relative to the
attachment structures (214) such that a number of lines (204) has a desired
configuration (228) in the fuselage of the aircraft (100) when connected to spacers
(212).

15

7. The method of claim 6, wherein the number of lines (204) is a first number of
lines and further comprising:

connecting a second number of lines to the spacers (212) with the support
structures (210) after connecting the support structures (210) to the attachment
20 structures (214).

8. The method of claims 6 or 7 further comprising:

connecting the number of lines (204) to the spacers (212) prior to connecting
the support structures (210) to the attachment structures (214).

25

9. The method of any of claims 6 through 8, further comprising:

connecting the number of lines (204) to the spacers (212) after connecting the
support structures (210) relative to the attachment structures (214).

30 10. The method of any of claims 6 through 9, wherein connecting the support
structures (210) to the attachment structures (214) such that the number of lines
(204) has the desired configuration (228) when connected to the spacers (212)
comprises:

connecting the support structures (210) to the attachment structures (214) such that the number of lines (204) has the desired configuration (228) when connected to the spacers (212) without using a tool (218).

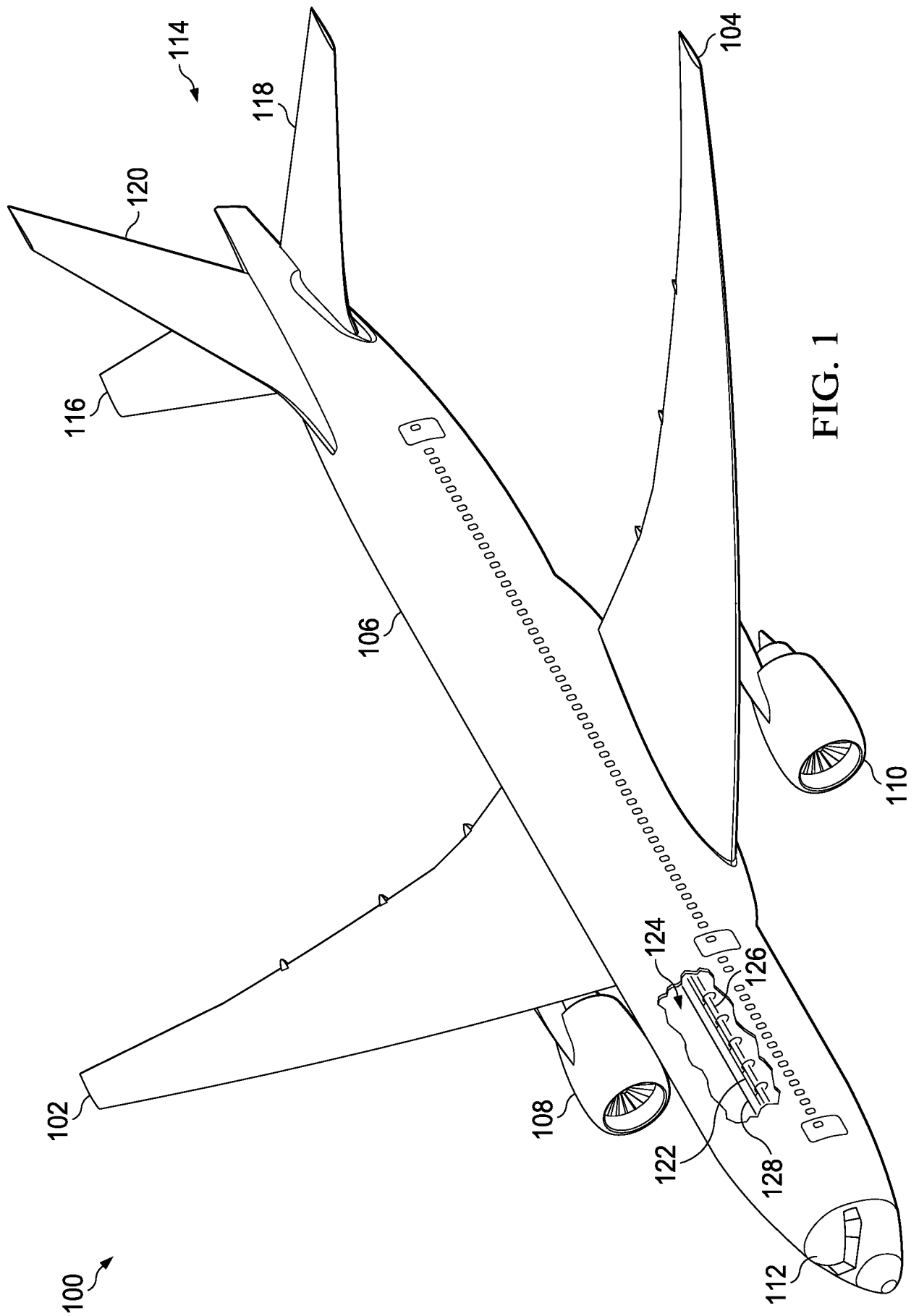
5 11. The method of any of claims 6 through 10, wherein a support structure (300) in the support structures (210) is connected to an attachment structure (304) in the attachment structures (214) with a fastener (320).

10 12. The method of any of claims 6 through 11, wherein a spacer in the spacers (212) has a number of locations in which a location in the number of locations is configured to receive a portion (312) of the number of lines (204) and hold the portion (312) of the number of lines (204) when a fastener (320) connects the portion (312) of the number of lines (204) to the spacer in the location.

15 13. The method of any of claims 6 through 12, wherein the desired configuration (228) is a desired minimum distance between the lines (204) in the number of lines (204).

20 14. The method of any of claims 6 through 13, wherein a support structure (300) in the support structures (210) comprises an elongate structure (308) having a channel (310) configured to receive a portion (312) of an attachment structure (304) in the attachment structures (214) when the support structure (300) is moved to a position (314) in the positions (216) for the support structures (210) relative to the attachment structure (304).

1/22



2/22

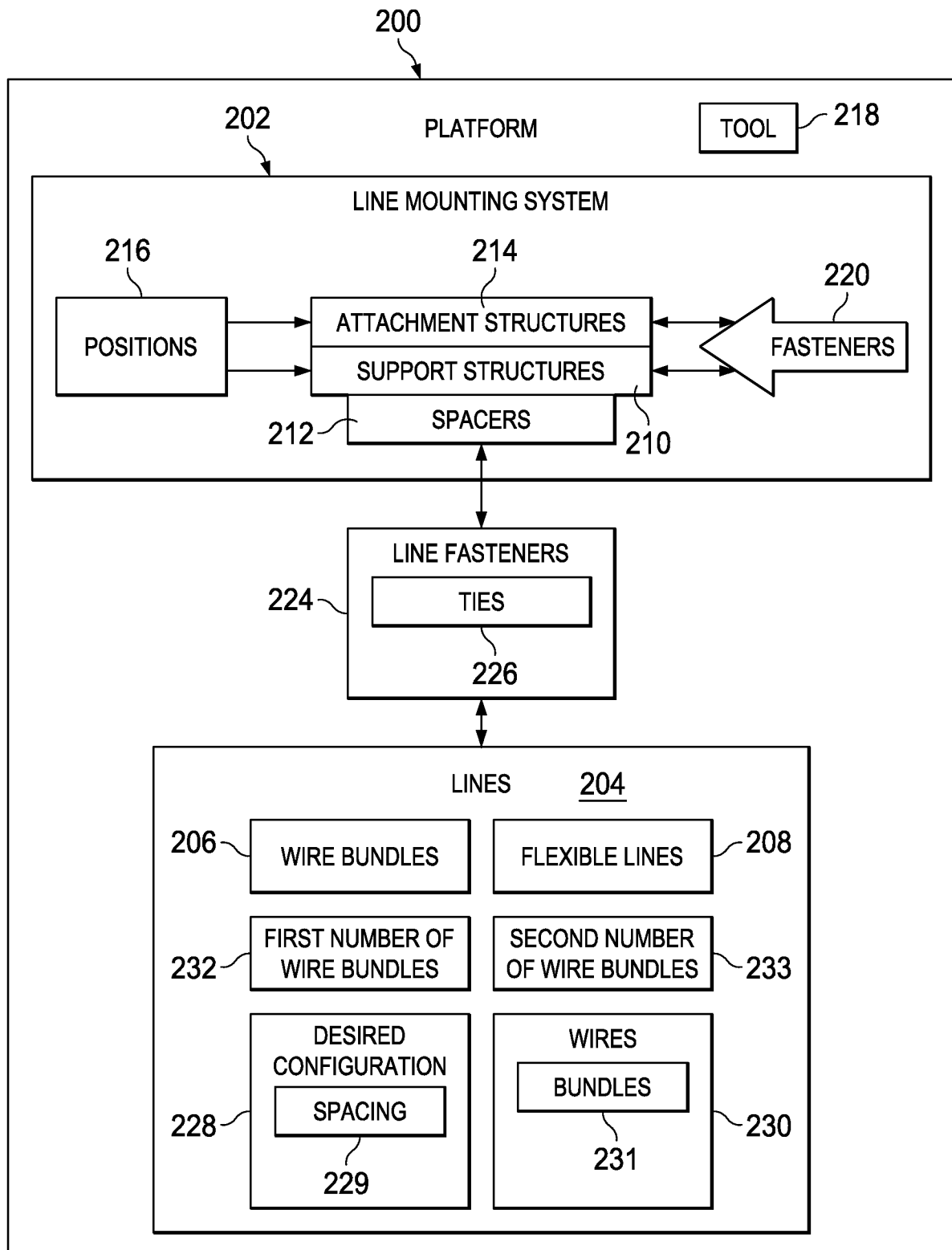


FIG. 2

3/22

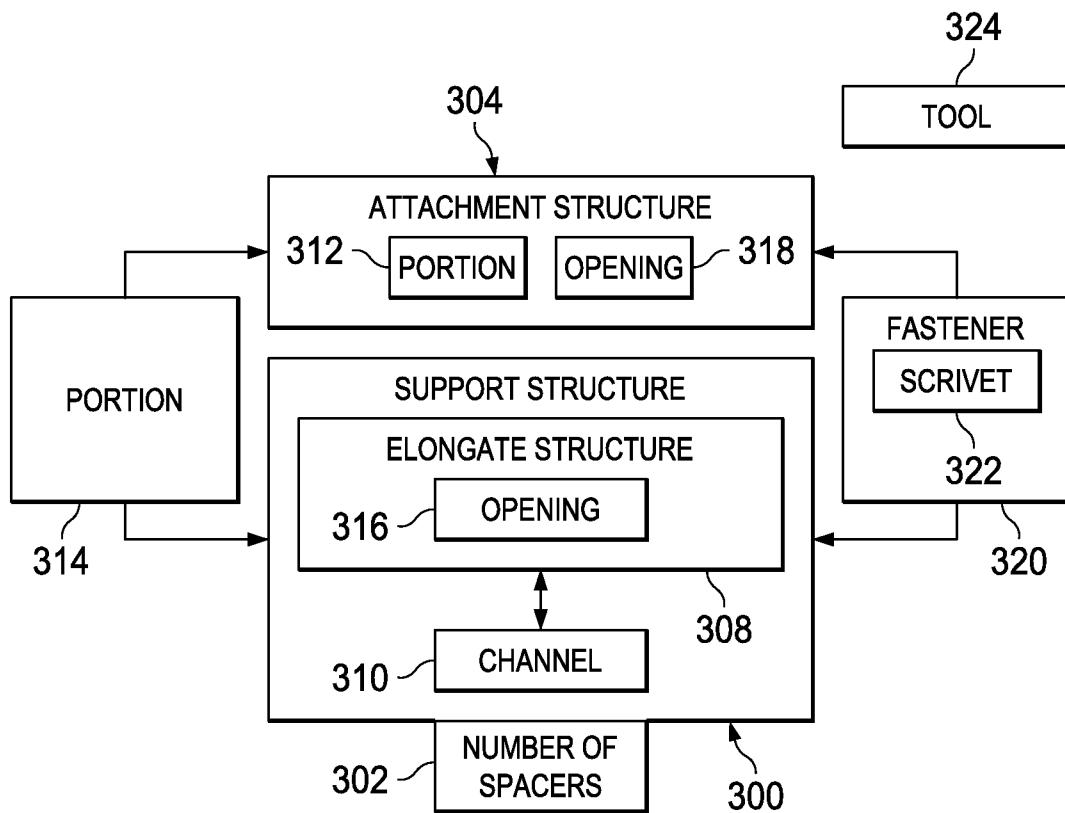


FIG. 3

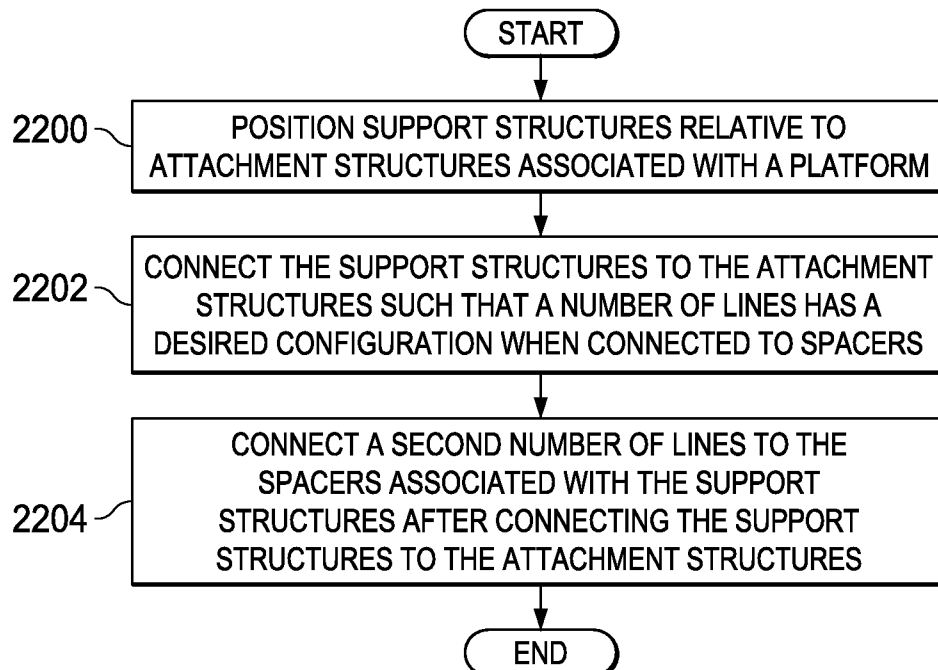
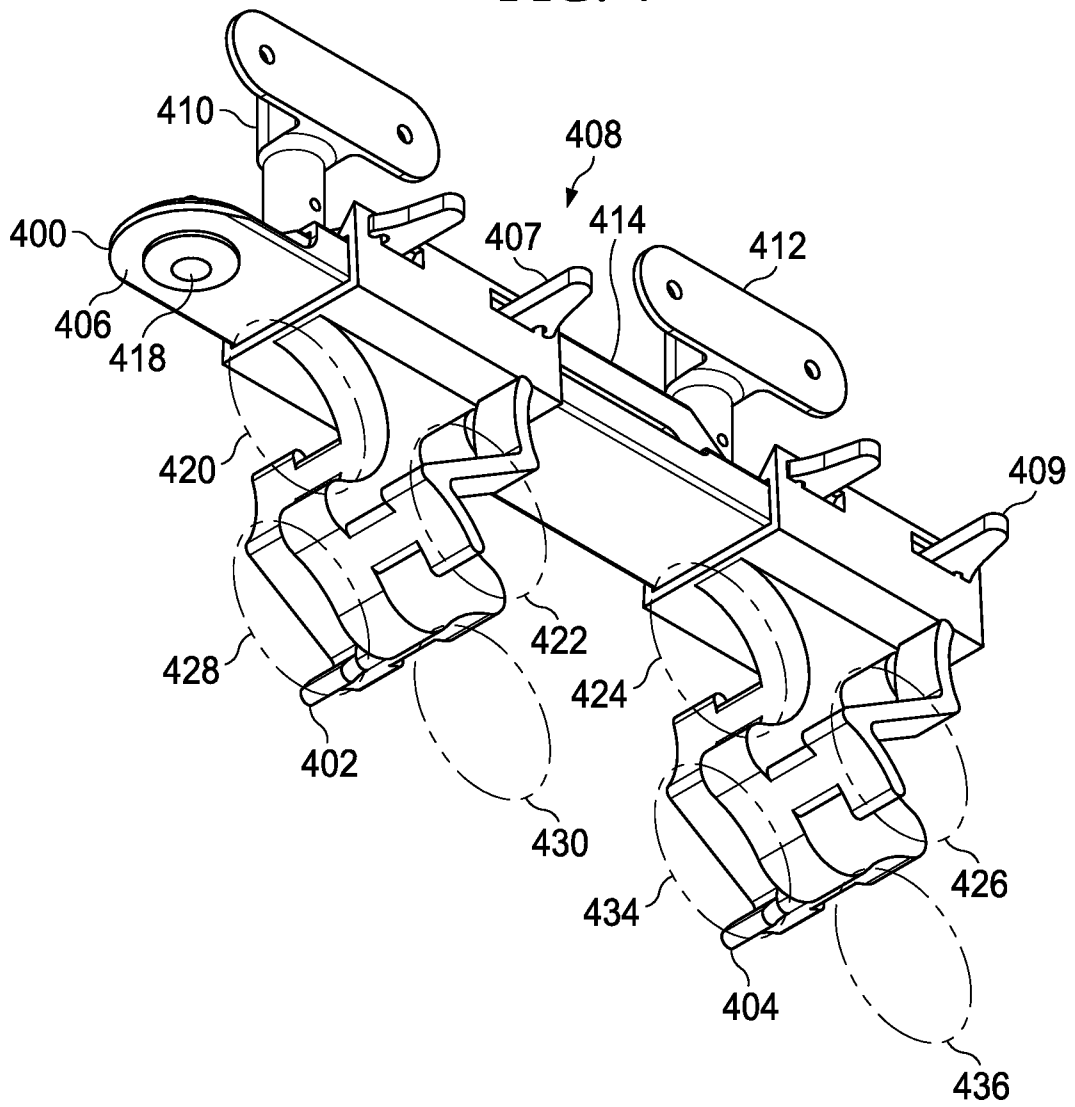


FIG. 22

4/22

FIG. 4



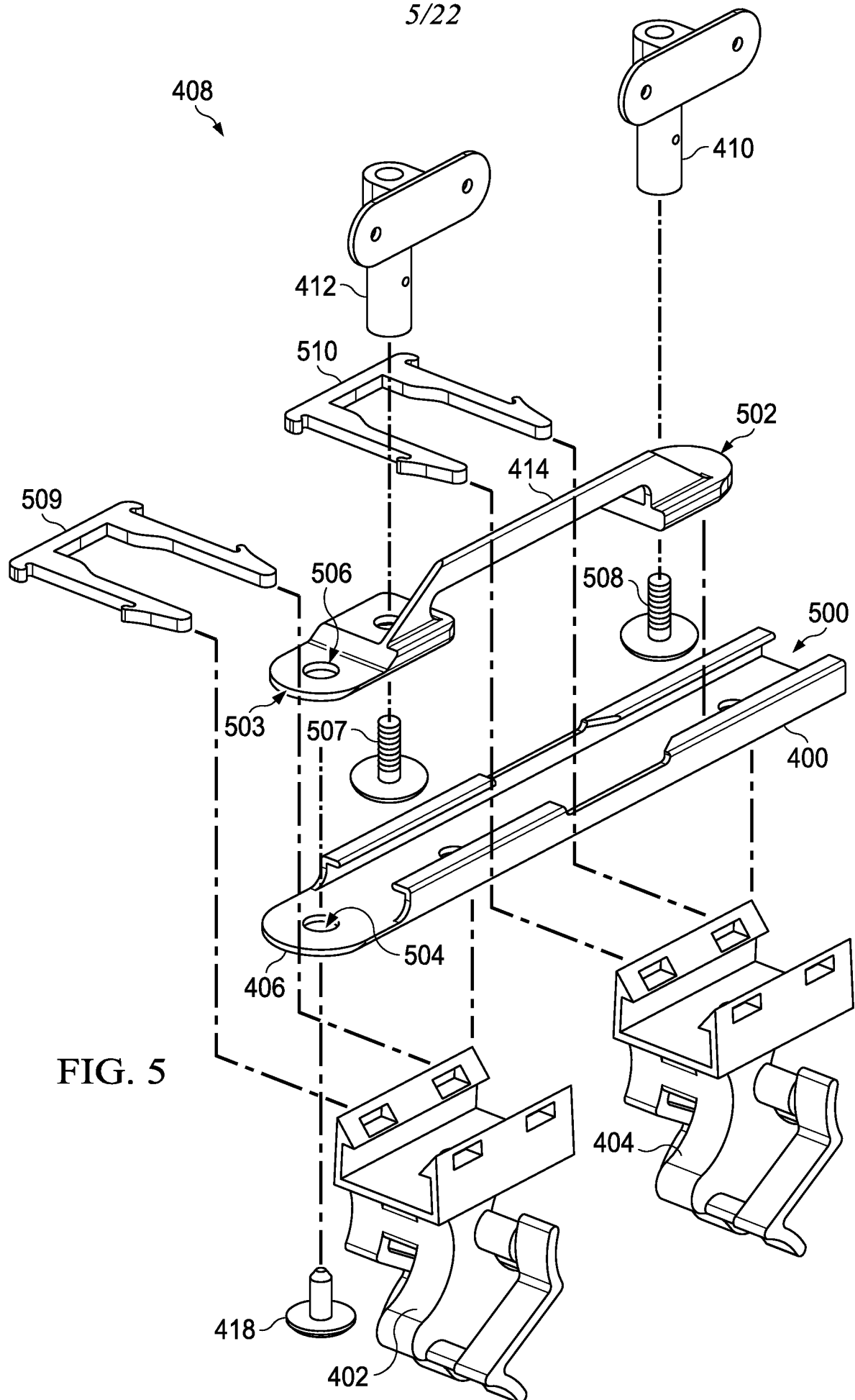
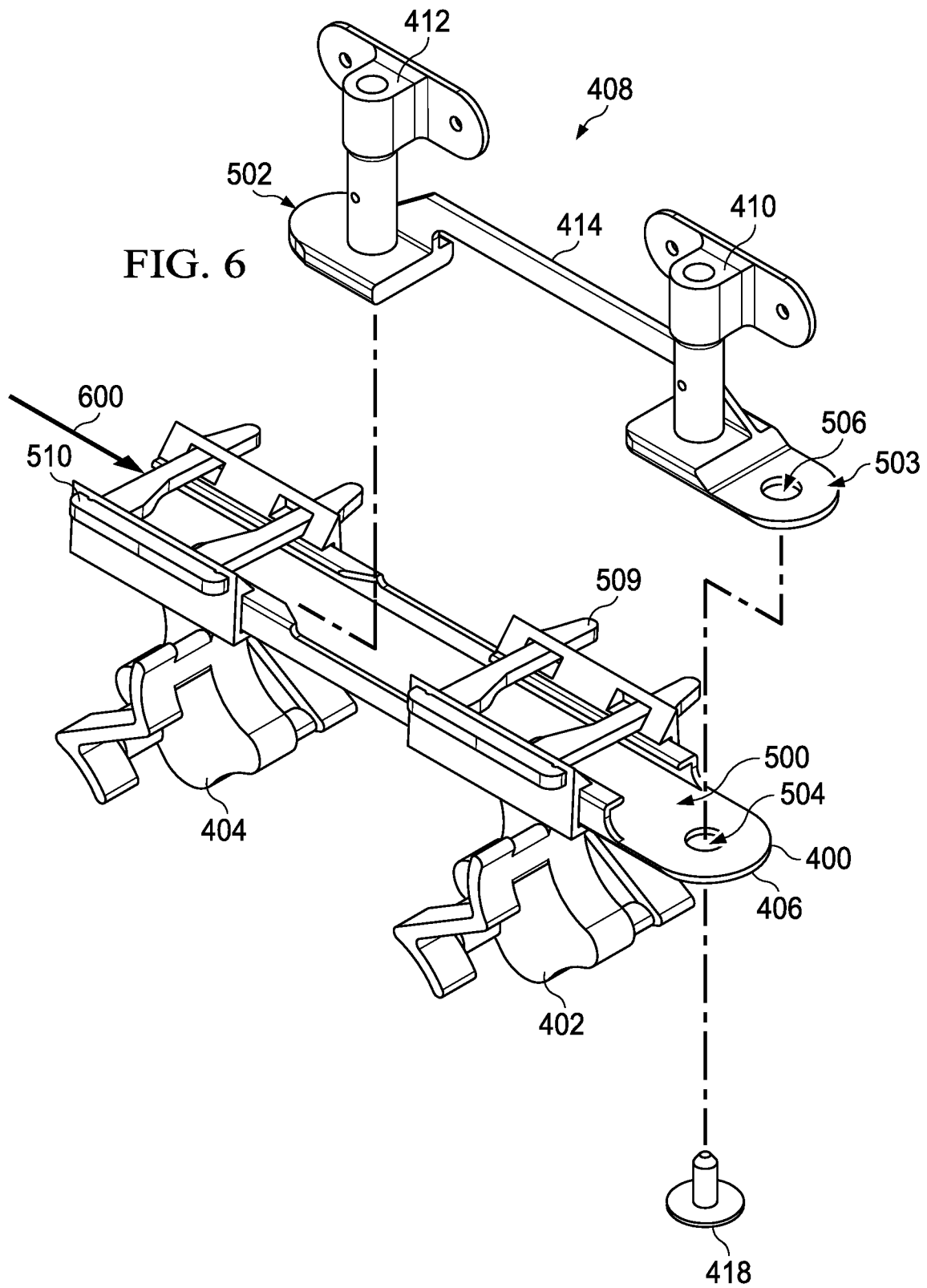


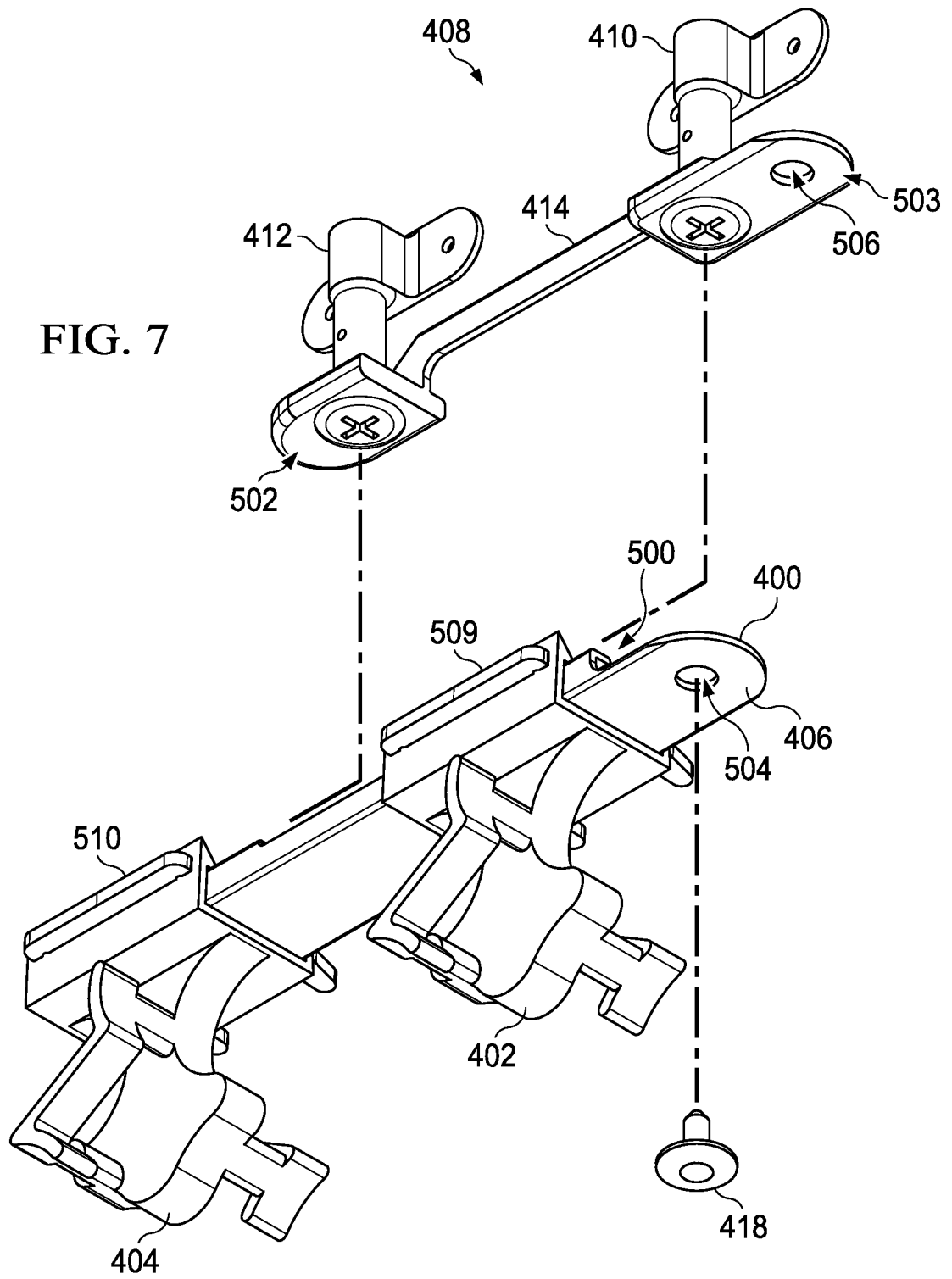
FIG. 5

6/22

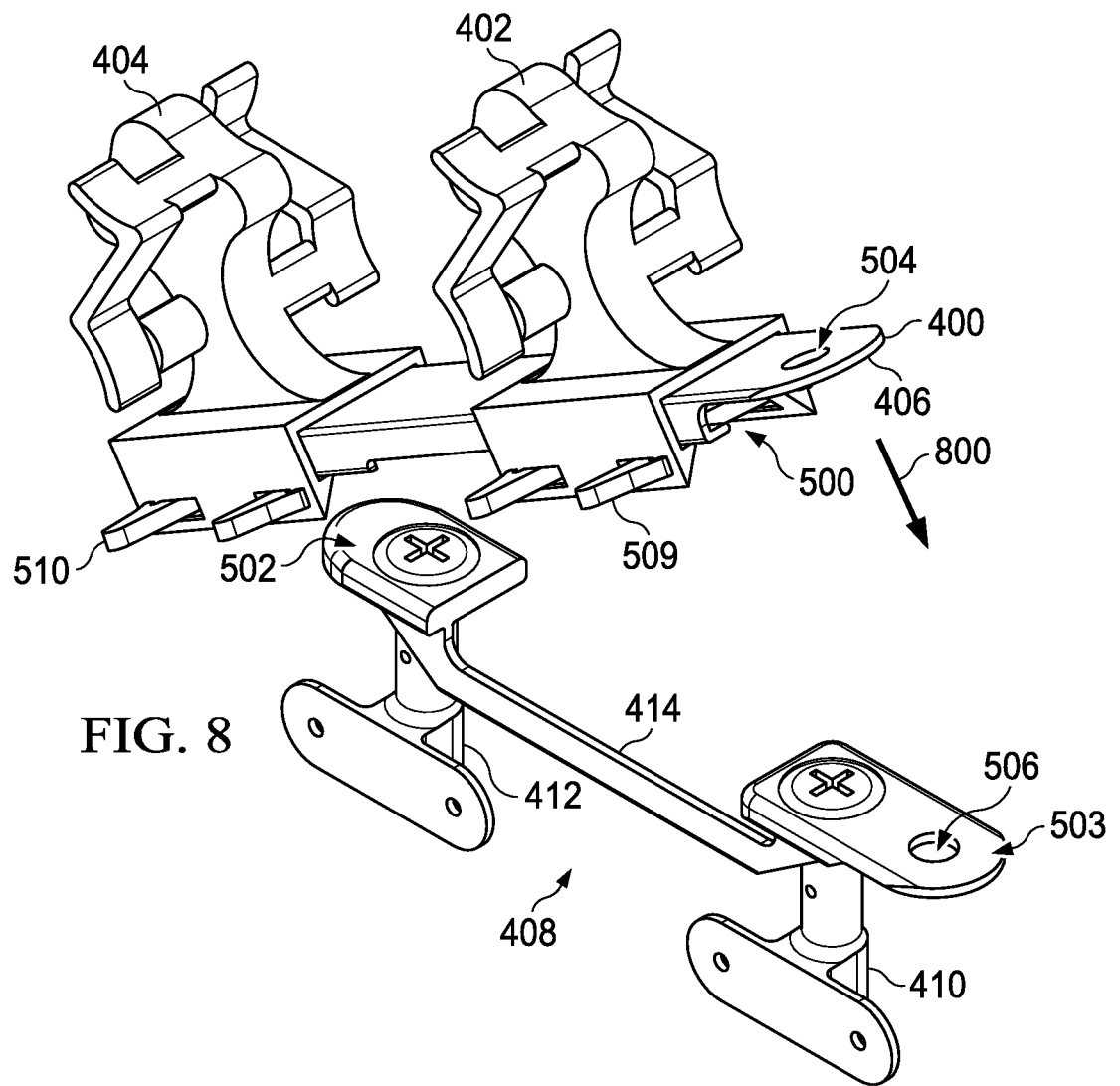


7/22

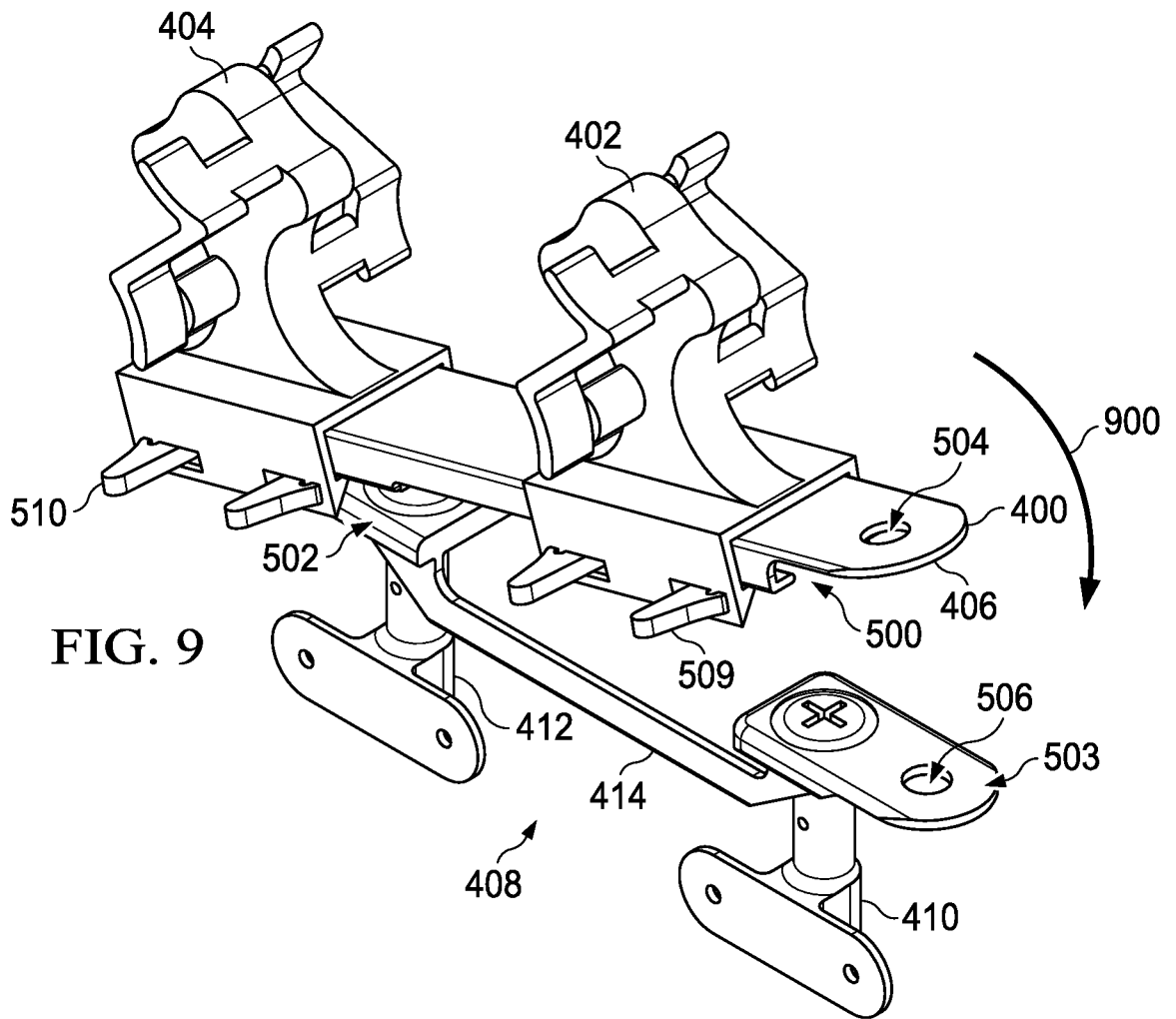
FIG. 7



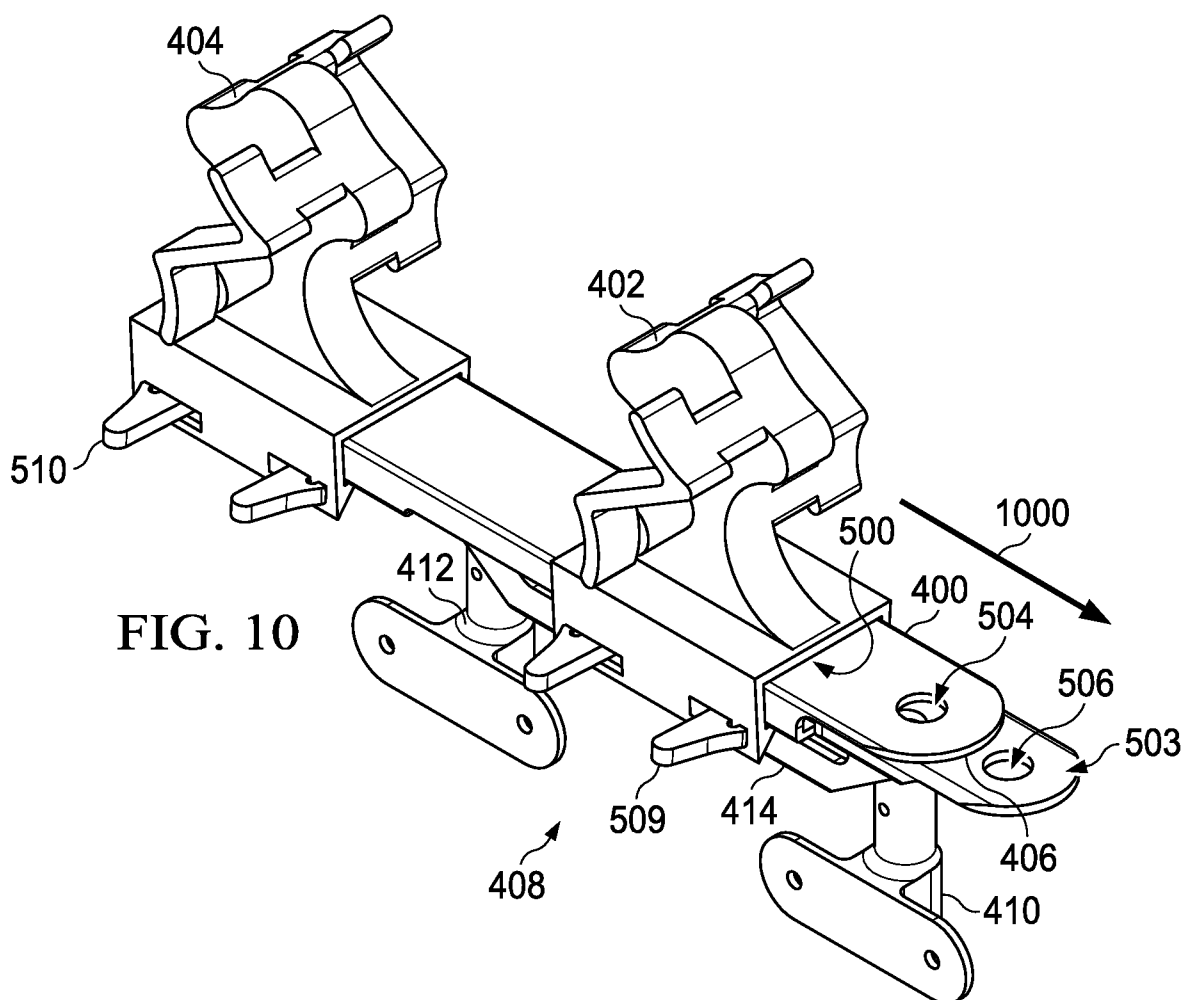
8/22

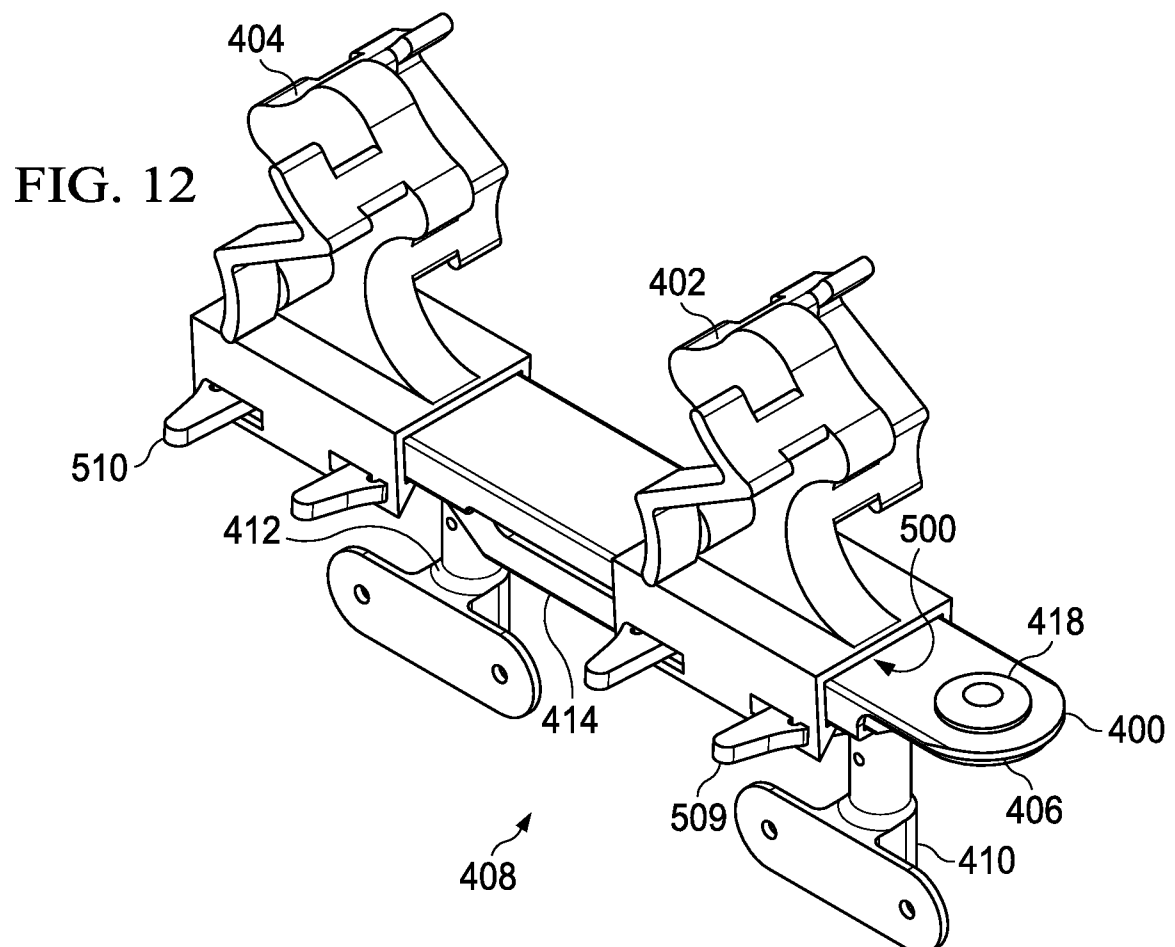
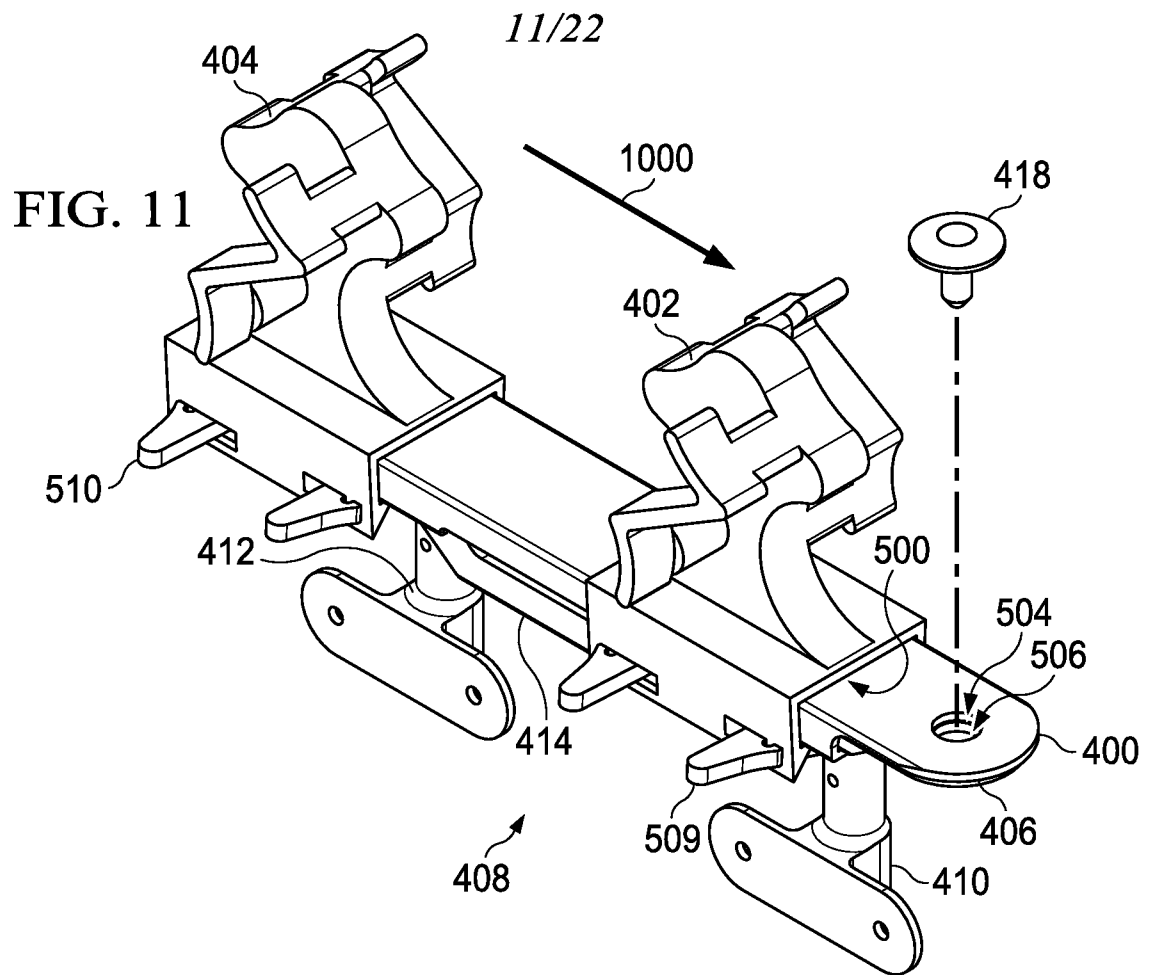


9/22

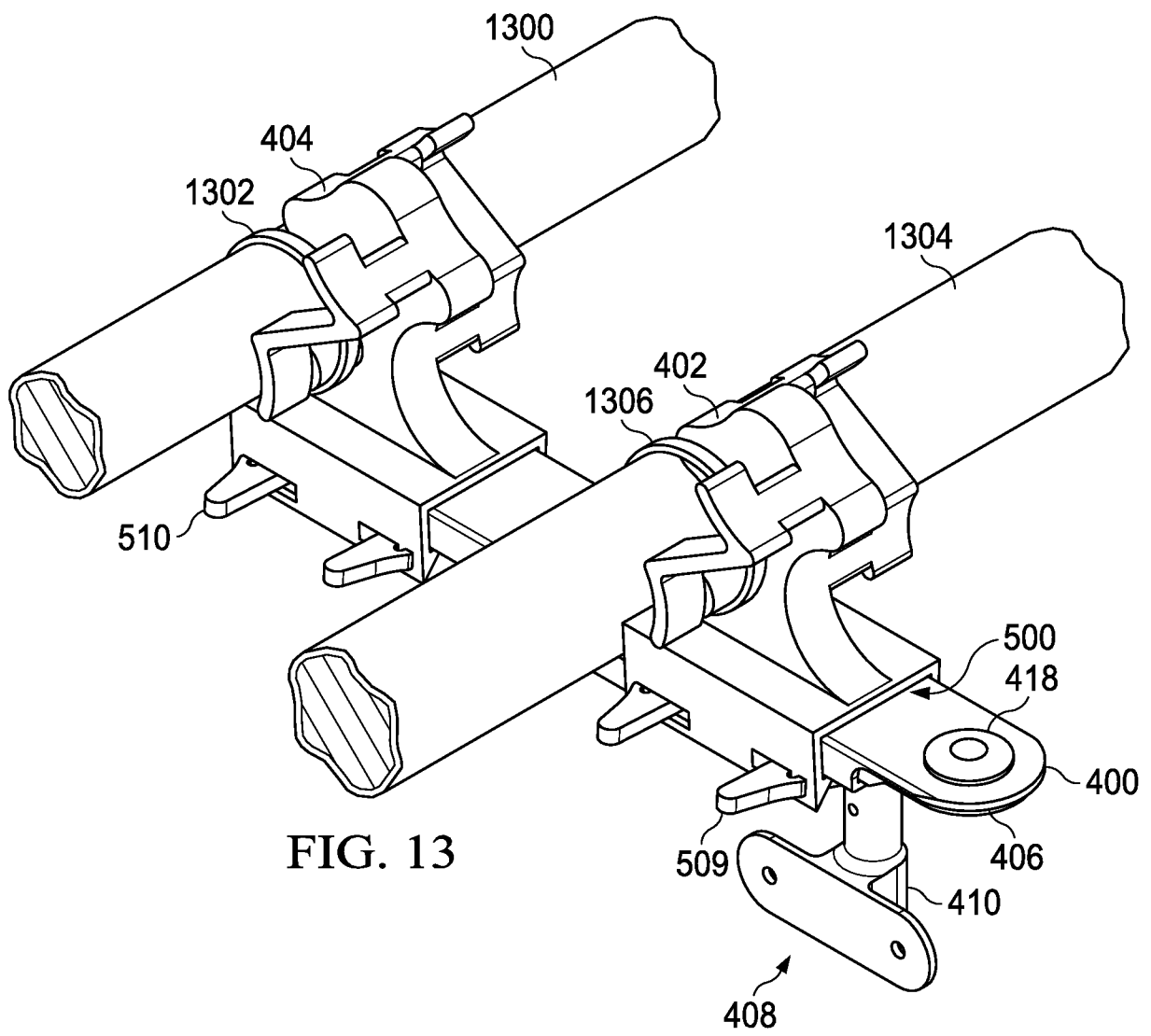


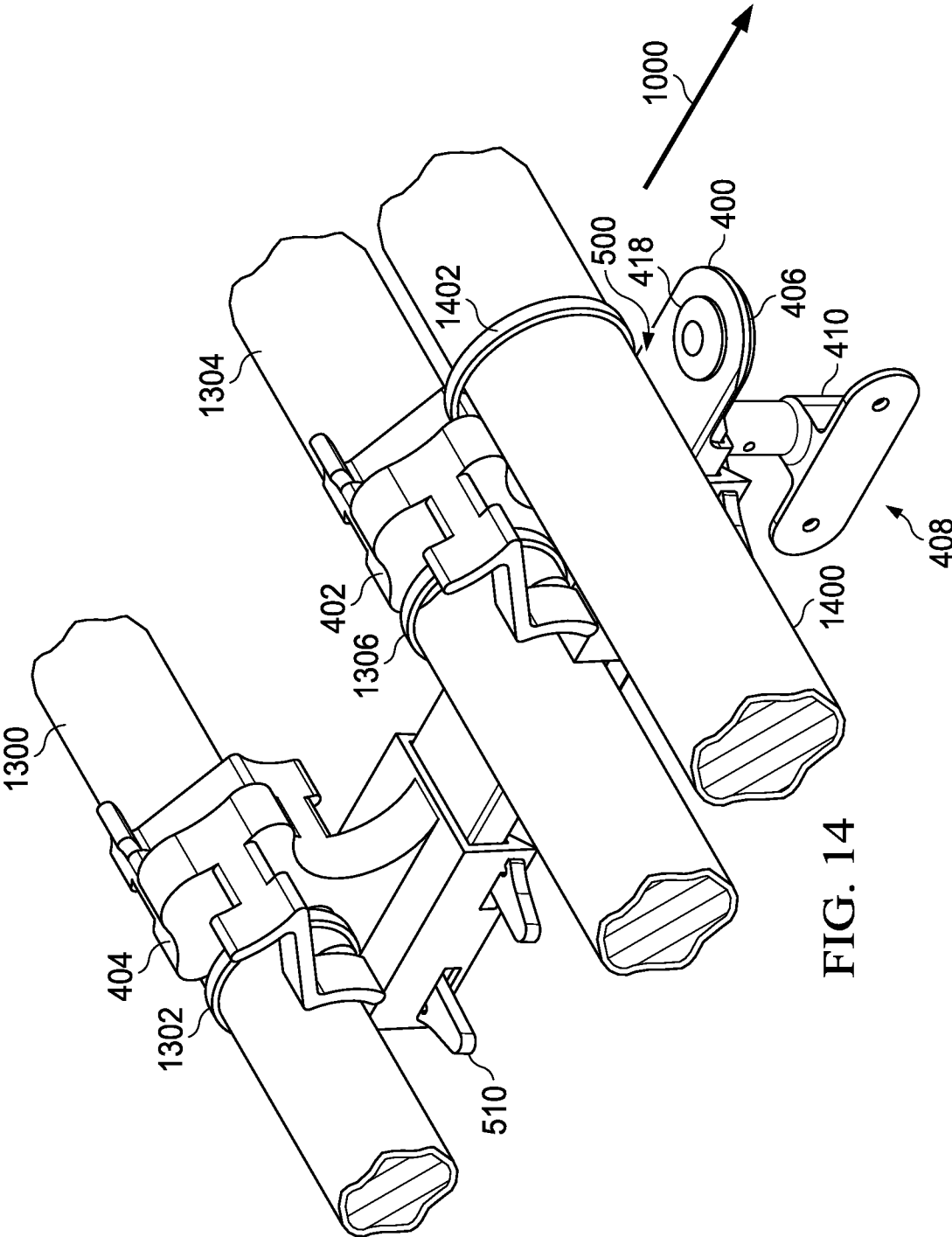
10/22





12/22





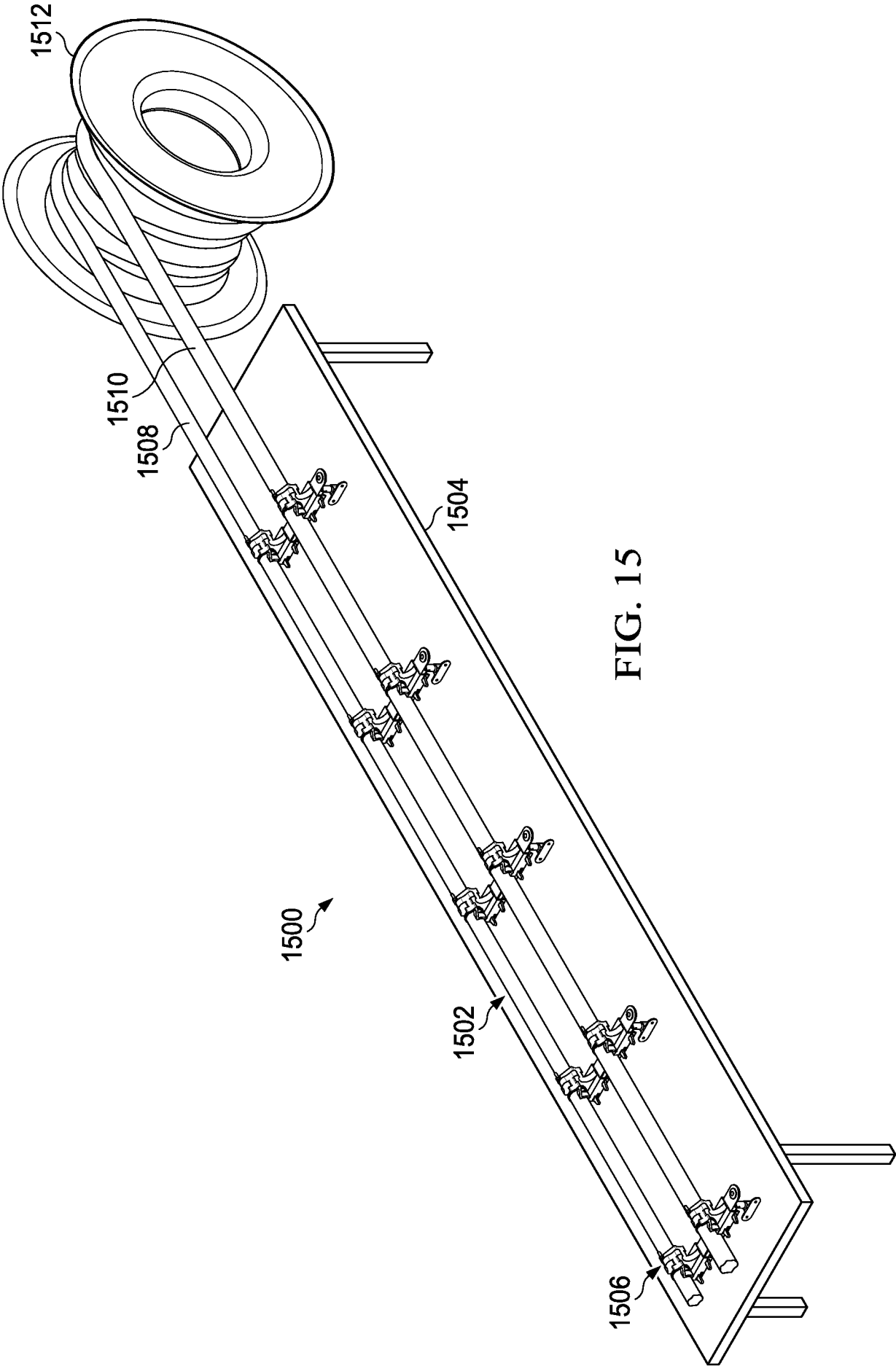
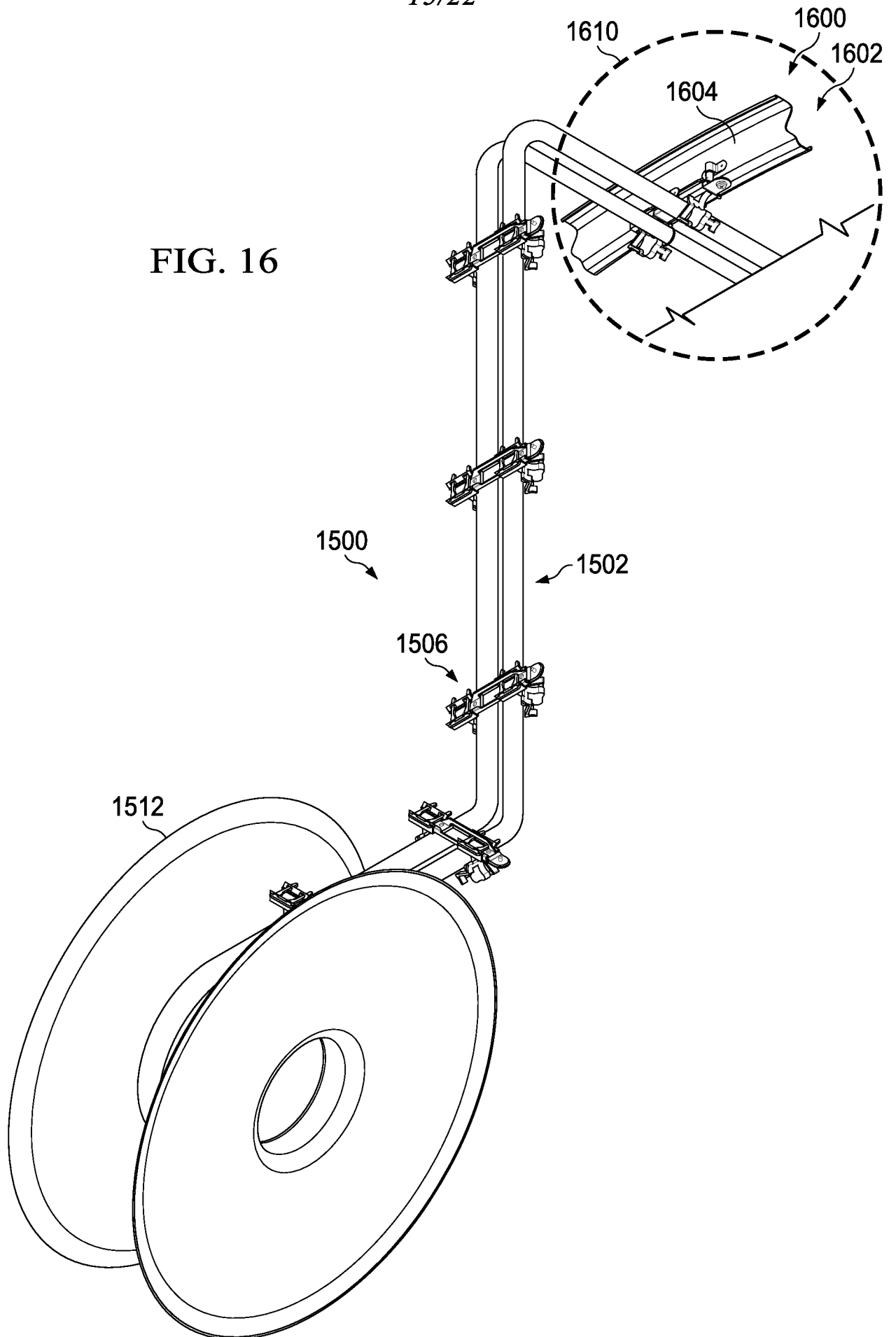
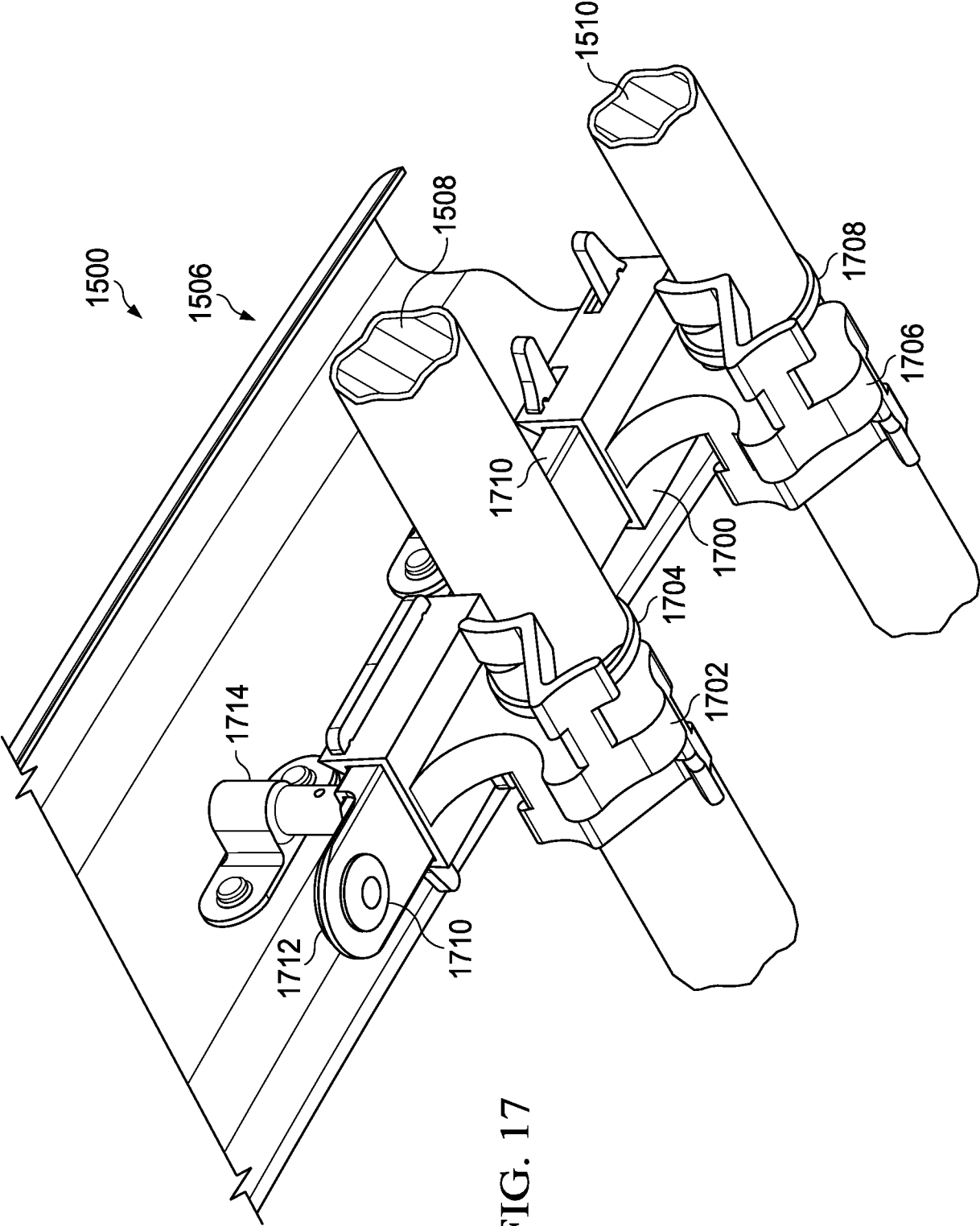


FIG. 15

15/22

FIG. 16





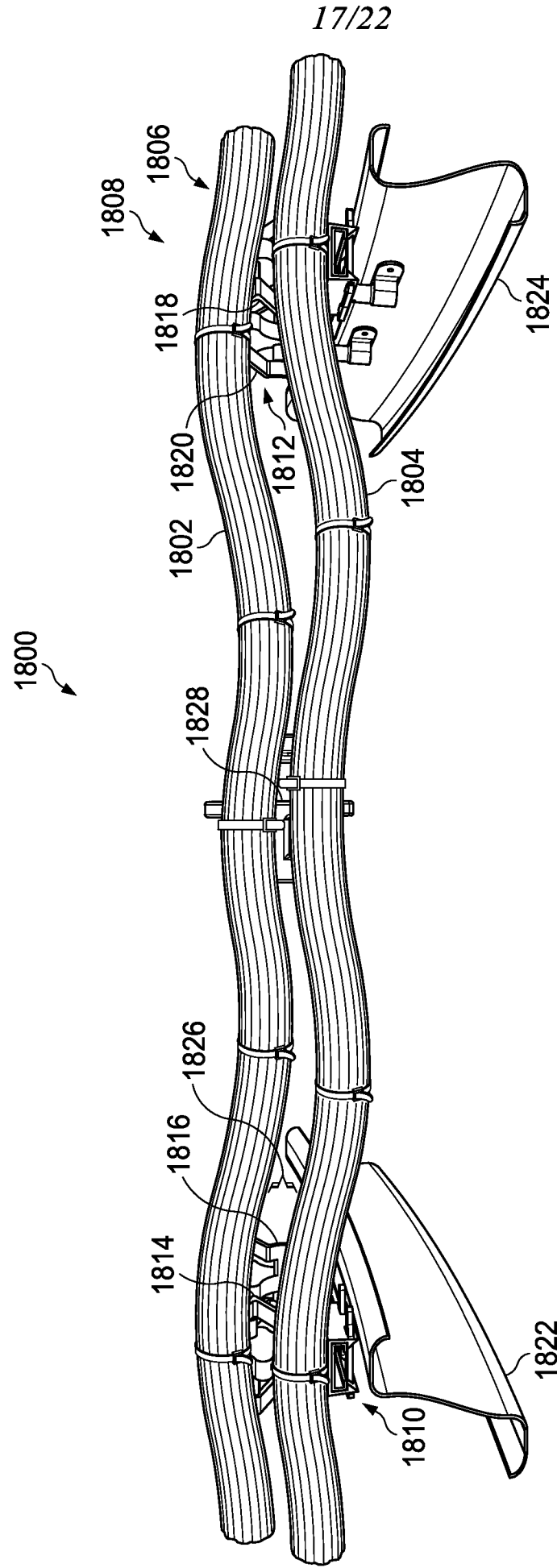


FIG. 18

18/22

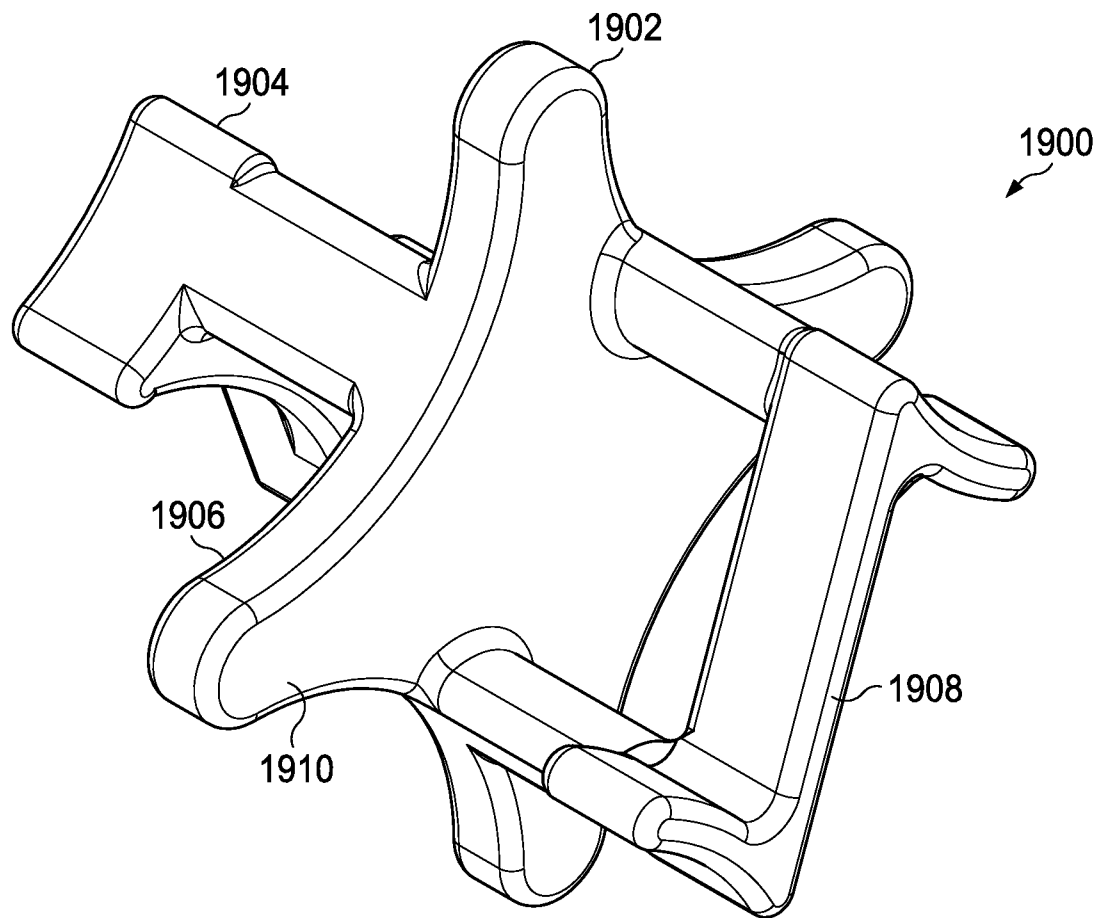
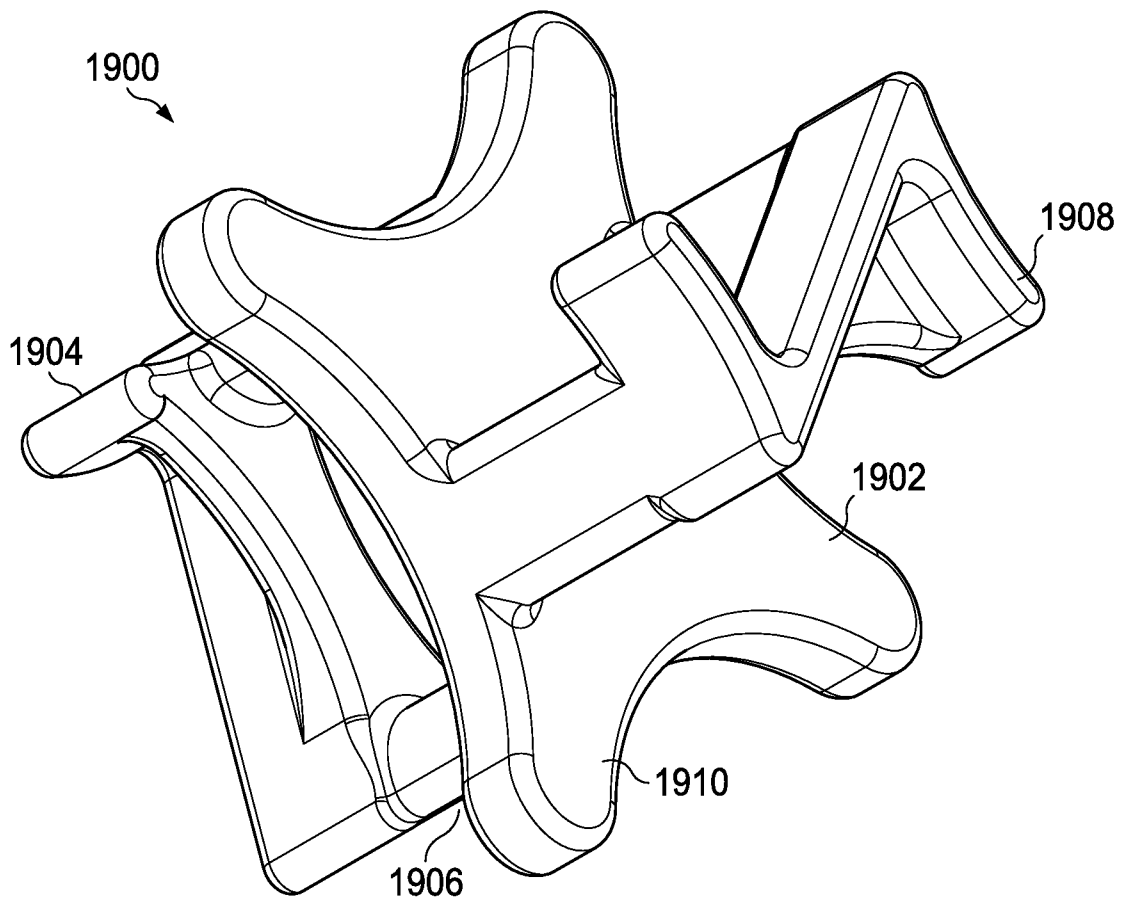


FIG. 19

19/22

FIG. 20



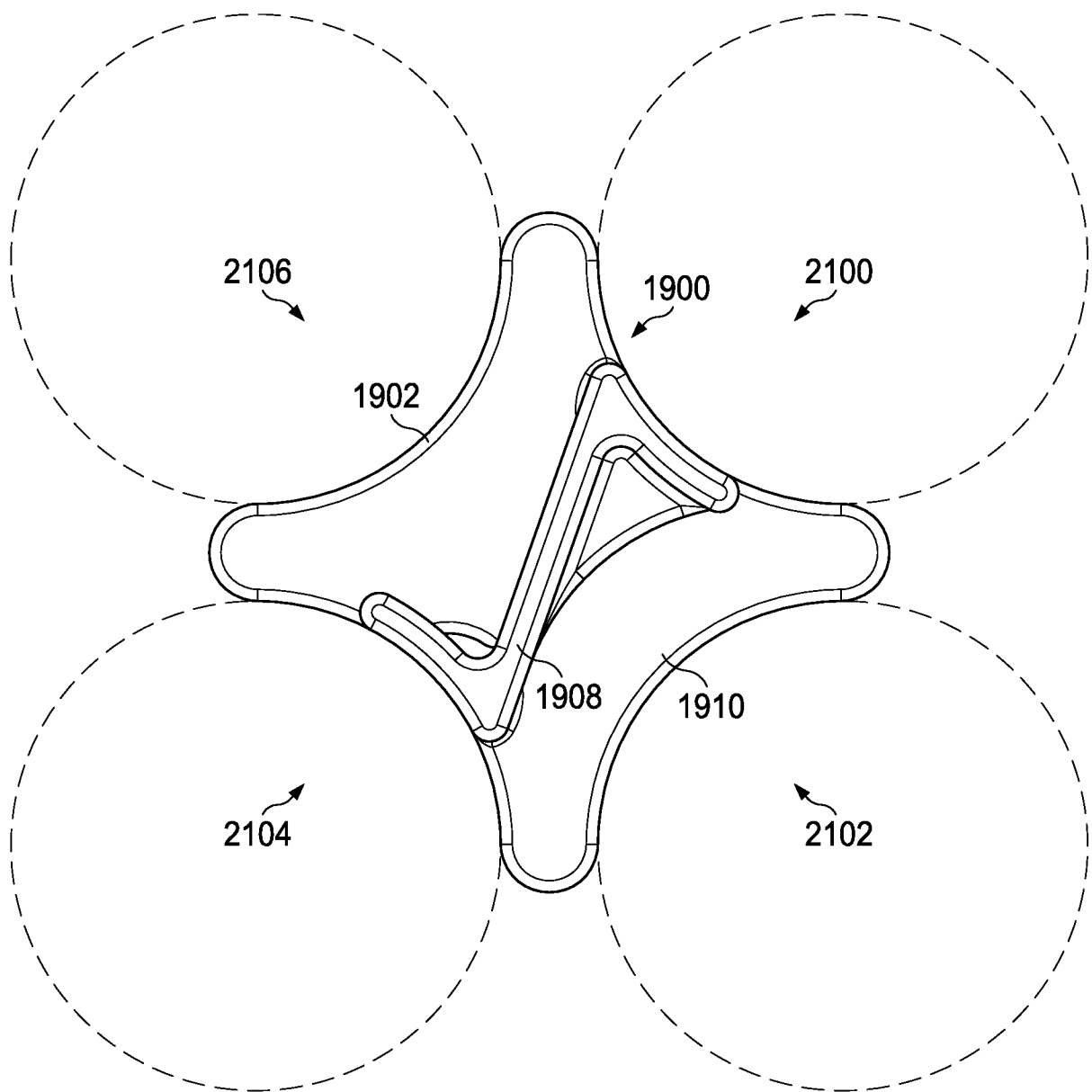


FIG. 21

21/22

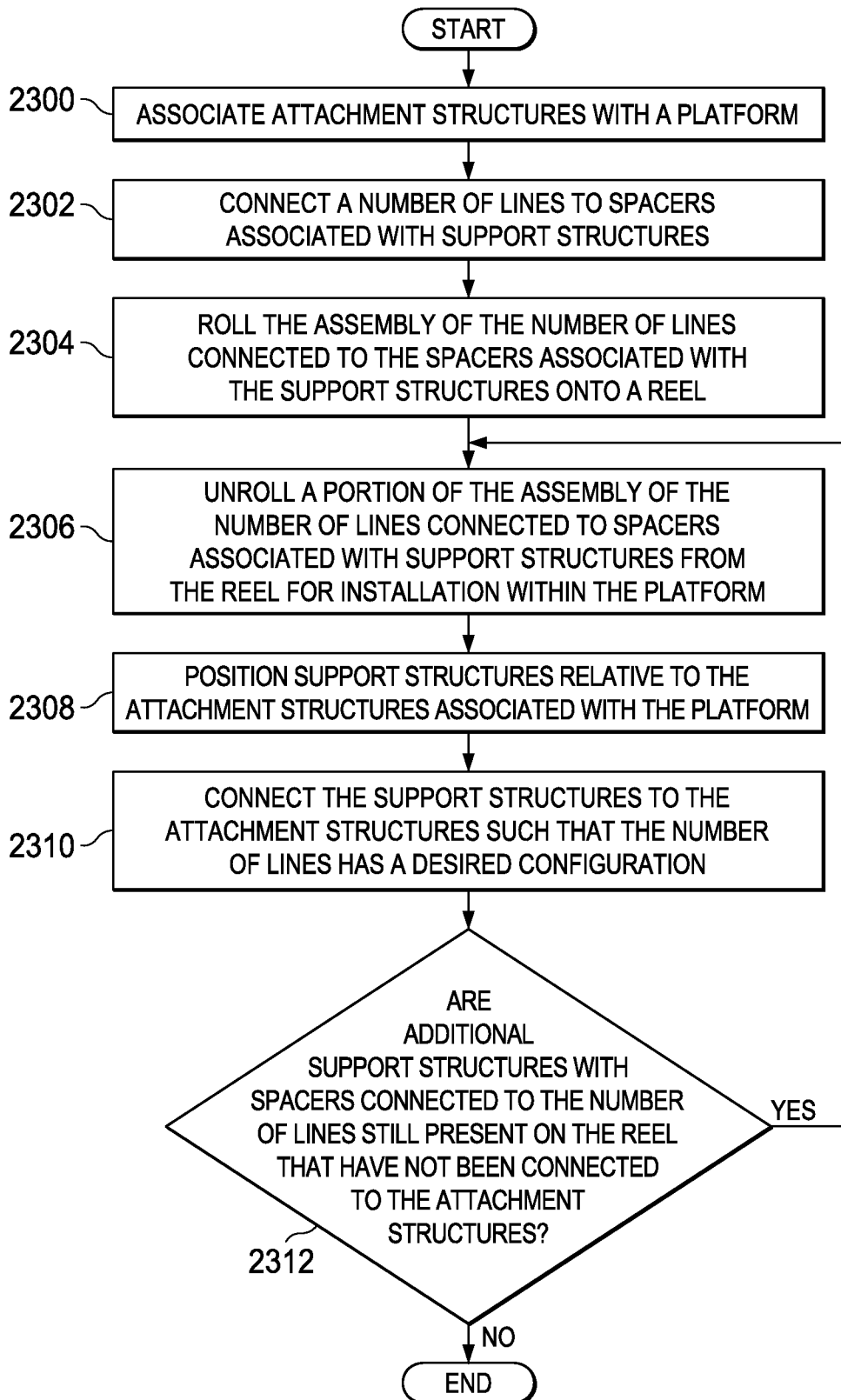
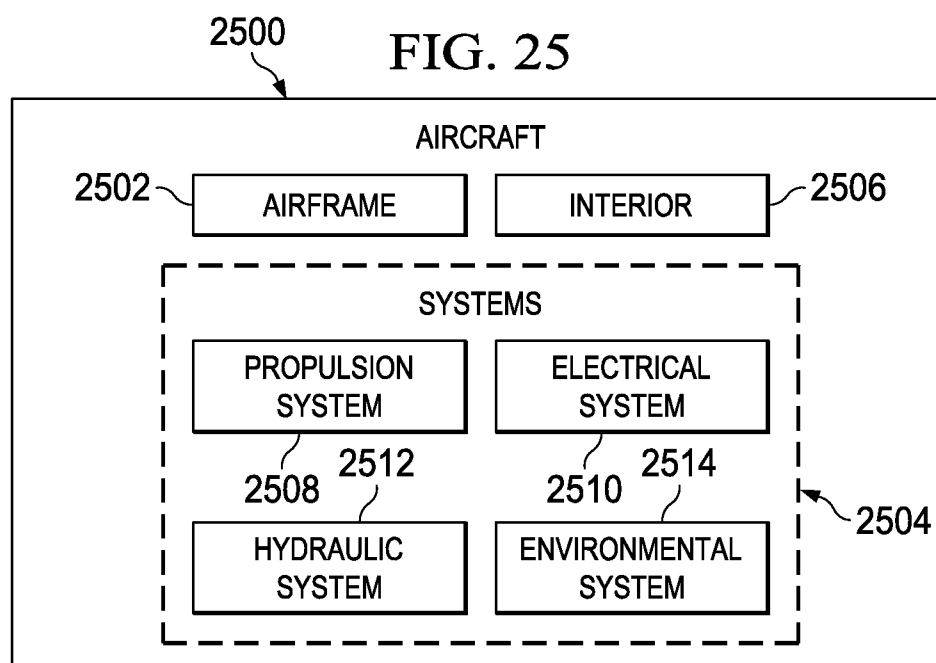
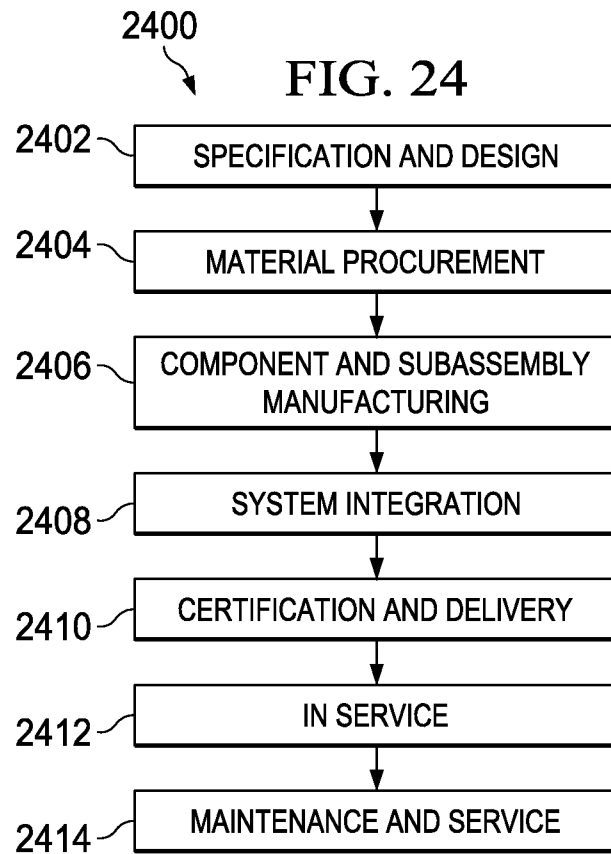


FIG. 23

22/22



INTERNATIONAL SEARCH REPORT

International application No
PCT/US2013/045036

A. CLASSIFICATION OF SUBJECT MATTER
INV. H02G3/32
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)

H02G B64C F16L

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)

EP0-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2005/242245 A1 (BALDERAMA MARK [US] ET AL) 3 November 2005 (2005-11-03) the whole document -----	1-14
X	EP 2 399 823 A1 (AIRBUS OPERATIONS SAS [FR]) 28 December 2011 (2011-12-28) the whole document -----	1,6
X	US 2009/159750 A1 (SAYILGAN CIHANGIR [DE] ET AL) 25 June 2009 (2009-06-25) the whole document -----	1,6
X	DE 10 2007 060030 A1 (AIRBUS GMBH [DE]) 4 December 2008 (2008-12-04) the whole document -----	1,5-7,9, 10



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"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

14 October 2013

Date of mailing of the international search report

24/10/2013

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Rieutort, Alain

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2013/045036

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2005242245 A1	03-11-2005	NONE	
EP 2399823 A1	28-12-2011	EP 2399823 A1	28-12-2011
		FR 2961490 A1	23-12-2011
		US 2012160962 A1	28-06-2012
US 2009159750 A1	25-06-2009	NONE	
DE 102007060030 A1	04-12-2008	DE 102007060030 A1	04-12-2008
		US 2008296443 A1	04-12-2008