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(54) Title: CLAMP DEVICE FOR USE WITH A DECOMPRESSION PANEL IN AN AIRCRAFT ASSEMBLY

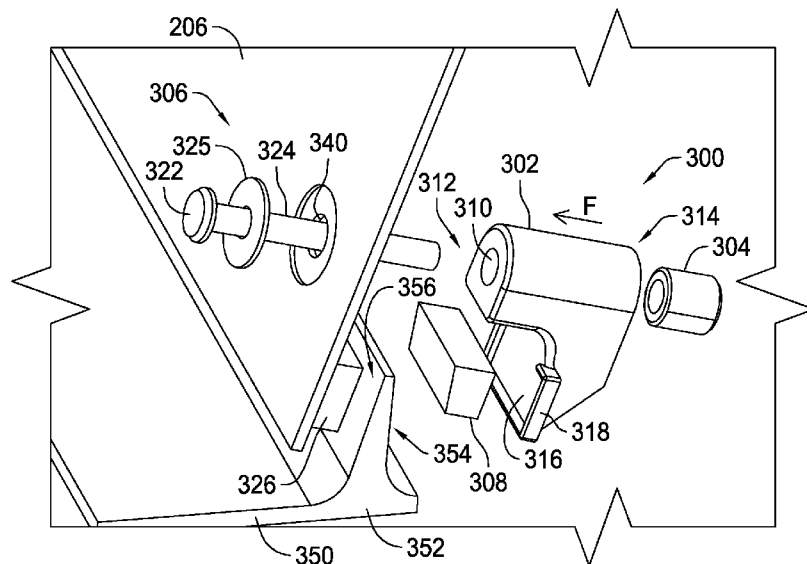


FIG. 4

(57) Abstract: A clamp device (30) includes a clamp portion (302) defining a threaded opening (310) therein. The clamp portion (302) is configured to contact a first side (354) of a beam (350). The clamp device (300) also includes a threaded fastener (306) configured for insertion into the threaded opening (310) via a hole (340) defined within the decompression panel (206). The clamp device (300) causes the decompression panel (206) to contact a second side (356) of the beam (350) when the threaded fastener (306) is tightened within the threaded opening (310).



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CLAMP DEVICE FOR USE WITH A DECOMPRESSION PANEL IN AN AIRCRAFT ASSEMBLY

BACKGROUND

5 The field of the present disclosure relates generally to aircraft assemblies and, more specifically, to decompression panels for use in aircraft assemblies.

 At least some known aircraft include several openings defined between a passenger compartment and adjacent compartments of an aircraft cabin. Such known openings serve a dual purpose. During normal operation, the openings define an air
10 flow path that enables conditioned air to be circulated through the aircraft cabin. During a decompression event, the openings allow large quantities of air to flow therethrough to facilitate equalizing the pressure within the aircraft cabin.

 In at least some known aircraft, the openings are covered with several panels including a grille and/or louvers. At least one known method of installing the panels in
15 the aircraft cabin includes shingling the panels together. However, such method does not provide positive retention between adjacent panels nor positive retention between panels and interfacing airplane components. Without positive retention, passengers may deflect panel surfaces to access areas behind the panel. Moreover, the panels may migrate during flight and expose gaps in the cabin.

20 Another method of installation includes coupling the panels to aircraft crease beams using clamping mechanisms that rotate or swing into place such that pads positioned against opposing sides of the crease beam hold the panel in place. However, such clamping mechanisms assume a uniform thickness of the crease beams, but crease beams actually have differing thicknesses. As such, the clamping
25 force applied by the clamping mechanisms may vary throughout the cabin.

BRIEF DESCRIPTION

 In one aspect, a clamp device for use with a decompression panel is provided. The clamp device includes a clamp portion defining a threaded opening therein. The clamp portion is configured to contact a first side of a beam. The clamp device also

5 includes a threaded fastener configured for insertion into the threaded opening via a hole defined within the decompression panel. The clamp device causes the decompression panel to contact a second side of the beam when the threaded fastener is tightened within the threaded opening.

10 In another aspect, an aircraft is provided. The aircraft includes a beam including a first side and an opposing second side and a decompression panel coupled to the beam. A clamp device is coupled to the beam and to the decompression panel. The clamp device includes a clamp portion defining a threaded opening therein, wherein the clamp portion is configured to be coupled to the first side. The clamp device also includes a threaded fastener configured for insertion into the threaded opening through
15 the decompression panel. The clamp device causes the decompression panel to contact the second side when the threaded fastener is rotated within the threaded opening.

In yet another aspect, a method of fastening a decompression panel to a beam is provided. The beam includes a first side and a second side. The method includes
20 positioning a decompression panel proximate the beam and positioning a clamp portion on the first side, wherein the clamp portion includes a threaded opening defined therein. A threaded fastener is then inserted through the decompression panel into the threaded opening and rotated such that the clamp device causes the decompression panel to contact the second side of the beam.

BRIEF DESCRIPTION OF THE DRAWINGS

25 FIG. 1 is a flow diagram of an exemplary aircraft production and service methodology.

FIG. 2 is a block diagram of an exemplary aircraft.

FIG. 3 is a perspective sectional view of an exemplary aircraft cabin.

FIG. 4 is an exploded view of an exemplary clamp device that may be used with
30 the decompression panel shown in FIG. 3.

5 FIG. 5 is a perspective view of a portion of the clamp device shown in FIG. 4 including a guide feature.

 FIG. 6 is a perspective view of the decompression panel shown in FIG. 3 including a plurality of holes.

 FIG. 7 is a schematic flow diagram of a method of fastening the decompression
10 panel using clamp device shown on FIG. 4.

DETAILED DESCRIPTION

 The implementations described herein relate to a clamp device for use in an aircraft assembly. More specifically, the clamp device includes a clamp portion that applies an axial clamping force when a fastener is tightened or rotated within the clamp portion. When the axial clamping force is applied, a pad coupled to the clamp portion is
15 configured to interface with a crease beam of an aircraft and couple a decompression panel to the crease beam. The axial clamp force enables the clamp device to apply a consistent clamping force for a variety of crease beam thicknesses. Moreover, the axial clamping creates a secure coupling between the decompression panel and the crease beam to restrict access to an area behind the decompression panel. Furthermore, the
20 threaded fastener is configured with a drive system that prevents passengers from unauthorized removal of the decompression panels.

 Referring to the drawings, implementations of the disclosure may be described in the context of an aircraft manufacturing and service method 100 (shown in FIG. 1) and via an aircraft 102 (shown in FIG. 2). During pre-production, including specification and
25 design 104 data of aircraft 102 may be used during the manufacturing process and other materials associated with the airframe may be procured 106. During production, component and subassembly manufacturing 108 and system integration 110 of aircraft 102 occurs, prior to aircraft 102 entering its certification and delivery process 112. Upon successful satisfaction and completion of airframe certification, aircraft 102 may be
30 placed in service 114. While in service by a customer, aircraft 102 is scheduled for periodic, routine, and scheduled maintenance and service 116, including any modification, reconfiguration, and/or refurbishment, for example. In alternative

5 implementations, manufacturing and service method 100 may be implemented via vehicles other than an aircraft.

Each portion and process associated with aircraft manufacturing and/or service 100 may be performed or completed by a system integrator, a third party, and/or an operator (e.g., a customer). For the purposes of this description, a system integrator
10 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, leasing company, military entity, service organization, and so on.

As shown in FIG. 2, aircraft 102 produced via method 100 may include an
15 airframe 118 having a plurality of systems 120 and an interior 122. Examples of high-level systems 120 include one or more of a propulsion system 124, an electrical system 126, a hydraulic system 128, and/or an environmental system 130. Any number of other systems may be included.

Apparatus and methods embodied herein may be employed during any one or
20 more of the stages of method 100. For example, components or subassemblies corresponding to component production process 108 may be fabricated or manufactured in a manner similar to components or subassemblies produced while aircraft 102 is in service. Also, one or more apparatus implementations, method implementations, or a combination thereof may be utilized during the production stages
25 108 and 110, for example, by substantially expediting assembly of, and/or reducing the cost of assembly of aircraft 102. Similarly, one or more of apparatus implementations, method implementations, or a combination thereof may be utilized while aircraft 102 is being serviced or maintained, for example, during scheduled maintenance and service 116.

30 As used herein, the term “aircraft” may include, but is not limited to only including, airplanes, unmanned aerial vehicles (UAVs), gliders, helicopters, and/or any other object that travels through airspace. Further, in an alternative implementation, the aircraft manufacturing and service method described herein may be used in any manufacturing and/or service operation.

5 FIG. 3 is a perspective sectional view of an exemplary aircraft cabin 200 that may be used with aircraft 102. In the exemplary implementation, aircraft cabin 200 includes a side wall 202, a floor panel 204, and decompression panels 206 coupled therebetween that at least partially define an interior 208 of aircraft cabin 200. Side wall 202 also includes a window opening 210 defined therein. In operation, decompression
10 panels 206 facilitate circulating conditioned air through aircraft cabin 200 and/or facilitate equalizing the pressure in aircraft cabin 200 during a decompression event.

 FIG. 4 is an exploded view of a clamp device 300 that may be used with decompression panel 206.

 In the exemplary implementation, clamp device 300 includes a clamp portion
15 302, a threaded insert 304, a fastener 306, and a first pad 308. Clamp portion 302 defines a threaded opening 310 therein extending from a clamp portion first end 312 to a clamp portion second end 314. At second end 314, opening 310 has a cross-sectional area that is greater than a cross-sectional area of opening 310 at first end 312 to facilitate receiving threaded insert 304 therein. Clamp portion 302 also includes a
20 clamp head 316 for receiving and securing first pad 308 in position against a crease beam 350. Crease beam 350 includes a flange 352 having a first, outboard side 354 and a second, inboard side 356. Clamp head 316 includes at least one molded sidewall 318 that aligns and retains first pad 308.

 In the exemplary implementation, fastener 306 is a bolt or screw that includes a
25 drive portion 322 and a threaded portion 324. Threaded portion 324 is configured to engage with threaded insert 304. More specifically, fastener is inserted through a hole 340 defined in decompression panel 206 from interior 208 of aircraft cabin 200 (shown in FIG. 3). Drive portion 322 has any drive design that enables clamp device 300 to function as described herein. In the exemplary implementation, drive portion 322
30 includes one of a hex socket, a security hex socket (pin-in-hex socket), a torx, a security torx, or a tri-wing style of fastener drive. In an alternative implementation, drive portion may have a design that is customized for a particular purchaser. As such, a customized tool is necessary to install and/or remove fastener 306 and it will be more difficult for the passengers to remove decompression panel 206 to access behind panel 206 from
35 interior 208. As fastener 306 is rotated within threaded insert 304, a clamping force F

5 pulls clamp portion 302 toward decompression panel 206 in an axial direction. In some
embodiments, a washer 325 may be provided between fastener 306 and
decompression panel 206 to distribute a load applied when torque is applied to engage
fastener 306 with threaded insert 304. In an alternative implementation, decompression
panel 206 may include geometry such that drive portion 322 contained concentric to
10 panel hole 340 without threaded portion 324 extended through hole 340.

In the exemplary implementation, first pad 308 may be fabricated from any
suitable material. Exemplary materials include, but are not limited to, silicone-based
materials and rubber-based materials. First pad 308 is coupled to clamp head 316 and
is configured to interface with flange first side 354 when fastener 306 is tightened via
15 rotation. In some implementations, a second pad 326 may be provided between
decompression panel 206 to interface with flange second side 356.

FIG. 5 is a perspective view of a portion of decompression panel 206 including at
least one guide feature 328. In the exemplary implementation, guide feature 328 is
coupled to decompression panel 206 above hole 340. Guide feature 328 has a shape
20 that corresponds to first end 312 of clamp portion 302. Guide feature 328 is configured
to receive first end 312 of clamp portion 302 and prevent clamp device 300 from rotating
as fastener 306 is tightened. Alternatively, guide feature 328 may have any geometry
that restrains angular orientation and translational position of clamp device 300 relative
to panel hole 340. Multiple guide features may be included in panel 206 such that clamp
25 device 300 may be modularly installed at alternative locations in order to be compatible
with variations in crease beam 350 geometry.

FIG. 6 is a perspective view of decompression panel 206 including a plurality of
holes. Decompression panel 206 includes a plurality of holes 340 at various locations
along decompression panel 206 for receiving clamp device 300. Having a plurality of
30 holes 340 enables a position of clamp device 300 to be adjusted for different
configurations of crease beams 350. A self-adhesive patch 342, such as TEDLAR®
(TEDLAR is a registered trademark of E. I. du Pont de Nemours and Company,
Wilmington, DE), is provided to cover any unused hole 340. Patch 342 is configured to
mimic a color and/or a texture of a decorative surface on and interior side 344 of
35 decompression panel 206. As such, multiple holes 340 are provided to support modular

5 installation of clamp device 300 at alternative locations without affecting visual aesthetics of decompression panel 206.

FIG. 7 is a schematic flow diagram of a method 400 of fastening a decompression panel, such as decompression panel 206 (shown in FIG. 3), to a beam, such as crease beam 350 (shown in FIG. 4), using a clamp device, such as clamp
10 device 300 (shown in FIG. 4). Method 400 includes providing 402 a beam having a first side, such as outboard side 354 (shown in FIG. 4), and a second side, such as inboard side 356 (shown in FIG. 4). Method 400 also includes providing 404 the decompression panel for mounting to the beam and positioning 406 a clamp portion, such as clamp portion 302 (shown in FIG. 4), proximate the decompression panel. The clamp portion
15 includes a threaded opening, such as threaded opening 310 (shown in FIG. 4), defined therein. A threaded fastener, such as threaded fastener 306 (shown in FIG. 4), is then inserted 408 through the decompression panel into the threaded opening.

Method 400 further includes inserting 410 a threaded insert, such as threaded insert 304 (shown in FIG. 4), into the threaded opening of the clamp portion, wherein
20 the threaded fastener is inserted into a first end of the clamp portion and the threaded insert is inserted into an opposing second end of the clamp portion. Once the threaded fastener, clamp, and decompression panel are thus assembled, the decompression panel is installed into an aircraft cabin relative to a sidewall, such as sidewall 202 (shown in Fig. 3) and the crease beam. As such, at least a portion of the clamp device
25 and the decompression panel are pre-assembled prior to installing 412 the decompression panel into the aircraft such that the clamp portion is proximate the first side. This is advantageous because it avoids a maintenance technician having to assemble the clamp device in place and allows the technician to simply position the pads and tighten the fastener, as described below.

30 A first pad, such as first pad 308 (shown in FIG. 4), is then coupled 414 between the clamp portion and the first side of the beam, and a second pad, such as second pad 326 (shown in FIG. 4), is coupled 416 between the decompression panel and the second side of the beam. Method also includes rotating 418 the threaded fastener such that the clamp device causes the decompression panel to contact the second side of
35 the beam.

5 The clamp device described herein includes a clamp portion that applies an axial clamping force when a fastener is tightened within the clamp portion, and facilitates at least one of (a) applying a consistent clamping force for a variety of crease beam thicknesses; (b) increasing a strength and a mechanical stability of a coupling between a decompression panel and the crease beam; (c) reducing clamping pad damage; and
10 (d) restricting access to areas behind the decompression panel; and (e) providing multiple configurable locations per panel to accommodate beam geometry variations.

Further, the disclosure comprises the embodiments according to the following clauses:

15 Clause 1. A clamp device for use with a decompression panel, said clamp device comprising: a clamp portion defining a threaded opening therein, said clamp portion configured to contact a first side of a beam; and a threaded fastener configured for insertion into the threaded opening via a hole defined within the decompression panel, wherein said clamp device causes the decompression panel to contact a second side of the beam when said threaded fastener is rotated within the threaded opening.

20 Clause 2. The clamp device in accordance with Clause 1 further comprising a guide feature coupled to the decompression panel proximate the hole, said guide feature configured to receive at least a portion of said clamp portion to prevent said clamp portion from rotating.

25 Clause 3. The clamp device in accordance with Clause 1, wherein said clamp portion includes a first end and an opposing second end, wherein a diameter of the threaded opening at said first end is smaller than a second diameter of the threaded opening at said second end.

30 Clause 4. The clamp device in accordance with Clause 3 further comprising a threaded insert configured for insertion into the threaded opening at said second end, wherein the threaded fastener is configured to be inserted into said first end and to engage said threaded insert.

5 Clause 5. The clamp device in accordance with Clause 1 further comprising: a first pad positioned between said clamp portion and the beam; and a second pad positioned between the decompression panel and the beam.

 Clause 6. The clamp device in accordance with Clause 1, wherein said clamp portion includes a clamp head configured to receive and secure a pad against said first
10 side of the beam.

 Clause 7. The clamp device in accordance with Clause 6, wherein said clamp head includes at least one molded sidewall configured to align and retain said pad against said first side of the beam.

 Clause 8. An aircraft comprising: a beam comprising a first side and an opposing
15 second side; a decompression panel coupled to said beam; and a clamp device coupled to said beam and to said decompression panel, said clamp device comprising: a clamp portion defining a threaded opening therein, said clamp portion configured to be coupled to said first side; and a threaded fastener configured for insertion into the threaded opening through said decompression panel, wherein said clamp device causes said
20 decompression panel to contact said second side when said threaded fastener is rotated within the threaded opening.

 Clause 9. The aircraft in accordance with Clause 8, wherein said decompression panel comprises a plurality of holes defined therein, said threaded fastener configured to be inserted through a first of said plurality of holes into said clamp portion.

25 Clause 10. The aircraft in accordance with Clause 9 further comprising a patch configured to cover a second of the plurality of holes defined in said decompression panel.

 Clause 11. The aircraft in accordance with Clause 8, wherein said decompression panel includes a guide feature configured to receive at least a portion of
30 said clamp portion to prevent said clamp portion from rotating.

 Clause 12. The aircraft in accordance with Clause 8, wherein said clamp portion includes a first end and an opposing second end, wherein a diameter of the threaded

- 5 opening at said first end is smaller than a second diameter of the threaded opening at said second end.

Clause 13. The aircraft in accordance with Clause 12, wherein said clamp device further comprises a threaded insert configured for insertion into the threaded opening at said second end, wherein said threaded fastener is configured to be inserted
10 into said first end and to engage said threaded insert.

Clause 14. The aircraft in accordance with Clause 8, wherein said clamp device further comprises: a first pad positioned between said clamp portion and said beam; and a second pad positioned between said decompression panel and said beam.

Clause 15. The aircraft in accordance with Clause 8, wherein said clamp portion
15 includes a clamp head configured to receive and secure a pad against said first side of said beam, wherein said clamp head includes at least one molded sidewall configured to align and retain said pad against said first side of said beam.

Clause 16. A method of fastening a decompression panel to a beam having a first side and a second side, said method comprising: providing a decompression panel
20 for mounting to the beam; positioning a clamp portion proximate the decompression panel, wherein the clamp portion includes a threaded opening defined therein; inserting a threaded fastener through the decompression panel into the threaded opening; and rotating the threaded fastener such that the clamp portion causes the decompression panel to contact the second side of the beam.

25 Clause 17. The method in accordance with Clause 16 further comprising coupling a guide feature to the decompression panel, wherein the guide feature is configured to receive at least a portion of the clamp portion to prevent the clamp portion from rotating.

Clause 18. The method in accordance with Clause 16 further comprising:
30 coupling a first pad between the clamp portion and the first side of the beam; and coupling a second pad between the decompression panel and the second side of the beam.

5 Clause 19. The method in accordance with Clause 18, wherein coupling a first pad between the clamp portion and the first side of the beam further comprises coupling the first pad between a clamp head of the clamp portion and the first side of the beam, wherein the clamp head is configured to receive and secure the first pad against the first side of the beam.

10 Clause 20. The method in accordance with Clause 16 further comprising inserting a threaded insert into the threaded opening of the clamp portion, wherein the threaded fastener is inserted into a first end of the clamp portion and the threaded insert is inserted into an opposing second end of the clamp portion.

15 This written description uses examples to disclose various implementations, including the best mode, and also to enable any person skilled in the art to practice the various implementations, including making and using any devices or systems and performing any incorporated methods. The patentable scope of the disclosure is defined by the claims, and may include other examples that occur to those skilled in the art. Such other examples are intended to be within the scope of the claims if they have
20 structural elements that do not differ from the literal language of the claims, or if they include equivalent structural elements with insubstantial differences from the literal language of the claims.

WHAT IS CLAIMED IS:

5 1. A clamp device (300) for use with a decompression panel (206), said clamp device comprising:

 a clamp portion (302) defining a threaded opening (310) therein, said clamp portion configured to contact a first side (354) of a beam (350); and

 a threaded fastener (306) configured for insertion into the threaded opening via a
10 hole (340) defined within the decompression panel, wherein said clamp device causes the decompression panel to contact a second side (356) of the beam when said threaded fastener is rotated within the threaded opening.

 2. The clamp device (300) in accordance with Claim 1 further comprising a guide feature (328) coupled to the decompression panel (206) proximate the hole (340), said
15 guide feature configured to receive at least a portion of said clamp portion (302) to prevent said clamp portion from rotating.

 3. The clamp device (300) in accordance with Claim 1 or 2, wherein said clamp portion (302) includes a first end (312) and an opposing second end (314), wherein a diameter of the threaded opening (310) at said first end is smaller than a second
20 diameter of the threaded opening at said second end.

 4. The clamp device (300) in accordance with Claim 3 further comprising a threaded insert (304) configured for insertion into the threaded opening (310) at said second end (314), wherein the threaded fastener (306) is configured to be inserted into said first end (312) and to engage said threaded insert.

25 5. The clamp device (300) in accordance with any of Claims 1-4 further comprising:

 a first pad (308) positioned between said clamp portion (302) and the beam (350); and

 a second pad (326) positioned between the decompression panel (206) and the
30 beam.

5 6. The clamp device (300) in accordance with any of Claims 1-5, wherein said clamp portion (302) includes a clamp head (316) configured to receive and secure a pad (308) against said first side (354) of the beam (350).

 7. The clamp device (300) in accordance with Claim 6, wherein said clamp head (316) includes at least one molded sidewall (318) configured to align and retain said pad
10 (308) against said first side (354) of the beam (350).

 8. An aircraft (102) comprising:

 the beam (350) comprising the first side (354) and the opposing second side (356);

 the decompression panel (206) coupled to said beam; and

15 the clamp device (300) of Claim 1 coupled to said beam and to said decompression panel.

 9. The aircraft (102) in accordance with Claim 1 or 8, wherein said decompression panel (206) comprises a plurality of holes (340) defined therein, said threaded fastener (306) configured to be inserted through a first of said plurality of holes
20 into said clamp portion (302).

 10. The aircraft (102) in accordance with Claim 9 further comprising a patch (342) configured to cover a second of the plurality of holes (340) defined in said decompression panel (206).

 11. A method (400) of fastening a decompression panel (206) to a beam (350)
25 having a first side (354) and a second side (356), said method comprising:

 positioning (406) a clamp portion (302) proximate the decompression panel, wherein the clamp portion includes a threaded opening (310) defined therein;

 inserting (408) a threaded fastener (306) through the decompression panel into the threaded opening; and

5 rotating (418) the threaded fastener such that the clamp portion causes the decompression panel to contact the second side of the beam.

12. The method (400) in accordance with Claim 11 further comprising coupling a guide feature (328) to the decompression panel (206), wherein the guide feature is configured to receive at least a portion of the clamp portion (302) to prevent the clamp
10 portion from rotating.

13. The method (400) in accordance with Claim 11 or 12 further comprising:

coupling (414) a first pad (308) between the clamp portion (302) and the first side (354) of the beam (350); and

coupling (416) a second pad (326) between the decompression panel (206) and
15 the second side (356) of the beam.

14. The method (400) in accordance with Claim 13, wherein coupling (414) a first pad (308) between the clamp portion (302) and the first side (354) of the beam (350) further comprises coupling the first pad between a clamp head (316) of the clamp portion and the first side of the beam, wherein the clamp head is configured to receive
20 and secure the first pad against the first side of the beam.

15. The method (400) in accordance with any of Claims 11-14 further comprising inserting (410) a threaded insert (304) into the threaded opening (310) of the clamp portion (302), wherein the threaded fastener (306) is inserted into a first end (312) of the clamp portion and the threaded insert is inserted into an opposing second end (314) of
25 the clamp portion.

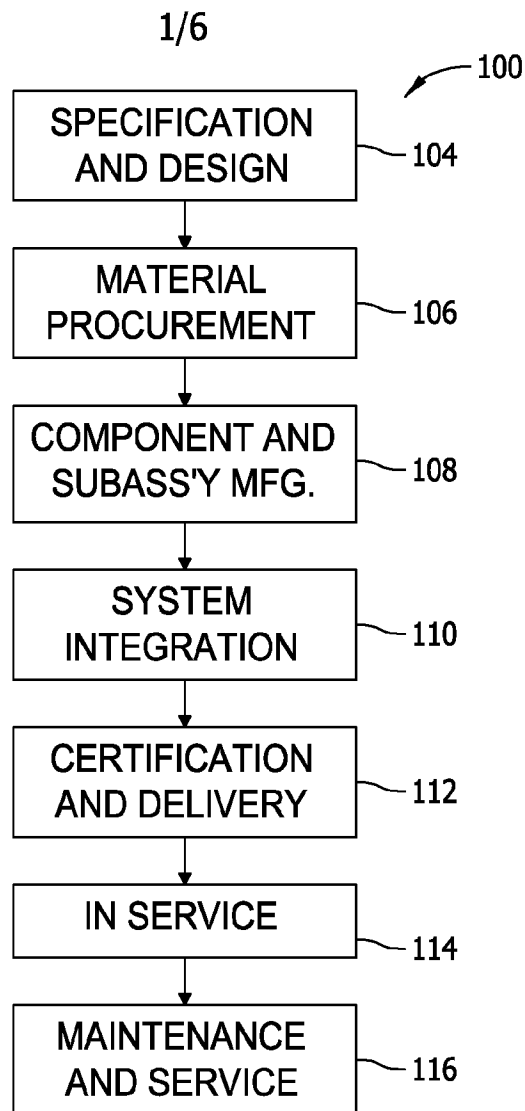


FIG. 1

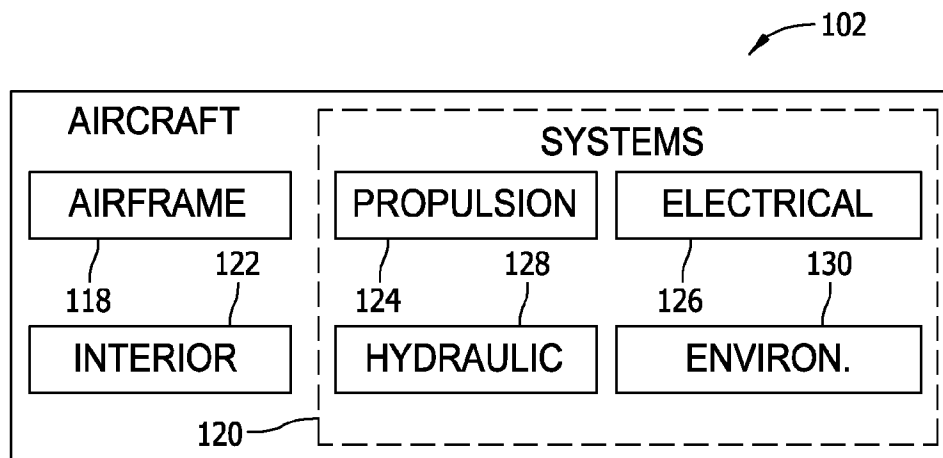


FIG. 2

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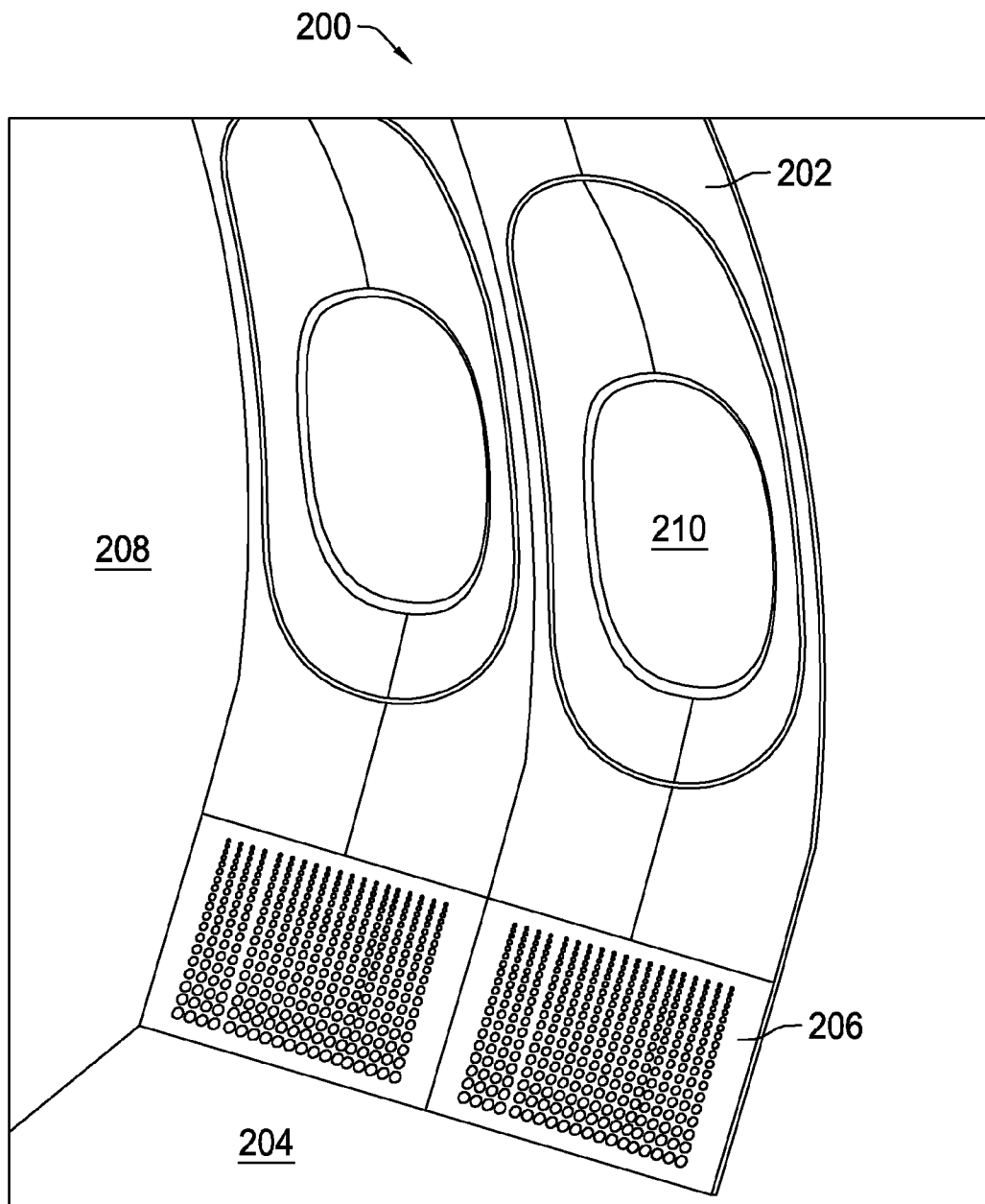


FIG. 3

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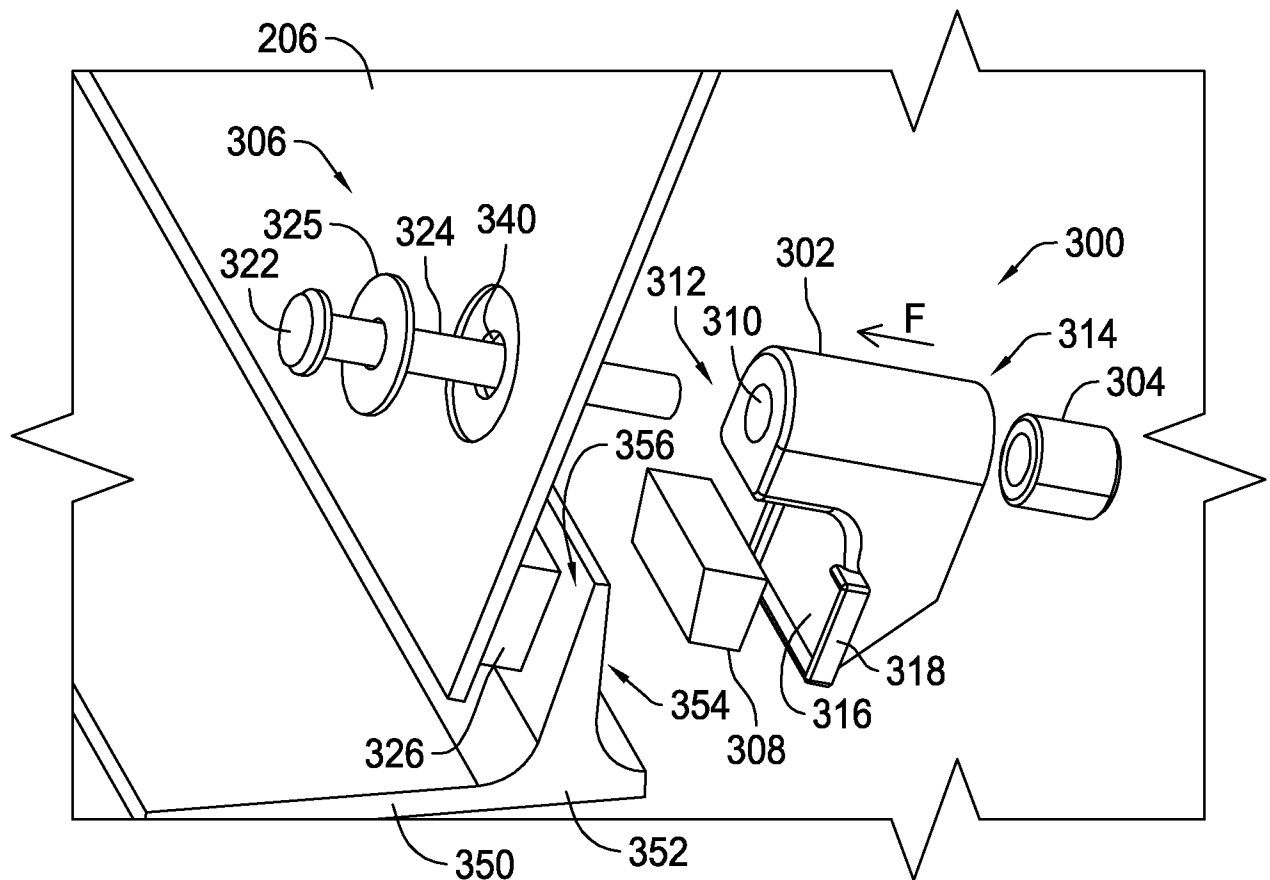


FIG. 4

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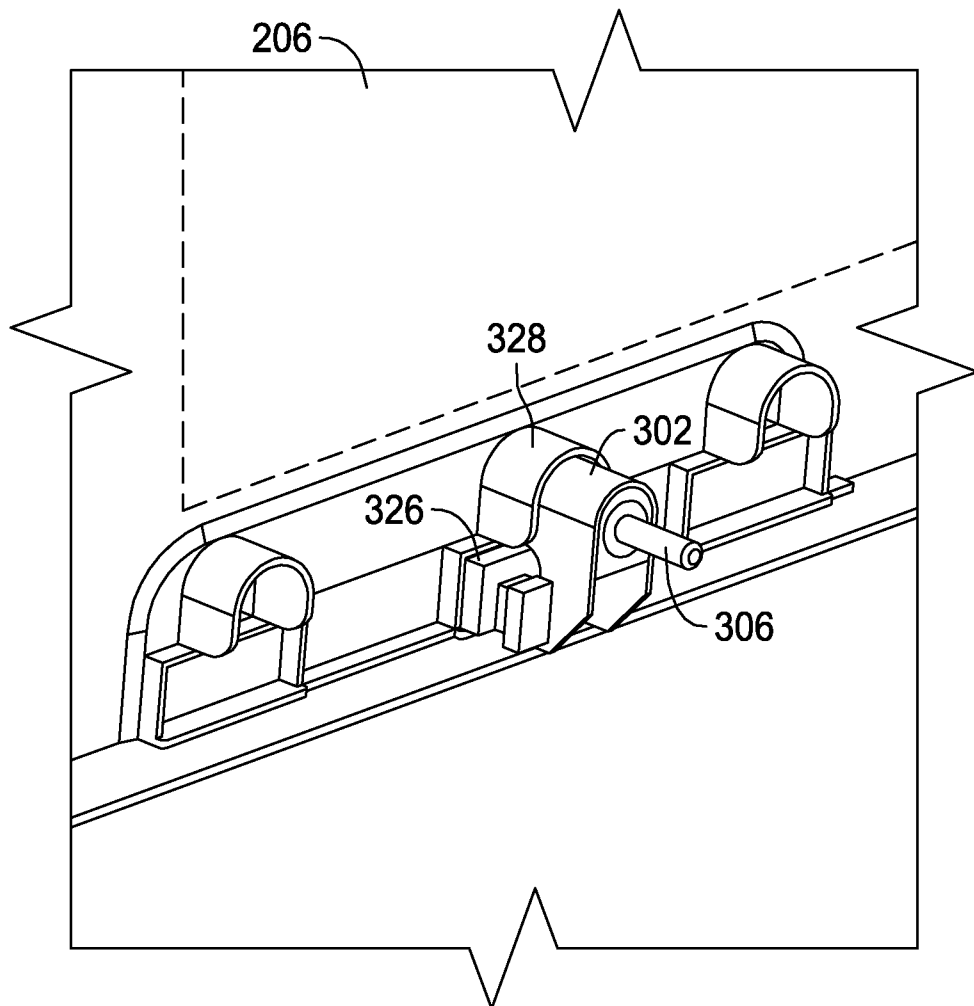


FIG. 5

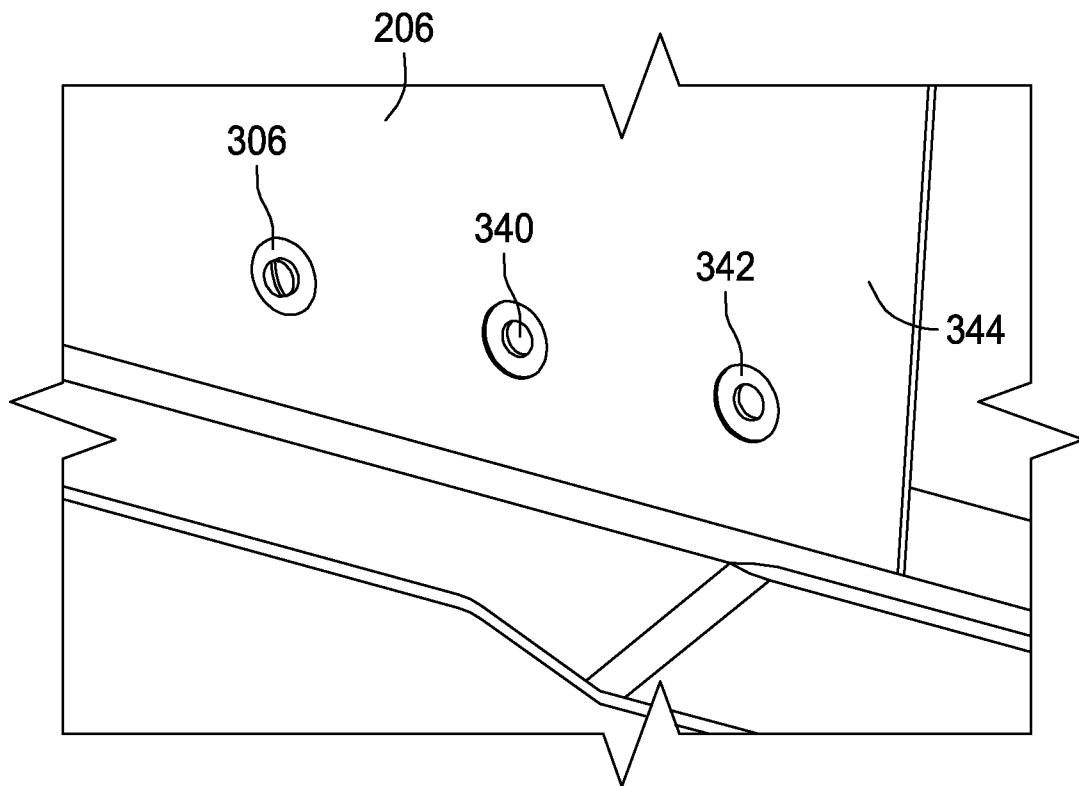


FIG. 6

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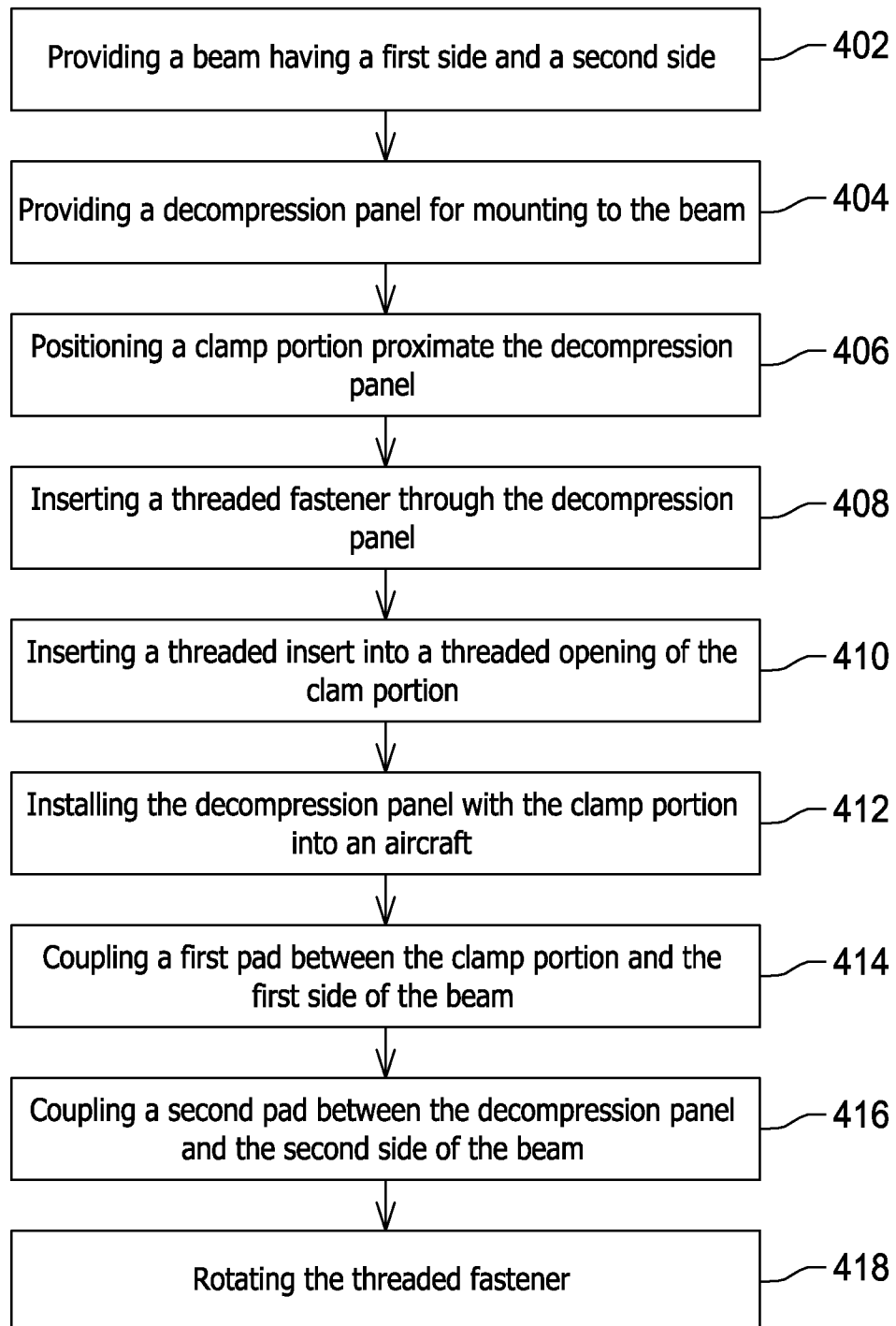
400 

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2014/050645

A. CLASSIFICATION OF SUBJECT MATTER

INV. B64C1/18 F16B2/06 B64C1/00
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)

B64C F16B

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, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	US 2011/041293 A1 (LANGEDIERS JUERGEN [DE] ET AL) 24 February 2011 (2011-02-24) page 2, paragraph 44 - page 5, paragraph 64; figures 1-9	1-3,8,9, 11,12 4-7,10, 13-15
X A	US 5 606 829 A (HARARAT-TEHRANI MOHAMMAD [DE]) 4 March 1997 (1997-03-04) column 3, line 49 - column 5, line 16; figures 1-7	1,11 2-10, 12-15
X A	US 2010/096500 A1 (BENTHIEN HERMANN [DE] BENTHIEN HERMANN [DE] ET AL) 22 April 2010 (2010-04-22) page 1, paragraph 7 page 2, paragraph 28 - paragraph 31 page 3, paragraph 42 - page 4, paragraph 46; figures 4-7	1,8,9,11 2-7,10, 12-15
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Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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