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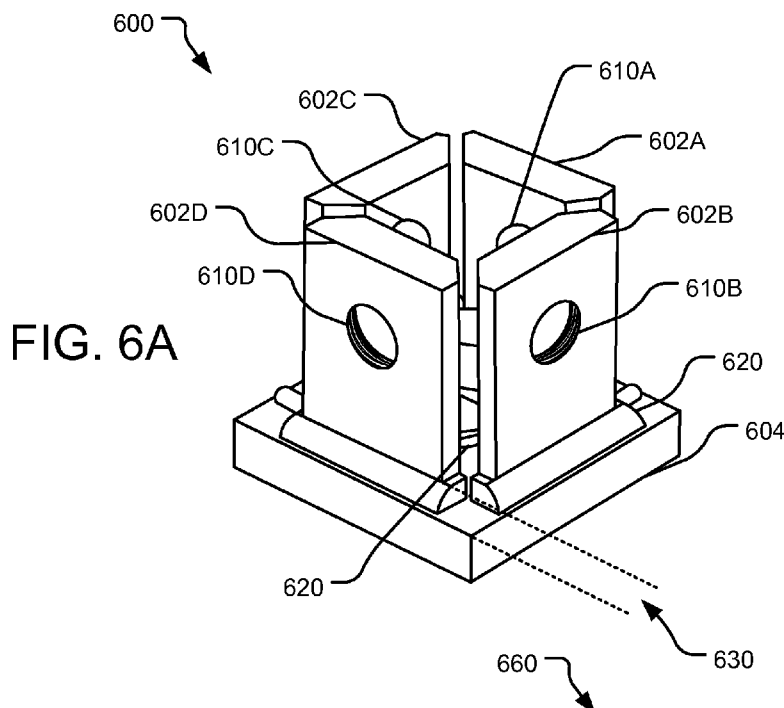
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(54) Title: SLEEVE CONNECTOR



(57) Abstract: An implementation of a sleeve connector disclosed herein includes a base plate having an opening at the center for passing a threaded rod and a plurality of side plates, wherein each of the plurality of side plates includes an opening for passing a threaded bolt and wherein each of the plurality of side plates are connected at a bottom surface to the base plate by welding. In an alternative implementation, a plurality of beveled and threaded side plates of a sleeve connector are used to attach a first column with a second column.

SLEEVE CONNECTOR

Cross-Reference to Related Applications

This application is a non-provisional of and claims benefit of U.S. Provisional Application Ser. No. 61/987,345 filed on May 01, 2014 entitled "Sleeve Connector," which is incorporated herein by reference in its entirety. Further, the present application is related to U.S. Patent Application 14/702,054, filed on May 1, 2015, entitled "Sleeve Connector," which is incorporated herein by reference in its entirety.

Technical Field

The invention relates to building construction components and, more particularly, to connecting components used in commercial and residential structures.

Summary

This Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used to limit the scope of the claimed subject matter. Other features, details, utilities, and advantages of the claimed subject matter will be apparent from the following more particular written Detailed Description of various implementations and implementations as further illustrated in the accompanying drawings and defined in the appended claims.

An implementation of a sleeve connector disclosed herein includes a base plate having an opening at the center for passing a threaded rod and a plurality of side plates, wherein each of the plurality of side plates includes an opening for passing a bolt and wherein each of the plurality of side plates are connected at a bottom surface to the base plate by welding.

Brief Descriptions of the Drawings

FIGS. 1A and 1B illustrate prior art welded connections.

FIGS. 2A and 2B illustrate prior art site applied splice plates.

FIG. 3 illustrates a prior art tubular columns connected using external capping plates.

FIG. 4 illustrates a prior art configuration connecting a column to a foundation.

FIG. 5 illustrates a prior art column-to-column connection configuration.

FIGS. 6A-6B illustrate an example column-to-foundation connection configuration using a sleeve connector disclosed herein.

5 FIG. 7 illustrates a plan view of an example sleeve connector disclosed herein.

FIG. 8 an alternative example column-to-column connection configuration using a sleeve connector disclosed herein.

FIGS. 9A-9B illustrate an example column-to-beam connection configuration using a sleeve connector disclosed herein.

10 FIGS. 10A-10B illustrate an example column-to-flange connection configuration using a sleeve connector disclosed herein.

FIG. 11 is an alternative example column-to-column connection configuration using a sleeve connector disclosed herein.

15 FIG. 12 is an alternative example configuration of a sleeve connector disclosed herein.

FIG. 13 illustrates an example flowchart of operations for using the sleeve connector disclosed herein.

Detailed Descriptions

20 In multi-story building construction it is necessary to join or splice structural columns vertically to transmit vertical compressive and uplift forces and lateral forces from floor to floor. Welding, capping plates, and external splice plates are typical approaches in making these connections.

25 FIGS. 1A and 1B illustrate prior art welded connections that are typically done in a welding shop to avoid site welding and site inspections. Specifically, FIG. 1 illustrates that I-beams 102 and 104 are connected to each other via a welding joint 110 and in an alternative implementation, the I-beams 112 and 114 are connected to each other via a welding joint 120. With welded column-to-column connections there is no adjustment tolerance once the welding is complete.

30 FIG. 2A illustrates prior art site applied splice-plates configuration. Specifically, flange columns 202 and 204 are connected using a plurality of splice plates 210a-210d. Splice plates are generally site applied and create an external sleeve at the column-to-column

joint. This type of connection is typical when connecting flange columns. FIG. 2B illustrates connecting flange column 212 using splice-plate 220 with flange columns 220 and 222.

FIG. 3 illustrates a prior art tubular columns configuration where tubular columns 302 and 304 are connected using external capping plates 310 and 312. The top column 302 and the bottom column 304 arrive at the jobsite with welded plates 310 and 312 and the column-to-column connection is made using bolts as illustrated in FIG. 3.

Exterior capping plates used to make vertical tubular column-to-column, column-to-foundation, or column-to-beams may have to be fastened concentrically (sharing the same center axis) to avoid overturning moment or overturning of the structure under lateral (wind or seismic forces) and vertical loading. However, certain areas and conditions within a building make concentric connections between elements difficult.

For example, FIG. 4 illustrates a prior art configuration connecting a column 410 to a foundation 402. Specifically, FIG. 4 illustrates a configuration where columns are connected to foundations at corners.

FIG. 5 illustrates a prior art column-to-column connection configuration where a top column 502 is connected to a bottom column 504 using plates 510 and 520 using bolts. The arrows 510 and 520 illustrate force direction.

Because the plates are not anchoring the column concentrically there is overturning moment forces at the back of the column where there is no plate. At assemblies where these conditions occur welding additional plates is typical to create a balance connection.

Additionally the welded plate approach to attaching columns creates a condition at the floor where the plates may not fit within the finished envelope of the wall (see Figure 4) especially in light gauge framing systems. This leads to the necessity to imbed the plates in the floor system to create a flush condition to install the finished floor, or for the architect to design around the connection by wrapping columns.

The present technology discloses a method of using interior plates to create an interior sleeve to make vertical tubular column-to-foundation, tubular column-to-column and tubular column-to-beam connections.

This sleeve method disclosed herein creates a coaxial connection (balances forces concentrically) that occurs in columns where square plates cannot be used. This method of making connections uses a mechanical connection (bolted connection) eliminating the need for welding external plates to tubular columns or the need for site welding that occurs where a site condition prevents a concentric connection. The present technology also increases installation efficiency and safety and reduces material costs and waste.

FIGS. 6A-6B illustrate an example column-to-foundation connection configurations using a sleeve connector disclosed herein. Specifically, FIG. 6A illustrates a sleeve connector 600 that may be used for connecting columns to foundations. The sleeve connector 600 is configured using a base plate 604 that may be connected to a foundation. The base plate 604 is connected to a plurality of side-plates 602a, 602b, 602c, and 602d (collectively referred to as "side plates 602"). In one implementation, the side plates 602 are connected to the base plate using welded joints 620. Note that the illustrated implementation discloses four side-plates 602, in an alternative implementation, an alternative number of side-plates 602 may be provided. For example, a triangular sleeve connector may have three side plates 602, a hexagonal sleeve connector may have six side plates 602, etc.

Furthermore, while the sleeve connector 600 is illustrated to have a square shape that may be used to connect a square column to a foundation, in an alternative implementation, a rectangular shape of sleeve connector 600, or a sleeve connector 600 having other shapes, such as a triangle, hexagon, a circle, or other shapes may also be provided. Each of the side plates 602 is provided with a side plate opening 610 that may be used to insert a bolt of another fastening mechanism. Thus, respectively, each of the side plates 602A, 602B, 602C, and 602D includes a side plate opening 610A, 610B, 610C, and 610D, respectively. The internal surface of each of the openings 610 may be threaded with receiving threads in a manner such that a threaded bolt may be threaded through the openings.

The sleeve connector 600 also includes a base opening 620 (partially shown) on base plate 604. The base opening may be a circular opening with its internal surface threaded with receiving threads to receive a bolt with external threads so that such bolt with the external threads can be threaded through the base opening 620 to secure the sleeve connector 600 to a foundation (not shown in FIG. 6A).

In one implementation, the sleeve connector 600 is configured such that the side plates 602 are not connected to each other. In other words, while each of the side plates 602 are attached to the base plate 604 they are not directly attached to each other. Such a configuration allows the side plates to be somewhat flexible under pressure that may be exerted from a threaded bolt that passes through the openings 610. Furthermore, such flexibility is also provided due to the structure of the sleeve connector 600 wherein the bottom edge of the side plates 602 are attached by the welded joints 620 to the base plate 604, while the top ends of the side plates 602 are unattached to any other component of the sleeve connector 600.

FIG. 6B illustrates an example connection 650 of a partial column 652 to a foundation 660 using a sleeve connector 614. In this implementation, the sleeve connector 614 may be securely connected to the foundation 660 using a threaded bolt (not shown) passed through the center of the base plate of the sleeve connector 614. The column 652 is illustrated to openings on its sides (two such openings 654a and 654b are shown). In the illustrated implementation, the column 652 is attached to a sleeve connector using Allen screws threaded through the openings 654. Specifically, Allen screws with hexagonal head is passed through the opening 654 and through the opening 610 of the sleeve connector side plates to secure the column 652 to the sleeve connector 614. Thus, the sleeve connector 614 is used to connect the column 654 to a foundation.

In one implementation, the cross-sectional shape of each of the side plates 602 is in the shape of a combination of a trapezoid and a rectangle with a longer side surface of the trapezoid aligned with a longer side surface of the rectangle. FIG. 6C discloses a detailed diagram of the cross-sectional shape 660 of the side plates 602 (in a plan view of one side plate 602). The cross-sectional shape 660 includes a rectangular section 662 towards the outer surface 664 of the side plates 602 and a trapezoidal shape 666 towards the internal surface 668 of the side plates 602. The internal surface 668 faces towards the center of the sleeve connector and it is opposite the external surface 664. The trapezoidal shape 666 is defined by two beveled side surfaces 670A and 670B (together referred to as the “beveled side surfaces”). Each of such beveled side surfaces 670 face at least one side surface of another of the side plates 602.

The positioning of the side plates 602 on the base plate may be varied based on the thickness of the column that is attached to the sleeve connector 600. For example, if the thickness of the column to be connected to the sleeve connector 600 is relatively large, the distance 630 between the outer edge of the base plate 620 and the outer edge of the side plates 602 is large. Alternatively, this distance 630 can be relatively small if the column attached to the sleeve connector 600 is made of thinner side walls. In other words the distance 630 can be selected such that when the column is placed on the sleeve connector 600 they both fit snugly. Providing the side plates 602 that are not connected to each other allows such variable placement of the side plates 602 on the base plate 620.

The cross-sectional shape 660 of the side plates 602 together with the configuration of the side plates wherein each of the side plates do not touch each other provides a flexibility to the side plates under pressure exerted on the side plates 602 from any threaded bolt or other connecting element that connects the side plates 602 to a column such as the column 652.

FIG. 7 illustrates a plan view of an example assembly 700 of a sleeve connector disclosed herein with a column. Specifically, the plan view illustrates a sleeve connector 708 fastening a column 740 to a foundation 750. The sleeve connector 708 is illustrated to include four side plates 702a, 702b, 702c, and 702d (collectively, 702). Each of the side plates 702 includes a threaded opening through which bolts 704a, 704b, 704c, and 704d (collectively, 704) can be passed to fasten the sleeve connector 708 to the column 740.

The sleeve connector 708 also includes a threaded opening 730 on a bottom surface of the sleeve connector. Threaded bolt 720A, 720B, 720C, and 720D (collectively, 720) can be passed through the threaded opening 730 to fasten the sleeve connector 708 to the foundation 750. A washer 710 may be provided between the threaded bolt 720 and the threaded opening 730.

In the illustrated example, first the sleeve connector 708 is secured to the foundation 750 using a threaded bolt passing through the threaded opening 730. In this case, the foundation 750 also has a threaded opening (not shown) therein to receive the threaded bolt that is aligned with the threaded opening 730 of the sleeve connector 708. Once the sleeve connector 708 is secured with the foundation 750, the column 740 is placed on top of the sleeve connector 708 such that the side walls of the column 740 encloses around or encircles the side plates 702 of the sleeve connector 708. The column 740 is placed around the sleeve connector 708 such that threaded openings on the sides of the column 740 are aligned with the threaded openings 702 of the sleeve connector 708. After arranging the column 740 around the sleeve connector 708, threaded bolts 720 are threaded through the openings of the column and the respectively aligned opening in the side plates 702 of the sleeve connector 708 to secure the column 740 to the sleeve connector 702 and therefore to the foundation 750.

FIG. 8A illustrates a first column 802 that may be connected to one of the sleeve connector 800. The first column 802 is provided with threaded openings in each of its side surface such that the first column 802 can be securely attached to side plates of the sleeve connector 800 using threaded bolts.

FIG. 8B illustrates the sleeve connector 800 including side plates 810A, 810B, 810C, and 810D (collectively, "side plates 810"). Each of the side plates has a number of threaded openings 812 that can be threaded through using a threaded bolt. In one implementation, each of the side plates 810 has a width that is determined based on the width of the column, such as the column 802 that is to be attached using the side plates 810. For example, the side plates 810 may be of a width such that it provides maximum strength while also fits snugly on the internal surface 806 of the first column 802 (and similarly on the internal surface of a side

wall of the second column 804). Furthermore, the threaded openings 812 on the side plates are spaced such that they align with the threaded openings 808 of the first column 802 as shown by the dotted lines in the figures 8A and 8B.

For example, FIGS. 8C and 8D illustrate connecting the first column 802 to a second
5 column 804 using the sleeve connector 800.

To fasten the columns 802 and 804 using the sleeve connector 800, the threaded openings 814 of the columns 802 and 804 can be aligned with the threaded openings 812 of the sleeve connector 800 and threaded bolts (not shown) can be passed there through.

FIGS. 9A-9B illustrate example column-to-beam connection configurations 900 and
10 950 using a sleeve connector disclosed herein. Specifically, FIG. 9A illustrates a rectangular beam 902 that is attached to sleeve connectors 910 and 920 via connector columns 904 and 906. In one implementation, the connectors 910 and 920 may be attached to the rectangular beam 902 as well as to the sleeve connectors 910 and 920 via welding. In an alternative implementation, an assembly of the connector column 904 and the sleeve connector 910 may
15 be manufactured as a single unit.

FIG. 9B illustrates fastening columns 960 and 970 to the beam rectangular 902 using the sleeve connectors 910 and 920. Specifically, threaded openings in the columns 960 and 970 are aligned with threaded openings of the sleeve connectors 910 and 920 and a threaded bolt is used to fasten the columns to the sleeve connectors.

FIGS. 10A-10B illustrate an example column-to-I-beam connection configuration
20 1000 using a sleeve connector disclosed herein. Specifically, FIG. 10A illustrates an I-beam 1002 that is attached to sleeve connectors 1004 and 1006. The sleeve connectors 1004 and 1006 may be connected to flanges 1012A and 1012B of the I-beam 1002 by welding. FIG. 10B illustrates connecting columns 1008 and 1010 to the sleeve connectors 1004 and 1006.
25 For example, the threaded openings 1020 of the columns 1008 and 1010 are aligned to the threaded openings 1030 of the sleeve connectors 1004 and 1006 and threaded bolts (not shown) are used to connect the sleeve connectors 1004 and 1006 with the columns 1008 and 1010.

FIG. 11 illustrates an alternative example column-to-column sleeve connector 1100.
30 The sleeve connector 1100 includes an upper sleeve 1120 and a lower sleeve 1130. Each of the upper sleeve 1120 and the lower sleeve 1130 includes a number of side plates. For example, the upper sleeve 1120 includes side plates 1122A, 1122B, 1122C, and 1122D (collectively, 1122) wherein the side plates 1122 are connected to a mid plate 1140. For example, the side plates 1122 may be welded to the mid plate 1140. Similarly, the bottom

sleeve 1130 includes side plates 1132A, 1132B, 1132C, and 1132D (collectively, 1132, not all shown) wherein the side plates 1132 are connected to a base plate 1140 by, for example, welded joints. Each of the side plates 1122 and 1132 also includes threaded openings that can be used to secure the sleeve connector 800 to one or more columns. In the implementation illustrated in FIG. 11, the distance between the outer edge of the side plates 1122, 1132 and the outer edge of the mid plate 1140 is shown to be minimal, which contemplates using the sleeve connector 1100 with columns having thin side walls. However, for connecting columns with relatively thicker side walls, the side plates 1122 and 1132 may be moved towards the center of the mid plate 1140 such that there is a snug fit of the columns to the sleeve connector 1100. The configuration of the sleeve connector 1100 with each of the side plates 1122 being separate from each other and each of the side plates 1132 also being separate from each other, allows such a variable configuration depending on the thickness of the side walls of the columns.

While the implementation disclosed in FIG. 11 illustrates each of the side plates 822 and 832 with only one threaded opening, in an alternative implementation, two or three vertically aligned openings may be provided.

FIG. 12 illustrates an alternative implementation of a sleeve connector 1200 wherein each of the side plates 1202 has two threaded openings 1210 and 1212 along the vertical length of the side plates.

FIG. 13 illustrates an example flowchart 1300 of operations for using the sleeve connector disclosed herein. An operation 1302 determines the widths of the columns to be connected using the sleeve connector disclosed herein. Subsequently, an operation 1304 manufactures the beveled side plates of a sleeve connector with width that depends on the width of the columns to be connected. An operation 1306 generates threaded openings on the side plates and columns such that a single threaded bolt can be threaded through at least one side plate and a side surface of a column.

An operation 1308 aligns the beveled and threaded plate to the inside surface of a first column such that the threaded openings of the beveled plate and the column are aligned. In one implementation, aligning the one or more threaded side plates with internal surface of the first column further comprises aligning the one or more threaded side plates with internal surface of the first column such that the beveled side of the side plates faces towards center of the first column. In an alternative implementation, aligning the one or more threaded side plates with internal surface of the first column further comprises aligning the one or more threaded side plates with internal surface of the first column such that the beveled edge of at

least one of the threaded side plates faces beveled edge of at least one of the other threaded side plates.

In an operation 1310 the aligned side plates are attached to the first column.

5 Subsequently, in operations 1312 and 1314, the side plates that are already attached to the first column are aligned to an inside surface of a second column and the second column is fastened to the beveled side plates using a threaded bolts threaded through the aligned openings of the beveled side plates and the second column.

10 The above specification, examples, and data provide a complete description of the structure and use of exemplary embodiments of the invention. Since many embodiments of the invention can be made without departing from the spirit and scope of the invention, the invention resides in the claims hereinafter appended. Furthermore, structural features of the different embodiments may be combined in yet another embodiment without departing from the recited claims. Although the present invention has been described with reference to preferred embodiments, workers skilled in the art will recognize that changes may be made in
15 form and detail without departing from the scope of the invention. The implementations described above and other implementations are within the scope of the following claims.

Claims

WHAT IS CLAIMED IS:

1. A sleeve connector, comprising:
a base plate having an opening for passing a threaded bolt to securely attach the base
5 plate to a foundation; and
a plurality of side plates attached to the base plate, wherein one of more of the
plurality of side plates includes an opening for passing a threaded bolt.
2. The sleeve connector of claim 1, wherein each of the plurality of side plates is
10 attached to the base plate via welded joints.
3. The sleeve connector of claim 1, wherein one of more of the side plates are
not connected to any of the other side plates.
4. The sleeve connector of claim 1, wherein a cross-section of each of the side
15 plates is in the shape of a combination of a rectangle and a trapezoid with the longer side
surface of the trapezoid aligned with a longer side surface of the rectangle.
5. The sleeve connector of claim 4, wherein the cross-section of each of the side
20 plates includes beveled side surfaces facing beveled side surfaces of the other of the plurality
of side plates.
6. The sleeve connector of claim 1, wherein each of the plurality of side plates
includes one or more openings for passing a threaded bolt.
25
7. The sleeve connector of claim 1, further comprising a connector column
welded to the base plate and to a rectangular beam.
8. The sleeve connector of claim 1, wherein the base plate is welded to a flange
30 of an I-beam.
9. A sleeve connector assembly, comprising:
an upper sleeve comprising a plurality of upper side plates, wherein each of the
plurality of upper side plates includes at least one opening for passing a bolt there through

and wherein each of the plurality of upper side plates is connected to a first side of a mid plate; and

a lower sleeve connected to a second side of the mid plate, the second side being opposite the first side, wherein the lower sleeve comprising a plurality of lower side plates, wherein each of the plurality of lower side plates includes at least one opening for passing a bolt there through and wherein each of the plurality of lower side plates is connected to the second side of the mid plate.

10. The sleeve connector assembly of claim 9, wherein each of the upper side plates is connected to a first side of the mid plate via a welded joint and each of the lower side plates is connected to a second side of the mid plate via a welded joint.

11. The sleeve connector assembly of claim 9, wherein one of more of the upper side plates are not connected to any of the other upper side plates.

12. The sleeve connector of claim 9, wherein a cross-section of each of the upper side plates is in the shape of a combination of a rectangle and a trapezoid with the longer side surface of the trapezoid aligned with a longer side surface of the rectangle.

13. The sleeve connector of claim 9, wherein the cross-section of each of the upper side plates includes beveled side surfaces facing beveled side surfaces of the other of the plurality of upper side plates.

14. A sleeve connector assembly, comprising:
an upper sleeve connector comprising a plurality of upper side plates, wherein each of the plurality of upper side plates includes an opening for passing a bolt and wherein each of the plurality of upper side plates is connected to an upper base plate;
an upper connector column with a first end welded to the base plate; and
a rectangular beam welded to a second end of the connector column.

15. The sleeve connector assembly of claim 14, further comprising:
a lower sleeve connector comprising a plurality of lower side plates, wherein each of the plurality of lower side plates includes an opening for passing a bolt and wherein each of the plurality of lower side plates is connected to a lower base plate;

a lower connector column with a first end welded to the lower base plate; and
the rectangular beam welded to a second end of the lower connector column.

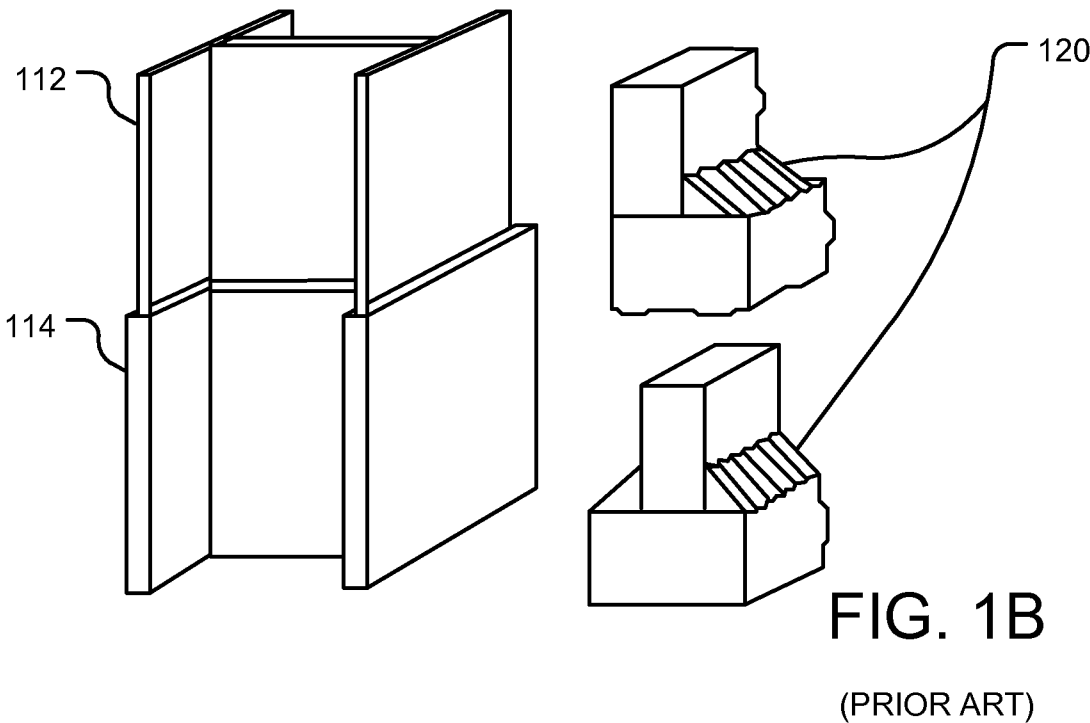
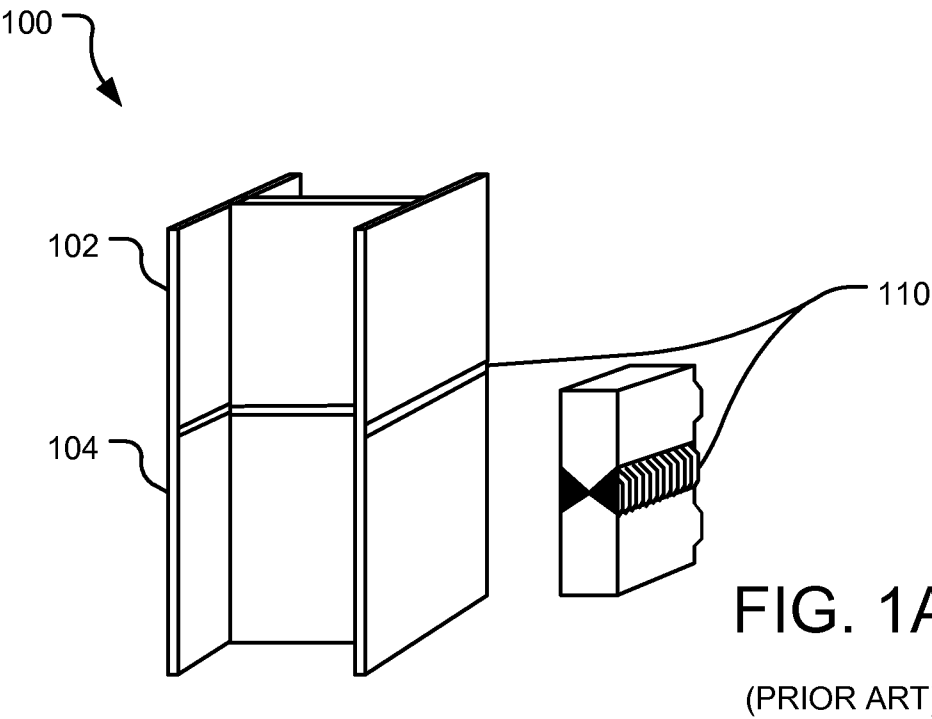
16. A method of attaching a first structural column with a second structural
5 column, the method comprising:
determining width of an internal wall surface of the first column;
manufacturing one or more beveled side plates wherein width of the beveled side
plates is determined based in the width of an internal wall surface of the first column;
generating threaded openings on the beveled side plates, the first column, and the
10 second column;
aligning the one or more threaded side plates with internal surface of the first column;
attaching the one or more threaded side plates with the first column using threaded
bolts;
aligning the one or more threaded side plates with internal surface of the second
15 column; and
attaching the one or more threaded side plates with the second column using threaded
bolts.

17. The method of claim 16, wherein the one or more beveled side plates
20 comprises four side plates.

18. The method of claim 16, wherein aligning the one or more threaded side plates
with internal surface of the first column further comprises aligning the one or more threaded
side plates with internal surface of the first column such that the beveled side of the side
25 plates faces towards center of the first column.

19. The method of claim 18, wherein aligning the one or more threaded side plates
with internal surface of the first column further comprises aligning the one or more threaded
side plates with internal surface of the first column such that the beveled edge of at least one
30 of the threaded side plates faces beveled edge of at least one of the other threaded side plates.

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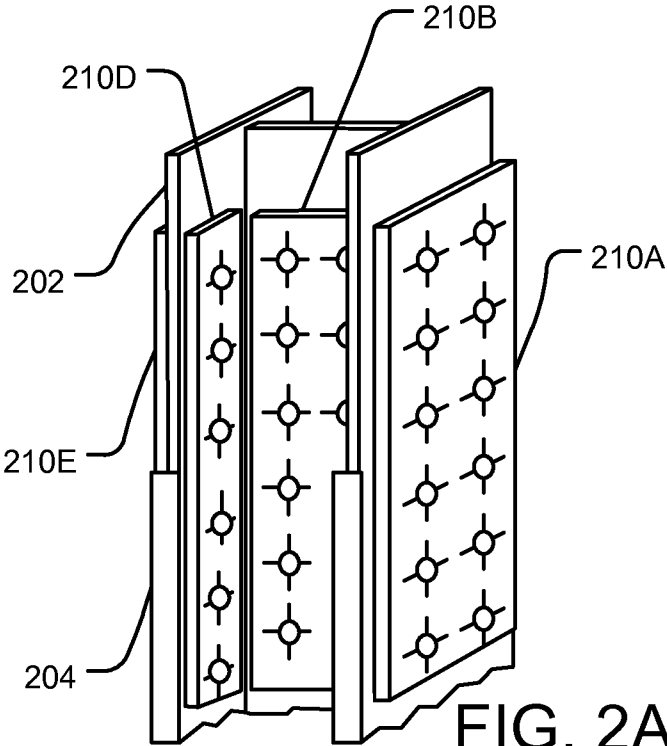


FIG. 2A

(PRIOR ART)

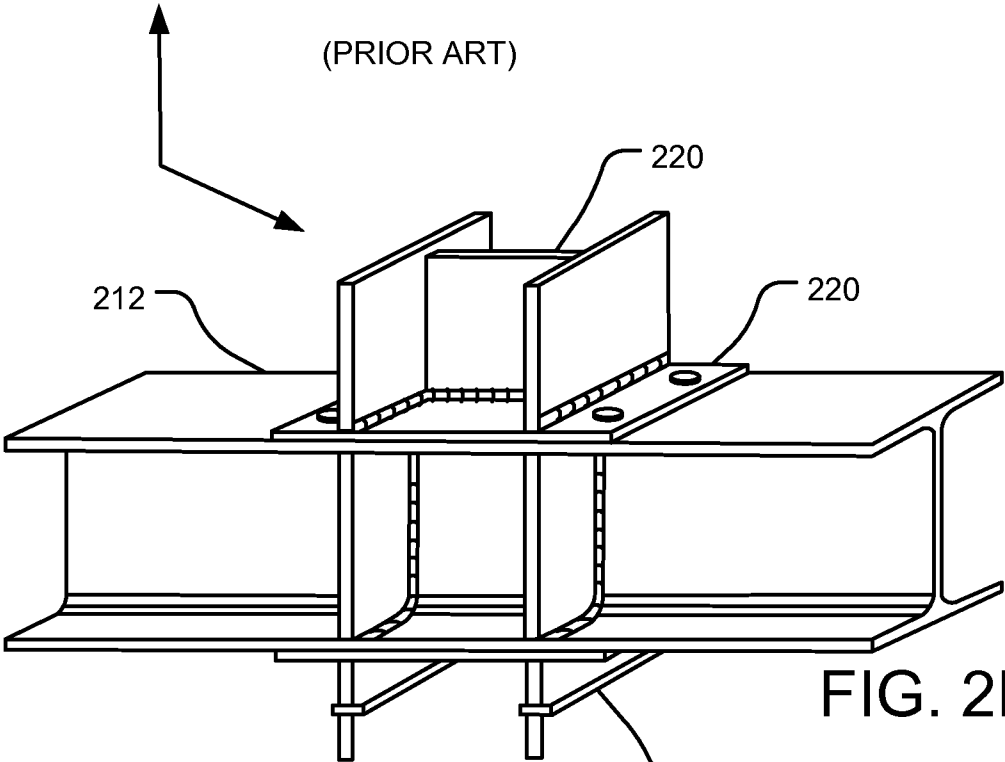


FIG. 2B

(PRIOR ART)

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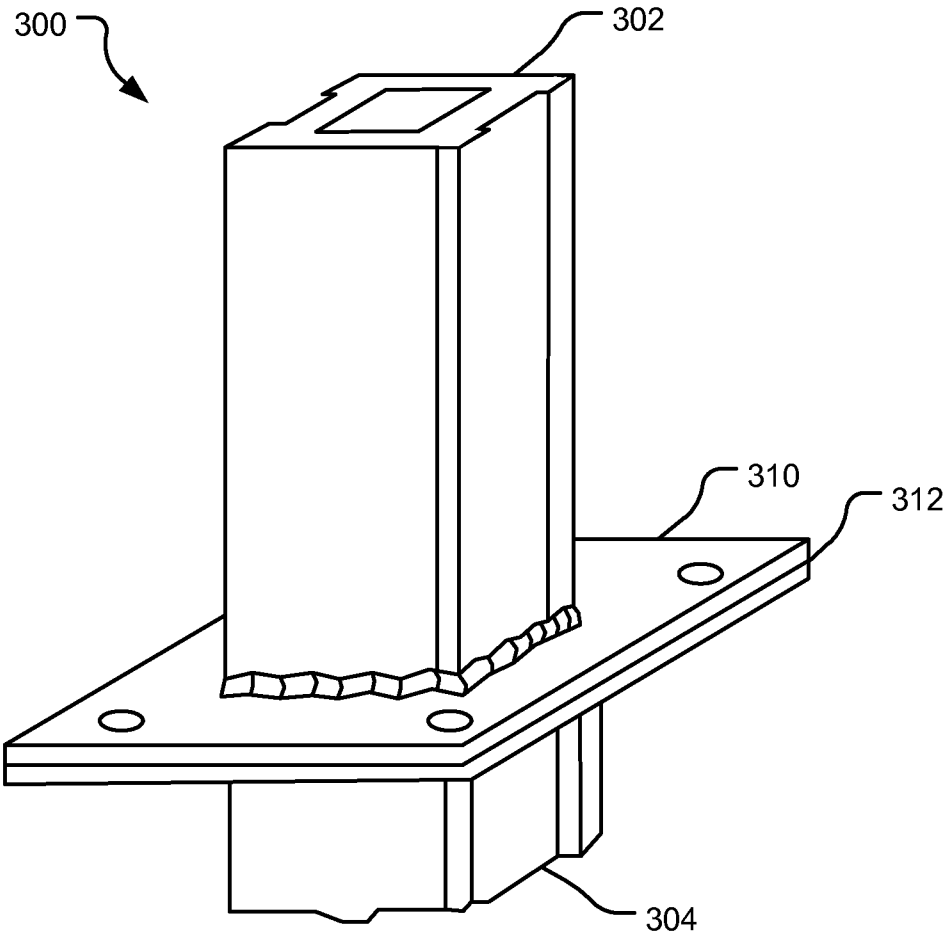


FIG. 3

(PRIOR ART)

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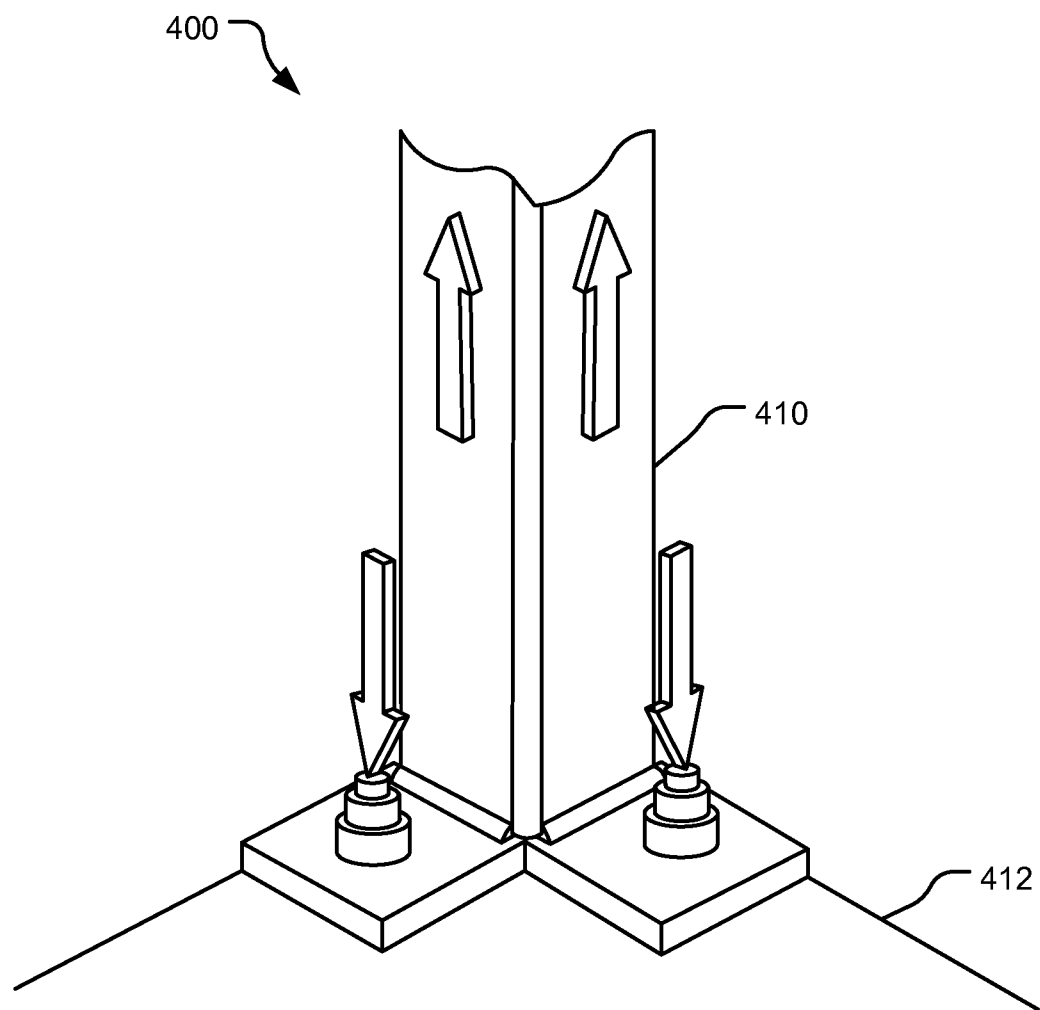


FIG. 4
(PRIOR ART)

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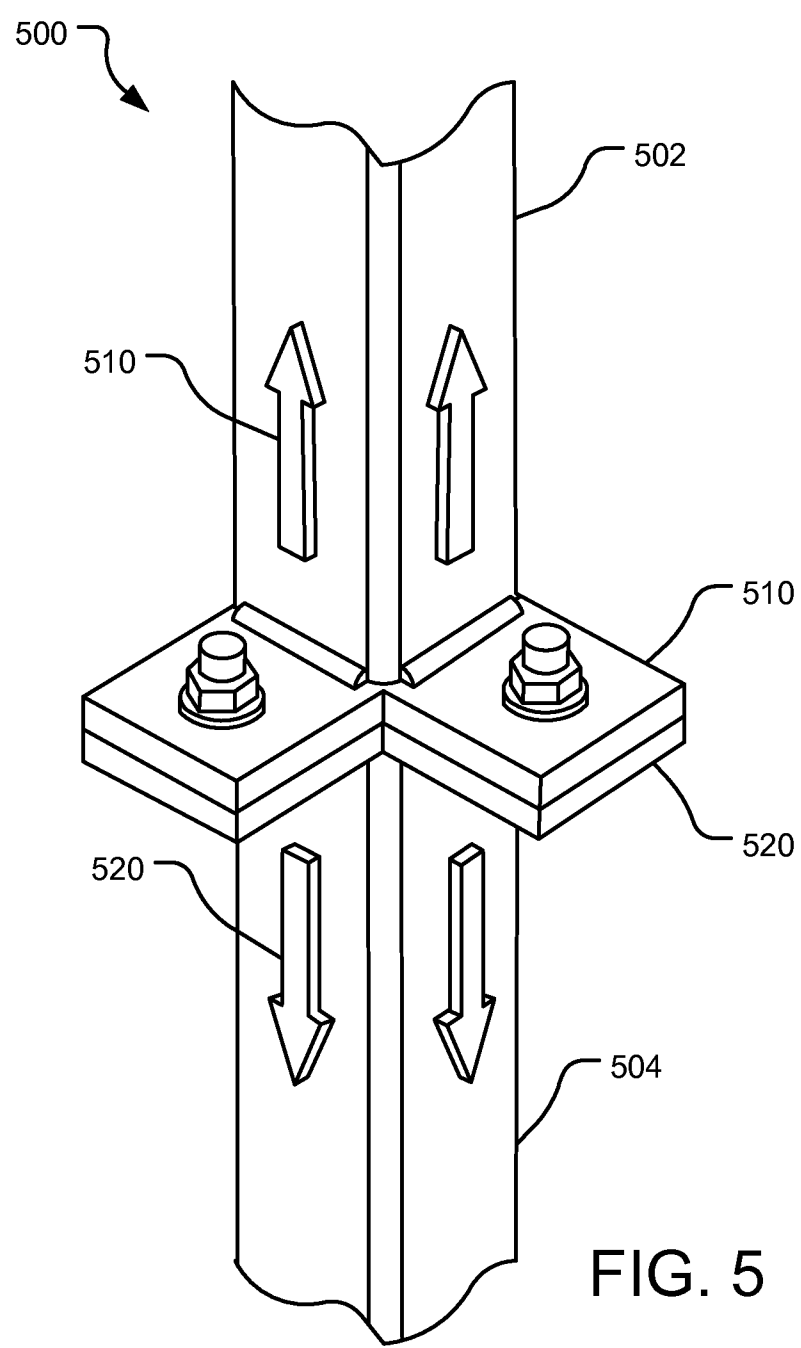


FIG. 5
(PRIOR ART)

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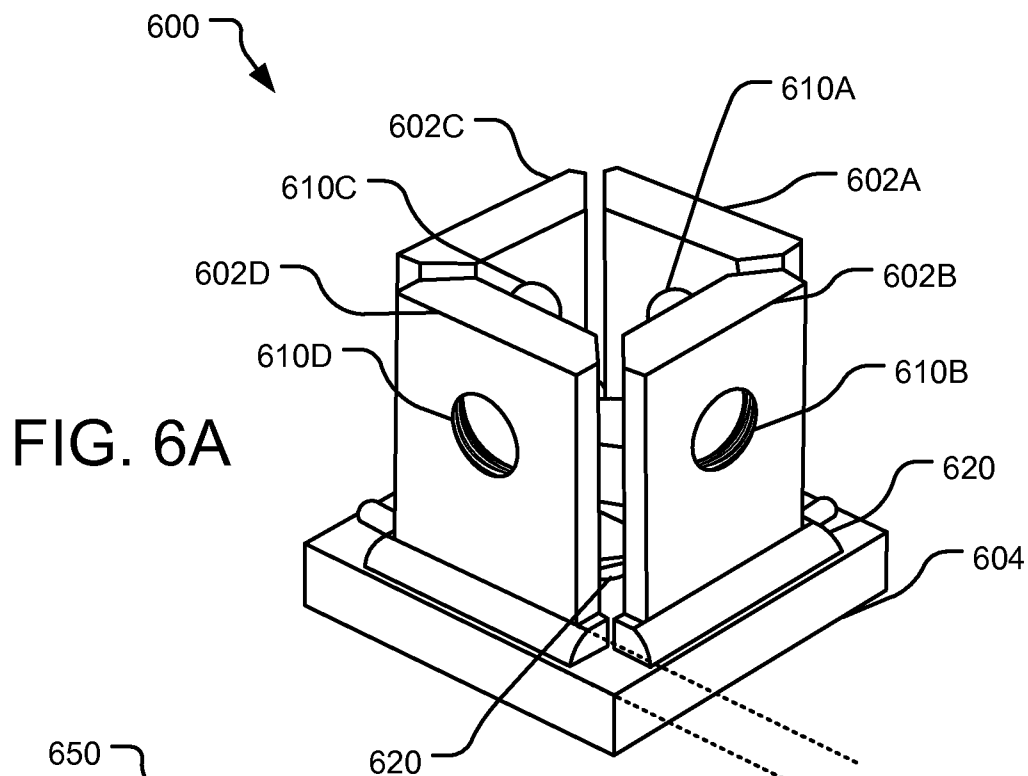


FIG. 6A

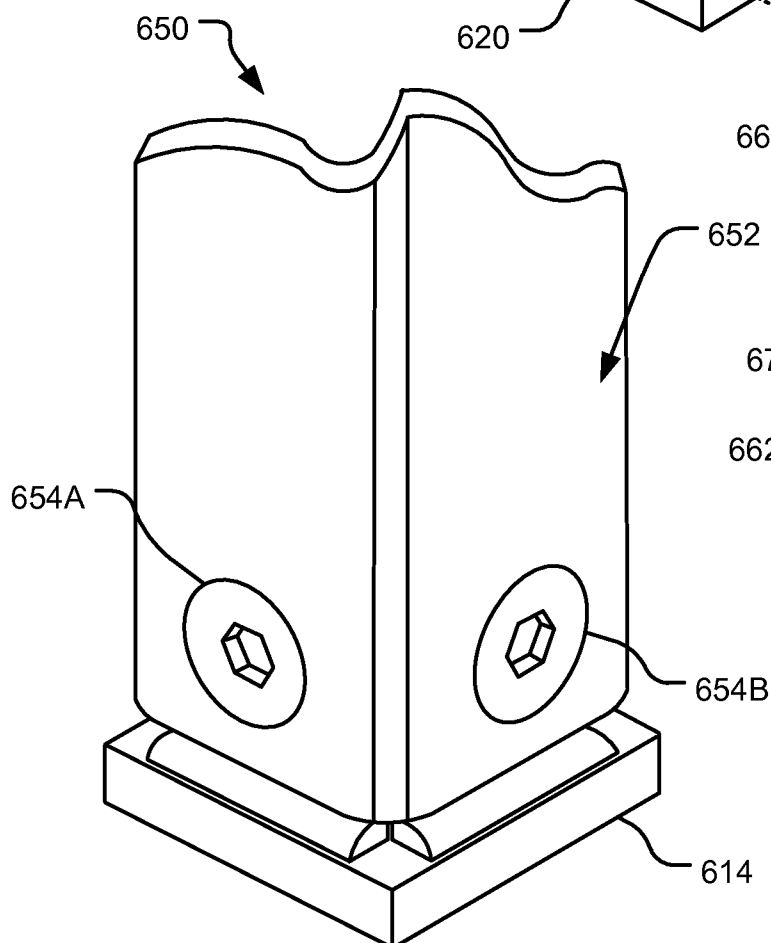


FIG. 6B

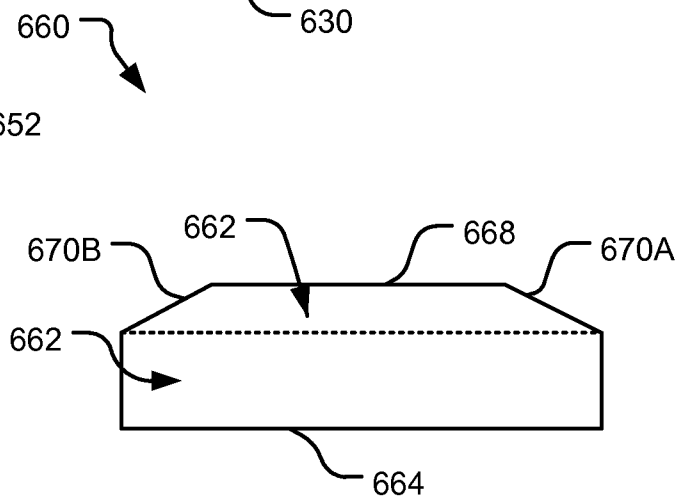
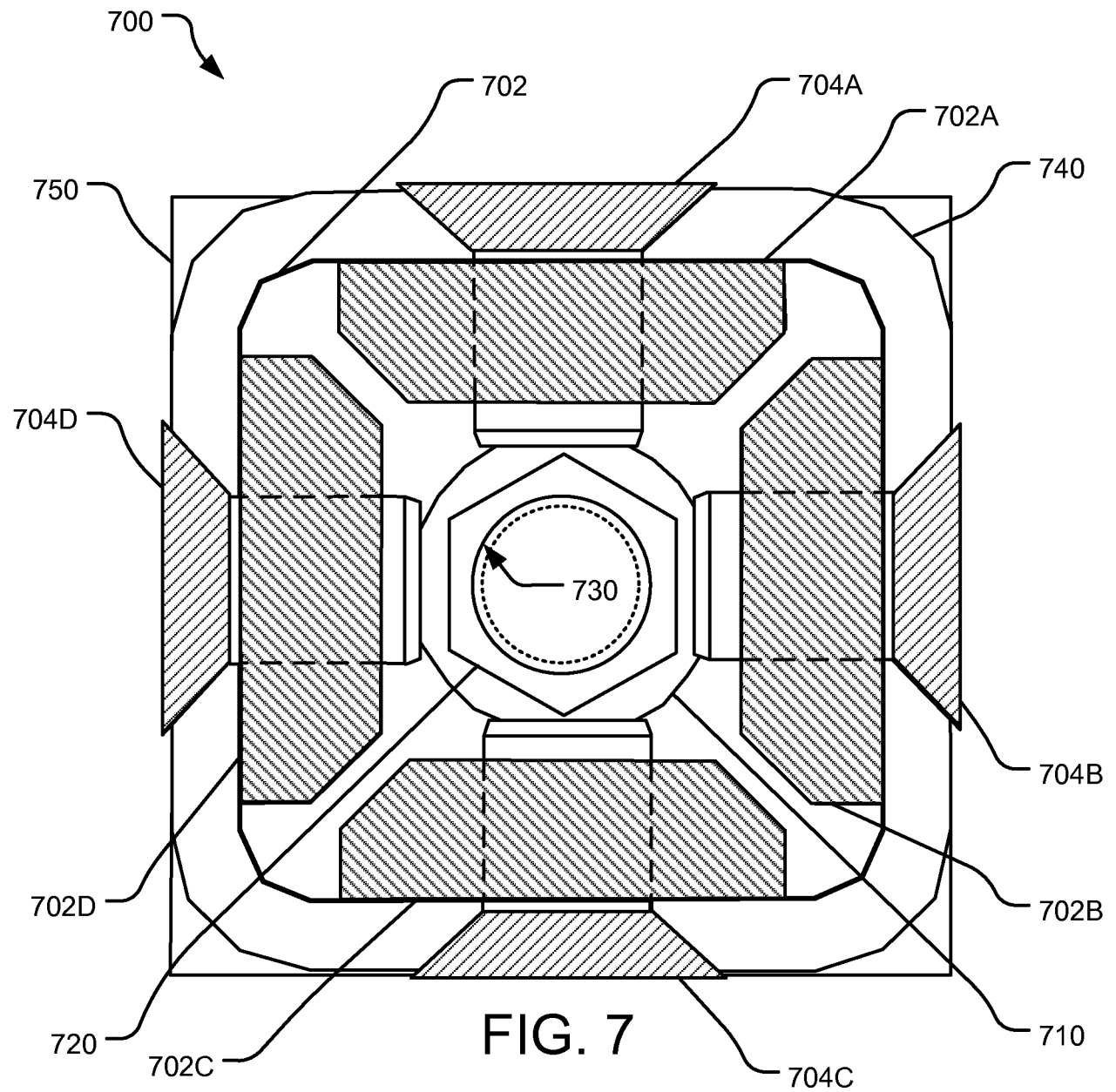


FIG. 6C





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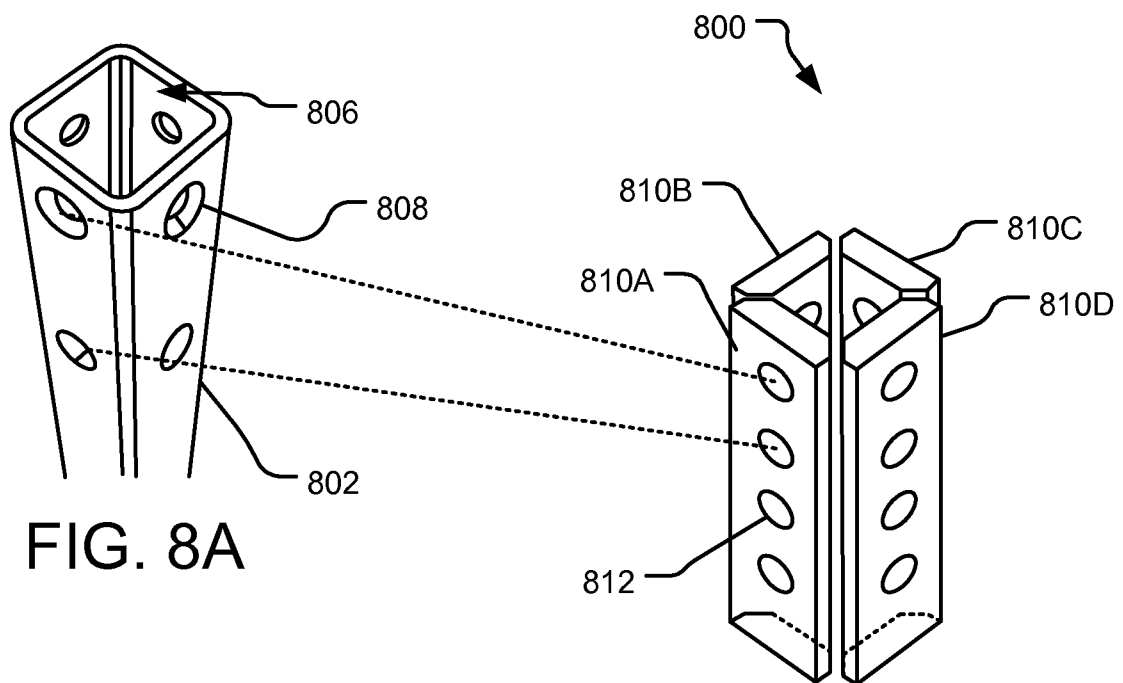


FIG. 8A

FIG. 8B

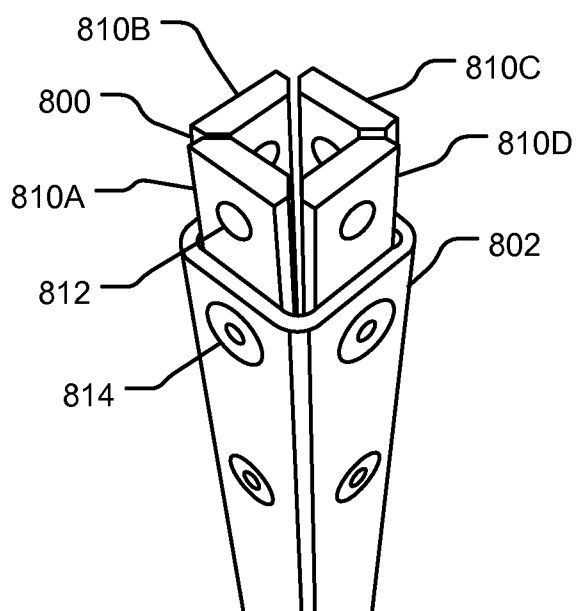


FIG. 8C

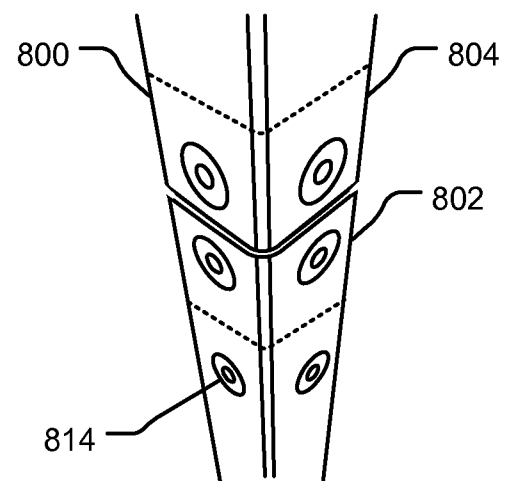
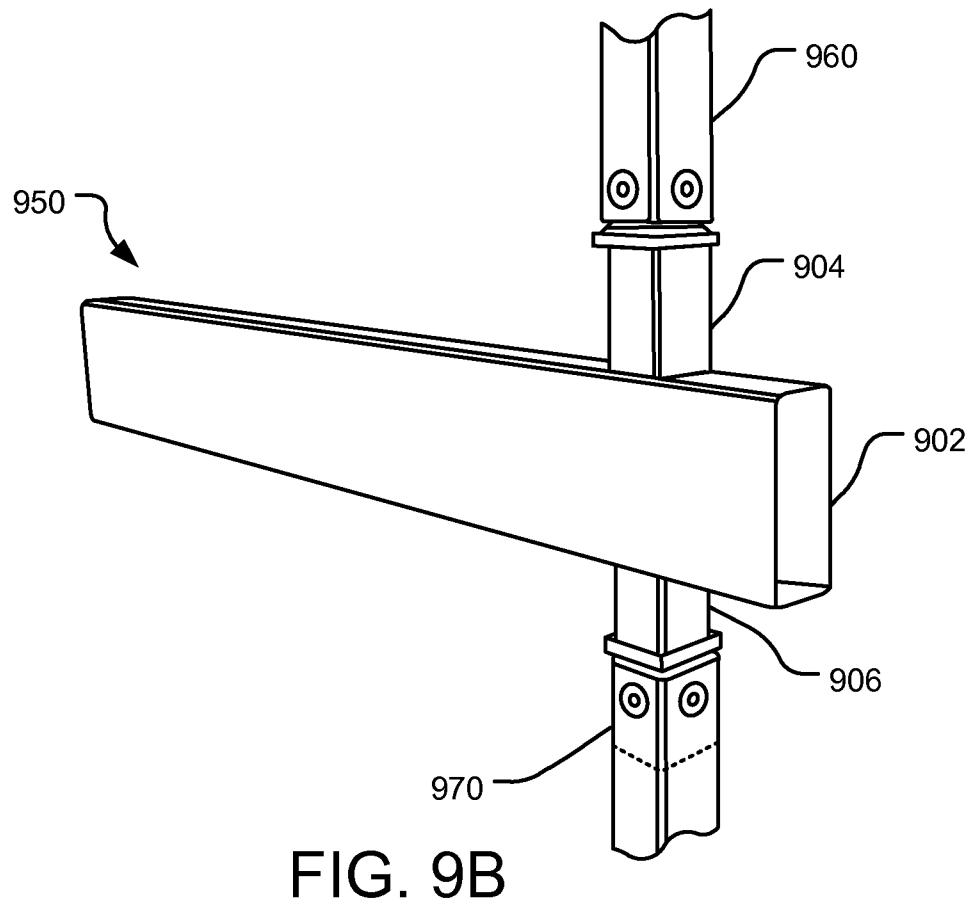
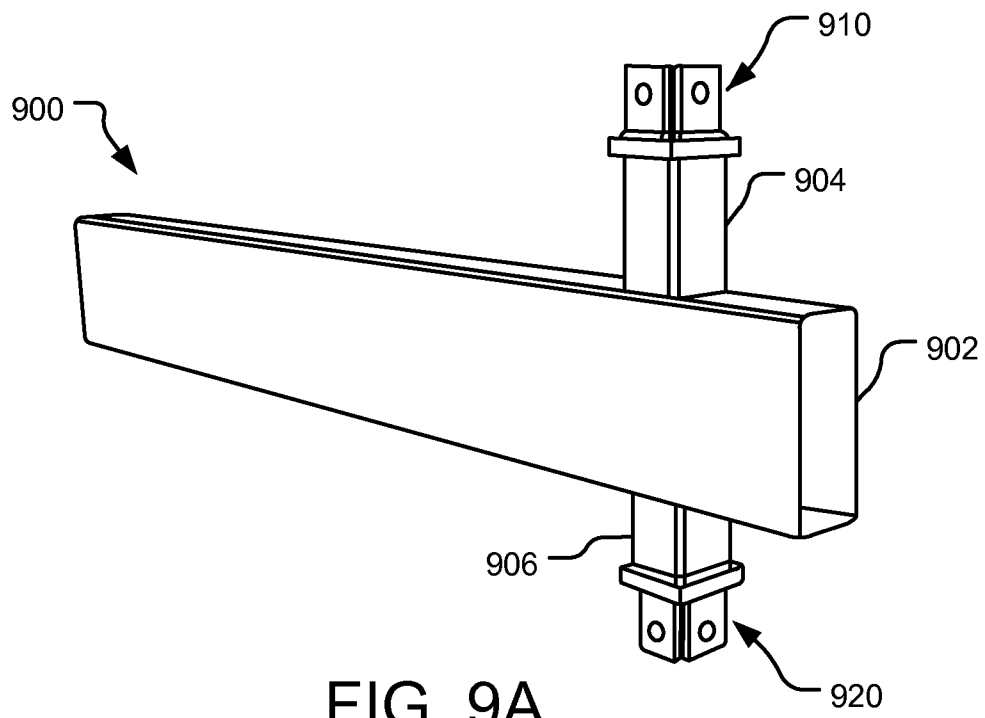
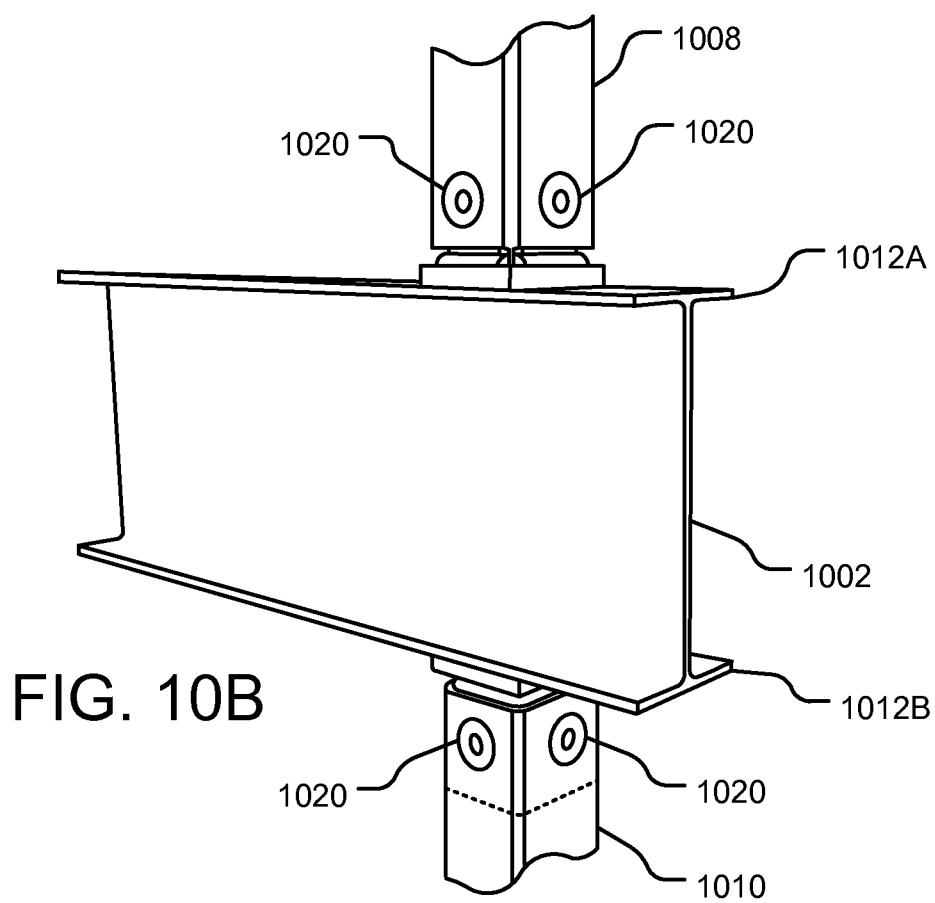
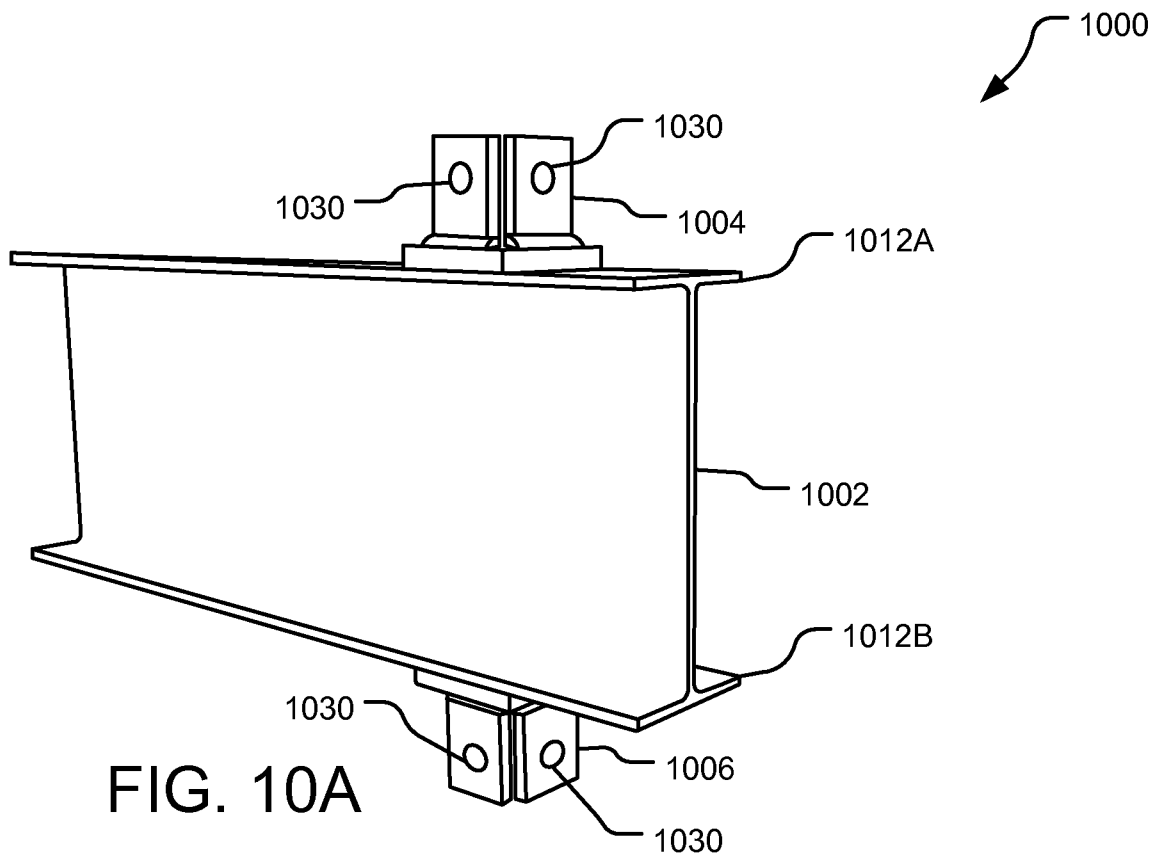


FIG. 8D

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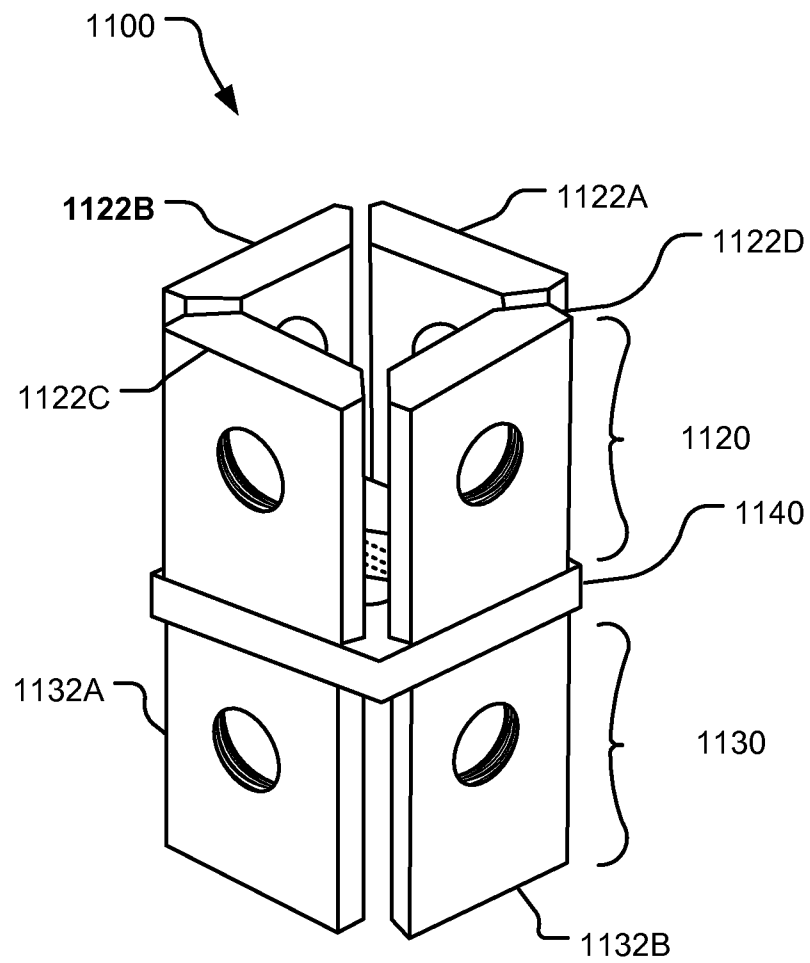


FIG. 11

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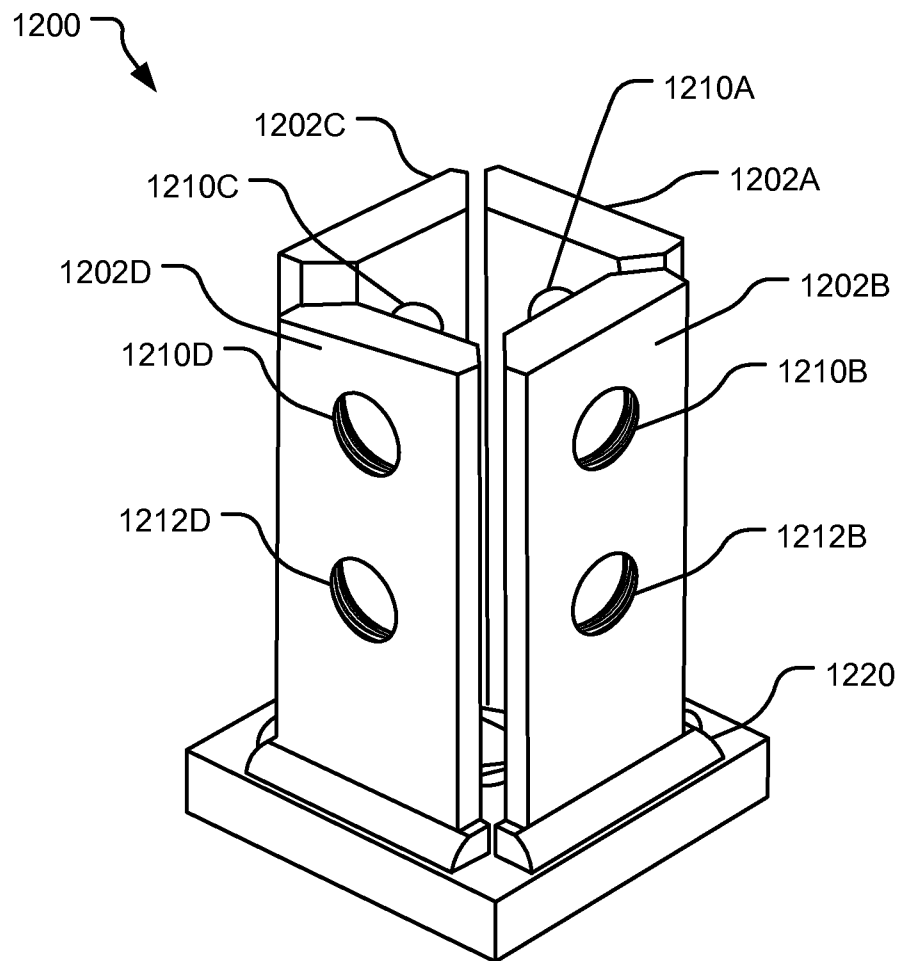


FIG. 12



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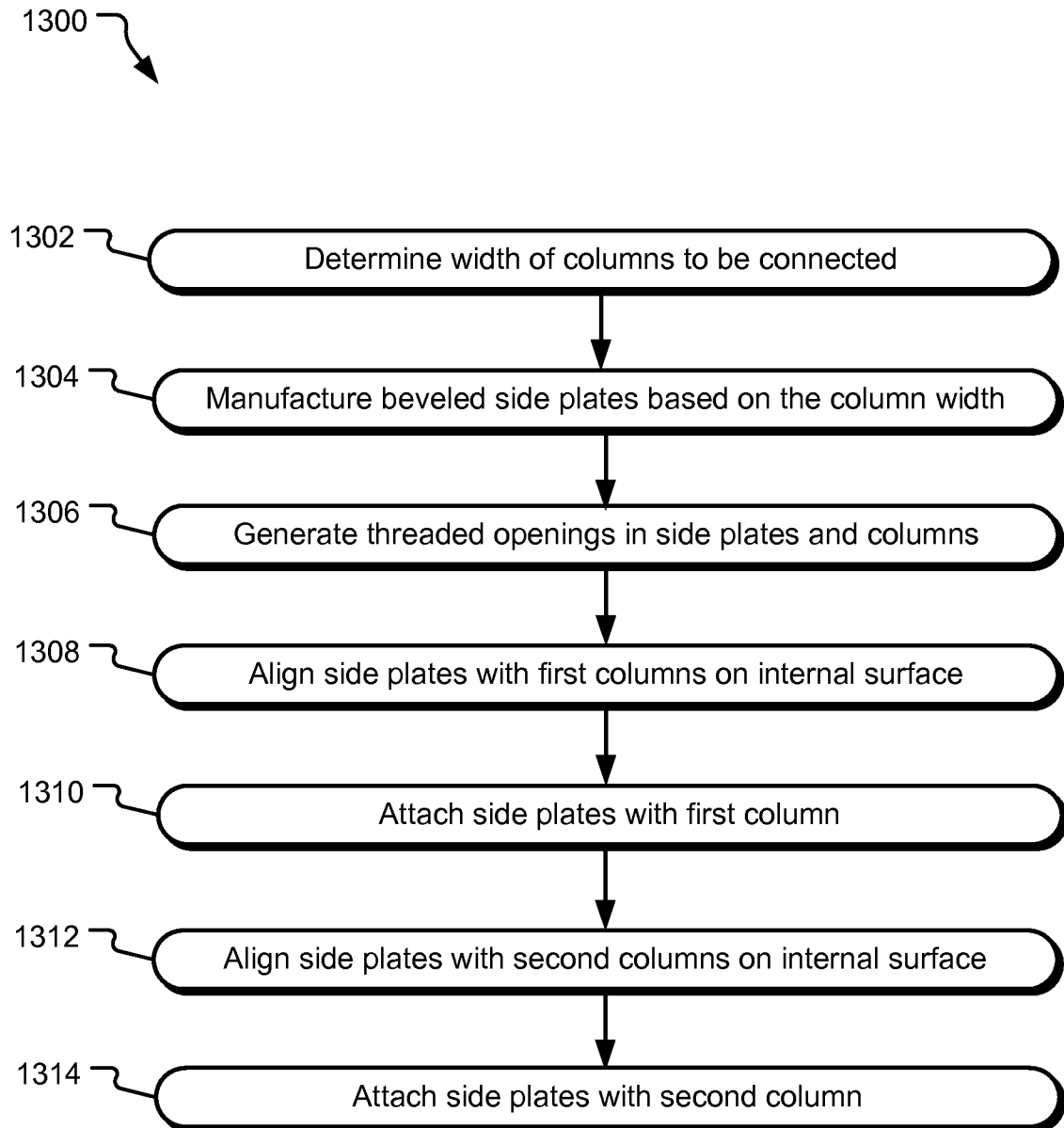


FIG. 13

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2015/028956**A. CLASSIFICATION OF SUBJECT MATTER****E04B 1/58(2006.01)i, E04B 1/19(2006.01)i, E04B 1/08(2006.01)i**

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)

E04B 1/58; E04B 1/24; E04B 1/30; E04H 9/02; E04B 1/19; E04B 1/08

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & Keywords: sleeve connector, base plate, side plate, welded joints, opening, and threaded bolt

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2006-104780 A (TAKENAKA KOMUTEN CO., LTD.) 20 April 2006 See paragraphs [0032], [0041], [0048] and figures 8-9, 14.	1-6,8
Y		7,9-19
Y	KR 10-2013-0141093 A (POSCO A&C CO., LTD.) 26 December 2013 See paragraphs [0030]-[0031], [0046]-[0050] and figures 5, 7a.	7,9-19
A	JP 07-317153 A (RIIDE K. K.) 05 December 1995 See paragraphs [0007]-[0008] and figures 1-2.	1-19
A	JP 2006-233445 A (HITACHI METALS TECHNO LTD.) 07 September 2006 See paragraphs [0012]-[0015] and figures 1-2.	1-19
A	JP 2009-024367 A (NIPPON STEEL CORP.) 05 February 2009 See paragraphs [0010]-[0011] and figure 1.	1-19



Further documents are listed in the continuation of Box C.



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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search

23 July 2015 (23.07.2015)

Date of mailing of the international search report

24 July 2015 (24.07.2015)

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

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cited in search reportPublication
datePatent family
member(s)Publication
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