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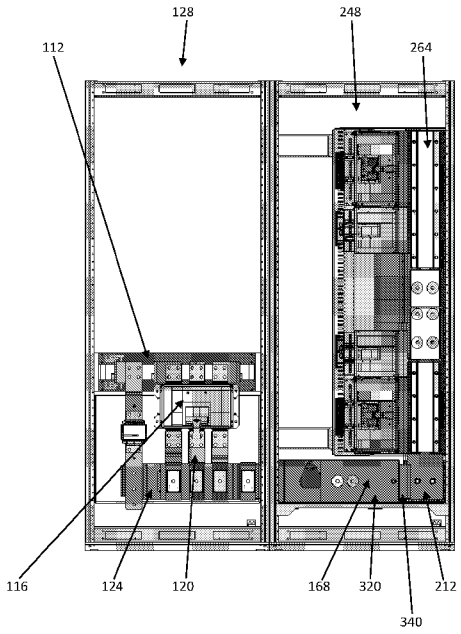



Figure 13

(57) Abstract: The present invention discloses a field assembled electrical distribution device assembled from various prepackaged modular kits. The prepackaged modular kits include all of the components required for their assembly. The prepackaged modular kits, when assembled by a certified assembler using a certified method and verification means provided by the modular kit manufacturer and one or more well know third-party certifiers, meets the requirements local, national and international electrical codes and is eligible for the third-party's certification mark.

*[Continued on next page]*

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# FIELD ASSEMBLED MODULAR ELECTRICAL DISTRIBUTION DEVICE

## TECHNICAL FIELD

[0001] The present disclosure relates to energy management, and more particularly, to field assembled modular electrical distribution devices.

## PRIORITY CLAIM

[0002] This application claims priority to and benefit from the following provisional patent applications: U.S. Provisional Application Ser. No. US 63/055,938 titled "Modular Switchboard Management System" filed on July 24, 2020. The entire contents of this aforementioned patent application are expressly incorporated by reference herein.

## BACKGROUND

[0003] Conventional factory-assembled electrical distribution devices typically come in a relatively limited number of configurations. Factory-assembled electrical distribution devices, such as switchboards and similar electrical devices, require a significant amount of copper electrical busbars that are heavy and very expensive. A fully assembled switchboard can also be large and heavy, which means shipping to the job site can be expensive and maneuvering to its final location at the job site can be very difficult. A completely assembled electrical distribution device can also be more difficult for installers to wire since some of the factory installed components block or restrict areas of the electrical distribution device where electrical connections to the utility power source and other downstream electrical distribution devices must be made. Electrical distribution devices also require third-party certification, which requires a representative of the certifying third-party to observe and compare the assembly process in the factory with assembly documentation prepared and approve by the certifying third-party or compare an assembled electrical distribution device in the factory with the third-party assembly documentation prepared and approve by the certifying third-party. If the assembled electrical distribution device meets all of the requirements of the

third-party's assembly documentation the manufacturer may apply a certification label to the assembled electrical distribution device. In some instances, certification of an electrical distribution device already at its final location in the field may require certification. In these instances, a third-party representative must go to the remote location and compare a factory assembled electrical distribution device with the certifying third-party's assembly documentation. These remote certifications are very expensive and do not eliminate the problems of shipping the large electrical distribution device to the job site or maneuvering the fully assembled heavy electrical distribution device to its final location.

## SUMMARY

[0004] The present invention solves the problems listed above associated with factory assembled electrical distribution devices by providing a method for assembling, in the field, at or very close to the final location of the assembled electrical distribution device, a third-party certified electrical distribution device from smaller and lighter prepackaged third-party certified modular kits.

## BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 illustrates a fully assembled modular electrical distribution device, according to one embodiment described herein.

Figure 2 illustrates a frame kit of the modular electrical distribution device, according to one embodiment described herein.

Figure 3 illustrates a line bus kit of the modular electrical distribution device, according to one embodiment described herein.

Figure 4 illustrates a load bus kit of the modular electrical distribution device, according to one embodiment described herein.

Figure 5 illustrates a main breaker kit of the modular electrical distribution device, according to one embodiment described herein.

Figure 6 illustrates a through bus kit of the modular electrical distribution device, according to one embodiment described herein.

Figure 7 illustrates the electrical connections between a modular electrical distribution device having a main breaker/fused switch and a modular electrical distribution device having a branch circuit breaker kit, according to one embodiment described herein.

Figure 8 illustrates in more detail the electrical connection of the through bus connector busbars of the through bus kit and the branch circuit breaker bus using a joint pack, according to one embodiment described herein.

Figure 9 illustrates in more detail the branch circuit breaker kit and a direct electrical connection of the through bus busbars of the through bus kit and the branch circuit breaker bus using a joint pack, according to one embodiment described herein.

Figure 10 illustrates a lighting panel kit, according to one embodiment described herein.

Figure 11 illustrates an alternate construction of the through bus kit, according to one embodiment described herein.

Figure 12 illustrates an alternate construction of the through bus kit, according to one embodiment described herein.

Figure 13 illustrates a final assembly of a switchboard main section and a branch circuit breaker kit, according to one embodiment described herein.

Figure 14 illustrates a special through bus kit, according to one embodiment described herein.

Figure 15 illustrates an alternat construction of the special through bus kit, according to one embodiment described herein.

Figure 16 illustrates an optional easy cabling kit in the closed position, according to one embodiment described herein.

Figure 17 illustrates an optional easy cabling kit in the open position, according to one embodiment described herein.

Figures 18A-B illustrate a flow chart of the assembly and certification process, according to one embodiment described herein.

[0005] A more detailed description of the disclosure, briefly summarized above, may be had by reference to various embodiments, some of which are illustrated in the appended drawings. While the appended drawings illustrate select embodiments of this disclosure, these drawings are not to be considered limiting of its scope, for the disclosure may admit to other equally effective embodiments.

[0006] Identical reference numerals have been used, where possible, to designate identical elements that are common to the figures. However, elements disclosed in one embodiment may be beneficially utilized on other embodiments without specific recitation.

## DETAILED DESCRIPTION

[0007] Figure 1 illustrates a fully assembled modular electrical distribution device **100** according to one embodiment described herein. This modular electrical distribution device **100** is constructed from various prepackaged modular kits **104**, such as a frame kit **108**, a line bus kit **112**, a main breaker/fused switch kit **116**, a load bus kit **120** and a through bus kit **124**. These particular modular kits **104**, when assembled, form a switchboard main section **128**. Similar modular electrical distribution devices **100**, can be assembled depending on the type of modular kits **104** ordered. The assembly of the various modular kits **104** required for the electrical distribution device **100** takes place at or near the final location of the electrical distribution device **100**. The various modular kits **104**, when assembled by an assembler certified by the modular kit manufacturer using a certified method and verification means **132** provided and approved by the modular kit **104** manufacturer and the third-party certifier, meet the requirements of third-party

organizations such as Under Writer's Laboratories, Inc (UL), the National Electrical Manufacturers Association (NEMA), the International Electrotechnical Commission (IEC) and/or the American National Standards Institute (ANSI). To be certified, the assembler must successfully pass one or more training courses provide by the modular kit manufacturer or provide verifiable proof of his electrical and mechanical skills and his ability to use augmented reality in assembling a modular electrical distribution device. The assembly verification means **132** includes a digital storage repository **136** located at a remote location and accessible by the modular kit manufacturer and the certifying third-party. The digital storage repository **136** maintains information **140** about the assembly of each modular kit **104** included in the assembled modular electrical distribution device **100**. This stored information **140** can include the original order number, an order specific bill of materials, listing of the ordered modular kits **104**, electrical rating information, the assembly hardware used in assembling the modular kits **104**, the certified assembler's certification information, the certified sequence of assembling the various modular kits **104** of the modular electrical distribution device **100**, the assemblers inputs **106**, visual records of the completion including digital artifacts **142** of each sequential step of the assembly of the modular electrical distribution device **100**, electrical performance tests and a performance and a traceability database for recording any subsequent maintenance, usage and performance of the assembled modular electrical distribution device **100**. The original order may require several frame kits **108** connected together, each housing a segment (main breaker, branch circuit breaker, utility bus, lighting panel or other similar electrical distribution devices **100**) of the complete electrical distribution device **100** assembly. The stored information **140** obtained prior to and during the assembly of each modular kit **104** of a modular electrical distribution device **100,** and stored in the digital storage repository **136,** is used by the certifying third-party to verify that the assembled electrical distribution device **100** meets their requirements and is eligible for the application of their certification mark on the assembled modular electrical distribution device **100**. Verification of each sequential step of assembling each modular kit **104** of the modular electrical distribution device **100** is accomplished by comparing inputs **106** from the certified assembler after completing each sequential step of assembling each modular kit **104** with a

previously stored list of the required sequential steps for that particular modular kit **104**. If the certified assembler's inputs **106** after completing each sequential step during assembly of each particular kit 104 match the previously stored list of required sequential steps, the assembled electrical distribution device **100** will be eligible for the application of the third-parties certification mark.

[0008] Referring now to Figure 2, a frame kit **108** according to one embodiment described herein includes uprights **144** (generally 4-6 pieces), each made of metal. Each upright **144** having a cross-section of a particular shape which increases the strength of the uprights **144**. The uprights **144** also have pre-punched holes **148** for assembly hardware **152**. The frame kit **108** also includes a bottom section **156** and top section **160** (generally 4 pieces each), which also have pre-punched holes **148** for assembly hardware and a cross-section of a particular shape which increases strength of the bottom section **156** and top section **160**. The bottom section **156** and top section **160** are attached to the uprights **144** by hardware **152** (screws, washers, nuts and bolts not shown) included in a hardware package **164** (not shown) prepared by the manufacturer specifically for the ordered modular frame kit **108**. The hardware package **164** contains the correct number, diameter, length, thread pitch and gauge of hardware **152** required for assembling the frame kit **108**. The term "hardware" as used herein is considered to be bolts, nuts, screws, washer, small brackets or any other similar items that might be required for assembly of a prepackage modular kit **104**. A matrix or 2D barcode **168** attached to one member of the frame kit **108**, in a position that is visible after assembly, provides access to information **140** describing each component of the frame kit **108**, the proper steps for assembly, the type of hardware **152**, its location in the frame kit **108** and any special tools required for assembling the frame kit **108**. Augmented reality can also be used to show the certified assembler, in an approved and certified sequence, where each component of the frame kit **108** is to be installed. In one embodiment, the augmented reality device **170** and/or the assembly software with 2D or Isometric views will show the next assembly step upon determining that the current step is completed, verified and recorded in the digital storage repository **136**. For example, the installation may require a special torque wrench which is capable of sending the measured torque applied to each

bolted connection to the digital storage repository **136**, where it is maintained. This torque information **140** may also be required for certification of the assembled frame kit **108.**

[0009] Referring to Figure 3, a line bus kit **112**, according to one embodiment described herein, includes line bus brackets **172** (Figures 1 and 2) that are securely attached between the front and rear uprights **144** on each side of the frame kit **108** and a line bus subframe **176** securely attached to the line bus brackets **172.** Line bus busbar supports **180** are located between and securely attached to line bus busbars **184**. The line bus busbar supports **180** are made from a nonconductive material and ensure that a safe electrical clearance between the line bus busbars **184** is maintained. The Line bus busbars **184** are electrically connected the line side of a main breaker/fused switch **188** by hardware **152** and to cable lugs **192**, which receive power from a utility power source or an upstream breaker/fuse device through cables (not shown). Alternate constructions my use busbars instead of cables. In either construction power can enter the frame kit **108** from the top, bottom or back of the modular electrical distribution device **100**. The main breaker/fused switch **188** is securely attached to the line bus subframe **176** by hardware **152**. A hardware package **164** prepared at the manufacturer specifically for the ordered line bus kit **112** contains the correct number, diameter, length, thread pitch and gauge of hardware **152** required for assembling the line bus kit **112**. A matrix or 2D barcode **168** attached to one member of the line bus kit **112**, in a position that is visible after assembly, provides access to information **140** describing each component of the line bus kit **112**, the proper steps for assembly, the type of hardware **152**, its location in line bus kit **112** and any special tools required for assembling the line bus kit **112**. As discussed above, an augmented reality device **170** can also be used to show the certified assembler, in an approved and certified sequence, where each component of the line bus kit **112** is to be installed. For example, the augmented reality device **170** can be configured to show the next assembly step responsive to determining (e.g., based on analyzing received torque wrench sensor data) that the current step is completed, verified and recorded in the digital storage repository **136**

[0010] Referring now to Figure 4, a load bus kit **120,** according to one embodiment described herein, includes load bus brackets **196** that are securely attached to the front and rear uprights **144** on each side of the frame kit **108**, a load bus subframe **200** securely attached to the load bus brackets **196** (Figures 1 and 2) and at least one load bus busbar support **204** which is securely attached to the load bus subframe **200**. The load bus busbar support **204** is made from a nonconductive material. Load bus busbars **208** are securely attached to the load bus busbar support **204** by hardware **152** such that a safe electrical clearance between the load bus busbars **208** is maintained. The load bus busbars **208** connect a main breaker/fused switch **188** to a through bus kit **124**. The hardware package **164** prepared at the manufacturer specifically for the ordered load bus kit **120** contains the correct number, diameter, length, thread pitch and gauge of hardware **152** required for assembling the load bus kit **120**. A matrix or 2D barcode **168** is attached to one member of the load bus kit **120**, in a position that is visible after assembly, provides access to information **140** describing each component of the load bus kit **120**, the proper steps for assembly, the type of hardware **152,** its location in the load bus kit **120** and any special tools required for assembling the load bus kit **120**. As discussed above, an augmented reality device **170** can also be used to show the certified assembler, in an approved and certified sequence, where each component of the load bus kit **120** is to be installed in a step-by-step manner, with the completion of each step being verified and recorded in a digital storage repository **136** throughout the process.

[0011] Referring now to Figure 5, the main breaker/fused switch **188** is a factory assembled component and requires no further assembly other than making electrical connections to the line bus busbars **184** (Figure 3) and load bus busbars **208** (Figure 4). The hardware package **164** prepared at the manufacturer specifically for the ordered main breaker/fused switch **188** contains the correct number, diameter, length, thread pitch and gauge of hardware **152** required for connecting the main breaker/fused switch **188** to the line bus busbars **184** and load bus busbars **208**. A matrix or 2D barcode **168** attached to a front surface of the main breaker/fused switch **188** provides access to information **140** describing the proper steps for connecting the main breaker/fused switch **188** to the line bus

busbars **184** and load bus busbars **208**, the type of hardware **152**, its location in the assembly and any special tools required for assembly. Augmented reality can also be used to show the certified assembler, in an approved and certified sequence, where each component of the main breaker/fused switch **188** is to be installed.

[0012] Referring now to Figure 6, a through bus kit **124** according to one embodiment is described herein. The through bus kit **124** provides a means for making electrical connections between the electrical devices assembled in one modular electrical distribution device **100** with electrical devices assembled in an adjacent modular electrical distribution device **100**. The through bus kit **124** includes through bus busbars **212** having a length sufficient to span the inside width of one frame kit **108**. The through bus kit **124** also includes through bus connector busbars **216** for making an electrical connection between the through bus busbars **212** and the load bus busbars **208** of a load bus kit **120** previously installed in the same modular electrical distribution device **100**. The through bus kit **124** also includes through bus busbar supports **220** made from nonconductive material. The through bus busbar supports **220** have notches **224** for receiving an edge of the through bus busbars **212** such that a safe electrical clearance between the through bus busbars **212** is maintained. The through bus busbar supports **220** are assembled in pairs such that the through bus busbar **212** are clamped between them in the notches **224**. Each pair of through bus busbar supports **220** is held together by U-shaped brackets **228** that are attached to the ends of the through bus busbar supports **220** using hardware **152**. The U-shaped brackets **228** are securely attached to plates **232** (Fig. 7), which are securely attached to the frame uprights **144** by hardware **152**. The hardware package **164**, prepared at the manufacturer specifically for the ordered through bus kit **124** contains the correct number, diameter, length, thread pitch and gauge of hardware **152** required for assembling the through bus kit **124**. A matrix or 2D barcode **168** attached to one element of the through bus kit **124** in a position visible after assembly provides access to information **140** describing each component of the through bus kit **124**, the proper steps for assembly, the type of hardware **152**, its location in the through bus kit **124** and any special tools required for assembling the through bus kit **124**.

Augmented reality can also be used to show the certified assembler, in an approved and certified sequence, where each component of the through bus kit **124** is to be installed. The augmented reality device **170** will not show the next assembly step until the current step is completed, verified and recorded in a digital storage repository **136**. This installation may require a special torque wrench which is capable of sending the measured torque applied to each bolted connection to master data repository **136**. The torque information **140** is required for certification of the through bus kit **124** assembly.

[0013] The electrical connections between through bus busbars **212** of one assembled modular electrical distribution device **100** and the through bus busbars **208** of an adjacent modular electrical distribution device **100** can be accomplished by bolted connector bus bars (not shown) similar to the through bus connector busbars **216**, joint packs **236** (Fig. 7) and spring jaw connectors **240** (Fig. 12) or combinations of these methods on opposite ends of the through bus busbars **212**. When using hardware **152** to make electrical connections a special torque wrench, which is capable of sending the measured torque applied to each bolted connection to the master data repository **136,** is generally required. This torque information **140** is required for verification by the certifying third-party that the electrical connections meet the requirements for certification of the assembled modular electrical distribution device **100**. The alternate methods of making electrical connections listed above will be discussed in more detail below.

[0014] A joint pack **236**, as shown in Figure 7, is a preassembled busbar connector which can simultaneously connect all three electrical phase busbars and an optional neutral busbar of a first modular kit **104** to all three electrical phase busbars and an optional neutral busbar of a second modular kit **104**. The joint pack **236** may have a double headed bolt **244** that does not require a torque wrench to make a properly torqued electrical connection. When a joint pack **236** is used to make electrical connections between the through bus busbars **212** of a previously assembled electrical distribution device and the through bus busbars **212** of an adjacent electrical distribution device, as shown in Figures 7 and 8, the joint pack **236** is slidingly installed between the two through bus kits **124** and the

double headed bolt **244** is tightened, using the outer bolt head, until the outer bolt head breaks off. When the outer bolt head breaks off the proper torque of approximately 70 foot/pounds for the electrical connection has been applied to the joint pack **236**.

[0015] As shown in Figure 8, a joint pack **236** is being slidingly installed between through bus connector busbars **216** and the branch circuit breaker bus **264** of a branch circuit breaker kit **248**. As shown in Figure 9, the joint pack **236** can be installed directly between the through bus busbars **212** and the branch circuit breaker bus **264**, thereby eliminating the need for the through bus connector busbars **216**.

[0016] A branch circuit breaker kit **248**, as shown in Figure 9, permits a number of branch circuit breakers **252** to be installed in a small space. The branch circuit breaker kit **248** includes branch circuit breaker brackets **256** (Figures 7 and 8) that are securely attached to the front and rear uprights **144** on each side of the frame kit **108**, and branch circuit breaker subframes **260** are securely attached to the branch circuit breaker brackets **256**. A branch circuit breaker bus **264** securely attached to the branch circuit breaker subframe **260** and a circuit breaker support frame **268** is also securely attached to the branch circuit breaker subframe **260**. The branch circuit breaker bus **264** is electrically connected to a through bus kit **124** and provides power to the branch circuit breakers **252**, which are attached to and supported by the circuit breaker support frame **268**. A matrix or 2D barcode **168** attached to one member of the branch circuit breaker kit **248**, in a position visible after assembly provides access to information **140** describing each component of the branch circuit breaker kit **248**, the proper steps for assembly, the type of hardware and its location in the assembly and any special tools required for assembling the branch circuit breaker kit **248**. Augmented reality can also be used to show the certified assembler, in an approved and certified sequence, where each component of the branch circuit breaker kit **248** is to be installed.

[0017] Figure 10 illustrates a lighting panel kit **272** according to one embodiment described herein. The lighting panel kit **272** includes a lighting panel **276**, lighting panel brackets (not shown) similar to the branch circuit breaker

brackets **256** (Figures 7 and 8) that are securely attached to the front and rear uprights **144** on each side of the frame kit **108** and lighting panel subframes **280** are securely attached to the lighting panel brackets. The lighting panel **276** is securely attached to the lighting panel subframes **280**. The lighting panel **276** is configured for receiving lighting control switches **284** and means similar to other modular kits **104** described herein for connecting the lighting panel **276** to a through bus kit **124**. A matrix or 2D barcode **168** attached to one member of the lighting panel kit **272**, in a position visible after assembly provides access to information **140** describing each component of the lighting panel kit **272**, the proper steps for assembly, the type of hardware and its location in the assembly and any special tools required for assembling the lighting panel kit **272**. Augmented reality can also be used to show the assembler, in an approved and certified sequence, where each component of the lighting panel kit **272** is to be installed.

[0018] An alternate construction for the through bus kit **124** is a bus bridge kit **288** as shown in Figures 11 and 12 (portions of the exterior metal covering are removed for a better view of the internal components). A bus bridge kit **288** can be easily installed into an otherwise completed modular electrical distribution device **100**. A slidable portion **292** of the bus bridge kit **288** permits the overall length of the bus bridge kit **288** to be compressed to a minimum length for easy installation into an otherwise completed modular electrical distribution device **100** and then expanded to a length which permits making electrical connections with through bus kits **124** of adjacent modular electrical distribution device **100**. The slidable portion **292** is accomplished by having right bus bridging busbar **296** and left bus bridging busbar **300** for each electrical phase. Electrical insulators **304** are placed between each phase to maintain the proper through air distance between electrical phases and prevent phase-to-phase arcing. The right bus bridging busbars **296** and left bus bridging busbars **300** are assembled such that the slidable portion **292** of the right bus bridging busbars **296** and left bus bridging busbars **300** are in juxtaposed position with each other. The slidable portion **292** of each of the right bus bridging busbars **296** and left bus bridging busbars **300**

include coinciding longitudinal slots **308**. The longitudinal slots **308** permit a variable sliding movement between the right and left bus bridging busbars, **296** and **300** respectively. The longitudinal slots **308** are for receiving one or more bolts **316**. When the bolts **316** are loose or removed the right and left bus bridging busbars, **296** and **300** respectively, can move back and forth with respect to each other to compress or expand the overall length of the bus bridge kit **288**. When the bolts **316** are tight the right and left bus bridging busbars, **296** and **300** respectively, cannot move back and forth with respect to each other. The bolts **316** are torqued to predetermined specific value (approximately 70 foot pounds) required for certifying the assembly of the bus bridge kit **288**.

[0019] Each of the right and left bus bridging busbars, **296** and **300** respectively, have an exterior end, **320**, that extend outward from a slidable housing **324**. The exterior ends **320**, as shown in Figure 11, have a longitudinal slot **328** configured for a bolted or joint pack **236** electrical connection, but can be configured for making an electrical connection with other bus bridging busbars **296** or **300**, through bus busbars **212**, load branch circuit breaker busses **264** or lighting panels **276**. The exterior ends **320** are supported by end plates **332** made from a high strength nonconductive material and are prevented from moving with respect to the slidable housing **324** by clamps **336**. In Figure 12, the end plates **332** have embedded spring jaws **240** that provide a plug-on electrical connection wherein the electrical bus bars are forced into a gap between the embedded spring jaw connectors **240**. Figure 13 illustrates a final assembly of a switchboard main section **128** and a branch circuit breaker kit **248** using a through bus kit **124** and a bus bridge kit **288** with spring jaw connectors **240** in the end plates **332**.

[0020] Figure 14 illustrates special application bus bridge kit **340** which has the same slidable portion **292** described above with respect to Figures 11 and 12. The special application bus bridge kit **340** has special electrical terminals **344** for electrically connecting to a load bus kit **120** at one end and an opening **348** in housing **352** for receiving connector bus bars similar to through bus connector busbars **216** in Figure 8 or a joint pack **236**. Figure 15 illustrates a slightly different

configuration of special application bus bridge kit **340** wherein special electrical terminals **344** extend outwardly from one end of the housing **352** and special application bus bridge busbars **356** extend outwardly from the other end of the housing **352**.

[0021] Referring now to Figures 16 and 17, an optional easy cabling kit **360** which, provides more room for pulling and connecting cables from the utility, is disclosed. The easy cabling kit **360** can be used with standard or slightly modified frame kits **108**, line bus kits **112** (configured similar to the load bus kit **120**), load bus kits **120**, main breaker/fused switch kits **116** and through bus kits **124** to easily provide more room for pulling and connecting utility power cables to the line bus kit **112** and any other wiring that is normally located behind the main breaker/fused switch kit **116**, load bus kit **120** and/or through bus kit **124**. The easy cabling kit **360** includes a main breaker/fused switch mounting bracket **364** on which a standard main breaker/fused switch **188** can be mounted, and an easy cabling subframe **368** on which the mounting bracket **364** is installed. The easy cabling subframe **368** includes two fixed section **372**, each being attached to one of two opposed side walls **376** of the electrical distribution device **100**. The easy cabling subframe **368** also includes a movable section **380**, which is rotatably attached to a first one of the two fixed sections **372** by a hinge **384**. The hinge **384** permits the movable section **380**, including a main breaker/fused switch **188** mounted on the main breaker/fused switch mounting bracket **364**, a standard load bus kit **120** and a standard through bus kit **124**, to be rotated away from the cabling area **388** as a single unit after the main breaker/fused switch **188** is disconnected from the line bus kit **112** and the through bus kit **124** has been disconnected from any adjacent through bus kits **124**. The line bus subframe **392** is securely attached to the rear frame uprights **144** and opposed side walls **376** by line bus brackets **396**, and therefore remains in place when the movable section **380** of the easy cabling subframe **368** is rotated away from the cabling area **388**. When the movable section **380** is not rotated away from the cabling area **388**, the movable end **400** of movable section **380** is securely attached to the second one of the two fixed section **372**. The line bus brackets **396** and fixed sections **372** of the easy cabling subframe **368** are easily positioned on the side

walls **376** and temporally supported by a combination of slots **404** and rivets **408**. The slots **404** are generally L-shaped and the rivets **408** have two heads separated by a space that is slidingly received in the slot **404**. In an alternative construction of the easy cabling kit **360** shown in Figure 17, the front uprights **144** can be removed to provide additional cabling access.

[0022] The enclosure package kit (not shown) is the final assembly of the modular electrical distribution device **100**. This kit includes side walls **376**, a top **412** and front covers **416** for the assembled electrical distribution device **100**. The side walls **376,** top **412** and front covers **416** are attached to frame kit **108** uprights **144** by hardware **152** contained in the hardware package 1**64**. The front covers **416** are metal panels that cover any exposed electrical connections, busbars or electrical cables contained inside the electrical distribution device **100** frame. They have openings for accessing the main breaker/switch handle and the handles of any enclosed branch circuit breakers **252** in the branch circuit breaker kit **248**. The front covers **416** can be attached by hinges that permit the covers to easily be opened or by hardware **152** which must be removed to gain access to the branch circuit breaker kit **248** interior. The hardware package **164** contains the correct number, diameter, length, thread pitch and gauge of hardware **152** required for assembling the enclosure package. The number and type of walls, tops and covers provided in the enclosure package will depend on the type and configuration of the modular electrical distribution device **100** ordered.

[0023] Figures 18A-B are flow charts illustrating assembly actions performed by the assembler and an assembly management program **420** stored in the digital storage repository **136**, according to one embodiment described herein. In block **424** the assembler is logging on to the assembly management program **420**. At block **428** the assembly management program **420** validates the assembler's login information. In block **432** the assembler selects the modular kits **104** that will be assembled for the modular electrical distribution device **100**. At block **436** the assembly management program **420** will arrange the selected modular kits **104** in a sequence for assembling approved by the modular kit **104**

manufacturer. At block **440** the assembly management program **420** will provide a sequential order, approved by the modular kit **104** manufacturer, for performing the assembly steps first modular kit **104** to be assembled. At block **444** the assembler will assemble the first step of the modular kit **104**. At block **448** the assembly management program **420** will provide the next step in assembling the first step of the modular kit **104**. At block **452** the assembler will assemble the next step of the modular kit **104** At block **456** the assembly management program **420** will determine if the executed assembly step at block **452** was the last step for assembling the first modular kit **104**. If it was not the last step the assembly management program **420** will return to block **448** for providing then next assembly step. If it was the last assembly step for the modular kit **104** the assembly management program **420** will proceed to block **460** where the next modular kit **104** in the sequence of modular kits **104** will be selected for assembly. At block **464** assembly management program **420** will provide the sequential steps for assembly steps for the selected modular kit **104**. At block **468** the assembler executes the first assembly step of the selected modular kit **104**. At block **472** the assembly management program **420** will provide the next sequential step for assembly steps for the selected modular kit **104**. At block **476** the assembler executes the next assembly step of the selected modular kit **104**. At block **480** the assembly management program **420** will determine if the executed assembly step at block **476** was the last step for assembling the first modular kit **104**. If it was not the last step the assembly management program **420** will return to block **472** where the next sequential step for assembly steps for the selected modular kit **104**. If, at block **480**, the assembly management program **420** determine that the executed assembly step at block **476** was the last step for assembling the first modular kit **104** it will proceed to block **484**. At block **484** the assembly management program **420** will determine if the assembly step at block **476** was the last assembly step of the last modular kit **104** of the selected modular kits **104**. If it was not the last modular kit **104** of the selected modular kits **104** the assembly management program **420** will return to block **460**. If the assembly management program **420** determines that the assembly step at block **476** was the last assembly step of the last modular kit **104** of the selected modular kits **104** it will proceed to block **488** where all of the information **140**

discovered during the assembly of the selected modular kits **104** including any digital artifacts obtained during the assembly will be processed to verify that all of the assembled kits **104** meet the certification requirements of the certifying third-party. The assembly management program **420** then proceeds to block **492** where the final report of the assembly including the stored information **140** will be recorded in the digital storage repository **136**. The assembly management program **420** then proceeds to block **496** where the certifying third -party's certification mark can be applied to the modular electrical distribution device **100**. At block **500** the assembler's job is completed.

[0024] Figure 19 is a block diagram of the assembly management program **420**, which is. The assembly management program **420** is in two-way communication with the stored information **140** and the assembler's inputs **106**, which are stored in the digital storage repository **136** and the assembler.

[0025] In the preceding, reference is made to various embodiments. However, the scope of the present disclosure is not limited to the specific described embodiments. Instead, any combination of the described features and elements, whether related to different embodiments or not, is contemplated to implement and practice contemplated embodiments. Furthermore, although embodiments may achieve advantages over other possible solutions or over the prior art, whether or not a particular advantage is achieved by a given embodiment is not limiting of the scope of the present disclosure. Thus, the preceding aspects, features, embodiments and advantages are merely illustrative and are not considered elements or limitations of the appended claims except where explicitly recited in a claim(s).

[0026] The various embodiments disclosed herein may be implemented as a system, method or computer program product. Accordingly, aspects may take the form of an entirely hardware embodiment, an entirely software embodiment (including firmware, resident software, micro-code, etc.) or an embodiment combining software and hardware aspects that may all generally be referred to herein as a "circuit," "module" or "system." Furthermore, aspects may take the form

of a computer program product embodied in one or more computer-readable medium(s) having computer-readable program code embodied thereon.

[0027] Any combination of one or more computer-readable medium(s) may be utilized. The computer-readable medium may be a non-transitory computer-readable medium. A non-transitory computer-readable medium may be, for example, but not limited to, an electronic, magnetic, optical, electromagnetic, infrared, or semiconductor system, apparatus, or device, or any suitable combination of the foregoing. More specific examples (a non-exhaustive list) of the non-transitory computer-readable medium can include the following: an electrical connection having one or more wires, a portable computer diskette, a hard disk, a random access memory (RAM), a read-only memory (ROM), an erasable programmable read-only memory (EPROM or Flash memory), an optical fiber, a portable compact disc read-only memory (CD-ROM), an optical storage device, a magnetic storage device, or any suitable combination of the foregoing. Program code embodied on a computer-readable medium may be transmitted using any appropriate medium, including but not limited to wireless, wireline, optical fiber cable, RF, etc., or any suitable combination of the foregoing.

[0028] Computer program code for carrying out operations for aspects of the present disclosure may be written in any combination of one or more programming languages. Moreover, such computer program code can execute using a single computer system or by multiple computer systems communicating with one another (e.g., using a local area network (LAN), wide area network (WAN), the Internet, etc.). While various features in the preceding are described with reference to flowchart illustrations and/or block diagrams, a person of ordinary skill in the art will understand that each block of the flowchart illustrations and/or block diagrams, as well as combinations of blocks in the flowchart illustrations and/or block diagrams, can be implemented by computer logic (e.g., computer program instructions, hardware logic, a combination of the two, etc.). Generally, computer program instructions may be provided to a processor(s) of a general-purpose computer, special-purpose computer, or other programmable data processing apparatus. Moreover, the execution of such computer program instructions using

the processor(s) produces a machine that can carry out a function(s) or act(s) specified in the flowchart and/or block diagram block or blocks.

[0029] The flowchart and block diagrams in the Figures illustrate the architecture, functionality and/or operation of possible implementations of various embodiments of the present disclosure. In this regard, each block in the flowchart or block diagrams may represent a module, segment or portion of code, which comprises one or more executable instructions for implementing the specified logical function(s). It should also be noted that, in some alternative implementations, the functions noted in the block may occur out of the order noted in the figures. For example, two blocks shown in succession may, in fact, be executed substantially concurrently, or the blocks may sometimes be executed in the reverse order, depending upon the functionality involved. It will also be noted that each block of the block diagrams and/or flowchart illustration, and combinations of blocks in the block diagrams and/or flowchart illustration, can be implemented by special purpose hardware-based systems that perform the specified functions or acts, or combinations of special purpose hardware and computer instructions.

[0030] It is to be understood that the above description is intended to be illustrative, and not restrictive. Many other implementation examples are apparent upon reading and understanding the above description. Although the disclosure describes specific examples, it is recognized that the systems and methods of the disclosure are not limited to the examples described herein but may be practiced with modifications within the scope of the appended claims. Accordingly, the specification and drawings are to be regarded in an illustrative sense rather than a restrictive sense. The scope of the disclosure should, therefore, be determined with reference to the appended claims, along with the full scope of equivalents to which such claims are entitled.

WE CLAIM:

1. A field assembled modular electrical distribution device constructed from various prepackaged modular kits comprising:

a frame kit containing structural elements of the modular electrical distribution device;

a line bus kit electrically connecting a utility power source to a main breaker/fused switch kit;

a load bus kit electrically connecting the main breaker/fused switch kit to a through bus kit, the through bus kit electrically connecting to a through bus kit of an adjacent field assembled modular electrical distribution devices; and

computer logic configured to verify that each kit of the field assembled modular electrical distribution device was assembled according to a third-party certified method by an assembler certified by the manufacturer of the modular kits such that the field assembled modular electrical distribution device meets the same compliance requirements as a factory assembled electrical distribution device and is eligible for the certifying third-party's certification mark.

2. The field assembled modular electrical distribution device of claim 1, wherein the frame kit includes uprights to which the various prepackaged modular kits of the field assembled modular electrical distribution device are attached and a top and a bottom connecting the uprights together structurally and establishing a footprint of the field assembled modular electrical distribution device.

3. The field assembled modular electrical distribution device of claim 1, wherein a scannable matrix or 2 D barcode is attached to one member of each of the various prepackaged modular kits at a location that is visible after assembly of the field assembled modular electrical distribution device is complete, the matrix or 2 D barcode providing access to information describing each component of the prepackaged modular kit being assembled.

4. The field assembled modular electrical distribution device of claim 1, wherein each of the various prepackaged modular kits includes a hardware package containing all of the hardware required for assembling the modular kit.

5. The field assembled modular electrical distribution device of claim 1, wherein an assembler, to be certified by a manufacturer of the various prepackaged modular kits, must provide proof of his electrical and mechanical skills and his ability to use an augmented reality device in assembling a modular electrical distribution device.

6. The field assembled modular electrical distribution device of claim 1, wherein an augmented reality device will show the certified assembler, in an approved and certified sequence, where each component of the modular kit being assembled is to be installed.

7. The field assembled modular electrical distribution device of claim 6, wherein augmented reality device will not show the next assembly step until the current assembly step is completed and verified.

8. The field assembled modular electrical distribution device of claim 1, wherein the verification means includes a digital storage repository for storing information about the assembly of each of the various prepackaged modular kits being assembled in each modular electrical distribution device.

9. The field assembled modular electrical distribution device of claim 8, wherein the information stored in the digital storage repositor can include any or all of the original order number, an order specific bill of materials, listing of the ordered modular kits, electrical rating information, the assembly hardware used in assembling the modular kits, the certified assembler's certification information, the certified sequence of assembling the various modular kits of the modular electrical distribution device, visual records of the completion of each sequential step of the assembly of the modular electrical distribution device, electrical performance tests and a performance and a traceability database for recording any subsequent maintenance, usage and performance of the assembled modular electrical distribution device.

10. The field assembled modular electrical distribution device of claim 9, wherein the certifying third-party uses the information stored in the digital storage repositor to determine whether the assembled modular electrical distribution device meets the same compliance requirements as a factory assembled

electrical distribution device and is eligible for the certifying third-party's certification mark.

11. The field assembled modular electrical distribution device of claim 1, wherein an enclosure kit includes side walls, a top and a front cover for enclosing the frame kit.

12. The field assembled modular electrical distribution device of claim 1 wherein the load bus kit, through bus kit and main breaker/fused switch kit can be mounted on an optional easy cabling access kit, which can be rotated away from a cabling area to provide more room pulling and connecting utility power cables

13. The field assembled modular electrical distribution device of claim 12 wherein the optional easy cabling access kit includes:

an improved cabling subframe having two fixed sections each being securely attached to opposing side walls of the electrical distribution device and a movable section attached to a first one of the two fixed sections by a hinge;

a main breaker/fused switch mounting bracket on which the main breaker/fused switch kit and a load bus kit electrically connected to main breaker/fused switch kit are mounted;

a through bus kit electrically connected to the load bus kit; wherein the main breaker/fused switch mounting bracket and the through bus kit are mounted on the movable section of the subframe such that the main breaker/fused switch kit, lode bus kit and through bus kit can be rotated away from the cabling area as a unit when the main breaker/fused switch kit is electrically disconnected from the line bus kit and the through bus kit is electrically disconnected from any adjacent through bus kit.

14. The field assembled modular electrical distribution device of claim 1 wherein the modular electrical distribution device may include a branch circuit breaker kit for installing multiple branch circuit breakers, a lighting panel kit for installing multiple light controlling switches.

15. The field assembled modular electrical distribution device of claim 1 wherein the modular electrical distribution device can include a bus bridge kit, which has a variable length for easier installation in the modular electrical distribution device, the variable length is accomplished by having a right busbar and a left busbar for each electrical phase, the right and left busbars having a slidable portion where the right busbar and left busbar are in juxtaposed position with each other, a longitudinal slot in each of the right and left busbars in a slidable portion of the right and left busbars permits a bolted electrical connection between the right and left busbars.

16. A method for managing the field assembly of a modular electrical distribution device, comprising:

upon receiving a login request from an assembler, validating the login request;

receiving, from the assembler, a selection of modular kits to be assembled and, in response, retrieving and providing, a sequence for assembling the selected modular kits and, for each selected modular kit, a plurality of sequential assembly steps;

performing, by the assembler, the sequential assembly steps that are associated with a particular modular kit;

recording digital artifacts of the modular electrical distribution device obtained during performance of the plurality of sequential assembly steps as part of the assembly process;

upon determining that compliance has been achieved for the assembled modular electrical distribution device based on the recorded digital artifacts satisfying a predefined compliance standard, recording a final assembly report for the modular electrical distribution device system; and

storing, in a digital storage repository, the final assembly report corresponding to the assembled modular electrical distribution device.

17. The method of claim 16, wherein after the assembler has successfully performed an assembly step the next sequential assembly step will be provide until all of the assembly steps have been successfully performed.

18. The method of claim 17, wherein after the assembler has successfully performed all of the sequential assembly steps for the current modular kit, the sequential assembly steps for the nest modular kit in the sequence of modular kits will be provided to the assembler until all of the selected modular kits have been assembled.

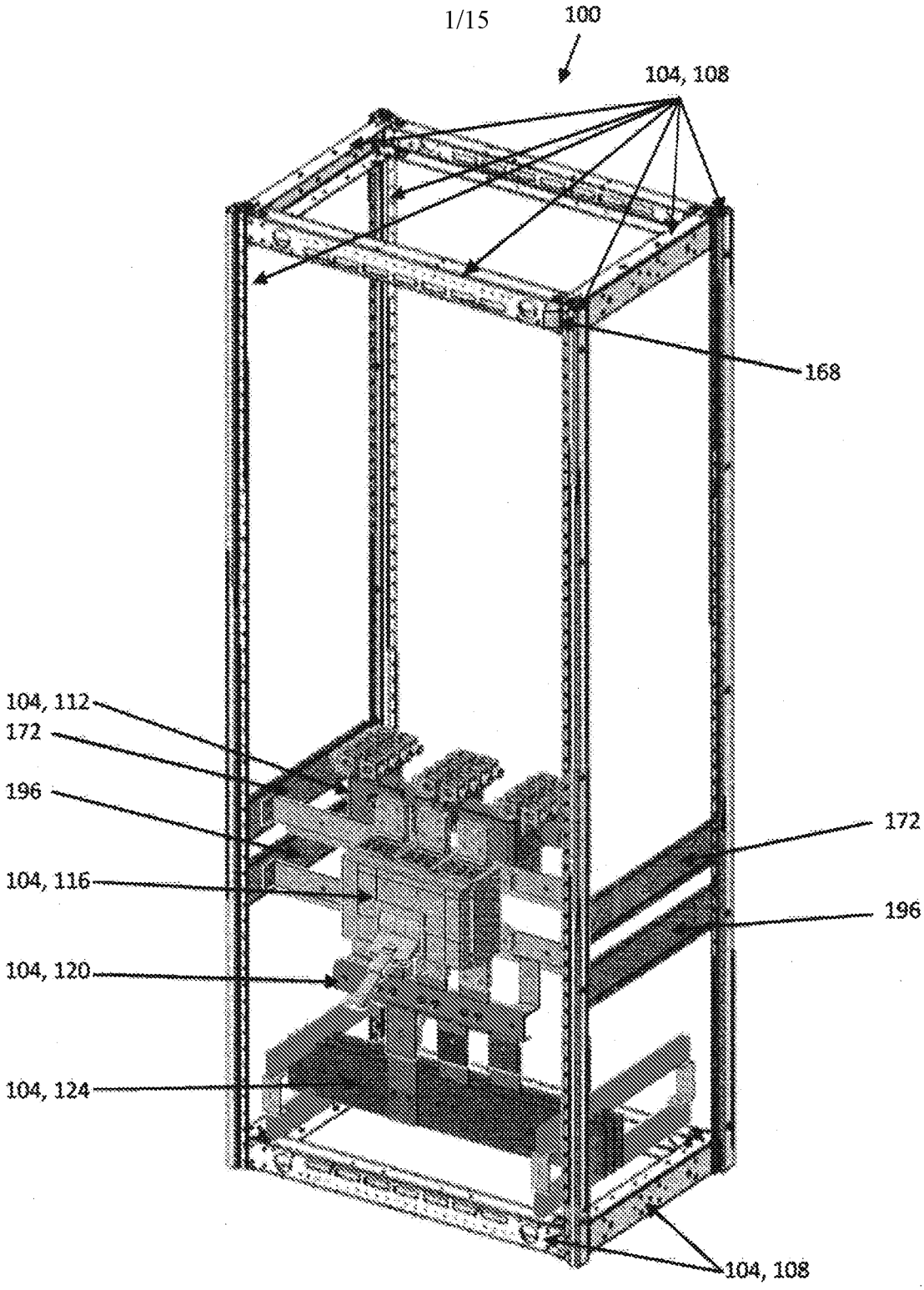

100
104, 108
168
104, 112
172
196
104, 116
104, 120
104, 124
172
196
104, 108

Figure 1

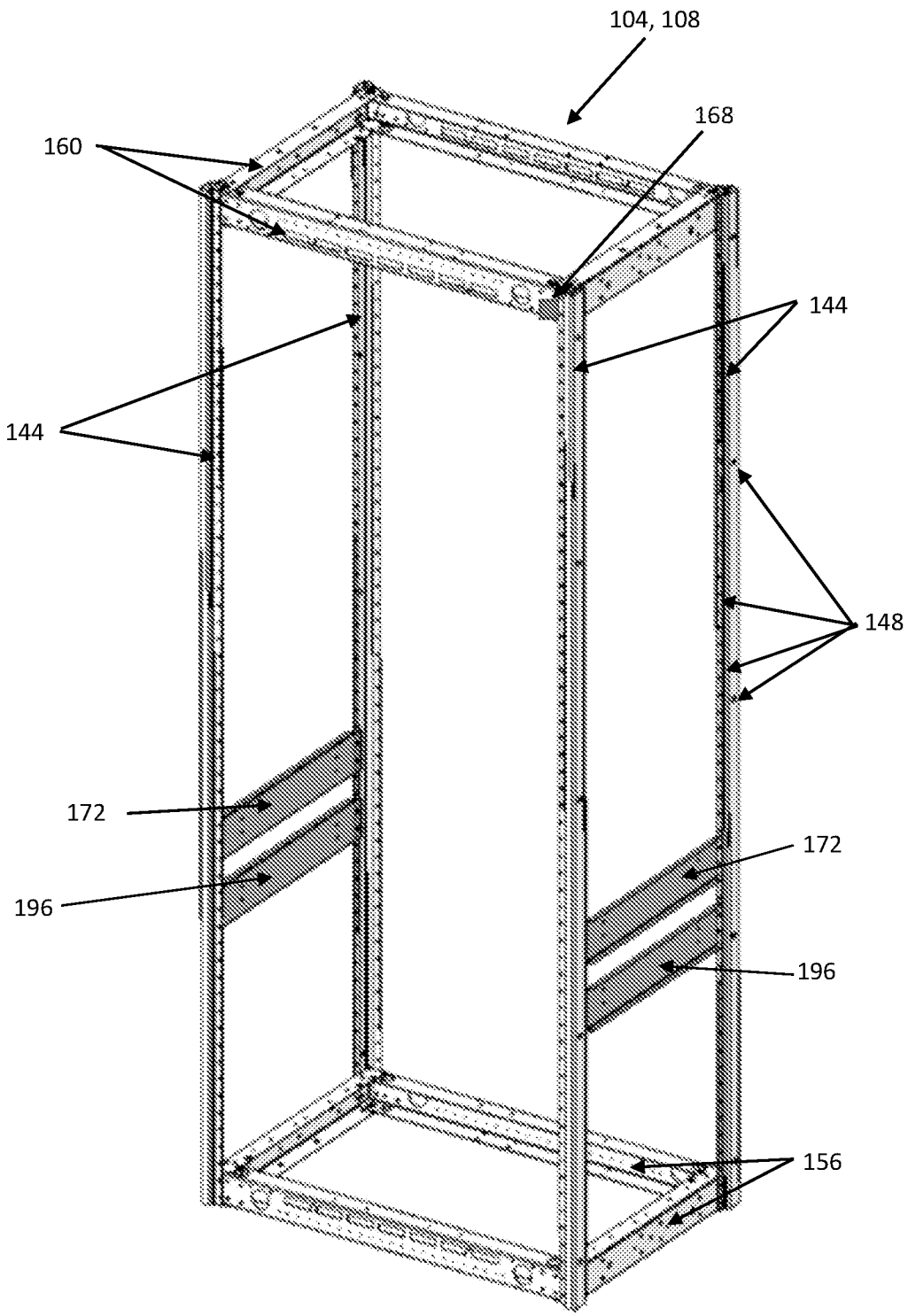



Figure 2

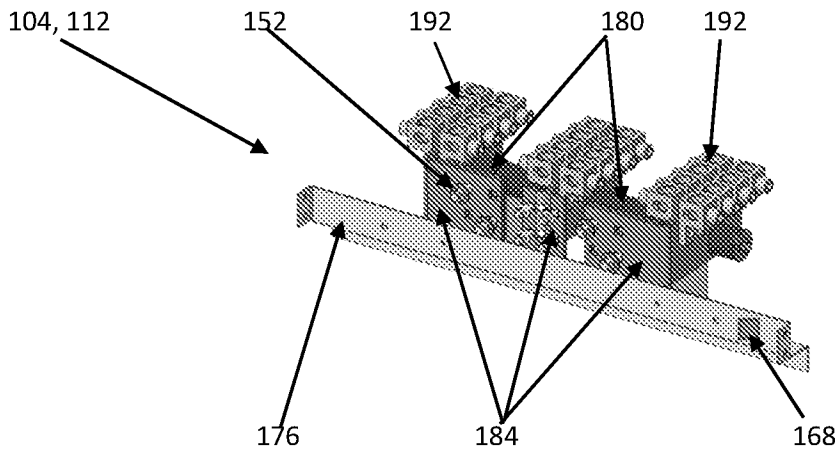



Figure 3

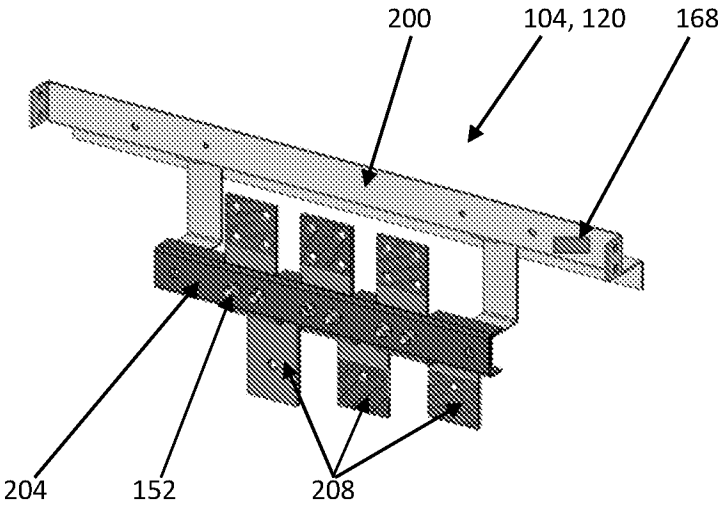



Figure 4

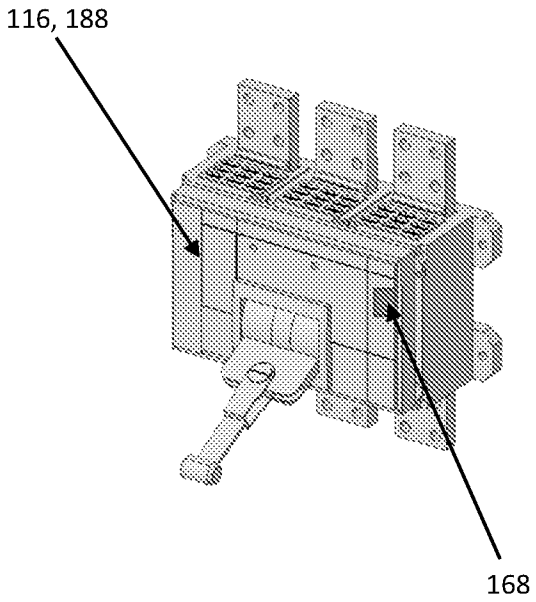



Figure 5

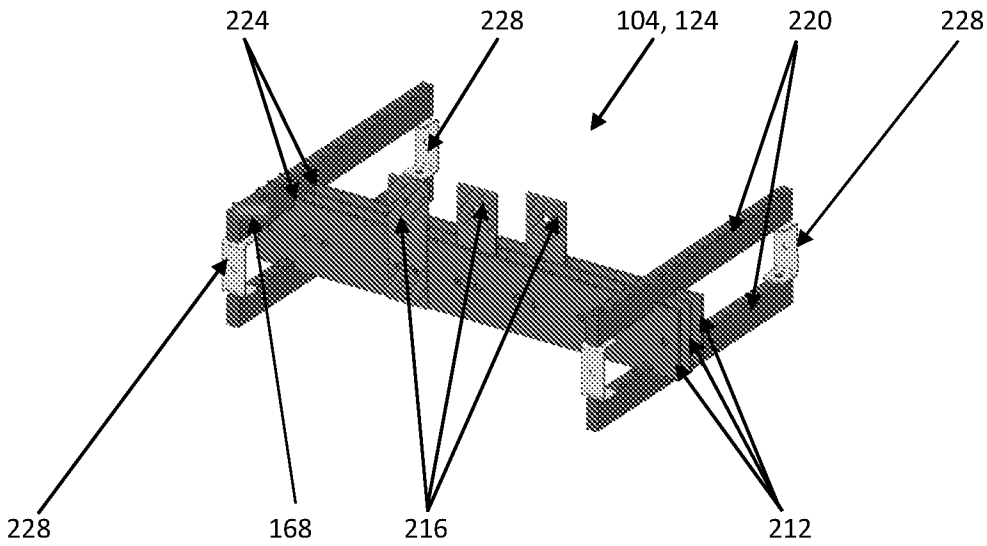



Figure 6

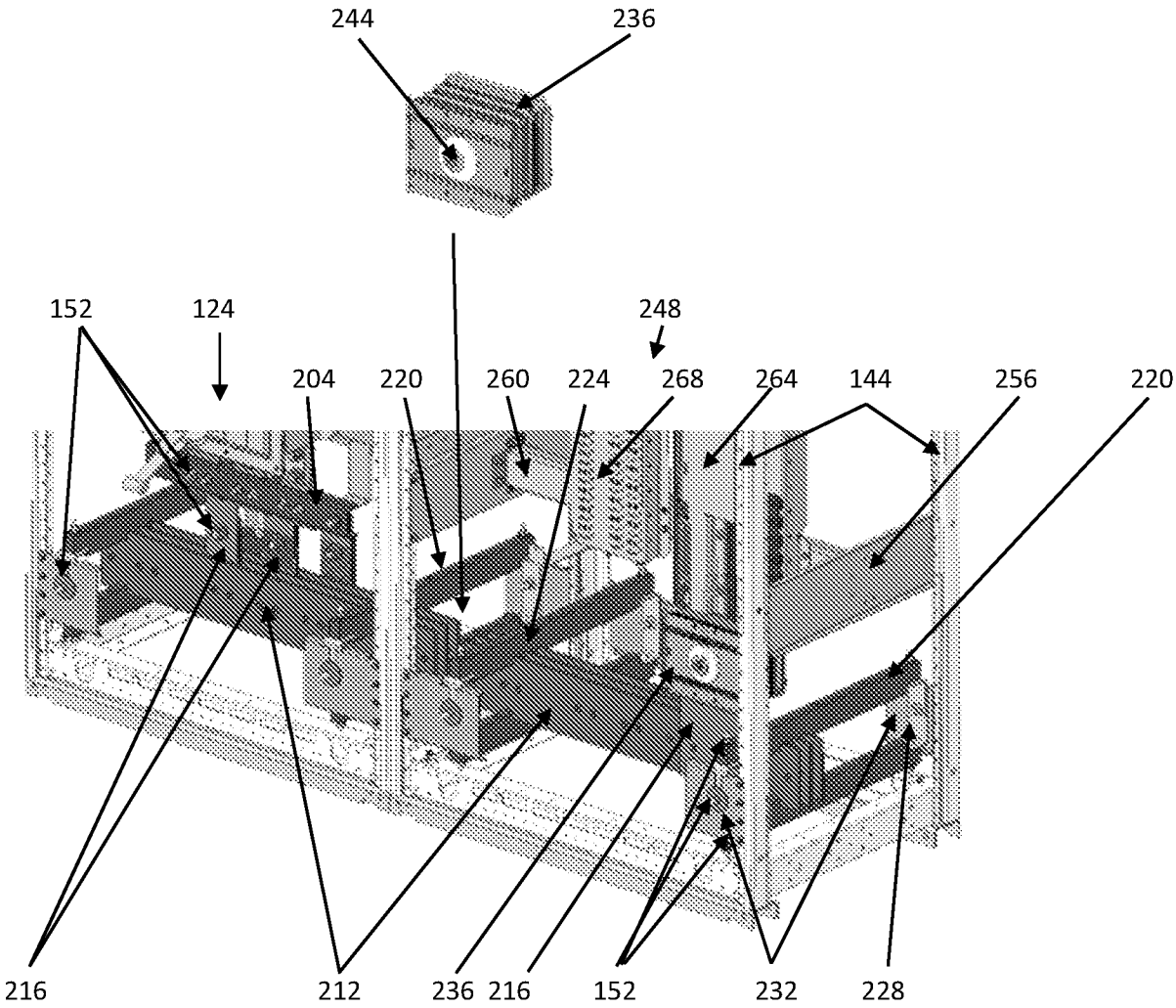

244
236
152
124
248
204
220
260
224
268
264
144
256
220
216
212
236
216
152
232
228

Figure 7

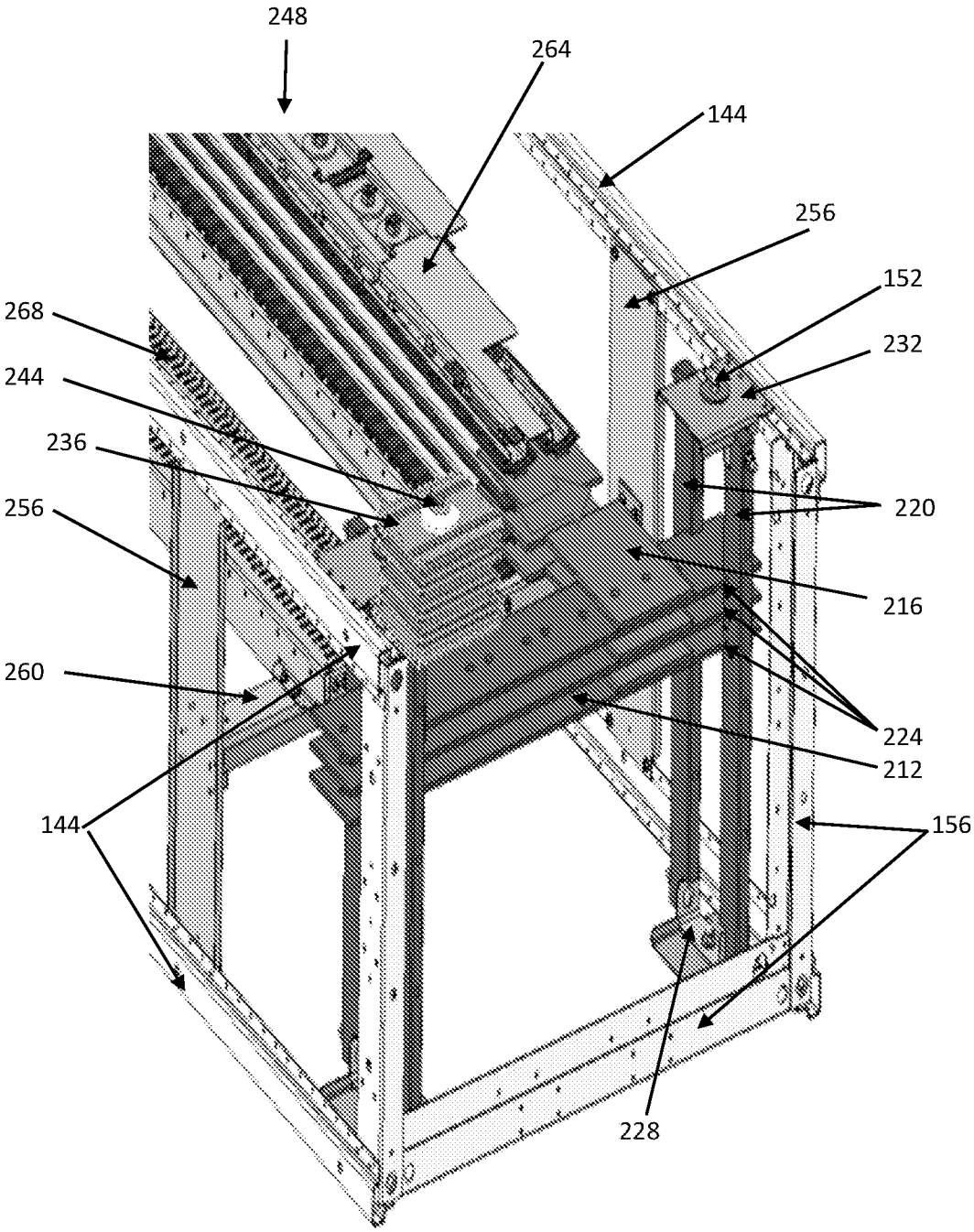

248
264
144
256
152
232
268
244
236
220
256
216
260
224
212
144
156
228

Figure 8

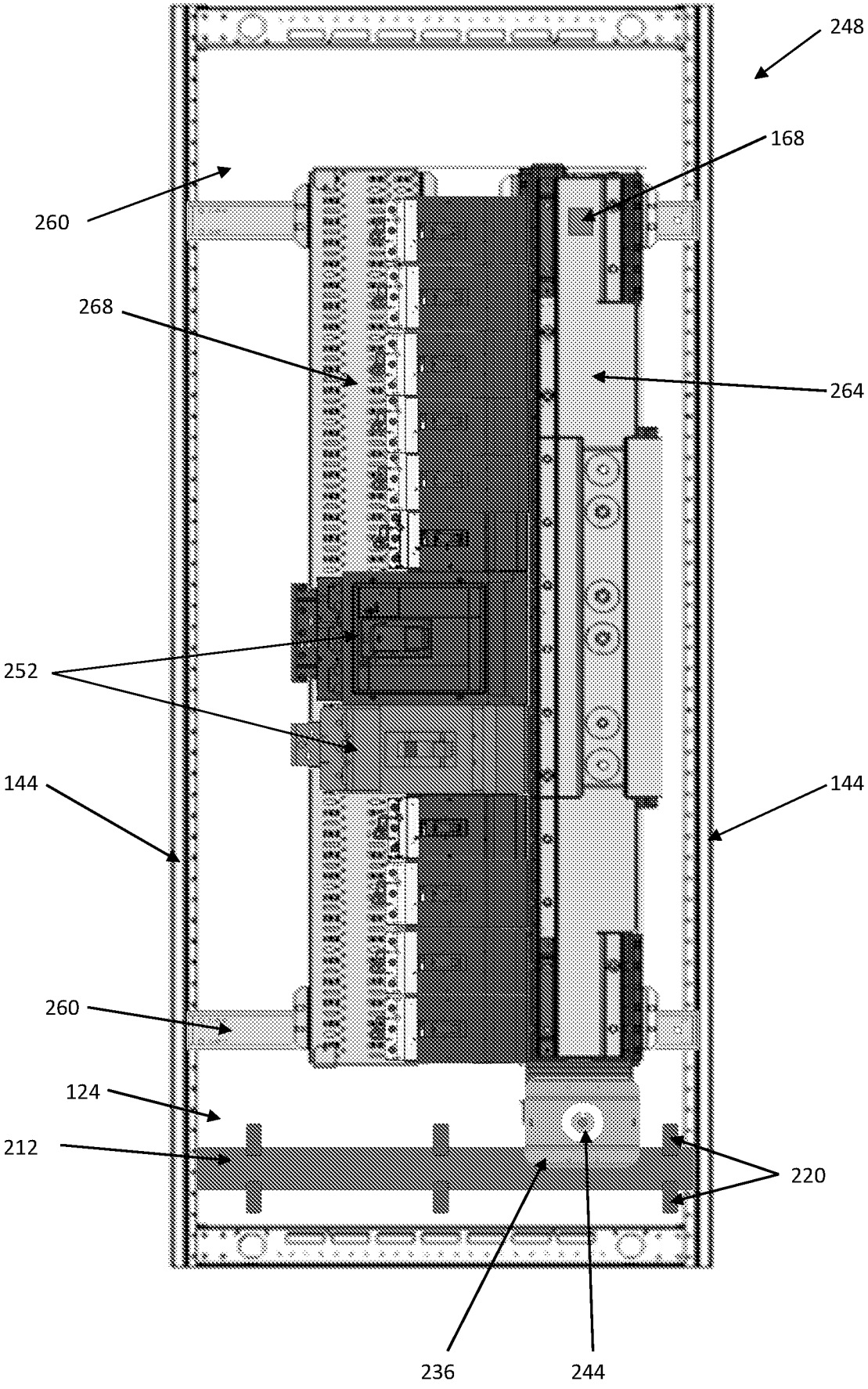



Figure 9

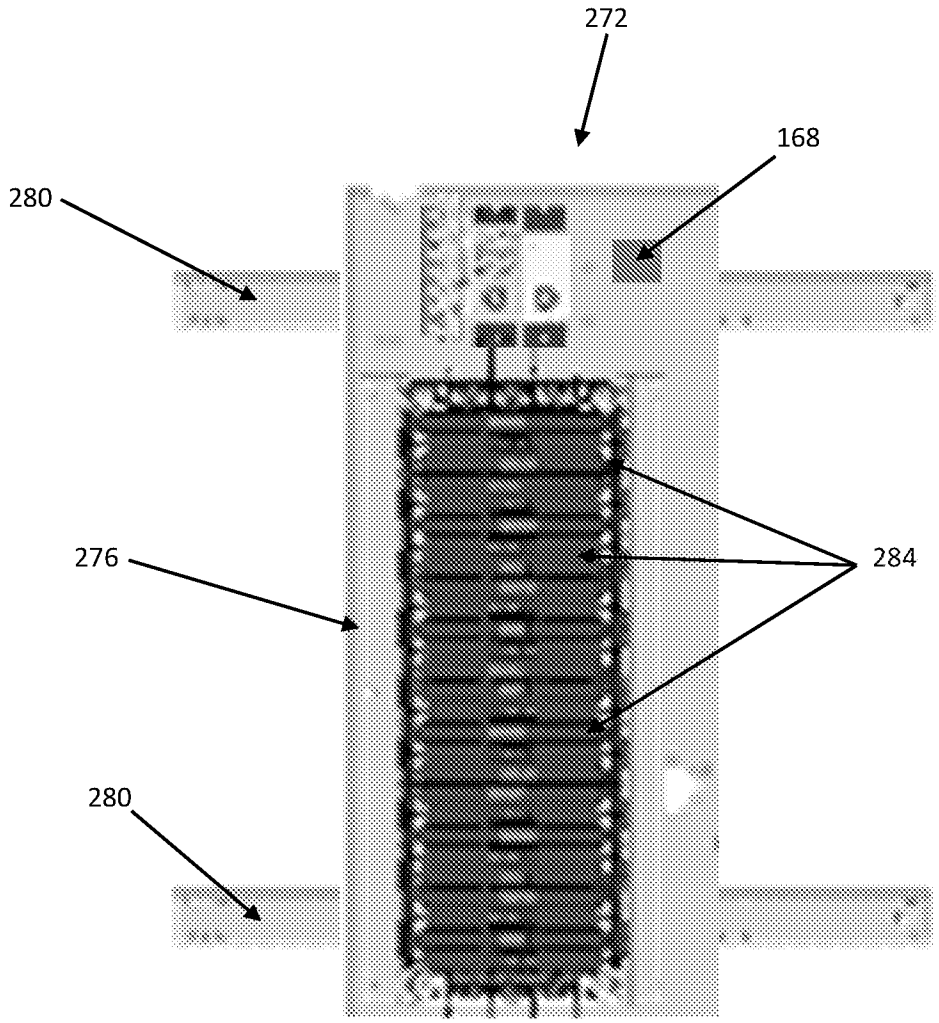



Figure 10

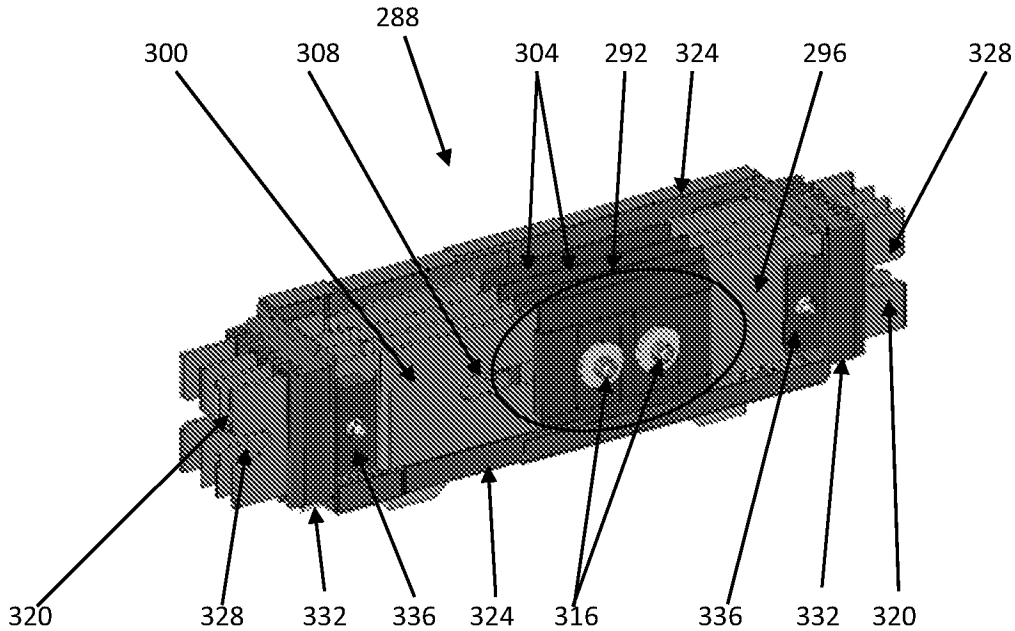



Figure 11

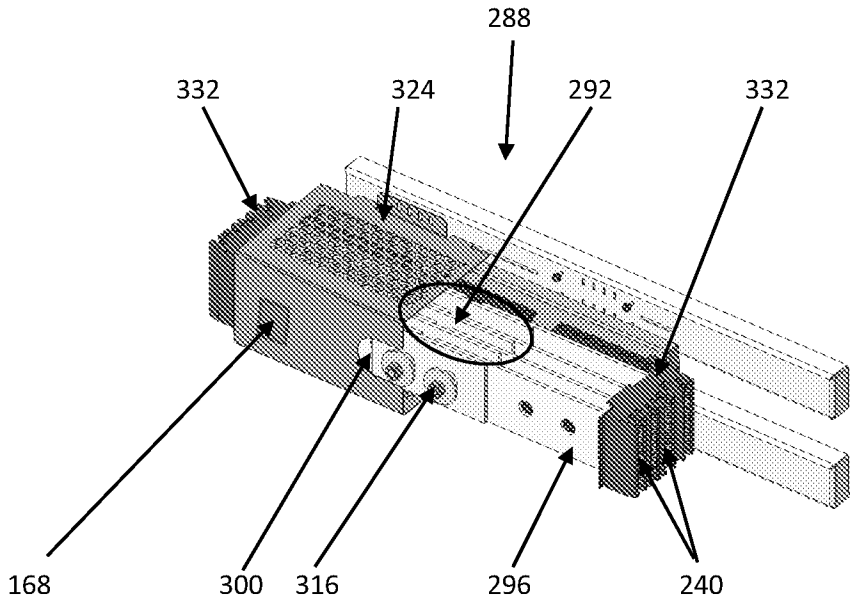



Figure 12

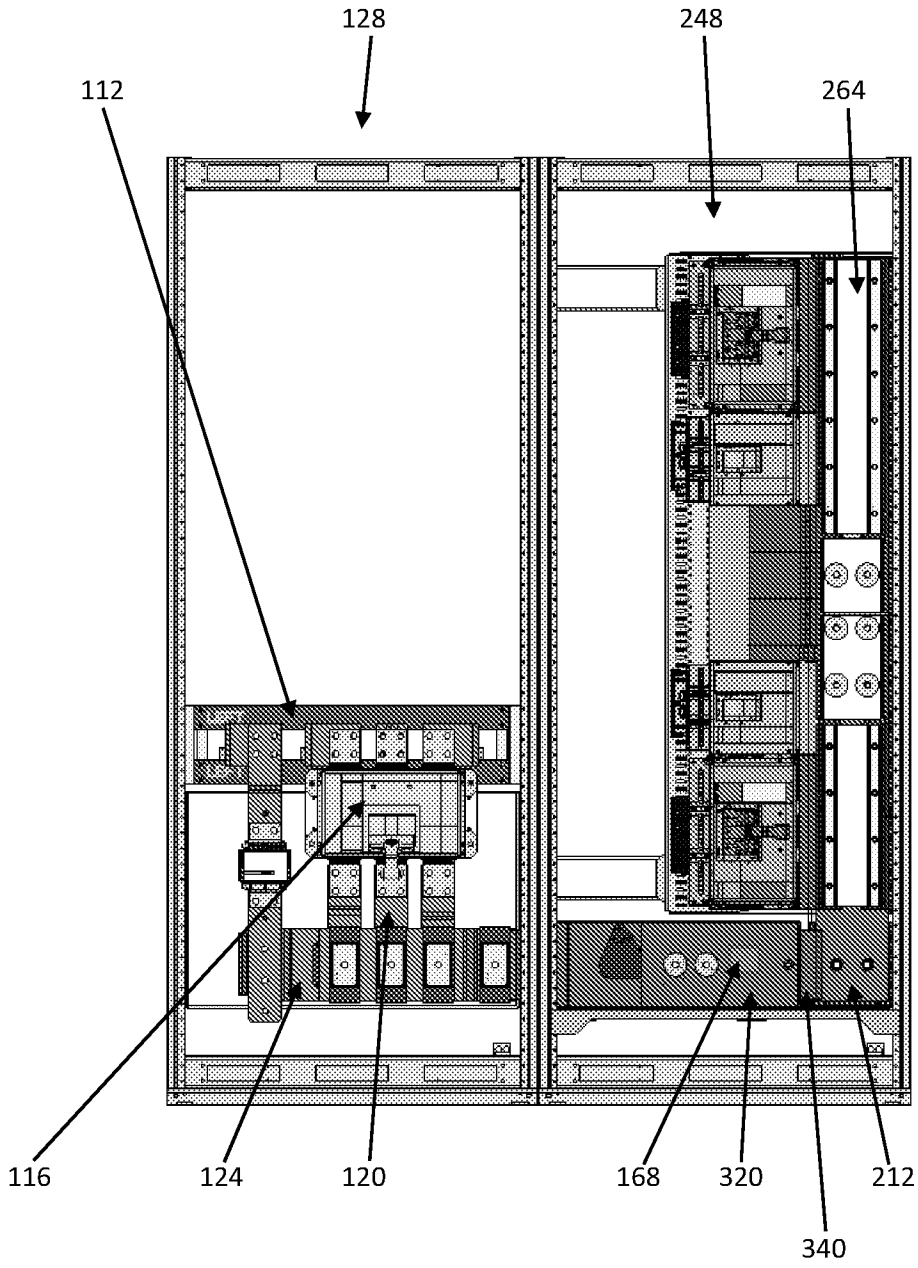



Figure 13

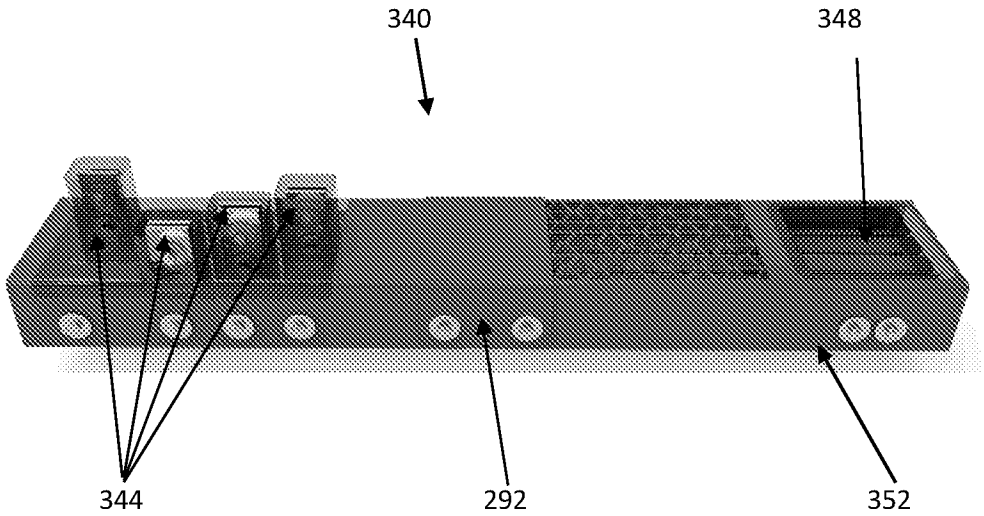



Figure 14

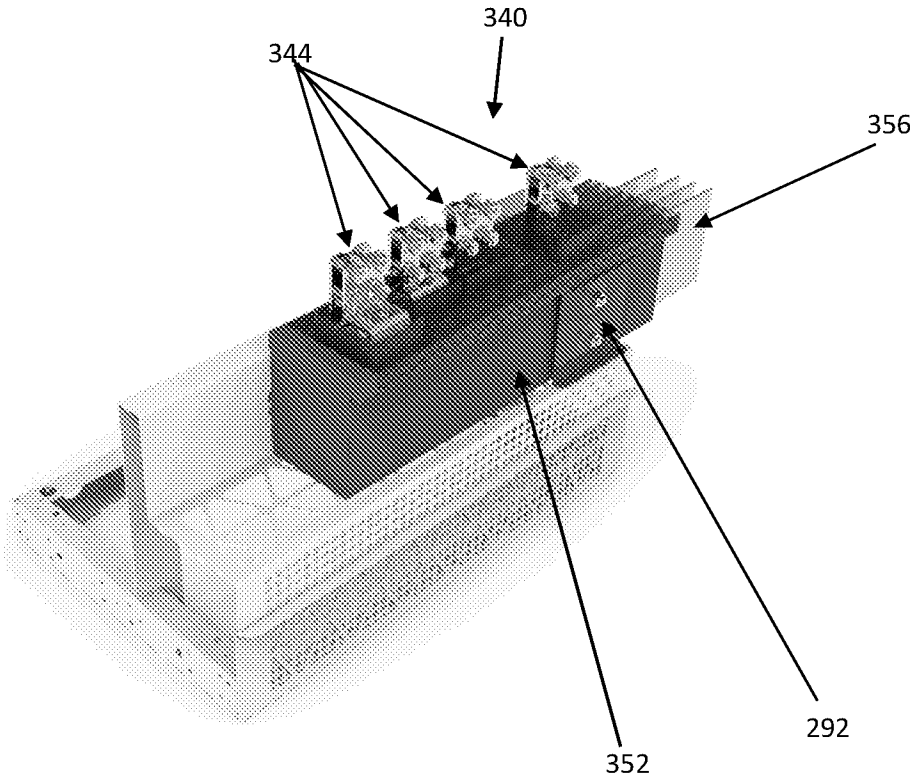



Figure 15

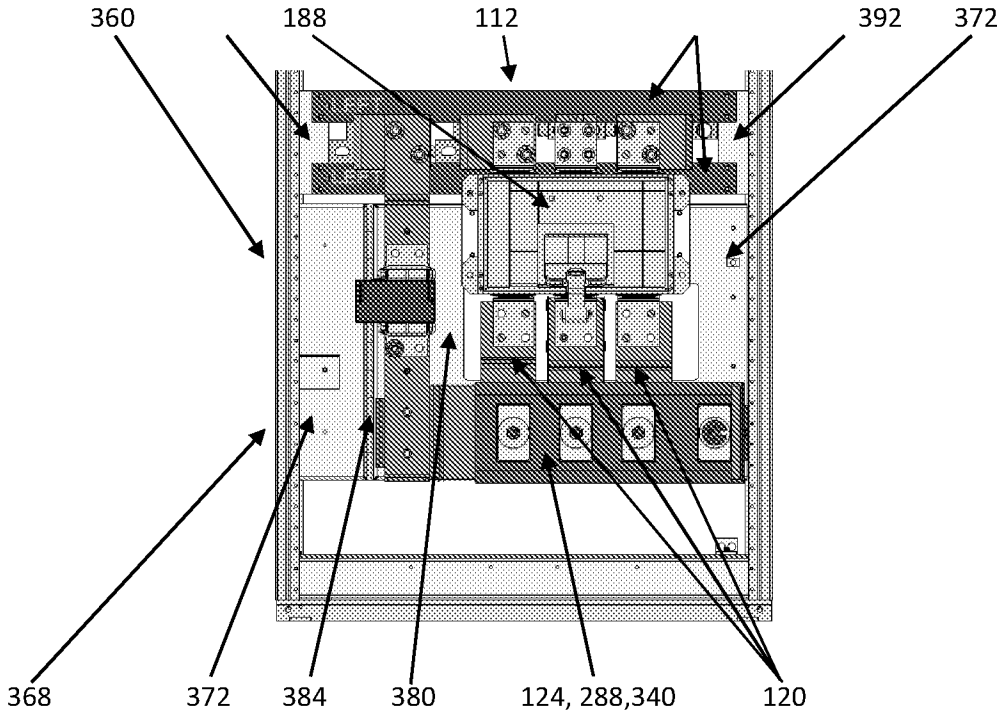



Figure 16

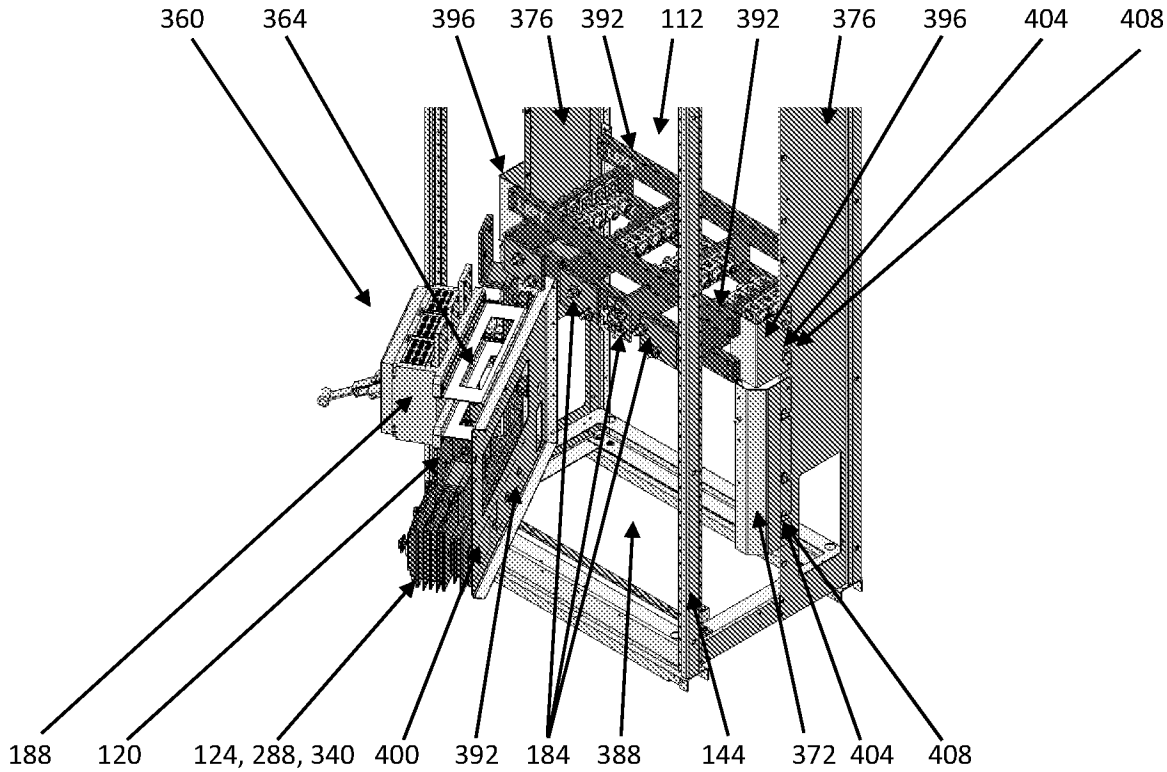



Figure 17

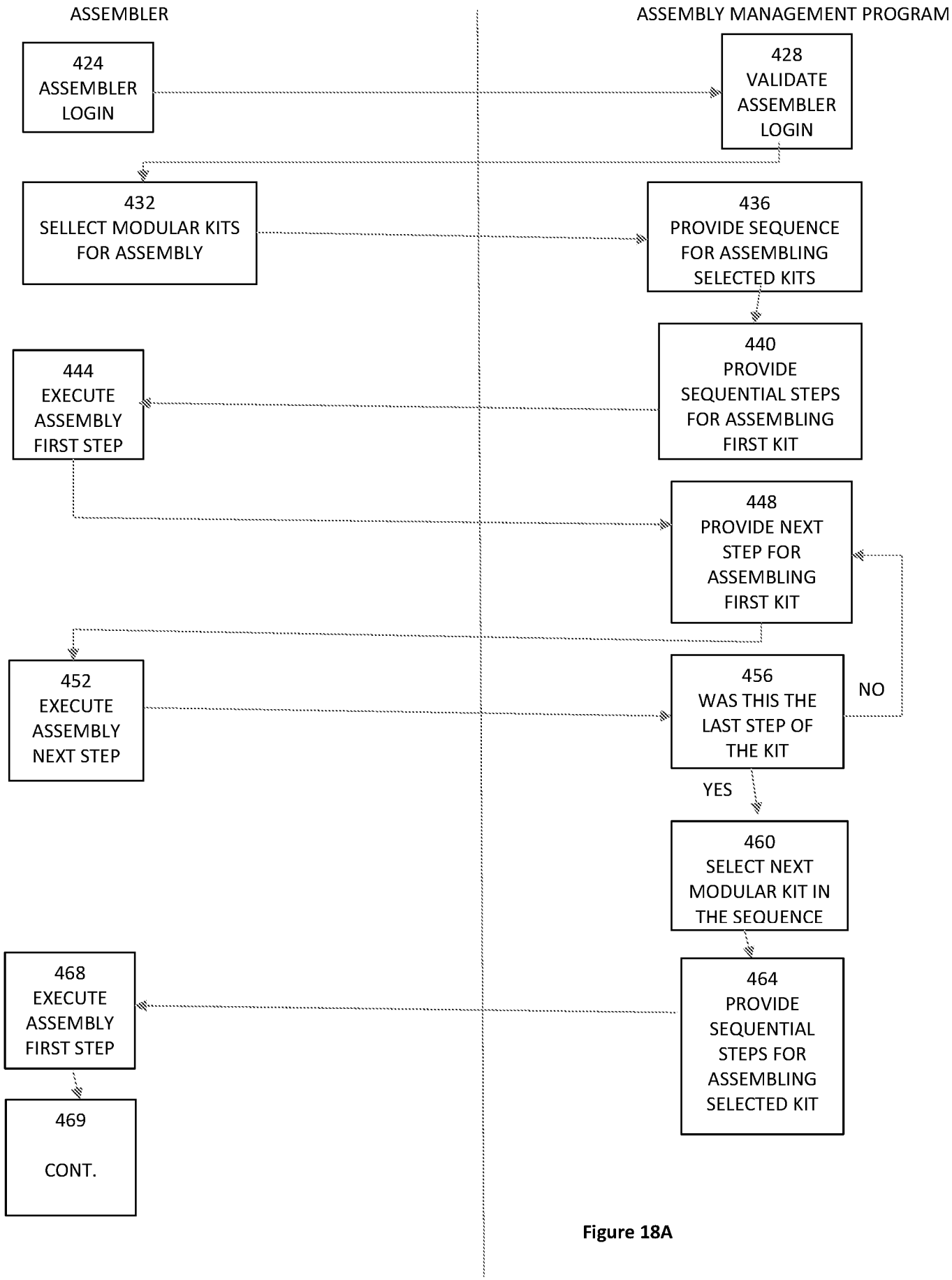

ASSEMBLER
ASSEMBLY MANAGEMENT PROGRAM
424 ASSEMBLER LOGIN
428 VALIDATE ASSEMBLER LOGIN
432 SELLECT MODULAR KITS FOR ASSEMBLY
436 PROVIDE SEQUENCE FOR ASSEMBLING SELECTED KITS
440 PROVIDE SEQUENTIAL STEPS FOR ASSEMBLING FIRST KIT
444 EXECUTE ASSEMBLY FIRST STEP
448 PROVIDE NEXT STEP FOR ASSEMBLING FIRST KIT
452 EXECUTE ASSEMBLY NEXT STEP
456 WAS THIS THE LAST STEP OF THE KIT
NO
YES
460 SELECT NEXT MODULAR KIT IN THE SEQUENCE
464 PROVIDE SEQUENTIAL STEPS FOR ASSEMBLING SELECTED KIT
468 EXECUTE ASSEMBLY FIRST STEP
469 CONT.

**Figure 18A**

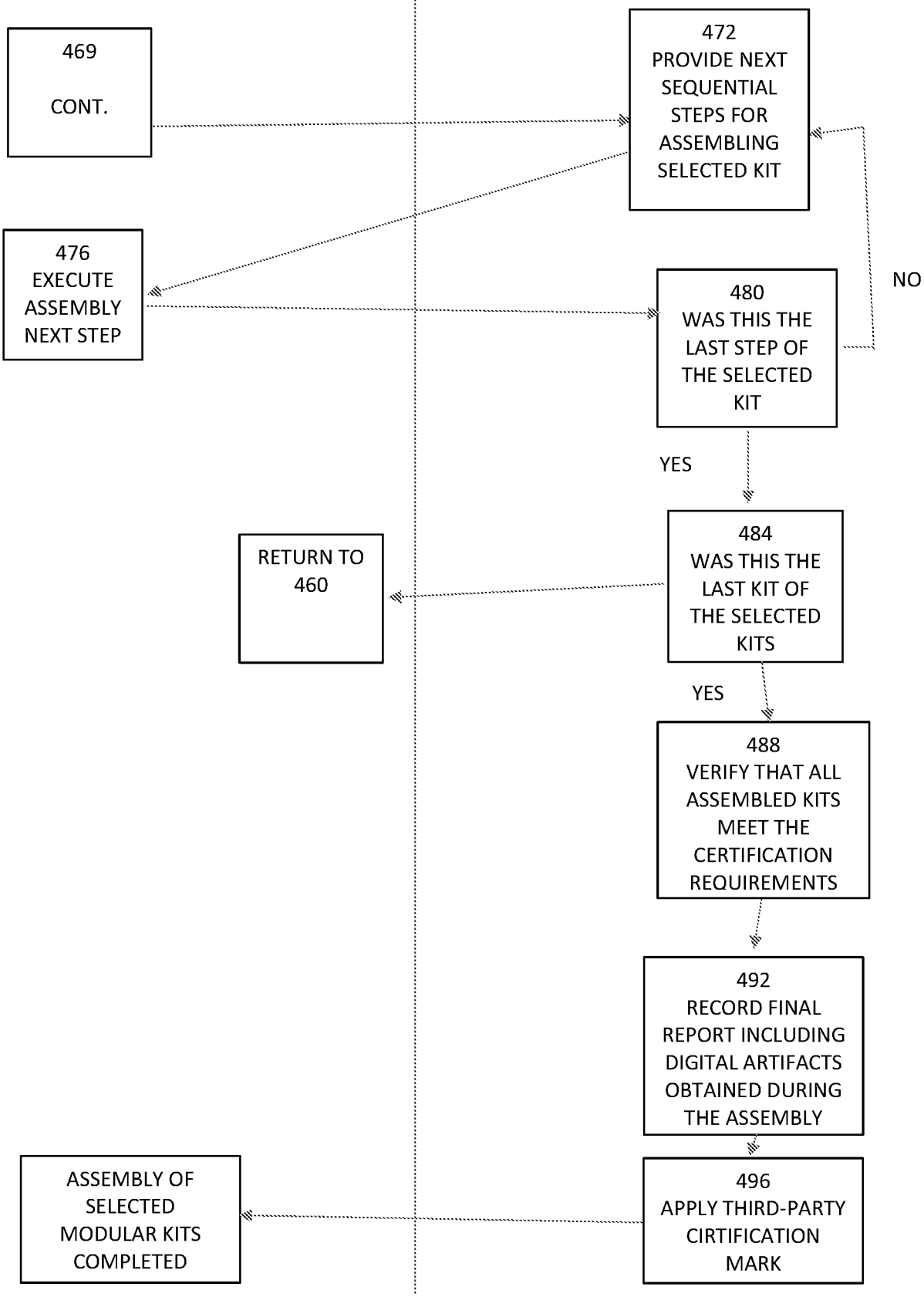

469
CONT.
472
PROVIDE NEXT SEQUENTIAL STEPS FOR ASSEMBLING SELECTED KIT
476
EXECUTE ASSEMBLY NEXT STEP
480
WAS THIS THE LAST STEP OF THE SELECTED KIT
NO
YES
484
WAS THIS THE LAST KIT OF THE SELECTED KITS
RETURN TO 460
YES
488
VERIFY THAT ALL ASSEMBLED KITS MEET THE CERTIFICATION REQUIREMENTS
492
RECORD FINAL REPORT INCLUDING DIGITAL ARTIFACTS OBTAINED DURING THE ASSEMBLY
496
APPLY THIRD-PARTY CIRTIFICATION MARK
ASSEMBLY OF SELECTED MODULAR KITS COMPLETED

**Figure 18B**

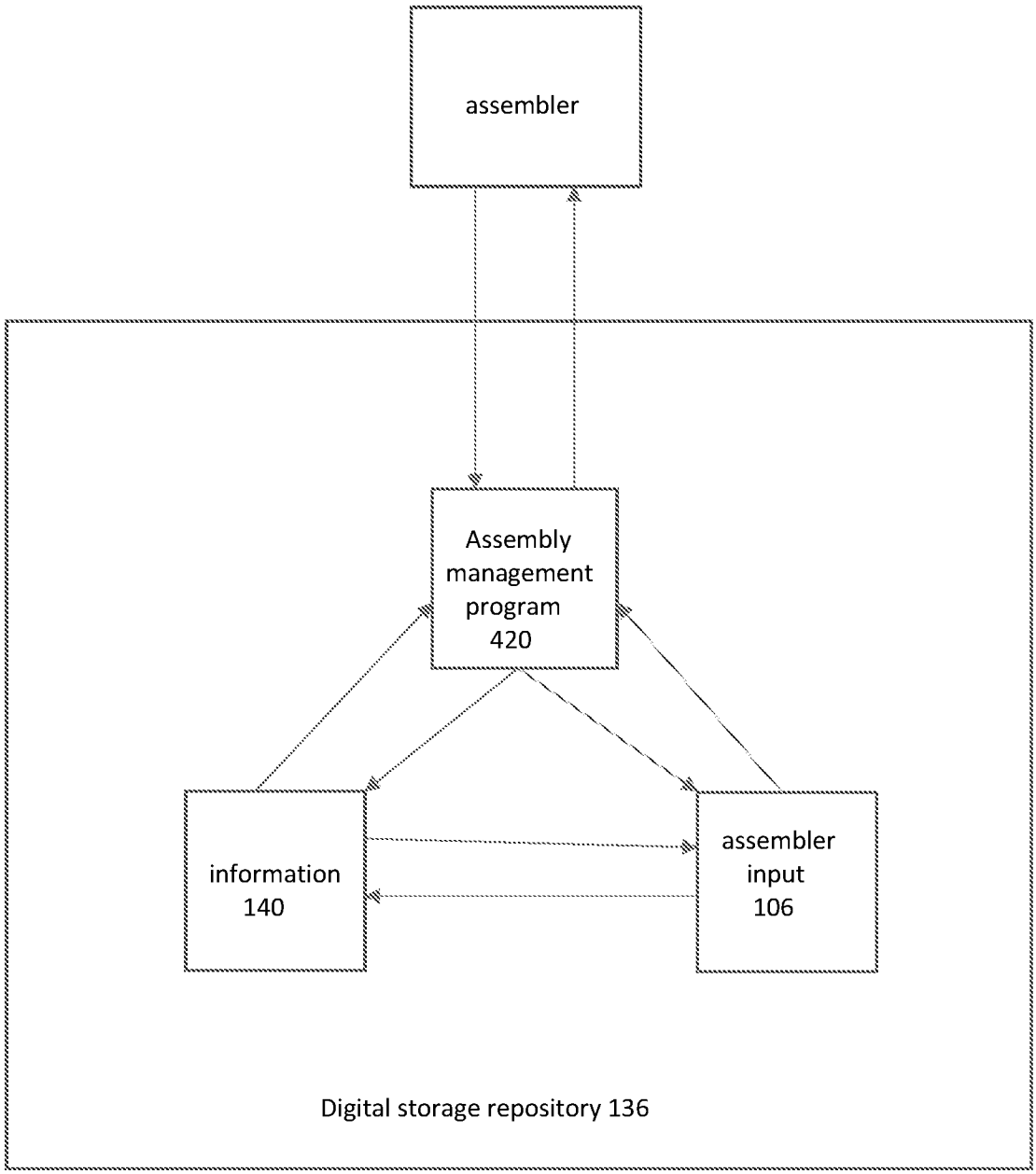

assembler
Assembly management program 420
information 140
assembler input 106
Digital storage repository 136

Figure 19