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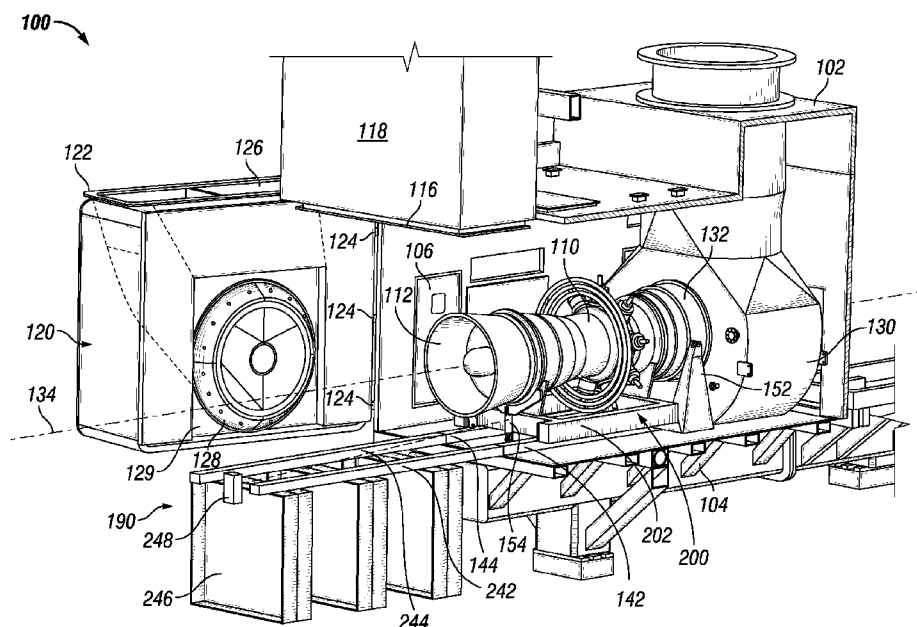


FIG. 3

(57) Abstract: A maintenance access system for a gas turbine. The maintenance access system includes an enclosure and an inlet wall assembly coupled to the enclosure by a pivotal connector. The maintenance access system further includes a pair of rails and a dolly disposed on the pair of rails within the enclosure. The dolly includes a frame, a plurality of wheel units, and a turbine support structure, and the dolly is configured to support the gas turbine on the turbine support structure and move along the pair of rails.

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Gas Turbine Maintenance Access System

Cross-Reference to Related Applications

[0001] This application claims the benefit of U.S. Provisional Patent Application having Serial No. 62/347,303, which was filed June 8, 2016. The aforementioned patent application is hereby incorporated by reference in its entirety into the present application to the extent consistent with the present application.

Background

[0002] Gas turbine packages are commonly used to drive generators for power generation or to drive process equipment such as compressors or pumps. There is typically a great emphasis on limiting spatial footprint for gas turbine packages, especially when installed in an offshore environment, such as on an offshore rig or marine vessel. One important factor of the total installed footprint is the peripheral area inevitably used for maintenance and disassembly of the gas turbine package. For example, access to the gas generator of an aero-derivative gas turbine unit often takes a considerable amount of available space at the side of the gas turbine package. This available space is known as a "lay-down" area and increases the total installed footprint needed for the gas turbine package. The lay-down area may also dictate the minimum pitch of multiple gas turbine packages installed side by side.

[0003] The common use of overhead crane based component movement in these traditional gas turbine package maintenance approaches presents further difficulties. While an overhead crane does not increase the total installed footprint, additional available space above the gas turbine package must be available for moving turbine components. There may also be safety concerns using overhead cranes. For example, there may be a significant concern on floating offshore installations where wave induced facility movement may induce unsafe swinging of the maintenance component while "on-hook" with the overhead crane. Similar concerns may occur for land installations due to wind gust inducing unsafe swinging of the maintenance component while hanging from the overhead crane.

[0004] What is needed, then, is an improved maintenance access system for a gas turbine.

Summary

[0005] Embodiments of the disclosure may provide a maintenance access system for a gas turbine. The maintenance access system may include an enclosure including a turbine outlet duct configured to couple to an outlet of the gas turbine. The maintenance access system may also include an inlet wall assembly coupled to the enclosure by a pivotal connector and including a turbine inlet mating ring configured to couple to an inlet of the gas turbine, where the inlet wall assembly is configured to move between a closed position and an opened position relative to the enclosure via the pivotal connector, and where the turbine inlet mating ring is circumferentially disposed about a longitudinal axis of the turbine outlet duct in the closed position. The maintenance access system may further include a pair of rails disposed within the enclosure and including a first rail and a second rail extending parallel to one another and extending below and parallel to the longitudinal axis of the turbine outlet duct. The maintenance access system may also include a dolly disposed within the enclosure below the longitudinal axis of the turbine outlet duct and on the pair of rails, where the dolly may include a frame, a plurality of wheel units, and a turbine support structure, and where the dolly is configured to support the gas turbine on the turbine support structure and configured to move along the pair of rails.

[0006] Embodiments of the disclosure may further provide a maintenance access system for a gas turbine. The maintenance access system may include an enclosure including a turbine outlet duct configured to couple to an outlet of the gas turbine. The maintenance access system may also include an inlet wall assembly coupled to the enclosure by a pivotal connector and including a turbine inlet mating ring configured to couple to an inlet of the gas turbine, where the inlet wall assembly is configured to move between a closed position and an opened position relative to the enclosure via the pivotal connector, and where the turbine inlet mating ring is circumferentially disposed about an axis of the turbine outlet duct in the closed position. The maintenance access system may further include a pair of rails disposed within the enclosure and including a first rail and a second rail extending parallel to one another and extending below and parallel to the longitudinal axis of the turbine outlet duct. The maintenance access system may also include a pair of rail extensions supported by a rail support and

extending parallel to the longitudinal axis of the turbine outlet duct, where the pair of rail extensions includes a first rail extension configured to be aligned with the first rail and a second rail extension configured to be aligned with the second rail. The maintenance access system may further include a dolly disposed within the enclosure below the longitudinal axis of the turbine outlet duct and on the pair of rails. The dolly may include a frame, a plurality of wheel units, and a turbine support structure, where the dolly is configured to support the gas turbine on the turbine support structure and configured to move along the pair of rails. Each wheel unit may include a stationary portion and an adjustable portion, where the stationary portion is coupled to the frame of the dolly, and where the adjustable portion includes a flanged wheel and is adjustably coupled to the stationary portion.

[0007] Embodiments of the disclosure may further provide a method for removing a gas turbine from an enclosure. The method may include disconnecting an inlet of the gas turbine from a turbine inlet mating ring of an inlet wall assembly, where the inlet wall assembly is coupled to the enclosure by a pivotal connector. The method may also include pivoting the inlet wall assembly by an angle of greater than 75° from a closed position to an opened position. The method may further include raising at least a portion of a dolly to lift the gas turbine and transfer the weight of the gas turbine to the dolly, where the dolly is disposed on a pair of rails contained in the enclosure. The method may also include moving the dolly containing the gas turbine along the pair of rails in an axial direction relative to a longitudinal axis of the gas turbine.

Brief Description of the Drawings

[0008] The present disclosure is best understood from the following detailed description when read with the accompanying Figures. It is emphasized that, in accordance with the standard practice in the industry, various features are not drawn to scale. In fact, the dimensions of the various features may be arbitrarily increased or reduced for clarity of discussion.

[0009] Figure 1 depicts a front side view of an exemplary gas turbine maintenance access system having an inlet wall assembly in a closed position and shown without a gas turbine, according to one or more embodiments.

[0010] Figure 2 depicts a cut-away, perspective view of the gas turbine maintenance access system containing a gas turbine and having the inlet wall assembly in the closed position, according to one or more embodiments.

[0011] Figure 3 depicts a cut-away, perspective view of the gas turbine maintenance access system having the inlet wall assembly in an opened position, according to one or more embodiments.

[0012] Figure 4 depicts a close-up view of the inlet wall assembly in the opened position, as illustrated in Figure 3.

[0013] Figure 5 depicts a rear side view of the gas turbine maintenance access system having the inlet wall assembly in the opened position, according to one or more embodiments.

[0014] Figure 6 depicts a perspective view of an exemplary dolly, according to one or more embodiments.

[0015] Figure 7 depicts a top view of the dolly illustrated in Figure 6.

[0016] Figure 8 depicts a side view of the dolly illustrated in Figure 6.

[0017] Figure 9 depicts another side view of the dolly illustrated in Figure 6.

[0018] Figure 10 depicts a sectional view of the dolly at line 10-10 in Figure 9.

[0019] Figure 11 depicts a close-up view of the gas turbine maintenance access system having a dolly and a pair of rails, according to one or more embodiments.

[0020] Figure 12 depicts another close-up view of the gas turbine maintenance access system having the dolly and the pair of rails, according to one or more embodiments.

[0021] Figure 13 depicts a perspective view of the gas turbine maintenance access system having the gas turbine disposed in the dolly and moved onto a pair of rail extensions positioned out of the enclosure, according to one or more embodiments.

[0022] Figure 14 depicts a flow chart of an illustrative method for removing a gas turbine from an enclosure, according to one or more embodiments.

Detailed Description

[0023] It is to be understood that the following disclosure describes several exemplary embodiments for implementing different features, structures, or functions of the invention. Exemplary embodiments of components, arrangements, and configurations are described below to simplify the present disclosure; however, these exemplary embodiments are provided merely as examples and are not intended to limit the scope of the invention. Additionally, the present disclosure may repeat reference numerals and/or letters in the various exemplary embodiments and across the Figures provided herein. This repetition is for the purpose of simplicity and clarity and does not in itself dictate a relationship between the various exemplary embodiments and/or configurations discussed in the various Figures. Moreover, the formation of a first feature over or on a second feature in the description that follows may include embodiments in which the first and second features are formed in direct contact, and may also include embodiments in which additional features may be formed interposing the first and second features, such that the first and second features may not be in direct contact. Finally, the exemplary embodiments presented below may be combined in any combination of ways, *i.e.*, any element from one exemplary embodiment may be used in any other exemplary embodiment, without departing from the scope of the disclosure.

[0024] Additionally, certain terms are used throughout the following description and claims to refer to particular components. As one skilled in the art will appreciate, various entities may refer to the same component by different names, and as such, the naming convention for the elements described herein is not intended to limit the scope of the invention, unless otherwise specifically defined herein. Further, the naming convention used herein is not intended to distinguish between components that differ in name but not function. Additionally, in the following discussion and in the claims, the terms "including" and "comprising" are used in an open-ended fashion, and thus should be interpreted to mean "including, but not limited to." All numerical values in this disclosure may be exact or approximate values unless otherwise specifically stated. Accordingly, various embodiments of the disclosure may deviate from the numbers, values, and ranges disclosed herein without departing from the intended scope. Furthermore, as it is

used in the claims or specification, the term "or" is intended to encompass both exclusive and inclusive cases, *i.e.*, "A or B" is intended to be synonymous with "at least one of A and B," unless otherwise expressly specified herein.

[0025] Figure 1 depicts a front side view of an exemplary gas turbine maintenance access system 100, according to one or more embodiments. The maintenance access system 100 may include an enclosure 102 and an inlet wall assembly 120. The enclosure 102 may include or otherwise contain one or more turbines, such as a gas turbine 110, as depicted in Figure 2, and an exhaust assembly 130.

[0026] As illustrated in Figure 1, the maintenance access system 100 may also include a turbine inlet mating ring 128 disposed on the inlet wall assembly 120 and a turbine outlet duct 132 disposed on the exhaust assembly 130. The turbine inlet mating ring 128 may be configured to couple to an inlet 112 on the gas turbine 110 and the turbine outlet duct 132 may be configured to couple to an outlet 114 on the gas turbine 110, as depicted in Figures 2 and 3. The enclosure 102 may include one or more access passages or panels 106 for accessing one or more portions or one or more components of the maintenance access system 100 and/or the gas turbine 110.

[0027] As illustrated in Figure 2, the gas turbine 110 may be fluidly coupled with a fluid inlet duct 118 (*e.g.*, motive fluid inlet duct) via the inlet wall assembly 120 that may be coupled to and in fluid communication therebetween. Although not shown in the Figures, the gas turbine 110 may include a compressor configured to receive and compress the motive air, a combustor configured to combust the compressed motive air with a fuel, and a turbine configured to receive and expand the combusted motive air to generate mechanical energy (*e.g.*, rotational energy). The rotational energy generated by the gas turbine 110 may be utilized to generate a power output in a generator (not shown) or other process components or equipment operatively coupled with the gas turbine 110.

[0028] As further described herein, the maintenance access system 100 may be configured to provide access (*e.g.*, axial access) to the gas turbine 110 disposed in the enclosure 102. The axial access may be along the axial direction, such as along and including a longitudinal axis 134 of the turbine outlet duct 132 and/or the gas turbine 110. The maintenance access system 100 may also be configured to move or transport

the gas turbine 110 into and out of the enclosure 102 to thereby allow an operator to maintain, service, replace, or otherwise access the gas turbine 110.

[0029] The inlet wall assembly 120 may be coupled to the enclosure 102 and/or the support structure 104 by one or more pivotal connectors 124 (three pivotal connectors 124 are shown in Figures 3-5). The pivotal connectors 124 may allow the side or the end wall 129 of the inlet wall assembly 120 to be actuated between multiple positions. The pivotal connector 124 may be or include, but is not limited to, one or more of: hinges, moveable joints, swivels, or any combination thereof. The inlet wall assembly 120 may be configured to swing, pivot, rotate, actuate, or otherwise move between a closed or operating position (Figures 1 and 2) and an opened or maintenance position relative to the enclosure 102 (Figures 3-5). In another embodiment, the inlet wall assembly 120 may be coupled to the enclosure 102 and/or the support structure 104, for example, via a plurality of bolts, in the operating position and decoupled, for example, unbolted, and removed from the enclosure 102 and/or the support structure 104 in the maintenance position. In the closed position, the gas turbine 110 may be in an operating mode to generate power, and in the opened position, the gas turbine 110 may be in a maintenance mode. For example, as shown in Figures 1 and 2, the turbine inlet mating ring 128 may be circumferentially disposed about the longitudinal axis 134 in the closed position, such as when the gas turbine 110 is operating to generate power. Generally, in some examples when the inlet wall assembly 120 is in the closed position, the gas turbine 110, the turbine inlet mating ring 128, and/or the turbine outlet duct 132 may each share the longitudinal axis 134 as a common axis. Also, as shown in Figures 3 and 4, the turbine inlet mating ring 128 may be non-circumferentially disposed about the longitudinal axis 134 when the inlet wall assembly 120 is in the opened position, such as when maintenance, repairs, and/or upgrades are conducted on the gas turbine 110.

[0030] As illustrated in Figure 4, the pivotal connectors 124 may be aligned along an axis 138 that may pass therethrough. The inlet wall assembly 120 may be pivoted or otherwise moved about the axis 138 by an angle α_1 between the closed and opened positions, which includes from the closed position to the opened position and from the opened position to the closed position. The angle α_1 may be measured from the axis

138 between the side 103 of the enclosure 102 and the end wall 129 of the inlet wall assembly 120. The angle α_1 may have a value great enough so that the gas turbine 110 disposed on a dolly 200 may be rolled or otherwise transported via the axial access along the longitudinal axis 134. In the closed position, the angle α_1 may be zero degrees (0°), but in the opened position, the angle α_1 may be greater than 0° , such as greater than 50° , greater than 65° , greater than 75° , or greater than 85° . In some example, the inlet wall assembly 120 may be pivoted, swung, or otherwise moved about the axis 138 by an angle α_1 of about 75° , about 85° , about 90° , or about 100° to about 110° , about 120° , about 135° , about 150° , about 165° , about 180° , about 200° , about 220° , or greater between the closed and opened positions. For example, the inlet wall assembly 120 may be pivoted, swung, or otherwise moved about the axis 138 by an angle α_1 of about 75° to about 200° , about 75° to about 180° , or about 90° to about 180° between the closed and opened positions.

[0031] The inlet wall assembly 120 may include one or more locking devices (not shown) configured to maintain the closed position. For example, the inlet wall assembly 120 may include a locking device, such as a latch, configured to detachably couple the end wall 129 with a surface or portion (e.g., a wall, a top, and/or a bottom) of the enclosure 102. In another embodiment, the inlet wall assembly 120 may be bolted to the enclosure 102 to maintain the closed position. In at least one embodiment, the inlet wall assembly 120 may be manually actuated between the closed and opened positions. In another embodiment, the inlet wall assembly 120 may be actuated with one or more actuation units 121 (Figure 5) or any suitable device capable of actuating the inlet wall assembly 120 between the closed and opened positions. For example, the inlet wall assembly 120 may be coupled to the actuation unit 121 configured to move the inlet wall assembly 120 between the closed position and the opened position. The actuation unit 121 may be or include one or more electric actuators (e.g., servos or motors), one or more hydraulic actuators (e.g., hydraulic pistons or cylinders), one or more pneumatic actuators, or any combination thereof, configured to actuate the inlet wall assembly 120 between the closed and opened positions.

[0032] The inlet wall assembly 120 may include one or more flanges 122, one or more inlet ducts 126, and a housing 127 configured to enclose one or more components of

the inlet wall assembly 120. For example, as illustrated in Figures 1-3, the inlet duct 126 may include an elbow or turn and the housing 127 may be configured to enclose the elbow. The elbow of the inlet wall assembly 120 may be detachably and fluidly coupled with the gas turbine 110 and the remaining portions (e.g., the vertical section) of the inlet duct 126 via the turbine inlet mating ring 128. Accordingly, as illustrated in Figure 2, the inlet wall assembly 120 and/or the end wall 129 thereof may be actuated to the closed position to detachably and fluidly couple to the inlet duct 126 with the gas turbine 110 to thereby provide fluid communication therebetween. Further, as illustrated in Figures 3-5, the inlet wall assembly 120 and/or the end wall 129 thereof may be actuated to the opened position to detach the turbine inlet mating ring 128 from the inlet 112 of the gas turbine 110.

[0033] In some configurations, the fluid inlet duct 118 may be coupled to and in fluid communication with the inlet duct 126 contained in the inlet wall assembly 120. For example, a flange 116 disposed on the fluid inlet duct 118 may be aligned with the flange 122 disposed on the inlet wall assembly 120 when in the closed position. The flange 122 may be coupled to and in fluid communication with the turbine inlet mating ring 128 via the inlet duct 126. The flanges 116, 122 may provide alignment and fluid communication between the fluid inlet duct 118, which is stationary, and the inlet wall assembly 120, once placed in the closed position.

[0034] The housing 127 of the inlet wall assembly 120 may be coupled or integrally formed with the end wall 129. As discussed above, the housing 127 may be configured to enclose one or more components of the inlet wall assembly 120. For example, the housing 127 and the end wall 129 may define a cavity 119 (Figure 1), and the one or more components of the inlet wall assembly 120 may be disposed in the cavity 119. In at least one embodiment, the inlet wall assembly 120 may include one or more starters 123 (e.g., electric motor starter) detachably and operatively coupled with the gas turbine 110 and configured to drive the gas turbine 110 during one or more modes of operation (e.g., startup). For example, as illustrated in Figures 1 and 2, the starter 123 may be configured to be coupled with the gas turbine 110 when the inlet wall assembly 120 and/or the end wall 129 thereof is in the closed position. In another example, illustrated in Figure 5, the starter 123 may be configured to be decoupled from the gas turbine 110,

when the inlet wall assembly 120 and/or the end wall 129 thereof is in the opened position.

[0035] The inlet wall assembly 120 may include one or more structural supports 125 configured to support one or more components thereof. For example, as illustrated in Figures 1 and 2, the structural supports 125 of the inlet wall assembly 120 may include beams, ribs, platforms, brackets, joists, or any combination thereof coupled with one another (e.g., weldments) and configured to support the inlet duct 126 and/or the starter 123. The structural supports 125 may also be configured to provide rigidity to the inlet wall assembly 120 or one or more components thereof. For example, the structural supports 125 may be configured to support the housing 127.

[0036] The inlet wall assembly 120 and/or one or more components thereof may be fabricated from and/or treated with one or more sound attenuating materials to attenuate the generation and/or proliferation of sound or sound waves provide by the motive air flowing therethrough. For example, one or more surfaces (e.g., exterior and/or interior surfaces) of the housing 127, the end wall 129, the inlet duct 126, the structural supports 125, or other components therein, may be treated with (e.g., coated or layered) one or more sound attenuating materials or acoustic treatment materials (not shown). Illustrative sound attenuating materials may include, but are not limited to, fiberglass, mineral wool, one or more polymers, steel wool or one or more other metal-containing wools, one or more acoustically treated media, or any combination thereof. In another example, the housing 127, the end wall 129, the inlet duct 126, and/or the structural supports 125 may be at least partially fabricated from the sound attenuating material, such as a fiber-reinforced polymer.

[0037] The maintenance access system 100 may include a transport system 190 configured to move or transport the gas turbine 110 into and out of the enclosure 102, as depicted in Figures 1-4. For example, the transport system 190 may include one or more dollies 200 (one is shown the Figures) and a pair of rails 142, 144 disposed within the enclosure 102. The dolly 200 may be disposed within the enclosure 102 below the longitudinal axis 134 and on the pair of rails 142, 144. The pair of rails 142, 144 may be a first rail 142 and a second rail 144 that may extend parallel to one another in a lower portion of the enclosure 102, such as along one or more lower surfaces within the

enclosure 102. For example, the pair of rails 142, 144 may extend below and parallel to the longitudinal axis 134.

[0038] As illustrated in Figure 3, the transport system 190 may also include a pair of rail extensions 242, 244, such as a first rail extension 242 and a second rail extension 244, that may be disposed or otherwise positioned adjacent and outside of the enclosure 102. In some examples, the pair of rail extensions 242, 244 may extend parallel to the longitudinal axis 134, as depicted in Figure 3. In other examples, not shown in the Figures, the pair of rail extensions 242, 244 may include a turn or bend and extend away from (e.g., not parallel to) the longitudinal axis 134. The rail extension 242 may be aligned end-to-end with the rail 142 to form one continuous or uniformed rail or path and the rail extension 244 may be aligned end-to-end with the rail 144 to form another continuous or uniformed rail or path. The pair of rail extensions 242, 244 may be supported by one or more rail supports 246. The rail support 246 may be or include one or more weldments, such as a plurality of steel weldments. The pair of rail extensions 242, 244 may be at least partially supported by the enclosure 102.

[0039] Figure 6 depicts a perspective view of the dolly 200 and Figure 7 depicts a top view of the dolly 200, according to one or more embodiments. Figures 8 and 9 depict side views of the dolly 200 and Figure 10 depicts a sectional view of the dolly at line 10-10 in Figure 9. The dolly 200 may include one or more frames 202, a plurality of wheel units 210 (four are shown in Figure 7), and one, two, or more turbine support structures, such as adjustable support plates 220 (two are shown in the Figures). Each adjustable support plate 220 may be coupled to the dolly 200 by one or more translatable connectors 222. Each of the translatable connectors 222 may be or include, but is not limited to, one or more of: hinges, moveable joints, swivels, or any combination thereof. The adjustable support plate 220 may be configured to swing, pivot, rotate, actuate, or otherwise move to make contact with the lower surface of the gas turbine 110.

[0040] Each of the wheel units 210 may include a main body or stationary portion 212, an adjustable portion 214, and one or more wheels 216. The wheel unit 210 may be configured to move the wheel 216 between a retracted position and an extended position relative to the frame 202 of the dolly 200. The stationary portion 212 may be coupled to the frame 202 of the dolly 200 and the adjustable portion 214 may be

adjustably coupled to the stationary portion 212. The adjustable portion 214 may include the one or more wheels 216. The wheel unit 210 may be configured to move the wheel 216 from the retracted position to the extended position in order to lift the frame 202 and the adjustable support plates 220 to make contact with and also lift the gas turbine 110. Additionally, the wheel unit 210 may be configured to move the wheel 216 from the extended position to the retracted position in order to lower the frame 202, the adjustable support plates 220, and the gas turbine 110 if contained on the adjustable support plates 220. In one or more examples, the wheel unit 210 may include a sliding block and jacking screw assembly, as depicted in the Figures. In other examples, not shown, the wheel unit 210 may include a sliding block and piston assembly, or other type of lift mechanism. An illustrative piston assembly, may be or include, but is not limited to, a hydraulic piston assembly or a pneumatic piston assembly.

[0041] In one or more examples, the plurality of wheel units 210 may include at least four wheel units 210 disposed on the frame 202 of the dolly 200. The wheels may have a variety of shapes, including, but not limited to, cylindrical, disk, or spherical, and may include flanged wheels and/or non-flanged wheels. For example, each wheel unit 210 may include a flanged wheel 216, such as the flanged wheel 216 depicted in Figures 11 and 12. The flanged wheel 216 may include a main contact portion 217 and a flanged portion 218. The main contact portion 217 of the flanged wheel 216 may be configured to make contact with one or more upper surfaces of the rails 142, 144 and/or the rail extensions 242, 244, such as one or more horizontal surfaces of the shoulders 146 on the rails 142, 144 and the rail extensions 242, 244. The flanged portion 218 of the flanged wheel 216 may be configured to make contact with one or more inner surfaces of the rails 142, 144 and/or the rail extensions 242, 244, such as one or more vertical surfaces of the shoulders 146 on the rails 142, 144 and the rail extensions 242, 244.

[0042] The dolly 200 may be configured to support the gas turbine 110 on the turbine support structure 220. The weight of the gas turbine 110 may be transferred to the turbine support structure 220 from one or more stands, one or more supports, one or more braces, one or more connections, or combinations thereof. For example, one or more supports 152 may support the turbine outlet duct 132 and the outlet side of the gas turbine 110 and one or more stands 154 may support the inlet side of the gas turbine

110, as shown in Figures 1-4 and 11. Figures 11 and 12 depict close-up views of the dolly 200, the rails 142, 144, and the stand 154, according to one or more embodiments.

[0043] The wheel unit 210 may be adjusted to move the wheel 216 from the retracted position to the extended position in order to raise the frame 202 and the adjustable support plates 220, relative to the wheel 216, towards the gas turbine 110. Once the adjustable support plates 220 make contact with the gas turbine 110, the weight of the gas turbine 110 may be transferred to the adjustable support plates 220 by continuing to raise the frame 202 and the adjustable support plates 220 and lift the gas turbine 110. The weight of the gas turbine 110 may further be transferred from the turbine support structure 220, through the frame 202, and to the pair of rails 142, 144 which the dolly 200 is disposed on. The dolly 200 may be configured to move along the pair of rails 142, 144.

[0044] The rails 142, 144 and the rail extensions 242, 244 may be configured to allow the dolly 200 to move in the axial direction, along the longitudinal axis 134, and may further be configured to at least partially limit the movement of the dolly 200 in the lateral directions. For example, as illustrated in Figures 11-12, at least one of the rails 142, 144 and at least one of the rail extensions 242, 244 may define the shoulder 146 extending axially along a top surface thereof. As further described herein, the shoulder 146 may be configured to allow the dolly 200 to be moved or transferred in the axial directions and/or prevent the dolly 200 from being moved in the lateral directions. While the transport system 190 is illustrated as having four rails (e.g., two rails 142, 144 and two rail extensions 242, 244), it should be appreciated that the transport system 190 may include any number of rails. For example, the transport system 190 may include a single rail, two rails, three rails, five rails, or six or more rails.

[0045] In at least one embodiment, the dolly 200, with or without the gas turbine 110 disposed thereon, may be manually moved or transferred in the axial directions along the rails 142, 144 and the rail extensions 242, 244 between the inside and the outside of the enclosure 102. In another embodiment, one or more linear actuation units 248 may be configured to move or transport the dolly 200, with or without the gas turbine 110 disposed thereon, in the axial directions along the rails 142, 144 and the rail extensions 242, 244 between the inside and the outside of the enclosure 102. For example, the

dolly 200 may be coupled to one or more linear actuation units 248 configured to move the dolly 200 along the rails 142, 144 and the rail extensions 242, 244. The linear actuation unit 248 may be or include, but is not limited to, one or more winches, one or more pulleys, one or more cables, one or more electric actuators (e.g., servos or motors), one or more hydraulic actuators (e.g., hydraulic pistons or cylinders), one or more pneumatic actuators, or any combination thereof to move the dolly 200 along the rails 142, 144 and the rail extensions 242, 244.

[0046] Figure 13 depicts a perspective view of the gas turbine maintenance access system 100 according to one or more embodiments. The gas turbine maintenance access system 100 is depicted having the inlet wall assembly 120 in the opened position and the gas turbine 110 disposed in the dolly 200 and moved onto the pair of rail extensions 242, 244 positioned out of the enclosure 102. The gas turbine 110, outside of the enclosure 102, is accessible to allow an operator to maintain, service, replace, or otherwise access the gas turbine 110.

[0047] Once maintenance, service, or replacement of the gas turbine 110 is complete, the gas turbine 110 may be transferred on the dolly 200 in the axial direction along the rails 142, 144 and the rail extensions 242, 244 into the enclosure 102. The weight of the gas turbine 110 may further be transferred from the turbine support structure 220 on the dolly 200 to the turbine outlet duct 132, the support 152, and the stand 154 once positioned in the enclosure 102. The weight may be transferred by adjusting the wheel unit 210 to move the wheel 216 from the extended position to the retracted position in order to lower the gas turbine 110, the adjustable support plates 220, and the frame 202, relative to the wheel 216. Thereafter, the inlet wall assembly 120, may be pivoted, swung, or otherwise moved against the enclosure 102 and may be placed in the closed position.

[0048] Figure 14 depicts a flow chart of an illustrative method 300 for removing a gas turbine from an enclosure, according to one or more embodiments. The method 300 may include disconnecting an inlet of the gas turbine from a turbine inlet mating ring of an inlet wall assembly, as shown at 310. The inlet wall assembly may be coupled to the enclosure by a pivotal connector. The method 300 may include pivoting an inlet wall assembly containing the turbine inlet mating ring at least 75° from a closed position to

an opened position relative to the enclosure, as shown at 320. The method 300 may also include raising at least a portion of a dolly to lift the gas turbine and transfer the weight of the gas turbine to the dolly, as shown at 330. The dolly may be disposed on a pair of rails contained in the enclosure. The method 300 may include moving the dolly containing the gas turbine along the pair of rails in an axial direction relative to an axis of the gas turbine, as shown at 340.

[0049] In some embodiments, the method 300 may also include, prior to raising the at least portion of the dolly, installing a pair of rail extensions that aligns end-to-end with the pair of rails and extends adjacent to the inlet wall assembly disposed in the opened position. For example, the first rail extension may be aligned end-to-end with the first rail and the second rail extension may be aligned end-to-end with the second rail. The method 300 may also include moving the dolly containing the gas turbine along the pair of rail extensions in the axial direction relative to the axis of the gas turbine. The inlet wall assembly may be pivoted or otherwise moved about 90° to about 180° from the closed position to the opened position.

[0050] In other embodiments, one or more portions of the dolly may be raised to lift the gas turbine. The raised portion of the dolly may include the frame and the turbine support structure. A plurality of wheel units may be disposed on the frame of the dolly and may be used to raise the portion of the dolly to lift the gas turbine. For example, each wheel unit may include a stationary portion and an adjustable portion, where the stationary portion may be coupled to the frame of the dolly and the adjustable portion may include a wheel and may be adjustably coupled to the stationary portion. The method 300 may include applying a force against the pair of rails with the plurality of wheels to raise the portion of the dolly and to lift the gas turbine.

[0051] The foregoing has outlined features of several embodiments so that those skilled in the art may better understand the present disclosure. Those skilled in the art should appreciate that they may readily use the present disclosure as a basis for designing or modifying other processes and structures for carrying out the same purposes and/or achieving the same advantages of the embodiments introduced herein. Those skilled in the art should also realize that such equivalent constructions do not depart from the spirit and scope of the present disclosure, and that they may make various changes,

substitutions and alterations herein without departing from the spirit and scope of the present disclosure.

Claims

We claim:

1. A maintenance access system for a gas turbine, comprising:
 - an enclosure comprising a turbine outlet duct configured to couple to an outlet of the gas turbine;
 - an inlet wall assembly coupled to the enclosure by a pivotal connector and comprising a turbine inlet mating ring configured to couple to an inlet of the gas turbine, wherein the inlet wall assembly is configured to move between a closed position and an opened position relative to the enclosure via the pivotal connector, and wherein the turbine inlet mating ring is circumferentially disposed about a longitudinal axis of the turbine outlet duct in the closed position;
 - a pair of rails disposed within the enclosure and comprising a first rail and a second rail extending parallel to one another and extending below and parallel to the longitudinal axis of the turbine outlet duct; and
 - a dolly disposed within the enclosure below the longitudinal axis of the turbine outlet duct and on the pair of rails, wherein the dolly comprises a frame, a plurality of wheel units, and a turbine support structure, and wherein the dolly is configured to support the gas turbine on the turbine support structure and configured to move along the pair of rails.
2. The system of claim 1, further comprising a pair of rail extensions supported by a rail support and extending parallel to the longitudinal axis of the turbine outlet duct, wherein the pair of rail extensions comprises a first rail extension aligned end-to-end with the first rail and a second rail extension aligned end-to-end with the second rail.
3. The system of claim 1, wherein the inlet wall assembly further comprises a duct, an electric motor starter, acoustic treatment material, or any combination thereof.
4. The system of claim 1, wherein the inlet wall assembly is configured to pivot about 75° to about 180° between the closed position and the opened position.

5. The system of claim 1, wherein the pivotal connector coupled to the inlet wall assembly and the enclosure comprises a hinge.
6. The system of claim 1, wherein the inlet wall assembly is coupled to an actuation unit configured to move the inlet wall assembly between the closed position and the opened position, wherein the actuation unit comprises an electric actuator, a hydraulic actuator, or a pneumatic actuator.
7. The system of claim 1, wherein each wheel unit comprises a main body and a wheel, and each wheel unit is configured to move the wheel between a retracted position and an extended position relative to the frame of the dolly.
8. The system of claim 1, wherein each wheel unit comprises a stationary portion and an adjustable portion, wherein the stationary portion is coupled to the frame of the dolly, and wherein the adjustable portion comprises a wheel and is adjustably coupled to the stationary portion.
9. The system of claim 1, wherein each wheel unit comprises a sliding block and jacking screw assembly, a sliding block and hydraulic piston assembly, or a sliding block and pneumatic piston assembly.
10. The system of claim 1, wherein the plurality of wheel units comprises at least four wheel units.
11. The system of claim 1, wherein each wheel unit comprises a flanged wheel, wherein the flanged wheel comprises a main contact portion and a flanged portion, wherein the main contact portion of the flanged wheel is configured to make contact with an upper surface of the first rail or the second rail and the flanged portion of the flanged wheel is configured to make contact with an inner surface of the first rail or the second rail.
12. The system of claim 1, wherein the turbine support structure comprises two

adjustable support plates.

13. The system of claim 1, wherein the dolly is coupled to a linear actuation unit configured to move the dolly along the rails and the rail extensions, wherein the linear actuation unit comprises a winch, a pulley, a cable, an electric motor, a hydraulic actuator, a pneumatic actuator, or any combination thereof.

14. A maintenance access system for a gas turbine, comprising:
an enclosure comprising a turbine outlet duct configured to couple to an outlet of the gas turbine;

an inlet wall assembly coupled to the enclosure by a pivotal connector and comprising a turbine inlet mating ring configured to couple to an inlet of the gas turbine, wherein the inlet wall assembly is configured to move between a closed position and an opened position relative to the enclosure via the pivotal connector, and wherein the turbine inlet mating ring is circumferentially disposed about an axis of the turbine outlet duct in the closed position;

a pair of rails disposed within the enclosure and comprising a first rail and a second rail extending parallel to one another and extending below and parallel to the longitudinal axis of the turbine outlet duct;

a pair of rail extensions supported by a rail support and extending parallel to the longitudinal axis of the turbine outlet duct, wherein the pair of rail extensions comprises a first rail extension configured to be aligned with the first rail and a second rail extension configured to be aligned with the second rail; and

a dolly disposed within the enclosure below the longitudinal axis of the turbine outlet duct and on the pair of rails, wherein the dolly comprises a frame, a plurality of wheel units, and a turbine support structure, wherein the dolly is configured to support the gas turbine on the turbine support structure and configured to move along the pair of rails, wherein each wheel unit comprises a stationary portion and an adjustable portion, wherein the stationary portion is coupled to the frame of the dolly, and wherein the adjustable portion comprises a flanged wheel and is adjustably coupled to the stationary portion.

15. A method for removing a gas turbine from an enclosure, comprising:
- disconnecting an inlet of the gas turbine from a turbine inlet mating ring of an inlet wall assembly, wherein the inlet wall assembly is coupled to the enclosure by a pivotal connector;
 - pivoting the inlet wall assembly by an angle of greater than 75° from a closed position to an opened position;
 - raising at least a portion of a dolly to lift the gas turbine and transfer the weight of the gas turbine to the dolly, wherein the dolly is disposed on a pair of rails contained in the enclosure; and
 - moving the dolly containing the gas turbine along the pair of rails in an axial direction relative to a longitudinal axis of the gas turbine.
16. The method of claim 15, further comprising, prior to raising the at least portion of the dolly, installing a pair of rail extensions that aligns end-to-end with the pair of rails and extends adjacent to the inlet wall assembly disposed in the opened position, wherein a first rail extension is aligned end-to-end with a first rail and a second rail extension is aligned end-to-end with a second rail.
17. The method of claim 16, further comprising moving the dolly containing the gas turbine along the pair of rail extensions in the axial direction relative to the longitudinal axis of the gas turbine.
18. The method of claim 15, wherein the inlet wall assembly is pivoted about 90° to about 180° from the closed position to the opened position.
19. The method of claim 15, wherein the portion of the dolly raised to lift the gas turbine comprises a frame and a turbine support structure, and wherein the dolly further comprises a plurality of wheels adjustably coupled to the frame.
20. The method of claim 19, further comprising applying a force against the pair of rails with the plurality of wheels to raise the portion of the dolly and to lift the gas turbine.

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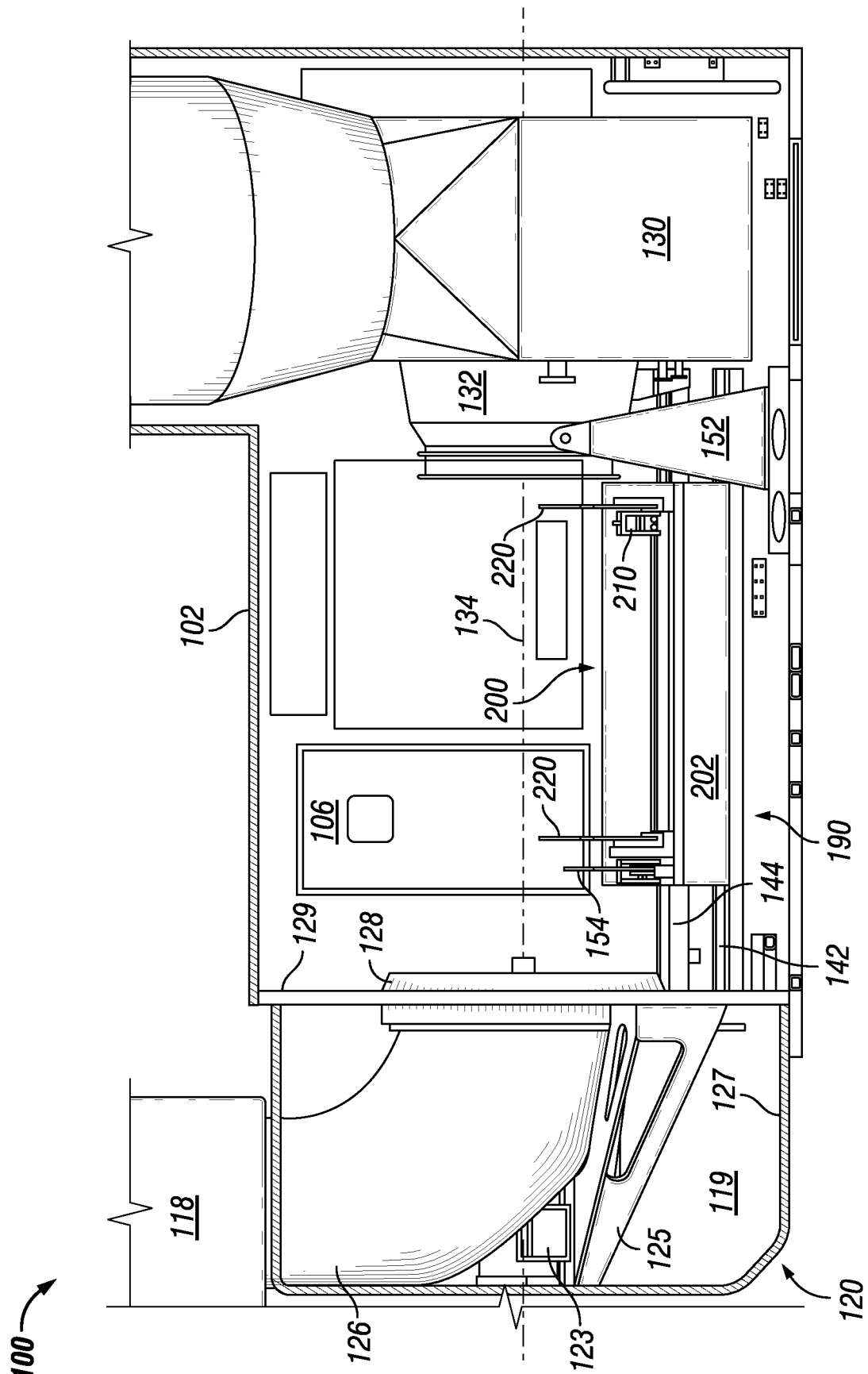
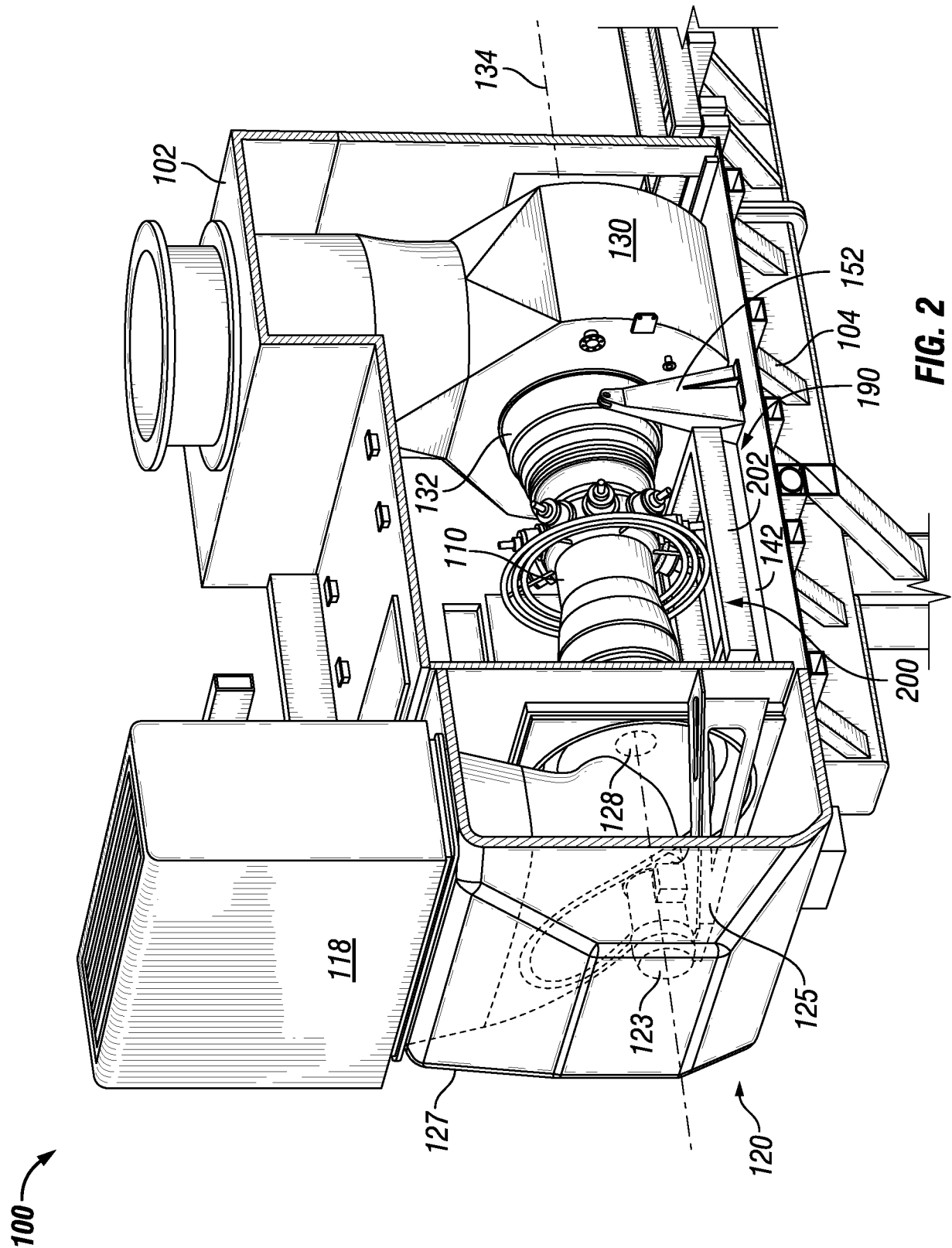


FIG. 1

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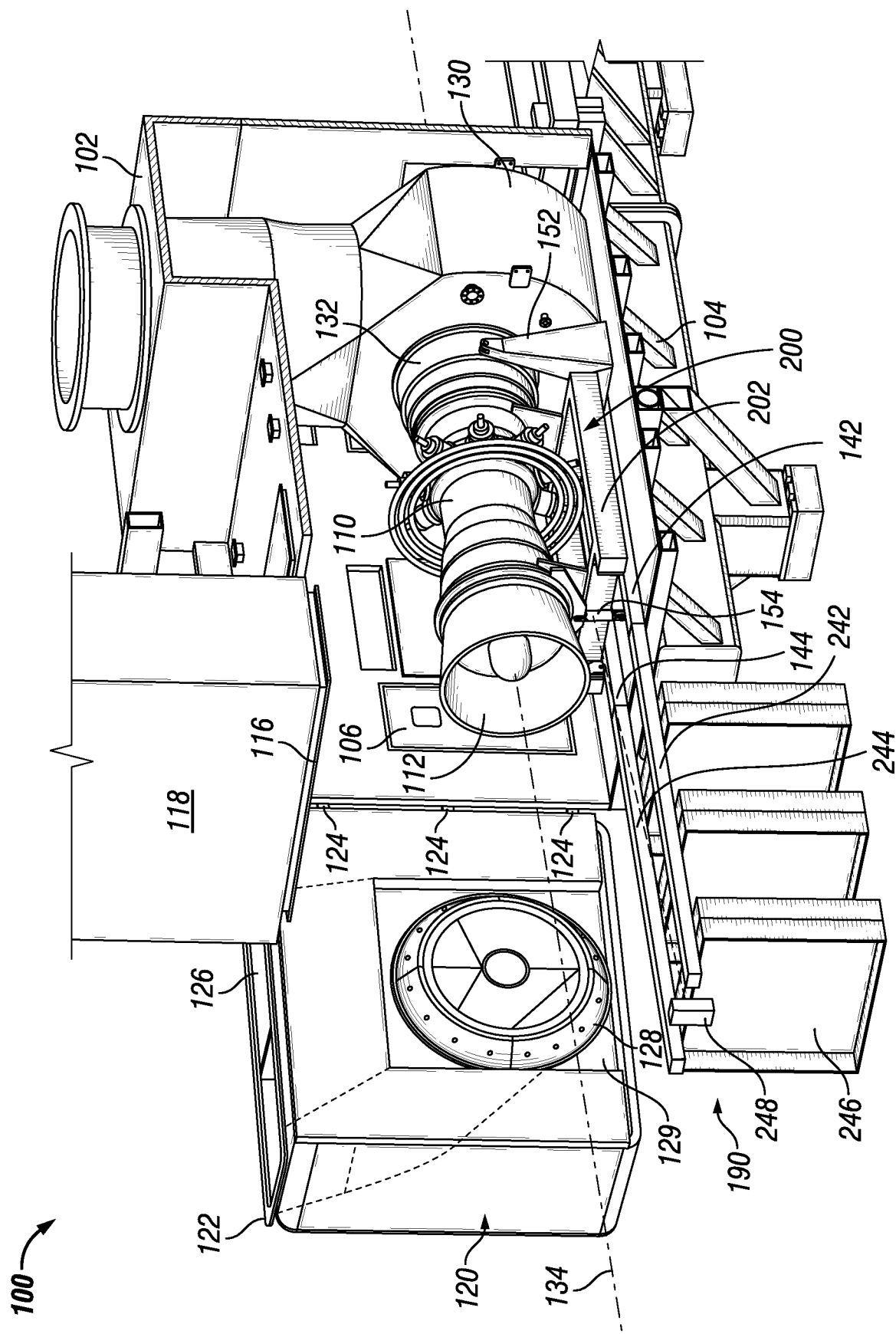


FIG. 3

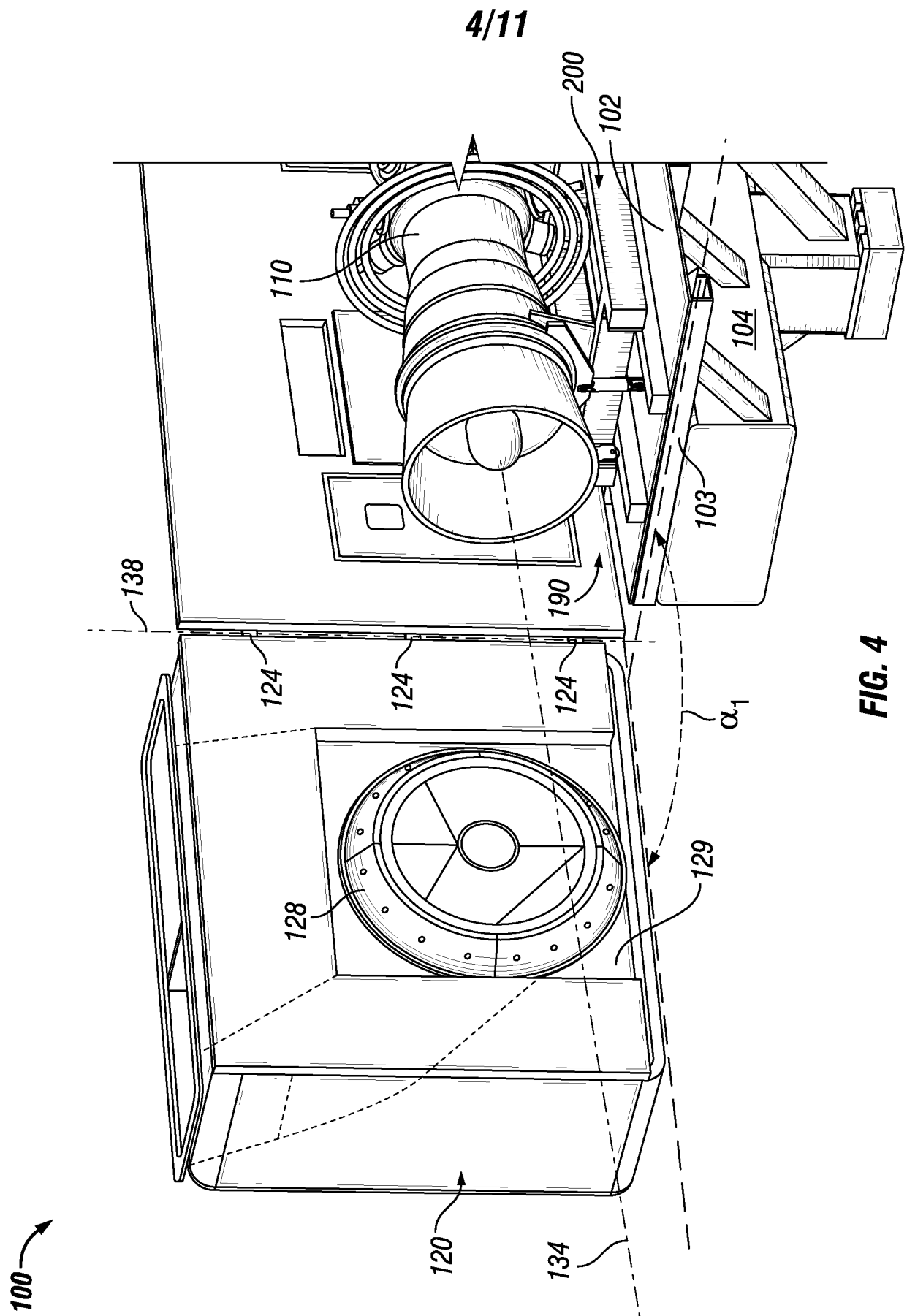


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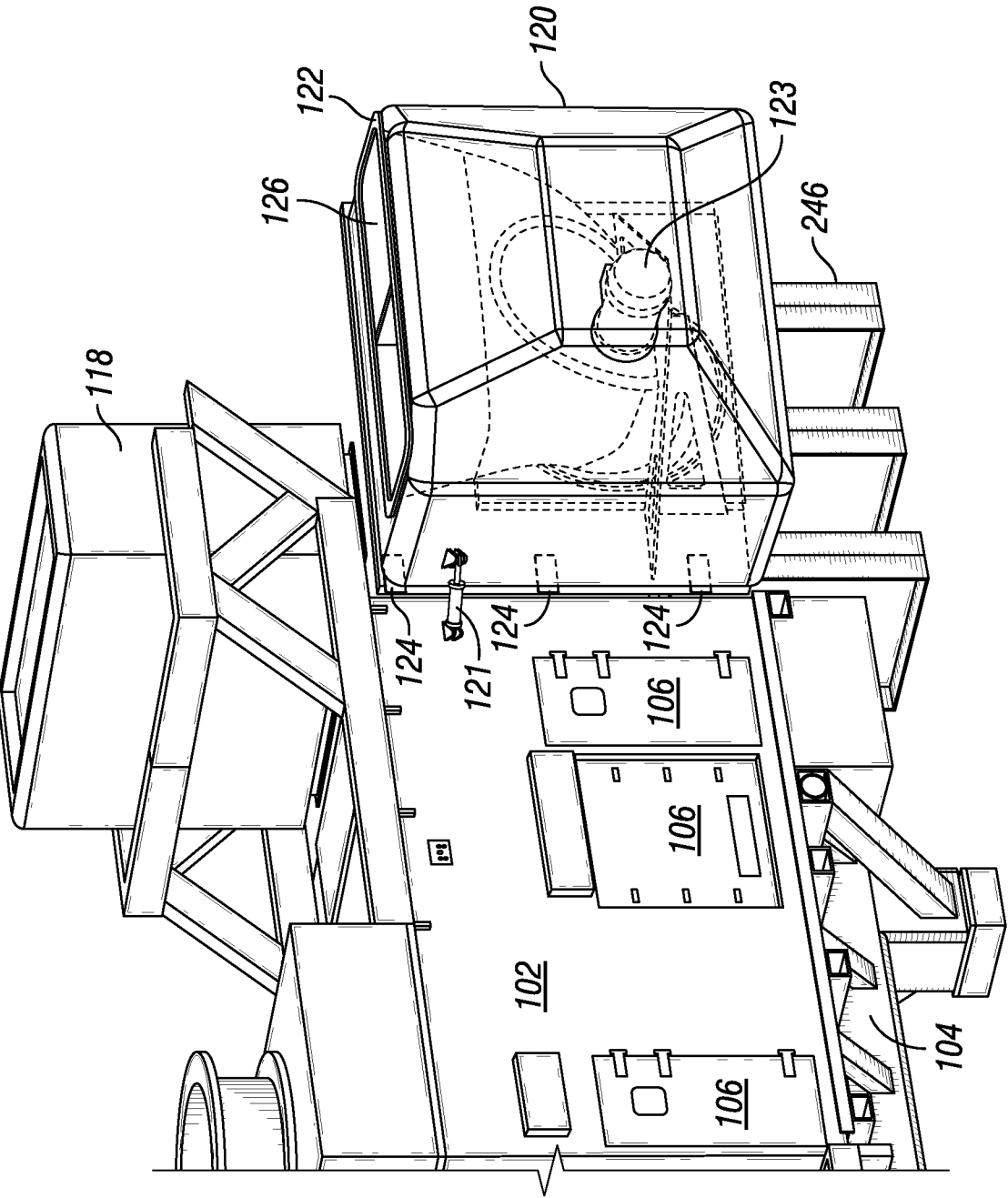


FIG. 5

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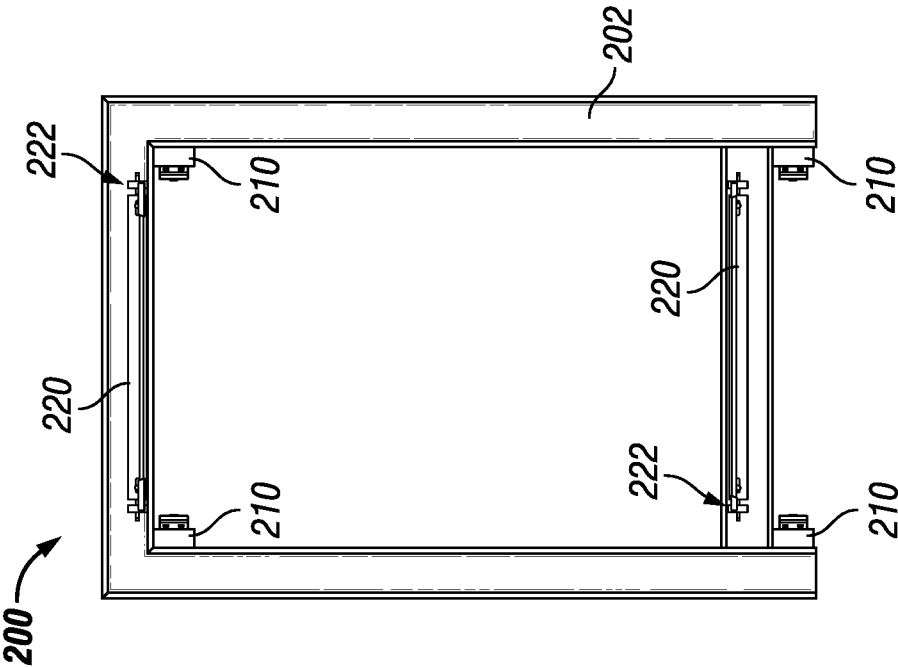


FIG. 7

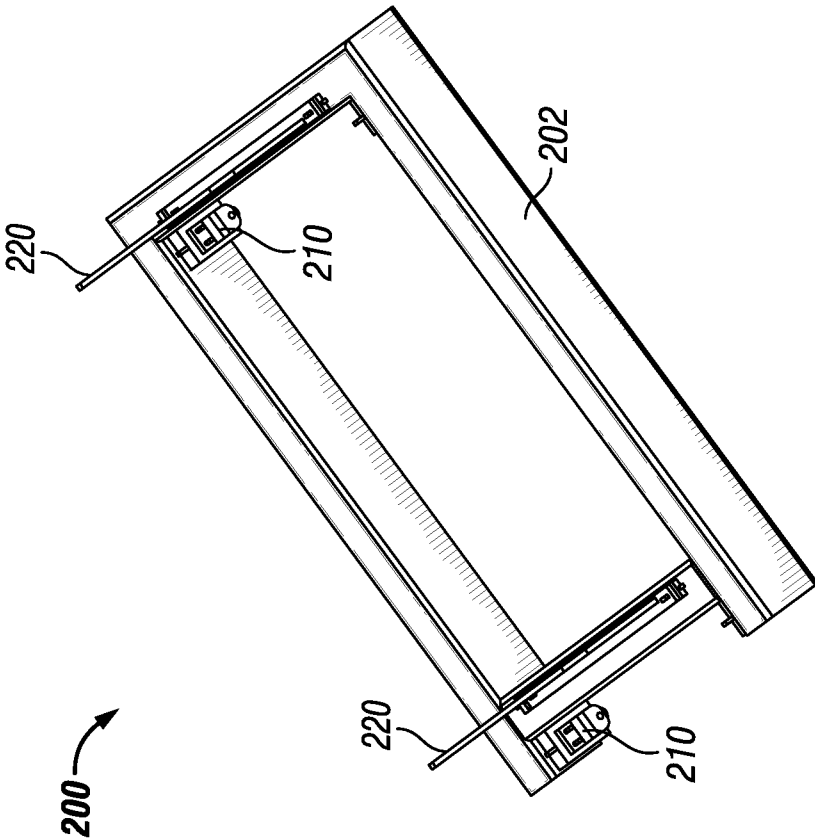


FIG. 6

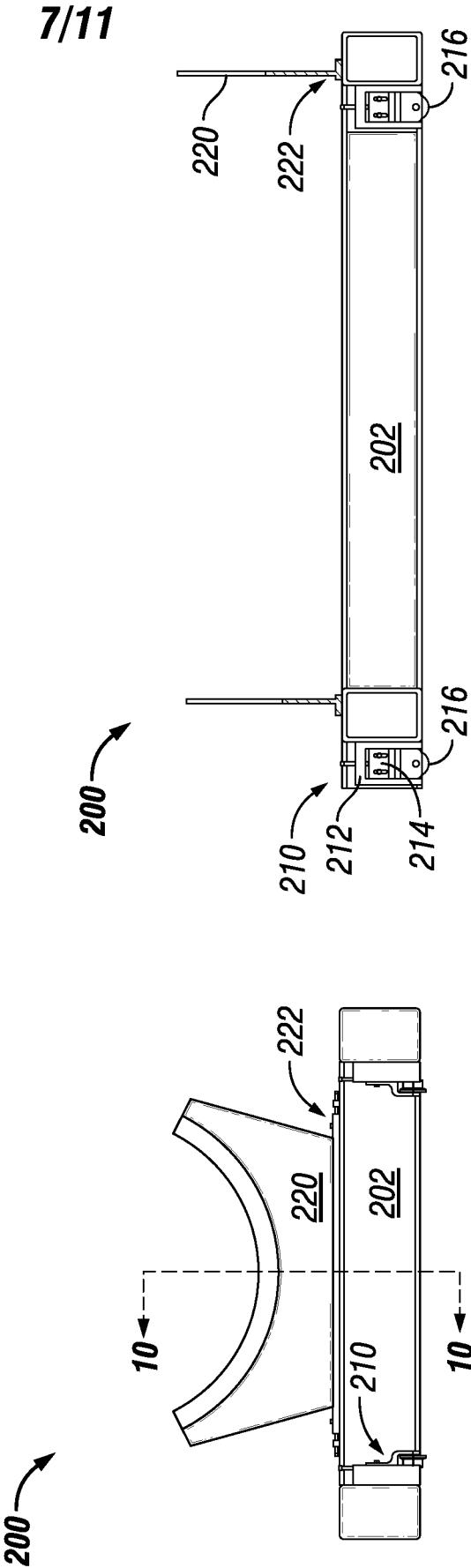
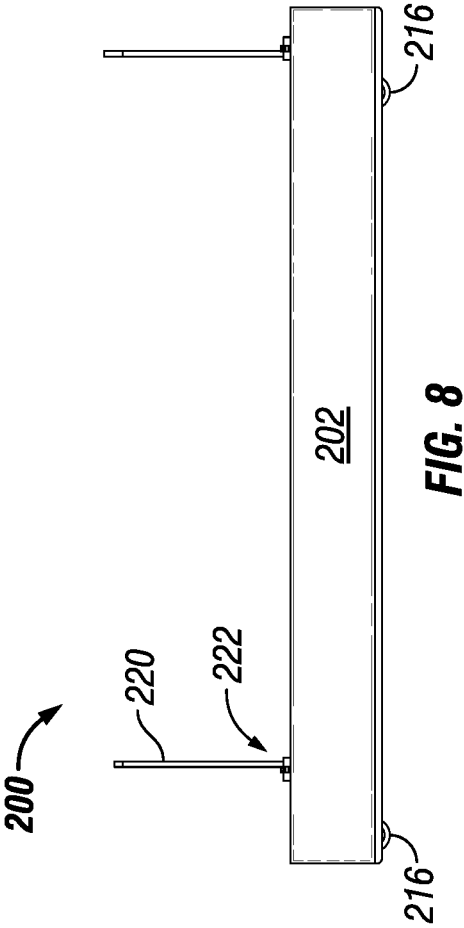


FIG. 10

FIG. 9

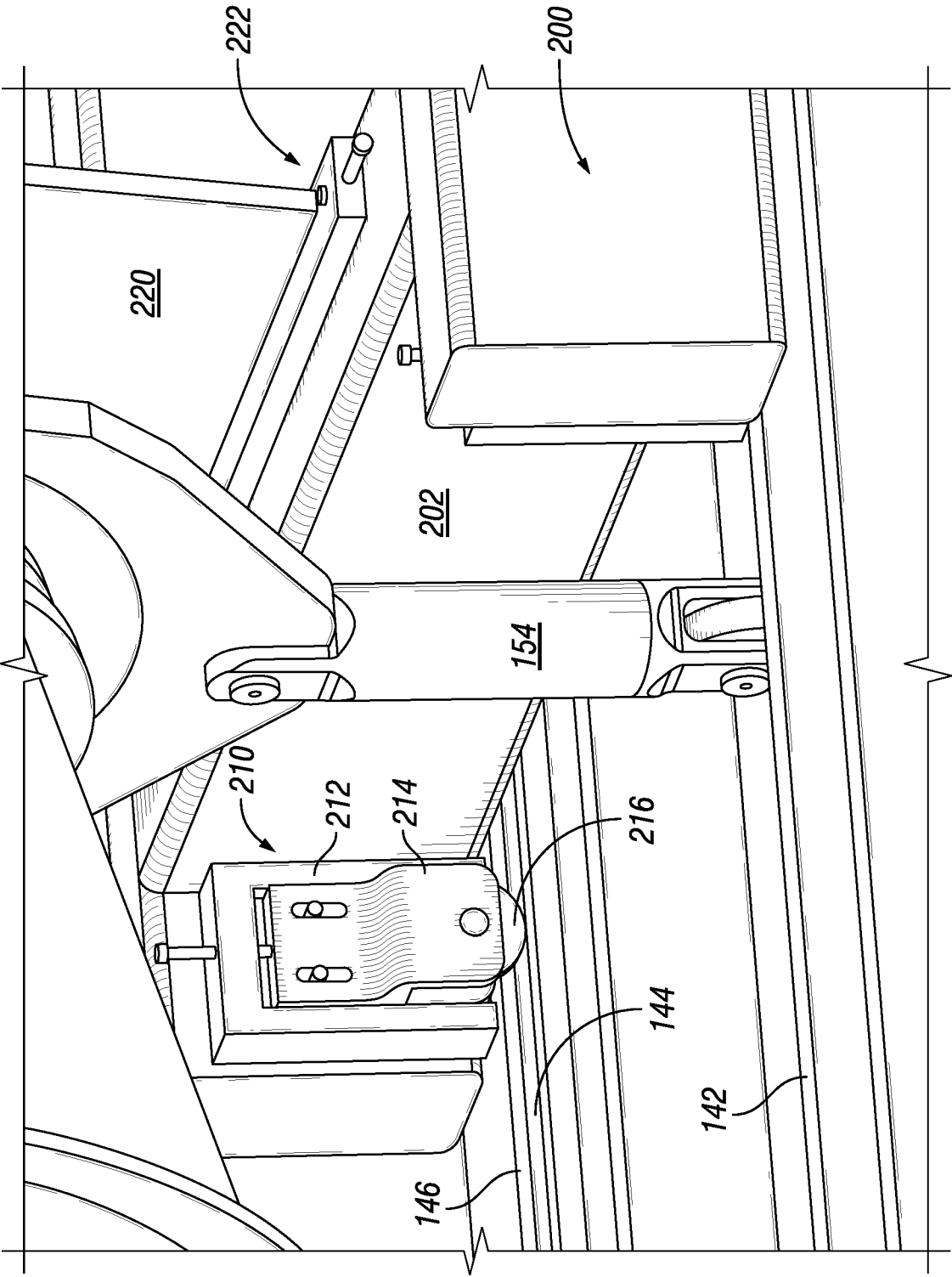


FIG. 11

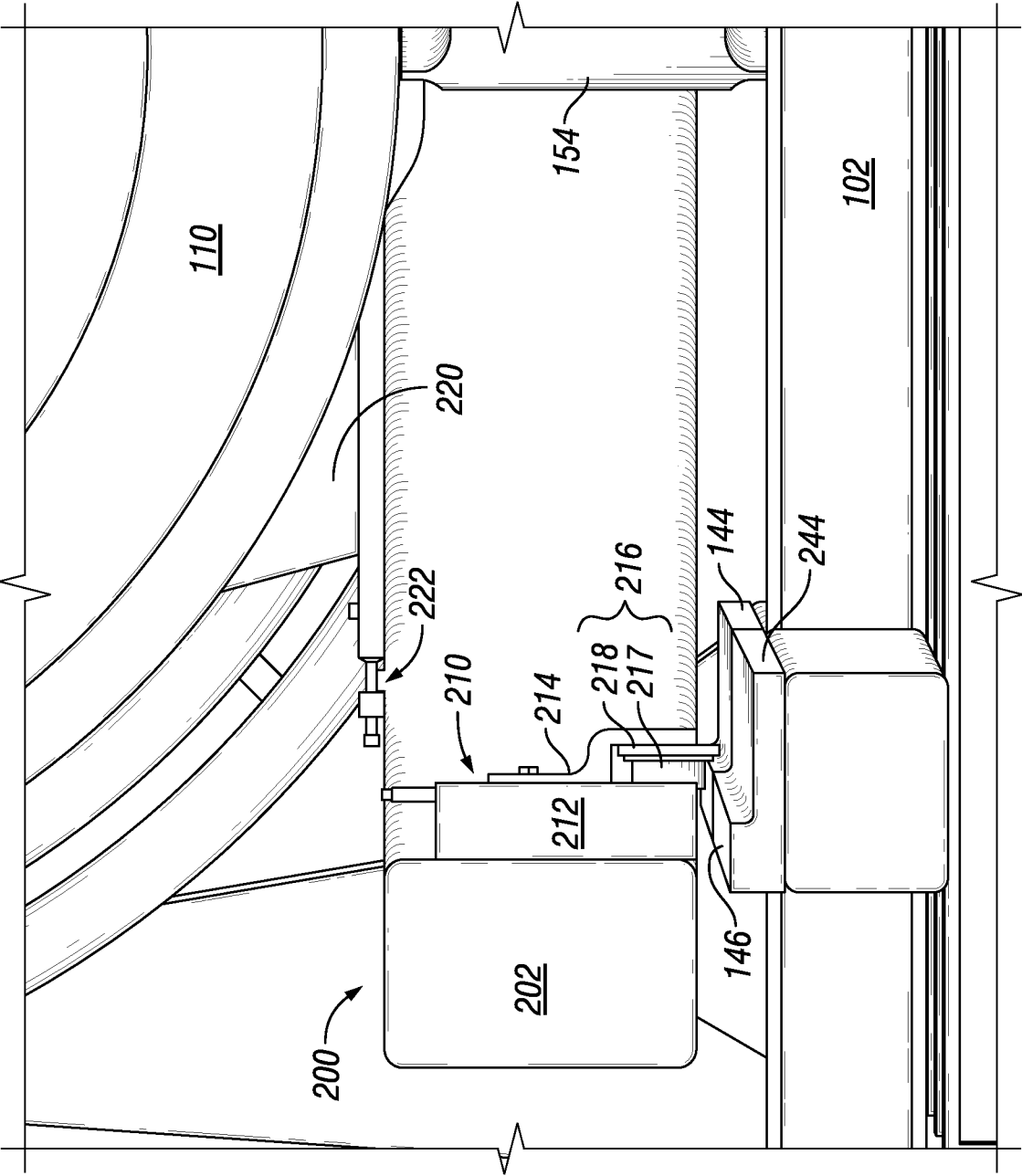


FIG. 12

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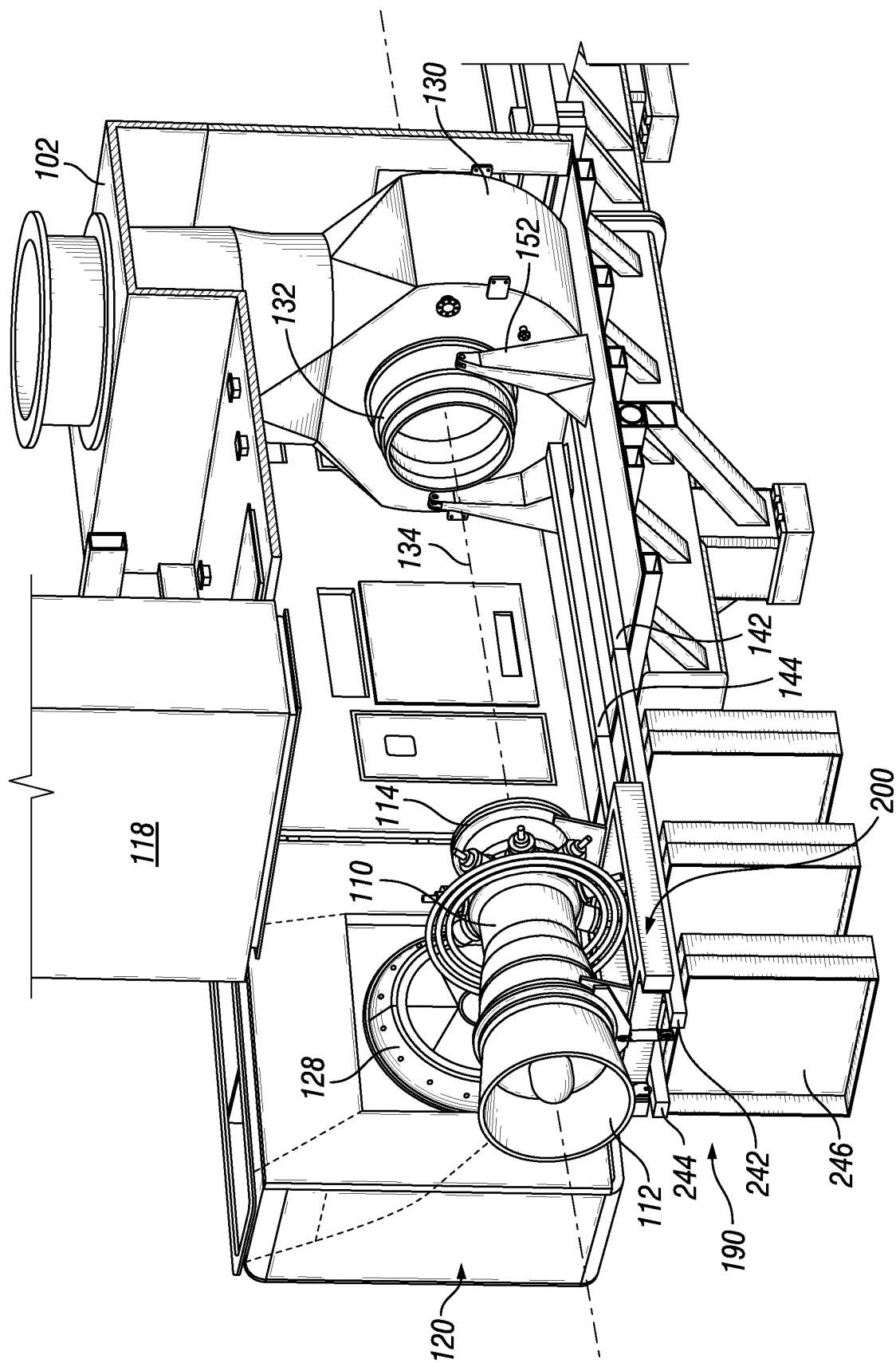
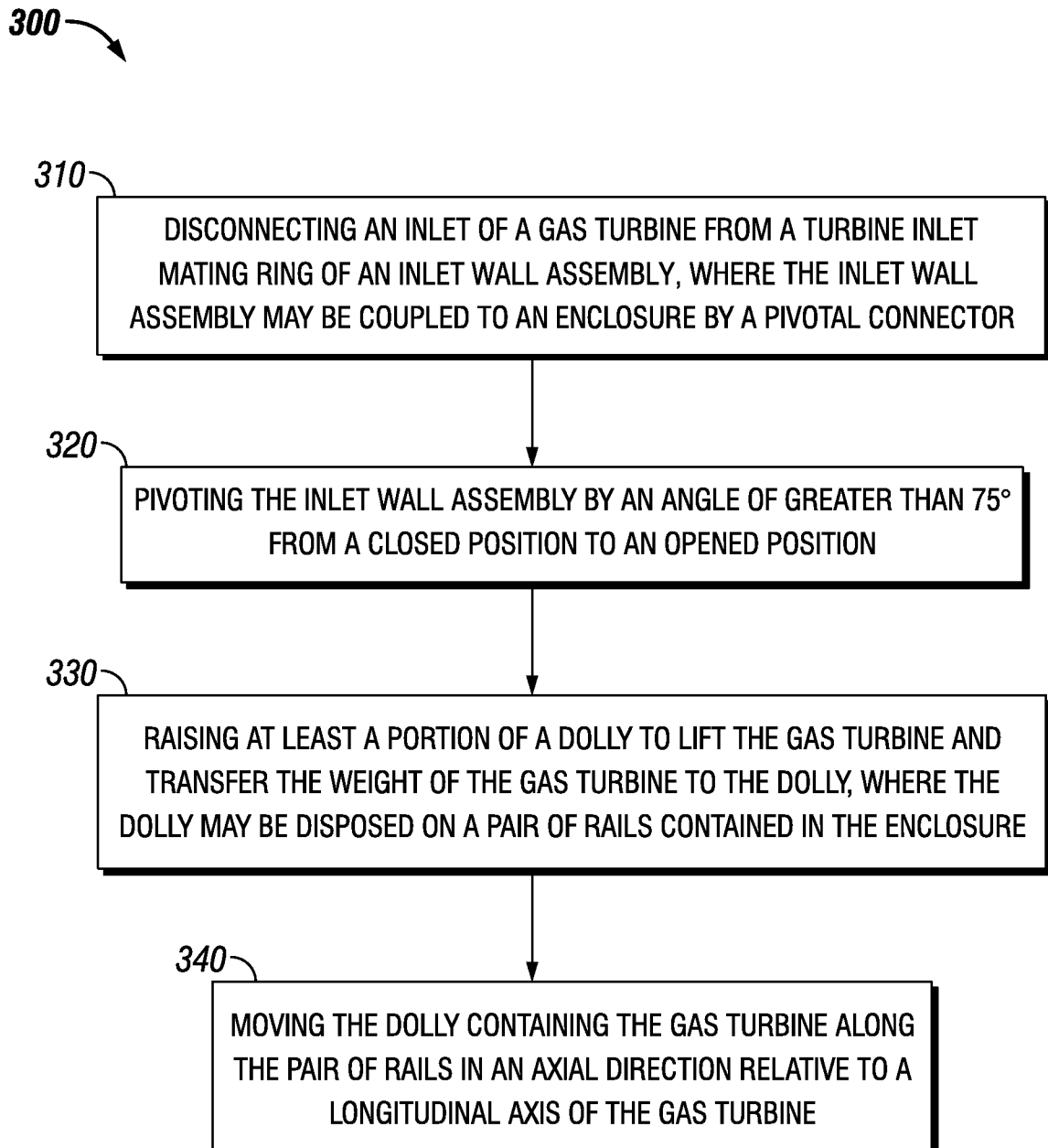


FIG. 13

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INTERNATIONAL SEARCH REPORT

International application No

PCT/US2017/034118

A. CLASSIFICATION OF SUBJECT MATTER

INV. F02C7/20 F01D25/28
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F02C F01D B64D B64F

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2 069 427 A (BRITISH AEROSPACE) 26 August 1981 (1981-08-26) page 1, line 123 - page 2, line 24; figure 2	1-20
A	----- US 2008/187431 A1 (BROWN IAN TREVOR [NZ] ET AL) 7 August 2008 (2008-08-07) figure 11	1-20
A	----- US 2014/013768 A1 (LAING DONALD GORDON [US] ET AL) 16 January 2014 (2014-01-16) figure 3	1,15
A	----- WO 00/17492 A1 (RAMGEN POWER SYSTEMS INC [US]; LAWLOR SHAWN P [US]; HICKS KENNETH HARO) 30 March 2000 (2000-03-30) figures 1, 9-12	1,15



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

16 August 2017

Date of mailing of the international search report

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Mihé, Julian

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2017/034118

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