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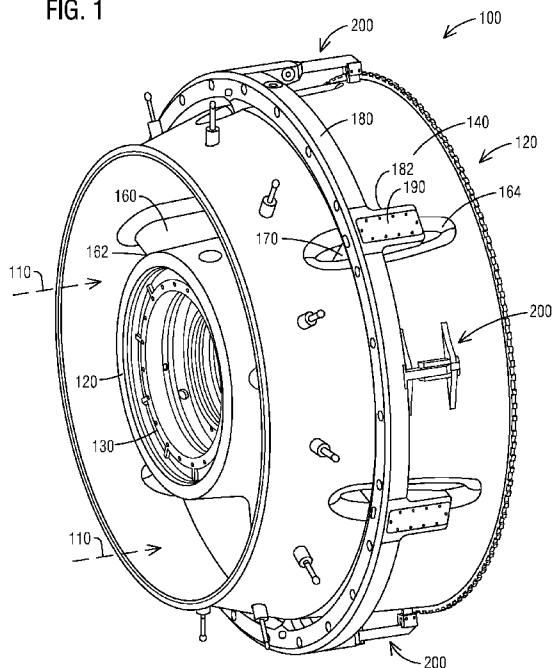
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(54) Title: ASSEMBLY AND METHOD FOR SUPPORTING TURBINE EXHAUST DIFFUSER

FIG. 1



(57) Abstract: An assembly and method for supporting turbine exhaust diffuser are presented. The turbine exhaust diffuser includes an inner diffuser and an outer diffuser circumferentially surrounded by an outer ring. The assembly includes a support bracket and a support rail assembly. The support bracket has a U-shape and is arranged on the outer ring extending axially. The support rail assembly includes a support rail arranged axially on the outer diffuser. The support rail is disposed within the U-shape of the support bracket such that a spline support connection is provided between the turbine exhaust diffuser and the outer ring. Mechanical and aero loads for supporting the turbine exhaust diffuser is transferred from the support rail to the outer ring. The support rail is free to move for minimizing thermal stresses of the turbine exhaust diffuser. Shims are attachable to the support bracket to compensate manufacturing and assembly tolerances.

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ASSEMBLY AND METHOD FOR SUPPORTING TURBINE EXHAUST DIFFUSER

FIELD OF THE INVENTION

[0001] This invention relates generally to an assembly and method for supporting a turbine exhaust diffuser of an industrial gas turbine engine.

DESCRIPTION OF THE RELATED ART

[0002] A turbine exhaust section is one of the sections of an industrial gas turbine engine that is located downstream of the last expansion stage of a turbine section of the gas turbine engine. The turbine exhaust section typically includes a turbine exhaust diffuser consisting of an inner diffuser and an outer diffuser. Exhaust gas from the turbine section enters the turbine exhaust diffuser between the inner and the outer diffusers. A plurality of struts may be arranged between the inner and outer diffusers. The turbine exhaust diffuser may encase a turbine exhaust casing. The turbine exhaust casing is a structural component that supports the aft end of the gas turbine rotor.

[0003] The turbine exhaust diffuser may be supported by the turbine exhaust casing using a variety of ways. It is desired to keep the turbine exhaust casing cooler than the turbine exhaust diffuser to improve the structural robustness of the component that supports and locates the gas turbine rotor. As a result, there is a large thermal mismatch between the turbine exhaust casing and turbine exhaust diffuser. The support system of the turbine exhaust diffuser onto the turbine exhaust casing must be able to compensate the large relative thermal growth between the components while providing constraints in the necessary degrees of freedom.

SUMMARY OF THE INVENTION

[0004] Briefly described, aspects of the present invention relate to an assembly for supporting a turbine exhaust diffuser, a method for supporting a turbine exhaust

diffuser and a turbine exhaust section.

[0005] According to an aspect, an assembly for supporting a turbine exhaust diffuser is presented. The turbine exhaust diffuser comprises an inner diffuser and an outer diffuser. An outer ring circumferentially surrounds the outer diffuser. The assembly comprises a support bracket arranged on the outer ring extending axially along the turbine exhaust diffuser. The assembly comprises a support rail assembly arranged on the outer diffuser. The support bracket comprises a U-shape with opening toward to the outer diffuser. The support rail assembly comprises a support rail axially arranged on the outer diffuser. The support rail is disposed within the U-shape of the support bracket such that a spline support connection is provided between the turbine exhaust diffuser and the outer ring for supporting the turbine exhaust diffuser by the outer ring.

[0006] According to an aspect, a method for supporting a turbine exhaust diffuser is presented. The turbine exhaust diffuser comprises an inner diffuser and an outer diffuser. An outer ring circumferentially surrounds the outer diffuser. The method comprises arranging a support bracket on the outer ring extending axially along the turbine exhaust diffuser. The method comprises arranging a support rail assembly on the outer diffuser. The support bracket comprises a U-shape with opening toward to the outer diffuser. The support rail assembly comprises a support rail axially arranged on the outer diffuser. The support rail is disposed within the U-shape of the support bracket such that a spline support connection is provided between the turbine exhaust diffuser and the outer ring for supporting the turbine exhaust diffuser by the outer ring.

[0007] According to an aspect, a turbine exhaust section is presented. The turbine exhaust section comprises a turbine exhaust diffuser comprising an inner diffuser and an outer diffuser. The turbine exhaust section comprises an outer ring circumferentially surrounding the outer diffuser. The turbine exhaust section comprises an assembly configured to provide a spline support connection between the turbine exhaust diffuser and the outer ring. The assembly comprises a support bracket arranged on the outer ring

extending axially along the turbine exhaust diffuser. The assembly comprises a support rail assembly arranged on the outer diffuser. The support bracket comprises a U-shape with opening toward to the outer diffuser. The support rail assembly comprises a support rail axially arranged on the outer diffuser. The support rail is disposed within the U-shape of the support bracket such that a spline support connection is provided between the turbine exhaust diffuser and the outer ring for supporting the turbine exhaust diffuser by the outer ring.

[0008] Various aspects and embodiments of the application as described above and hereinafter may not only be used in the combinations explicitly described, but also in other combinations. Modifications will occur to the skilled person upon reading and understanding of the description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Exemplary embodiments of the application are explained in further detail with respect to the accompanying drawings. In the drawings.

[0010] FIG. 1 illustrates a schematic perspective view of a portion of a turbine exhaust section in which embodiments of the present invention may be incorporated;

[0011] FIGs. 2 to 3 illustrate schematic perspective views of an assembly for supporting a turbine exhaust diffuser from various viewing directions according to an embodiment of the present invention;

[0012] FIG. 4 illustrates a perspective view of a support bracket according to an embodiment of the present invention;

[0013] FIG. 5 illustrates a perspective view of support frames according to an embodiment of the present invention;

[0014] FIG. 6 illustrates a perspective view of a support rail according to an

embodiment of the present invention;

[0015] FIG. 7 illustrates a perspective view of a support rail assembly according to an embodiment of the present invention; and

[0016] FIGs. 8 and 9 illustrate schematic perspective views of an assembly for supporting the turbine exhaust diffuser according to various embodiments of the present invention.

[0017] To facilitate understanding, identical reference numerals have been used, where possible, to designate identical elements that are common to the figures.

DETAILED DESCRIPTION OF THE INVENTION

[0018] A detailed description related to aspects of the present invention is described hereafter with respect to the accompanying figures.

[0019] FIG. 1 illustrates a schematic perspective view of a portion of a turbine exhaust section 100 of a gas turbine engine. The turbine exhaust section 100 is typically arranged axially downstream of a gas turbine (not shown) for diffusing exhaust gas 110 from the gas turbine. As shown in FIG. 1, the turbine exhaust section 100 includes a turbine exhaust diffuser 120 diverging axially toward downstream of the exhaust gas 110. The turbine exhaust diffuser 120 consists of an inner diffuser 130 and an outer diffuser 140. The exhaust gas 110 from the gas turbine enters the turbine exhaust diffuser 120 between the inner diffuser 130 and the outer diffuser 140 that forms a diverging exhaust flow path. The turbine exhaust section 100 may extend axially further downstream to diffuse the exhaust gas 110.

[0020] A plurality of strut shields 160 are arranged between the inner diffuser 130 and the outer diffuser 140. The strut shields 160 are circumferentially spaced apart from each other. The strut shields 160 may be oriented radially between the inner diffuser 130 and the outer diffuser 140, as shown in FIG. 1. However, the strut shields

160 may also be oriented tangentially to the inner diffuser 130. The strut shield 160 may have an airfoil shape cross section. The strut shield 160 may have an inner collar 162 and an outer collar 164 that are attached to the inner diffuser 130 and the outer diffuser 140 respectively. The inner collar 162 and the outer collar 164 may reduce stress concentrations and hence improve part life. The inner collar 162 and the outer collar 164 may also reduce flow separation and hence prevent vortex generation. The inner collar 162 and the outer collar 164 may be welded to the inner diffuser 130 and outer diffuser 140. The strut shield 160 is hollow inside and encloses a strut 170. Inner end of the strut 170 is attached to a bearing support 150.

[0021] The turbine exhaust section 100 includes an outer ring 180 circumferentially surrounding the turbine exhaust diffuser 120. The outer ring 180 is attached to a turbine casing (not shown). The outer ring 180 includes a plurality of protrusions 182 axially extending downwardly from the outer ring 180. The protrusions 182 are arranged along the outer ring 180 and circumferentially align with the struts 170. Outer end of the strut 170 is attached to bottom of the protrusion 182. A cover plate 190 is attached on the top side of the protrusion 182. For illustration purpose, six strut shields 160 enclosing six struts 170 are shown in FIG. 1. The six strut shields 160 and the six struts 170 may be located circumferentially at different positions, such as at 2, 4, 6, 8, 10 and 12 o'clock positions. It is understood that other numbers of struts shield 160 and strut 170 may be implemented in the turbine exhaust section 100.

[0022] The turbine exhaust section 100 includes a plurality of assemblies 200 for supporting the turbine exhaust diffuser 120. The assemblies 200 are arranged on the outer diffuser 140 of the turbine exhaust diffuser 120 and connected to the outer ring 180 which provides a spline support connection between the turbine exhaust diffuser 120 and the outer ring 180. The assemblies 200 are circumferentially spaced apart from each other such that position of the turbine exhaust diffuser 120 is constrained in both lateral and vertical directions. For example, the assemblies 200 may be arranged circumferentially on the outer diffuser 140 of the turbine exhaust diffuser 120 at 3, 6, 9 and 12 o'clock positions. The assemblies 200 arranged at 3 and 9 o'clock positions

provide vertical support of the turbine exhaust diffuser 120. The assemblies 200 arranged at 6 and 12 o'clock positions provide lateral support of the turbine exhaust diffuser 120. It is understood that the assemblies 200 may be arranged circumferentially on the outer diffuser 140 of the turbine exhaust diffuser 120 at other positions, such as 2, 4, 8, 10 o'clock positions, etc.

[0023] FIGs. 2 and 3 illustrate schematic perspective views of an assembly 200 for supporting the turbine exhaust diffuser 120 from various viewing directions according to an embodiment of the present invention. As shown in FIGs. 2 and 3, the assembly 200 includes a support bracket 220. The support bracket 220 is arranged on the outer ring 180 extending axially along the turbine exhaust diffuser 120. The forward end of the support bracket 220 is attached to the outer ring 180. The support bracket 220 may be attached to the outer ring 180 by fasteners 210, such as bolts. The assembly 200 includes a support rail assembly 300. The support rail assembly 300 is arranged on the outer diffuser 140 of the turbine exhaust 120. The support rail assembly 300 includes a forward frame 232 located upstream and an aft frame 234 located axially downstream from the forward frame 232 with respect to the exhaust gas flow direction 110, as indicated in FIG. 1. The forward frame 232 and the aft frame 234 are attached to the outer diffuser 140 of the turbine exhaust diffuser 120 in a circumferential direction and radially extending upwardly. The forward frame 232 and the aft frame 234 may be attached to the outer diffuser 140 of the turbine exhaust diffuser 120, for example, by welding. The support rail assembly 300 includes a support rail 240. The support rail 240 is assembled to the forward frame 232 and the aft frame 234 in an axial direction. Aft end of the support rail 240 may be fixedly attached to the aft frame 234 by fasteners 210, such as bolts. The support bracket 220 may have a U-shape like a groove with opening toward to the outer diffuser 140 of the turbine exhaust diffuser 120. The U-shape may be arranged toward to the aft end of the support bracket 220 and is disposed between the forward frame 232 and the aft frame 234. The support rail 240 is disposed within the U-shape of the support bracket 220 such that a spline support connection is provided between the turbine exhaust diffuser 120 and the outer ring 180. The assembly 200 includes shim 250. The shim 250 is attached to an inner side of the U-

shape of the support bracket 220 facing to the support rail 240. The shim 250 compensates tolerance of the assembly 200 during final assembly to maintain an accurate position of the turbine exhaust diffuser 120. The shim 250 may be attached to the support bracket 220 by fasteners 210, such as bolts.

[0024] According to the embodiment, the assembly 200 provides a spline support connection between the turbine exhaust diffuser 120 and the outer ring 180. The support rail 240 provides a spline on the outer diffuser 140 of the turbine exhaust diffuser 120. The support rail 240 meshes within the U-shape of the support bracket 220. The support bracket 220 matches the support rail 240 which transfers mechanical and aero loads from the support rail 240 exerted by the turbine exhaust diffuser 120 and the exhaust gas 110 to the outer ring 180. The support bracket 220 is attached to the outer ring 180 and is arranged away from the strut 170. Such arrangement reduces heat transfer into the strut 170 which reduces thermal gradient of the strut 170. The reduced thermal gradient of the strut 170 may ultimately improve rotor centering and gas turbine engine performance. The support rail 240 is attached to the outer diffuser 140 of the turbine exhaust diffuser 120 having a large radius which reduces a reaction force from torsional aero load.

[0025] With references to FIGs 2 and 3, a radial gap 262 may exist between the support bracket 220 and the outer diffuser 140 of the turbine exhaust diffuser 120. A radial gap 264 may exist between the support rail 240 and the support bracket 220. An axial gap 266 may exist between the U-shape of the support bracket 220 and the forward frame 232. An axial gap 268 may exist between the U-shape of the support bracket 220 and the aft frame 234. A tangential gap 270 may exist between at least one of the shims 250 and the support rail 240. For example, one tangential gap 270 may exist between top side of the support rail 240 and top side shim 250 for assemblies 200 arranged at 3 and 9 o'clock positions providing vertical support of the turbine exhaust diffuser 120. Two tangential gaps 270 may exist between both shims 250 and the support rail 240 at both sides for assemblies 200 arranged at 6 and 12 o'clock positions providing lateral support of the turbine exhaust diffuser 120. The radial gaps 262 and

264, the axial gaps 266 and 268 and the tangential gap 270 provide room for relative movements between the support bracket 220, the support rail 240 and the turbine exhaust diffuser 120 due to various causes, such as thermal expansion and contraction, manufacturing tolerance and assembly tolerance.

[0026] FIG. 4 illustrates a perspective view of the support bracket 220 according to an embodiment of the present invention. As shown in FIG. 4, the support bracket 220 includes an axial plate 222 extending in an axial direction. A forward plate 224 is attached to the forward end of the axial plate 222 with respect to exhaust gas flow direction 110 as indicated in FIG. 1. The forward plate 224 includes holes 212. The support bracket 220 is attached to the outer ring 180 by fastening the forward plate 224 to the outer ring 180 via the fasteners 210 penetrating through the holes 212, as shown in FIG. 2. An axial beam 223 may be attached on the axial plate 222. The axial beam 223 may improve mechanical strength of the support bracket 220. The support bracket 220 includes two side plates 226 arranged on two circumferential sides of the axial plate 222 toward to the aft end of the axial plate 222 forming a U-shape at the aft end of the support bracket 220. The side plates 226 radially extend toward to the outer diffuser 140 of the turbine exhaust diffuser 120 with the radial gap 262 there between, as shown in FIG. 3. The support rail 240 is disposed within the U-shape of the support bracket 220 with a radial gap 264 between the axial plate 222 and the support rail 240, as shown in FIG. 3. Shims 250 are attached to inner sides of the side plates 226 by fasteners 210, such as bolts. The shims 250 are bolted to the side plates 226 from outer sides of the side plates 224. Dimension of the shims 250 is defined during final assembly for proper alignment of the assembly 200 with the turbine exhaust diffuser 120.

[0027] FIG. 5 illustrates a perspective view of the forward frame 232 and the aft frame 234 according to an embodiment of the present invention. As shown in FIG. 5, the forward frame 232 and the aft frame 234 are attached to the outer diffuser 140 of the turbine exhaust diffuser 120 in a circumferential direction and radially extending upwardly. The forward frame 232 is located upstream. The aft frame 234 is located

axially downstream from the forward frame 232 with respect to the exhaust gas flow direction 110, as indicated in FIG. 1. The forward frame 232 and the aft frame 234 may be attached to the outer diffuser 140 of the turbine exhaust diffuser 120, for example, by welding. The forward frame 232 and the aft frame 234 may have a full penetration weld to the outer diffuser 140 with access to both sides which improves welding quality and reduces risk of cracks. Shapes of the forward frame 232 and the aft frame 234 may be defined such that a transition of load between the turbine exhaust diffuser 120 and the forward frame 232 and the aft frame 234 is gradual to reduce thermal stresses. The forward frame 232 and the aft frame 234 may have similar shape. According to an exemplary embodiment as shown in FIG. 5, the forward frame 232 and the aft frame 234 have an arc shape. Top area of the arc shaped forward frame 232 and the aft frame 234 includes a slot 236 cutting from top surface downwardly. The aft frame 234 includes holes 212.

[0028] FIG. 6 illustrates a perspective view of a support rail 240 according to an embodiment of the present invention. As shown in FIG. 6, the support rail 240 includes an axial panel 242. Bottom surface of the axial panel 240 includes undercuts 246 located at the forward end and the aft end of the axial panel 242. The undercut 246 at the forward end of the support panel 242 mates with the slot 236 of the forward frame 232 after assembly. The undercut 246 at the aft end of the support panel 242 mates with the slot 236 of the aft frame 234 after assembly. The support rail 240 includes an aft plate 244 arranged on the aft end of the support panel 242 radially extending downwardly. The aft plate 244 includes holes 212.

[0029] FIG. 7 illustrates a perspective view of the support rail assembly 230. As shown in FIG. 7, the support rail assembly 230 includes the forward frame 232 and the aft frame 234 attached to the outer diffuser 140 of the turbine exhaust diffuser 120. The support rail assembly 230 includes the support rail 240 assembled to forward frame 232 and the aft frame 234 in the axial direction. The undercut 246 at the aft end of the support rail 240 is disposed into the slot 236 of the aft frame 234. The aft plate 244 of the support rail 240 is fixed to the aft frame 234 by fasteners 210 penetrating through

the holes 212 such that the aft end of the support rail 240 is fixedly secured to the aft frame 234. The undercut 246 at the forward end of the support rail 240 is disposed into the slot 236 of the forward frame 232 such that the forward end of the support rail 240 has a sliding joint with the forward frame 232. The sliding joint makes the support rail 240 axially free relative to the front frame 232. The slide joint accommodates thermal stresses between the forward frame 232 and the aft frame 234 as well as the support rail 240.

[0030] FIG. 8 illustrates a schematic perspective view of an assembly 200 for supporting the turbine exhaust diffuser 100 according to an embodiment of the present invention. As shown in FIG. 8, the assembly 200 includes a support bracket 220. The support bracket 220 includes an axial plate 222 extending in an axial direction. A forward plate 224 is attached to the forward end of the axial plate 222 with respect to exhaust gas flow direction 110, as indicated in FIG. 1. The forward plate 224 includes holes 212. The support bracket 220 is attached to the outer ring 180 of the turbine exhaust diffuser 100 by fastening the forward plate 224 to the outer ring 180 via the fasteners 210 penetrating through the holes 212. The support bracket 220 includes two side plates 226 arranged on two circumferential sides of the axial plate 222 forming a U-shape along the axial direction like a groove with opening toward to the outer diffuser 140 of the turbine exhaust diffuser 120. The side plates 226 radially extend toward to the outer diffuser 140 of the turbine exhaust diffuser 120 with a radial gap 262 there between.

[0031] With reference to FIG. 8, the assembly 200 includes a support rail assembly 230 arranged on the outer diffuser 140 of the turbine exhaust diffuser 120. The support rail assembly 230 includes a support rail 240 attached to the outer diffuser 140 of the turbine exhaust diffuser 120 in the axial direction. The support rail 240 may be attached to the outer diffuser 140 of the turbine exhaust diffuser 120, for example, by welding. The support rail 240 may have a full penetration weld to the outer diffuser 140 with access to both sides which improves welding quality and reduces risk of cracks. The support rail 240 is disposed within the U-shape of the support bracket 220 which

provides a spline support connection between the turbine exhaust diffuser 120 and the outer ring 180. A radial gap 264 may exist between the axial plate 222 of the support bracket 220 and the support rail 240. Shims 250 are attached to inner sides of the side plates 226 by fasteners 210, such as bolts. The shims 250 are bolted to the side plates 226 from outer sides of the side plates 224. Dimension of the shims 250 is defined during final assembly for proper alignment of the assembly 200 with the turbine exhaust diffuser 120. A tangential gap 270 may exist between at least one of the shims 250 and the support rail 240. For example, one tangential gap 270 exists between top side of the support rail 240 and top side shim 250 for assemblies 200 arranged at 3 and 9 o'clock positions providing vertical support of the turbine exhaust diffuser 120. Two tangential gaps 270 may exist between both shims 250 and the support rail 240 at both sides for assemblies 200 arranged at 6 and 12 o'clock positions providing lateral support of the turbine exhaust diffuser 120. As illustrated in FIG. 8, the support rail 240 is free to move axially. The radial gaps 262 and 264, the tangential gap 270 and the free axial movement of the support rail 240 provide room for relative movements between the support bracket 220, the support rail 240 and the turbine exhaust diffuser 120 due to various causes, such as thermal expansion and contraction, manufacturing tolerance and assembly tolerance.

[0032] FIG. 9 illustrates a schematic perspective view of an assembly 200 for supporting the turbine exhaust diffuser 100 according to an embodiment of the present invention. As shown in FIG. 9, the outer ring 180 includes a protrusion 182 axially extending downwardly from the outer ring 180. A cover plate 190 is attached on the top side of the protrusion 182. The cover plate 190 may be attached on the top side of the protrusion 182 by fasteners 210, such as bolts. The strut 170 radially extends out from the outer collar 164 and are attached to bottom of the protrusion 182. The assembly 200 includes a support bracket 220. The support bracket 220 includes an axial plate 222. A forward plate 224 is attached to the forward end of the axial plate 222. The support bracket 220 is attached to the protrusion 182 of the support ring 180 by fastening the forward plate 224 to the protrusion 182 via the fasteners 210. The support bracket 220 includes two side plates 226 arranged on two circumferential sides of the axial plate

222 toward to the aft end of the axial plate 222 forming a U-shape at the aft end of the support bracket 220. The side plates 226 radially extend toward to the outer diffuser 140 of the turbine exhaust diffuser 120 with a radial gap 262 there between.

[0033] With reference to FIG. 9, the assembly 200 includes a support rail assembly 230 arranged on the outer diffuser 140 of the turbine exhaust diffuser 120. The support rail assembly 230 includes a support rail 240 attached to the outer diffuser 140 of the turbine exhaust diffuser 120 in the axial direction. The support rail 240 may be attached to the outer diffuser 140 of the turbine exhaust diffuser 120, for example, by welding. The support rail 240 may have a full penetration weld to the outer diffuser 140 with access to both sides which improves welding quality and reduces risk of cracks. The support rail 240 is located axially downstream from the outer collar 164. The support rail 240 is disposed within the U-shape of the support bracket 220 which provides a spline support connection between the turbine exhaust diffuser 120 and the outer ring 180. A radial gap 264 may exist between the axial plate 222 of the support bracket 220 and the support rail 240. Shims 250 are attached to inner sides of the side plates 226 by fasteners 210, such as bolts. The shims 250 are bolted to the side plates 226 from outer sides of the side plates 224. Dimension of the shims 250 is defined during final assembly for proper alignment of the assembly 200 with the turbine exhaust diffuser 120. A tangential gap 270 may exist between at least one of the shims 250 and the support rail 240. For example, one tangential gap 270 may exist between top side of the support rail 240 and top side shim 250 for assemblies 200 arranged at 3 and 9 o'clock positions providing vertical support of the turbine exhaust diffuser 120. Two tangential gaps 270 may exist between both shims 250 and the support rail 240 at both sides for assemblies 200 arranged at 6 and 12 o'clock positions providing lateral support of the turbine exhaust diffuser 120. As illustrated in FIG. 9, the support rail 240 is free to move axially. The radial gaps 262 and 264, the tangential gap 270 and the free axial movement of the support rail 240 provide room for relative movements between the support bracket 220, the support rail 240 and the turbine exhaust diffuser 120 due to various causes, such as thermal expansion and contraction, manufacturing tolerance and assembly tolerance.

[0034] According to an aspect, the proposed assembly 200 provides a spline support for supporting the turbine exhaust diffuser 120 by the outer ring 180. The proposed assembly 200 provides a spline support connection between the turbine exhaust diffuser 120 and the outer ring 180. The proposed spline support assembly 200 is attached to the outer ring 180 which is away from the struts 170. The proposed assembly 200 reduces thermal input and gradients to the struts 170 which ultimately improves rotor centering ability and gas turbine engine performance.

[0035] According to an aspect, the proposed assembly 200 includes a support rail 240 attached to the outer diffuser 140 of the turbine exhaust diffuser 120. The support rail 240 provides a spline on the turbine exhaust diffuser 120 and is disposed within the support bracket 220. The support bracket 220 transfers mechanical and aero loads from the support rail 240 exerted by the turbine exhaust diffuser 120 and the exhaust gas 110 to the outer ring 180. The support rail 240 provides torsional support and maintains a centered flow path of the turbine exhaust diffuser 120. The support rail 240 reduces reaction force from torsional loads due to a large radius of outer diffuser 140 of the turbine exhaust diffuser 120. The support rail 240 may be radially and axially free to move for minimizing thermal stresses of the turbine exhaust diffuser 120.

[0036] According to an aspect, the proposed assembly 200 includes shims 250 to compensate assembly and manufacturing tolerances. The shims 250 are machined during the final assembly for a proper alignment of the assembly 200 with the turbine exhaust diffuser 120 to maintain an accurate position of the turbine exhaust diffuser 120.

[0037] According to an aspect, the proposed assembly 200 provides proper access for full penetration weld to the outer diffuser 140 of the turbine exhaust diffuser 120. The full penetration weld may be performed at both sides to provide backing, grind flush and inspection which improves welding quality and reduces risk of cracks. The proposed assembly 200 provides a cost effective and service friendly design for supporting the turbine exhaust diffuser 120.

[0038] Although various embodiments that incorporate the teachings of the present invention have been shown and described in detail herein, those skilled in the art can readily devise many other varied embodiments that still incorporate these teachings. The invention is not limited in its application to the exemplary embodiment details of construction and the arrangement of components set forth in the description or illustrated in the drawings. The invention is capable of other embodiments and of being practiced or of being carried out in various ways. Also, it is to be understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting. The use of “including,” “comprising,” or “having” and variations thereof herein is meant to encompass the items listed thereafter and equivalents thereof as well as additional items. Unless specified or limited otherwise, the terms “mounted,” “connected,” “supported,” and “coupled” and variations thereof are used broadly and encompass direct and indirect mountings, connections, supports, and couplings. Further, “connected” and “coupled” are not restricted to physical or mechanical connections or couplings.

Reference List:

- 100: Turbine Exhaust Section
- 110: Exhaust Gas from Gas Turbine
- 120 Turbine Exhaust Diffuser
- 130: Inner Diffuser
- 140: Outer Diffuser
- 150: Bearing Support
- 160: Strut Shield
- 162: Strut Shield Inner Collar
- 164: Strut Shield Outer Collar
- 170: Strut
- 180: Outer Ring
- 182: Protrusion of Outer Ring
- 190: Cover Plate
- 200 Turbine Exhaust Diffuser Support Assembly
- 210: Fastener
- 212: Hole
- 220: Support Bracket
- 222: Support Bracket Axial Plate
- 223: Support Bracket Axial Beam
- 224: Support Bracket Forward Plate
- 226: Support Bracket Side Plate
- 230: Support Rail Assembly
- 232: Forward Frame
- 234: Aft Frame
- 236: Frame Slot
- 240: Support Rail
- 242: Support Rail Axial Beam
- 244: Support Rail Aft Plate
- 246: Support Rail Undercut

- 250: Adjustment Shim
- 262: Radial Gap between Support Bracket and Outer Diffuser
- 264: Radial Gap between Support Bracket and Support Rail
- 266: Axial Gap between Support Bracket and Forward Frame
- 268: Axial Gap between Support Bracket and Aft Frame
- 270: Tangential Gap between Shim and Support Rail

CLAIMS

What is claimed is:

1. An assembly for supporting a turbine exhaust diffuser, wherein the turbine exhaust diffuser comprises an inner diffuser and an outer diffuser, wherein an outer ring circumferentially surrounds the outer diffuser, the assembly comprising:
 - a support bracket arranged on the outer ring extending axially along the turbine exhaust diffuser; and
 - a support rail assembly arranged on the outer diffuser,wherein the support bracket comprises a U-shape with opening toward to the outer diffuser,
 - wherein the support rail assembly comprises a support rail axially arranged on the outer diffuser, and
 - wherein the support rail is disposed within the U-shape of the support bracket such that a spline support connection is provided between the turbine exhaust diffuser and the outer ring for supporting the turbine exhaust diffuser by the outer ring.
2. The assembly as claimed in claim 1, wherein the support rail is attached to the outer diffuser.
3. The assembly as claimed in claim 1, wherein the U-shape is arranged toward to aft end of the support bracket.
4. The assembly as claimed in claim 1, wherein the support rail assembly further comprises a forward frame and an aft frame located axially downstream from the forward frame, wherein the forward frame and the aft frame are circumferentially attached to the outer diffuser and extending radially upwardly, and wherein the support rail is axially assembled to the forward frame and the aft frame.

5. The assembly as claimed in claim 4, wherein the U-shape is disposed between the forward frame and the aft frame.
6. The assembly as claimed in claim 4, wherein the forward frame and the aft support frame comprise slots cutting downwardly from top surface of the forward frame and the aft frame.
7. The assembly as claimed in claim 4, wherein the forward frame and the aft frame comprise an arc shape.
8. The assembly as claimed in claim 6, wherein the support rail comprises an axial support panel, and wherein bottom of the axial support panel comprises undercuts at forward end and aft end that mate with the slots of the forward frame and the aft frame respectively.
9. The assembly as claimed in claim 8, wherein the support rail comprises an aft side plate arranged on the aft end of the support panel extending radially downwardly, and wherein the aft side plate is fastened to the aft frame.
10. The assembly as claimed in claim 1, further comprising a shim attached to an inner side of a side plate of the support bracket facing to the support rail.
11. A method for supporting a turbine exhaust diffuser, wherein the turbine exhaust diffuser comprises an inner diffuser and an outer diffuser, wherein an outer ring circumferentially surrounds the outer diffuser, the method comprising:
 - arranging a support bracket on the outer ring extending axially along the turbine exhaust diffuser;
 - arranging a support rail assembly on the outer diffuser;
 - wherein the support bracket comprises a U-shape with opening toward to the outer diffuser,

wherein the support rail assembly comprises a support rail axially arranged on the outer diffuser, and

wherein the support rail is disposed within the U-shape of the support bracket such that a spline support connection is provided between the turbine exhaust diffuser and the outer ring for supporting the turbine exhaust diffuser by the outer ring.

12. The method as claimed in claim 11, wherein the support rail is attached to the outer diffuser.

13. The method as claimed in claim 11, wherein the U-shape is arranged toward to aft end of the support bracket.

14. The method as claimed in claim 11, wherein the support rail assembly further comprises a forward frame and an aft frame located axially downstream from the forward frame, wherein the forward frame and the aft frame are circumferentially attached to the outer diffuser and extending radially upwardly, and wherein the support rail is axially assembled to the forward frame and the aft frame.

15. The method as claimed in claim 14, wherein the U-shape is disposed between the forward frame and the aft frame.

16. The method as claimed in claim 14, wherein the forward frame and the aft support frame comprise slots cutting downwardly from top surface of the forward frame and the aft frame.

17. The method as claimed in claim 16, wherein the support rail comprises an axial support panel, and wherein bottom of the axial support panel comprises undercuts at forward end and aft end that mate with the slots of the forward frame and the aft frame respectively.

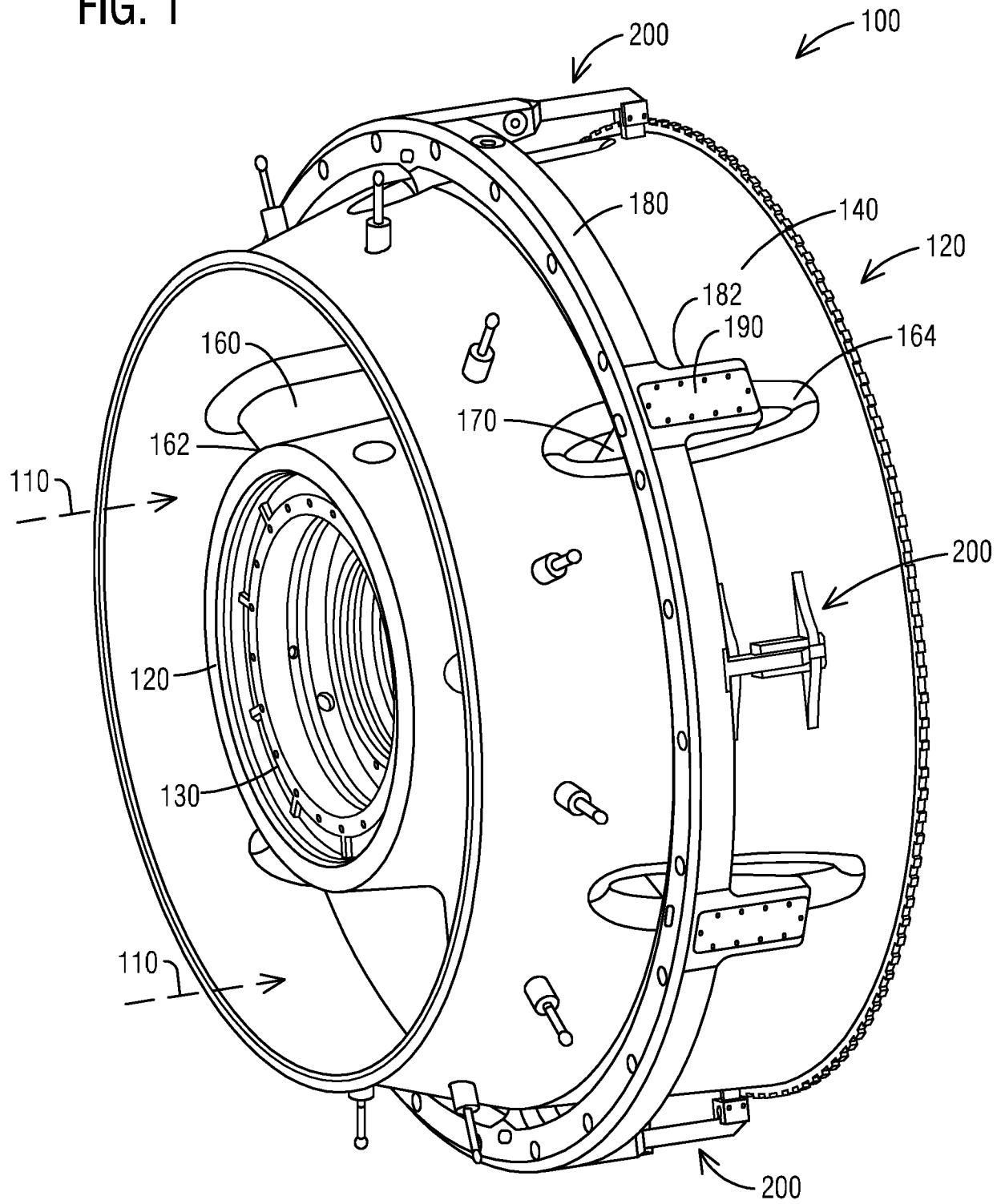
18. The method as claimed in claim 17, wherein the support rail comprises an aft side plate arranged on the aft end of the support panel extending radially downwardly, and wherein the aft plate is fastened to the aft frame.

19. The method as claimed in claim 11, further comprising attaching a shim to an inner side of a side plate of the support bracket facing to the support rail.

20. A turbine exhaust section comprising:
a turbine exhaust diffuser comprising an inner diffuser and an outer diffuser;
an outer ring circumferentially surrounding the outer diffuser; and
an assembly configured to provide a spline support connection between the turbine exhaust diffuser and the outer ring,
wherein the assembly comprises:
a support bracket arranged on the outer ring extending axially along the turbine exhaust diffuser; and
a support rail assembly arranged on the outer diffuser,
wherein the support bracket comprises a U-shape with opening toward to the outer diffuser,
wherein the support rail assembly comprises a support rail axially arranged on the outer diffuser, and
wherein the support rail is disposed within the U-shape of the support bracket such that the spline support connection is provided between the turbine exhaust diffuser and the outer ring for supporting the turbine exhaust diffuser by the outer ring.

$\frac{1}{4}$

FIG. 1



2/4

FIG. 2

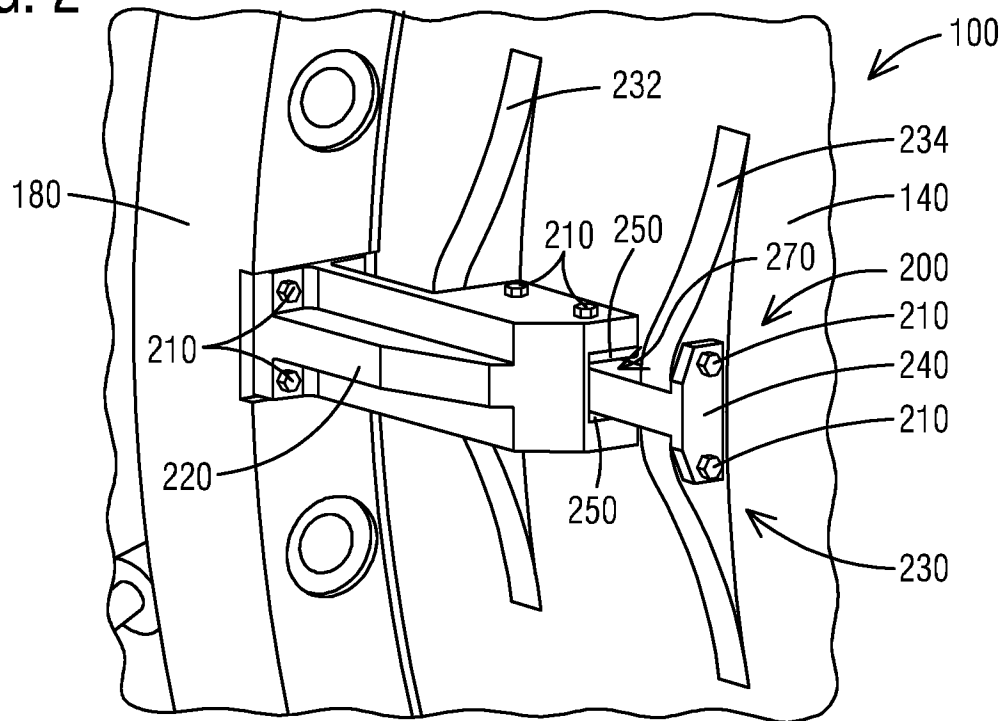


FIG. 3

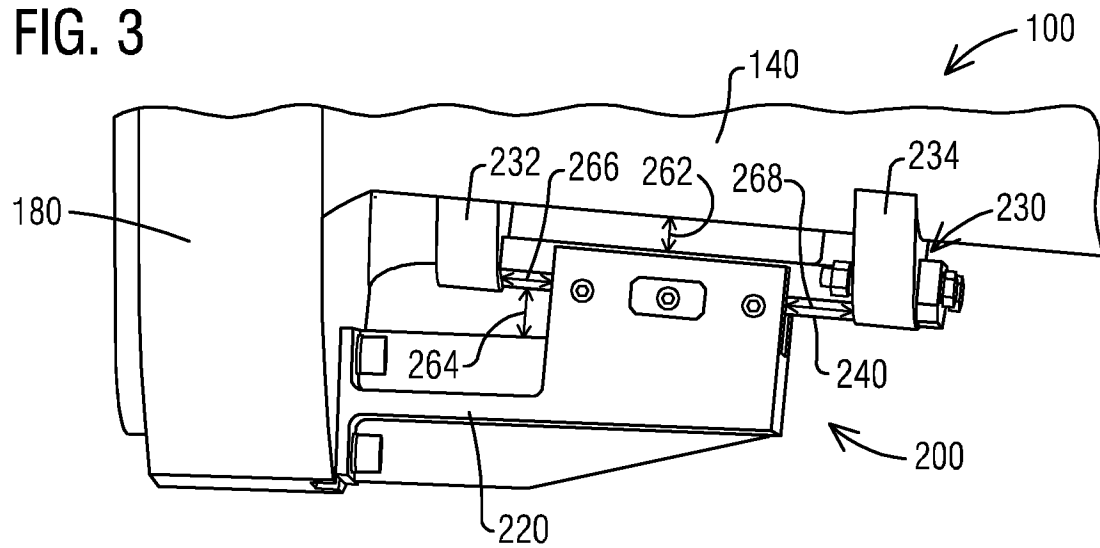
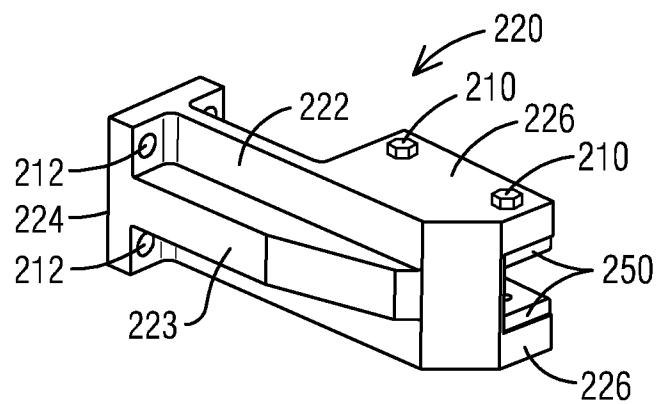


FIG. 4



3/4

FIG. 5

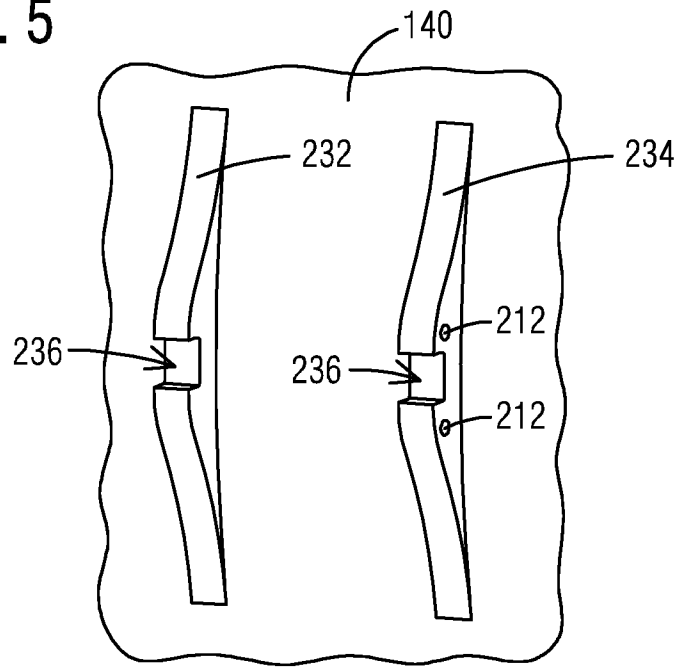


FIG. 6

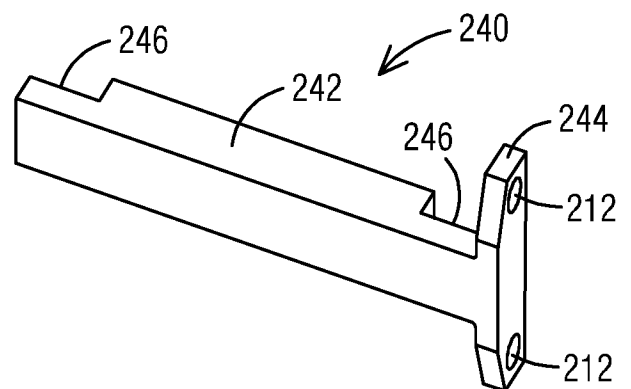
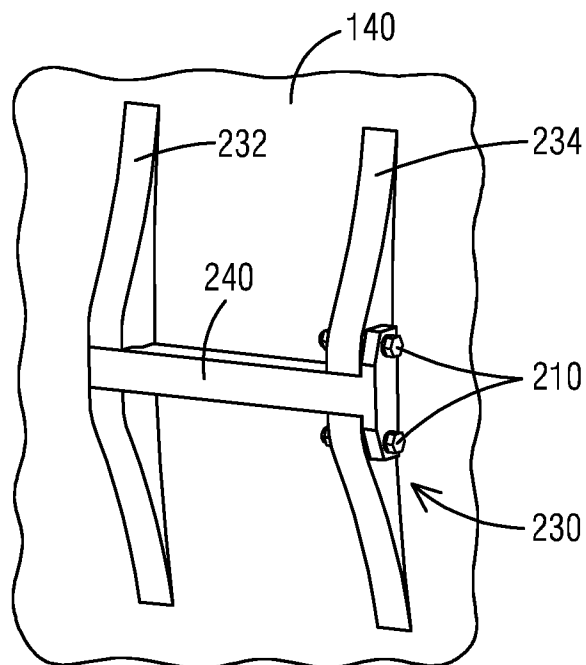


FIG. 7



4/4

FIG. 8

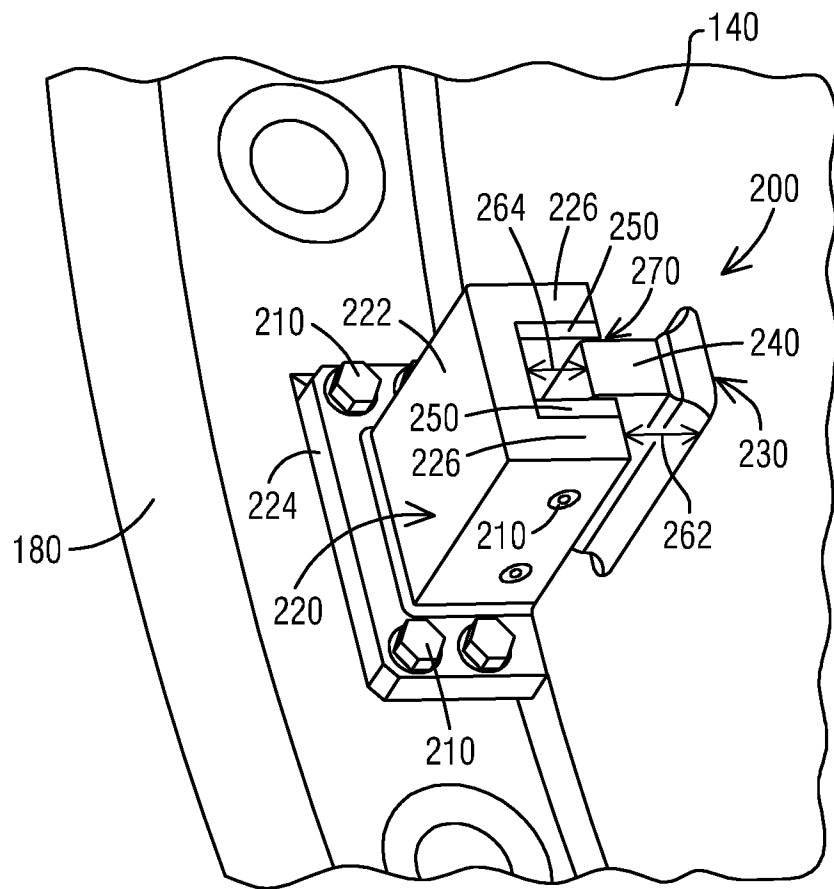
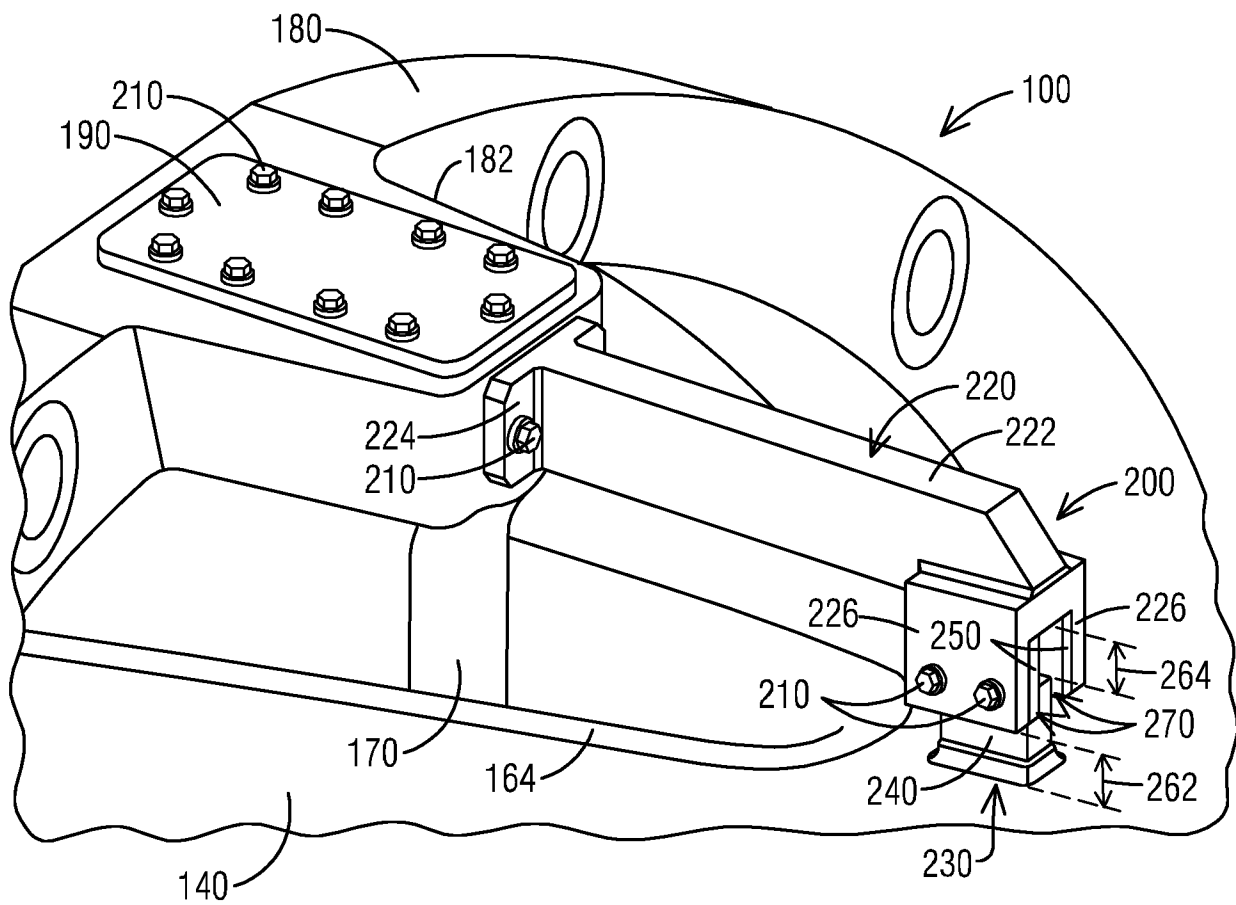


FIG. 9



INTERNATIONAL SEARCH REPORT

International application No
PCT/US2018/047018

A. CLASSIFICATION OF SUBJECT MATTER
INV. F01D25/28 F01D25/30
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)
F01D

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2014/064031 A1 (NUOVO PIGNONE SRL [IT]) 1 May 2014 (2014-05-01) pages 8-11 figures 4-8	1-20
X	----- US 2017/145843 A1 (JAMIOLKOWSKI ROBERT [PL] ET AL) 25 May 2017 (2017-05-25) paragraphs [0033] - [0045] figures 1-6	1-3, 11-13,20
X	----- US 2010/296923 A1 (YAMASHITA SHOKI [JP] ET AL) 25 November 2010 (2010-11-25) paragraphs [0065] - [0134] figures 1-10	1-3, 11-13,20



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

18 December 2018

Date of mailing of the international search report

04/01/2019

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2018/047018

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