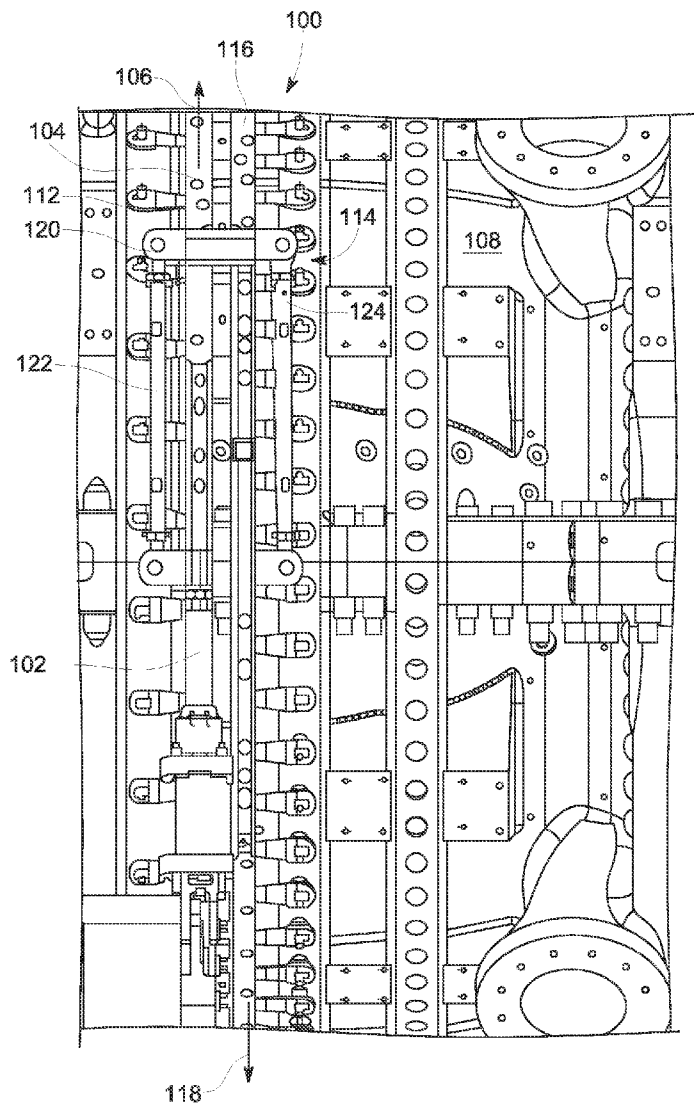




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(19) **United States**(12) **Patent Application Publication**
Velampati et al.(10) **Pub. No.: US 2014/0064912 A1**(43) **Pub. Date: Mar. 6, 2014**(54) **SYSTEMS AND METHODS TO CONTROL
VARIABLE STATOR VANES IN GAS TURBINE
ENGINES**(52) **U.S. Cl.**
USPC **415/1; 415/159**(75) Inventors: **Jayakrishna Velampati**, Bangalore (IN);
Dnyaneshwar D., Bangalore (IN); **Sasi
Kumar Tippabhotla**, Bangalore (IN)(57) **ABSTRACT**(73) Assignee: **GENERAL ELECTRIC COMPANY**,
Schenectady, NY (US)

Embodiments of the present application include a variable stator vanes control mechanism for a gas turbine engine. The control mechanism may include a moveable actuation rod in operative communication with a gear ring such that movement of the actuation rod drives the gear ring. The control mechanism may also include a first plurality of variable stator vanes disposed on a first side of the gear ring, the first plurality of variable stator vanes comprising gear stems in operative communication with the gear ring. Moreover, the control mechanism may include a second plurality of variable stator vanes disposed on a second side of the gear ring, the second plurality of variable stator vanes comprising gear stems in operative communication with the gear ring.

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F01D 17/12 (2006.01)

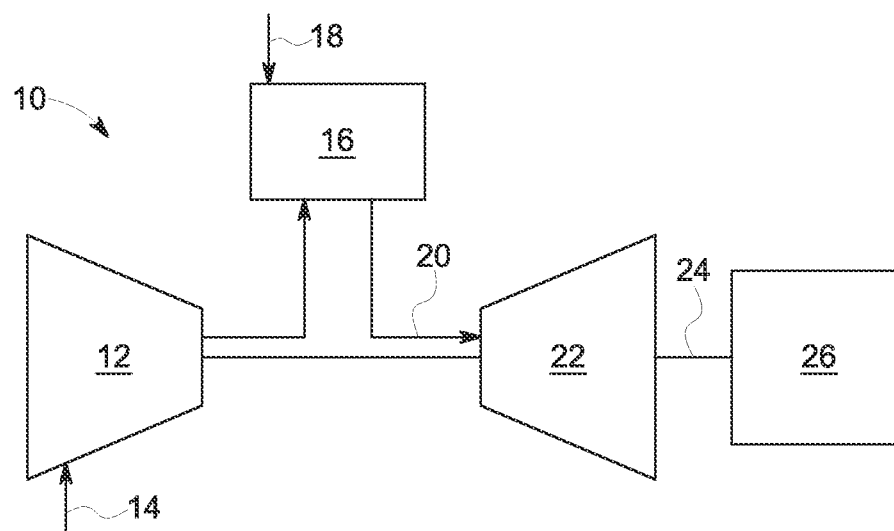


FIG. 1
(PRIOR ART)

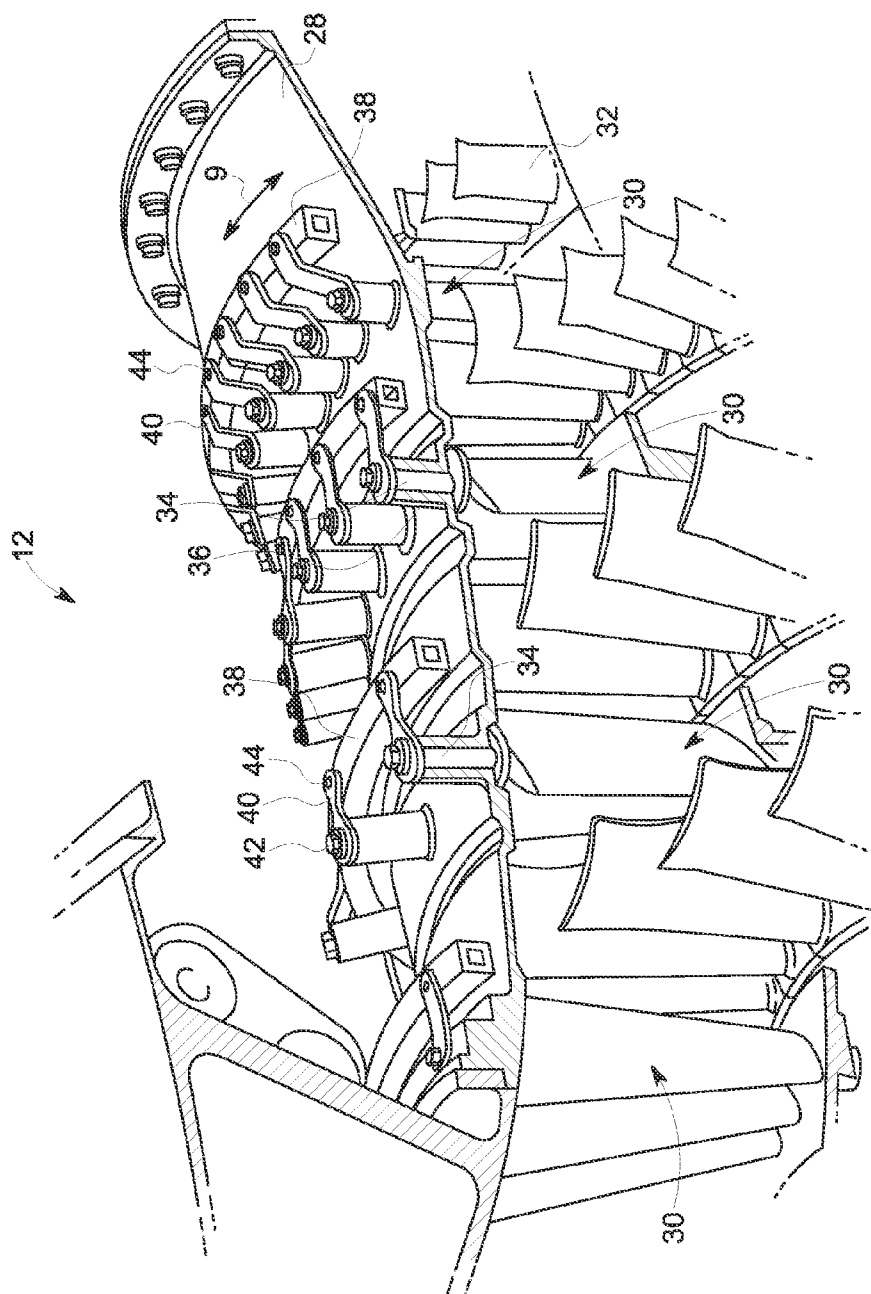


FIG. 2
(PRIOR ART)

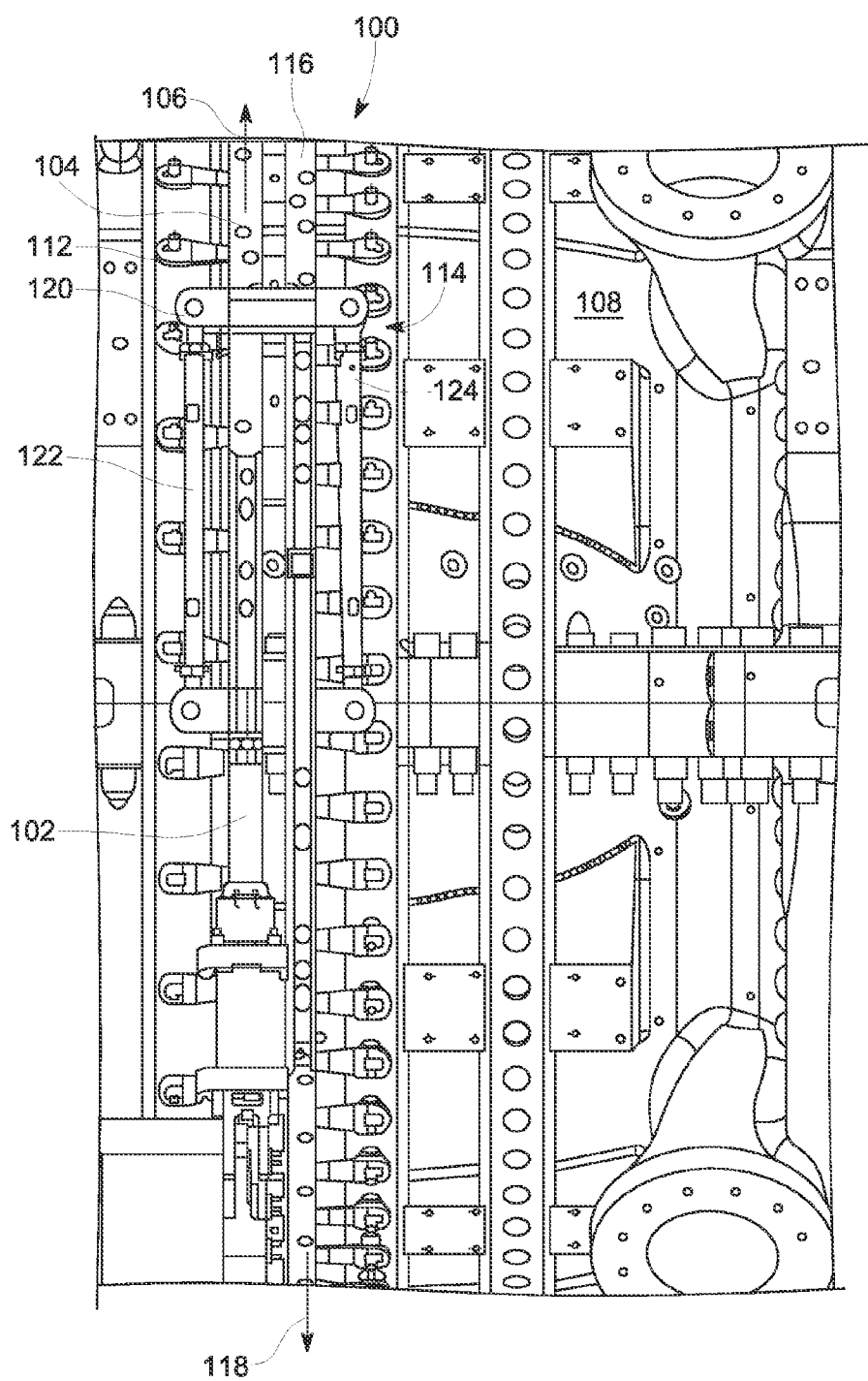


FIG. 3

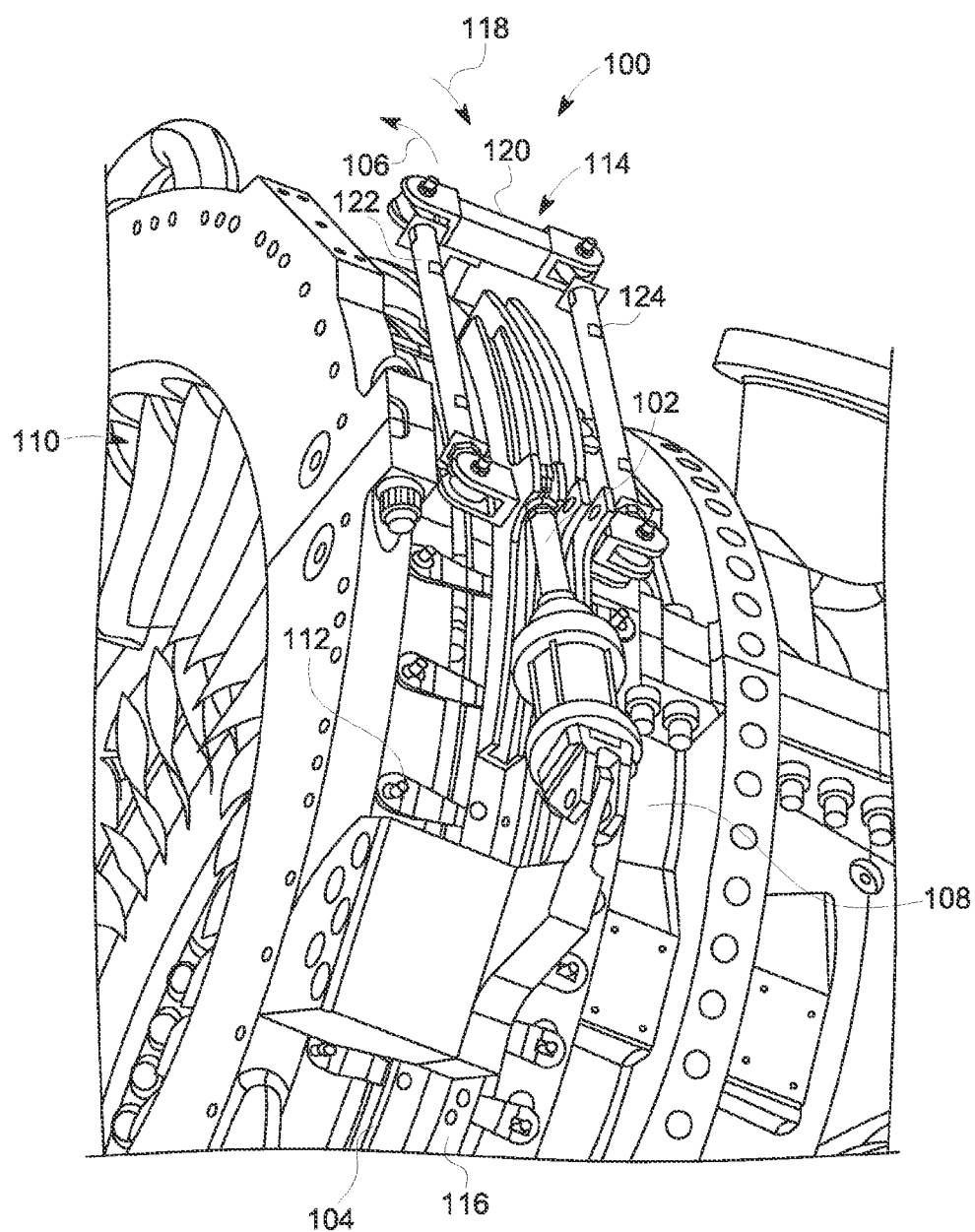


FIG. 4

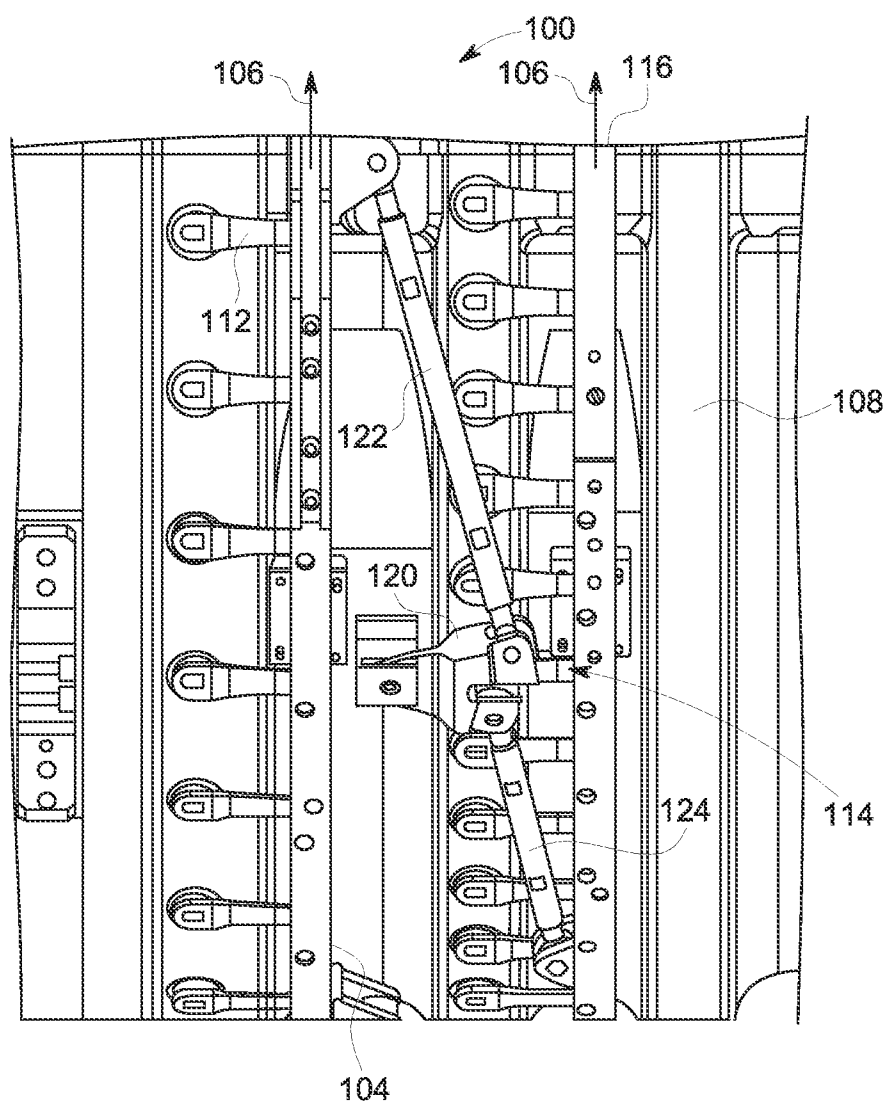


FIG. 5

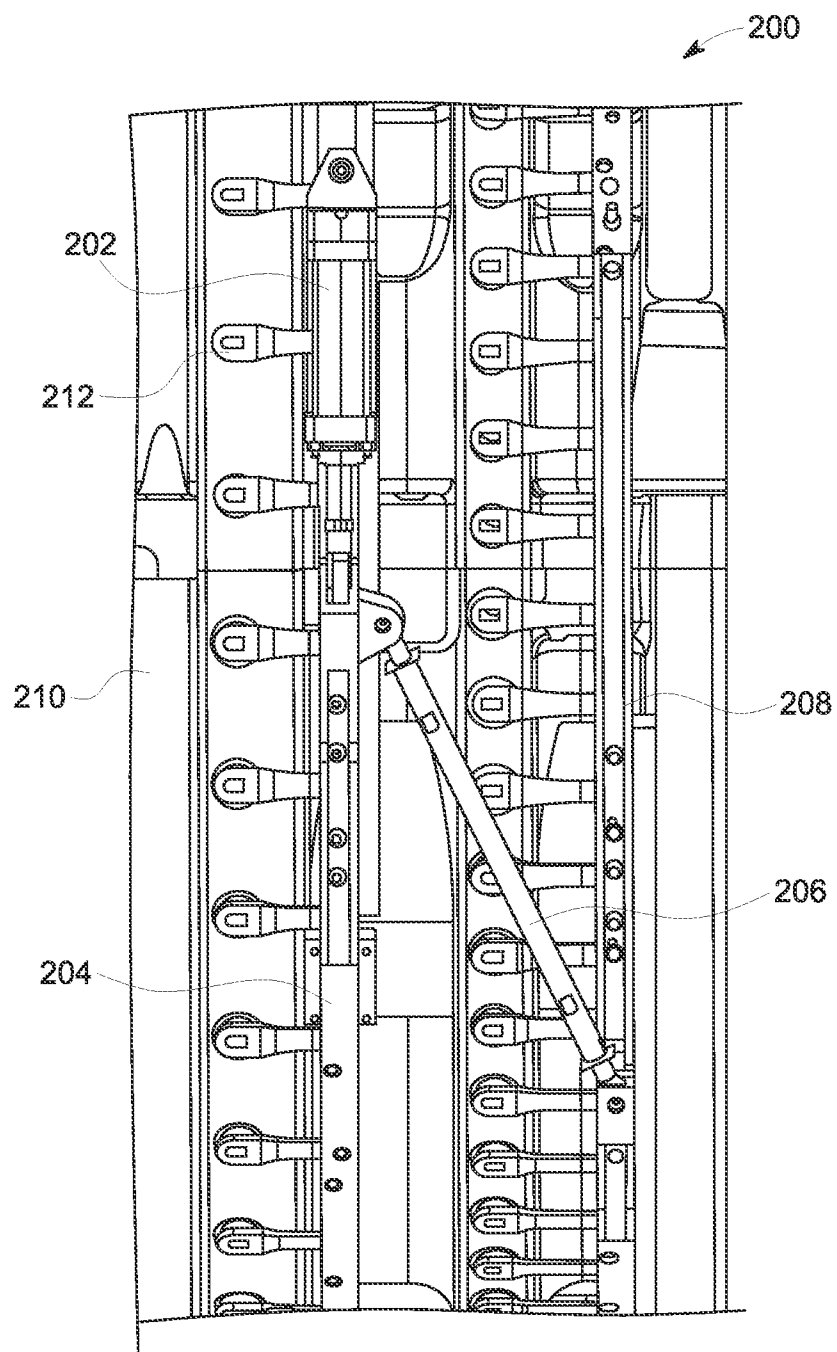


FIG. 6

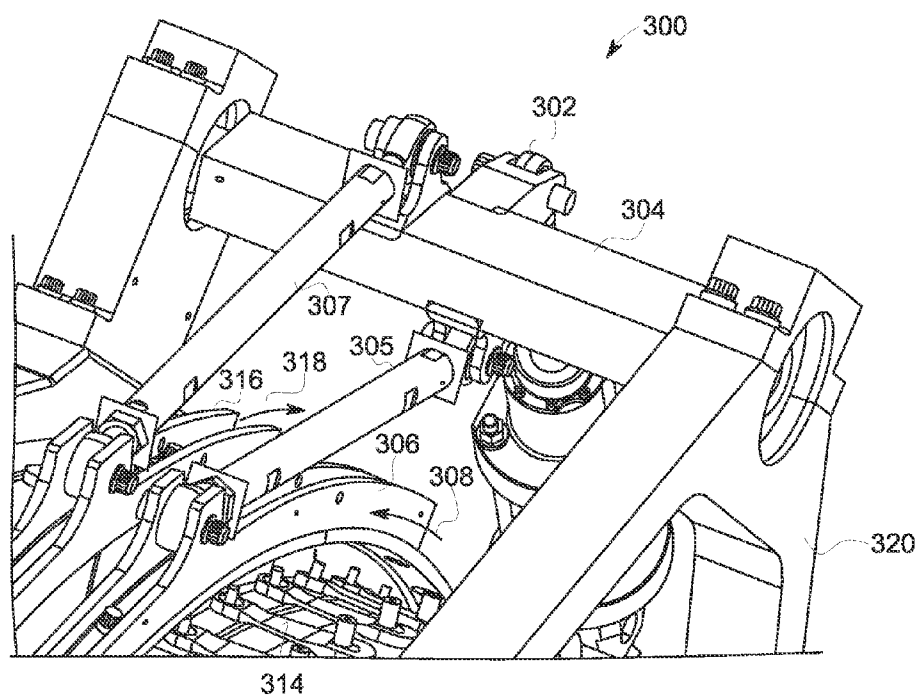


FIG. 7

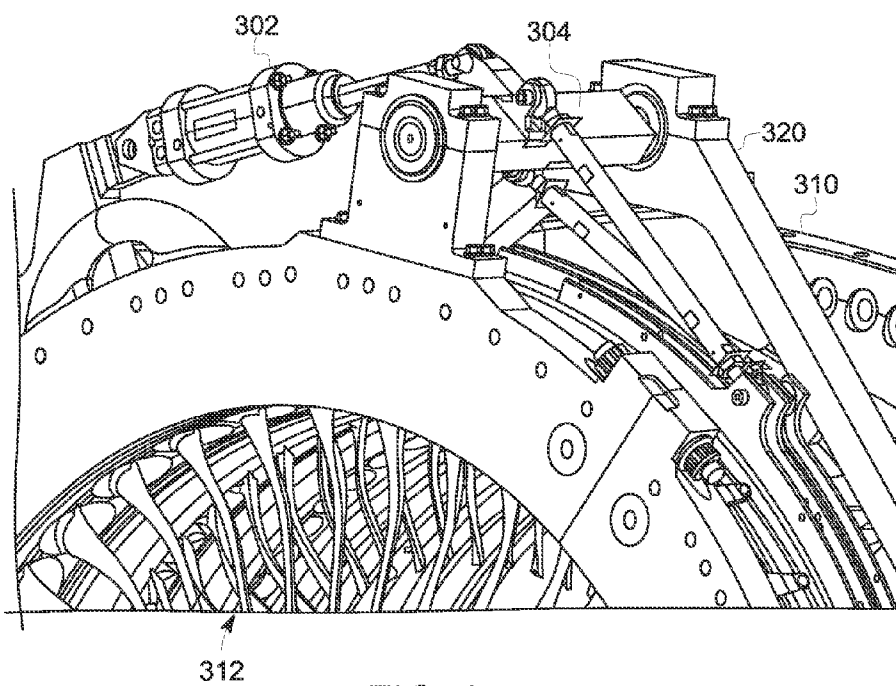


FIG. 8

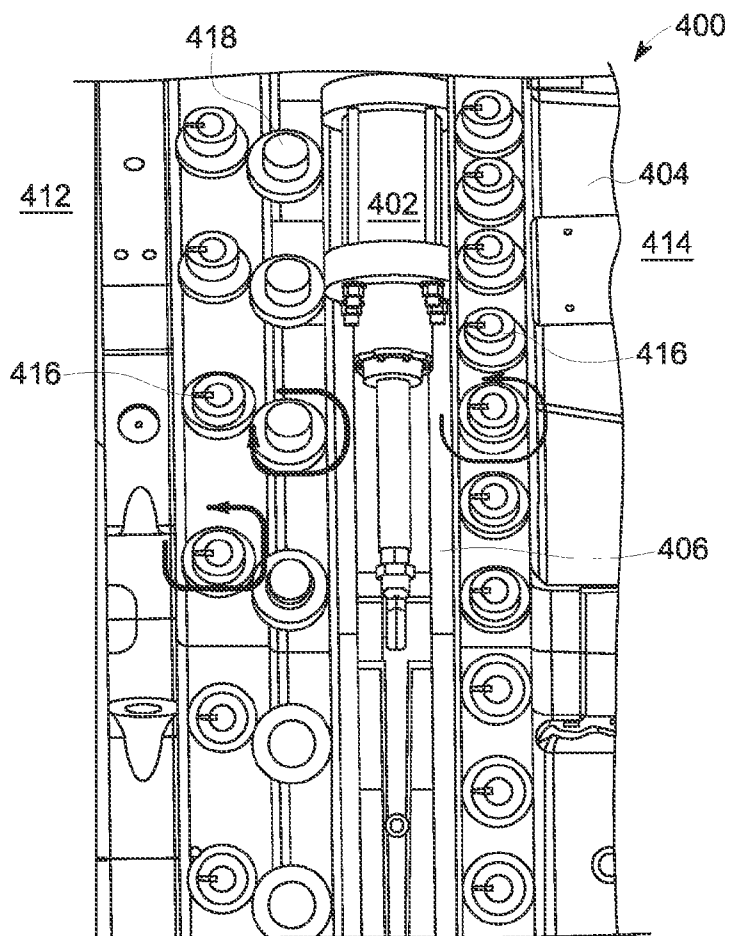


FIG. 9

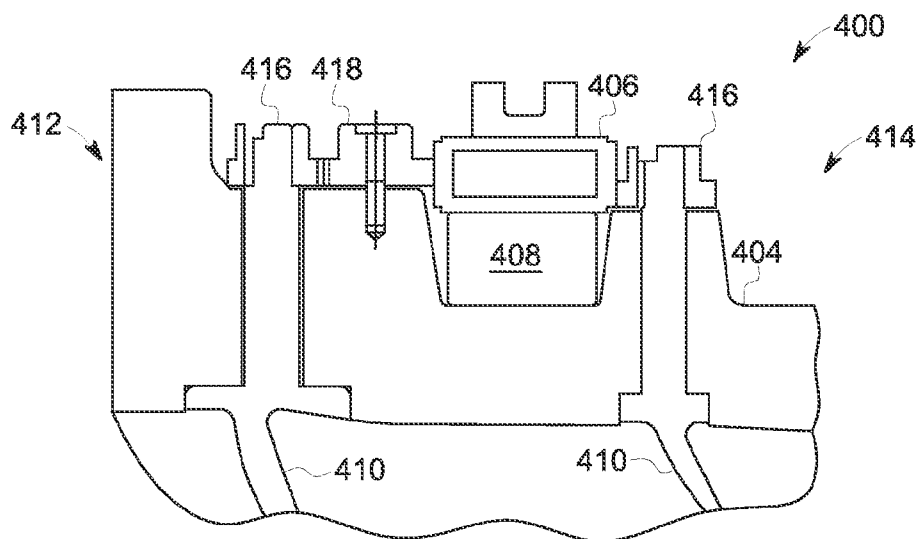


FIG. 10

SYSTEMS AND METHODS TO CONTROL VARIABLE STATOR VANES IN GAS TURBINE ENGINES

FIELD OF THE INVENTION

[0001] Embodiments of the present application relate generally to gas turbine engines and more particularly to systems and methods to control variable stator vanes in gas turbine engines.

BACKGROUND OF THE INVENTION

[0002] During operation of a gas turbine engine using a multi-stage axial compressor, a turbine rotor is turned at high speeds by a turbine so that air is continuously induced into the compressor. The air is accelerated by rotating blades and swept rearwards onto adjacent rows of variable stator vanes. Each rotor blade/variable stator vane stage increases the pressure of the air.

[0003] In addition to translating the kinetic energy of the air into pressure, the variable stator vanes also serve to correct the deflection given to the air by the rotor blades and to present the air at the correct angle to the next stage of rotor blades. Pivoting the variable stator vanes permits the flow capacity of the compressor or turbine to be changed, thereby ensuring that the flow capacity is always at an optimum value for the particular operating conditions of the gas turbine engine. Accordingly, there is a need to control the angle of the variable stator vanes.

BRIEF DESCRIPTION OF THE INVENTION

[0004] Some or all of the above needs and/or problems may be addressed by certain embodiments of the present application. According to one embodiment, there is disclosed a variable stator vanes control mechanism for a gas turbine engine. The control mechanism may include a moveable actuation rod in operative communication with a gear ring such that movement of the actuation rod drives the gear ring. The control mechanism may also include a first plurality of variable stator vanes disposed on a first side of the gear ring. The first plurality of variable stator vanes may include gear stems in operative communication with the gear ring. Moreover, the control mechanism may include a second plurality of variable stator vanes disposed on a second side of the gear ring. The second plurality of variable stator vanes may include gear stems in operative communication with the gear ring.

[0005] According to another embodiment, there is disclosed a method to control variable stator vanes in a gas turbine engine. The method may include actuating a moveable actuation rod in operative communication with a gear ring such that movement of the actuation rod drives the gear ring. The method may also include driving a first plurality of variable stator vanes disposed on a first side of the gear ring. The first plurality of variable stator vanes may include gear stems in operative communication with the gear ring. Moreover, the method may include driving a second plurality of variable stator vanes disposed on a second side of the gear ring. The second plurality of variable stator vanes may include gear stems in operative communication with the gear ring.

[0006] Further, according to another embodiment, there is disclosed a variable stator vanes control mechanism for a gas turbine engine. The gas turbine engine may include a compressor having a compressor casing. The control mechanism

may include a moveable actuation rod in operative communication with a gear ring such that movement of the actuation rod drives the gear ring about the compressor casing. The control mechanism may also include a first plurality of variable stator vanes disposed on a first side of the gear ring. The first plurality of variable stator vanes may include gear stems in operative communication with the gear ring by way of a plurality of respective connecting gears. Moreover, the control mechanism may include a second plurality of variable stator vanes disposed on a second side of the gear ring. The second plurality of variable stator vanes may include gear stems in operative communication with the gear ring. Accordingly, the first plurality of variable stator vanes and the second plurality of variable stator vanes may be in operative communication with the gear ring such that they rotate in similar directions.

[0007] Other embodiments, aspects, and features of the invention will become apparent to those skilled in the art from the following detailed description, the accompanying drawings, and the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] Reference will now be made to the accompanying drawings, which are not necessarily drawn to scale, and wherein:

[0009] FIG. 1 is a schematic of an example diagram of a gas turbine engine with a compressor, a combustor, and a turbine, according to an embodiment.

[0010] FIG. 2 is a schematic of an example portion of a compressor assembly, according to an embodiment.

[0011] FIG. 3 is a perspective view of a portion of a compressor assembly, according to an embodiment.

[0012] FIG. 4 is a perspective view of a portion of a compressor assembly, according to an embodiment.

[0013] FIG. 5 is a perspective view of a portion of a compressor assembly, according to an embodiment.

[0014] FIG. 6 is a perspective view of a portion of a compressor assembly, according to an embodiment.

[0015] FIG. 7 is a perspective view of a portion of a compressor assembly, according to an embodiment.

[0016] FIG. 8 is a perspective view of a portion of a compressor assembly, according to an embodiment.

[0017] FIG. 9 is a perspective view of a portion of a compressor assembly, according to an embodiment.

[0018] FIG. 10 is a perspective view of a portion of a compressor assembly, according to an embodiment.

DETAILED DESCRIPTION OF THE INVENTION

[0019] Illustrative embodiments will now be described more fully hereinafter with reference to the accompanying drawings, in which some, but not all embodiments are shown. The present application may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Like numbers refer to like elements throughout.

[0020] Illustrative embodiments are directed to, among other things, systems and methods to control variable stator vanes in gas turbine engines. FIG. 1 shows a schematic view of a gas turbine engine 10 as may be used herein. As is known, the gas turbine engine 10 may include a compressor 12. The compressor 12 compresses an incoming flow of air 14. The compressor 12 delivers the compressed flow of air 14 to a combustor 16. The combustor 16 mixes the compressed flow

of air 14 with a pressurized flow of fuel 18 and ignites the mixture to create a flow of combustion gases 20. Although only a single combustor 16 is shown, the gas turbine engine 10 may include any number of combustors 16. The flow of combustion gases 20 is in turn delivered to a turbine 22. The flow of combustion gases 20 drives the turbine 22 so as to produce mechanical work. The mechanical work produced in the turbine 22 drives the compressor 12 via a shaft 24 and an external load 26 such as an electrical generator and the like.

[0021] The gas turbine engine 10 may use natural gas, various types of syngas, and/or other types of fuels. The gas turbine engine 10 may be any one of a number of different gas turbine engines offered by General Electric Company of Schenectady, N.Y., including, but not limited to, those such as a 7 or a 9 series heavy duty gas turbine engine and the like. The gas turbine engine 10 may have different configurations and may use other types of components.

[0022] Other types of gas turbine engines also may be used herein. Multiple gas turbine engines, other types of turbines, and other types of power generation equipment also may be used herein together.

[0023] FIG. 2 depicts a section of the compressor 12 of the gas turbine engine 10 of FIG. 1. The compressor 12 includes a tubular casing 28. Sets of variable stator vanes 30 are mounted within the casing 28 circumferentially about the central axis of the compressor 12. Corresponding sets of rotor vanes 32 are mounted downstream of each set of variable stator vanes 30. Each variable stator vane 30 terminates at the casing 28 in a stem 34. The stem 34 is rotatable in a bush bearing 36 on the outside of the casing 28.

[0024] Located externally of the casing 28 and adjacent to each set of variable stator vanes 30 are unison rings 38 extending circumferentially about the casing 28. The vane stems 34 of each set of variable stator vanes 30 are connected to the corresponding unison ring 38 by a respective lever 40. One end of the lever 40 is clamped to the end of the vane stem 34 by a bolt 42 so that there is no relative movement between the stem 34 and the lever 40. The other end of the lever 40 is connected to the unison ring 38 by a pin 44 rotatable in a bush bearing located in the unison ring 38.

[0025] The unison ring 38 is arranged so that it may be rotated about the central axis of the compressor section 12 in either direction of arrow 9. Consequently, rotation of the unison ring 38 causes rotation of each variable stator vane 30 via the levers 40 and thus enables the variable stator vanes 30 to assume required angles of incidence to the incoming air.

[0026] FIGS. 3 and 4 depict an embodiment of a variable stator vanes control mechanism 100. The variable stator vanes control mechanism 100 enables the transfer of motion from one unison ring to another using only one actuator. The variable stator vanes control mechanism 100 may include a moveable actuation rod 102. The moveable actuation rod 102 may be in operative communication with a first unison ring 104 such that movement of the actuation rod 102 drives the first unison ring 104 in a first direction 106 about the central axis of the casing 108. Rotation of the first unison ring 104 causes rotation of each variable stator vane 110 connected to the first unison ring by the levers 112.

[0027] The variable stator vanes control mechanism 100 may also include a bell crank mechanism 114. The bell crank mechanism 114 may be in operative communication with the first unison ring 104. The bell crank mechanism 114 may also be in operative communication with a second unison ring 116 such that movement of the first unison ring 104 in the first

direction 106 translates movement, by way of the bell crank mechanism 114, to the second unison ring 116 in a second direction 118 that is opposite the first direction 106 of the first unison ring 104. Rotation of the second unison ring 116 causes rotation of each variable stator vane 110 connected to the second unison ring 116 by the levers 112.

[0028] Still referring to FIGS. 3 and 4, the bell crank mechanism 114 may include a pivot 120, a first turnbuckle 122, and a second turnbuckle 124. The first turnbuckle 122 operatively connects the first unison ring 104 to the pivot 120. Similarly, the second turnbuckle 124 operatively connects the second unison ring 116 to the pivot 120. The first turnbuckle 122 and the second turnbuckle 124 are attached to the pivot 120 such that rotation of the pivot 120 drives the first turnbuckle 122 and the second turnbuckle 124 in opposite directions.

[0029] In operation, the movable actuator rod 102 actuates the first unison ring 104 thereby rotating the first unison ring 104 in the first direction 106 about the casing 108. As the first unison ring 104 rotates about the casing 108 in the first direction 106, it drives the first turnbuckle 122. The first turnbuckle 122 then applies a pivoting force to the pivot 120. The pivoting of the pivot 120 causes the second turnbuckle 124 to drive the second unison ring 116 thereby causing the second unison ring 116 to rotate in the second direction 118 about the casing 108. In this embodiment, the second direction 118 and the first direction 106 are opposite of each other. The rotation of the first unison ring 104 and the second unison ring 116 causes the respective variable stator vanes 110 attached to each unison ring to rotate in opposite directions due to the movement of the levers 112. Accordingly, the angle of the variable stator vanes 110 may be adjusted with the variable stator vanes control mechanism 100.

[0030] As described above, the first direction 106 and the second direction 118 are relative to each other. Accordingly, the first direction 106 and the second direction 118 may be any direction about the casing 108. Moreover, the moveable actuation rod 102 may be in operative communication with the first unison ring 104, the second unison ring 106, or the bell crank mechanism 114.

[0031] In certain embodiments, the bell crank mechanism 114 may be at least partially secured to the casing 108 of the compressor. In other embodiments, the moveable actuator rod 102 may be at least partially secured to the casing 108 of the compressor. One will appreciate, however, that the bell crank mechanism 114 and the moveable actuator rod 102 may be at least partially secured at any location on or about the gas turbine engine.

[0032] A relative movement between the first unison ring 104 and the second unison ring 116 and the angle of the variable stator vanes 110 may be adjusted by varying the dimensions of the pivot 120, the first turnbuckle 122, and the second turnbuckle 124. Moreover, the angle of the variable stator vanes 110 may be varied by varying the length of the levers 112.

[0033] In an embodiment, as depicted in FIG. 5, the variable stator vanes control mechanism 100 may enable the transfer of motion from one unison ring to another using only one actuator. In this embodiment, however, the first unison ring and the second unison ring may rotate in the same direction. For example, the bell crank mechanism 114 may include a pivot 120, a first turnbuckle 122, and a second turnbuckle 124. The first turnbuckle 122 operatively connects the first unison ring 104 to the pivot 120. Similarly, the second turn-

buckle **124** operatively connects the second unison ring **116** to the pivot **120**. The first turnbuckle **122** and the second turnbuckle **124** may be attached to the pivot **120** such that rotation of the pivot **120** drives the first turnbuckle **122** and the second turnbuckle **124** in the same direction. Accordingly, in operation, the movable actuator rod actuates the first unison ring **104** thereby rotating the first unison ring **104** in a first direction **106** about the casing **108**. As the first unison ring **104** rotates about the casing **108** in the first direction **106**, it drives the first turnbuckle **122**. The first turnbuckle **122** then applies a pivoting force to the pivot **120**. The pivoting of the pivot **120** causes the second turnbuckle **124** to drive the second unison ring **116** thereby causing the second unison ring **116** to rotate in the first direction about the casing **108**. The rotation of the first unison ring **104** and the second unison ring **116** causes the respective variable stator vanes **110** attached to each unison ring to rotate in the same direction due to the movement of the levers **112**.

[0034] The embodiments as depicted in FIGS. 3-5 may include one or more additional unison rings in operative communication with the bell crank mechanism such that movement of the first unison ring in the first direction drives the one or more additional unison rings in the first or second direction respectively.

[0035] FIG. 6 depicts an embodiment of a variable stator vanes control mechanism **200**. The variable stator vanes control mechanism **200** enables the transfer of motion from one unison ring to another using only one actuator. The variable stator vanes control mechanism **200** may include a moveable actuation rod **202** in operative communication with a first unison ring **204**. The moveable actuation rod **202** may actuate the first unison ring **204**. The variable stator vanes control mechanism **200** may also include a linkage **206** in operative communication with the first unison ring **204** and a second unison ring **208** such that movement of the first unison ring **204** drives the second unison ring **208**. This embodiment is similar to the previously described embodiments, except that it does not include the bell crank mechanism. Instead, this embodiment provides a direct linkage **206** between the unison rings **204** and **208**. Accordingly, in this embodiment, the linkage **206** translates movement from the actuated first unison ring **204** to the second unison ring **208** in the same direction. In certain aspects, the linkage **206** may pull the second unison ring **208**. In other aspects, the linkage **206** may push the second unison ring **208**.

[0036] Still referring to FIG. 6, in operation, the movable actuator rod **202** is attached to the casing **210** and actuates the first unison ring **204** thereby rotating the first unison ring **204** about the casing **210**. As the first unison ring **204** rotates about the casing **210**, it drives the linkage **206**. The linkage **206** may be a turnbuckle. The linkage **206** then applies a force to the second unison ring **208** thereby causing the second unison ring **208** to rotate about the casing **210**. In this embodiment, the first unison ring **204** and the second unison ring **206** rotate in the same direction about the casing **210**. The rotation of the first unison ring **204** and the second unison ring **206** causes the respective variable stator vanes attached to each unison ring by way of the respective levers **212** to rotate. Accordingly, the angle of the variable stator vanes may be adjusted with the variable stator vanes control mechanism **200**.

[0037] The embodiment as depicted in FIG. 6 may include one or more additional unison rings in operative communication with one or more additional linkages such that move-

ment of the first unison ring in the first direction drives the one or more additional unison rings respectively.

[0038] FIGS. 7 and 8 depict an embodiment of a variable stator vanes control mechanism **300**. The variable stator vanes control mechanism **300** enables the actuation of multiple unison rings using only one actuator. The variable stator vanes control mechanism **300** may include a moveable actuation rod **302**. The moveable actuation rod **302** may be in operative communication with a torque shaft **304** such that the movable actuation rod **302** rotates the torque shaft **304**. A first unison ring **306** may be in operative communication with the torque shaft **304** via a turnbuckle **305** such that rotation of the torque shaft **304** drives the first unison ring **306** in a first direction **308** about a central axis of the casing **310**. Rotation of the first unison ring **306** causes rotation of each variable stator vane **312** connected to the first unison **306** ring by the levers **314**. Similarly, a second unison ring **316** may be in operative communication with the torque shaft **304** via a turnbuckle **307** such that rotation of the torque shaft **304** drives the second unison ring **316** in a second direction **318** about the central axis of the casing **310**. Rotation of the second unison ring **316** causes rotation of each variable stator vane **312** connected to the second unison **316** ring by the levers **314**.

[0039] As described above, the first direction **308** and the second direction **318** are relative. The first direction **308** and the second direction **318** may be the same direction or different directions about the casing **310**. For example, in embodiments where the first direction and the second direction are the same, the turnbuckles **305** and **307** may be attached on the same side of the torque shaft. Conversely, in embodiments where the first direction and the second direction are different, the turnbuckles **305** and **307** may be attached on opposite sides of the torque shaft. The first direction **308** and the second direction **318** may be any direction about the casing **310**. Moreover, the moveable actuation rod **302** may be in operative communication with the first unison ring **306**, the second unison ring **316**, or the torque shaft **304**.

[0040] In operation, the movable actuator rod **302** is attached to the casing **310** and actuates the torque shaft **304** thereby rotating the torque shaft **304**. The turnbuckle **305** connects the first unison ring **306** to the torque shaft **304**, and the turnbuckle **307** connects the second unison ring **316** to the torque shaft **304**. As the torque shaft **304** rotates, the turnbuckles **305** and **307** drive the first unison ring **306** and the second unison ring **316** about the compressor casing **310**. The rotation of the first unison ring **306** and the second unison ring **316** causes the respective variable stator vanes attached to each unison ring by the respective levers **314** to rotate. Accordingly, the angle of the variable stator vanes may be adjusted with the variable stator vanes control mechanism **300**. One will appreciate that one or more additional unison rings may be in communication with the torque shaft by one or more respective turnbuckles.

[0041] In certain embodiments, the moveable actuator rod **302** may be at least partially secured to the casing **310** of the compressor. One will appreciate, however, that the moveable actuator rod **302** may be at least partially secured at any location on or about the gas turbine engine. Moreover, the torque shaft **304** may be rotatably supported about the casing **310** of the compressor by a support structure **320**. The support structure **320** may be any configuration that facilitates the rotation of the torque shaft about the compressor casing **310**.

[0042] FIGS. 9 and 10 depict an embodiment of a variable stator vanes control mechanism 400. The variable stator vanes control mechanism 400 enables the actuation of two variable stator vanes stages using only one actuator and a system of gears. The actuator engages the gear system which engages the two stages of variable stator vanes thereby adjusting the variable stator vanes.

[0043] The variable stator vanes control mechanism 400 may include a moveable actuation rod 402. The moveable actuation rod 402 may be attached to the casing 404 or any other location on or about the gas turbine engine. The moveable actuation rod 402 may also be attached to a gear ring 406. The gear ring 406 may be disposed about the compressor casing 404 such that the gear ring 406 rotates about the compressor casing 404 when actuated by the moveable actuation rod 402. A rub block 408 may be disposed between the casing 404 and the gear ring 406 to facilitate smooth rotation of the gear ring 406 about the casing 404.

[0044] A number of variable stator vanes 410 may be disposed on a first side 412 and a second side 414 of the gear ring 406. The variable stator vanes 410 form a first compressor stage and a second compressor stage respectively on each side of the gear ring 406. The variable stator vanes 410 may include gear stems 416. The gear stems 416 may be in operative communication with the gear ring 406.

[0045] In operation, the moveable actuation rod 402 is attached to the casing 404 and actuates the gear ring 406 thereby rotating the gear ring 406 about the casing 404. The gear stems 416 of the variable stator vanes 410 are in operative communication with the gear ring 406 such that as the gear ring 406 rotates about the casing 404, the gear stems 416 of the variable stator vanes 410 are rotated. The rotation of the gear stems 416 adjusts the angle of the variable stator vanes 410.

[0046] In certain embodiments, the rotation of the variable stator vanes 410 may be controlled by the addition of gears or gear train type mechanisms operatively disposed between the gear stems and the gear ring. For example, as depicted in FIGS. 9 and 10, additional gears 418 are operatively disposed between the gear ring 406 and the respective gear stems 416 of the first compressor stage. The addition of additional gears 418 enables the first compressor stage of variable stator vanes and the second compressor stage of variable stator vanes to rotate in the same direction. In contrast, if the gear stems 416 of the variable stator vanes 410 were in direct communication with the gear ring 406, the variable stator vanes 410 would rotate in opposite directions.

[0047] One will appreciate that any number of additional gears or gear train type mechanisms may be operatively disposed between the gear ring and the gear stems to facilitate a desired rotation. Moreover, the gear ratio and the number of gear teeth may be adjusted to control the schedule between variable stator vane stages.

[0048] Although embodiments have been described in language specific to structural features and/or methodological acts, it is to be understood that the disclosure is not necessarily limited to the specific features or acts described. Rather, the specific features and acts are disclosed as illustrative forms of implementing the embodiments.

That which is claimed:

1. A variable stator vanes control mechanism for a gas turbine engine, comprising:

- a gear ring;
- a moveable actuation rod in operative communication with the gear ring such that movement of the actuation rod drives the gear ring;
- a first plurality of variable stator vanes disposed on a first side of the gear ring, the first plurality of variable stator vanes comprising a first plurality of respective gear stems in operative communication with the gear ring; and
- a second plurality of variable stator vanes disposed on a second side of the gear ring, the second plurality of variable stator vanes comprising a second plurality of respective gear stems in operative communication with the gear ring.

2. The control mechanism of claim 1, wherein the first plurality of variable stator vanes is in operative communication with the gear ring by way of a gear train.

3. The control mechanism of claim 1, wherein the second plurality of variable stator vanes is in operative communication with the gear ring by way of a gear train.

4. The control mechanism of claim 1, wherein the first plurality of variable stator vanes and the second plurality of variable stator vanes are in operative communication with the gear ring such that they rotate in similar directions.

5. The control mechanism of claim 1, wherein the first plurality of variable stator vanes and the second plurality of variable stator vanes are in operative communication with the gear ring such that they rotate in opposite directions.

6. The control mechanism of claim 1, wherein the gear ring is disposed about a rub block.

7. The control mechanism of claim 1, wherein the gear ratio is adjusted to control the schedule between variable stator vane stages.

8. The control mechanism of claim 1, wherein the number of teeth on the gears is adjusted to control the schedule between variable stator vane stages.

9. The control mechanism of claim 1, wherein the moveable actuator rod is at least partially secured to a casing of a compressor.

10. The control mechanism of claim 1, wherein the moveable actuator drives at least two variable stator vane stages.

11. A method to control variable stator vanes in a gas turbine engine, comprising:

- actuating a moveable actuation rod in operative communication with a gear ring such that movement of the actuation rod drives the gear ring;

- driving a first plurality of variable stator vanes disposed on a first side of the gear ring, the first plurality of variable stator vanes comprising a first plurality of respective gear stems in operative communication with the gear ring; and

- driving a second plurality of variable stator vanes disposed on a second side of the gear ring, the second plurality of variable stator vanes comprising a second plurality of respective gear stems in operative communication with the gear ring.

12. The method of claim 11, further comprising:

- rotating the first plurality of variable stator vanes and the second plurality of variable stator vanes are in similar directions.

13. The method of claim 11, further comprising:

- rotating the first plurality of variable stator vanes and the second plurality of variable stator vanes are in opposite directions.

14. The method of claim **11**, further comprising:
adjusting the gear ratio and the number of gear teeth to
control the schedule between variable stator vane stages.

15. A variable stator vanes control mechanism for a gas turbine engine, comprising:
a compressor having a compressor casing;
a gear ring disposed about the compressor casing;
a moveable actuation rod in operative communication with the gear ring such that movement of the actuation rod drives the gear ring about the compressor casing;
a first plurality of variable stator vanes disposed on a first side of the gear ring, the first plurality of variable stator vanes comprising a first plurality of respective gear stems in operative communication with the gear ring by way of a plurality of respective connecting gears; and
a second plurality of variable stator vanes disposed on a second side of the gear ring, the second plurality of variable stator vanes comprising a second plurality of respective gear stems in operative communication with the gear ring;

wherein the first plurality of variable stator vanes and the second plurality of variable stator vanes are in operative communication with the gear ring such that they rotate in similar directions.

16. The control mechanism of claim **15**, wherein the gear ring is disposed about a rub block.

17. The control mechanism of claim **15**, wherein the gear ratio is adjusted to control the schedule between variable stator vane stages.

18. The control mechanism of claim **15**, wherein the moveable actuator rod is at least partially secured to a casing of a compressor.

19. The control mechanism of claim **15**, wherein the moveable actuator rod drives at least two variable stator vane stages.

20. The control mechanism of claim **15**, wherein the number of teeth on the gears is adjusted to control the schedule between variable stator vane stages

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