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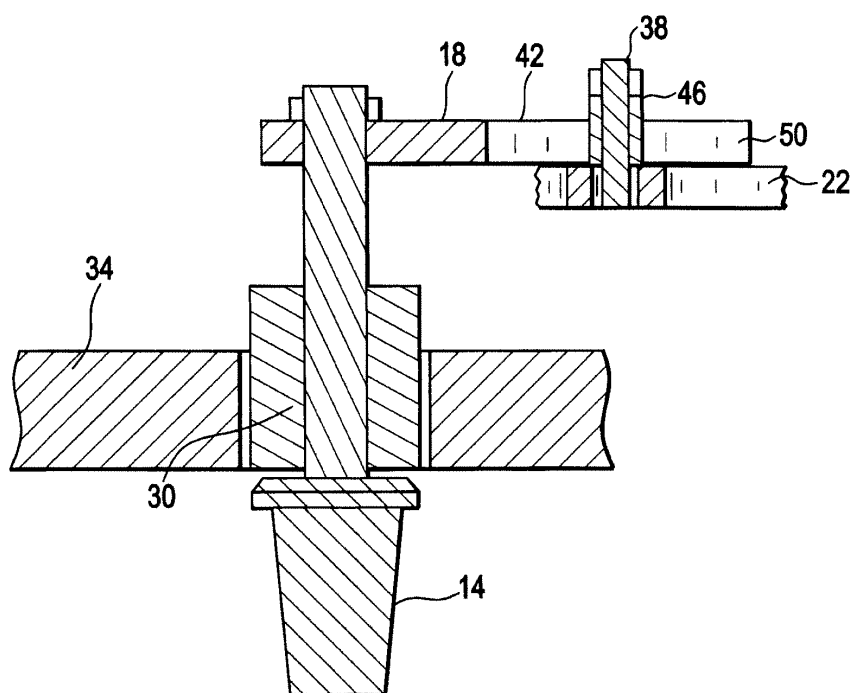
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(54) **Variable position guide vane actuation system and method**

(57) Disclosed herein is a turbine variable position guide vane actuation system (10). The system (10) includes, a plurality of variable position guide vanes (14), a plurality of actuators (18) and each actuator (18) is in

operable communication with one of the plurality of variable position guide vanes (14), and at least one structure (22) in operable communication with a plurality of the plurality of actuators (18) and movable parallel to an axis of the turbine (26).

FIG. 2



Description

BACK GROUND OF THE INVENTION

[0001] The disclosed invention relates to a system and method for actuating variable position guide vanes in a turbine engine. More specifically the invention relates to actuating the variable position guide vanes by moving a structure in operable communication with a plurality of the variable position guide vanes.

[0002] Aerodynamic efficiency of the vanes of a turbine engine is an important factor in the overall operational efficiency of the engine. Operators rotate the vanes in an attempt to improve the aerodynamic performance at different power settings of the turbine. Systems and methods to improve precision and control of rotation of the multitude of vanes in a turbine engine is of value to operators in the industry.

BRIEF DESCRIPTION OF THE INVENTION

[0003] Disclosed herein is a turbine variable position guide vane actuation system. The system includes, a plurality of variable position guide vanes, a plurality of actuators and each actuator is in operable communication with one of the plurality of variable position guide vanes, and at least one structure in operable communication with a plurality of the plurality of actuators and movable parallel to an axis of the turbine.

[0004] Further disclosed herein is a method of actuating a plurality of turbine variable position guide vanes. The method includes, moving a structure in a direction parallel to an axis of a turbine and rotating a plurality of turbine variable position guide vanes in operable communication with the structure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] The following descriptions should not be considered limiting in any way. With reference to the accompanying drawings, like elements are numbered alike. In the drawings:

FIG. 1 depicts a partial perspective view of a turbine variable position guide vane actuation system disclosed herein;

FIG. 2 depicts a cross sectional view of a portion of the turbine variable position guide vane actuation system of FIG. 1 taken along arrows 2-2;

FIG. 3 depicts a partial perspective view of an alternate variable position guide vane actuation system disclosed herein; and

FIG. 4 depicts a partial perspective view of another alternate variable position guide vane actuation system disclosed herein.

DETAILED DESCRIPTION OF THE INVENTION

[0006] A detailed description of one or more embodiments of the disclosed apparatus and method are presented herein by way of exemplification and not limitation with reference to the Figures.

[0007] Turbine engines, such as, gas turbine engines for power generation, for example, have stationary guide vanes and rotating guide vanes. Compressed air flows past both types of guide vanes during operation of the turbine. Performance of the turbine can vary depending upon, among other things, angles of the stationary guide vanes. During different operating conditions, however, different guide vane angles may be preferred. As such, having guide vanes, wherein angles of the vanes are variable, has benefits to the turbine operator. Systems and methods for adjusting the variable guide vanes are described in detail below.

[0008] Referring to FIG. 1, an embodiment of a turbine variable position guide vane actuation system 10 disclosed herein is illustrated. The system 10 includes, a plurality of variable position guide vanes 14 with an actuator 18, depicted herein as a lever, attached to each one of the variable position guide vanes 14, and at least one structure 22, depicted herein as a plate, engaged with a plurality of the levers 18. The plate 22 is configured to be moved in a direction parallel to an axis of the turbine 26 to cause rotational motion of each of the levers 18, engaged therewith, and consequently to rotate the variable position guide vanes 14 attached thereto.

[0009] Referring to FIG. 2, a cross sectional view through one of the variable position guide vanes 14, the lever 18 and the plate 22, of FIG. 1, along arrows 2-2, is shown. A bearing 30 rotationally mounts each of the variable position guide vanes 14 to a casing 34 of the turbine 26. A pin 38 extends from each of the levers 18 to engage with a slot 42 of the plate 22. Optionally, a sleeve 46 can be rotationally engaged with each of the pins 38 to reduce frictional engagement between the pins 38 and walls 50 of the slots 42.

[0010] By moving the plates 22 parallel to an axis of the turbine 26, the lateral or radial instability (as the case may be), that occurs in typical systems that have the plate 22 move circumferentially with respect to the turbine 26, can be reduced. In addition to decreasing friction between the sleeve 46 and the plate 22, in comparison to typical systems, embodiments disclosed herein can more easily control the precision of the rotational motion of the variable position guide vanes 14. This ease of control is due to a reduced offset between the linear motion of the plate 22 and the rotational motion of the variable position guide vanes 14, as compared to a circumferential motion of a plate. This control precision can be maintained in alternate embodiments as will be described below.

[0011] Referring to FIG. 3, an alternate embodiment of a turbine variable position guide vane actuation system 210 with a plate 222 disclosed herein is illustrated. Unlike

the plate 22 shown above that functionally engages with just a few levers 18, the plate 222 forms a ring perimet-
rically around a significant portion of the turbine 26. In
fact, the plate 222 can be a continuous ring that encircles
the casing 34 and actuates all of the levers 18, or be
segmented to actuate any selected number of levers 18
desired. For assembly and removal purposes splitting
the plate 222 into at least two portions, with each encir-
cling approximately half of the casing 34, may be advan-
tageous.

[0012] Referring to FIG. 4, yet another alternate em-
bodiment of a turbine variable position guide vane actua-
tion system 310 with plates 322 disclosed herein is il-
lustrated. The plates 322 are a variation of the structures
22. The plates 322 are configured to actuate levers 18
on multiple stages simultaneously. The plates 322, ac-
tuate variable position guide vanes 14 from different stag-
es 312A, 312B and 312C of the turbine 26.

[0013] Such a "ganged" system can significantly sim-
plify the linkages required to actuate a multitude of the
variable position guide vanes 14 at once. Two or more
stages can be "ganged" together forming one or more
"gangs," for example. This variation of the "ganged" sys-
tem can also be used for the plates 222.

[0014] While the invention has been described with ref-
erence to an exemplary embodiment or embodiments, it
will be understood by those skilled in the art that various
changes may be made and equivalents may be substi-
tuted for elements thereof without departing from the
scope of the invention. In addition, many modifications
may be made to adapt a particular situation or material
to the teachings of the invention without departing from
the essential scope thereof. Therefore, it is intended that
the invention not be limited to the particular embodiment
disclosed as the best mode contemplated for carrying
out this invention, but that the invention will include all
embodiments falling within the scope of the claims. Also,
in the drawings and the description, there have been dis-
closed exemplary embodiments of the invention and, al-
though specific terms may have been employed, they
are unless otherwise stated used in a generic and de-
scriptive sense only and not for purposes of limitation,
the scope of the invention therefore not being so limited.
Moreover, the use of the terms first, second, etc. do not
denote any order or importance, but rather the terms first,
second, etc. are used to distinguish one element from
another. Furthermore, the use of the terms a, an, etc. do
not denote a limitation of quantity, but rather denote the
presence of at least one of the referenced item.

Claims

1. A turbine variable position guide vane actuation sys-
tem (10), comprising:

a plurality of variable position guide vanes (14);
a plurality of actuators (18) with each actuator

(18) being in operable communication with one
of the plurality of variable position guide vanes
(14); and

at least one structure (22) in operable commu-
nication with a plurality of the plurality of actua-
tors (18) being movable parallel to an axis of the
turbine (26).

2. The turbine variable position guide vane actuation
system (10) of claim 1, wherein the at least one struc-
ture (22) includes a plurality of pins (38), each pin
(38) being in operable communication with an actua-
tor (18).
3. The turbine variable position guide vane actuation
system (10) of claim 2, wherein each pin (38) has a
sleeve (46) rotationally mounted thereto.
4. The turbine variable position guide vane actuation
system (10) of claim 2 or claim 3, wherein each of
the plurality of actuators (18) includes a slot (42) re-
ceptive of one of the plurality of pins (38).
5. The turbine variable position guide vane actuation
system (10) of any preceding claim, wherein the at
least one structure (22) is arcuate shaped and is sub-
stantially concentric with a casing (34) of the turbine
(26).
6. The turbine variable position guide vane actuation
system (10) of any preceding claim, wherein move-
ment of the at least one structure (22) in a direction
parallel to an axis of the turbine (26) causes rotation
of each of the actuators (18) in operable communi-
cation therewith.
7. The turbine variable position guide vane actuation
system (10) of claim 6, wherein rotation of each of
the actuators (18) causes rotation of one of the var-
iable position guide vanes (14) in operable commu-
nication therewith.
8. The turbine variable position guide vane actuation
system (10) of any preceding claim, wherein the plu-
rality of actuators (18) are a plurality of levers.
9. The turbine variable position guide vane actuation
system (10) of any preceding claim, wherein the at
least one structure (22) is at least one plate.
10. The turbine variable position guide vane actuation
system (10) of any preceding claim, wherein the plu-
rality of variable position guide vanes (14) are from
more than one stage (312A-C) of the turbine (26).
11. The turbine variable position guide vane actuation
system (10) of any preceding claim, wherein a plu-
rality of actuators (18) in operable communication

with one of the at least one structure (22) are in operable communication with variable position guide vanes (14) from more than one stage (312A-C) of the turbine.

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- 12.** A method of actuating a plurality of turbine variable position guide vanes (14), comprising:

moving a structure (22) in a direction parallel to an axis of a turbine (26); and
rotating a plurality of turbine variable position guide vanes (14) in operable communication with the structure (22).

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- 13.** The method of actuating a plurality of turbine variable position guide vanes of claim 12, further comprising:

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rotating a plurality of actuators (18) in operable communication with the structure (22); and
rotating the plurality of turbine variable position guide vanes (14) in operable communication with the plurality of actuators (18).

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FIG. 1

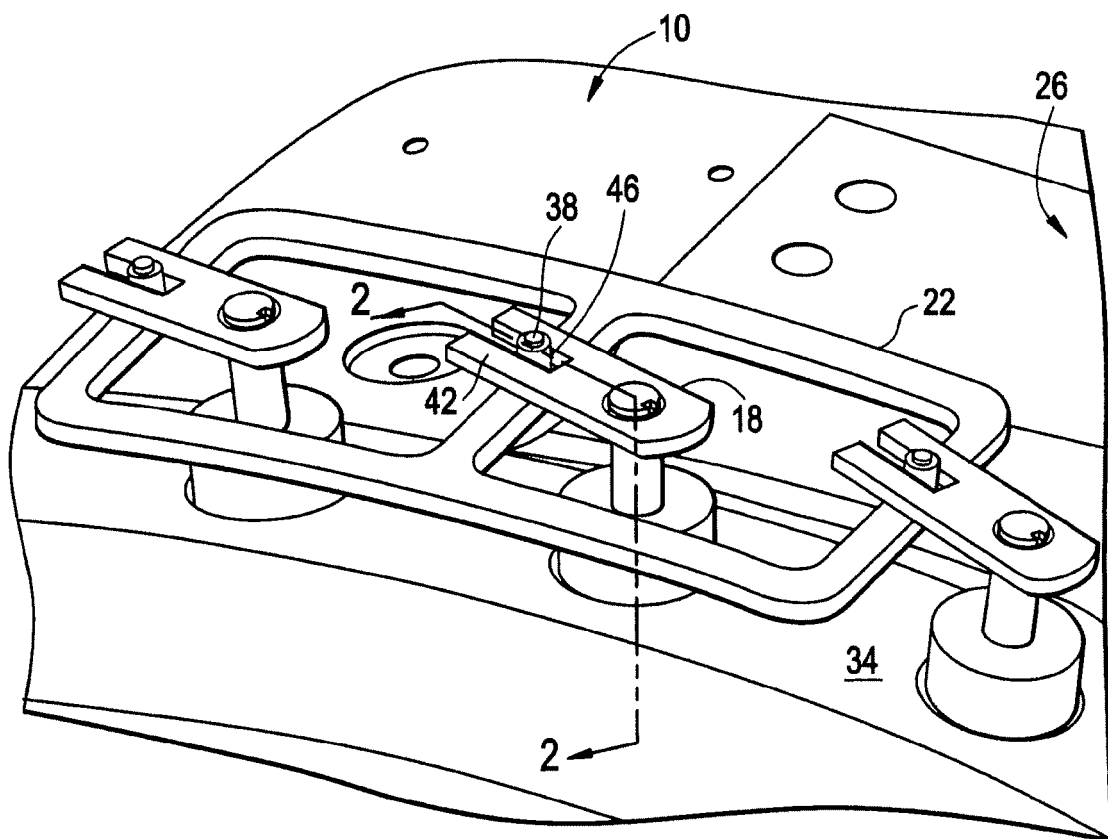


FIG. 2

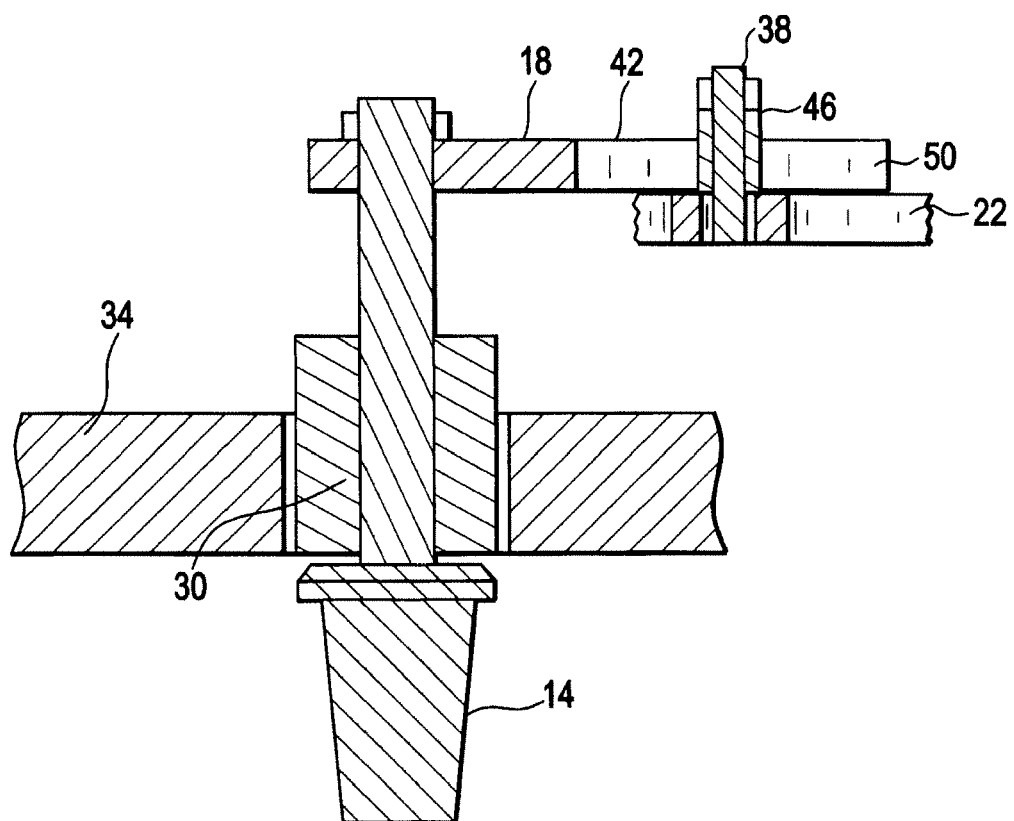


FIG. 3

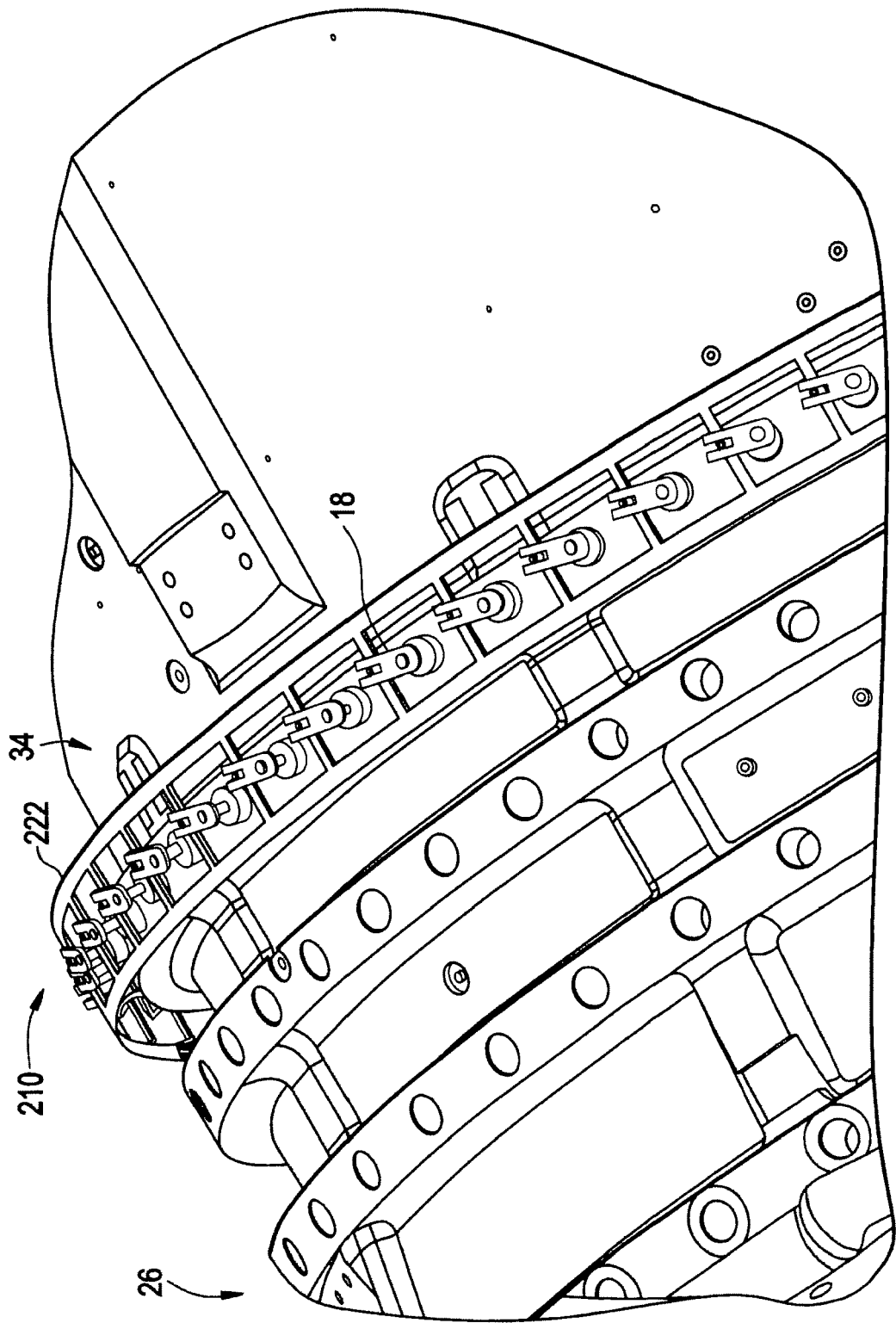


FIG. 4

