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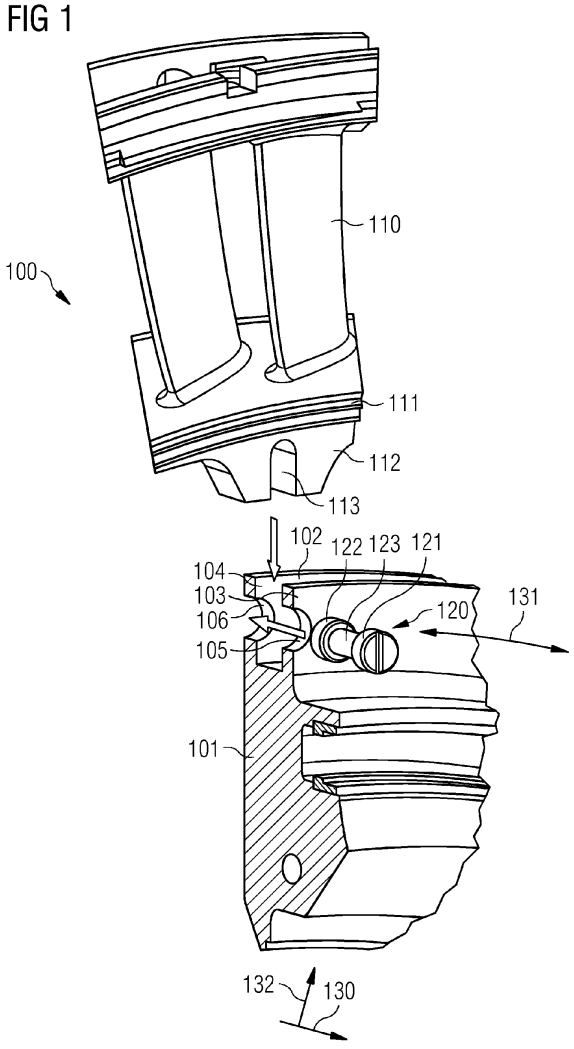
(71) Applicant: **Siemens Aktiengesellschaft**
80333 München (DE)

(72) Inventors:
- **Jenkinson, Paul**
  LN1 2FF Lincoln (GB)
- **McKenna, Mike**
  Newark, NG241GL (GB)

(54) Eccentric diaphragm adjusting pins for a gas turbine engine

(57) The present invention relates to a stator stage (100) for a gas turbine and a method of adjusting a relative position between a vane segment (110) and a centre section (101) of the stator stage. A groove (102) is formed between a first rim (103) and a second rim (104) of a radially outer edge of the centre section, wherein the groove, the first rim and the second rim run along a circumferential direction (131). The vane segment comprises a radially inner shroud (111) from which a protrusion (112) protrudes radially inwards. The protrusion is inserted into the groove. An adjusting pin (120) comprises a first end section (121), a second end section (122) and an eccentric section (123) which runs between the first end section and the second end section. The first end section is coupled to the first rim, the second end section is coupled to the second rim and the eccentric section is coupled to the protrusion such that by pivoting the adjusting pin the relative position between the vane segment and the centre section is adjustable.

FIG 1



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Description

Field of invention

[0001] The present invention relates to a stator stage for a gas turbine and to a method of adjusting a vane segment of a stator stage for a gas turbine with respect to a centre section of the stator stage.

Art Background

[0002] A gas turbine comprises stator stages and rotor stages. The stator stages are located adjacent to rotor stages. In order to provide a proper sealing of the stator stage between a high pressure side and a low pressure side which are divided by the stator stage, the central section, in particular the static diaphragm, of the stator stage should accurately be located relative to the rotating components, i.e. the turbine shaft and the adjacent rotor stages. Moreover, the supporting elements of the central section should also allow a relative radial expansion while maintaining an accurate circumferential location. Furthermore, a proper balancing of the axial loads caused by the pressure differential across the stator stage should be achieved.

[0003] The central section of a stator stage may be adjusted by key blocks and dowels that are drilled and fixed to the stator stage assembly. First of all, the central section is aligned to a vane section of a stator stage and after aligning a through hole is drilled through key blocks at the overlapping portions of the central section and the vane section. Next, a dowel is fixed into the through hole in order to fix the relative position between the central section and the vane section.

[0004] US 3,647,311 discloses a turbine interstage seal assembly. In order to adjust welded segments of a vane section an eccentric bushing is fixed to a radial slot, wherein a cylindrical bold may be inserted in the eccentric bushing for adjusting the welded segments.

[0005] US 3,529,904 discloses a diaphragm sealed structure. A sealed support arrangement for a bladed diaphragm of a gas turbine comprises a seal housing ring which is supported from diaphragm segments by radially movable keys for permitting a relative radial motion between the diaphragm segments and the seal assembly while maintaining the seal concentric with a shaft of the gas turbine. Centering of the seal housing ring is accomplished by utilizing integral guided keys and pins together with an adjustable eccentric bushing.

[0006] US 4,863,342 discloses a gas turbine with a fixed guide vane ring and a sealing ring which cooperates with a sealing member of a turbine rotor. The sealing ring is connected to the guide vane ring through a number of links which are suitable orientated in a substantially tangential direction. By the attachment of the sealing ring with link means, a centering of the sealing ring relative to the rotor is achieved, in particular if the guide vane ring expands relative to the sealing ring.

[0007] US 4,890,978 discloses a method and an apparatus for a vane segment support and alignment in a combustion turbine. A vane segment alignment device comprises a rotatable eccentric bushing and a pin which is inserted into a slot of the vane segment. The eccentric bushing further comprises a cover plate which is peen to the cover plate thus holding the eccentric bushing in place against the vane segment but allowing an adjustment of the vane segments.

[0008] US 5,141,394 discloses an apparatus and a method for supporting a vane segment in a gas turbine. The vane segments are mounted to an inner cylinder of the gas turbine. A plate comprising threaded holes is fixed to the inner cylinder. A threaded plug having an eccentric hole is threaded into each threaded hole in the plate. A pin is inserted into the eccentric hole in the plug.

[0009] US 5,921,749 discloses a vane segment support and alignment assembly for supporting and aligning a vane segment. A plate defines an opening for receiving an eccentric pin and a locking end member for receiving a lock socket member.

[0010] US 5,772,401 discloses a diaphragm construction for a turbo machinery, wherein a particular method of manufacturing a split diaphragm for use in turbo machinery is described.

Summary of the Invention

[0011] It may be an objective of the present invention to provide a more effective adjustment of a diaphragm to a stator stage with respect to a rotary axis of the gas turbine.

[0012] This objective is solved by a stator stage for a gas turbine and by a method of adjusting a vane segment of a stator stage for a gas turbine with respect to a centre section of the stator stage according to the independent claims.

[0013] According to a first aspect of the present invention a stator stage for a gas turbine is presented. The stator stage comprises a centre section, a vane segment and at least an adjusting pin. The centre section comprises a center hole in which a rotary axis of the gas turbine is inserted. A groove is formed between a first rim and a second rim of a radial outer edge of the centre section. The groove, the first rim and the second rim run along the circumferential direction.

[0014] The vane segment is mountable to a housing of the turbine. The vane segment comprises a radially inner shroud from which a protrusion protrudes radially inwards. The protrusion is inserted into the groove.

[0015] The adjusting pin comprises a first end section, a second end section and an eccentric section formed between the first end section and the second end section. The eccentric section is eccentric with respect to a symmetry line of both, the first end section and the second end section. The first end section is coupled to the first rim, the second end section is coupled to the second rim and the eccentric section is coupled to the protrusion

such that a relative position between the vane segment and the centre section is adjustable by pivoting the adjusting pin.

[0016] According to a further aspect, the method of adjusting a vane segment of a stator stage for a gas turbine with respect to a centre section of the stator stage is presented. According to the method, a protrusion of the vane segment is inserted into a groove of the centre section. The centre section comprises a center hole in which a rotary shaft of the gas turbine is insertable. The groove is formed between a first rim and a second rim of a radially outer edge of the centre section. The groove, the first rim and the second rim run along a circumferential direction, wherein the vane segment is mountable to a housing of the turbine. The vane segment comprises a radially inner shroud from which the protrusion protrudes radially inwards.

[0017] Furthermore, according to the method, a relative position between the vane segment and the centre section is adjusted by pivoting an adjusting pin. The adjusting pin comprises a first end section, a second end section and an eccentric section formed between the first end section and the second end section. The eccentric section is eccentric with respect to a symmetry axis of both, the first end section and the second end section. The first end section is coupled to the first rim, the second end section is coupled to the second rim and the eccentric section is coupled to the protrusion.

[0018] In the following, an axial direction describes a direction which is parallel to a rotary axis of the turbine shaft of the gas turbine. A radial direction describes a direction which runs through a center point of the rotary axis of the turbine shaft and which is perpendicular to the rotary axis. The circumferential direction describes the direction running around the rotary axis, wherein at a crossing of the circumferential direction with the radial direction, the circumferential direction is perpendicular to the radial direction.

[0019] The stator stage is generally located at a downstream location of a rotary stage of the gas turbine. The rotor stage comprises rotating blades, wherein the stator stage comprises vanes, which guides a fluid streaming along a main flow direction of the gas turbine. The vane segment may comprise one, two or a plurality of vanes. Along the circumferential direction, a plurality of sub vane sections may be attached adjacent to each other and form together the annular vane segment of the stator stage.

[0020] The centre section (diaphragm section), the turbine shaft of the gas turbine and the inner shroud of the vane segment separate an upstream region of the gas turbine (comprising a higher pressure) from a downstream region of the gas turbine (comprising a lower pressure). Alternatively, the centre section (diaphragm section), the turbine shaft of the gas turbine and the inner shroud of the vane segment separate an upstream region of a compressor section of the gas turbine (comprising a lower pressure) from a downstream region of the compressor section of the gas turbine (comprising a higher pressure). The centre section comprises the center hole. The turbine shaft of the gas turbine is insertable through the center hole. The radially inner surface of the center hole is either in slidable contact with the turbine shaft or comprises sealing elements which seals a gap between the radially inner surface and the turbine shaft for sealing purposes. In order to provide a proper sealing, the centre section has to be adjusted properly with respect to the turbine shaft. Preferably, the centre section is aligned with respect to the turbine shaft in such a way that a center point of the center hole is located onto the rotary axis of the turbine shaft. In other words, the centre section is adjusted preferably in such a way that the centre section is concentric with the rotary axis of the turbine shaft. The centre section is supported and fixed to the vane segment which is again fixed to the housing of the gas turbine. Hence, the relative position between the turbine shaft and the centre section is adjusted by adjusting the relative position between the centre section and the vane segment by the adjusting pin.

[0021] The vane segment is mountable in particular with the radially outer edge to the housing of the gas turbine. At the radially inner end of the vane segment, the inner shroud is formed which runs in particular along the circumferential direction. The protrusion, such as a plug or tenon, extends radially inwards along the radial direction from the inner shroud.

[0022] At a radially outer end of the centre section the radially outer edge is formed which comprises a first rim and a second rim between of which a groove is formed. Between the first rim and the second rim, the protrusion of the vane segment is fited.

[0023] The adjusting pin comprises the first end section and the second end section, wherein the first and second end sections may comprise a larger diameter than the eccentric section. The first end section and the second end section comprise a first symmetry axis, wherein the eccentric section comprises a second symmetry axis. The first symmetry axis and the second symmetry axis are substantially parallel, wherein the first symmetry axis and the second symmetry axis are spaced about from each other by a predefined distance i.e. along the radial direction.

[0024] Hence, by rotating the adjusting pin, the vane segment which is supported by the eccentric section, is relocated with respect to the centre section at which the first end section and the second end section are supported. By supporting the first end section and the second end section within both, the first rim and the second rim of the centre segment, a very robust adjusting pin is provided, e.g. in comparison to an eccentric pin which comprises a free end along its rotational access. Hence, an adjustable and robust connection between the centre section and the vane segment is achieved. Hence, due to the robust adjusting pin, further supporting elements, such as keys inside the groove for supporting the adjusting pin, may be obsolete. Hence, an easier assembly and

a proper adjusting of a centre section with respect to the vane segment is achieved.

[0025] Furthermore, the use of the above described eccentric adjusting pin allows an adjustment of the centre section along its radial location, if the centre section is already mounted to the vane segment. For example, in contrary to conventional approaches, it is not longer necessary to compensate manufacturing tolerances by machining the components when the centre section is already mounted to the vane segment. Hence, there is no need to clean the assembled stator stage in order to remove debris. Additionally, this also allows assembling and installing the stator stage inside a clean room environment. Moreover, because the need of key blocks inside the groove is obsolete, the amount of parts is also reduced and thus the overall weight and the overall costs.

[0026] According to a further aspect of the present invention, the protrusion comprises a further through hole in which the adjusting pin is insertable in such a way that the vane segment rests onto the eccentric section of the adjusting pin.

[0027] According to a further exemplary embodiment, the protrusion comprises a slot in which the adjusting pin is insertable in such a way that the vane segment rests onto the eccentric section of the adjusting pin. The through hole or the slot may be formed with respect to the eccentric section in such a way that e.g. a form fitting, in particular a press fitting or a closure fitting connection, may be provided. Alternatively, the through hole or the slots may be formed with respect to the eccentric section such that a play is provided. Hence, manufacturing tolerances may be cleared.

[0028] According to a further exemplary embodiment, the first rim and/or the second rim comprise(s) a further slot in which the adjusting pin is insertable in such a way that the respective first end section and/or the respective second end section rests onto the respective first rim and/or the respective second rim of the centre section.

[0029] According to a further exemplary embodiment, the first rim and/or the second rim comprise(s) a through hole in which the adjusting pin is insertable in such a way that the respective first end section and/or the respective second end section rest(s) onto the respective first rim and/or the respective second rim of the centre section.

[0030] In particular, according to a further exemplary embodiment, the first end section and/or the second end section form(s) a press fit connection or transition fit connection with the respective through hole of the respective first rim and/or the respective second rim.

[0031] Hence, by providing a press fit connection of the respective end sections of the adjusting pin with the respective through holes or slots of the respective rims, a fixation and a locking of the adjusting pin against e.g. unintended readjusting is provided.

[0032] Alternatively, a closure fit of the respective end sections of the adjusting pin with the respective through hole or slots of the respective rims may be provided, so that manufacturing tolerances of the vane segment and/or the centre section may be cleared.

[0033] In particular, the bore hole and/or the further slot of the protrusion and/or the slot or the through hole of the first and second rim may comprise an extending direction of its symmetry lines which is generally parallel with the axial direction.

[0034] Additionally or alternatively, the first end section and/or the second end section may form at the respective first and second rim a screw connection.

[0035] For example, the respective through hole may comprise a thread and the first and/or second end section may comprise an external male screw thread which fits into the thread of the respective through hole. In a further exemplary embodiment, the bore hole of the protrusion may comprise an inner thread and the eccentric section may comprise a screw thread which may fit into the thread of the bore hole.

[0036] According to a further exemplary embodiment, the first end section and/or the second end section comprises a coupling section, in particular a screw slot, for coupling an adjusting tool to the adjusting pin. The coupling section may comprise a screw slot, a cross slot or a square drive, for example. The coupling section may preferably be formed at a front face of the adjusting pin, wherein the front face runs along a plane which normal is parallel to a rotating access of the adjusting pin.

[0037] The adjusting tool may be for instance a screw driver which comprises an engaging section that fits into the respective coupling section. Hence, by screwing and thus pivoting the adjusting pin, the relative position between the centre section and the vane segment is adjusted.

[0038] According to a further exemplary embodiment, the stator stage comprises a safety element, in particular a safety screw or a split pin, for securing the adjusting pin against unintentional adjusting. The first end section and/or the second end section comprise a through hole into which the safety element is insertable.

[0039] The safety element is for example a split pin which may be inserted into a through hole of the respective first end section and/or second end section. The safety element extends from the respective first end section and second end section and blocks the adjusting pin from being pulled off from the centre section. If a removing of the adjusting pin is intended, the safety element has to be removed in order to unblock a movement of the adjusting pin through the through holes or slots of the respective first and second rim.

[0040] According to a further exemplary embodiment, the stator stage comprises a further adjusting pin. Furthermore, a further protrusion protrudes radially inwards from the inner shroud. The further protrusion is spaced along the circumferential direction from the protrusion, wherein the further protrusion is inserted into the groove. The further adjusting pin comprise a further first end section, a further second end section and a further eccentric section formed between the first end section and the second end section. The further eccentric section is eccen-

trically in respect to the first end section and the further second end section. The further first end section is coupled to the first rim, the further second end section is coupled to the second rim and the further eccentric section is coupled to the further protrusion such that by pivoting the further adjusting pin a relative position between the vane segment and the centre section is adjustable.

[0041] In particular, according to a further exemplary embodiment, the plurality of further adjusting pins are comprised by a stator stage. Furthermore, a plurality of further protrusions may protrude radially inward from the inner shroud, wherein the further protrusions are spaced from each other along the circumferential direction. A respective one of the plurality of adjusting pins is coupled to a respective one of the plurality of further protrusions.

[0042] By the above described exemplary embodiment, a stator stage is presented by which the relative position between the centre section and the vane segment is adjustable by the plurality of adjusting pins that are distributed along the circumferential direction.

[0043] In particular, each adjusting pin defines a radial line which runs between the adjusting pin and the center point of the turbine shaft. Such a radial line between an adjusting pin and the centre point comprises for example an angle to an adjacent radial line between an adjacent adjusting pin and the centre point of approximately 90° degree. Alternatively, each radial line may comprise an angle to an adjacent radial line for example of 45°, 30° or 60° degree. With other words, along an annual run of the groove of the central section 2, 4, 6, 8, 10, 12 or more through holes in the respective rims and respective protrusions formed at the inner shroud are provided, wherein respectively fixable adjusting pins may be attached.

[0044] According to a further exemplary embodiment of the method, as a first step the first end section of the adjusting pin and the second end section of the adjusting pin are coupled to the respective first rim and the respective second rim. Subsequently, the protrusion of the vane segment is inserted into the groove of the centre section. Further subsequently, the relative position between the vane segment and the centre section is adjusted by pivoting the adjusting pin. Hence, only a few steps are necessary to mount and adjust a centre section to a vane section, or vice versa. Hence, an efficient mounting and adjusting method for assembling a turbine may be achieved.

[0045] Summarizing, by the present invention, the centre section is supported and adjusted by e.g. an array of adjusting pins, which couples the vane segment with the centre section. For example, at least three adjusting pins are mountable at annular spaced locations to the respective first and second rims of the central section and to the respective protrusions in order to control the required degrees of freedom. Additionally, more than three adjusting pins may be applied, for example for structural purposes. Additionally, a plurality of concentric pins may be mounted to the respective rims of the centre section and respective protrusions of the vane segment between the adjusting pins to improve the structural stability of the connection between the centre section and the vane segment.

[0046] It has to be noted that embodiments of the invention have been described with reference to different subject matters. In particular, some embodiments have been described with reference to apparatus type claims whereas other embodiments have been described with reference to method type claims. However, a person skilled in the art will gather from the above and the following description that, unless otherwise notified, in addition to any combination of features belonging to one type of subject matter also any combination between features relating to different subject matters, in particular between features of the apparatus type claims and features of the method type claims is considered as to be disclosed with this application.

Brief Description of the Drawings

[0047] The aspects defined above and further aspects of the present invention are apparent from the examples of embodiment to be described hereinafter and are explained with reference to the examples of embodiment. The invention will be described in more detail hereinafter with reference to examples of embodiment but to which the invention is not limited.

Fig. 1 shows a schematical view of a stator stage for a gas turbine and of a method of adjusting a vane segment to a centre section according to an exemplary embodiment of the present invention;

Fig. 2 shows a schematical view of the stator stage according to an exemplary embodiment of the present invention;

Fig. 3 shows a schematical view of the adjusting pin according to an exemplary embodiment of the present invention;

Fig. 4 shows a schematical view of the adjusting pin comprising a coupling section according to an exemplary embodiment of the present invention;

Fig. 5 shows a schematical view of a stator stage comprising the adjusting pin which is secured by a split pin, according to an exemplary embodiment of the present invention; and

Fig. 6 shows a front view of the stator stage according to an exemplary embodiment of the present invention.

Detailed Description

[0048] The illustrations in the drawings are schematical. It is noted that in different figures, similar or identical

elements are provided with the same reference signs.

[0049] Fig. 1 shows a stator stage 100 for a gas turbine. The stator stage 100 comprises a centre section 101, a vane segment 110 and an adjusting pin 120.

[0050] The centre section 101 comprises a center hole in which a turbine shaft 601 (shown in Fig. 6) of the gas turbine is insertable. A groove 102 is formed between the first rim 103 and the second rim 104 of a radially outer edge of the centre section 101. The groove 102, the first rim 103 and the second rim 104 run along a circumferential direction 131.

[0051] The vane segment 110 is mountable to a housing 200 (shown in Fig. 2) of the gas turbine. The vane segment 110 comprises a radially inner shroud 111 - or an inner platform of the vane segment 110 - from which a protrusion 112 protrudes radially inwards. The protrusion 112 is inserted into the groove 102.

[0052] The adjusting pin 120 comprises a first end section 121, a second end section 122 and an eccentric section 123 which run(s) between the first end section 121 and the second end section 122. The eccentric section 123 is eccentric with respect to the first end section 121 and the second end section 122.

[0053] The first end section 121 is coupled to the first rim 103, the second end section 122 is coupled to the second rim 104 and the eccentric section 123 is coupled to the protrusion 112, such that the relative position between the vane segment 110 and the centre section 101 is adjustable by pivoting the adjusting pin 120.

[0054] The inner shroud 111 may be a radially inner band or ground plate which runs along the circumferential direction 131, wherein from the inner shroud 111 the protrusion 112 of the vane segment 110 extends along a radially inwardly directed radial direction 132.

[0055] As shown in Fig. 1, the protrusion 112 comprises a slot 113, wherein the slot is formed through the protrusion 112 along the axial direction 130 of the turbine shaft.

[0056] The adjusting pin 120 is fixed with a first end section 121 to a first through hole 105 of the first rim 103 and with a second end section 122 to a second through hole 106 of the second rim 104. The first through hole 105 and the second through hole 106 are concentrically along the axial direction 130. The center axis (symmetry axis) of the eccentric section 123 is parallel but spaced from a centre axis (symmetry axis) of the first end section 121 and the second end section 122. The first end section 121 and the second end section 122 are fixed to the respective through holes 105, 106 e.g. by a press fit connection or a clearance fit connection.

[0057] Furthermore as shown in Fig. 1, the method of adjusting the vane segment 110 of the stator stage 100 to the centre section 101 of the stator stage 100 is shown. As indicated by the bold arrows, first of all the first end section 121 of the adjusting pin 120 is coupled to the first rim 103 and the second end section 122 of the adjusting pin 120 is coupled to the second rim 104.

[0058] Subsequently, the vane segment 110 is inserted with its protrusion 112 into the groove 102 of the centre section 101. Hence, the centre section 101 is supported by the adjusting pin 120.

[0059] Finally, the relative position between the vane segment 110 and the centre section 101 is adjusted by pivoting/rotating the adjusting pin 120.

[0060] Fig. 2 shows the stator stage 100. As shown in Fig. 2, the vane segment 110 is fixed to the housing 200 of the gas turbine. The centre section 101 is fixed to the vane segment 110 by the adjusting pin 120. Besides the adjusting pin 120 further concentrical pins may be additionally added to the stator stage 100 in order to restrain the support of the centre section 101 to the vane segment 110.

[0061] Fig. 3 shows a more detailed view of the adjusting pin 120. The adjusting pin 120 comprises the first end section 121, the second end section 122 and the eccentric section 123. As shown in Fig. 3, the first end section 121 and the second end section 122 comprise a common center axis 302 (symmetry axis). The eccentric section 123 comprises a further center axis 303 (symmetry axis) which is parallel to the center axis 302 of the first and second end sections 121, 122, wherein the further center axis 303 is spaced by a predefined distance e from the center axis 302. Hence, because the centre section 101 is coupled to the end sections 121, 122 and the vane segment 110 is coupled to the eccentric section 123, a pivoting of the adjusting pin 120 adjusts the relative position between the centre section 101 and the vane segment 110.

[0062] Moreover, as shown in Fig. 3, the adjusting pin 120 is formed in a dumbbell shape, i.e. the diameters of the first end section 121 and the second end section 122 are larger than the diameter of the eccentric section 123. Furthermore, to the first end section 121 through holes 301 are formed through which a safety element, such as a split pin 501 (as shown in Fig. 5) may be installed in order to safe the adjusting pin 120 against unintentional adjusting or removing.

[0063] A coupling section, such as a screw slot 401 (as shown in Fig. 4), may be formed to a front surface 304 of the second end section 122.

[0064] Fig. 4 shows the coupling section which is formed by a screw slot 401 inside the front surface 304. An adjusting tool, such as a screw driver, may be coupled to the screw slot 401 in order to pivot the adjusting pin 120.

[0065] Fig. 5 shows a further view of the stator stage 100, wherein the adjusting pin 120 is shown in an assembled and adjusted state. The adjusting pin 120 is fixed by its first and second end sections 121, 122 to the centre section 101. The vane segment 110 is coupled to the eccentric section 123 of the adjusting pin 120. In order to prevent an unintentional adjustment and pivoting of the adjusting pin 120, a split pin 501 as safety element is inserted into a further through hole 301 at the first end section 121. Hence, the adjusting pin 120 is secured from being unintentionally removed from the stator stage 100.

Furthermore, in order to prevent an unintentionally pivoting of the adjusting pin 120, the split pin 501 is inserted additionally in a further through hole which is formed into the first rim 103, for example. Hence, a relative pivoting between the adjusting pin 120 and the centre section 101 and hence with respect to the vane segment 110 is prevented.

[0066] Fig. 6 shows a front view of the stator stage 100. In particular, the centre hole of the centre section 101 is shown in Fig. 6, through which centre hole the turbine shaft 601 is guided. The turbine shaft 601 defines the rotary axis 130. The centre section 101 and/or the vane segment 110 may be separated into two half sections or into four quarter sections, for example. The vane segment 110 may comprise an annular shape and runs along the circumferential direction 131 all around the centre section 101. Furthermore, the vane segment 110 may be built by a plurality of sub vane segments which forms together the annular vane segment 110 as shown in Fig. 6.

[0067] Generally as shown in Fig. 6, the stator stage 100 may be formed of an upper half and a lower half. Each half comprises three adjusting pins 120, 601. By applying at least three adjusting pins 120, 601 to each half of the stator segment 100, each half is adjustable along the required degrees of freedom (as indicated by the arrows). For example each half of the stator stage 100 may be adjusted along the vertical and a horizontal direction as indicated by the arrows in Fig. 6.

[0068] After adjusting the relative position of the centre section 101 with respect to the vane segment 110, a plurality of concentrical pins 602 may be attached in order to fix and support the centre section 101 to the vane segment 110.

[0069] It should be noted that the term "comprising" does not exclude other elements or steps and "a" or "an" does not exclude a plurality. Also elements described in association with different embodiments may be combined. It should also be noted that reference signs in the claims should not be construed as limiting the scope of the claims.

Claims

1. Stator stage (100) for a gas turbine, the stator stage (100) comprising
   a centre section (101) comprising a centre hole in which a turbine shaft of the gas turbine is insertable,
   wherein a groove (102) is formed between a first rim (103) and a second rim (104) of a radially outer edge of the centre section (101), and
   wherein the groove (102), the first rim (103) and the second rim (104) run along a circumferential direction (131),
   a vane segment (110) which is mountable to a housing (200) of the gas turbine,
   wherein the vane segment (110) comprises a radially inner shroud (111) from which a protrusion (112) protrudes radially inwards,
   wherein the protrusion (112) is inserted into the groove (102), and
   an adjusting pin (120),
   wherein the adjusting pin (120) comprises a first end section (121), a second end section (122) and an eccentric section (123) formed between the first end section (121) and the second end section (122),
   wherein the eccentric section (123) is eccentric with respect to a symmetry axis of both the first end section (121) and the second end section (122), and
   wherein the first end section (121) is coupled to the first rim (103), the second end section (122) is coupled to the second rim (104) and the eccentric section (123) is coupled to the protrusion (112) such that by pivoting the adjusting pin (120) a relative position between the vane segment (110) and the centre section (101) is adjustable.

2. Stator stage (100) according to claim 1,
   wherein the protrusion (112) comprises a bore hole in which the adjusting pin (120) is insertable in such a way that the vane segment (110) is coupled to the eccentric section (123) of the adjusting pin (120).

3. Stator stage (100) according to claim 1,
   wherein the protrusion (112) comprises a slot (113) in which the adjusting pin (120) is insertable in such a way that the vane segment (110) is coupled to the eccentric section (123) of the adjusting pin (120).

4. Stator stage (100) according to one of the claims 1 to 3,
   wherein the first rim (103) and/or the second rim (104) comprise a further slot in which the adjusting pin (120) is insertable in such a way that the respective first end section (121) and/or the respective second end section (122) is coupled to the respective first rim (103) and/or the respective second rim (104) of the centre section (101).

5. Stator stage (100) according to one of the claims 1 to 4,
   wherein the first rim (103) and/or the second rim (104) comprise a through hole (104; 105) in which the adjusting pin (120) is insertable in such a way that the respective first end section (121) and/or the respective second end section (122) is coupled to the respective first rim (103) and/or the respective second rim (104) of the centre section (101).

6. Stator stage (100) according to claim 5,
   wherein the first end section (121) and/or the second end section (122) form a press fit connection with the respective through hole (104; 105) of the respective first rim (103) and/or the respective second rim (104).

7. Stator stage (100) according to one of the claims 1 to 6,
wherein the first end section (121) and/or the second end section (122) comprise a coupling section, in particular a screw slot (401), for coupling an adjusting tool to the adjusting pin (120).

8. Stator stage (100) according to one of the claims 1 to 7, further comprising
a safety element, in particular a split pin (501), for securing the adjusting pin (120) against unintentional readjusting,
wherein the first end section (121) and/or the second end section (122) comprise a through hole (301) into which the safety element is insertable.

9. Stator stage (100) according to one of the claims 1 to 8, further comprising
a further adjusting pin (620),
wherein a further protrusion (112) protrudes radially inwards from the inner shroud (111),
wherein the further protrusion (112) is spaced along the circumferential direction (131) from the protrusion (112), wherein the further protrusion (112) is inserted into the groove (102),
wherein the further adjusting pin (620) comprises a further first end section (121), a further second end section (122) and a further eccentric section (123) formed between the first end section (121) and the second end section (122), wherein the further eccentric section (123) is eccentric with respect to a further symmetry axis of both, the further first end section (121) and the further second end section (122), and
wherein the further first end section (121) is coupled to the first rim (103), the further second end section (122) is coupled to the second rim (104) and the further eccentric section (123) is coupled to the further protrusion (112) such that by pivoting the further adjusting pin (620) a relative position between the vane segment (110) and the centre section (101) is adjustable.

10. Stator stage (100) according to claim 9,
further comprising
a plurality of further adjusting pins (620),
wherein a plurality of further protrusions (112) protrudes radially inwards from the inner shroud (111),
wherein the further protrusions (112) are spaced from each other along the circumferential direction (131),
wherein to each of the plurality of further protrusions (112) a respective one of the plurality of adjusting pins (120) is coupleable.

11. Method of adjusting a vane segment (110) of a stator stage (100) for a gas turbine with respect to a centre section (101) of the stator stage (100), the method comprising
inserting a protrusion (112) of the vane segment (110) into a groove (102) of the centre section (101), wherein the centre section (101) comprises a centre hole in which a turbine shaft of the gas turbine is insertable, wherein the groove (102) is formed between a first rim (103) and a second rim (104) of a radially outer edge of the centre section (101), and wherein the groove (102), the first rim (103) and the second rim (104) run along a circumferential direction (131), wherein the vane segment (110) is mountable to a housing (200) of the turbine,
wherein the vane segment (110) comprises a radially inner shroud (111) from which the protrusion (112) protrudes radially inwards, and
adjusting a relative position between the vane segment (110) and the centre section (101) by pivoting an adjusting pin (120),
wherein the adjusting pin (120) comprises a first end section (121), a second end section (122) and an eccentric section (123) formed between the first end section (121) and the second end section (122),
wherein the eccentric section (123) is eccentric with respect to a symmetry axis of both, the first end section (121) and the second end section (122), and
wherein the first end section (121) is coupled to the first rim (103), the second end section (122) is coupled to the second rim (104) and the eccentric section (123) is coupled to the protrusion (112).

12. Method according to claim 11,
wherein the method further comprises, at first, coupling the first end section (121) of the adjusting pin (120) the first rim (103) and the second end section (122) of the adjusting pin (120) to the second rim (104), subsequently
inserting the protrusion (112) of the vane segment (110) into the groove (102) of the centre section (101), and further subsequently
adjusting the relative position between the vane segment (110) and the centre section (101) by pivoting the adjusting pin (120).

FIG 1

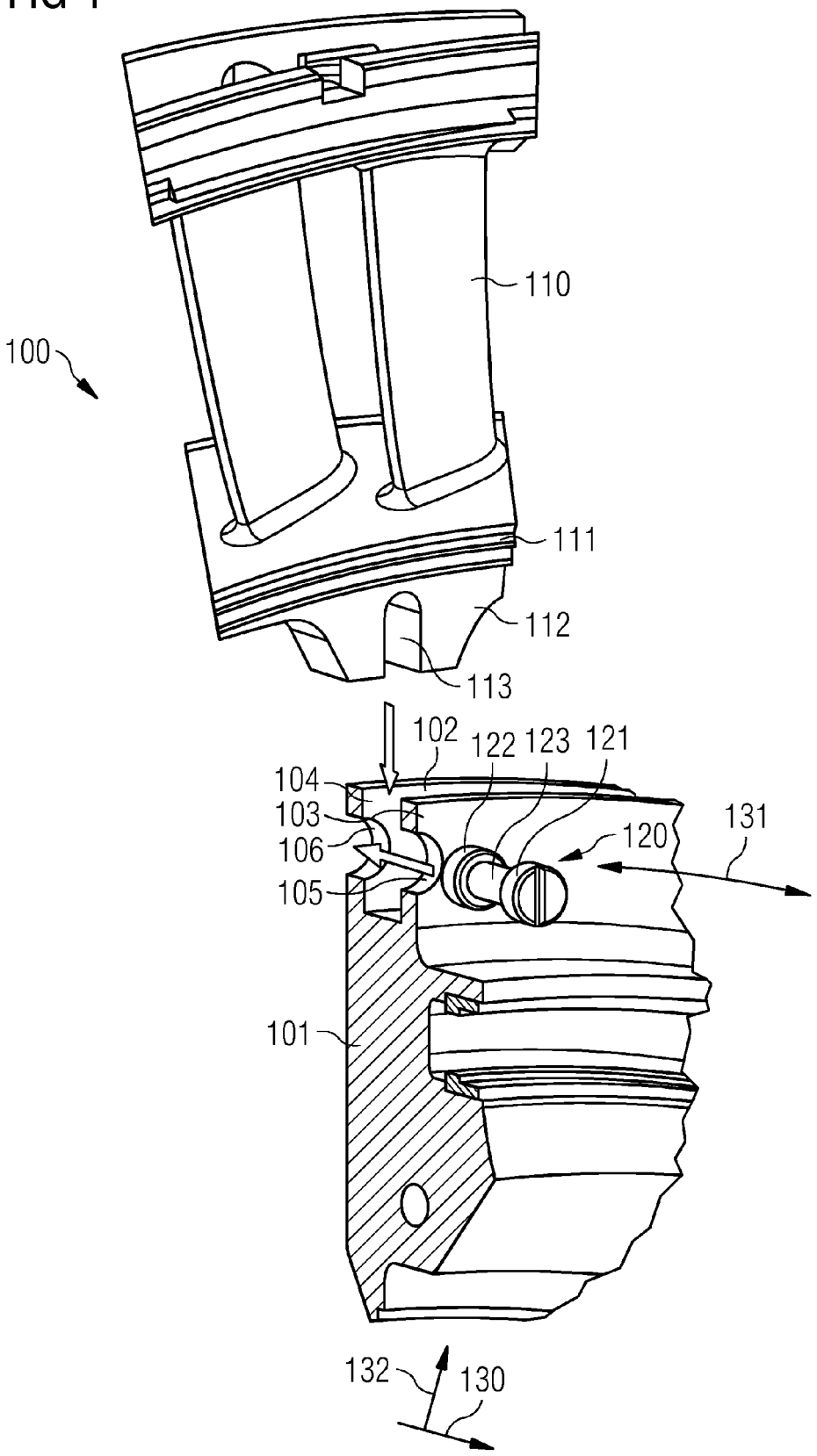

100
110
111
112
113
102
122
123
121
104
103
106
105
120
131
101
132
130

FIG 2

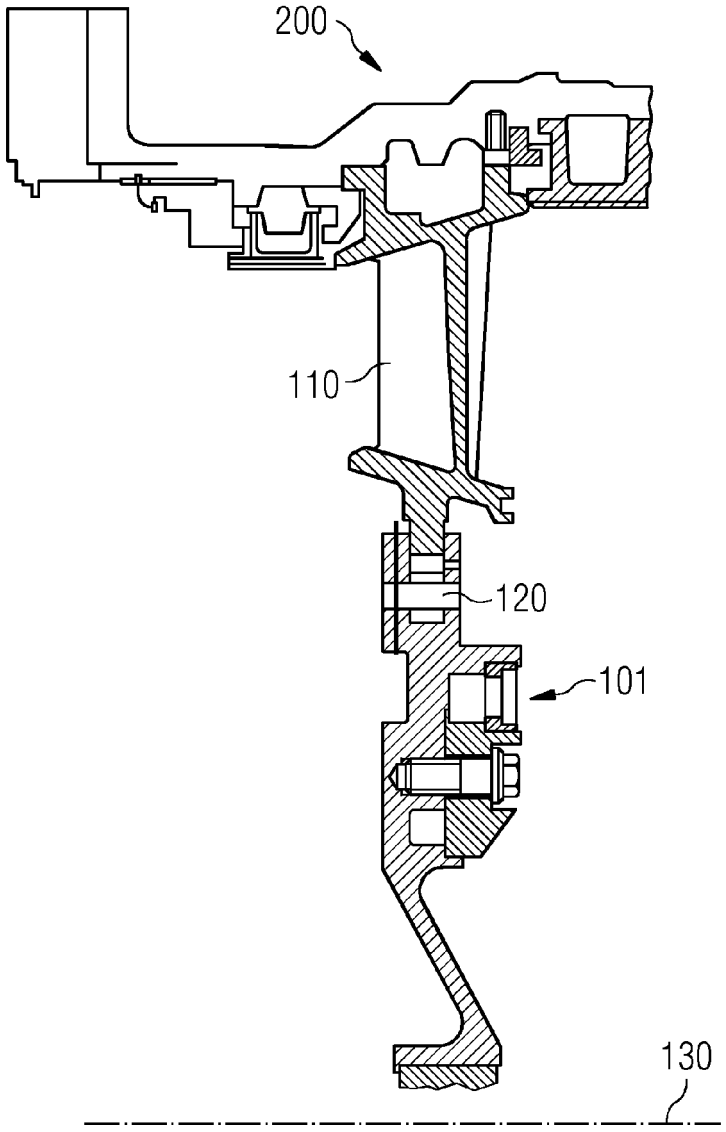


FIG 4

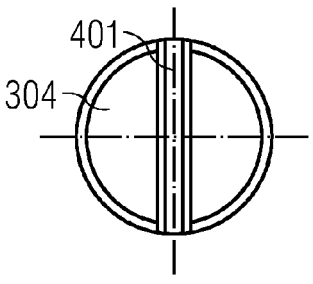


FIG 3

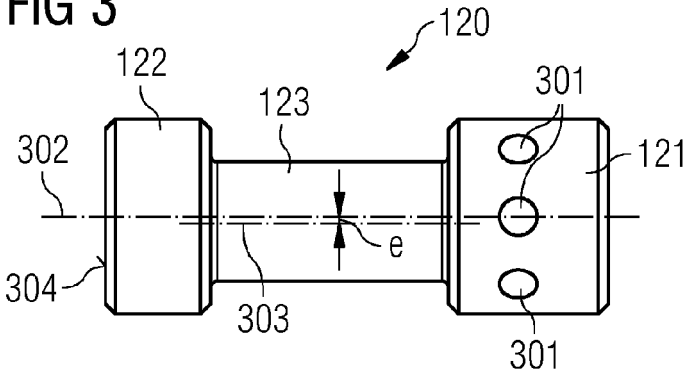


FIG 5

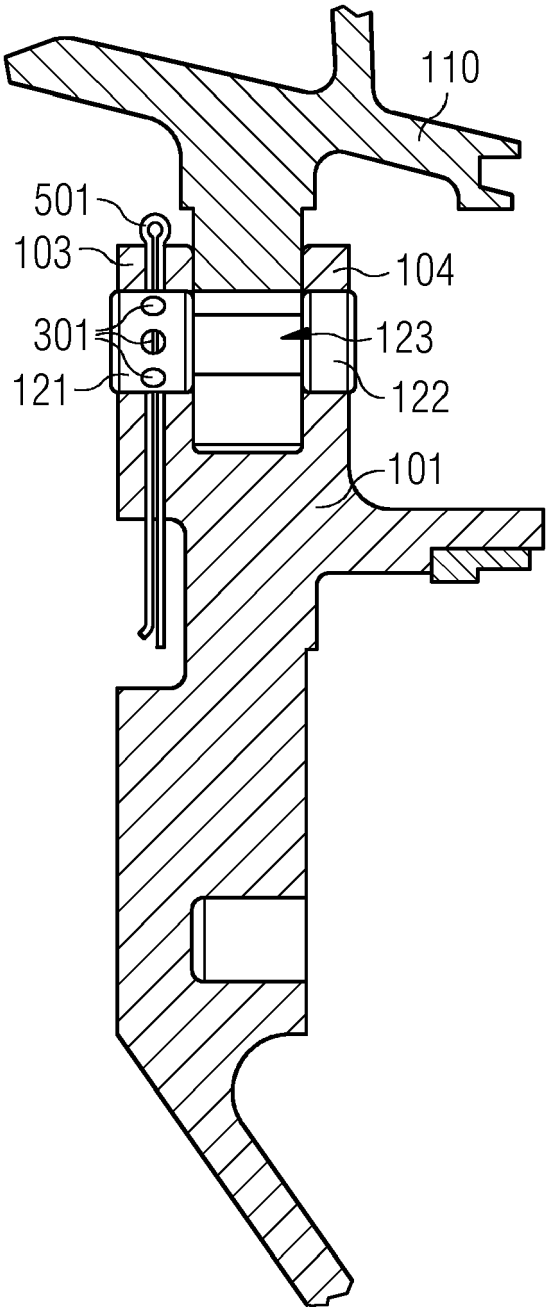
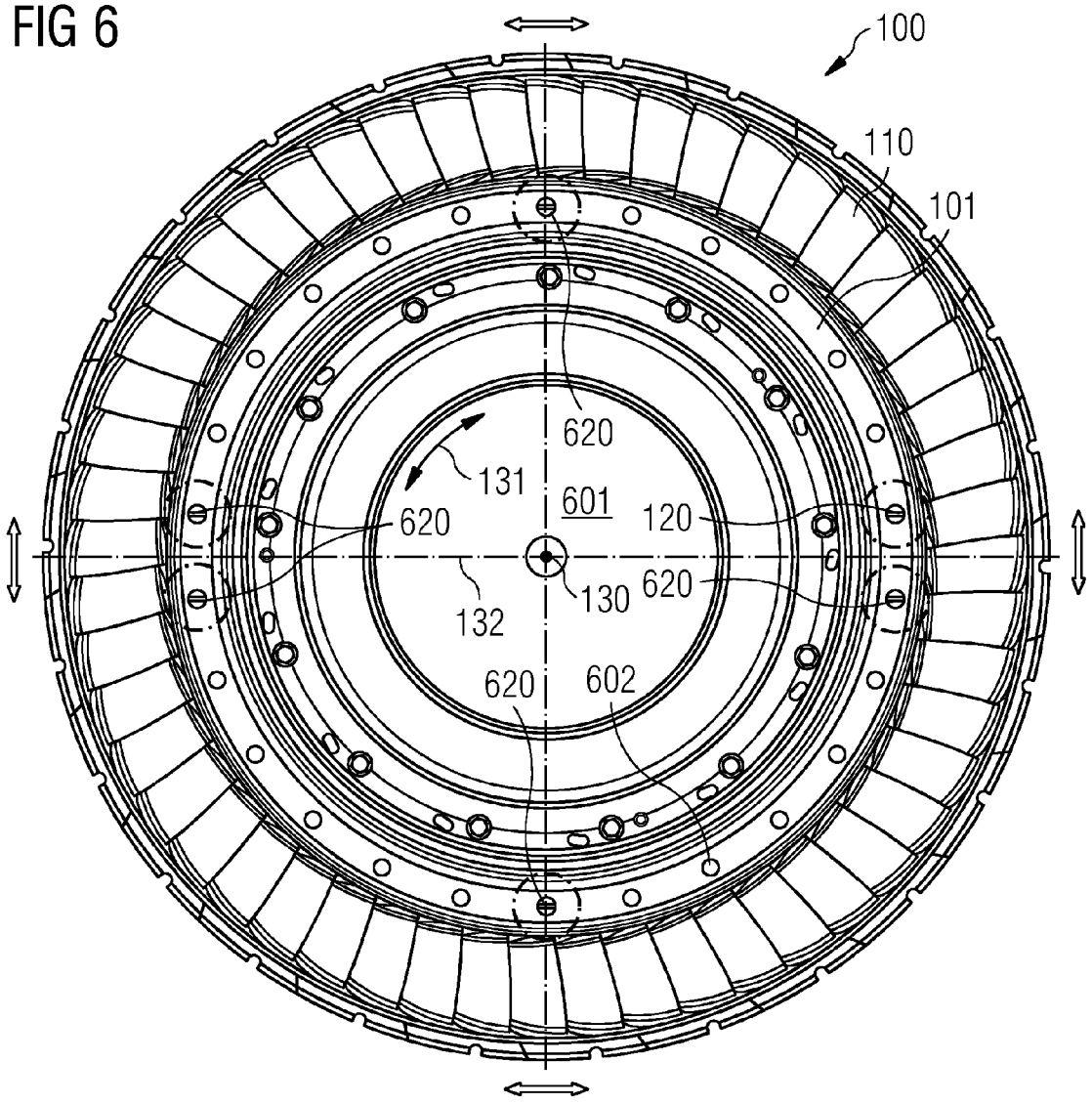


FIG 6



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EUROPEAN SEARCH REPORT

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EP 11 18 9936

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	17 April 2012	Koch, Rafael

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