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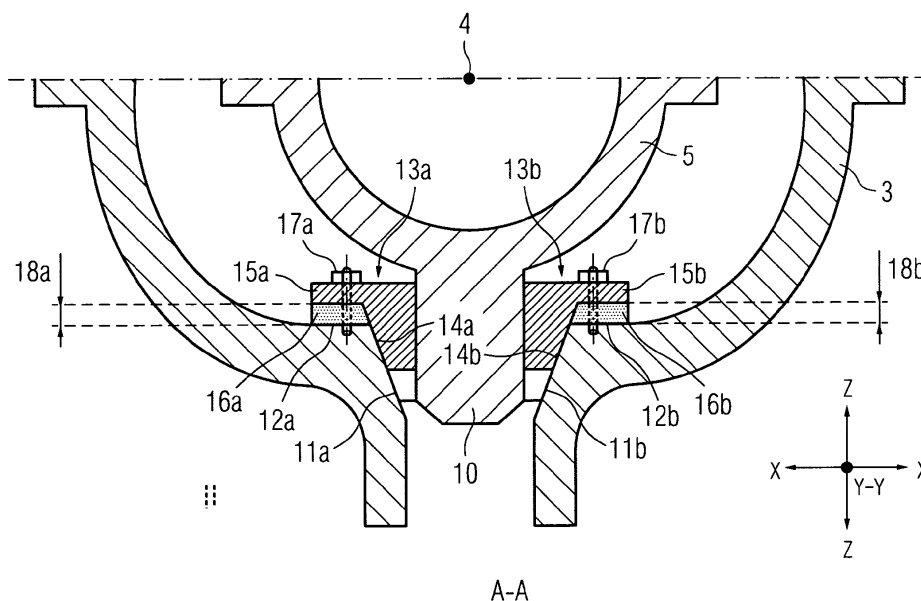
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(54) **Steam turbine assembly and method of assembling a steam turbine**

(57) A steam turbine assembly (1) comprises an inner casing (3) arranged around a longitudinal rotor axis (4) and a guide blade carrier or stationary blade ring (5) arranged in said inner casing circumferentially around said rotor axis. The guide blade carrier or stationary blade ring comprises a radially outward arm (10) supported be-

tween a pair of transversely separated support faces (11a,11b) of said inner casing. The assembly further includes a pair of tapered keys (13a,13b) slidably fitted respectively between said arm and each of said support faces, for transversely fastening said guide blade carrier or stationary blade ring to said inner casing.

FIG 2



Description

[0001] The present invention relates to steam turbines, used, for example, in power generation. In particular, the present invention relates to assembly of such a steam turbine.

[0002] A steam turbine conventionally includes an outer casing and an inner casing arranged therein. Inside the inner casing is mounted one or more stationary blade rings and guide blade carriers. Guide blade carriers are normally placed in the regions having high steam temperature and pressure whereas stationary blade rings are placed after in the regions having relatively lower steam temperature and pressure. Guide blade carriers are typically formed by casting wherein stationary blades are assembled in the guide blade carrier via grooves machined in the inner diameter of the guide blade carrier. Stationary blade rings are normally fabricated wherein the stationary blades are welded in the inner diameter of stationary blade rings.

[0003] On each Stationary blade ring or guide blade carrier are mounted one or more rows of guide blades axially separated from each other. Each guide blade row includes several guide blades arranged next to each other in a circumferential direction.

[0004] Conventionally, transverse fixing of the inner casing to the components within, such as guide blade carriers or stationary blade ring are done by using flat faced fixing keys or liners. During assembly, the thicknesses of the keys or liners are adjusted by machining at site based on the available space for fitment of the keys or liners as measured at the site. This adjustment of thickness of the keys by machining at site is required for proper fastening of these components each time the steam turbine needs to reassemble following an overhaul, outage or upgrade.

[0005] The object of the present invention is to overcome the above-mentioned disadvantages of the state of the art, in particular, to obviate the need for machining the fixing keys at site every time during assembly of a steam turbine.

[0006] The above object is achieved by the steam turbine assembly according to claim 1 and the method according to claim 5.

[0007] Advantageous embodiments of the present invention are the subject matter of the dependent claims.

[0008] The underlying idea of the present invention is to provide transverse fixing of the guide blade carrier or stationary blade ring to the inner casing in a steam turbine using tapered keys having varying thickness fitted therebetween. To that end, the guide blade carrier or stationary blade ring comprises a radially outward arm supported between a pair of transversely separated support faces of said inner casing. A pair of keys are slidably fitted respectively between the arm and each of the support faces, for transversely fastening said guide blade carrier or stationary blade ring to said inner casing. An essential feature of the present invention is that each said key is

tapered to have a varying thickness between said radial arm and the respective support face.

[0009] An advantage of the present invention is that it provides easy assembly of the turbine by eliminating the need for on the site machining of the surface of the keys to adjust the thickness prior to assembly of the steam turbine. A second advantage of the present invention is that the use of tapered keys provides improved alignment of such components.

[0010] In a further embodiment, each of the support faces of the inner casing is correspondingly tapered to interface with a respective tapered surface of each of the keys. Advantageously, in a further embodiment, vertical adjustment is provided by the use of shims in the vertical gap between a transverse portion of the keys and a corresponding transverse surface of the inner casing, which vertical gap is resultant of the fitting of the keys between the inner casing and the guide blade carrier or stationary blade ring.

[0011] The present invention is further described hereinafter with reference to illustrated embodiments shown in the accompanying drawings, in which:

FIG 1 is a portion of a longitudinal cross-section of a low pressure steam turbine, and

FIG 2 is a cross-sectional view of the steam turbine taken at an axial location, showing a guide blade carrier or stationary blade ring mounted on to the inner casing.

[0012] There is shown in FIG. 1 a longitudinal cross-section from the top of a low pressure steam turbine assembly 1 where the present invention finds an exemplary application. The steam turbine assembly 1 includes an outer casing 2, enclosing an inner casing 3 arranged around a rotor 6 having a longitudinal axis 4 along a horizontal direction Y-Y.

[0013] The inner casing 3 and rotor 6 form an annular steam flow path between themselves, the inner casing 3 forming the outer periphery of the flow path. A plurality of stationary guide blades 7 and rotating blades 8 are arranged in alternate rows interspaced axially. Each row of moving blades includes a plurality of blades 8 affixed to the rotor 6 and arranged side by side in a circumferential direction, each blade having an airfoil portion extending radially outward from the rotor 6 into the steam flow path. Each row of guide blades includes a plurality of guide blades 7 arranged side by side in a circumferential direction on a stationary blade ring or guide blade carrier or stationary blade ring 5 that is affixed to the inner casing 3. Each stationary guide blade 7 has an airfoil portion extending radially inwardly from the guide blade carrier or stationary blade ring 5 into the steam flow path.

[0014] The present invention provides a means for fastening the blade carrier or stationary blade ring 5 to the inner casing 3 in the transverse direction X-X. An exemplary arrangement for transverse fastening of the guide

blade carrier or stationary blade ring 5 to the inner casing 3 is shown in FIG 2, which shows a simplified cross-sectional view through the section A-A in FIG 1. In the illustrated embodiment, the inner casing 3 and the guide blade carrier or stationary blade ring 5 are each made of an upper half and a lower half affixed to each other. In FIG 2, only the lower halves of the inner casing 3 and the guide blade carrier or stationary blade ring 5 are shown, wherein the essential features of the present invention are incorporated.

[0015] Referring to FIG 2, the guide blade carrier or stationary blade ring 5, i.e., the lower half thereof, includes a radial arm 10. The inner casing 3, i.e., the lower half of the inner casing in this embodiment, includes a pair of transversely separated support faces 11a and 11b. The radial arm 10 of the guide blade carrier or stationary blade ring 5 is supported between the faces 11a and 11b of the inner casing 3. A pair of keys 13a and 13b are inserted on opposite sides of the radial arm 10, between the arm 10 and the respective support face 11a and 11b. The keys 13a and 13b are tapered to have a varying thickness between the radial arm 10 and the respective support faces 11a and 11b. To that end, each of the keys 13a and 13b includes a tapered surface 14a and 14b. The support faces 11a and 11b are machined to have a corresponding taper that interfaces with the surfaces 14a and 14b of the keys 13a and 1b respectively.

[0016] The assembly method includes positioning the guide blade carrier or stationary blade ring 5 within the inner casing 3 such that the radial arm 10 of the guide blade carrier or stationary blade ring 5 extends between the support faces 11a and 11b. The keys 13a and 13b are then vertically inserted into the spaces between the arm 10 and the support faces 11a and 11b, such that the surfaces 14a and 14b slide over the surfaces 12a and 12b till a tight fit is obtained, whereby the guide blade carrier or stationary blade ring 5 is locked or fastened in the transverse direction X-X. The above method of fastening obviates the need machining the surfaces of the keys for providing the required clearance with the guide blade carrier or stationary blade ring each time during assembly or reassembly, for example, following an overhaul, outage or upgrade of the steam turbine. Further using tapered keys of the above type provides a better transverse alignment of the guide blade carrier or stationary blade ring with respect to the inner casing.

[0017] In the illustrated embodiment, each of the keys 13a and 13b includes a transverse arm 15a and 15b which is supported over a respective transverse surface 12a and 12b on the inner casing. The keys 13a and 13b are inserted to the required extent to obtain the necessary clearance. Subsequently, a pair of shims 16a, 16b are inserted into the resultant vertical gaps 18a and 18b between the transverse arms 15a, 15b and the surfaces 12a, 12b after the fitment of the keys. The shims 16a and 16b are fastened by bolts 17a and 18b, to provide fastening in the vertical direction Z-Z. In practice, the vertical

gaps 18a and 18b may vary in thickness from assembly to assembly. Accordingly, shims of a required thickness may be inserted into these gaps to provide vertical adjustment to the assembly. Such a practice is less time consuming and more economical than the process of machining the surface of the flat keys for each assembly.

[0018] While this invention has been described in detail with reference to certain preferred embodiments, it should be appreciated that the present invention is not limited to those precise embodiments. Rather, in view of the present disclosure which describes the current best mode for practicing the invention, many modifications and variations would present themselves, to those of skill in the art without departing from the scope and spirit of this invention. The scope of the invention is, therefore, indicated by the following claims rather than by the foregoing description. All changes, modifications, and variations coming within the meaning and range of equivalency of the claims are to be considered within their scope.

Claims

1. A steam turbine assembly (1), comprising:

- an inner casing (3) arranged around a longitudinal rotor axis (4),
- a guide blade carrier or stationary blade ring (5) arranged in said inner casing (3) circumferentially around said rotor axis (4), said guide blade carrier or stationary blade ring (5) comprising a radially outward arm (10) supported between a pair of transversely separated support faces (11a, 11b) of said inner casing (3), and
- a pair keys (13a, 13b) slidably fitted respectively between said radial arm (10) and each of said support faces (11a, 11b), for transversely fastening said guide blade carrier or stationary blade ring (5) to said inner casing (3), wherein each said key (13a, 13b) is tapered to have a varying thickness between said radial arm (10) and the respective support face (11a, 11b).

2. The steam turbine assembly (1) according to claim 1, wherein each of said support faces (11a, 11b) of the inner casing (3) is correspondingly tapered to interface with a respective tapered surface (14a, 14b) of each of said keys (13a, 13b).

3. The steam turbine assembly (1) according to any of the preceding claims, wherein each of said keys (13a, 13b) further includes a transverse arm (15a, 15b) supported over a corresponding transverse surface (12a, 12b) of said inner casing (3), and wherein a shim (16a, 16b) is disposed in a vertical gap (18a, 18b) between said transverse arm (16a, 16b) of each key (13a, 13b) and the corresponding transverse surface (12a, 12b) of the inner

casing (3), which vertical gap (18a,18b) is caused resultant of said slidable fit of said key (13a,13b).

4. The steam turbine assembly (1) according to any of the preceding claims, wherein

- said inner casing (3) comprises an upper inner casing half and a lower inner casing half, and said pair of support faces (11a,11b) is provided on said lower inner casing half, and
- said guide blade carrier or stationary blade ring (5) comprises an upper guide blade carrier or stationary blade ring half and a lower guide blade carrier or stationary blade ring half, and said radial arm (10) is provided on said lower guide blade carrier or stationary blade ring half.

5. A method of assembling a steam turbine (1), comprising:

- arranging an inner casing (3) around a longitudinal rotor axis (4),
- arranging a guide blade carrier or stationary blade ring (5) in said inner casing (3) circumferentially around said rotor axis (4), said arrangement of said guide blade carrier or stationary blade ring (5) comprising positioning a radially outward arm (10) of said guide blade carrier or stationary blade ring (5) between a pair of transversely separated support faces (11a,11b) of said inner casing (3),
- slidably fitting a pair of keys (13a,13b) respectively between said radial arm (10) and each of said support faces (11a,11b) to transversely fasten said guide blade carrier or stationary blade ring (5) to said inner casing (3), wherein each said key (13a,13b) is tapered to have a varying thickness between said radial arm (10) and the respective support face (11a,11b).

6. The method according to claim 5, wherein each of said support faces (11a,11b) of the inner casing (3) is correspondingly tapered to interface with a respective tapered surface (14a,14b) of each of said keys (13a,13b).

7. The method according to any of claims 5 and 6, wherein each of said keys (13a,13b) further includes a transverse arm (15a,15b) supportable over a corresponding transverse surface (12a,12b) of said inner casing (3), wherein said method further includes disposing a shim (16a,16b) in a vertical gap (18a,18b) between said transverse arm (15a,15b) of each key (13a,13b) and the corresponding transverse surface (12a,12b) of the inner casing (3), which vertical gap (18a,18b) is caused resultant of said slidable fit of said key (13a,13b).

8. The method according to any of claims 5 to 7, wherein

- arranging said inner casing (3) comprises arranging an upper inner casing half and a lower inner casing half, wherein said pair of support faces (11a,11b) is provided on said lower inner casing half, and
- arranging said guide blade carrier or stationary blade ring (5) comprises arranging an upper guide blade carrier or stationary blade ring half and a lower guide blade carrier or stationary blade ring half, and said radial arm (10) is provided on said lower guide blade carrier or stationary blade ring half.

FIG 1

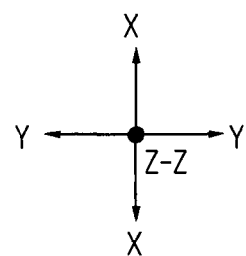
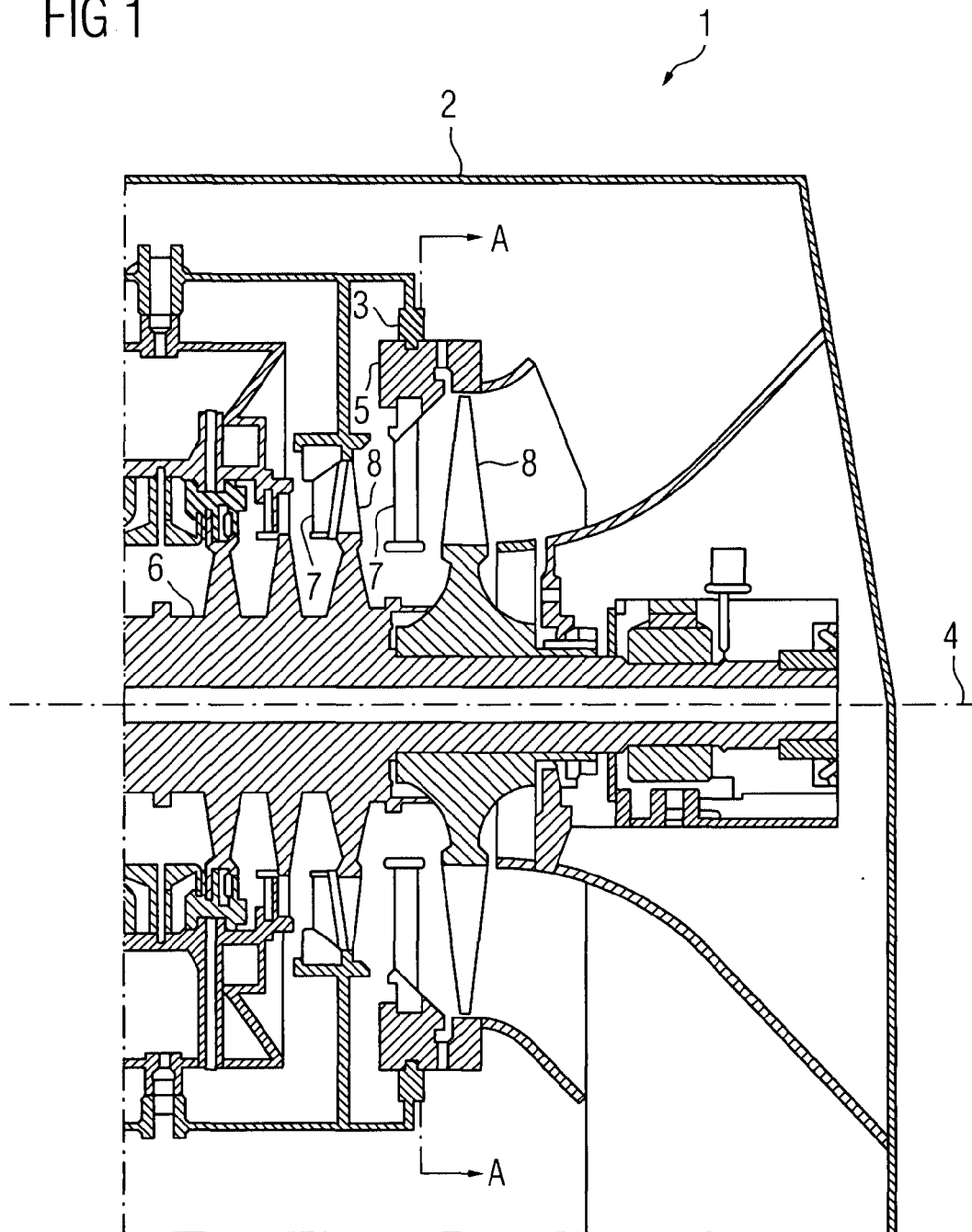
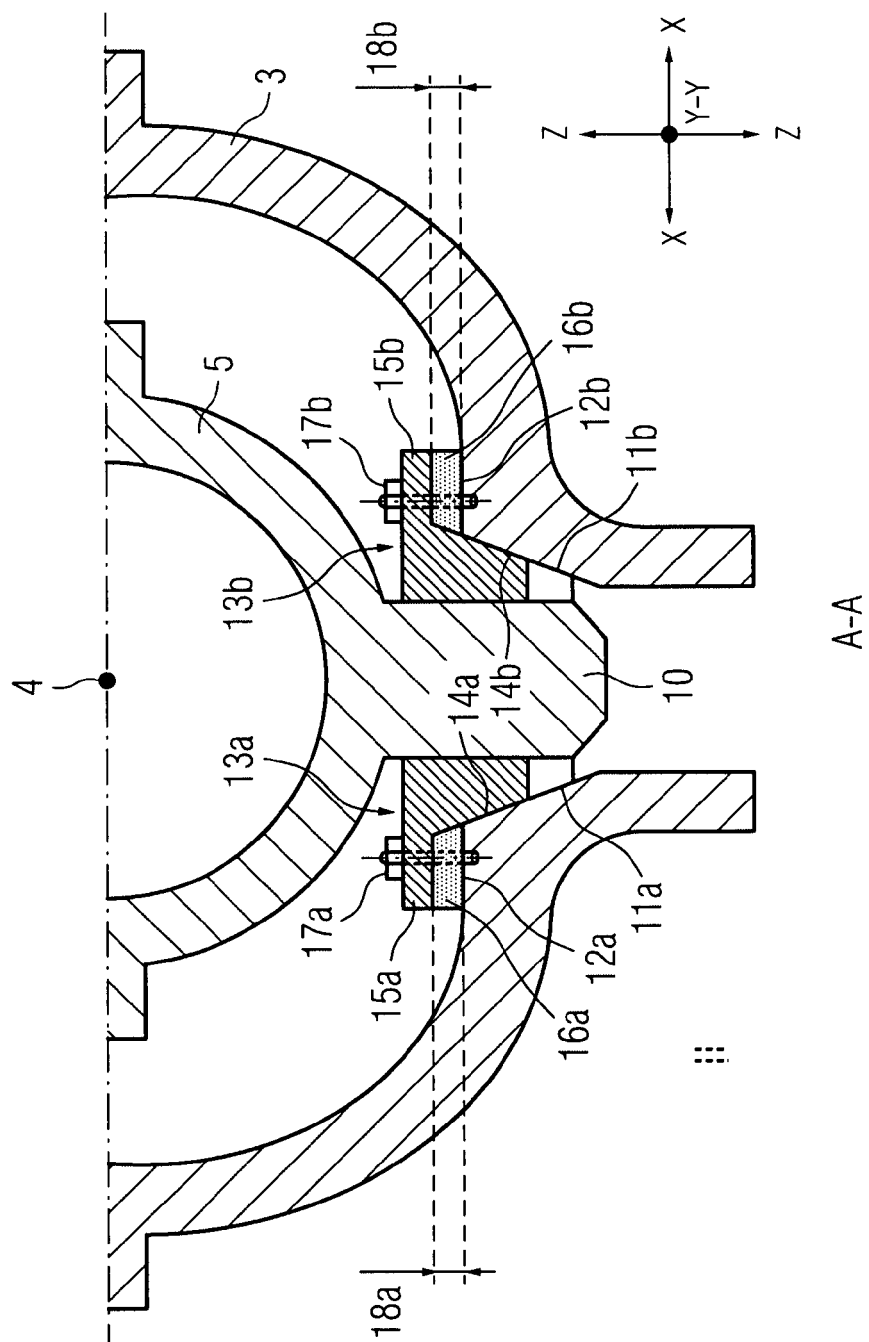


FIG 2





EUROPEAN SEARCH REPORT

Application Number
EP 10 00 5811

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 28 October 2010	Examiner O'Shea, Gearóid
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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