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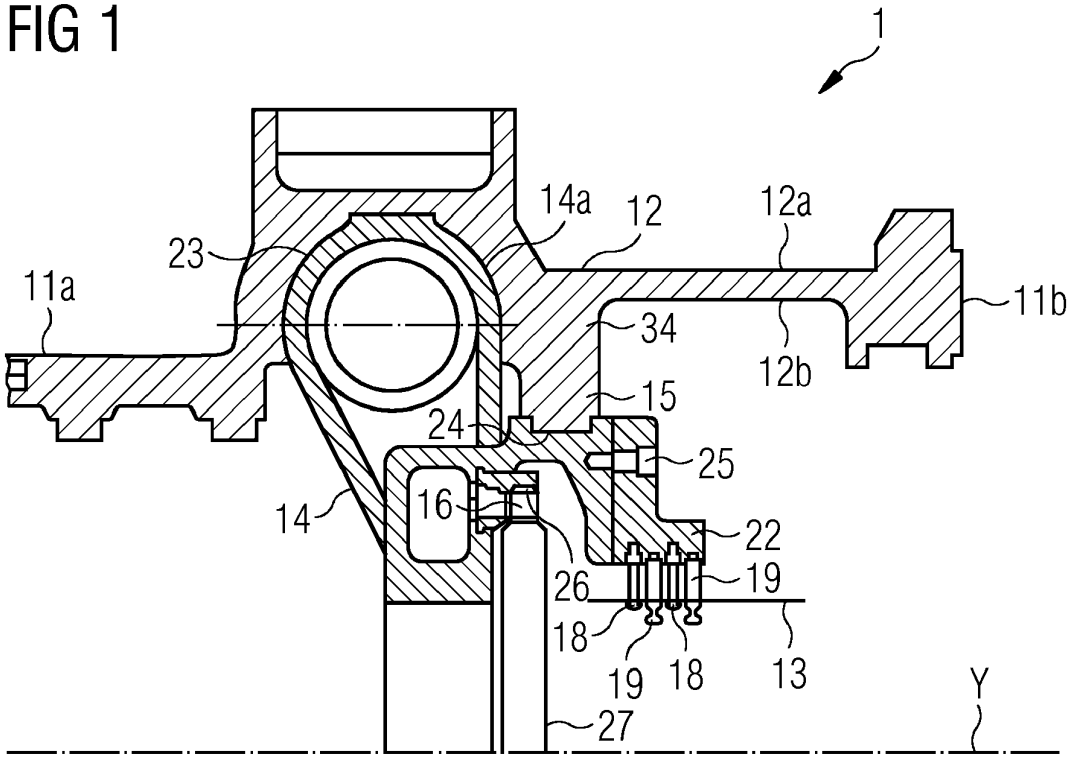
(54) **TURBINE ASSEMBLY**

(57) A turbine (1) comprises:
- an outer casing (12),
- a plurality of nozzle blades (16),
- a plurality of stator blades (18),
- a nozzle valve casing (14) supporting the plurality of nozzle blades (16), the nozzle valve casing (14) being fixed to the casing (12),
- a stator blade carrier (22) supporting the plurality of stator blades (18), the stator blade carrier (22) being supported by the nozzle valve casing (14).

The casing (12) comprises at least one seat (23, 24) to which the nozzle valve casing (14) is coupled. The nozzle valve casing (14) is interposed between the casing (12) and the stator blade carrier (22) in such a way that the casing (12) and the stator blade carrier (22) are separated from each other.

FIG 1



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Description

Field of invention

[0001] The present invention relates to a turbine assembly, in particular to a steam turbine assembly. More particularly the present invention relates to a turbine assembly, for example a steam turbine assembly, including an outer turbine casing, a nozzle valve casing and a stator blade carrier.

Art Background

[0002] In a steam turbine a flow of steam is channelled, through a plurality of nozzle blades, towards a plurality of turbine stage which transform the energy from the hot steam into work for powering one or more devices which converts power, for example including a generator in a power generation application.

Each stage of the turbine includes a row of stator blades which channel the hot steam into a corresponding row of rotor blades. The stator blades extend radially inwardly from stator components of the turbine. The rotor blades extend radially outwardly from a rotor of the turbine. The flowing and the expansion of the steam through the turbine stages cause the rotation of the rotor blades and of the rotor itself around its axis. The rotation of the rotor is the source of work which is usable as output for powering one or more devices which converts power.

The outer turbine casing of a steam turbine has an axis of symmetry, which is normally coincident with the axis of rotation of the rotor, and is constituted by a lower part and an upper part joined together by means of joining bolts at a splitting plane. In operation the splitting plane is typically horizontally disposed.

The turbine further comprises a nozzle valve casing and a stator blade carrier, which are fixed to the outer turbine casing for supporting, respectively, the plurality of nozzle blades and the plurality of stator blades.

The outer turbine casing, the nozzle valve casing and the stator blade carrier comprise respective lower half portions and upper half portions joined together at the horizontal splitting plane.

According to known technical solutions, the nozzle valve casing and the stator blade carrier are fixed to the casing in such a way that:

- the nozzle valve casing is coupled to at least a seat provided in the outer turbine casing.
- the stator blade carrier is attached to the nozzle valve casing, by means of a plurality of coupling bolts distributed around the central axis of symmetry of the rotor, and is also coupled to at least a second seat provided in the outer turbine casing.

Such solution is not considered optimal, as it exhibits some drawbacks, including:

- a not satisfactory level of stiffness for the casing assembly,
- a not satisfactory level of strength for the casing assembly ,
- excessive length of the coupling bolts, which are needed to couple together the stator blade carrier and the nozzle valve casing. This implies an excessive length of the respective coupling holes provided in the stator blade carrier and a consequent weakening of the structure of the stator blade carrier.

It is therefore desirable to provide a new design for a turbine where the coupling between the casing, the nozzle valve casing and the stator blade carrier limits or removes the above mentioned drawbacks.

Summary of the Invention

[0003] It may be an object of the present invention to provide a turbine, in particular a steam turbine, having a higher level of stiffness, with respect to the existing turbine solutions.

[0004] It may be another object of the present invention to provide a a turbine, in particular a steam turbine, having a higher level of strength, with respect to the existing turbine solutions.

[0005] It may be a further object of the present invention to provide a turbine, in particular a steam turbine, where the extension of the coupling between the stator blade carrier and the nozzle valve casing is minimized.

[0006] In order to achieve the objects defined above, a turbine is provided in accordance to the independent claim. The dependent claims describe advantageous developments and modifications of the invention.

[0007] According to an aspect of the present invention, a turbine is provided. The turbine comprises:

- a casing,
- a plurality of nozzle blades,
- a plurality of stator blades,
- a nozzle valve casing supporting the plurality of nozzle blades, the nozzle valve casing being fixed to the casing,
- a stator blade carrier supporting the plurality of stator blades, the stator blade carrier being supported by the nozzle valve casing.

The casing comprises at least one seat to which the nozzle valve casing is coupled, the nozzle valve casing being interposed between the casing and the stator blade carrier in such a way that the casing and the stator blade carrier are separated from each other.

[0008] More particularly, the above described turbine may be a steam turbine.

[0009] According to the present invention no coupling between the stator blade carrier and the casing are provided. The stator blade carrier is in contact only with the nozzle valve casing, which is interposed between the

casing and the stator blade carrier. This implies a plurality of advantages, with respect to known stators, including:

- easier assembly of the with the nozzle valve casing and of the stator blade carrier to the stator,
- higher stiffness of the stator assembly,
- higher strength of the stator assembly,
- improvement of the design of the flow channel in the direction of steam flow, i.e. from nozzle ring to stator blades,
- decreasing of cost for the manufacturing process.

[0010] According to an exemplary embodiment of the present invention, the nozzle valve casing and the stator blade carrier are distinct components, the stator comprising at least a fixing connection between the nozzle valve casing and the stator blade carrier.
In particular, the fixing connection may include a plurality of bolts or a welding.
Advantageously, this allows, with respect to known stators mean term, an easier manufacturing process of the nozzle valve casing and of the stator blade carrier.
[0011] According to another exemplary embodiment of the present invention, the nozzle valve casing and the stator blade carrier are integrated in a single component.
In particular, the nozzle valve casing and the stator blade carrier may be obtained through casting of a single component.
Advantageously, this permits to avoid the use of connecting means between the nozzle valve casing and the stator blade carrier.
[0012] According to a further exemplary embodiment of the present invention, the casing comprises at least two seats to which the nozzle valve casing is coupled, for example by a forced coupling.
Advantageously, this permits to further improve the stiffness and strength of the stator assembly and to further facilitate the assembly of the with the nozzle valve casing and of the stator blade carrier to the outer turbine casing.

Brief Description of the Drawings

[0013] 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 is a partial sectional view of a first embodiment of a steam turbine according to the present invention,

FIG. 2 is a partial sectional view of a second embodiment of a steam turbine according to the present invention.

Detailed Description

[0014] Hereinafter, above-mentioned and other features of the present invention are described in details. A plurality of embodiments is described with reference to the drawings, wherein the same reference numerals are used to refer to the same elements throughout. The illustrated embodiments are intended to explain, and not to limit the invention.
[0015] **FIG. 1** shows an example of a steam turbine 1 in a vertical sectional view.
The steam turbine 1 comprises an outer casing 12 and rotor 13, having a common axis of symmetry Y, also coincident with the rotational axis of the rotor 13. Both the turbine outer casing 12 and the rotor 13 are partially represented in Fig. 1.
In the following, the terms axial, radial and circumferential are made with reference to the rotational axis Y of the rotor 13.
[0016] The rotor 13 comprises a plurality of rows of rotor blades 19. The rotor blades 19 extend radially outwardly from the rotor 13 of the steam turbine 1. In each row, which corresponds to a respective stage of the steam turbine 1, the rotor blades 19 are regularly distributed around the rotational axis Y.
The outer turbine casing 12 is constituted by a first lower portion and a second upper portion (only the latter is represented in the attached figures). Each of the lower and upper portions of the casing 12 extends circumferentially for angle of 180° around the rotational axis Y and are joined together, by means of joining bolts (not represented in the attached figures), at an intermediate horizontal splitting plane (in the attached figures the dot-dashed line Y also represent the trace of the horizontal splitting plane).
The outer casing 12 comprises an external surface 12a, towards the external environment, an internal surface 12b towards the rotational axis Y.
[0017] In the representation of **FIG. 1,** the outer casing 12 extends radially between a first axial end 11a and a second axial end 11b. Inside the casing, steam flows mainly according to an axial direction oriented from the first axial end 11a towards second axial end 11b.
In the following, the terms upstream and downstream refer to the flow direction of the steam flow through the casing 12 of the turbine 1, unless otherwise stated.
The turbine 1 further comprises a nozzle valve casing 14 for supporting a plurality of nozzle blades 16. Through the nozzle blades 16, the flow of steam is channelled towards a plurality of stages of the steam turbine 1. Each stage of the steam turbine 1 comprises a row of stator blades 18 which channel the hot steam into a corresponding row of the rotor blades 19.
The plurality of nozzle blades 16 are connected to the nozzle valve casing 14 by means of a nozzle ring 26. The nozzle ring 26 is radially supported by a wheel 27 fixed to the rotor 13. The plurality nozzle blades 16, the nozzle ring 26 and the connections between the nozzle ring 26

and the nozzle valve casing 14 and between the nozzle ring 26 and the wheel 27 are not described in further detail, as they are conventional and do not form specific part of the present invention.

The nozzle valve casing 14 is fixed to the outer casing 12. For the fixing of the nozzle valve casing 14 to the casing 12, at least one seat in the casing is provided.

With reference to the embodiments in attached figures, two seats 23, 24 are provided on the internal surface 12b of the casing 12 for fixing the nozzle valve casing 14 to the casing 12. A first upstream seat 23 is provided as a circumferential cylindrical groove to be coupled, for example by means of a forced coupling, to a correspondent cylindrical surface 14a of the nozzle valve casing 14. A second downstream seat 24, axially adjacent to the first upstream seat 23, is provided as a circumferential surface at the radial end of an annular protrusion 34 extending radially inward from the internal surface 12b of the casing 12 towards the rotational axis Y. The second downstream seat 24 is coupled, for example by means of a forced coupling, to a correspondent circumferential surface 14b of the nozzle valve casing 14. The turbine 1 further comprises a stator blade carrier 22 supporting the plurality of stator blades 18.

The stator blades 18 are distributed into a plurality of rows of stator blades 18, one for each of the stages of the steam turbine 1. The stator blades 18 extend radially inwardly from the stator blade carrier 22 and are regularly distributed around the rotational axis Y. In each stage of the steam turbine 1, a row of stator blades 18 are axially upstream a corresponding row of rotor blades 19.

The stator blade carrier 22 is supported by the nozzle valve casing 14. The nozzle valve casing 14 is interposed between the casing 12 and the stator blade carrier 22 in such a way that the casing 12 and the stator blade carrier 22 are separated from each other, i.e. no seat is provided in the casing 12 for coupling with the stator blade carrier 22.

In other words, according to the present invention, the nozzle valve casing 14 and the stator blade carrier 22 are connected in series between the casing 12 and the stator blades 18.

With reference to the embodiment of **FIG. 1,** the nozzle valve casing 14 and the stator blade carrier 22 are distinct components. The turbine 1 comprises a plurality of bolts, parallel to the rotational axis Y and circumferentially distributed around the rotational axis Y. The length of the bolts 25 are long enough to assure the connection between the nozzle valve casing 14 and the stator blade carrier 22 and are considerably shorter than in other known-in-the-art application where bolts are provided to couple the stator blade carrier 22 to the nozzle valve casing 14 and at the same time to the casing 12 of the turbine.

According to other embodiments of the present invention (not represented in the attached figures), other fixing connections may be provided between the stator blade carrier 22 and the nozzle valve casing 14, for example a welding.

[0018] With reference to the embodiment of **FIG. 2,** the nozzle valve casing 14 and the stator blade carrier 22 are integrated in a single component 15. According to a possible embodiment of the present invention, such single component may be obtained through casting. Such a solution permits to avoid the use of the bolts 25 of the embodiment of **FIG. 1.** In this embodiment, the stator blade carrier 22 is identified as the portion of the single component 15 which is downstream of the nozzle valve casing 14 and of the annular protrusion 34.

In any case, in all the embodiments of the present invention, it is essential that the stator blade carrier 22 has not direct connection to the outer casing 12 of the turbine 1.

Claims

1. A turbine (1) comprising:

- a casing (12),
- a plurality of nozzle blades (16),
- a plurality of stator blades (18),
- a nozzle valve casing (14) supporting the plurality of nozzle blades (16), the nozzle valve casing (14) being fixed to the casing (12),
- a stator blade carrier (22) supporting the plurality of stator blades (18), the stator blade carrier (22) being supported by the nozzle valve casing (14),

wherein the casing (12) comprises at least one seat (23, 24) to which the nozzle valve casing (14) is coupled, the nozzle valve casing (14) being interposed between the casing (12) and the stator blade carrier (22) in such a way that the casing (12) and the stator blade carrier (22) are separated from each other.

2. The turbine (1) according to claim 1, wherein the nozzle valve casing (14) and the stator blade carrier (22) are distinct components, the turbine (1) comprising at least a fixing connection (25) between the nozzle valve casing (14) and the stator blade carrier (22).

3. The turbine (1) according to claim 2, wherein the fixing connection (25) includes at least a bolt.

4. The turbine (1) according to claim 2 or 3, wherein the fixing connection (25) includes at least a welding.

5. The turbine (1) according to claim 1, wherein the nozzle valve casing (14) and the stator blade carrier (22) are integrated in a single component.

6. The turbine (1) according to claim 5, wherein the nozzle valve casing (14) and the stator blade carrier (22) are integrated in a single casted component (15).

7. The turbine (1) according to any of the preceding claims, wherein the casing (12) comprises at least two seats (23, 24) to which the nozzle valve casing (14) is coupled.

8. The turbine (1) according to any of the preceding claims, further comprising a nozzle valve ring (26) for connecting the plurality of nozzle blades (16) to the nozzle valve casing (14).

FIG 1

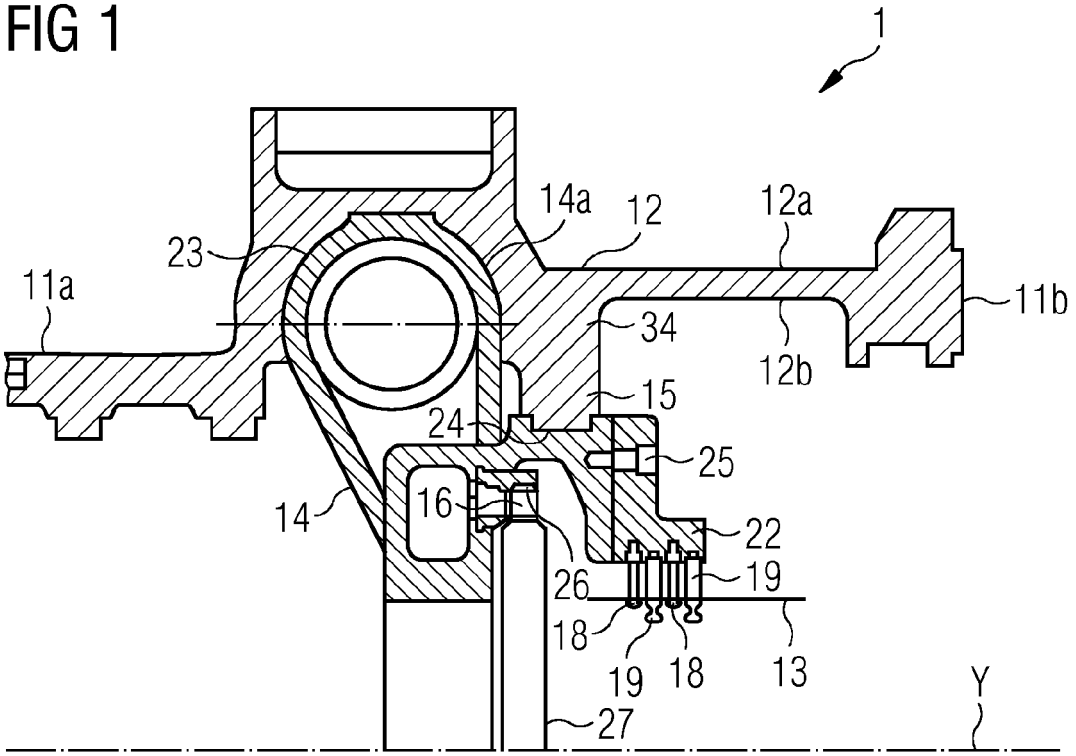
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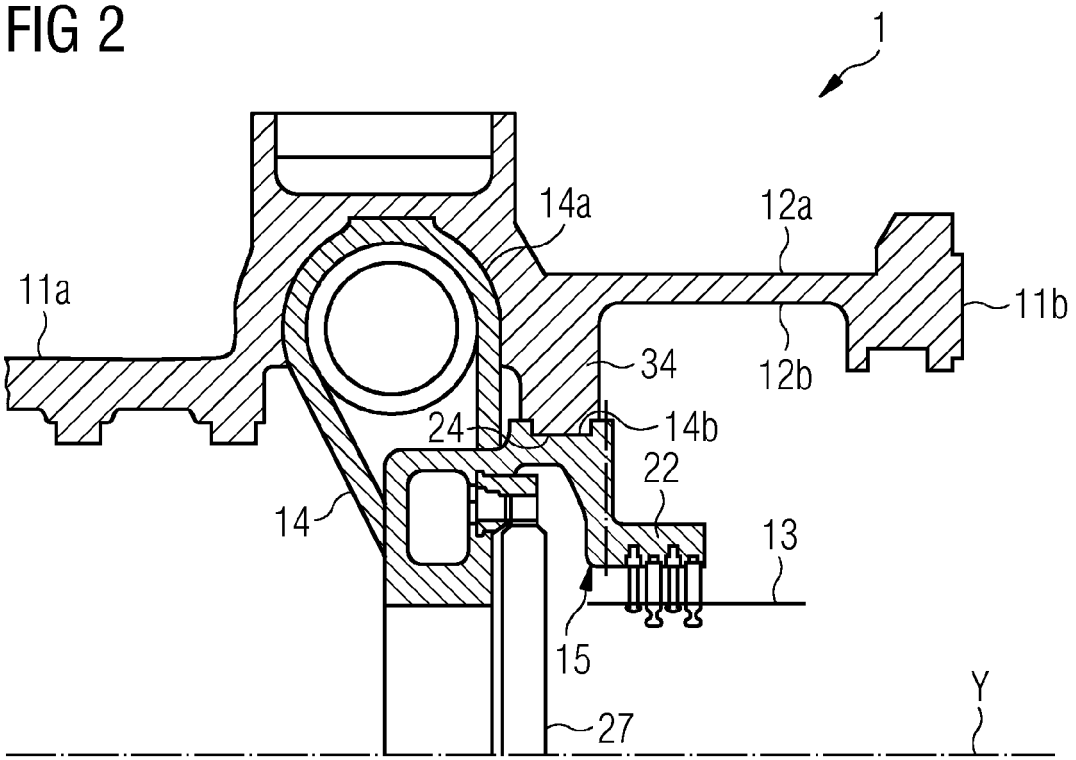
FIG 2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EUROPEAN SEARCH REPORT

Application Number
EP 16 17 7535

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	GB 2 076 065 A (FORSTER TERENCE OWEN) 25 November 1981 (1981-11-25) * page 1, lines 1-57; figure 1 *	1-8	INV. F01D25/24 F01D9/02
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A	US 2014/334925 A1 (CASAVANT MATTHEW STEPHEN [US] ET AL) 13 November 2014 (2014-11-13) * paragraphs [0024], [0025]; figure 2 *	8	

TECHNICAL FIELDS SEARCHED (IPC)

F01D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	10 March 2017	Chatziapostolou, A

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10-03-2017

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