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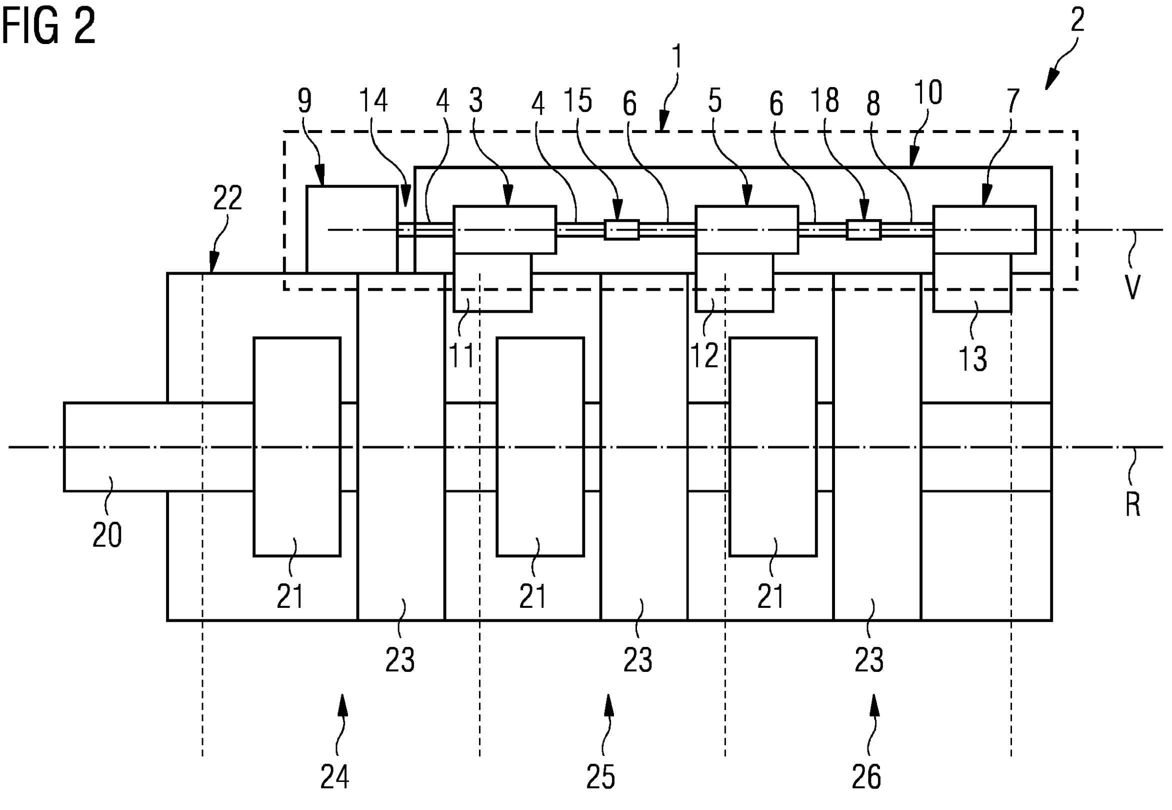
(54) **TURBINE CONTROL SYSTEM FOR A STEAM TURBINE AND STEAM TURBINE**

(57) The invention relates to a turbine control system (1) for a steam turbine (2) comprising a first valve (3) with a first valve spindle (4), a second valve (5) with a second valve spindle (6) and a third valve (7) with a third valve spindle (8), a servomotor (9) for driving the first valve (3) and a valve chest (10). The turbine control system (1) further comprises a first rotation protection system (14) for preventing rotational movement of the first valve spindle (4) relative to the valve chest (10). The turbine control system (1) further comprises a second rotation protection system (15) mechanically coupled to the first valve spindle (4) and the second valve spindle (6) for preventing rotational movement of the second valve spindle (6) relative to the first valve spindle (4). Moreover, the invention relates to a steam turbine (2) comprising such turbine control system (1).

FIG 2



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Description

[0001] The invention relates to a turbine control system for a steam turbine. Moreover, the invention relates to a steam turbine comprising a turbine control system.

[0002] Steam turbines are used for transforming enthalpy of steam into kinetic energy, especially rotational energy of a rotor. The rotational energy can be provided for driving a generator for generating electricity, e.g. at an electric power plant.

[0003] Steam for powering steam turbines is often generated in a steam generating plant. Such steam generating plants are usually configured for generating a constant amount of steam within a certain timeframe. Therefore, for power control of a steam turbine, steam turbines comprise a turbine control system for bypassing steam to different axial turbine sections of the turbine or for distributing the steam to certain load point via nozzle group.

[0004] A common type of turbine control system comprises a plurality of valves, each for controlling steam flow into a bypass or a certain load point via nozzle group. By these means, axial sections of the steam turbine can be selectively provided with steam through respective bypasses. Usually, the valves are prioritized in a way that some valves can only be opened when another valve is in an open position, already. Therefore, a typical turbine control system with a three valve configuration has the following valve settings. According to a first setting, all valves are closed. According to a second setting, only a first valve is in an open position. According to a third setting, the first valve and a second valve are in the open position and a third valve is still in the closed position. According to a fourth setting, all valves are in an open position.

[0005] Valves of such turbine control systems comprise a valve spindle that is configured for a translational movement for shifting the valve between the open and closed position. For forcing the valves into a closed position, each valve comprises a valve spring. However, rotational movement of the valve spindle has to be avoided. Rotational forces at the valve spindles can e. g. be inflicted by the steam passing by or through the respective valve. Therefore, turbine control systems comprise means for rotation protection for valve spindles.

[0006] In a common configuration of a turbine control system with three valves, the valves are located within a valve chest. For rotational protection, a first valve spindle is coupled to the servomotor, a third valve is coupled to a second valve. The second valve is then coupled to a flange fixed in valve chest.

[0007] This configuration has the disadvantage that friction forces inside the second valve and the third valve and the weight of the second valve spindle are relatively high. Consequently relatively strong valve springs have to be provided in order to guarantee correct closing of the valves.

[0008] Therefore, it is an object of the present invention to provide a turbine control system for a steam turbine as well as a steam turbine with a turbine control system that overcome the drawbacks of the state of the art. In particular, it is an object of the present invention to provide a turbine control system for a steam turbine as well as a steam turbine with a turbine control system that provides an improved rotational protection of the valve spindles and/or less friction forces of the valves.

[0009] The aforementioned object is solved by the patent claims. Therefore, the object is solved by a turbine control system according to independent claim 1 and by a steam turbine according to independent claim 9. Further features and details of the invention are specified in the dependent claims, the description and the drawings. By these means, features and details that are described with respect to the inventive turbine control system can be certainly applied to the inventive steam turbine and the other way round. Consequently, concerning the disclosure of the invention, reference to these different aspects of the invention can and will be made mutually.

[0010] According to a first aspect of the invention, the object is solved by a turbine control system for a steam turbine comprising a first valve with a first valve spindle, a second valve with a second valve spindle and a third valve with a third valve spindle, a servomotor for driving the first valve spindle and a valve chest for housing the first valve, the second valve and the third valve. The first valve is configured for closing a first steam bypass of the steam turbine in a closed position and for opening the first steam bypass in an open position. The second valve is configured for closing a second steam inlet of the steam turbine in a closed position and for opening the second steam bypass in an open position. The third valve is configured for closing a third steam bypass of the steam turbine in a closed position and for opening the third steam bypass in an open position. The servomotor is configured for actuating the first valve, the first valve is configured for actuating the second valve and the second valve is configured for actuating the third valve. Moreover, the turbine control system comprises a first rotation protection system mechanically coupled to the first valve spindle and the servomotor for preventing rotational movement of the first valve spindle relative to the valve chest. The first rotation protection system is located outside the valve chest. According to the invention, the turbine control system comprises a second rotation protection system mechanically coupled to the first valve spindle and the second valve spindle for preventing rotational movement of the second valve spindle relative to the first valve spindle.

[0011] Preferably, the first valve spindle, the second valve spindle and the third valve spindle are arranged parallel to each other, preferably on a common axis. The valve chest can be part of a turbine housing of the steam turbine.

[0012] For moving the first valve from the closed position to the open position, a servomotor spindle is engaged with the first valve spindle, preferably via a connector. The connector can be part of the first valve spindle and/or the servomotor spindle. The connector is preferably configured for preventing a relative rotation of the servomotor spindle and the first valve spindle. Moreover, the connector is preferably configured for preventing a relative translational movement of the servomotor spindle and the first valve spindle.

[0013] The servomotor is preferably configured for performing a translational movement of the servomotor spindle relative to a servomotor housing. By such translational movement in direction of the first valve, the first valve spindle is forced by the servomotor spindle along its longitudinal axis towards the second valve spindle of the second valve and thereby move the first valve to the open position. The second valve spindle is arranged such that by continuing this translational movement of the first valve spindle, the first valve spindle can push the second valve spindle towards the third valve spindle, thereby moving the second valve from closed position to the open position. The third valve spindle is arranged that by continuing this translational movement of the second valve spindle, the second valve spindle can push the third valve spindle along its longitudinal axis, thereby moving the third valve from closed position to the open position. Thereby, it is preferred that the third valve can only be opened when the second valve is fully open or at least partially open and that the second valve can only be opened when the first valve is fully open or at least partially open.

[0014] Preferably, the second valve comprises a second valve spring for forcing the second valve into the closed position and/or the third valve comprises a third valve spring for forcing the third valve into the closed position. Preferably, the first valve comprises a first valve spring for forcing the third valve into the closed position. By these means, when the servomotor is inactive, the first valve, second valve and third valve can be moved into the closed position automatically.

[0015] The first rotation protection system is mechanically coupled to the first valve spindle and to the valve chest via the servomotor. Preferably, the first rotation protection system comprises a connector for connecting the servomotor spindle with the first valve spindle. Preferably, the first rotation protection system is located outside the valve chest and, by these means, is not exposed to hot steam of the turbine. The coupling of the servomotor housing to the valve chest can be established directly via further components of the turbine control system. The servomotor spindle is rotationally secured within the servomotor housing. By means of this coupling, rotational movement of the first valve spindle relative to the valve chest is prevented due to form-fit. Thus, rotational forces at the first valve spindle due to steam flow can be compensated outside the valve chest and translational movement of the first valve spindle is improved. In other words, functioning of the first valve spindle is improved by preventing relative rotational movement of the first valve spindle to the valve chest.

[0016] The second rotation protection system is mechanically coupled to the first valve spindle and to the second valve spindle. By means of this coupling, rotational movement the second valve spindle relative to the first valve spindle is prevented due to form-fit. Thus, functioning of the second valve spindle is improved by preventing relative rotational movement of the second valve spindle to the first valve spindle and, therefore, to the valve chest as well.

[0017] The coupling of the second rotation protection system has the advantage that torque forces with respect to the second valve spindle are compensated via the first rotation protection system outside the valve chest. Since the first rotation protection system is located outside the valve chest, it is not exposed to hot steam. Thus, frictional forces of the turbine control system, especially inside the third valve, are reduced and, consequently, dimensions of the first spring and/or second spring and/or third spring can be reduced as well. Moreover, weight of the turbine control system, especially of the second valve spindle, can be reduced.

[0018] In a preferred embodiment of the present invention, the second rotation protection system comprises a first part and a second part, wherein the first part and the second part are configured for a guided relative translational movement relatively to each other and for preventing a relative rotational movement by form-fit to each other. Preferably, the first part and the second part are configured for slideable relative movement along the common axis of the first valve spindle and the second valve spindle. It is further preferred that the first part is fixed to the first valve spindle and that the second part is fixed to the second valve spindle. Within the scope of the present invention, a fixed connection does neither allow translational nor rotational relative movement. Such second rotation protection system has the advantage that it is easy to manufacture, easy to assemble and provides reliable rotation protection.

[0019] It is further preferred that the first part is integrally formed with the first valve spindle and/or the second part is integrally formed with the second valve spindle. An integrally formed part has the advantage that the second rotation protection system is manufactured by manufacturing the first valve spindle and the second valve spindle. Therefore, less parts and less assembly steps are necessary.

[0020] Preferably, the first part comprises at least one tooth and the second part comprises at least one longitudinal clearance, wherein the at least one tooth is configured for a guided translational movement within the clearance. Further preferred, the first part comprises at least two teeth arranged spaced apart from each other and preferably protruding parallel to each other. Such second rotation protection system is easy to manufacture and easy to assemble. The tooth is preferably guided by side limits of the clearance, such as side walls, rods, teeth or the like. Teeth and clearances are easy to manufacture and easy to assemble.

[0021] According to a preferred embodiment of the invention, the turbine control system comprises a third rotation protection system for preventing rotational movement of the third valve spindle relative to the valve chest. The third rotation protection system is preferably coupled with the third valve spindle. By means of this coupling, rotational movement the third valve spindle relative to the valve chest is prevented due to form-fit. Thus, functioning of the third valve spindle is improved by preventing relative rotational movement of the third valve spindle to the valve chest.

[0022] It is preferred that the third rotation protection system is mechanically coupled to a third valve cage and the third valve spindle. The third valve cage is a cage for housing and guiding the third valve .The third valve cage is located within the valve chest. By means of this coupling, rotation protection of the third valve can be provided by simple means and in a cost efficient way.

[0023] Alternatively or additionally it is preferred that the third rotation protection system is mechanically coupled to the second valve spindle and the third valve spindle. By these means, rotational forces at the third valve can be transferred via the third valve spindle, the second valve spindle and the first valve spindle to the valve chest. Thus, frictional forces of the third valve can be further reduced.

[0024] Therefore, the size of the third spring can be reduced as well.

[0025] Preferably, the third rotation protection system is equally constructed or at least partly equally constructed as the second rotation protection system. Such construction has the advantage that the manufacturing process as well as the assembly process of the second rotation protection system and the third rotation protection system is facilitated due to similarity of the processes. Thus, the risk of manufacturing and assembly mistakes is reduced.

[0026] According to a second aspect of the invention, the object is solved by a steam turbine, comprising a rotor with multiple rotor blades, a turbine housing with multiple guide blades, a first steam bypass for guiding steam towards a first axial turbine section, a second steam bypass for guiding steam towards a second axial turbine section and a third steam bypass for guiding steam towards a third axial turbine section. The steam turbine comprises a turbine control system according to the first aspect of the invention.

[0027] Preferably the rotor blades and guide blades are grouped to a plurality of turbine stages, wherein the rotor blades and guide blades of a turbine stage are equally distributed in circumferential direction of the rotor. The Turbine comprises at least three turbine stages, wherein each axial turbine section comprises at least one turbine stage.

[0028] By means of the first bypass, the second bypass and the third bypass, steam can be guided to the first axial turbine section, the second axial turbine section and the third axial turbine section. The steam flow through the bypasses is controlled by the turbine control system, especially by the first valve, the second valve and the third valve. With respect to a flow direction of the steam, the third axial turbine section is located before the second axial turbine section and the second axial turbine section is located before the first axial turbine section. When the first valve is opened, only the first axial turbine section will be directly exposed to the steam. When the first valve and the second valve are opened, the first axial turbine section and the second axial turbine section will be directly exposed to the steam. In case the first valve, the second valve and the third valve are opened, the first axial turbine section, the second axial turbine section and the third axial turbine section will be directly exposed to the steam.

[0029] The inventive steam turbine has the same advantages as already pointed out with respect to the turbine control system according to the first aspect of the invention. Therefore, the inventive steam turbine has the advantage over conventional steam turbines that torque forces with respect to the second valve spindle are compensated via the first rotation protection system outside the valve chest. Since the first rotation protection system is located outside the valve chest, it is not exposed to hot steam. Thus, frictional forces of the turbine control system, especially inside the third valve, are reduced and, consequently, dimensions of the first spring and/or second spring and/or third spring can be reduced as well. Moreover, weight of the turbine control system, especially of the second valve spindle, can be reduced.

[0030] The inventive turbine control system for a steam turbine as well as the inventive steam turbine are described in the following with respect to the accompanying drawings. For the purpose of illustrating the invention, there is shown in the drawings embodiments that are presently preferred, it is understood, however, that the invention is not limited to the specific features disclosed. Included in the drawings are the following schematic Figures:

- Figure 1: a side sectional view of a turbine control system according to prior art,
- Figure 2 a side view of a preferred embodiment of a steam turbine according to the invention,
- Figure 3 a sectional side view of a first valve spindle and a second valve spindle of the steam turbine of Figure 2, and
- Figure 4 a sectional front view of the first valve spindle and second valve spindle of Figure 3.

[0031] In the figures 1 to 4, similar features are assigned the same reference numerals.

[0032] Fig. 1 schematically shows a turbine control system 1 according to prior art in a sectional side view. The turbine control system 1 comprises a first valve 3 with a first valve spindle 4, a second valve 5 with a second valve spindle 6, a third valve 7 with a third valve spindle 8 and a valve chest 10 for housing the first valve 3, the second valve 5 and the third valve 7. The first valve spindle 4, second valve spindle 6 and third valve spindle 8 are arranged at a common valve spindle axis V.

[0033] A servomotor 9 of the turbine control system 1 is located outside the valve chest 10 and is connected to the first valve spindle 4 via a connector 27 of the turbine control system 1 which is engaged the first valve spindle 4. The connector 27 can be an integral part of the servomotor 9 or the first valve spindle 4. Alternatively, the connector can comprise at least two connector parts, wherein a first connector part of the connector 27 is part of the servomotor 9 and a second connector part of the connector 27 is part of the first valve spindle 4.

[0034] In this turbine controls system 1, a first rotation protection system 14 is provided by the connector 27 and the servomotor 9 which is connected to the valve chest 10 and prevents the first valve spindle 4 from rotating. Between the first valve spindle 4 and the second valve spindle 6 is a gap. Thus, rotational forces cannot be transmitted between the first valve spindle 4 and the second valve spindle 6. Moreover, the turbine control system 1 comprises a second rotation protection system 15, preventing a relative rotation of the second valve spindle 6 to the third valve spindle 8. For preventing a relative rotation of the third valve spindle 8 to the valve chest 10, the turbine control system 1 comprises a third rotation protection system 18, located at an end of the third valve spindle 8 which is facing away from the first valve 3 and the second valve 5. The third rotation protection system 18 is engaged with a third valve cage 19 for housing the third valve 7 and the third valve spindle 8.

[0035] Fig. 2 schematically shows a preferred embodiment of a steam turbine 2 according to the invention. The steam turbine 2 comprises a rotor 20 with a rotor axis R, wherein the rotor 20 is divided into a first axial turbine section 24, a second axial turbine section 25 and a third axial turbine section 26, each comprising a set of rotor blades 21 and a set of guide blades 23. The rotor blades 21 are fixed to the rotor 20, the guide blades 23 are fixed to the turbine housing 22.

[0036] A first steam bypass 11 is configured to bypass steam to the rotor blades 21 and guide blades 23 of the first axial turbine section 24, a second steam bypass 12 is configured to bypass steam to the rotor blades 21 and guide blades 23 of the second axial turbine section 22, and a third steam bypass 13 is configured to bypass steam to the rotor blades 21 and guide blades 23 of the third axial turbine section 26. For controlling the steam flow though the bypasses, the steam turbine 2 comprises a turbine control system 1 according to the invention.

[0037] In this embodiment, the turbine control system 1 comprises a first valve 3 with a first valve spindle 4 for controlling steam flow through the first steam bypass 11, a second valve 5 with a second valve spindle 6 for controlling steam flow through the second steam bypass 12 and a third valve 7 with a third valve spindle 8 for controlling steam flow through the third steam bypass 13. The first valve 3, second valve 5 and third valve 7 are located on a common valve axis V within a valve chest 10 of the turbine control system 1. Furthermore, the turbine control system 1 comprises a servomotor 9 located outside the valve chest 10 and mechanically connected to the valve chest 10 as shown in Fig. 1 for driving the first valve spindle 4 in a direction parallel to the valve axis V.

[0038] In an alternative embodiment of the invention, the first steam bypass 11, the second steam bypass 12 and the third steam bypass 13 can be merged in a way that steam streaming through the first steam bypass 11, the second steam bypass 12 and the third steam bypass 13 is guided to a common steam inlet of the steam turbine 2.

[0039] For rotation protection of the first valve spindle 4, the turbine control system 1 comprises a first rotation protection system 14, connected to the valve chest 10 and engaging the first valve spindle 4. In this preferred embodiment, the servomotor 9 and the connector 27 are part of the first rotation protection system 14. For rotation protection of the second valve spindle 6, the turbine control system 1 comprises a second rotation protection system 15, connected to the first valve spindle 4 and the second valve spindle 6. For rotation protection of the third valve spindle 8, in this embodiment, the turbine control system 1 comprises a third rotation protection system 18, connected to the second valve spindle 6 and the third valve spindle 8. Alternatively or additionally to a connection to the second valve spindle 6, the third rotation protection system 18 could be connected to the third valve spindle 8 and the third valve housing 19 as illustrated in Fig. 1. Concerning the first rotation protection system 14, the second rotation protection system 15 and the third rotation protection system 18, the term "connection" is understood as an interlinking which is preventing relative rotation and allowing relative translational movement.

[0040] Fig. 3 schematically shows a first valve spindle 4 and a second valve spindle 6 of the steam turbine 2 of Fig. 2 in a sectional side view, wherein Fig. 4 shows a sectional view of Fig. 3. An end part of the first valve spindle 4 that is facing towards the second valve spindle 6 is configured as first part 15a of the second rotation protection system 15. An end part of the second valve spindle 6 that is facing towards the first valve spindle 4 is configured as second part 15b of the second rotation protection system 15. The first part 15a comprises two teeth 16 spaced apart from each other and protrude parallel to the valve axis V. The second part 15b comprises two clearances 17 extending parallel to the valve axis V. The teeth 16 are slideably guided within the clearances 17, thus preventing relative rotational movement and allowing relative translational movement within a predetermined distance of the first valve spindle 4 and the second valve spindle 6.

Claims

1. Turbine control system (1) for a steam turbine (2) comprising a first valve (3) with a first valve spindle (4), a second valve (5) with a second valve spindle (6) and a third valve (7) with a third valve spindle (8), a servomotor (9) for driving the first valve (3) and a valve chest (10) for housing the first valve (3), the second valve (5) and the third valve (7), wherein the first valve (3) is configured for closing a first steam bypass (11) of the steam turbine (2) in a closed position and for opening the first steam bypass (11) in an open position, wherein the second valve (5) is configured for closing a second steam bypass (12) of the steam turbine (2) in a closed position and for opening the second steam bypass (12) in an open position, wherein the third valve (7) is configured for closing a third steam bypass (13) of the steam turbine (2) in a closed position and for opening the third steam bypass (13) in an open position, wherein the servomotor (9) is configured for actuating the first valve (3), the first valve (3) is configured for actuating the second valve (5) and the second valve (5) is configured for actuating the third valve (7), and wherein the turbine control system (1) comprises a first rotation protection system (14) mechanically coupled to the first valve spindle (4) and the servomotor (9) for preventing rotational movement of the first valve spindle (4) relative to the valve chest (10), wherein the first rotation protection system (14) is located outside the valve chest (10),
characterized in,
that the turbine control system (1) comprises a second rotation protection system (15) mechanically coupled to the first valve spindle (4) and the second valve spindle (6) for preventing rotational movement of the second valve spindle (6) relative to the first valve spindle (4).

2. Turbine control system (1) according to claim 1,
characterized in,
that the second rotation protection system (15) comprises a first part (15a) and a second part (15b), wherein the first part (15a) and the second part (15b) are configured for a guided relative translational movement relatively to each other and for preventing a relative rotational movement by form-fit to each other.

3. Turbine control system (1) according to claim 2,
characterized in,
that the first part (15a) is integrally formed with the first valve spindle (4) and/or the second part (15b) is integrally formed with the second valve spindle (6).

4. Turbine control system (1) according to claim 2 or 3,
characterized in,
that the first part (15a) comprises at least one tooth (16) and the second part (15b) comprises at least one longitudinal clearance (17), wherein the at least one tooth (16) is configured for a guided translational movement within the clearance (17).

5. Turbine control system (1) according to any of the previous claims,
characterized in,
that the turbine control system (1) comprises a third rotation protection system (18) for preventing rotational movement of the third valve spindle (8) relative to the valve chest (10).

6. Turbine control system (1) according to claim 5,
characterized in,
that the third rotation protection system (18) is mechanically coupled to a third valve cage (19) and the third valve spindle (8).

7. Turbine control system (1) according to claim 5 or 6,
characterized in,
that the third rotation protection system (18) is mechanically coupled to the second valve spindle (6) and the third valve spindle (8).

8. Turbine control system (1) according to any of claims 5 to 7,
characterized in,
that the third rotation protection system (18) is equally constructed or at least partly equally constructed as the second rotation protection system (15).

9. Steam turbine (2), comprising a rotor (20) with multiple rotor blades (21), a turbine housing (22) with multiple guide blades (23), a first steam bypass (11) for guiding steam towards a first axial turbine section (24), a second steam bypass (12) for guiding steam towards a second axial turbine section (25) and a third steam bypass (13) for guiding steam towards a third axial turbine section (26),
c**haracterized in**,
that the steam turbine (2) comprises a turbine control system (1) according to any of the previous claims.

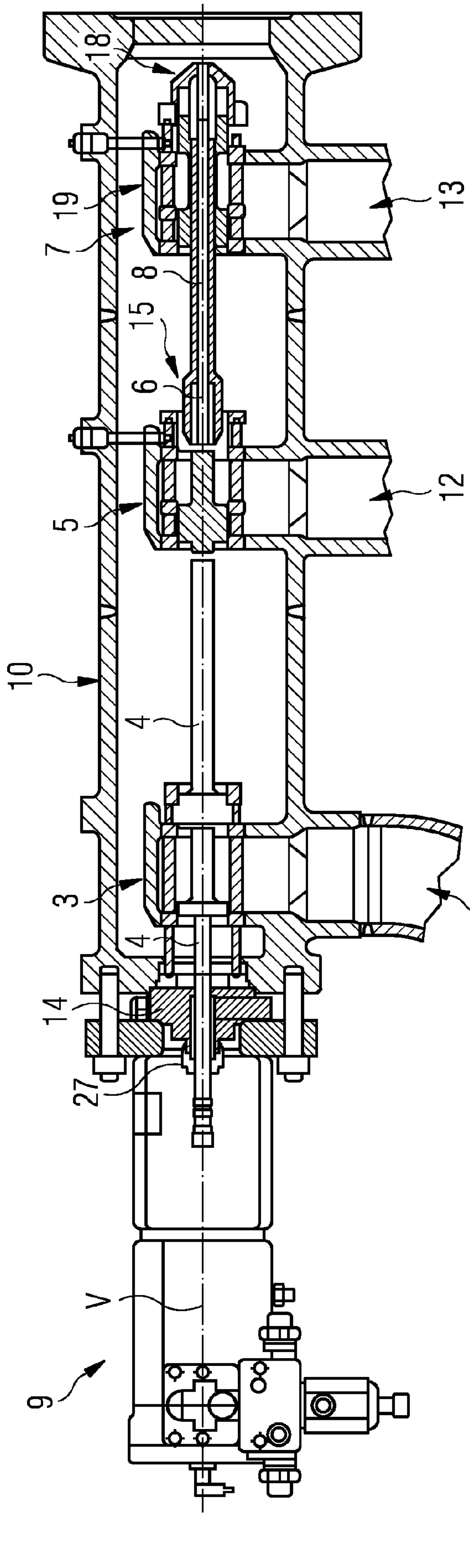


FIG 1 PRIOR ART

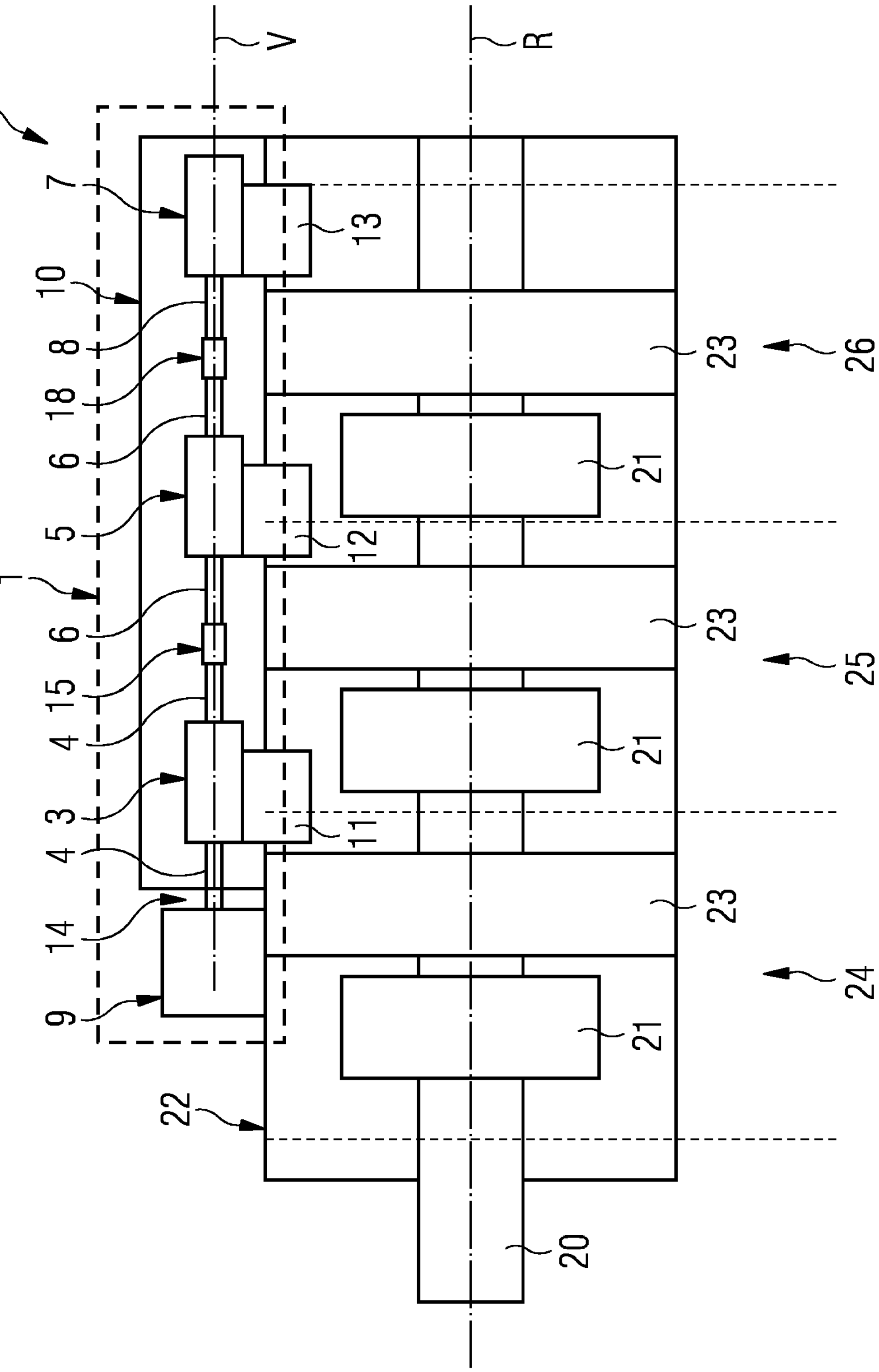


FIG 2

FIG 3

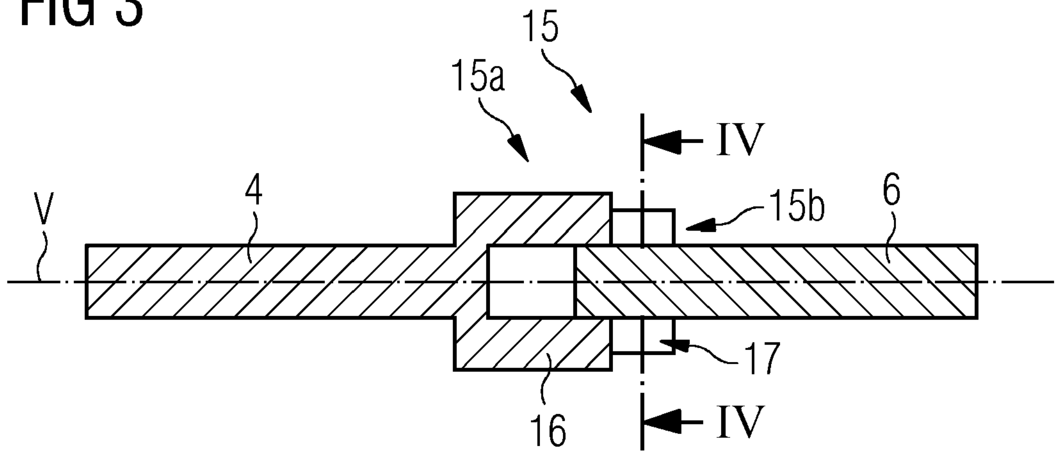
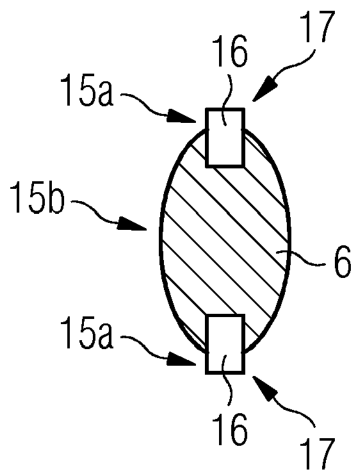


FIG 4



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EUROPEAN SEARCH REPORT

Application Number
EP 17 20 3084

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	WO 2017/071912 A1 (SIEMENS AG [DE]) 4 May 2017 (2017-05-04) * page 6, lines 21-37; figure 1 * * page 7 * * page 10, lines 30-37 * * pages 11,12 *	1-9	INV. F01D17/14 F01D17/18
A	DE 582 436 C (SIEMENS AG) 15 August 1933 (1933-08-15) * figure 1 *	1-9	
A	FR 473 094 A (EMILE MERTZ [CH]) 30 December 1914 (1914-12-30) * figure 2 *	1-9	
A	DE 198 10 580 A1 (SIEMENS AG [DE]) 16 September 1999 (1999-09-16) * figures 2,3 *	1-9	

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	13 August 2018	Chatziapostolou, A

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CATEGORY OF CITED DOCUMENTS

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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 17 20 3084

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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13-08-2018

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2017071912 A1	04-05-2017	CN 108350750 A	31-07-2018
		DE 102015221311 A1	04-05-2017
		EP 3353385 A1	01-08-2018
		WO 2017071912 A1	04-05-2017
DE 582436 C	15-08-1933	NONE	
FR 473094 A	30-12-1914	NONE	
DE 19810580 A1	16-09-1999	AT 221954 T	15-08-2002
		CN 1297509 A	30-05-2001
		DE 19810580 A1	16-09-1999
		EP 1062408 A1	27-12-2000
		JP 4287592 B2	01-07-2009
		JP 2002506167 A	26-02-2002
		US 6336330 B1	08-01-2002
		WO 9946483 A1	16-09-1999

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