(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 339 122 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
29.06.2011 Bulletin 2011/26

(51) Int Cl.:
F01D 9/04 (2006.01) *F01D 25/24* (2006.01)

(21) Application number: 09015958.3

(22) Date of filing: 23.12.2009

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR
Designated Extension States:
AL BA RS

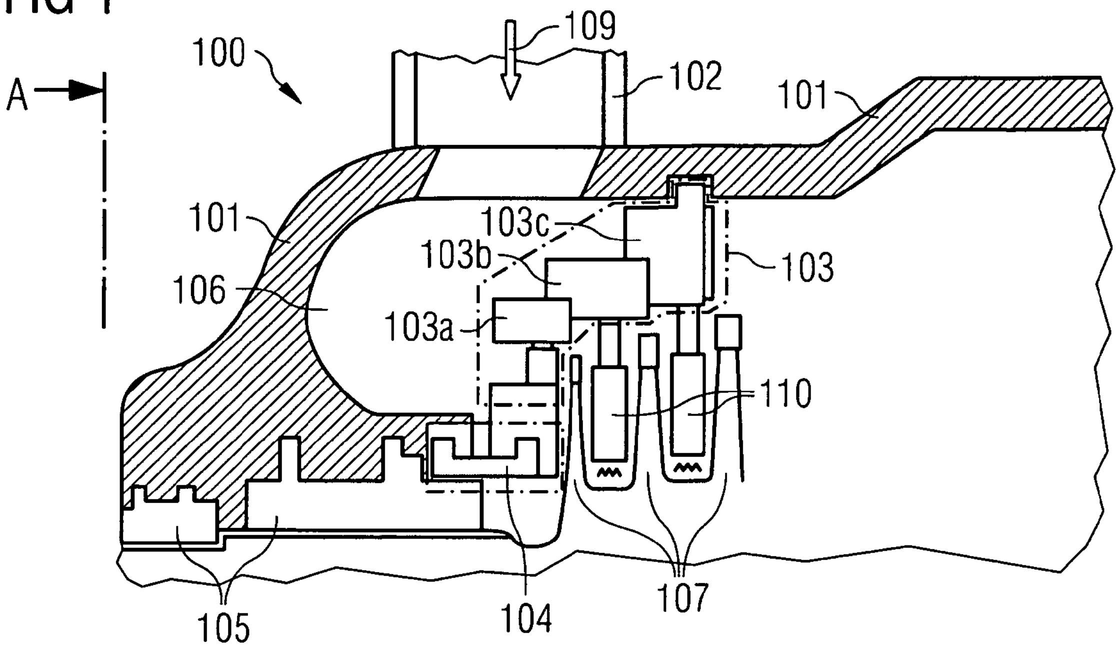
(71) Applicant: SIEMENS AKTIENGESELLSCHAFT
80333 München (DE)

(72) Inventor: Foglander, Thomas
61237 Finspang (SE)

(54) Turbine with adjustable volume inlet chamber

(57) A turbine (100) is provided which comprises a casing (101) having an inlet terminal (102), a diaphragm unit (103), and a sealing ring (104) arranged between the diaphragm unit (103) and an inlet end sealing (105), wherein the casing (101), the diaphragm unit (103) and the sealing ring (104) form at least a portion of a boundary of an adjustable inlet chamber (106) of the turbine (100).

FIG 1



EP 2 339 122 A1

Description

Field of invention

[0001] The present invention relates to a turbine for converting energy from a flowing fluid flowing.

Art Background

[0002] From the state-of-the-art turbines are known which can convert energy from a flowing fluid. Potential energy (pressure head) and kinetic energy (velocity head) may be extracted from a flowing fluid using a turbine and may be converted to mechanical energy, such as rotational energy. In particular, this rotational energy may be used to drive a generator to generate electric energy.

[0003] There are a number of turbine types known in the art. A steam turbine extracts energy from a flowing steam and is often used for the generation of electricity in thermal power plants. The steam may thereby be generated using coal or fuel oil or nuclear power. Gas turbines comprise upstream a compressor and a combustion chamber, where fuel is burned, wherein the burned fuel is used to drive the turbine, in particular the compressor.

[0004] In general a turbine comprises a rotor shaft which is rotatably supported by a bearing. Plural rotor blades are connected to the rotor shaft extending radially outwardly from the rotor shaft. The rotor blades are connected via rotor blade holders to the rotor shaft. A row of rotor blade holder may also be called a disk.

[0005] The rotor blades have a particularly defined surface profile such as to convert energy of a flowing fluid into a mechanical movement of the rotor blade. In a typical turbine plural rotor blades are arranged in a so-called rotor blade row substantially forming a row perpendicular to a rotation axis of the rotor shaft. Typically, a turbine may comprise several rotor blade rows arranged spaced apart in an axial direction from each other. In between each pair of rotor blade row a row of guide vanes is arranged that are connected to a stator part of the turbine. The stator part also comprises the bearing for the rotor shaft. Thus, the rotor blade rows may rotate relative to the static guide vane rows.

[0006] Whatever type of turbine is concerned the flowing fluid used to drive the turbine often has a high temperature, a high pressure and a high velocity. Therefore, the rotor blades, the rotor blade holders as well as the guide vanes must be constructed and designed to withstand the impact of the hot, high pressure, high velocity fluid. A further requirement of modern turbines is a compactness and flexible design of the turbine, in particular with respect of the casing of the turbine. Furthermore, the volume of the fluid inputted into turbines may be different depending on the application.

[0007] Thus, there may be a need for providing a turbine which can be adapted in a flexible way to different inlet flows while maintaining a compact design.

Summary of the Invention

[0008] This need may be met by a turbine according to the independent claim. Advantageous embodiments are described by the dependent claims.

[0009] According to an exemplary aspect a turbine is provided which comprises a casing having an inlet terminal, a diaphragm unit, and a sealing ring arranged between the diaphragm unit and an inlet end sealing, wherein the casing, the diaphragm unit and the sealing ring form at least a portion of a boundary of an adjustable inlet chamber of the turbine.

[0010] In particular, the turbine may comprise one or more rows of rotor blades arranged on a rotor shaft. The diaphragm unit may form a part or portion of a sealing element impeding the flow of the fluid through the turbine by bypassing the rotor blades, e.g. by flowing in a free region between the stator part including the casing and the rotor part including the rotor blades. In particular, the inlet end sealing may be part of the stator.

[0011] By providing a turbine having an adjustable inlet chamber it may be possible to provide a turbine able to handle large amount of fluid flow in the inlet end of the turbine. The fluid may be either gas, e.g. combustion gas in case of a gas turbine, or steam, e.g. in case of a steam turbine. In particular, the use of the connecting or sealing ring together with the adjustable diaphragm unit may provide an efficient way to handle variances or tolerances introduced by the machining of the single elements.

[0012] Next further embodiments of the turbine will be described.

[0013] According to another exemplary embodiment of the turbine the diaphragm unit comprises a plurality of diaphragm elements which are moveable with respect to each other.

[0014] By providing a diaphragm unit having diaphragm elements which are movable with respect to each other or relative to each other it may be possible to provide a diaphragm unit which is adjustable in length so that an efficient way to provide an adjustable inlet chamber, e.g. having an adjustable volume, may be possible. Such an adjustable length of the diaphragm unit may also be an efficient way to take care of possible tolerance differences in building elements of the turbine.

[0015] According to another exemplary embodiment of the turbine the sealing ring is moveable with respect to the inlet end sealing.

[0016] In particular, the sealing ring may be moveable or slidable in an axial direction of the rotor shaft along the inlet end sealing. However, even when mounted slidably along the inlet end sealing a tight or at least substantially tight connection may be formed between the sealing ring and the inlet end sealing. In one embodiment the sealing ring may be slidably mounted directly to the inlet end sealing while in another embodiment the sealing ring may be slidably mounted to the casing in which the inlet end sealing is mounted or fitted. However, both mountings may provide for a sealing ring which is slidable with respect to the inlet end sealing.

[0017] According to another exemplary embodiment of the turbine the sealing ring is formed as a U-profile.

[0018] According to another exemplary embodiment of the turbine an end of the sealing ring is adapted to form fit into a recess in the diaphragm unit. In particular, one leg of a U profile may form fit with a recess in the diaphragm unit.

[0019] According to another exemplary embodiment the turbine further comprises a rotor shaft, wherein the inlet end sealing is part of a sealing arrangement sealing the inlet chamber with respect to the rotor shaft.

[0020] In particular, the inlet sealing may be part of the stator of the turbine, while the rotor shaft is part of the rotor of the turbine. Thus, the inlet sealing may form part of the sealing of the stator with respect to the rotor.

[0021] According to another exemplary embodiment of the turbine the casing comprises a cast portion. In particular, the main or bigger part of the casing may be formed by casting.

[0022] According to another exemplary embodiment of the turbine the inlet terminal is welded to the casing.

[0023] The use of a welded inlet terminal together with a cast main body of the casing may enable a flexible adaptation of a common casing to a specific application or need. For example, a common casing may be used for different lengths of rotor assemblies or for turbine which have to handle different amount of input steam. That is, one type of casing may be used for turbines which have to handle different amounts of input fluid by just choosing an appropriate input terminal for the specific needs or application.

[0024] According to another exemplary embodiment of the turbine the diaphragm unit is mounted to the casing. In particular, the diaphragm unit may be connected to the casing in a form fit way. For example, a projection or a ring on the diaphragm unit may fit into a recess or groove in the inner surface of the casing. In particular, the recess or groove may be formed in a portion welded to the main body or cast body of the casing, for example, the groove may be formed in the region of the inlet terminal.

[0025] A gist of an exemplary aspect may be seen in providing a turbine having an inlet chamber which may be an efficient way to handle increasing and/or decreasing flow demands in the inlet end of the turbine. This flexible handling may be provided by connecting a diaphragm unit or diaphragm package mounted in a casing to a sealing end of a stator of the turbine. The main body of the casing may be cast while an inlet terminal or a region around the inlet terminal may be welded to the main body of the cast casing. The welded inlet terminal or a welded inlet connection may enable the handling of a large amount of flowing fluid, e.g. steam, into the inlet end of the turbine. That is, a great flexibility of nominal size of the inlet connection may be possible while having only little impact on the total building length and smaller casing sizes by just welding another inlet terminal or inlet connection to the casing. Furthermore, this flexibility may be increased by providing a flexible or adjustable diaphragm unit comprising a plurality of diaphragm elements which are moveable with respect to each other. Additionally, a flexible or adjustable sealing or connection ring may be provided which may connect the diaphragm unit mounted to the casing with an inlet end sealing arranged between the stator part of the turbine and the rotor shaft. The sealing or connection ring may be flexible in that sense that it may be moveable with respect to the inlet end sealing, e.g. may be slidably mounted to the inlet end sealing. It should further be noted that an independent aspect may be seen in providing a turbine comprising casing having a cast main body and an inlet terminal or inlet region which is welded to the main body of the casing. In this context the inlet region may be particularly denote the region or portion forming the inlet for gas or steam into an inlet chamber of the turbine.

[0026] Summarizing a turbine according to an exemplary aspect may enable to increase steam flow velocity and volume flow by providing an adjustable inlet chamber at least partially formed by connecting the diaphragm unit or package to the inlet end sealing, e.g. via a slidable or moveable sealing ring. The inlet chamber may link the steam inputted via the inlet terminal into the steam path of the turbine, i.e. the path leading the steam through the one or more turbine blade rows. In particular, the connecting or sealing ring may provide an efficient way to handle variances or tolerances introduced by the machining of the single elements. Additionally, the use of an inlet terminal or inlet connection welded to a main body of the casing may enable flexibility in inlet nominal size while using a standard casing size.

[0027] 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.

Brief Description of the Drawings

[0028]

Fig. 1 shows a schematic longitudinal section of a steam turbine.

Fig. 2 shows a detail of Fig. 1.

Fig. 3 shows a schematic cross-sectional view of Fig. 1.

Detailed Description

[0029] The illustration in the drawings is schematic.

[0030] Fig. 1 shows a schematic longitudinal section of a steam turbine 100. The turbine comprises a casing 101 having an inlet region or inlet terminal 102 which may be casted or welded to the cast casing 101. Furthermore, a diaphragm unit or package 103 is mounted to the casing 101, preferably to the welded inlet region 102, e.g. by form fitting into a recess of the welded inlet region 102. An additional sealing may be provided between the diaphragm unit 103 and the recess formed in the casing. Furthermore, the turbine comprises a rotor part, formed by a rotor shaft which is not shown in Fig. 1, which defines a longitudinal axis of the turbine. The diaphragm unit 103 comprises a plurality of diaphragm elements 103a, 103b, 103c which are flexible or moveable with respect to each other, so that the length of the diaphragm unit at least along the longitudinal axis is variable or changeable.

[0031] Additionally, the diaphragm elements may be moveable or slidably with respect to each other along a radial direction, i.e. perpendicular to the rotor shaft, so that as well a thickness or diameter of the diaphragm unit 103 with respect to the rotor shaft may be altered. The diaphragm unit 103 is further connected to one end of a sealing or connection ring 104 which may be form fit to the diaphragm unit 103 and may have a U-shaped form as depicted in more detail in Fig. 2.

[0032] The other end of the sealing ring 104 may be connected or mounted to an inlet end sealing 105 which is part of the stator of the turbine as well. The connection of the inlet end sealing 105 and the sealing ring 104 may be slidable so that the diaphragm unit 103 can be moved with respect to the inlet end sealing at lest in the axial direction of the turbine.

[0033] The casing 101, the inlet terminal 102, the diaphragm unit 103, and the sealing ring 104 may form walls or borders of an inlet chamber 106 which may, even for a given size of the casing, have a variable size or volume due to the variable or slidable mounted diaphragm unit 103. Furthermore, the inlet terminal may be adaptable to a specific application or specific needs with respect to the flow volume, even for a given size of the casing, as well, since specific different inlet terminals may be welded to the casing. Additionally, rotor blades 107 are schematically depicted in Fig. 1, which may form rows of rotor blades optionally having guide vanes 110 arranged there between to guide the steam or gas from one rotor blade row downstream to the next one. In Fig. 1 the inputted steam is schematically indicated by arrow 109.

[0034] Fig. 3 shows a schematic cross-sectional view of Fig. 1. showing the main body of the casing 101 and the inlet terminal 102 welded to the main body of the casing at weld 308. The diaphragm unit 103 and the main body of the casing 101 together may be part of or may form the casing or stator of the turbine. As already noted, due to the fact that the inlet terminal is welded to the main body of the casing different or specific inlet terminals may be implemented even for the same type or size of the main body of the casing.

[0035] Finally, it should be noted that the above-mentioned embodiments illustrate rather then limit the invention, and that those skilled in the art will be capable of designing many alternative embodiments without departing from the scope of the invention as defined by the appended claims. In the claims, any reference signs placed in parentheses shall not be construed as limiting the claims. The word "comprising" and "comprises", and the like, does not exclude the presence of elements or steps other than those listed in any claim or the specification as a whole. The singular reference of an element does not exclude the plural reference of such elements and vice-versa. In a device claim enumerating several means, several of these means may be embodied by one and the same item. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage.

<u>List of reference signs:</u>

[0036]

100	Turbine
101	Casing
102	Inlet terminal
103	Diaphragm unit
103a	Diaphragm element
103b	Diaphragm element
103c	Diaphragm element
104	Sealing ring
105	Inlet end sealing
106	Inlet chamber
107	Rotor blades
109	Steam
110	Guide vanes
308	Weld

Claims

1. A turbine (100) comprising:

a casing (101) having an inlet terminal (102),
a diaphragm unit (103),
a sealing ring (104) arranged between the dia-

phragm unit (103) and an inlet end sealing (105), wherein the casing (101), the diaphragm unit (103) and the sealing ring (104) form at least a portion of a boundary of an adjustable inlet chamber (106) of the turbine (100).

2. The turbine (100) according to claim 1, wherein the diaphragm unit (103) comprises a plurality of diaphragm elements (103a, 103b, 103c) which are moveable with respect to each other.

3. The turbine (100) according to claim 1 or 2, wherein the sealing ring (104) is moveable with respect to the inlet end sealing (105).

4. The turbine (100) according to any one of the claims 1 to 3, wherein the sealing ring (104) is formed as a U-profile.

5. The turbine (100) according to any one of the claims 1 to 4, wherein an end of the sealing ring (104) is adapted to form fit into a recess in the diaphragm unit (103).

6. The turbine (100) according to any one of the claims 1 to 5, further comprising a rotor shaft, wherein the inlet end sealing (105) is part of a sealing arrangement sealing the inlet chamber (106) with respect to the rotor shaft.

7. The turbine (100) according to any one of the claims 1 to 6, wherein the casing (100) comprises a cast portion.

8. The turbine (100) according to claim 7, wherein the inlet terminal (102) is welded to the casing (101).

9. The turbine (100) according to any one of the claims 1 to 8, wherein the diaphragm unit (103) is mounted to the casing (101).

FIG 1

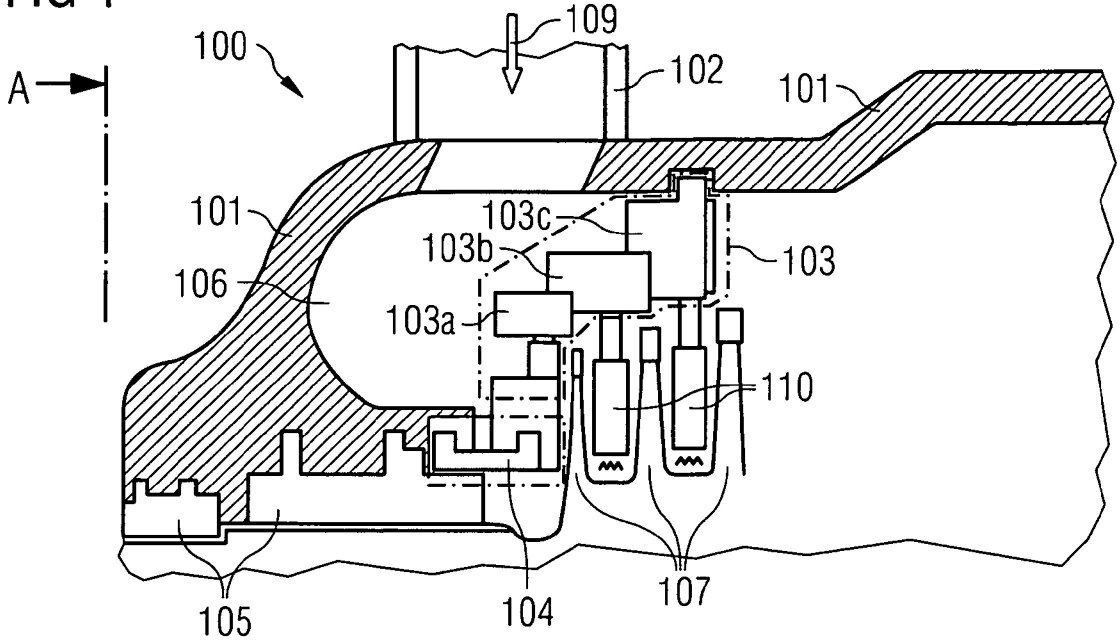


FIG 2

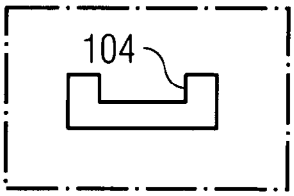
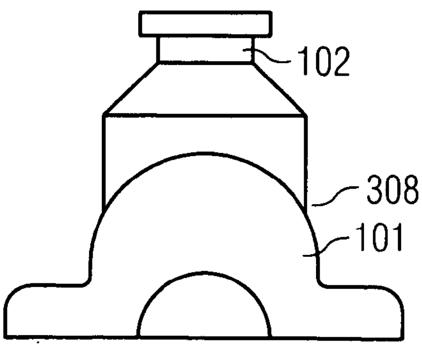


FIG 3 A-A



Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 09 01 5958

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	DE 44 25 343 A1 (ABB PATENT GMBH [DE]) 25 January 1996 (1996-01-25) * column 1, line 66 - column 2, line 54; figures 1,2,10,11 * * column 5, lines 21-29 *	1-9	INV. F01D9/04 F01D25/24
A	US 4 441 856 A (TSUJIMURA KAZUNARI [JP] ET AL) 10 April 1984 (1984-04-10) * figures 1,2 *	1-9	
A	EP 1 249 577 A1 (SIEMENS AG [DE]) 16 October 2002 (2002-10-16) * paragraphs [0011], [0013], [0019]; figure 1 *	1-9	
A	US 7 540 708 B2 (LAURER KURT NEAL [US] ET AL) 2 June 2009 (2009-06-02) * column 3, lines 3-14; figure 2 *	1-9	
A	GB 222 283 A (KARL BAUMANN; VICKERS ELECTRICAL CO LTD) 2 October 1924 (1924-10-02) * figures 1-3 *	1-9	TECHNICAL FIELDS SEARCHED (IPC): F01D
A	EP 2 028 346 A2 (TOSHIBA KK [JP]) 25 February 2009 (2009-02-25) * paragraph [0039]; figure 2 *	1-9	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	9 June 2010	Teusch, Reinhold

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

2

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 09 01 5958

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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

09-06-2010

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 4425343 A1	25-01-1996	NONE	
US 4441856 A	10-04-1984	JP 57073307 U	06-05-1982
		JP 61023601 Y2	15-07-1986
		MX 153529 A	11-11-1986
EP 1249577 A1	16-10-2002	CN 1381670 A	27-11-2002
		ES 2286054 T3	01-12-2007
		JP 4283488 B2	24-06-2009
		JP 2002327603 A	15-11-2002
		US 2002164246 A1	07-11-2002
US 7540708 B2	02-06-2009	CN 101096915 A	02-01-2008
		DE 102007030135 A1	03-01-2008
		JP 2008014310 A	24-01-2008
		KR 20080003266 A	07-01-2008
		US 2008003100 A1	03-01-2008
GB 222283 A	02-10-1924	NONE	
EP 2028346 A2	25-02-2009	AU 2008207425 A1	12-03-2009
		CN 101372897 A	25-02-2009
		JP 2009047122 A	05-03-2009
		US 2009053048 A1	26-02-2009

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82