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(54) **TURBINE BLADE-CASCADE END WALL**

KASKADENENDWAND FÜR EINE TURBINENSCHAUFEL

PAROI D'EXTRÉMITÉ DE GRILLE D'AUBE DE TURBINE

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Description

Technical Field

[0001] The present invention relates to a turbine blade cascade endwall according to the preamble portion of claim 1 or 2.

Background Art

[0002] On a turbine blade cascade endwall in a turbine serving as a motive power generator that obtains motive power by converting kinetic energy of a fluid to rotational motion, a so-called "crossflow (secondary flow)" occurs from the pressure side of one turbine blade to the suction side of an adjacent turbine blade.

[0003] In order to enhance the turbine performance, it is necessary to reduce this crossflow and to reduce secondary-flow loss that occurs in association with the crossflow.

[0004] Therefore, as a turbine blade cascade endwall that reduces such secondary-flow loss associated with crossflow to improve turbine performance, one having non-axisymmetric irregularities formed thereon has been known (for example, see Patent Citation 1).
Patent Citation 1: U.S. Patent No. 6,283,713, Specification.

Disclosure of Invention

[0005] In a turbine blade cascade endwall disclosed in the above-described Patent Citation, a concave portion is formed on a suction-side trailing edge of one turbine blade and a convex portion is formed on a pressure-side trailing edge of an adjacent turbine blade.

[0006] However, in the convex portion formed on the pressure-side trailing edge, static pressure declines thereat, and a discharge angle of a blade outlet ends up increasing, which deteriorates the performance of a blade cascade located downstream of a blade cascade having irregularities, thereby posing the risk of decreasing the overall performance of a turbine having a plurality of blade cascades.

[0007] The present invention has been conceived in light of above-described circumstances, and an object thereof is to provide a turbine blade cascade endwall that is capable of reducing a crossflow and that is also capable of reducing secondary-flow loss that occurs in association with the crossflow, thus being capable of achieving enhanced turbine performance.

[0008] EP 1681438 A2 discloses a turbine blade cascade end wall of a turbine blade stage which is provided with a convex portion having its peak at about 0 to 5% Cax and at a pitch of about 95 to 100%, and a concave or depression portion having its bottom point at about 50% Cax and 0% pitch.

[0009] US 2007/258819 A1 discloses a turbine blade

cascade end wall of a turbine blade stage which has a concave portion with a bottom point at approximately 30 to about 120% of the axial cord length of the blade, and a lateral range from a pressure surface of the blade to about 60% of the passage width. The concave portion is thus rather located towards the downstream end in the axial direction of the cascade end wall.

[0010] In order to solve the above-described problems, the present invention employs a turbine blade cascade end wall as defined by claim 1 or by claim 2.

[0011] In a first aspect the turbine blade cascade end wall has a convex portion, which is gently swollen as a whole, which has an apex at a position of 0 to 20 % pitch at a position of 5 to 25 % Cax, which gently slopes from this apex toward a downstream side and the suction side surface of the adjacently disposed turbine stationary blade or turbine moving blade, and which slopes slightly steeply from the apex toward an upstream side, is provided between one turbine stationary blade or turbine moving blade and another turbine stationary blade or turbine moving blade disposed adjacent to one turbine stationary blade or turbine moving blade.

[0012] With the turbine blade cascade endwall according to the first aspect of the present invention, because the static pressure near the convex portion can be reduced and the flow of working fluid in the axial direction can be increased, it is possible to reduce the crossflow and to reduce secondary-flow loss that occurs in association with the crossflow; therefore, enhanced turbine performance can be achieved.

[0013] A turbine blade cascade endwall according to a second aspect of the present invention has a concave portion, which is gently depressed as a whole, which has a bottom point at a position of 70 to 90 % pitch in a position of 5 to 25 % Cax, which gently slopes from this bottom point toward a downstream side and the pressure side surface of the adjacently disposed turbine stationary blade or turbine moving blade, and which slopes slightly steeply from the bottom point toward an upstream side, is provided between one turbine stationary blade or turbine moving blade and another turbine stationary blade or turbine moving blade disposed adjacent to one turbine stationary blade or turbine moving blade.

[0014] With the turbine blade cascade endwall according to the second aspect of the present invention, because the static pressure near the concave portion can be increased and the flow of working fluid in the axial direction can be increased, it is possible to reduce the crossflow and to reduce secondary-flow loss that occurs in association with the crossflow; therefore, enhanced turbine performance can be achieved.

[0015] It is further preferable that a second convex portion that is gently swollen as a whole or a convex portion be provided near a throat of the turbine blade cascade endwall according to the first aspect or the second aspect described above.

[0016] According to the turbine blade cascade endwall as described above, because the flow rate of the working

fluid passing near the throat increases, thereby reducing the static pressure thereof and alleviating a pressure gradient generated at the suction side surface of the turbine stationary blade or the turbine moving blade in a blade-height direction, vortices generated at the suction side surface of the turbine stationary blade or the turbine moving blade can be suppressed, and therefore, it is possible to reduce secondary-flow loss associated with these vortices.

[0017] A turbine according to a third aspect of the present invention is provided with the turbine blade cascade endwall according to the first aspect or the second aspect described above.

[0018] With the turbine according to the third aspect of the present invention, because it is equipped with a turbine blade cascade endwall that is capable of reducing the crossflow and is capable of reducing secondary-flow loss that occurs in association with the crossflow, it is possible to achieve enhanced overall turbine performance.

[0019] With the present invention, an advantage is afforded in that it is possible to reduce the crossflow and to reduce secondary-flow loss that occurs in association with the crossflow, and therefore, enhanced turbine performance can be achieved.

Brief Description of Drawings

[0020]

[Fig. 1] Fig. 1 is a plan view of relevant portions of a turbine blade cascade endwall according to a first embodiment of the present invention.

[Fig. 2] Fig. 2 is a plan view of relevant portions of a turbine blade cascade endwall according to a second embodiment of the present invention.

[Fig. 3] Fig. 3 is a plan view of relevant portions of a turbine blade cascade endwall according to a third embodiment of the present invention.

[Fig. 4] Fig. 4 is a plan view of relevant portions of a turbine blade cascade endwall according to a fourth embodiment of the present invention.

[Fig. 5] Fig. 5 is a plan view of relevant portions of a turbine blade cascade endwall according to another embodiment of the present invention.

[Fig. 6] Fig. 6 is a diagram showing isobaric lines at a suction side surface of a turbine stationary blade shown in Fig. 5.

Best Mode for Carrying Out the Invention

[0021] A first embodiment of a turbine blade cascade endwall according to the present invention will be described below, with reference to Fig. 1.

[0022] As shown in Fig. 1, each turbine blade cascade endwall (hereinafter, referred to as "third-stage stationary-blade tip endwall") 10 according to this embodiment has a first convex portion 11 between one turbine third-

stage stationary blade (hereinafter, referred to as "third-stage stationary blade") B1 and another third-stage stationary blade B1 disposed adjacent to this third-stage stationary blade B1.

[0023] Note that, solid lines drawn on the third-stage stationary-blade tip endwall 10 in Fig. 1 indicate contour lines of the first convex portion 11, contour lines of a second convex portion 12, to be described later, and contour lines of a third convex portion 13, to be described later.

[0024] The first convex portion 11 has an apex (peak) P1 at a position of 0 to 20 % pitch (substantially 7 % pitch in this embodiment) at a position of 5 to 25 % Cax (substantially 14 % Cax in this embodiment) and is, as a whole, a gently (smoothly) swollen portion which moderately slopes, from the apex P1, toward the downstream side and the suction side surface of the adjacently disposed third-stage stationary blade B1, and which slopes slightly steeply (slopes at a sloping angle that is larger (steeper) than a sloping angle toward the downstream side and the suction side surface of the adjacently disposed third-stage stationary blade B1 from the apex P1) toward the upstream side from the apex P1.

[0025] Here, 0 % Cax indicates a leading edge position of the third-stage stationary blade B1 in the axial direction, and 100 % Cax indicates a trailing edge position of the third-stage stationary blade B1 in the axial direction. - (minus) indicates a position on the upstream side going up from the leading edge position of the third-stage stationary blade B1 in the axial direction, and + (plus) indicates a position on the downstream side going down from the leading edge position of the third-stage stationary blade B1 in the axial direction. Furthermore, 0 % pitch indicates a position on the pressure side surface of the third-stage stationary blade B1, and 100 % pitch indicates a position on the suction side surface of the third-stage stationary blade B1.

[0026] The height (degree of convexity) of the apex P1 of this first convex portion 11 is set at 5 % to 20 % (about 13 % in this embodiment) of the axial chord length of the third-stage stationary blade B1 (length of the third-stage stationary blade B1 in the axial direction).

[0027] Note that, as shown in Fig. 1, the third-stage stationary-blade tip endwall 10 according to this embodiment has, in addition to the first convex portion 11, a second convex portion 12 that moderately slopes toward a base of the first convex portion 11 from a position of substantially 100 % pitch at a position of substantially 0 % Cax, and a third convex portion 13 that moderately slopes toward the base of the first convex portion 11 from a position of substantially 100 % pitch at a position of substantially 90 % Cax.

[0028] With the third-stage stationary-blade tip endwall 10 according to this embodiment, because the static pressure near the first convex portion 11 can be reduced and the flow of working fluid in the axial direction can be increased, it is possible to reduce cross flow and to reduce secondary-flow loss that occurs in association with

the crossflow; therefore, enhanced turbine performance can be achieved.

[0029] A second embodiment of a turbine blade cascade endwall according to the present invention will be described with reference to Fig. 2.

[0030] As shown in Fig. 2, each turbine blade cascade endwall (hereinafter, referred to as "third-stage stationary-blade hub endwall") 20 according to this embodiment has a fourth convex portion 21 between one turbine third-stage stationary blade (hereinafter, referred to as "third-stage stationary blade") B1 and another third-stage stationary blade B1 disposed adjacent to this third-stage stationary blade B1. Note that, solid lines drawn on the third-stage stationary-blade hub endwall 20 in Fig. 2 indicate contour lines of the fourth convex portion 21 and contour lines of a fifth convex portion 22, to be described later.

[0031] The fourth convex portion 21 has an apex (peak) P2 at a position of 0 to 20 % pitch (substantially 3 % pitch in this embodiment) at a position of 5 to 25 % Cax (substantially 14 % Cax in this embodiment) and is, as a whole, a gently (smoothly) swollen portion which moderately slopes from the apex P2 toward the downstream side and the suction side surface of the adjacently disposed third-stage stationary blade B1, and which slopes slightly steeply (slopes at a sloping angle that is larger (steeper) than a sloping angle toward the downstream side and the suction side surface of the adjacently disposed third-stage stationary blade B1 from the apex P2) toward the upstream side from the apex P2.

[0032] The height (degree of convexity) of the apex P2 of this fourth convex portion 21 is set at 5 % to 20 % (about 12.5 % in this embodiment) of the axial chord length of the third-stage stationary blade B1 (length of the third-stage stationary blade B1 in the axial direction).

[0033] Note that, as shown in Fig. 2, the third-stage stationary-blade hub endwall 20 according to this embodiment has the fifth convex portion 22 that moderately slopes toward a base of the fourth convex portion 21 from a suction side surface located between substantially -10 % Cax and substantially 85 % Cax of the adjacently disposed third-stage stationary blade B1.

[0034] With the third-stage stationary-blade hub endwall 20 according to this embodiment, because the static pressure near the fourth convex portion 21 can be reduced and the flow of working fluid in the axial direction can be increased, it is possible to reduce crossflow and to reduce secondary-flow loss that occurs in association with the crossflow; therefore, enhanced turbine performance can be achieved.

[0035] A third embodiment of a turbine blade cascade endwall according to the present invention will be described with reference to Fig. 3.

[0036] As shown in Fig. 3, each turbine blade cascade endwall (hereinafter, referred to as "fourth-stage stationary-blade tip endwall") 30 according to this embodiment has a first concave portion 31 between one turbine fourth-stage turbine stationary blade (hereinafter, referred to

as "fourth-stage stationary blade") B2 and another fourth-stage stationary blade B2 disposed adjacent to this fourth-stage stationary blade B2. Note that, solid lines drawn on the fourth-stage stationary-blade tip endwall 30 in Fig. 3 indicate contour lines of the first concave portion 31 and contour lines of a sixth convex portion 32, to be described later.

[0037] The first concave portion 31 has a bottom point (depression peak) P3 at a position of 70 to 90 % pitch (substantially 83 % pitch in this embodiment) at a position of 5 to 25 % Cax (substantially 17 % Cax in this embodiment) and is, as a whole, a gently (smoothly) depressed portion which moderately slopes from the bottom point P3 toward the downstream side and the pressure side surface of the adjacently disposed fourth-stage stationary blade B2, and which slopes slightly steeply (slopes at a sloping angle that is larger (steeper) than a sloping angle toward the downstream side and the pressure side surface of the adjacently disposed fourth-stage stationary blade B2 from the bottom point P3) toward the upstream side from the bottom point P3.

[0038] The depth (degree of concavity) of the bottom point P3 of this first concave portion 31 is set at 5 % to 15 % (about 6 % in this embodiment) of the axial chord length of the fourth-stage stationary blade B2 (length of the fourth-stage stationary blade B2 in the axial direction).

[0039] Note that, as shown in Fig. 3, the fourth-stage stationary-blade tip endwall 30 according to this embodiment has a sixth convex portion 32 that has an apex (peak) P4 at a position of substantially 90 % pitch at a position of substantially 90 % Cax and that moderately slopes toward the bottom point P3 and a pressure side surface of the adjacently disposed fourth-stage stationary blade B2.

[0040] With the fourth-stage stationary-blade tip endwall 30 according to this embodiment, because the static pressure near the first concave portion 31 can be increased and the flow of working fluid in the axial direction can be increased, it is possible to reduce crossflow and to reduce secondary-flow loss that occurs in association with the crossflow; therefore, enhanced turbine performance can be achieved.

[0041] A fourth embodiment of a turbine blade cascade endwall according to the present invention will be described with reference to Fig. 4.

[0042] As shown in Fig. 4, each turbine blade cascade endwall (hereinafter, referred to as "fourth-stage stationary-blade hub endwall") 40 according to this embodiment has a second concave portion 41 between one turbine fourth-stage stationary blade (hereinafter, referred to as "fourth-stage stationary blade") B2 and another fourth-stage stationary blade B2 disposed adjacent to this fourth-stage stationary blade B2. Note that, solid lines drawn on the fourth-stage stationary-blade hub endwall 40 in Fig. 4 indicate isobathic lines of the second concave portion 41.

[0043] The second concave portion 41 has a bottom

point (depression peak) P5 at a position of 70 to 90 % pitch (substantially 81 % pitch in this embodiment) at a position of 5 to 25 % Cax (substantially 18 % Cax in this embodiment) and is, as a whole, a gently (smoothly) depressed portion which moderately slopes from the bottom point P5 toward the downstream side and the pressure side surface of the adjacently disposed fourth-stage stationary blade B2, and which slopes slightly steeply (slopes at a sloping angle that is larger (steeper) than a sloping angle toward the downstream side and the pressure side surface of the adjacently disposed fourth-stage stationary blade B2 from the bottom point P5) toward the upstream side from the bottom point P5.

[0044] The depth (degree of concavity) of the bottom point P5 of this second concave portion 41 is set at 5 % to 15 % (about 9.4 % in this embodiment) of the axial chord length of the fourth-stage stationary blade B2 (length of the fourth-stage stationary blade B2 in the axial direction).

[0045] With the fourth-stage stationary-blade hub endwall 40 according to this embodiment, because the static pressure near the second concave portion 41 can be increased and the flow of working fluid in the axial direction can be increased, it is possible to reduce crossflow and to reduce secondary-flow loss that occurs in association with the crossflow; therefore, enhanced turbine performance can be achieved.

[0046] With a turbine equipped with the turbine blade cascade endwall 10, 20, 30, or 40 according to the embodiments described above, because it is equipped with the turbine blade cascade endwall 10, 20, 30, or 40 that is capable of reducing crossflow and is capable of reducing secondary-flow loss that occurs in association with the crossflow, it is possible to achieve enhanced overall turbine performance.

[0047] As shown in Fig. 5, in the above-described embodiments, it is further preferable that a seventh convex portion 51 (not shown) be provided (formed) on the turbine blade cascade endwall 10, 20, 30, or 40 near a throat thereof.

[0048] By providing such a seventh convex portion 51 on the turbine blade cascade endwall 10, 20, 30, or 40 near the throat thereof, because the flow rate of working fluid passing near the throat increases, thereby reducing the static pressure thereof and alleviating a pressure gradient generated at the suction side surfaces of the third-stage stationary blade B1 and the fourth-stage stationary blade B2 in a blade-height direction (up-down direction in Fig. 6), as in the contour lines shown by the solid lines in the blade surface in Fig. 6, vortices generated at the suction side surfaces of the third-stage stationary blade B1 and the fourth-stage stationary blade B2 can be suppressed, and therefore, it is possible to reduce secondary-flow loss associated with these vortices.

[0049] The present invention is not limited to the above-described embodiments, and appropriate modifications, alterations, and combinations thereof that do not depart from the gist of the present invention are possible.

[0050] In the above-described embodiments, a turbine blade cascade endwall has been described as exemplified in the third-stage stationary-blade tip endwall, the third-stage stationary-blade hub endwall, the fourth-stage stationary-blade tip endwall, and the fourth-stage stationary-blade hub endwall; however, the present invention is not limited thereto, and it can be applied to a hub endwall of turbine moving blades, a tip endwall of turbine moving blades, a stationary-blade tip endwall of other stages, or a stationary-blade hub endwall of other stages.

[0051] Furthermore, the turbine blade cascade endwall according to the present invention can be applied to both a gas turbine and a steam turbine.

Claims

1. A turbine blade cascade endwall (10;20) that is positioned on a tip side or a hub side of a stage including a plurality of turbine stationary or moving blades (B1) arranged in the form of a ring, in which 0% Cax is defined as a leading edge position of the turbine blades (B1) in an axial direction and 100% Cax is defined as a trailing edge position of the turbine blades (B1) in the axial direction of the stage from an upstream side to a downstream side, and 0% pitch is defined as a position on a pressure side surface of each turbine blade (B1) and 100% pitch is defined as a position on a suction side surface of the adjacent turbine blade (B1) facing the pressure side surface of the respective turbine blade (B1) in the circumferential direction of the stage, wherein said turbine blade cascade endwall (10;20) comprises a convex portion (11;21) which is provided between each turbine blade (B1) and the respective adjacent turbine blade (B1) and has the form of a swelling as a whole, **characterized in that** said convex portion (11;21) has an apex (P1;P2) at a position of 0 to 20% pitch and at a position of 5 to 25% Cax, has a moderate slope from the apex (P1;P2) toward the downstream side and toward the suction side surface of the adjacent turbine blade (B1), has a slope from the apex (P1;P2) toward the upstream side which has a sloping angle that is larger than the sloping angle toward the downstream side and the suction side surface of the adjacent turbine blade, and has a height at the apex (P1;P2) which is set at 5 to 20% of the axial chord length of the turbine blades (B1) of the stage.
2. A turbine blade cascade endwall (30;40) that is positioned on a tip side or a hub side of a stage including a plurality of turbine stationary or moving blades (B2)

arranged in the form of a ring, in which 0% Cax is defined as a leading edge position of the turbine blades (B2) in an axial direction and 100% Cax is defined as a trailing edge position of the turbine blades (B2) in the axial direction of the stage from an upstream side to a downstream side, and 0% pitch is defined as a position on a pressure side surface of each turbine blade (B2) and 100% pitch is defined as a position on a suction side surface of the adjacent turbine blade (B2) facing the pressure side surface of the respective turbine blade (B2) in the circumferential direction of the stage, wherein said turbine blade cascade endwall (30;40) comprises a concave portion (31;41) which is provided between each turbine blade (B2) and the respective adjacent turbine blade (B2) and has the form of a depression as a whole,

characterized in that

said concave portion (31;41)

has a bottom point (P3;P5) at a position of 70 to 90% pitch and at a position of 5 to 25% Cax,

has a moderate slope from the bottom point (P3;P5) toward the downstream side and toward the pressure side surface of the adjacent turbine blade (B2), has a slope from the bottom point (P3;P5) toward the upstream side which has a sloping angle that is larger than the sloping angle toward the downstream side and the pressure side surface of the adjacent turbine blade, and

has a depth at the bottom point (P3;P5) which is set at 5 to 15% of the axial chord length of the turbine blades (B2) of the stage.

3. A turbine blade cascade endwall (10;20;30;40) according to claim 1 or 2, comprising a further convex portion (51) which is provided between adjacent turbine blades (B1;B2) near a throat of the cascade endwall and has the form of a swelling as a whole.
4. A turbine provided with a turbine blade cascade endwall (10;20;30;40) according to any one of claims 1 to 3.

Patentansprüche

1. Eine Kaskadenendwand für eine Turbinenschaufel (10;20), die an einer Außenseite oder einer Naben-seite einer Stufe mit einer Vielzahl von Turbinenleit- oder -laufschaufeln (B1), welche in der Form eines Rings angeordnet sind, positioniert ist, wobei 0% Cax als eine Vorderkantenposition der Turbinenschaufeln (B1) in einer Axialrichtung und 100% Cax als eine Hinterkantenposition der Turbinenschaufeln (B1) in der Axialrichtung der Stufe von einer stromaufwärtigen Seite zu einer stromabwärtigen Seite definiert ist, und wobei 0% Teilungsabstand als eine

Position an einer Druckseitenfläche jeder Turbinenschaufel (B1) und 100% Teilungsabstand als eine Position an einer Saugseitenfläche der benachbarten Turbinenschaufel (B1), welche der Druckseitenfläche der jeweiligen Turbinenschaufel (B1) in der Umfangsrichtung der Stufe zugewandt ist, definiert ist,

wobei die Kaskadenendwand für eine Turbinenschaufel (10;20) einen konvexen Abschnitt (11;21) aufweist, der zwischen jeder Turbinenschaufel (B1) und der jeweiligen benachbarten Turbinenschaufel (B1) vorgesehen ist und insgesamt die Form einer Aufwölbung besitzt,

dadurch gekennzeichnet, dass

der konvexe Abschnitt (11;21)

einen Scheitelpunkt (P1;P2) an einer Position von 0 bis 20% Teilungsabstand und an einer Position von 5 bis 25% Cax besitzt,

eine moderate Neigung von dem Scheitelpunkt (P1;P2) zu der stromabwärtigen Seite und zu der Saugseitenfläche der benachbarten Turbinenschaufel (B1) besitzt,

eine Neigung von dem Scheitelpunkt (P1;P2) zu der stromaufwärtigen Seite besitzt, die einen Neigungswinkel hat, der größer ist als der Neigungswinkel zu der stromabwärtigen Seite und der Saugseitenfläche der benachbarten Turbinenschaufel, und

eine Höhe an dem Scheitelpunkt (P1; P2) besitzt, die bei 5 bis 20% der axialen Sehnenlänge der Turbinenschaufeln (B1) der Stufe liegt.

2. Eine Kaskadenendwand für eine Turbinenschaufel (30;40), die an einer Außenseite oder einer Naben-seite einer Stufe mit einer Vielzahl von Turbinenleit- oder -laufschaufeln (B2), welche in der Form eines Rings angeordnet sind, positioniert ist, wobei 0% Cax als eine Vorderkantenposition der Turbinenschaufeln (B2) in einer Axialrichtung und 100% Cax als eine Hinterkantenposition der Turbinenschaufeln (B2) in der Axialrichtung der Stufe von einer stromaufwärtigen Seite zu einer stromabwärtigen Seite definiert ist, und wobei 0% Teilungsabstand als eine Position an einer Druckseitenfläche jeder Turbinenschaufel (B2) und 100% Teilungsabstand als eine Position an einer Saugseitenfläche der benachbarten Turbinenschaufel (B2), welche der Druckseitenfläche der jeweiligen Turbinenschaufel (B2) in der Umfangsrichtung der Stufe zugewandt ist, definiert ist,

wobei die Kaskadenendwand für eine Turbinenschaufel (30;40) einen konkaven Abschnitt (31;41) aufweist, der zwischen jeder Turbinenschaufel (B2) und der jeweiligen benachbarten Turbinenschaufel (B2) vorgesehen ist und insgesamt die Form einer Vertiefung besitzt,

dadurch gekennzeichnet, dass

der konkave Abschnitt (31;41)

einen Tiefpunkt (P3;P5) an einer Position von 70 bis

90% Teilungsabstand und an einer Position von 5 bis 25% Cax hat,
 eine moderate Steigung von dem Tiefpunkt (P3;P5) zu der stromabwärtigen Seite und zu der Druckseitenfläche der benachbarten Turbinenschaufel (B2) hat,
 eine Steigung von dem Tiefpunkt (P3;P5) zu der stromaufwärtigen Seite hat, welche einen Steigungswinkel besitzt, der größer ist als der Steigungswinkel zu der stromabwärtigen Seite und der Druckseitenfläche der benachbarten Turbinenschaufel, und
 eine Tiefe an dem Tiefpunkt (P3;P5) hat, die bei 5 bis 15% der axialen Sehnenlänge der Turbinenschaufeln (B2) der Stufe liegt.

3. Eine Kaskadenendwand für eine Turbinenschaufel (10;20;30;40) gemäß Anspruch 1 oder 2, mit einem weiteren konvexen Abschnitt (51), der zwischen benachbarten Turbinenschaufeln (B1;B2) nahe einem Hals ("throat") der Kaskadenendwand vorgesehen ist und insgesamt die Form einer Aufwölbung besitzt.
4. Eine mit einer Kaskadenendwand für eine Turbinenschaufel (10;20;30;40) gemäß einem der Patentansprüche 1 bis 3 versehene Gasturbine.

Revendications

1. Paroi d'extrémité de grille d'aube de turbine (10 ; 20) qui est positionnée sur un côté bout ou un côté moyeu d'un étage incluant une pluralité d'aubes mobiles ou fixes de turbine (B1) agencées sous la forme d'un anneau, dans lequel un Cax de 0 % est défini comme une position de bord d'attaque des aubes de turbine (B1) dans une direction axiale et un Cax de 100 % est défini comme une position de bord de fuite des aubes de turbine (B1) dans la direction axiale de l'étage depuis un côté amont jusqu'à un côté aval, et un pas de 0 % est défini comme une position sur une surface côté pression de chaque aube de turbine (B1) et un pas de 100 % est défini comme une position sur une surface côté aspiration de l'aube de turbine (B1) adjacente faisant face à la surface côté pression de l'aube de turbine (B1) respective dans la direction circonférentielle de l'étage, dans laquelle ladite paroi d'extrémité de grille d'aube de turbine (10 ; 20) comprend une portion convexe (11 ; 21) qui est disposée entre chaque aube de turbine (B1) et l'aube de turbine (B1) adjacente respective et a la forme d'un renflement dans son ensemble, **caractérisée en ce que** ladite portion convexe (11 ; 21) comporte un sommet (P1 ; P2) à une position de pas de 0 à 20 % et à une position de Cax de 5 à 25 %, a une pente modérée depuis le sommet (P1 ; P2) vers le côté aval et vers la surface côté aspiration

de l'aube de turbine (B1) adjacente, a une pente depuis le sommet (P1 ; P2) vers le côté amont qui a un angle de pente qui est supérieur à l'angle de pente vers le côté aval et la surface côté aspiration de l'aube de turbine adjacente, et a une hauteur au sommet (P1 ; P2) qui est établie à 5 à 20 % de la longueur de la corde axiale des aubes de turbine (B1) de l'étage.

2. Paroi d'extrémité de grille d'aube de turbine (30 ; 40) qui est positionnée sur un côté bout ou un côté moyeu d'un étage incluant une pluralité d'aubes mobiles ou fixes de turbine (B2) agencées sous la forme d'un anneau, dans lequel un Cax de 0 % est défini comme une position de bord d'attaque des aubes de turbine (B2) dans une direction axiale et un Cax de 100 % est défini comme une position de bord de fuite des aubes de turbine (B2) dans la direction axiale de l'étage depuis un côté amont jusqu'à un côté aval, et un pas de 0 % est défini comme une position sur une surface côté pression de chaque aube de turbine (B2) et un pas de 100 % est défini comme une position sur une surface côté aspiration de l'aube de turbine (B2) adjacente faisant face à la surface côté pression de l'aube de turbine (B2) respective dans la direction circonférentielle de l'étage, dans laquelle ladite paroi d'extrémité de grille d'aube de turbine (30 ; 40) comprend une portion concave (31 ; 41) qui est disposée entre chaque aube de turbine (B2) et l'aube de turbine (B2) adjacente respective et a la forme d'un creux dans son ensemble, **caractérisée en ce que** ladite portion concave (31 ; 41) comporte un point inférieur (P3 ; P5) à une position de pas de 70 à 90 % et à une position de Cax de 5 à 25 %, a une pente modérée depuis le point inférieur (P3 ; P5) vers le côté aval et vers la surface côté pression de l'aube de turbine (B2) adjacente, a une pente depuis le point inférieur (P3 ; P5) vers le côté amont qui a un angle de pente qui est supérieur à l'angle de pente vers le côté aval et la surface côté pression de l'aube de turbine adjacente, et a une profondeur au niveau du point inférieur (P3 ; P5) qui est établie à 5 à 15 % de la longueur de la corde axiale des aubes de turbine (B2) de l'étage.
3. Paroi d'extrémité de grille d'aube de turbine (10 ; 20 ; 30 ; 40) selon la revendication 1 ou 2, comprenant une portion convexe supérieure (51) qui est disposée entre des aubes de turbine (B1 ; B2) adjacentes à proximité d'une gorge de la paroi d'extrémité de grille et a la forme d'un renflement dans son ensemble.
4. Turbine pourvue d'une paroi d'extrémité de grille d'aube de turbine (10 ; 20 ; 30 ; 40) selon l'une quelconque des revendications 1 à 3.

FIG. 1

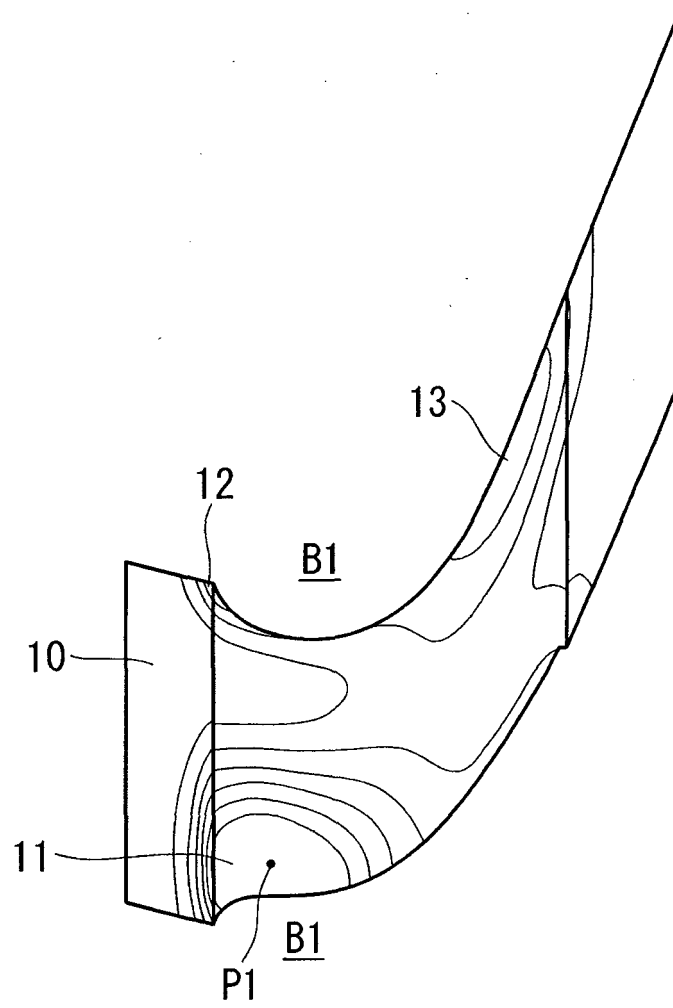


FIG. 2

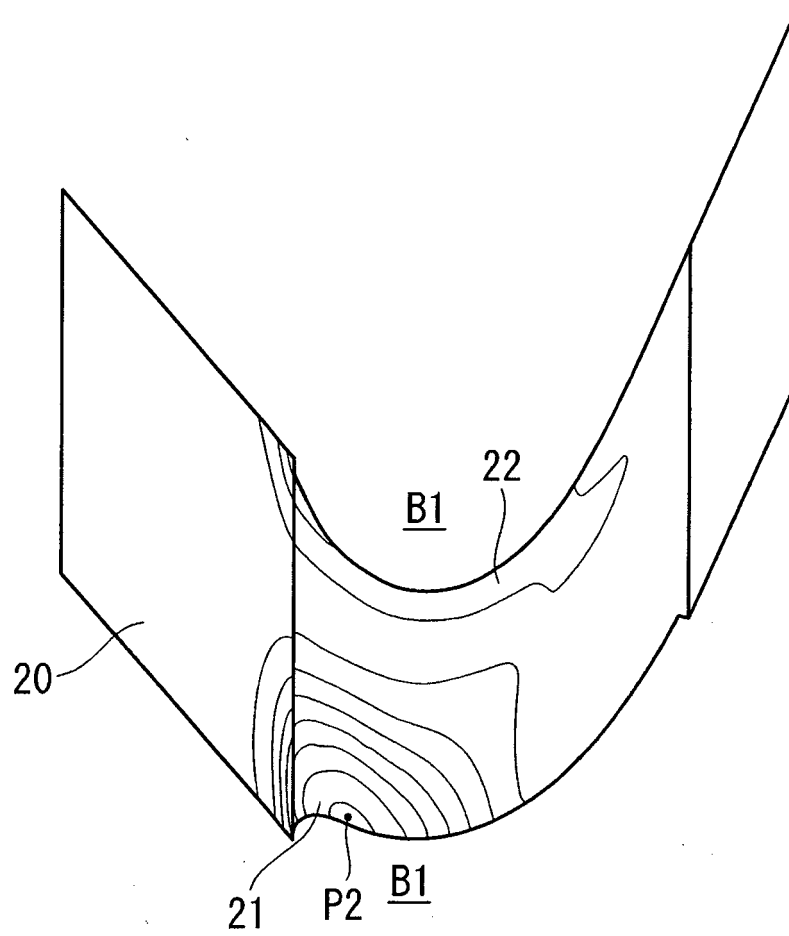


FIG. 3

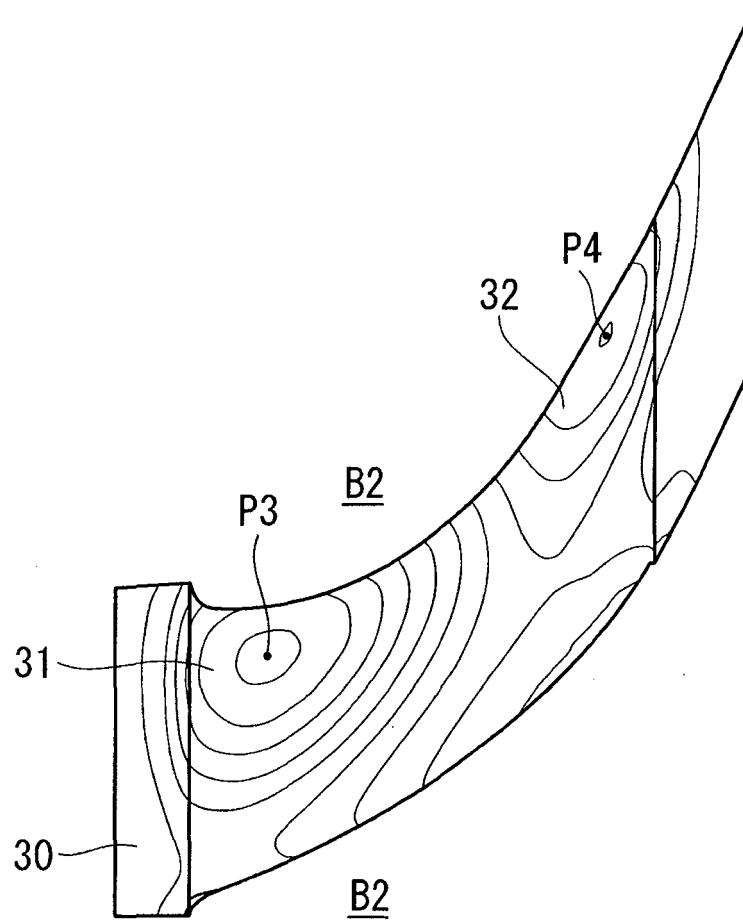


FIG. 4

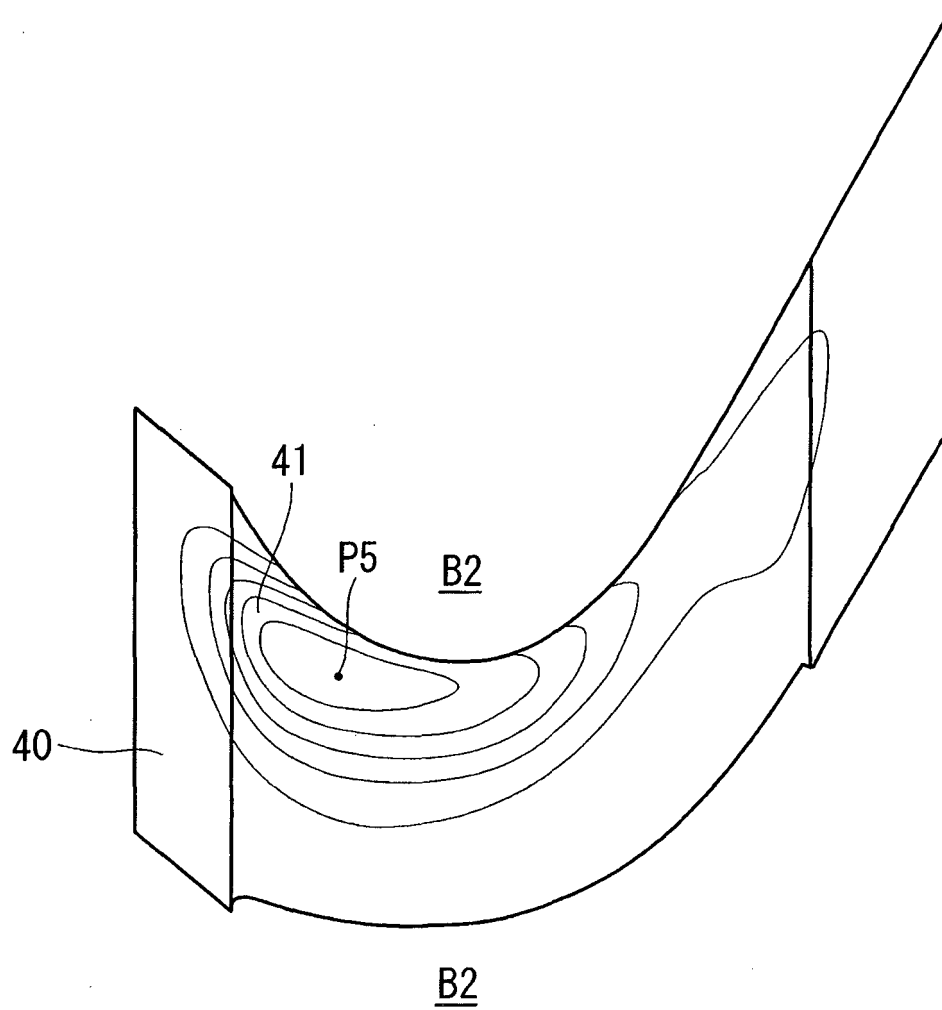


FIG. 5

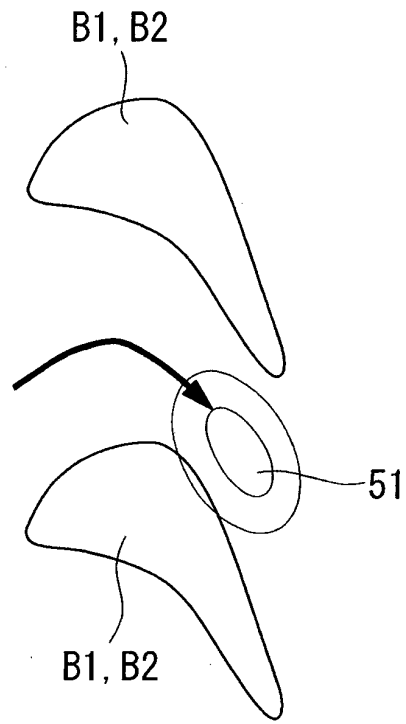
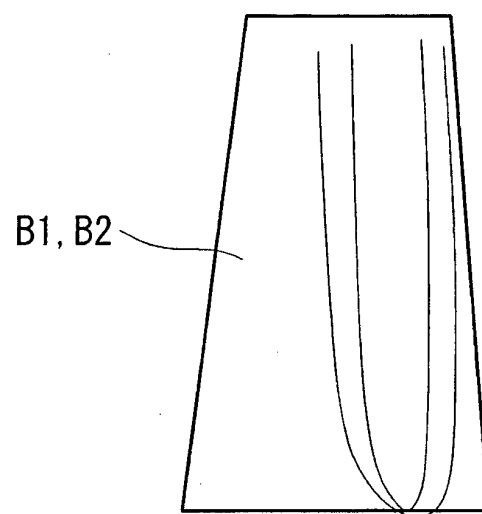


FIG. 6



REFERENCES CITED IN THE DESCRIPTION

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