Appeal decision

Appeal No. 2017-12371

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The case of appeal against the examiner's decision of refusal of Japanese Patent Application No. 2012-275237 "Apparatus, system and/or method for cooling turbine rotor blade platform" [the application published on Jul. 18, 2013: Japanese Unexamined Patent Application Publication No. 2013-139772] has resulted in the following appeal decision:

Conclusion

The appeal of the case was groundless.

Reason

No. 1 History of the procedures

The present application is an application filed on Dec. 18, 2012 (Priority Claim under the Paris Convention on Dec. 30, 2011, the United States), and reasons for refusal were notified as of Aug. 31, 2016. Although a written opinion, a written amendment, and a written correction of mistranslation were submitted on Dec. 5 of the same year which was within the designated period, a decision of refusal was made with the date of Apr. 14, 2017 (the dispatch date: Apr. 25 of the same year), and, against this, an appeal against the examiner's decision of refusal was demanded on Aug. 22 of the same year and, at the same time as the appeal, an amendment was made.

No. 2 Decision to dismiss amendment for the amendment of Aug. 22, 2017

[Conclusion of Decision to Dismiss Amendment]

The amendment dated Aug. 22, 2017 (hereinafter, referred to as "Amendment of the case") shall be dismissed.

[Reason]

1 Amended Invention of the present application

Amendment of the case is one that includes, regarding claim 1 of the scope of claims, amending the statements of claim 1 before the amendment of

"[Claim 1]

A platform cooling arrangement in a turbine rotor blade having a platform at a joined part between an airfoil and a root, wherein the rotor blade includes an interior cooling passage formed therein and extending approximately to a height of the platform in a radius direction from a connection with a coolant supply source in the root, wherein, in operation, the interior cooling passage comprises a high-pressure coolant region and a low-pressure coolant region, wherein, along a side corresponding with a suction side of the airfoil, a suction side of the platform comprises a topside extending circumferentially from the airfoil to a suction side slash surface, and wherein the suction side of the platform comprises an aft end corresponding with a trailing edge of the airfoil, wherein

the platform cooling arrangement includes:

a manifold positioned within at least one of a front side and an aft side of the suction side of the platform;

a high-pressure connector that connects the manifold to the high-pressure coolant region of the interior cooling passage;

a low-pressure connector that connects the manifold to the low-pressure coolant region of the interior cooling passage; and

a heat transfer structure positioned within the manifold so as to interact with a coolant flowing from the high-pressure connector to the low-pressure connector in operation, wherein

a position connecting the high-pressure connector to the manifold and a position connecting the low-pressure connector to the manifold are situated at approximately opposite sides of the manifold from each other,

the manifold includes a position within the aft side of the suction side of the platform and a shape approximately identical with the shape of the aft side of the suction side of the platform, a first internal wall of the manifold extends in a spaced-apart relationship with an outline of the suction side of a base portion of the airfoil, a second internal wall extends in an approximately spaced-apart relationship with the aft end of the platform, and a third internal wall extends in an approximately spaced-apart relationship with the suction side slash surface of the platform, wherein

the manifold narrows in the axial direction as the manifold extends from a first position in the side of the suction side slash surface to a second position in the side of the positive pressure side slash surface, and the manifold has an approximately constant radius direction height, and wherein

a plurality of cooling apertures extend between the manifold and the suction side slash surface and between the manifold and the aft end of the platform, the cooling apertures are configured to provide an exit for a part of the coolant flowing through the manifold, and the cooling apertures are configured so as to have a predetermined flow region corresponding to a desired coolant impingement characteristic." (the written amendment on Dec. 5, 2016),

to

"[Claim 1]

A platform cooling arrangement in a turbine rotor blade having a platform at a joined part between an airfoil and a root, wherein the rotor blade includes an interior cooling passage formed therein and extending approximately to a height of the platform in a radius direction from a connection with a coolant supply source in the root, wherein, in operation, the interior cooling passage comprises a high-pressure coolant region and a low-pressure coolant region, wherein, along a side corresponding with a suction side of the airfoil, a suction side of the platform comprises a topside extending circumferentially from the airfoil to a suction side slash surface, and wherein the suction side of the platform comprises an aft end corresponding with a trailing edge of the airfoil, wherein

the platform cooling arrangement includes:

a manifold positioned <u>within</u> an aft side <u>of</u> the suction side of the platform;

a high-pressure connector that connects the manifold to the high-pressure coolant region of the interior cooling passage;

a low-pressure connector that connects the manifold to the low-pressure coolant region of the interior cooling passage; and

a heat transfer structure positioned within the manifold so as to interact with a coolant flowing from the high-pressure connector to the low-pressure connector in operation, wherein

a position connecting the high-pressure connector to the manifold and a position connecting the low-pressure connector to the manifold are situated in approximately opposite sides of the manifold from each other <u>along the outline of the suction side of the airfoil</u>, wherein

the manifold includes a position within the aft side of the suction side of the platform and a shape approximately identical with the shape of the aft side of the suction side of the platform, a first internal wall of the manifold extends in a spaced-apart relationship with an outline of the suction side of a base portion of the airfoil, a second internal wall extends in an approximately spaced-apart relationship with the aft end of the platform, and a third internal wall extends in an approximately spaced-apart relationship with the suction side slash surface of the platform, wherein

the manifold narrows in the axial direction as the manifold extends from a first position in the side of the suction side slash surface to a second position in the side of the positive pressure side slash surface, and the manifold has an approximately constant radius direction height, and wherein

a plurality of cooling apertures extend between the manifold and the suction side slash surface and between the manifold and the aft end of the platform, the cooling apertures are configured to provide an exit for a part of the coolant flowing through the manifold, and the cooling apertures are configured so as to have a predetermined flow region corresponding to a desired coolant impingement characteristic." (the underlines were added by the Appellant in order to indicate the amended portion).

The above amendment is an amendment that limits, regarding "manifold" that is a matter necessary for specifying the invention, "positioned within at least one of a front side and an aft side" to "positioned within an aft side," and, similarly, makes, regarding "a position connecting the high-pressure connector to the manifold and a position connecting the low-pressure connector to the manifold", a limitation that those positions are situated in approximately opposite sides of the manifold "along the outline of the suction side of the airfoil." In addition, the invention described in claim 1 before the amendment and the invention described in claim 1 after the amendment are identical in field of industrial application and the problem to be solved. Accordingly, the Amendment of the case falls under the category of ones that are made for the purpose of restriction of the scope of claims stipulated in Article 17-2(5)(ii) of the Patent Act.

Therefore, whether or not it is possible for the Appellant to be granted a patent independently for the invention described in claim 1 after the Amendment of the case (hereinafter, referred to as "the Amended Invention") at the time of filing of the patent application (whether the invention complies with the provisions of Article 126(7) of the Patent Act as applied mutatis mutandis pursuant to the provisions of Article 17-2(6) of the same Act) will be discussed below.

2 Cited Document

(1) Cited Document 1

In the description of the United States Patent No. 5813835 (hereinafter, referred to as "Cited Document 1") that was cited in the reasons for refusal stated in the examiner's decision and distributed before the priority date for the present application, there are described the following matters relating to "AIR-COOLED TURBINE BLADE" (air cooled turbine blade) together with drawings (in particular, refer to FIG. 1, FIG. 2, FIG. 4-FIG. 7, FIG. 9 and FIG. 11). Note that, the temporary translations and underlines were made by the body, and the same applies hereafter.

A Column 1, lines 27 to 39

"A wide variety of air-cooled turbine blades have been developed as a result. They are similar in that each is hollow and incorporates one or more internal cooling passages. During turbine operation, a supply of pressurized air is directed from the compressor section through these passages to provide the desired cooling effect. The air is directed into the blade through one or more openings provided in the root. Being under a pressure greater than that within the turbine casing, the cooling air continues to travel through the internal passages within the airfoil section and is then exhausted into the turbine gas stream. In this way, the airfoil is cooled, and sustained, efficient turbine operation is made feasible."

(Temporary translation)

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B Column 2, lines 12 to 21

"Accordingly, it is a primary object of the present invention is to provide an air-cooled turbine blade overcoming the limitations and disadvantages of the prior art.

Another object of the present invention is to provide an air-cooled turbine blade utilizing multiple cooling passages for assuring a substantially uniform temperature gradient across the blade.

Another object of the present invention is to provide an air-cooled turbine blade including cooling passages disposed so as to actively cool the platform of the turbine blade."

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Another object of the present invention is to provide an air-cooled turbine blade including cooling passages disposed so as to actively cool the platform of the turbine blade."

C　Column 2, lines 37 to 44

"To achieve the foregoing and other objects and in accordance with the purposes of the present invention as described herein, an air-cooled turbine blade incorporates multiple internal cooling passages in the airfoil section of the blade, as well as in the platform, in order to provide improved cooling. During turbine operation, a substantially uniform temperature gradient is achieved enhancing blade reliability and longevity."

(Temporary translation)

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D　Column 4, line 24 to Column 5, line 36

"Reference is directed to FIGS. 1 and 2, wherein the air-cooled turbine blade 10 of the present invention is illustrated. The turbine blade 10 includes a root 12 for mounting the blade to the turbine wheel (not shown), a platform 14 and an airfoil 16 formed integrally with the platform 14. The airfoil 16 includes a concave side 18 and a convex side 20. During operation of the turbine, combustion discharge gasses impinge on the concave side 18 of the airfoil 16. As can be appreciated, the concave side 18 of the airfoil 16 is subjected to higher temperatures during operation than the downstream, convex side 20.

Reference is now directed to FIGS. 4 and 5, sectional views of the airfoil 16. As will be described in move detail below, the airfoil 16 includes two serpentine side cooling passages 22, 24 and a third middle airfoil cooling passage 26. Additionally, a leading edge cooling passage 28, as well as a trailing edge cooling passage 30 are provided to effectively cool those areas (17 and 19 respectively) as well. As shown, various film cooling holes 29 are located in the leading edge 17, the concave side 18, and the convex side 20 of the airfoil 16 to exhaust at least some of the air in the associated passages and to provide a thin film of lower temperature air on the surfaces of the airfoil 16 for an additional cooling effect.

As shown in FIGS. 6 and 8, the flow of cooling air, indicated by the arrows, is admitted into the turbine blade 10 through the root 12. The cooling air continues to travel in each passage within the airfoil 16 thereby cooling the surrounding metal surfaces. As shown in FIG. 8, the side cooling passage 22 directs the flow of air to "double back", changing direction twice before exiting at orifice 52, thus maximizing the cooling action over a large portion of the concave side 18 of the airfoil 16. As shown in FIG. 6, the side cooling passage 24 cools the convex side 20 of the airfoil 16 in a similar manner. The air within the leading edge cooling passage 28 is ejected through the film cooling holes 29 providing the dual benefit of cooling the leading edge 17 as well as providing the film cooling as heretofore described. The air within the trailing edge cooling passage 30 is ejected across the height of the blade trailing edge 19.

Advantageously, a portion of the flow of the cooling air is utilized to cool the platform 14. Reference is made to FIG. 9 taken along section line 9--9 of FIG. 1. As shown, three platform cooling passages 31, 32, and 34 are provided. See also FIGS. 10 and 11, illustrating the relative placement of passages 31 and 32 within the platform 14. As further shown in FIG. 9, orifices 36, 38, and 40 are in fluid communication with the cooling passages 22, 24, and 28 respectively, to provide the desired diversion of a portion of the cooling air into the platform cooling passages. Advantageously, a uniform cooling is maintained within the platform 14 by the provision of several sets of outlet orifices 42, 44 and 46. Thus a continuous flow of cooling air is directed into the corners to assure even cooling. It should be appreciated that the size and number of these outlet orifices can be readily varied in order to fit a wide variety of applications.

Advantageously, and according to an important aspect of the present invention, an additional set of orifices 48, 50 are in outlet fluid communication with the platform cooling passages 31, 32 respectively. After passing through the platform cooling passages 31, 32 the cooling air (shown by the dashed arrows) enters the middle airfoil cooling passage 26 via these orifices 48, 50. Refer also to FIG. 7 wherein the orifice 50 is shown. In a like manner, entry of cooling air into the middle airfoil cooling passage 26 is also provided through the orifice 48. This arrangement has the two fold advantage of cooling the platform 14, as well as cooling the middle airfoil area. Moreover, the additional desirable result of cooling the middle airfoil area without overcooling it is achieved. More specifically, as the cooling air traverses the platform passage 31, 32 it is warmed. This warmed air is next directed through the middle airfoil cooling passage 26 via the orifices 48, 50 respectively to provide a lesser degree of cooling to the cooler middle airfoil area than is provided to the directly cooled concave 18 and convex side 20 of the airfoil 16. The cooling air then continues upwardly in the cooling passage 26 and ultimately exits through exit orifices 52."

(Temporary translation)

"Reference is directed to FIGS. 1 and 2, wherein the air-cooled turbine blade 10 of the present invention is illustrated. <u>The turbine blade 10 includes a root 12</u> for mounting the blade to the turbine wheel (not shown), <u>a platform 14 and an airfoil 16 formed integrally with the platform 14</u>. <u>The airfoil 16 includes a concave side 18 and a convex side 20.</u> During operation of the turbine, combustion discharge gasses impinge on the concave side 18 of the airfoil 16. As can be appreciated, the concave side 18 of the airfoil 16 is subjected to higher temperatures during operation than the downstream, convex side 20.

Reference is now directed to FIGS. 4 and 5, sectional views of the airfoil 16. As will be described in move detail below, the airfoil 16 includes two serpentine side cooling passages 22, 24 and a third middle airfoil cooling passage 26. Additionally, a leading edge cooling passage 28, as well as a trailing edge cooling passage 30 are provided to effectively cool those areas (17 and 19 respectively) as well. As shown, various film cooling holes 29 are located in the leading edge 17, the concave side 18, and the convex side 20 of the airfoil 16 to exhaust at least some of the air in the associated passages and to provide a thin film of lower temperature air on the surfaces of the airfoil 16 for an additional cooling effect.

As shown in FIGS. 6 and 8, the flow of cooling air, indicated by the arrows, is admitted into the turbine blade 10 through the root 12. The cooling air continues to travel in each passage within the airfoil 16 thereby cooling the surrounding metal surfaces. As shown in FIG. 8, the side cooling passage 22 directs the flow of air to "double back", changing direction twice before exiting at orifice 52, thus maximizing the cooling action over a large portion of the concave side 18 of the airfoil 16. As shown in FIG. 6, the side cooling passage 24 cools the convex side 20 of the airfoil 16 in a similar manner.

The air within the leading edge cooling passage 28 is ejected through the film cooling holes 29 providing the dual benefit of cooling the leading edge 17 as well as providing the film cooling as heretofore described. The air within the trailing edge cooling passage 30 is ejected across the height of the blade trailing edge 19.

Advantageously, a portion of the flow of the cooling air is utilized to cool the platform 14. Reference is made to FIG. 9 taken along section line 9--9 of FIG. 1. As shown, three platform cooling passages 31, 32, and 34 are provided. See also FIGS. 10 and 11, illustrating the relative placement of passages 31 and 32 within the platform 14. As further shown in FIG. 9, orifices 36, 38, and 40 are in fluid communication with the cooling passages 22, 24, and 28 respectively, to provide the desired diversion of a portion of the cooling air into the platform cooling passages. Advantageously, a uniform cooling is maintained within the platform 14 by the provision of several sets of outlet orifices 42, 44 and 46. Thus a continuous flow of cooling air is directed into the corners to assure even cooling. It should be appreciated that the size and number of these outlet orifices can be readily varied in order to fit a wide variety of applications.

Advantageously, and according to an important aspect of the present invention, an additional set of orifices 48, 50 are in outlet fluid communication with the platform cooling passages 31, 32 respectively. After passing through the platform cooling passages 31, 32, the cooling air (shown by the dashed arrows) enters the middle airfoil cooling passage 26 via these orifices 48, 50. Refer also to FIG. 7 wherein the orifice 50 is shown. In a like manner, entry of cooling air into the middle airfoil cooling passage 26 is also provided through the orifice 48. This arrangement has the two fold advantage of cooling the platform 14, as well as cooling the middle airfoil area. Moreover, the additional desirable result of cooling the middle airfoil area without overcooling it is achieved. More specifically, as the cooling air traverses the platform passage 31, 32 it is warmed. This warmed air is next directed through the middle airfoil cooling passage 26 via the orifices 48, 50 respectively to provide a lesser degree of cooling to the cooler middle airfoil area than is provided to the directly cooled concave 18 and convex side 20 of the airfoil 16. The cooling air then continues upwardly in the cooling passage 26 and ultimately exits through exit orifices 52."

E Column 5, lines 49 to 58

"The foregoing description of a preferred embodiment of the invention has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed. Obvious modifications or variations are possible in light of the above teachings. For example, additional orifices can be provided to direct fluid communication from the trailing edge cooling passage 30 to the platform cooling passages 31, 32. This would provide for a greater flow of cooling air within the platform."

(Temporary translation)

"The foregoing description of a preferred embodiment of the invention has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed. Obvious modifications or variations are possible in light of the above teachings. For example, <u>additional orifices can be provided to direct fluid communication from the trailing edge cooling passage 30 to the platform cooling passages 31, 32.</u> <u>This would provide for a greater flow of cooling air within the platform.</u>"

F In FIG. 5 to FIG. 7, it is shown that the turbine blade 10 has the cooling passages 24 and 26 formed therein, and extending approximately to the radius direction height of the platform 14. Then, when cooling air passes through the cooling passages 24 and 26, a pressure loss is formed along the cooling passages 24 and 26, and thus it is obvious that the cooling passages 24 and 26 have a high pressure region and a low pressure region.

G In FIG. 9, there is indicated the upper surface of the platform 14, and it can be understood that the upper surface in the side of the convex surface 20 of the airfoil 16 includes a front convex-surface-20-side upper surface and a rear convex-surface-20-side upper surface (these are collectively called as "a convex-surface-20-side upper surface"), and includes a concave-surface-18-side upper surface in the side of the concave surface 18 of the airfoil 16. In addition, it is shown that the convex-surface-20-side upper surface of the platform 14 extends from the airfoil 16 to the convex-surface-20-side end face (the end face of the platform 14 in the upper side in FIG. 9) in a circumferential direction, and, in addition, includes a trailing end corresponding with the trailing edge 19 of the airfoil 16 (the right-hand edge of the platform 14 in FIG. 9).

Then, it can be said that it is shown, in FIG. 9, that, along the side corresponding with the convex surface 20 of the airfoil 16, the convex-surface-20-side upper surface of the platform 14 includes an upper surface extending in a circumferential direction from the airfoil 16 to the convex-surface-20-side end face, and the convex-surface-20-side upper surface of the platform 14 includes a trailing end corresponding with the trailing edge 19 of the airfoil 16.

H In FIG. 9, it is shown that a meandering part and a divided part are arranged within the cooling passage 32. It is obvious that the meandering part and the divided part are for the purpose of cooling of the platform 14.

I In FIG. 9, it is shown that the position at which the orifice 38 is coupled to the cooling passage 32 and the position at which the orifice 50 is coupled to the cooling passage 32 are situated along the outline of the convex surface 20 of the airfoil 16.

J In FIG. 9, it is shown that, when observing the cooling passage 32 as a whole, the cooling passage 32 has a position within the rear convex-surface-20-side upper surface of the convex-surface-20-side upper surface of the platform 14, and a shape approximately identical with that of the rear convex-surface-20-side upper surface of the convex-surface-20-side upper surface of the platform 14.

K In FIG. 9, it is shown that a route from the orifice 38 of the cooling passage 32 to the exit orifices 44 extends in a spaced-apart relationship with the outline of the convex surface 20 of the base portion of the airfoil 16, and a route in the aft side (the right side of FIG. 9) extends in an approximately spaced-apart relationship with the trailing end of the platform 14, and a route neighboring the convex-surface-20-side end face (the upper side of FIG. 9) extends in an approximately spaced-apart relationship with the convex-surface-20-side end face of the platform 14.

L In FIG. 9, it is shown that the concave-surface-18-side upper surface of the platform 14 extends from the airfoil 16 to the concave-surface-18-side end face (the lower side end face of the platform 14 in FIG. 9). In addition, in FIG. 9, it is shown that, when observing the cooling passage 32 as a whole, the cooling passage 32 is narrowed in the axial direction when it extends from a position in the side of the convex-surface-20-side end face to a position in the side of the concave-surface-18-side end face.

M In FIG. 11, it is shown that the cooling passage 32 provided in the platform 14 has an approximately constant vertical direction height.

N In FIG. 9, it is shown that a plurality of exit orifices 44 are provided in the rear side route of the cooling passage 32, and the exit orifices 44 are configured so as to provide exits for a part of cooling air flowing through the cooling passage 32.

When the above-mentioned described matters and the illustrated contents are put together and organized in conformity to the description style of the Amended Invention, there is described, in Cited Document 1, the following invention (hereinafter, referred to as "Cited Invention").

"An air cooling structure in the turbine blade 10 having the platform 14 at a joined part between the airfoil 16 and the root 12, wherein the turbine blade 10 includes the cooling passages 24 and 26 formed therein and extending from a connection with a compressor section in the root 12 to an approximately radius direction height of the platform 14, wherein, in operation of the turbine, the cooling passages 24 and 26 comprise a high-pressure region and a low-pressure region, wherein, along a side corresponding with the convex surface 20 of the airfoil 16, the convex-surface-20-side upper surface of the platform 14 comprises an upper surface extending from the airfoil 16 to the convex-surface-20-side end face in a circumferential direction, and wherein the convex-surface-20-side upper surface of the platform 14 comprises a trailing end corresponding with the trailing edge 19 of the airfoil 16, wherein

the air cooling structure includes:

the cooling passage 32 positioned within a rear convex-surface-20-side upper surface of the convex-surface-20-side upper surface of the platform 14;

the orifice 38 that connects the cooling passage 32 to the high pressure region of the cooling passages 24 and 26;

the orifice 50 that connects the cooling passage 32 to the low pressure region of the cooling passages 24 and 26,

the meandering part and the divided part positioned within the cooling passage 32 in such a manner interacting with cooling air flowing from the orifice 38 to the orifice 50 during the turbine operation, wherein

a position connecting the orifice 38 to the cooling passage 32 and a position connecting the orifice 50 to the cooling passage 32 are situated along the outline of the convex surface 20 of the airfoil 16, wherein

the cooling passage 32 includes a position within the rear convex-surface-20-side upper surface of the convex-surface-20-side upper surface of the platform 14 and a shape approximately identical with the shape of the rear convex-surface-20-side upper surface of the convex-surface-20-side upper surface of the platform 14, a route from the orifice 38 of the cooling passage 32 to the exit orifices 44 extends in a spaced-apart relationship with an outline of the convex surface 20 of the base portion of the airfoil 16, a route in the side of the rear side extends in an approximately spaced-apart relationship with the trailing end of the platform 14, a route neighboring the convex-surface-20-side end face extends in an approximately spaced-apart relationship with the convex-surface-20-side end face of the platform 14, wherein

the cooling passage 32 narrows in the axial direction as the cooling passage 32 extends from a position in the side of the convex-surface-20-side end face to a position in the side of the concave-surface-18-side end face, and the cooling passage 32 has an approximately constant vertical direction height, wherein

a plurality of exit orifices 44 are provided in a route in the side of the rear side of the cooling passage 32, and the exit orifices 44 are configured to provide an exit for a part of the cooling air flowing through the cooling passage 32."

(2) Cited Document 2

In Japanese Unexamined Patent Application Publication No. H11-236805 (hereinafter, referred to as "Cited Document 2") that was cited in the reasons for refusal stated in the examiner's decision and distributed before the priority date for the present application, there are described, relating to "Gas turbine moving blade platform," the following matters along with drawings (in particular, refer to FIG. 1)

A "[0019]
[Embodiments of the invention] Hereinafter, embodiments of the present invention will be described specifically based on drawings. FIG. 1 indicates a platform of a gas turbine moving blade according to a first embodiment of the present invention, and (a) is a plan view of the platform and (b) is a sectional view taken along line A-A in (a).
[0020] In FIG. 1 (a), reference numeral 1 indicates a platform, and 51 a moving blade. Reference numeral 2 indicates a cavity within the platform 1, and the cavity is formed in one side. Reference numerals 3 and 4 are also cavities, and are formed in the other side of the platform 1. Reference numerals 5, 6, 7 and 8 indicate cooling holes of a plurality of rows, respectively, and the cooling holes 5 are in communication with the

cavity 2, are drilled at an angle as indicated later in the periphery of one side of the platform 1, and blow cooling air obliquely upward. The cooling holes 6 are in communication with the cavity 3, and blow cooling air obliquely upward toward the other side of the platform 1. The cooling holes 7 and 8 are in communication with the cavity 4, and are constituted so as to blow cooling air obliquely upward toward the other side and toward the rear side of the platform 1, respectively.

[0021] Reference numerals 9 and 10 are also cooling holes, are respectively provided in the middle parts of the platform 1 in the both sides of the moving blade 51, incline together, and blow cooling air in an inclined manner toward the upper surface. On the upper surface, an expanded portion of a divergent shape is provided as indicated by 9a and 10a so as to diffuse cooling air on the surface.

[0022] FIG. 1 (b) is a sectional view taken along the line A-A in FIG. 1 (a). The cavities 2 and 4 are formed in the platform 1, the impingement plate 11 is attached in the lower portion of the cavities 2 and 4 to cover the cavities 3 and 4, the cooling air 70 is led from the multiple holes 12 of the impingement plate 11, and impingement cooling of the insides of the cavities 2 and 4 is carried out.

[0023] In one side of the platform 1, there are provided: the cooling holes 5 that are in communication with the cavity 2, incline upward, open at the end, and blow cooling air obliquely upward; and the cooling holes 9 that blow cooling air obliquely at the middle part of the upper surface.

[0024] Also, in the other side of the platform 1, there are provided in a similar fashion the cooling holes 7 that incline in the periphery and blow cooling air obliquely upward, and the cooling holes 10 that blow cooling air obliquely upward at the middle part.

[0025] In the first embodiment of the above-mentioned constitution, the cooling air 70 flows into the cavities 2, 3, and 4 through the holes 12 of the impingement plate 11 from the wing root of a moving blade to perform impingement cooling of these cavity portions, and thus essential portions of the platform 1 in the wing periphery are uniformly cooled. The cooling air flows out from these cavities 2, 3, and 4 through a plurality of the cooling holes 5, 6, 7, and 8, respectively, in an inclined manner to flow obliquely upward at both sides and the rear side of the platform 1, and the cooling air cools each periphery part of the platform 1 from the bottom to the top.

[0026] In the platform 1 according to the first embodiment mentioned above, conventional complicated routes are eliminated, and, regarding essential parts of the platform 1, their whole surfaces are made to be cooled uniformly by the cavities 2, 3, and 4 and the impingement plate 11, and its periphery parts are cooled by disposing multiple short cooling holes 5-10 in the oblique direction upward and making cooling air flow out of each cavities 2, 3, and 4. As a result of such constitution, machining and processing of the platform 1 becomes easy, and, along with this, the whole surface and the periphery of the platform 1 can be cooled uniformly without complicated and long cooling routes."

B In FIG. 1, it is shown that the cavity 4 is provided inside of the rear side portion of the platform 1 in the convex part side of the moving blade 51. In addition, in FIG. 1, it is shown that a plurality of cooling holes 7 and 8 extend between the cavity 4 and the end face of the platform 1 in the convex part side of the moving blade 51 (the lower-side end face in the figure) and between the cavity 4 and the trailing end of the platform 1 (the right-hand end in the figure).

As viewed from the above-mentioned described matters and the illustrated contents, there is described in Cited Document 2 the following matters (hereinafter, referred to as "described matters in Cited Document 2").

"The cavity 4 is provided inside of the rear side portion of the platform 1 in the convex part side of the moving blade 51, a plurality of cooling holes 7 and 8 extend between the cavity 4 and the end face of the platform 1 in the convex part side of the moving blade 51 and between the cavity 4 and the trailing end of the platform 1, the cooling holes 7 and 8 are configured to provide exits for a part of cooling air flowing through the cavity 4, the part of cooling air flows at an angle from the cooling holes 7 and 8 and flows out obliquely upward at the end face of the platform 1 in the convex part side of the moving blade 51 and at the rear of the platform 1 to cool the periphery parts of the platform 1 respectively from the bottom to the top."

3 Comparison / Judgment

When the Amended Invention and Cited Invention are compared, "the airfoil 16" of the latter corresponds to "airfoil" of the former, and, in a similar fashion, "the root 12" corresponds to "root," "the platform 14" to "platform," "the turbine blade 10" to "turbine rotor blade," "air cooling structure" to "platform cooling arrangement," "cooling air" to "coolant," "compressor section" to "coolant supply source" because it provides a desired cooling effect, "the cooling passages 24 and 26" to "interior cooling passage," "during the turbine operation" to "in operation," "high pressure region" and "low pressure region" to "high-pressure coolant region" and "low-pressure coolant region," "the convex surface 20 of the airfoil 16" to "the suction side of the airfoil," "the convex-surface-20-side upper surface of the platform 14" to "the suction side of the platform," "rear convex-surface-20-side upper surface" to "aft side," "the convex-surface-20-side end face" to "suction side slash surface," "trailing end" to "aft end," "upper surface extending from the airfoil 16 to the convex-surface-20-side end face in a circumferential direction" to "topside extending circumferentially from the airfoil to a suction side slash surface," "the trailing edge 19 of the airfoil 16" to "the trailing edge of the airfoil," "the cooling passage 32" to "manifold," "the orifice 38" to "high-pressure connector," "the orifice 50" to "low-pressure connector," "the meandering part and the divided part positioned within the cooling passage 32" to "heat transfer structure positioned within the manifold," "a route from the orifice 38 of the cooling passage 32 to the exit orifices 44" to "a first internal wall of the manifold" because the former has a wall surface, "a route in the side of the rear side" to "a second internal wall," "route neighboring the convex-surface-20-side end face" to "a third internal wall," "as the cooling passage 32 extends from a position in the side of the convex-surface-20-side end face to a position in the side of the concave-surface-18-side end face" to "as the manifold extends from a first position in the side of the suction side slash surface to a second position in the side of the positive pressure side slash surface," and "the cooling passage 32 has an approximately constant vertical direction height" to "manifold has an approximately constant radius direction height," respectively.

In addition, "a plurality of exit orifices 44 are provided in a route in the side of the rear side of the cooling passage 32, and the exit orifices 44 are configured to provide an exit for a part of the cooling air flowing through the cooling passage 32" of the latter and "a plurality of cooling apertures extend between the manifold and the suction side slash surface and between the manifold and the aft end of the platform, the cooling apertures are configured to provide an exit for a part of the coolant flowing through the manifold, and the cooling apertures are configured so as to have a predetermined flow region corresponding to a desired coolant impingement characteristic" of the former are identical to the extent of being "a plurality of cooling apertures are constituted so as to provide exits for a part of the coolant flowing through the manifold."

Therefore, the both are identical in a point of
"A platform cooling arrangement in a turbine rotor blade having a platform at a joined part between an airfoil and a root, wherein the rotor blade includes an interior cooling passage formed therein and extending approximately to a height of the platform in a radius direction from a connection with a coolant supply source in the root, wherein, in operation, the interior cooling passage comprises a high-pressure coolant region and a low-pressure coolant region, wherein, along a side corresponding with a suction side of the airfoil, a suction side of the platform comprises a topside extending circumferentially from the airfoil to a suction side slash surface, and wherein the suction side of the platform comprises an aft end corresponding with the trailing edge of the airfoil, wherein
the platform cooling arrangement includes:

a manifold positioned within the aft side of the suction side of the platform;

a high-pressure connector that connects the manifold to the high-pressure coolant region of the interior cooling passage;

a low-pressure connector that connects the manifold to the low-pressure coolant region of the interior cooling passage; and

a heat transfer structure positioned within the manifold so as to interact with a coolant flowing from the high-pressure connector to the low-pressure connector in operation, wherein

a position connecting the high-pressure connector to the manifold and a position connecting the low-pressure connector to the manifold are situated along the outline of the suction side of the airfoil, wherein

the manifold includes a position within the aft side of the suction side of the platform and a shape approximately identical with the shape of the aft side of the suction side of the platform, a first internal wall of the manifold extends in a spaced-apart relationship with an outline of the suction side of a base portion of the airfoil, a second internal wall extends in an approximately spaced-apart relationship with the aft end of the platform, and a third internal wall extends in an approximately spaced-apart relationship with the suction side slash surface of the platform, and wherein

the manifold narrows in the axial direction as the manifold extends from a first position in the side of the suction side slash surface to a second position in the side of the positive pressure side slash surface, and the manifold has an approximately constant radius direction height, and wherein

a plurality of cooling apertures are constituted so as to provide exits for a part of the coolant flowing through the manifold."
, and differ in the following points.

[Different Feature 1]

A point that, in the Amended Invention, a position at which a high-pressure connector connects to the manifold and a position at which a low-pressure connector connects to the manifold are positioned "in approximately opposite sides of the manifold from each other" along the outline of the suction side of the airfoil, whereas,

in Cited Invention, although a position at which the orifice 38 connects to the cooling passage 32 and a position at which the orifice 50 connects to the cooling passage 32 are positioned along the outline of the convex surface 20 of the airfoil 16, they cannot be said to be positioned "in approximately opposite sides of the manifold from each other."

[Different Feature 2]

A point that, in the Amended Invention, "a plurality of cooling apertures extend between the manifold and the suction side slash surface and between the manifold and the aft end of the platform," and "the cooling apertures are configured so as to have a predetermined flow region corresponding to a desired coolant impingement characteristic," whereas,

in Cited Invention, although "a plurality of exit orifices 44 are provided in a route in the side of the rear side of the cooling passage 32, and the exit orifices 44 are configured to provide an exit for a part of the cooling air flowing through the cooling passage 32," it is not provided with the above-mentioned matters specifying the invention of the Amended Invention.

Therefore, each of the different features will be examined.

(1) Regarding Different Feature 1

In the Cited Document 1, it is described that "additional orifices can be provided to direct fluid communication from the trailing edge cooling passage 30 to the platform cooling passages 31, 32. This would provide for a greater flow of cooling air within the platform." (the above-mentioned 2(1)E). As viewed from such statement and FIG. 9, in a case where an additional orifice is provided in the trailing edge cooling passage 30, it can be understood by a person skilled in the art that a position at which the additional orifice connects to the cooling passage 32 and a position at which the orifice 50 connects to the cooling passage 32 will be positioned in approximately opposite sides of the cooling passage 32 along the outline of the convex surface 20 of the airfoil 16 when the cooling passage 32 is observed as a whole.

Then, in Cited Invention, a person skilled in the art could have been easily conceived of the matter specifying the invention of the Amended Invention concerning Different Feature 1 by taking into consideration the above-mentioned statements of Cited Document 1.

(2) Regarding Different Feature 2

The matters described in Cited Document 2 are "The cavity 4 is provided inside of the rear side portion of the platform 1 in the convex part side of the moving blade 51, a plurality of cooling holes 7 and 8 extend between the cavity 4 and the end face of the platform 1 in the convex part side of the moving blade 51 and between the cavity 4 and the trailing end of the platform 1, the cooling holes 7 and 8 are configured to provide exits for a part of cooling air flowing through the cavity 4, the part of cooling air flows at an angle from the cooling holes 7 and 8 and flows out obliquely upward at the end face of the platform 1 in the convex part side of the moving blade 51 and at the rear of the platform 1 to cool the periphery parts of the platform 1 respectively from the bottom to the top."

Cited Invention and the matters described in Cited Document 2 are common in a point of cooling a platform by making cooling air pass through the inside of the rear side portion of the platform in the convex part side of the airfoil in a manner covering the whole surface. In addition, in Cited Document 2, it is described that the cooling holes 10 are provided from the cavity 4 to the upper surface of the platform 1 in the convex part side of the airfoil, and cooling air blows obliquely upward. The cooling holes 10 of Cited Document 2 and the exit orifices 44 of Cited Invention are common in a point that cooling air blows from the upper surface of the platform 1 in the convex part side of the airfoil.

From the above, it can be said that there is a motivation to apply the matters described in Cited Document 2 to Cited Invention, and, therefore, it is not particularly difficult for a person skilled in the art to apply the matter that "a plurality of cooling holes 7 and 8 extend between the cavity 4 and the end face of the platform 1 in the convex part side of the moving blade 51 and between the cavity 4 and the trailing end of the platform 1, the cooling holes 7 and 8 are configured to provide exits for a part of cooling air flowing through the cavity 4" that is a matter described in Cited Document 2 to the cooling passage 32 of Cited Invention, and make it be "a plurality of cooling apertures extend between the manifold and the suction side slash surface and between the manifold and the aft end of the platform, the cooling apertures are configured to provide an exit for a part of the coolant flowing through the manifold" of the Amended Invention concerning Different Feature 2.

Next, regarding the matter of the Amended Invention that "the cooling apertures are configured so as to have a predetermined flow region corresponding to a desired coolant impingement characteristic," there is a statement in the description of the present application that "the cooling aperture 156 can be configured to have a predetermined flow region corresponding to desired coolant impingement characteristics. In other words, the cooling aperture 156 can be formed narrowly so as to make the released coolant be impinged and directed with velocity against a slash surface of a neighboring turbine blade 100, and, by this, a cooling effect of the coolant is improved generally." (paragraph [0024]). According to this statement, it is recognized that "desired coolant impingement characteristics" can be obtained by making the cooling aperture "be formed narrowly so as to make the released coolant be impinged and directed with velocity against a slash surface of a neighboring turbine blade 100."

Considering the state of the art as of the priority date for the present application, it was a well-known technical matter to form the cooling aperture in such a way that the emitted coolant is impinged and directed with velocity against a neighboring turbine blade (for example, refer to Japanese Unexamined Patent Application Publication No. S61-70104, statements of page 2, the lower left column, line 14 to the lower right column, line 9, and FIG. 1 and FIG. 2; and Japanese Unexamined Patent Application Publication No. 2002-201906, the statement of paragraph [0025] and FIG. 9).

On the other hand, the matter described in Cited Document 2 is that cooling air "flows at an angle from the cooling holes 7 and 8 and flows out obliquely upward at the end face of the platform 1 in the convex part side of the moving blade 51 and at the rear of the platform 1 to cool the periphery parts of the platform 1 respectively from the bottom to the top," and it is recognized that alignment of the cooling holes 7 and an outflow speed of cooling air are design matters. Furthermore, it is obvious that the end face of the platform 1 in the convex part side of the moving blade 51 neighbors the end face of the neighboring platform 1 in the concave part side of the moving blade 51.

Then, it is not particularly difficult for a person skilled in the art to accordingly design alignment of the cooling holes 7 and an outflow speed of cooling air that are matters described in Cited Document 2, and make, in a product that is made by applying the matters described in Cited Document 2 to Cited Invention, the product be of a configuration that "the cooling apertures are configured so as to have a predetermined flow region corresponding to a desired coolant impingement characteristic" of the Amended Invention concerning Different Feature 2.

In view of the above, it could have been easily conceived by a person skilled in the art to apply the matters described in Cited Document 2 to Cited Invention, and make it be the matter specifying the invention of the Amended Invention concerning Different Feature 2.

(3) Regarding the effects

As a whole, the Amended Invention does not provide a specific effect beyond the effects predicted on the basis of Cited Invention and the matters described in Cited Document 2.

(4) Summary

Accordingly, the Amended Invention could have been invented by a person skilled in the art with ease based on Cited Invention and the matters described in Cited Document 2, and, therefore, the appellant should not be granted a patent for this independently at the time of patent application under the provisions of Article 29(2) of the Patent Act.

4 Closing

Therefore, the Amendment of the case violates the provisions of Article 126(7) of the Patent Act as applied mutatis mutandis pursuant to the provisions of Article 17-2(6) of the same Act, and thus it should be dismissed under the provisions of Article 53(1) of the same Act which is applied mutatis mutandis pursuant to the provisions of Article 159(1) of the same Act.

No. 3 Regarding the Invention

1 The Invention

Since the Amendment of the case has been dismissed as above, it is recognized that the inventions according to claims 1 to 14 of the present application are as described in claims 1 to 14 of the scope of claims amended by the amendment dated

Dec. 5, 2016, and the invention according to claim 1 (hereinafter, referred to as "the Invention") is one as described in the above "No. 2 [reason] 1" as claim 1 before the amendment.

2 The reasons for refusal stated in the examiner's decision

The inventions according to the following claims of the present application could have been invented with ease by a person having a usual knowledge in the technical field to which the Invention belongs before the application was filed, based on the inventions described in the following publications distributed in Japan or abroad before the priority date thereof, and, therefore, the appellant should not be granted a patent in accordance with the provisions of Article 29(2) of the Patent Act.

Note

Claims 1, 3-7, and 11-14
Cited Documents 1 and 4

Claims 2, and 8-10
Cited Documents 1, 3, and 4

< List of Cited Documents, etc.>

1. United States Patent No. 5813835 (Cited Document 1 in this Appeal decision)
2. Japanese Unexamined Patent Application Publication No. 2011-185271
3. Japanese Unexamined Patent Application Publication No. H5-52102
4. Japanese Unexamined Patent Application Publication No. H11-236805 (Cited Document 2 in this Appeal decision)

3 Cited Documents

Cited Documents 1 and 2 of the appeal decision cited in the reasons for refusal stated in the examiner's decision, the described matters thereof, and Cited Invention are as has been described in the above mentioned "No. 2 [Reason] 2."

4 Comparison / Judgment

The Invention is an invention made by expanding "positioned within the aft side" regarding "manifold" in the Amended Invention examined in the above mentioned "No. 2 [Reason]" to "positioned within at least one of a front side and an aft side," and eliminating the limitation of "along the outline of the suction side of the airfoil" regarding "a position connecting the high-pressure connector with the manifold and a position connecting the low-pressure connector with the manifold" in the Amended Invention examined in the above mentioned "No. 2 [Reason]."

In view of the above, the Amended Invention that substantially corresponds to one including all the matters specifying the invention of the Invention could have been invented by a person skilled in the art with ease based on Cited Invention and the described matters of Cited Document 2 as has been described in the above mentioned "No. 2 [Reason] 3," and, therefore, also the Invention is an invention that could have been invented by a person skilled in the art with ease based on Cited Invention and the matters described in Cited Document 2 for a substantially similar reason.

5 Summary

Accordingly, the Invention could have been invented by a person skilled in the art with ease based on Cited Invention and the matters described in Cited Document 2, and, therefore, the Appellant should not be granted a patent for that under the provisions of Article 29(2) of the Patent Act.

No. 4 Closing

As above, the Appellant should not be granted a patent for the Invention under the provisions of Article 29(2) of the Patent Act, and, therefore, the present application should be rejected without examining the inventions according to the other claims of the present application.

Therefore, the appeal decision shall be made as described in the conclusion.

Jun. 4, 2018

Chief administrative judge: KANAZAWA, Toshio
Administrative judge: TOMIOKA, Kazuhito
Administrative judge: SUZUKI, Mitsuru