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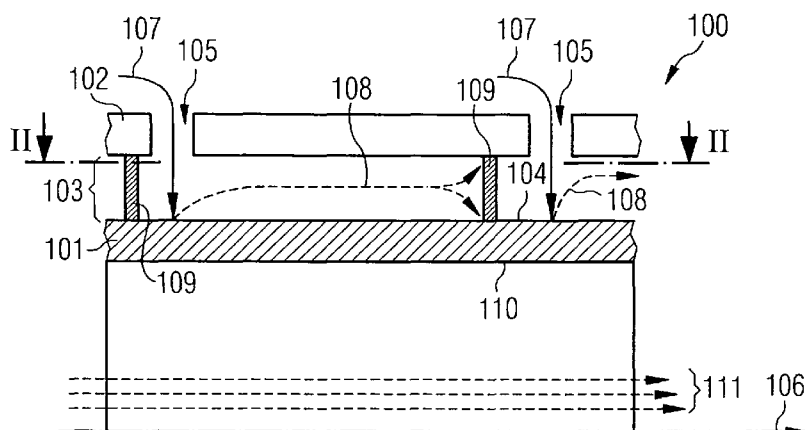
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(54) Title: CROSS-FLOW BLOCKERS IN A GAS TURBINE IMPINGEMENT COOLING GAP

FIG 1



(57) Abstract: The present invention describes a system (100) for cooling a wall element (101) of a device located in a gas turbine. The system (100) comprises a guiding device (102) that is located with respect to the wall element (101) in such a way that a gap (103) between a surface (104) of the wall element (101) and the guiding device (102) is formed. The guiding device (102) comprises a hole (105) for guiding a cooling fluid stream (107) through the guiding device (102) towards the surface (104) in such a way that the cooling fluid stream (107) impinges at the surface (104), so that the cooling fluid stream (107) is heated up to a heated fluid stream (108) after impinging on the surface (104) and the heated fluid stream (108) flows along the surface (104) to an exhaust region of the system (100). Furthermore, the system (100) comprises a fluid deflecting element (109) located inside the gap (103) in such a way that the heated fluid stream (108) is guided around a further cooling fluid stream (107) streaming through a further hole (105) of the guiding device (102).



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DESCRIPTION

CROSS-FLOW BLOCKERS IN A GAS TURBINE IMPINGEMENT COOLING GAP

5 Field of invention

The present invention relates to a system for cooling a wall
element of a device located in a gas turbine and to a gas
turbine. Moreover, the present invention relates to a method
10 of cooling a wall element of a device located in a gas tur-
bine.

Art background

15 Gas turbine components may be heated up by hot gases, so that
the components need to be cooled. It is known to use jets of
high pressure cooling air to cool the hot components inside
the gas turbine.

20 In conventional systems, an impingement tube is used that
provides small holes, wherein the jets of air are guided
through the holes to a surface of a wall element of a heated
gas turbine component to be cooled. The jets of air impinge
on the surface of the wall element of the component. After
25 impinging of the cooling jets of air, the jets of air are
heated up and flow further along the surface of the wall
element. The flow of heated up jets of air passes across a
flow of further, downstream located, impingement jets of
cooling air. The flow of the heated up jets of air is denoted
30 as cross-flow.

The cross-flow of air may reduce the effectiveness of an
impingement cooling because the cross-flow between the im-
pingement tube and the wall element may affect the more
35 downstream located jets of cooling air because the cross-flow
interrupts the cooling jets, changing their speed and direc-
tion, and so reducing the cooling effect. Thus, the higher

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the cross-flow velocity and mass flow rate, the less effective the impingement cooling of the further cool jets of air.

5 The cross-flow effect often occurs because there may be many rows of impingement holes, so that the cross-flow from all upstream located holes heats up the cooling air streaming through the downstream located holes, and also change the speed and direction of the flow of air through the downstream located holes. The last row of holes located at most downstream then is affected by the cross-flow from all of the upstream located rows.

15 In conventional designs, the cross-flow effect is reduced by designing one or more escape flow paths. The escape flow path thereby gathers the jets of air after impinging and thus provides an evacuation route guiding the cross-flow away from the downstream located impingement jets.

20 US 5,363,654 discloses an impingement cooling of jet engine components, whereby the air that impinges at a surface of the wall to be cooled is guided to adjacent corrugation portions that guides the impinged jets of air outside of the cooling area. The corrugation portions may be a part of a corrugated plate that is used as impingement tube.

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Further embodiments that use evacuation routes by forming a corrugated plate are known from DE 42 44 302 A1, DE 102 027 83 A1, and US 5,480,281 A.

30 DE 25 50 100 A1 discloses a cooling system for a gas turbine wherein a first cooling air channel comprises nozzles for cooling air that may flow through the nozzles to the surface of a wall element to be cooled. After impingement of the cooling air at the surface of the wall element the impinged heated air is guided away by an escape channel that surrounds the cooling channel. Thus, it may be prevented that the

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impinged air flows back through the small holes of the cooling channel.

Summary of the Invention

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It may be an object of the present invention to provide a proper cooling system for a turbine.

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In order to achieve the object defined above, a system for cooling a wall element of a device in a gas turbine, the gas turbine with the system and a method of cooling a wall element of a device located in a gas turbine according to the independent claims are provided. The dependent claims describe advantageous developments and modifications of the invention.

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According to a first exemplary embodiment, a system for cooling a wall element of a device located in a gas turbine is provided. The system comprises a guiding device that is located with respect to the wall element in such a way that a gap between a surface of the wall element and the guiding device is formed. The guiding device comprises a hole for guiding a cooling fluid stream through the guiding device towards the surface in such a way that the cooling fluid stream impinges at the surface, so that the cooling fluid stream is heated up to a heated fluid stream after impinging on the surface and the heated fluid stream flows along the surface to an exhaust region of the system. The system further comprises a fluid deflecting element located inside the gap in such a way that the heated fluid stream is guided around a further cooling fluid stream streaming through a further hole of the guiding device.

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According to a further exemplary embodiment, the gas turbine comprising the above-described system is provided.

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According to a further exemplary embodiment, a method of cooling a wall element of a device located in a gas turbine is provided. According to the method a cooling fluid stream is guided through a hole of a guiding device towards a surface of the wall element in such a way that the cooling fluid stream impinges at the surface, so that the cooling fluid stream is heated up to a heated fluid stream after impinging and the heated fluid stream flows along the surface to an exhaust region. The heated fluid stream is furthermore guided around a further cooling fluid stream streaming through a further hole of the fluid deflecting element.

The term "guiding device" denotes a device that may cover at least partially the surface of the wall element to be cooled, wherein a gap through which an airstream may flow is formed between the guiding device and the wall element. Moreover, the guiding device denotes a device that is adapted to guide the heated fluid stream, i.e. the fluid stream after impinging on the surface, along a predefined direction inside the gap. The predefined direction may be a direction of the fluid stream that ends in an exhaust region of the system. The guiding device may comprise a plate-like element made of metal, ceramics or other preferably heat resistant materials. The guiding device may also be formed as a tube-like element that surrounds the wall element or is surrounded by the wall element, i.e. a tubular wall element, for instance. It will be noted, that the hole and the further hole may comprise identical physical characteristics but are only located to different locations. Also the cooling fluid stream and the further cooling fluid stream may comprise identical physical characteristics but are only located to different locations.

The device located in the gas turbine may denote for instance a combustion chamber, a fluid guiding channel for combustion products of a gas turbine, a movable aerofoil, such as a rotor blade, or a stationary aerofoil, such as a stator blade, of the turbine stage or compressor stage of the gas

turbine, or other parts and devices of the gas turbine that need to be cooled.

The term "cooling fluid stream" may denote e.g. a gas for
5 example comprising an oxidant, carbon dioxide or steam.

Moreover, the cooling fluid may denote a stream of fluid that is adapted for cooling a surface of the wall element to be cooled. The fluid of the cooling fluid stream may be for instance compressed cooling air but may also be a cooled
10 cooling liquid that streams through holes of the guiding device with a high pressure. The cooling fluid may have a temperature of 200 C (Celsius) degree to 700 C degree, in particular 300 C degree to 500 C degree, and may be taken from a compressor stage of a gas turbine.

15 The term "heated fluid stream" may denote the fluid stream of the fluid after impinging at the surface of the wall element to be cooled. After impinging of the fluid stream at the surface, the fluid stream may be heated up by the hot surface, so that the heated fluid stream may comprise a higher
20 temperature than the cooling fluid stream.

The term "exhaust region" may denote a region of the system where the heated fluid stream may be evacuated outside of the
25 gap and where the heated fluid stream may be exhausted to the environment of the system. The exhaust region may be located at a desired and predetermined location of the system, so that the heated fluid stream may be exhausted in a predetermined direction where the heated fluid stream may not affect
30 negatively other components. The exhaust region may be a cooling hole or a plurality of cooling holes through the hot wall that creates a cooling film on the main gas path side of the cooled wall.

35 The stream direction of the heated fluid stream may be determined e.g. by impinging the cooling fluid stream with a predefined impinging angle with respect to the surface of the

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5 wall element, so that the cooling fluid stream impinges in a predetermined direction and flows consequently to the exhaust region. The stream direction may also be determined by the respective pressures in the system, with the heated fluid steam flowing towards the low pressure region of the system. Features (e.g. the fluid deflection elements) may be provided that further direct the heated fluid stream towards the exhaust region without passing across the path of downstream impingement jets. These features (e.g. the fluid deflection
10 elements) ensure that the effectiveness of the downstream cooling jets is not reduced by the cross-flow. The features (e.g. the fluid deflection elements) also cause the local velocity of the heated fluid stream to be increased, so that the convection cooling effect of the heated fluid stream as
15 it flows towards the exhaust region may be increased.

Thus, a so called impingement cooling may be provided, wherein a proper convection cooling is generated with a higher velocity, a controlled direction and a lower temperature of
20 the cooling fluid stream, so that the effectiveness and the convection respectively of the cooling system may be improved. In conventional cooling systems, the cross-flow, i.e. the heated fluid stream of the fluid after impinging on the wall element, flows downstream through a further impinging
25 area where the cooling fluid stream impinges at the surface. Because the heated fluid stream affects the cooling fluid stream before or during impinging, the cooling fluid stream is heated up and thereby loses the cooling effectiveness when impinging at the wall element. Moreover, the cross-flow of
30 the heated fluid stream may change the speed and direction of the jets of the cooling fluid stream before it impinges on the surface, so that the convection of the cooling fluid stream when impinging may be reduced. Thus, the overall effectiveness of the conventional cooling system may be
35 reduced. Moreover, in conventional cooling systems, evacuation routes for the cross-flow of the heated fluid stream may be provided, e.g. by providing a corrugated plate or a corru-

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gated impingement tube. Such a corrugated profile increases the complexity of the impingement tube and thus increases the production costs. Moreover, the arrangement of evacuation routes may lead to a complex design.

5

By the present invention a proper cooling system for a wall element may be provided simply by using a conventional guiding device, such as a guiding plate comprises holes, without the need of providing separate evacuation routes for the heated up cross-flow fluid (e.g. the heated fluid stream). By the present invention fluid deflecting elements are located inside the gap between the guiding device and the wall element. The fluid deflecting elements guide the cross-flow fluid (e.g. the heated fluid stream) around a region where a cooling fluid stream streams through a further hole of the guiding device and impinges on the surface of the wall element. Thus, the cooling fluid stream may not be affected by the heated fluid stream and may thus no longer be negatively affected by the heated fluid stream. In other words, the fluid deflecting elements protect the cooling fluid stream from the heated cross-flow. Further complex designs of the guiding device, such as the integration of evacuation channels in the guiding device, may not be necessary.

25 The fluid deflecting element may be a cast element that is formed on the wall element and/or may be a part of the guiding device. The fluid deflecting elements may also be separate elements that are attached, for instance by welding, to the wall element and/or the guiding device. Moreover, the fluid deflecting elements may provide predetermined streaming surfaces that comprise a streaming profile for guiding effectively the heated fluid stream around the area where the cooling fluid stream impinges at the wall element.

35 According to a further exemplary embodiment, the fluid deflecting element is a sheet metal. The sheet metal may com-

prise a thickness that is smaller than 1 cm (centimeter), in particular smaller than 0,2 cm.

According to a further exemplary embodiment, the fluid deflecting element is formed in a V-shape comprising a leading edge. The V-shaped fluid deflecting element is located inside the gap in such a way that a part of the heated fluid stream flows against the leading edge and is guided along the outer surface of the V-shaped fluid deflecting element around the downstream impinging further cooling fluid stream. The V-shaped fluid deflecting elements may extend with its leading edge from the wall element to the direction of the guiding device or vice versa. The heated fluid stream may thus be guided around the impinging cooling fluid stream without causing negative effecting turbulences that may be caused when the heated fluid stream is guided by a guiding device that is perpendicular to the flow direction extending wall. Thus, by the V-shaped fluid deflecting element a proper fluid streaming characteristic with reduced flow loss may be provided.

According to a further exemplary embodiment, the system comprises a plurality of fluid deflecting elements that are located inside the gap in such a way that between two of the plurality of fluid deflecting elements a flow channel for the heated fluid stream is formed. The fluid channel may be defined by the width between two opposed locate edges or flanges of the two fluid deflecting elements. In particular, a virtual connection line between the edges of the two fluid deflecting elements may be perpendicular to the velocity vector or the fluid direction respectively of the heated fluid stream. Thus, a narrowest diameter of the fluid channel may be generated, so that a kind of nozzle may be formed. Thus, the heated fluid stream may be accelerated in the fluid channel region, so that the heated fluid stream may be led away faster, so that the convection cooling effect of the

heated fluid steam is increased and an improved characteristic of the cooling system may be achieved.

5 According to a further exemplary embodiment, the fluid deflecting element is spatially fixed to the guiding device. Thus, the guiding device comprising the fluid deflecting elements may be pre-assembled and may modularly attached to an already installed wall element of a device of a gas turbine. Thereby, existing gas turbines may also be retrofitted
10 by the claimed cooling system. Thus, a simple and effective assembling condition may be provided because no major reconstructions may be necessary for the wall element for attaching the guiding device with the fluid deflecting elements.

15 According to a further exemplary embodiment, the fluid deflecting element is formed in such a way that a portion of the guiding device element is bent up towards the surface. Thus, a simple manufacturing method for the guiding device may be applied by simply bending up some regions of the
20 guiding device. Thus, by bending up some regions of the guiding device simultaneously the holes and as well the fluid deflecting elements are formed. Thus, a faster and simpler manufacturing method may be applied. In other words, the guiding device may be formed e.g. out of a conventional plate
25 by perforating the plate for achieving a perforated plate or a perforated metal sheet that may integrally comprise the fluid deflecting elements.

According to a further exemplary embodiment, the system
30 further comprises the device, wherein the device is a stationary device. A stationary (non-movable) device may be for instance a combustion chamber or a stator blade of the gas turbine. The stator blade may be formed as a stationary fixed aerofoil. The described cooling system may be integrated in
35 such a stationary stator blade of a turbine section of a gas turbine.

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According to a further exemplary embodiment, the wall element forms an outer wall of the aerofoil, wherein the guiding device is formed or installed inside the aerofoil and extends along an inner surface of the outer wall in such a way that the guiding device is opposite to the inner surface and covers at least partially the inner surface. In other words, the guiding device may form a cooling air duct for feeding the holes with cooling fluid, so that the cooling fluid stream may be streamed in the gap between the inner surface and the guiding device. Thus, by the constructive arrangement of the guiding device inside the aerofoil, a simple cooling system for the aerofoils may be provided. Thus, the aerofoils that may be exposed to hot gases, such as combustion products of the combustion chamber, may stand higher temperatures due to the internal cooling.

According to a further exemplary embodiment, the aerofoil comprises a trailing edge, wherein the exhaust region is formed in vicinity of or at the trailing edge. The trailing edge is located downstream of a gas flow of the turbine. Thus, when exhausting the heated fluid stream in the exhaust region close to the trailing edge, in particular with the same velocity vector as the gas stream of the gas turbine, the exhaustion of the heated gas stream thus may reduce the negative effect of the exhaustion of the heated airstream inside the gas flow of the turbine. In other words, turbulences caused due to an exhaustion of the heated airstream inside the turbine may be reduced. Thus, the overall effectiveness of the gas turbine may be at most marginally affected by the cooling system.

According to a further exemplary embodiment, the system comprises the device wherein the device is a movable device such as an aerofoil or a rotor blade respectively. The described cooling system may be integrated in such a movable device, such as a rotor blade of a turbine section of a gas

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turbine, in the same way as into a stationary aerofoil as described above.

According to a further exemplary embodiment, the fluid deflecting element is spatially fixed to the wall element. Moreover, it may further be possible that the fluid deflecting element is spatially fixed both, to the wall element and the guiding device.

- 10 By the present invention a proper cooling system for applying an impingement cooling for a gas turbine may be provided. Upstream of the regions (the impinging areas) of the wall element, where the impingement jets of the cooling fluid stream hit the wall element, fluid deflecting elements, such as cast elements or sheet plate elements, are installed for preventing an effect of the cooling air stream by the cross-flow, in particular the heated fluid stream. In other words, by the fluid deflecting elements the cross-flow air will be directed around the impinging area. Moreover, by the use of the fluid deflecting element the velocity of the heated fluid stream inside the gap may be increased, so that the convection cooling effect of the cooling fluid stream may be improved as well.
- 25 The fluid deflecting elements may be attached as separate pieces either to the guiding device or the wall element. Moreover, the fluid deflecting elements may be integrally formed with the guiding device, for instance by bending up material regions of the guiding device, so that virtually fingers of the fluid deflecting elements may be formed and thereby protect each hole and each impinging area of the cooling fluid stream from the heated fluid stream. The fluid deflecting elements may be in a V-shape, so that V-shape ribs in the gap may be formed, wherein by the trailing edge of the V-shape fluid deflecting elements the aerodynamic of the fluid deflecting elements will be improved, so that less turbulences of the heated fluid stream may be created. More-

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over, the V-shaped ribs inside the gap may create protected pockets at its downstream side, in particular on the side where the impinging area of the cooling fluid stream may be located.

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Moreover, the fluid deflecting elements may be in contact with both, the guiding device and the wall elements, so that the fluid deflecting elements can be used as spacers for the gap, i.e. the fluid deflecting elements may also be used to
10 maintain the correct gap between the wall element and the guiding device.

It has to be noted that embodiments of the invention have been described with reference to different subject matters.
15 In particular, some embodiments have been described with reference to apparatus type claims whereas other embodiments have been described with reference to method type claims. However, a person skilled in the art will gather from the above and the following description that, unless other noti-
20 fied, in addition to any combination of features belonging to one type of subject matter also any combination between features relating to different subject matters, in particular between features of the apparatus type claims and features of the method type claims is considered as to be disclosed with
25 this application.

Brief Description of the Drawings

The aspects defined above and further aspects of the present
30 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 embodi-
ment but to which the invention is not limited.

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Fig. 1 shows a schematic view of a system for cooling a wall element according to an exemplary embodiment of the present invention;

5 Fig. 2 shows a top view of the exemplary embodiment of the invention shown in Fig. 1;

Fig. 3 shows a schematic view of a fluid streaming of the cooling and heated fluid stream according to an exemplary
10 embodiment of the invention;

Fig. 4 shows a schematic view of a guiding device with integrally formed fluid deflecting elements according to an
15 exemplary embodiment of the invention;

Fig. 5 shows schematically an aerofoil comprising the system for cooling a wall element according to an exemplary embodiment of the present invention; and

20 Fig. 6 shows a schematic view of a tubular guiding device according to an exemplary embodiment of the present invention.

Detailed Description

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The illustrations in the drawings are schematic. It is noted that in different figures, similar or identical elements are provided with the same reference signs.

30 **Fig. 1** shows a cross sectional view of a system 100 for cooling a wall element 101 of a device located in a gas turbine according to an exemplary embodiment of the present invention. The system 100 comprises a guiding device 102 that is located with respect to the wall element 101 in such a way
35 that a gap 103 between a surface 104 of the wall element 101 and the guiding device 102 is formed. The guiding device 102 comprises a hole 105 for guiding a cooling fluid stream 107

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through the guiding device 102 towards the surface 104 in such a way that the cooling fluid stream 107 impinges at the surface 104, so that the cooling fluid stream 107 is heated up to a heated fluid stream 108 after impinging on the surface 104 and the heated fluid stream 108 flows along the surface 104 to an exhaust region of the system 100. The system 100 further comprises a fluid deflecting element 109 located inside the gap 103 in such a way that the heated fluid stream 108 is guided around a further cooling fluid stream 107 streaming through a further hole 105 of the guiding device 102.

The guiding device 102 may be formed as a plate-like element that covers at least partially the wall element 101 and may be assembled parallel to the wall element 101. The guiding device 102 may comprise holes or slots, e.g. the holes 105, possibly arranged in rows and columns. The wall element 101 comprises a surface 104 that may be cooled by a cooling fluid stream 107. The wall element 101 furthermore comprises a further surface 110 that is exposable to heat, in particular to a gas stream 111, caused e.g. by combustion products from a combustion chamber of the gas turbine.

The wall element 101 and/or the guiding device 102 may be formed with a tubular shape that may be defined by a symmetry line 106, for example when the wall element 101 being the inner wall of a combustion chamber. A cooling fluid stream 107 may be guided through one or a plurality of holes 105 of the guiding device 102. The cooling fluid stream 107 impinges in an impinging area 203 (shown in Fig.2) of the surface 104 of the wall element 101. When impinging on the surface 104, the cooling fluid stream 107 absorbs heat energy from the wall element 101 and thereby cools the wall element 101 and heats up itself. Thus, after impinging on the surface 104, the cooling fluid stream 107 is transferred to a heated fluid stream 108 that flows along the surface 104 to an exhaust region. The flow direction of the heated fluid stream 108 may

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be controlled by an impinging angle of the cooling fluid stream 107 with respect to the surface 104, or may be controlled by the relative pressures within the system 100, and flows towards the lowest pressure within the system 100.

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As shown in Fig. 1, the fluid deflecting elements 109 are interposed between the guiding device 102 and the wall element 101 inside the gap 103. The fluid deflecting elements 109 may be spatially fixed either to the wall element 101 or the guiding device 102 or to both. The left fluid deflecting elements 109 shown in Fig. 1 may be spatially fixed for example to the surface 104 of the wall element 101. Fluid deflecting element 109 shown on the right side in Fig. 1 is for example in contact with the wall element 101 and the guiding device 102 and may be spatially fixed to the wall element 101, the guiding device 102 or to both.

Even with a fluid deflecting element 109 that extends across the whole width of the gap 103 or comprise a larger size than the diameter of the hole 105, not the complete cross-flow effect will be prevented, but will be reduced and improve the cooling efficiency. The fluid deflecting element 109 may cover the complete space or only cover a part of the space between the guiding device 102 and the wall element 101. In the latter case, some cross-flow may be still allowed, but the amount of cross flow will be reduced.

As indicated in Fig. 1, the part of or the complete heated fluid stream 108 is guided by the fluid deflecting elements 109 around the cooling fluid stream 107 that impinges on the surface 104.

Fig. 2 illustrates a top view - as seen from the direction as indicated in Fig. 1 by the line II-II - of the exemplary embodiment shown in Fig. 1 wherein the flow characteristics of the cooling fluid stream 107 and the heated fluid stream 108 are illustrated in more detail. In Fig. 2, the impinging

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area 203 is indicated. The impinging area 203 defines the region on the surface 104 where the cooling fluid stream 107 impinges on the surface 104. The fluid deflecting elements 109 are interposed upstream of the impinging area 203. Thus, the heated fluid stream 108 flows around the fluid deflecting elements 109, so that the heated fluid stream 108 is not mixed with the cooling fluid stream 107. The impinging area 203 may be in particular located at the downstream side of the fluid deflecting elements 109 with respect to the heated fluid stream 108. After impinging on the surface 104, the cooling fluid stream 107 is transformed to the heated fluid stream 108 and flows downstream to an exhaust region.

As shown in Fig. 2, the fluid deflecting elements 109 may be formed as a simple plate-like sheet. Moreover, the fluid deflecting element 109 may comprise profiles with an improved fluid dynamic, such as a V-shape fluid deflecting element 109. The V-shaped fluid deflecting element 109 may comprise a leading edge 201 and outer surfaces 202. The outer surfaces 202 extend from the leading edge 201 in a downstream direction, so that the heated fluid stream 108 may be guided more effectively. The heated fluid stream 108 may impinge on the outer surface 202 of the V-shaped fluid deflecting element 109 and may be guided smoothly around the impinging area 203 without causing negatively effecting turbulences of the heated fluid stream 108. The V-shaped fluid deflecting element 109 creates in other words protected pockets on its downstream sides, i.e. where the impingement area 203 is located. Moreover, the fluid deflecting element 109 may be formed of a cast material and may form a bump profile, so that the fluid deflecting element 109 may particularly provide rounded edges that may also provide good fluid dynamic characteristics.

Fig. 3 illustrates an arrangement of fluid deflecting elements 109, whereby between two fluid deflecting elements 109 a flow channel 301 may be formed. The edges or flanges of the

two fluid deflecting elements 109 that are located close to each other or opposed to each other may define the flow channel 301. A virtual connection line between the edges of the fluid deflecting elements 109 may be defined perpendicular to the flow directions of the heated fluid stream 108.

The flow channel 301 may define the narrowest width between the two fluid deflecting elements 109, so that a nozzle effect may be generated. When generating such a nozzle effect with the flow channel 301, the velocity of the heated fluid stream 108 may be increased wherein on the other side the velocity of the cooling fluid stream 107 may be not affected or even reduced. Thus, by accelerating the velocity of the heated fluid stream 108 better convection may be achieved.

Furthermore, as can be seen in Fig. 3, the V-shaped fluid deflecting elements 109 may provide a fluid flow channel 301 as well. The leading edge 201 separates the heated fluid stream 108, so that the one part of the heated fluid stream 108 flows along the right surface 202 and the other part of the heated fluid stream 108 flows along the other surface 202 of the V-shaped fluid deflecting element 109.

Fig. 4 illustrates a perspective view of a guiding device 102 that is formed in a sheet metal style. The holes 105 are for example blanked out, wherein the blanked out material is still connected on one side with the guiding device 102. The blanked out material may be bent up in the direction of the wall element 101 to which it will be assembled, so that the blanked out material forms the fluid deflecting elements 109. Thus, a simple and fast production method of the guiding device 102 may be provided.

As further indicated in Fig. 4, a predetermined pattern of a plurality of further holes 105 may be formed in the guiding device 102. Thus, the mass flow rate of the cooling fluid stream 109 that impinges on the wall element 102 may be

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defined individually by an individual predetermined pattern of holes 105.

Fig. 5 illustrates an aerofoil 500 - e.g. a stator vane of a turbine stage within a turbine section of a gas turbine - comprising the system 100 for cooling a wall element 101. The wall element 101 defines the outer wall 501 of the aerofoil 500. The gap 103 is formed between the inner surface 502 of the outer wall 501 and the guiding device 102. The guiding device 102 is installed inside the aerofoil 500. From the inside of the guiding device 102 the cooling fluid stream 107 may flow outside in the direction to the inner surface 502 of the outer wall 501. The cooling fluid stream 107 may flow through the holes 105 of the guiding device 102. After impingement on the inner surface 502, the cooling fluid stream 107 is transferred to a heated fluid stream 108 and flows to an exhaust region of the aerofoil 500.

The fluid deflecting elements 109 are thereby located inside the gap 103 that is formed between the inner surface 502 and the guiding device 102.

As shown in Fig. 5, the heated fluid stream 108 travels circumferentially due to the lowest pressure at the exhaust region, e.g. at the trailing edge 503 of the aerofoil 500, and so the heated fluid stream 108 is driven in this direction by the pressure gradient.

The exhaust region may be defined at the trailing edge 503 of the aerofoil 500. Thus, the exhausted heated fluid stream 108 may be mixed with the hot gas stream 111 that surrounds the aerofoil 500. Moreover, when exhausting the heated fluid stream 108 in a trailing edge region 503, the velocity vector respectively the streaming direction may be similar to the flow direction of the hot gas stream 111, so that reduced turbulences are generated when exhausting the heated fluid

stream 108. Thus, the exhaustion of the heated fluid stream 108 may not affect the effectiveness of the gas turbine.

Fig. 6 illustrates a guiding device 102 that is formed in a tubular design. Such a tubular designed guiding device 102 may be integrated into the aerofoil 500 shown in Fig. 5. The tubular guiding device 102 may form an inner duct, through which the cooling fluid for the cooling fluid stream 107 may be fed. Moreover, a plurality of holes 105 may be defined in the guiding device 102, so that a desired pattern of holes 105 may be formed. Thus, the pattern of holes 105 may define a predefined flow characteristic or aerodynamic fluid profile inside the gap 103 of the system 100 for instance.

It should be noted that the term "comprising" does not exclude other elements or steps and "a" or "an" does not exclude a plurality. Also elements described in association with different embodiments may be combined. It should also be noted that reference signs in the claims should not be construed as limiting the scope of the claims.

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CLAIMS

1. A system for cooling a wall element (101) of a device located in a gas turbine, the system (100) comprising

5 a guiding device (102) that is located with respect to the wall element (101) in such a way that a gap (103) between a surface (104) of the wall element (101) and the guiding device (102) is formed,

10 wherein the guiding device (102) comprises a hole (105) for guiding a cooling fluid stream (107) through the guiding device (102) towards the surface (104) in such a way that the cooling fluid stream (107) impinges at the surface (104), so that the cooling fluid stream (107) is heated up to a heated fluid stream (108) after impinging on the surface (104) and
15 the heated fluid stream (108) flows along the surface (104) to an exhaust region of the system (100), and

a fluid deflecting element (109) located inside the gap (103) in such a way that the heated fluid stream (108) is guided around a further cooling fluid stream (107) streaming
20 through a further hole (105) of the guiding device (102).

2. The system of claim 1,

wherein the fluid deflecting element (109) is a sheet metal.

25 3. The system of claim 1 or 2,

wherein the fluid deflecting element (109) is formed in a V-shape comprising a leading edge (201),

30 wherein V-shaped fluid deflecting element (109) is located inside the gap (103) in such a way that the heated fluid stream (108) flows against the leading edge (201) and is guided along the outer surface (202) of the V-shaped fluid deflecting element (109) around the downstream impinging further cooling fluid stream (107).

35 4. The system of one of the claims 1 to 3, further comprising

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a plurality of fluid deflecting elements (109) that are located inside the gap (103) in such a way that between two of the plurality of fluid deflecting elements (109) a flow channel (301) for the heated fluid stream (108) is formed.

5

5. The system of one of the claims 1 to 4,
wherein the fluid deflecting element (109) is spatially fixed to the guiding device (102).

10

6. The system of claim 5,
wherein the fluid deflecting element (109) is formed in such a way that a portion of the guiding device (102) element is bent up towards the surface (104).

15

7. The system of one of the claims 1 to 6, further comprising
the device,
wherein the device is a stationary device.

20

8. The system of claim 7,
wherein the stationary device is an aerofoil (500).

25

9. The system of claim 8,
wherein the wall element (101) forms an outer wall (501)
of the aerofoil (500),
wherein the guiding device (102) is formed inside the aerofoil (500) and extends along an inner surface (502) of the outer wall (501) in such a way that the guiding device (102) covers at least partially the inner surface.

30

10. The system of claim 8 or 9,
the aerofoil (500) comprises a trailing edge (503),
wherein the exhaust region is formed in the vicinity of the trailing edge (503).

35

11. The system of one of the claims 1 to 6, further comprising

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the device,
wherein the device is a movable device.

12. The system of one of the claims 7 to 11,
5 wherein the fluid deflecting element (109) is spatially
fixed to the wall element (101).

13. A gas turbine comprising
the system (100) of one of the claims 1 to 12.

10

14. A method of cooling a wall element (101) of a device
located in a gas turbine, the method comprising:

guiding a cooling fluid stream (107) through a hole
(105) of a guiding device (102) towards a surface (104) of
15 the wall element (101) in such a way that the cooling fluid
stream (107) impinges at the surface (104), so that the
cooling fluid stream (107) is heated up to a heated fluid
stream (108) after impinging and the heated fluid stream
(108) flows along the surface (104) to an exhaust region,
20 guiding the heated fluid stream (108) around a further
cooling fluid stream (107) streaming through a further hole
(105) by an fluid deflecting element (109).

FIG 3

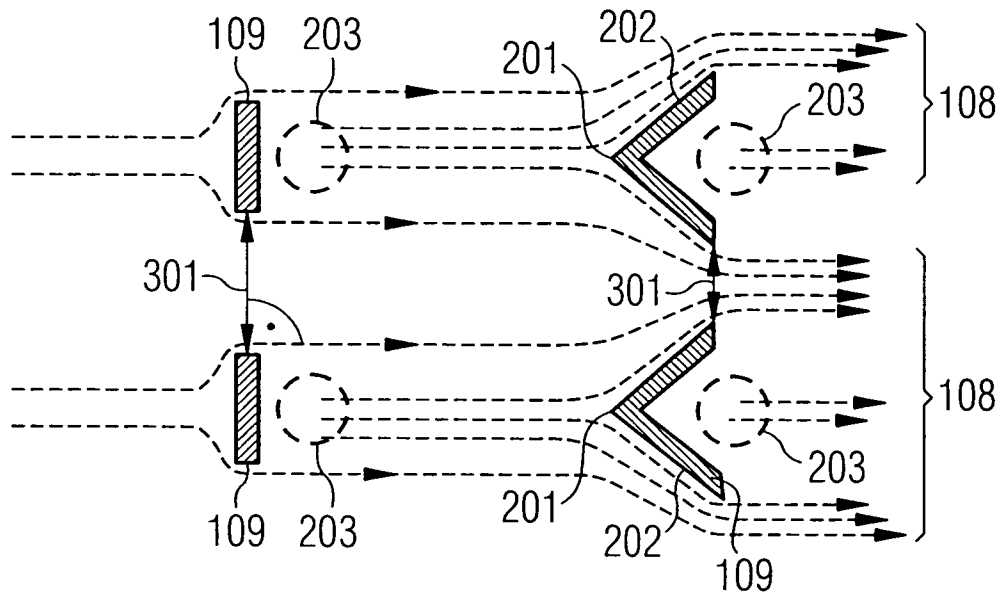


FIG 4

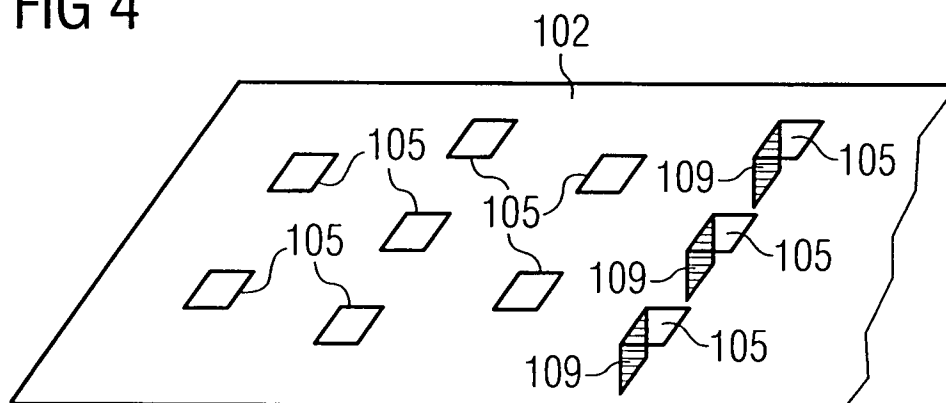


FIG 5

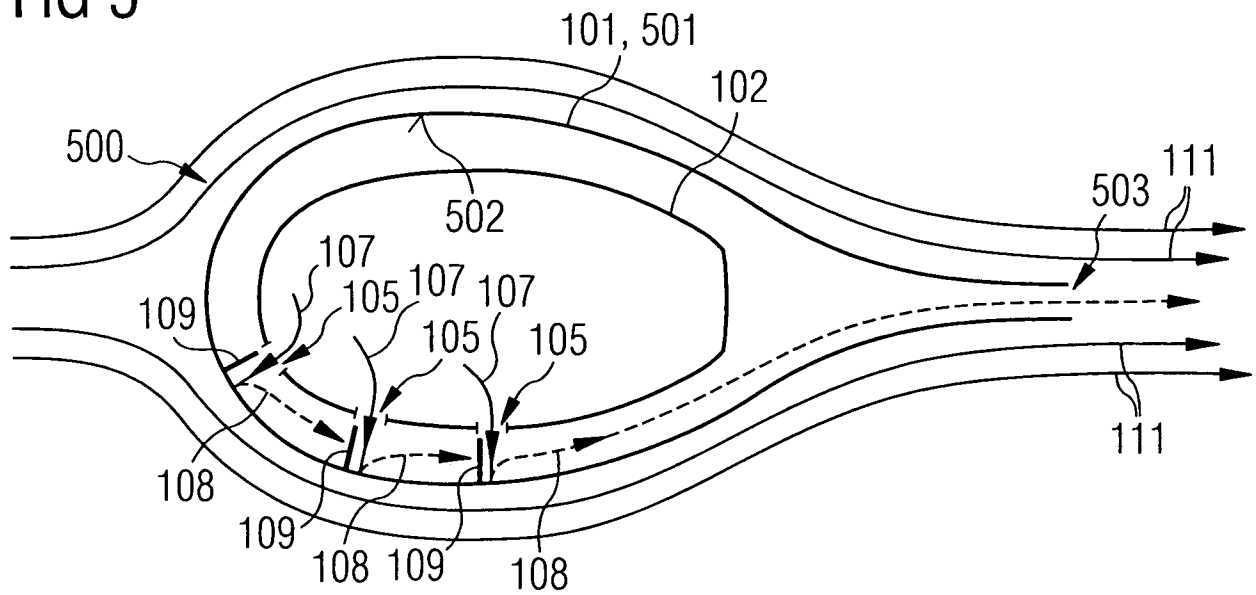
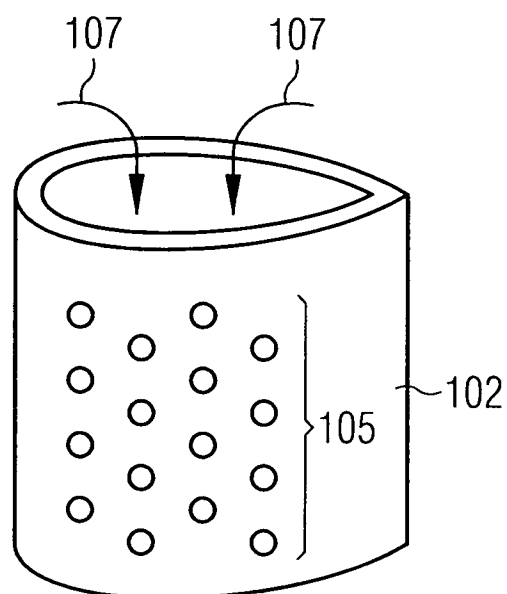


FIG 6



INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2009/006044

A. CLASSIFICATION OF SUBJECT MATTER

INV. F01D5/18 F01D25/08
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F01D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1 188 902 A1 (SIEMENS AG [DE]) 20 March 2002 (2002-03-20) paragraphs [0019] - [0020]; figures 1,2 -----	1-14
X	US 4 105 364 A (DODD ALEC GEORGE) 8 August 1978 (1978-08-08) column 2, lines 11-63; figures 1-3 -----	1-14
X	US 4 064 300 A (BHANGU JAGNANDAN KUMAR) 20 December 1977 (1977-12-20) column 2, lines 4-57; figures 1-5 -----	1-14

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"&" document member of the same patent family

Date of the actual completion of the international search

4 May 2010

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2009/006044

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