GAS TURBINE WITH ANNULAR HEAT SHIELD

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ABSTRACT
A gas turbine includes a supporting structure which concentrically surrounds a hot gas path and is shielded with respect to the hot gas path by an annular heat shield (15'), which heat shield (15') includes a multiplicity of segments which are arranged one behind the other in a circumferential direction and which in each case butt against one another in the circumferential direction so as to form a gap, seals (16'), being arranged for sealing off the gaps between the segments butt ing against one another, the seals having thin elongate sealing strips (23), which are accommodated in corresponding sealing slots (19), delimited transversely with respect to the longitudinal direction by a wall (25), in the mutually opposite end faces of the segments of the heat shield (15') which butt against one another. Vibrationally-induced rubbing through of the wall is inhibited or prevented by the frictional surface between the wall (25) and the sealing strips (23) being markedly enlarged with respect to the end face (22) of the sealing strip (23).
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BACKGROUND

[0002] 1. Field of Endeavor

[0003] The present invention relates to gas turbines.

[0004] 2. Brief Description of the Related Art

[0005] Feather seals or strip seals between adjacent segments in the hot gas path have been known for a long time in gas turbines (U.S. Pat. No. 3,752,598).

[0006] It is known, furthermore, where intersecting seals are concerned, to provide, between the segments, separate angled transition seals sealing off the intersection points (U.S. Pat. No. 5,154,577).

[0007] Finally, U.S. Pat. No. 5,655,876 (FIGS. 4 and 5) discloses a strip seal for segments, which emerges from a slot open at the end and which is angled there in order to fix the position of the seal.

[0008] Gas turbines already in use, such as, for example, the ALSTOM’s gas turbines of type GT14/26, have an internal structure, such as is illustrated in details in FIGS. 1, 2, and 4. Gas turbine 10 has a rotor (not illustrated) with a plurality of moving blades 13, which is concentrically surrounded by a supporting structure 11 so as to form a hot gas path 12. Guide vanes 14 are fastened to the supporting structure 11. Between the guide vanes of successive stages, the supporting structure 11 is shielded with respect to the hot gas path 12 by an annular heat shield 15 segmented in the circumferential direction (see in this respect, for example, DE-A1-103 42 208). Between adjacent segments of the heat shield 15, a gap remains free, which is sealed off by seals 16 and 17 arranged in the gap. The seals 16, 17 are known as feather seals or strip seals and in each case have thin elongate sealing strips (20 in FIG. 4) which are accommodated in mutually corresponding sealing slots 18, delimited transversely with respect to the longitudinal direction by an end wall 21, in the mutually opposite end faces of the segments of the heat shield 15 which butt against one another.

[0009] The seal 17 prevents cooling air from flowing through the gaps between the segments into the hot gas path 12. The seal 16, conversely, prevents hot gases from flowing out of the hot gas path 12 through the gaps between the segments. The pressure drop across the seal 16 is low. The associated sealing strip 20 therefore lies loosely in the corresponding sealing slots 18 of the segments buttting against one another (FIGS. 2 and 4). During operation, therefore, vibrations of the sealing strip 20 in the sealing slots 18 may occur.

[0010] When the sealing strip 20 vibrates in the sealing slots 18 (see the double arrow in FIG. 4, which illustrates the principle direction of vibration), the sharp end of the strip (end face 22 in FIG. 4) scrapes against the end wall 21 of the sealing slot 18 and ultimately pierces the wall. Metallurgical changes which occur due to oxidation increase the hardness of the sealing strips 20 and may further accelerate the rubbing through of the wall. When the sealing strip 20 has worn through the wall of the heat shield completely, there is nothing more to hold the sealing strip 20 in the sealing slot 18. The sealing strip 20 emerges from the slot and penetrates into the hot gas path 12. This event is hazardous for two reasons: on the one hand, the loose sealing strip may cause unforeseeable damage in the hot gas path to the components lying downstream; on the other hand, the seal between the segments of the heat shield is absent, so that hot gas may emerge between the segments and damage the structure lying behind them or cooling air consumption increases and thus the gas turbine performance is reduced.

SUMMARY

[0011] One of numerous aspects of the present invention includes a segment seal for a gas turbine, which can avoid the disadvantage of known seals and is distinguished particularly in that piercing of the wall of the sealing slot by the vibrating strip seal is avoided or at least greatly delayed in a simple way.

[0012] Another aspect of the present invention includes the marked enlargement of the frictional surface between the wall and the sealing strips with respect to the end face of the sealing strip. What is achieved thereby is that the material-stripping effect of the friction is reduced, and piercing of the end wall of the sealing slots, by the sealing strip moving to and fro in the slot, is prevented or at least considerably delayed.

[0013] Yet another aspect includes that the sealing strips have, at their end facing the wall, an angled end portion, the outside of which forms the contact surface with the wall. The angled portion provides in a particularly simple way a considerably larger contact surface for the frictional contact of the sealing strip with the wall.

[0014] An exemplary embodiment can include that, at the ends of the sealing slots, angled slot extensions are provided, into which the sealing strips engage with their angled end portions.

[0015] The slot extensions may in this case be angled at right angles. They may, however, also be angled at an angle of 90°±0°<b>±</b>20° being applicable.

[0016] A simplified embodiment of this slot configuration includes the slot extensions designed as slot portions intersecting the sealing slots.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] The invention will be explained in more detail below with reference to exemplary embodiments, in connection with the drawing in which:

[0018] FIG. 1 shows, in a detail, a longitudinal section through a gas turbine according to the prior art with a segmented heat shield concentrically surrounding the hot gas path, for shielding the stator;

[0019] FIG. 2 shows a view in the circumferential direction of an enlarged detail of the end face of a heat shield segment from FIG. 1;

[0020] FIG. 3 shows the detail, corresponding to FIG. 2, of the end face of the heat shield according to an exemplary embodiment of the invention;

[0021] FIG. 4 shows a longitudinal section through the end region of the sealing slot from FIG. 2 with the sealing strip arranged in it;

[0022] FIG. 5 shows an illustration, comparable to FIG. 4, of the end region of the sealing slot with an inserted sealing strip according to FIG. 3, and
FIG. 6 shows an illustration, comparable to FIG. 5, of the end region of a sealing slot with an inserted sealing strip according to another exemplary embodiment of the invention.

**DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS**

FIGS. 5 and 6 illustrate exemplary embodiments of a seal according to principles of the present invention, from which an essential point of the technical solution may be gathered: in a sealing slot 19 or 27 close to the end, as before, lies a sealing strip 23 or 29 which at its end has an end portion 24 or 30 angled with respect to the longitudinal direction of the sealing strip. The outside of the angled end portion 24, 30 forms, with respect to the end wall 21 (FIG. 4), a greatly enlarged contact surface 26 or 32 which comes into contact with the end wall 25, 31 of the sealing slot 19, 27 during frictional vibration (double arrows in FIGS. 5 and 6, which illustrate the principle direction of vibration) of the sealing strip 23, 29. As a result of the enlarged surface 26 or 32, the force exerted on the slot wall by the sealing strip 23, 29 is distributed over a larger area. By the force being distributed over a larger area, the contact pressure and the friction stress are reduced. With a reduction in the stress, the damage to the wall caused by friction is drastically reduced, if not even eliminated entirely, so that the probability of the wall being rubbed through is greatly reduced.

If the sealing slot 19, 27 is sufficiently wide, the angled end portion 24, 30 can be introduced, without the slot geometry having to be changed. In order to allow larger contact surfaces, it is advantageous to provide, at the ends of the sealing slots 19, 27, angled slot extensions 28, 33 which receive the angled end portion 24, 30 of the sealing strip 23, 29. In the exemplary embodiment of FIG. 3 or FIG. 5, the slot extension 28 is bent at right angles.

In the exemplary embodiment of FIG. 6, the slot extension 33 forms with the longitudinal direction of the sealing slot 27 an angle deviating from 90°. This may be advantageous when the configuration of the slot has to take into account geometric restrictions. It has in this case proved appropriate to have an angle which lies in the region of 90°±8°, 0°±20° being applicable.

According to FIG. 6, it may be advantageous for production reasons (for example, simplification) to design the slot extension 33 as short slots intersecting the sealing slot 27.

**LIST OF REFERENCE SYMBOLS**

10 Gas turbine
11 Supporting structure
12 Hot gas path
13 Moving blade
14 Guide vane
15, 15′, 15″ Heat shield (segmented)
16, 16′, 16″, 17 Seal (strip or feather seal)
18, 19, 27 Sealing slot
20, 23, 29 Sealing strip
21 End wall (sealing slot)
22 End face (sealing strip)
24, 30 End portion (angled)
25, 31 Wall (slot extension)
26, 32 Contact surface (end portion)
28, 33 Slot extension
29 End face (sealing strip)
30 End portion (angled)
31 Wall (slot extension)
32 Contact surface (end portion)
33 Slot extension
34 End face (sealing strip)
35 End portion (angled)
36 Wall (slot extension)
37 Contact surface (end portion)
38 End face (sealing strip)
39 End portion (angled)
40 Wall (slot extension)