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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/769,224	08/20/2015	Sarah Riley	71593US02;67097-2488PUS1	6690

54549 7590 06/23/2020

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EXAMINER	
WALTHOUR, SCOTT J	

ART UNIT	PAPER NUMBER
3741	

NOTIFICATION DATE	DELIVERY MODE
06/23/2020	ELECTRONIC

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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte SARAH RILEY, MARK A. BOEKE, and SHAWN J. GREGG

Appeal 2019-006976
Application 14/769,224
Technology Center 3700

Before KEVIN F. TURNER, JOHN C. KERINS, and LEE L. STEPINA, *Administrative Patent Judges.*

STEPINA, *Administrative Patent Judge.*

DECISION ON APPEAL

STATEMENT OF THE CASE

Pursuant to 35 U.S.C. § 134(a), Appellant[1] appeals from the Examiner's decision to reject claims 1, 2, 5–14, and 16. We have jurisdiction under 35 U.S.C. § 6(b).

We AFFIRM.

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[1] We use the word Appellant to refer to "applicant" as defined in 37 C.F.R. § 1.42. Appellant identifies the real party in interest as United Technologies Corporation. Appeal Br. 1.

CLAIMED SUBJECT MATTER

The claims are directed to gas turbine engines and associated components that have vanes including first and second cooling hole shapes and first and second thermal barrier thicknesses.

Claim 1, reproduced below with emphases added, is illustrative of the claimed subject matter.

> 1. A stator for a gas turbine engine comprising:
> a platform supporting multiple vanes including a first vane and a second vane, wherein the first vane includes a first region and the second vane includes a second region, the first and second regions arranged at a same location on the first and second vanes, the first region includes a first cooling hole configuration and the second region includes a second cooling hole configuration, *the first cooling hole configuration and the second cooling hole configuration being different from one another*, the first region having a thermal barrier coating having a first thickness, and the second region having a thermal barrier coating having a second thickness that is different from the first thickness, wherein *the first cooling hole configuration includes a first cooling hole having an oblong exit, and the second cooling hole configuration includes a second cooling hole having a conical exit*.

Appeal Br. 6 (Claims App.).

REFERENCES

The prior art relied upon by the Examiner is:

Name	Reference	Date
Kercher	US 5,356,265	Oct. 18, 1994
Busch	US 2005/0135921 A1	June 23, 2005
Lee	US 2010/0047056 A1	Feb. 25, 2010
McMahan	US 2011/0217159 A1	Sept. 8, 2011

REJECTION

Claims 1, 2, 5–14, and 16 are rejected under 35 U.S.C. § 103(a) as unpatentable over Lee, Busch, McMahan, and Kercher.

OPINION

Appellant argues for the patentability of claims 1, 2, 5–14, and 16 as a group. Appeal Br. 3–5. We select claim 1 as representative of the group, and claims 2, 5–14, and 16 stand or fall with claim 1.

The Examiner finds that Lee discloses a gas turbine engine having many of the elements recited in claim 1, but does not disclose (i) first and second regions with thermal barriers of different thickness and (ii) a first cooling hole configuration including a first cooling hole having an oblong exit, and a second cooling hole configuration including a second cooling hole having a conical exit. Final Act. 3–7. The Examiner finds Busch teaches first and second regions with first and second thermal barrier thicknesses. *Id.* at 5. The Examiner finds McMahan teaches a gas turbine nozzle with multiple vanes, wherein one vane may have different numbers, sizes, and/or shapes of cooling holes than another vane. *Id.* at 6. The Examiner reasons that a person of ordinary skill in the art would have found it obvious to include cooling holes with an oblong shape, as taught by Lee, in combination with cooling holes of a different shape, as taught by McMahan, "to provide preferential cooling to address differences in heating in the nozzle." *Id.* (citing Lee ¶¶ 60, 62, 87; McMahan ¶¶ 20, 37).

As for the requirement in claim 1 that the second cooling hole configuration includes a second cooling hole having a *conical* exit, the Examiner finds Kercher discloses a vane with "film cooling holes with a

conical shape." *Id.* (citing Kercher, 8:11–12, 18–21, Figs. 1, 2). The Examiner reasons that it would have been obvious to provide cooling holes with conical exits in order to control the rate of cooling fluid flow. *Id.* (citing Kercher, 8:12–15). Thus, according to the Examiner, the teachings of Lee and McMahan would have made it obvious to use cooling hole exits of an oblong shape and a second, different shape, while the additional teachings of Kercher would have made it obvious to make the second shape a conical shape.

Appellant presents three arguments in support of the patentability of claim 1. Appeal Br. 3–4. First, Appellant contends "[t]he Examiner has not identified any reason one would use the conical exit of Kercher instead of a different cooling hole diameter, distribution, or pitch as taught by Lee or a different number of cooling holes as taught by McMahan to change the rate of cooling fluid." *Id.* at 3.

In response, the Examiner refers to paragraphs 36, 37, 43, and 44 of McMahan and finds that McMahan teaches the use of holes of different sizes and of different shapes and that both of these practices provide a benefit. Ans. 3–4. The Examiner reiterates that the rejection of claim 1 relies on Kercher to teach the claimed conical shape and that the use of this shape serves a purpose.[2] The Examiner states that, contrary to Appellant's argument, "the references themselves suggest it would have been obvious to one of ordinary skill in the art to provide the oblong-shaped cooling holes of Lee on one vane and the conical-shaped cooling holes of Kercher on the other vane" in light of McMahan's teaching to use cooling holes of different

[2] Appellant does not contest the Examiner's finding that Kercher teaches the claimed conical shape. *See* Appeal Br. 3–5.

shapes and Kercher's teaching that conically shaped holes can be used to control the rate of cooling fluid channel through the cooling hole. *Id.* at 4 (citing Kercher 8:12–15).

Appellant does not identify error in the Examiner's reasoning for modifying the cooling holes of Lee to include different first and second cooling hole configurations (as taught by McMahan) and for one of these configurations to include a cooling hole having a conical exit (as taught by Kercher). Describing the arrangement of its cooling holes, McMahan states "the relative sizes and/or shapes of the cooling holes 54 may vary to provide less cooling in the vanes 46A and/or band segments 48A and 50A than in the vanes 46B and/or band segments 48B and 50B." McMahan ¶ 37 (emphasis omitted). McMahan teaches that, aside from circular cooling holes, *non-circular* cooling holes may be used, including "rectangular, square, or triangular, among others." *Id.* McMahan explains that some portions of the vanes on its turbine may include one shape of hole, while other portions may include a different shape. *See id.* Accordingly, we agree with the Examiner that, in light of McMahan's disclosure, "[o]ne of ordinary skill in the art would have therefore understood that either the number or the shape of cooling holes could be different on two adjacent vanes in order to produce the intended preferential cooling effect." Ans. 3.

As for the Examiner's reasoning to implement a cooling hole having a *conical* exit in the second cooling hole configuration (Ans. 4), Kercher teaches controlling a rate of flow via the use of conical cooling holes (Kercher 8:12–15). In other words, Kercher provides a reason for using conical cooling holes. The fact that the shapes and sizes of cooling holes disclosed in each of Lee and McMahan are adequate (before incorporation of the conical shape taught by Kercher) for their intended purpose of

controlling cooling does not undermine the Examiner's reasoning for modifying the cooling hole configuration of Lee. Rather, McMahan teaches the use of two different cooling hole shapes, lists certain shapes, and then states that *other* shapes may be used. *See* McMahan ¶ 37. Thus, McMahan itself suggests the use of shapes not specifically listed in paragraph 37.

Next, Appellant notes the Examiner's finding that McMahan teaches the use of differently shaped cooling holes, but contends that McMahan fails to teach or suggest that any of these cooling holes should be conical. Appeal Br. 4 (citing Final Act. 16, McMahan ¶ 37). For this reason, Appellant asserts, the Examiner failed to provide an adequate rationale for the proposed modification.

As discussed above, McMahan suggests the use of cooling hole shapes other than rectangular, square, or triangular. *See* McMahan ¶ 37. Accordingly, we see no reason a person of ordinary skill in the art would consider the cooling holes disclosed by McMahan to be limited to any specific shape. Further, contrary to Appellant's argument, the Examiner finds that Kercher teaches that the use of conical cooling holes would provide the benefit of controlling flow. Ans. 4. Appellant does not contest this finding. *See* Appeal Br. 3–5. Consequently, Appellant's argument that the Examiner failed to provide an adequate rationale for the proposed implementation of a conical shape cooling hole exit is unavailing.

Finally, Appellant argues "paragraph [0052] of the pending application explains 'the conical exits 98 may provide more effective film cooling, which compensates for a thinner thermal barrier coating on the first cooling region.' This is an unexpected benefit over other available exit hole geometries that is not apparent from any of the cited references." Appeal Br. 4.

In response, the Examiner finds that the conical cooling holes disclosed by Kercher would provide the benefit of controlling fluid flow regardless of the presence of a thermal barrier coating. Ans. 5. Additionally, the Examiner states, "[t]here is no evidence on the record that Kercher's conical cooling holes could not or would not provide the benefit disclosed by Kercher if a thermal barrier coating were present or that any unexpected result would occur by providing an airfoil having a thermal barrier coating and conical cooling holes." Ans. 5.

In reply, Appellant reiterates that an unexpected benefit results from the use of cooling holes having conical exits in combination with the claimed thermal barrier coating. *See* Reply Br. 1–2. Additionally, Appellant contends that no evidence supports the Examiner's finding that the Kercher's conical cooling holes would function identically regardless of the presence of a thermal barrier. *Id.* at 2. Specifically, Appellant states, "[i]n fact, Busch teaches using different cooling configurations for vanes having different thicknesses of thermal barrier coating" and "[t]hese teachings of Busch suggest the cooling arrangements would function differently for different thicknesses of thermal barrier coating." *Id.* (citing Busch ¶¶ 69, 75).

Appellant's argument does not apprise us of Examiner error because the characteristic that Appellant touts as an unexpected benefit (more effective film cooling) appears to be the same benefit Kercher teaches is the result of using conical cooling holes. *See* Kercher ¶ 37. In other words, rather than providing an unexpected benefit, Appellant's cooling hole configuration appears to perform as already described in the prior art. Appellant provides no objective evidence or technical reasoning supporting a conclusion the presence of a relatively thin thermal barrier would change

the expectation that the conical cooling holes can be used to control cooling, and Appellant does not assert that any other benefit is provided. Even assuming, for the sake of argument, that effective cooling is especially *desirable* in areas where the thermal barrier is relatively thin, the result of the use of conical cooling holes (more effective film cooling) is still the same and would have been expected.

We have considered all of Appellant's arguments in support of the patentability of claim 1, but find them unavailing. Accordingly, we sustain the rejection of claims 1, 2, 5–14, and 16.

CONCLUSION

The Examiner's rejections are affirmed.

DECISION SUMMARY

Claims Rejected	35 U.S.C. §	Basis	Affirmed	Reversed
1, 2, 5–14, 16	103(a)	Lee, Busch, McMahan, Kercher	1, 2, 5–14, 16	

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a).

AFFIRMED