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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte KEVIN J. RYAN, KARL A. MENTZ, and MARK J. ROGERS

Appeal 2019-006057
Application 14/908,225
Technology Center 3700

Before JENNIFER D. BAHR, WILLIAM A. CAPP, and LISA M. GUIJT, *Administrative Patent Judges.*

BAHR, *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 1–23. 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(a). Appellant identifies the real party in interest as United Technologies Corporation. Appeal Br. 1.

CLAIMED SUBJECT MATTER

Appellant's invention is directed to "a gas turbine engine, and more particularly to a wedge seal for use[] between non-rotating structures of a gas turbine engine." Spec. ¶ 2. Claim 1, reproduced below, is illustrative of the claimed subject matter.

> 1. A seal assembly arrangement for a gas turbine engine comprising:
>
> first and second non-rotating structures respectively providing first and second faces;
>
> a sealing assembly includes discrete first and second sealing rings respectively engaging the first and second faces, the first and second sealing rings slideably engaging one another at a sliding wedge interface.

REFERENCES

The prior art relied upon by the Examiner is:

Name	Reference	Date
Glynn	US 5,292,138	Mar. 8, 1994
Nakaoka	US 2006/0038355 A1	Feb. 23, 2006
Lutjen	US 2013/0113168 A1	May 9, 2013
Sha	US 2014/0035240 A1	Feb. 6, 2014

REJECTIONS

Claims 1, 7, 10–13, 15, 16, 21, and 22 stand rejected under 35 U.S.C. § 103 as unpatentable over Sha and Glynn.

Claims 2–6 and 17–20 stand rejected under 35 U.S.C. § 103 as unpatentable over Sha, Glynn, and Lutjen.

Claims 8, 9, 14, and 23 stand rejected under 35 U.S.C. § 103 as unpatentable over Sha, Glynn, and Nakaoka.

OPINION

Obviousness—Sha and Glynn

Appellants argue claims 1, 7, 10–13, 15, 16, 21, and 22 together. Appeal Br. 2–4. We decide the appeal of this rejection on the basis of claim 1, with the remaining claims standing or falling with claim 1. *See* 37 C.F.R. § 41.37(c)(1)(iv) (permitting the Board to select a single claim to decide the appeal as to a single ground of rejection of a group of claims argued together).

The Examiner finds that Sha discloses a seal assembly arrangement substantially as recited in claim 1, including, in pertinent part, first and second sealing rings respectively providing first and second faces that slideably engage one another at a sliding wedge interface. Final Act. 3–4 (citing Sha, Figs. 2, 7, 8, 14; ¶¶ 28, 29). However, the Examiner finds that Sha "does not teach: [w]herein the rings are discrete." *Id.* at 4.

Notably, it is not apparent to us, and the Examiner does not cogently explain, why the first and second seal sections of Sha's "annular split ring" seal, for use at joints between casings, such as a joint between a casing of a combustion can and the annular plate of a combustion wrapper, are not "discrete" first and second sealing rings as called for in claim 1. *See* Sha ¶¶ 23, 27–30. Although Sha refers to the annular seal as "*an* annular split ring having inclined surfaces between the split sections of the seal" (Sha ¶ 28 (emphasis added)), the split seal sections are separate and discrete rings. *See id.* ¶ 33 (disclosing alignment devices, such as corresponding tongues and grooves, arranged at one or more locations along the circumference of the seal to ensure that the first section remains aligned and in contact with the second section). If the split seal sections were part of a unitary, one-

piece seal structure, rather than discrete sealing rings, there would be no need for alignment devices arranged along the circumference to ensure alignment of the sections. Likewise, the disclosure of such alignment devices at one or more locations along the circumference of the seal conveys that the first and second seal sections are coextensive along the circumference of the ring. Further, Sha's disclosure in paragraphs 27, 41 and 42 regarding how the sliding seal operates, using pressure differences across the split seal to cause one section of the seal to slide over the other section until it abuts against the walls of the slots to form a seal, suggests that both seal sections extend along substantially the entire circumference of the annular ring to form an effective annular seal along the substantially the entire circumference thereof, thereby each forming a ring.

Nevertheless, the Examiner relies on Glynn for its teaching of using a split ring assembly comprising two separate and distinct rings to permit improved sealing, which provides the ability to seal over a wider range of pressures, lower leakage rates, and the ability to adjust the parameters of the seal more easily by merely altering the angle of the seals. Final Act. 4 (citing Glynn, Fig. 2, 3:1–54, 4:5–34). The Examiner determines it would have been obvious to modify Sha by using two separate rings angled opposite each other, as taught by Glynn, "for the purpose of improving the sealing rate, widening the sealing pressure values it is usable under, and making the seal more easily adjustable to varying sealing needs, by applying the two rings with the angular sealing ranges along it as taught." *Id.*

Appellant argues that Glynn's split ring assembly is intended to overcome problems associated with rotating seals and, thus, would not be applicable to Sha's seal, which is between non-rotating structures. Appeal

Br. 3. This argument is not persuasive because, although the friction and centrifugal forces generated when using a split ring between rotating structures presents additional complicating factors, both Sha and Glynn use differential pressure to bias the split seal sections into sealing position. *See* Sha ¶¶ 27, 32; Glynn 1:16–18, 4:5–8. Thus, the advantages that Glynn cites for using a split ring assembly comprising two separate and distinct rings would also be applicable to Sha.[2]

Appellant also argues that the "proposed modification would change the principle of operation [of Sha] and render [Sha] unsatisfactory for its intended purpose because," according to Appellant, "both embodiments of Glynn's split ring assembly 41 require centrifugal force to move to sealing engagement" and "[t]he non-rotating structures of Sha would not provide this centrifugal or 'rotating inertial force.'" Appeal Br. 3–4. This argument is unpersuasive. As discussed above, both Sha and Glynn use differential pressure to bias the split seal sections into sealing position. *See* Sha ¶¶ 27, 32; Glynn 1:16–18, 4:5–8. Although Glynn addresses additional friction forces and centrifugal forces that result from the rotation of the rotating structures, neither Sha nor Glynn suggests that differential pressure alone, without the centrifugal forces that would result from rotation, would be insufficient to bias the sections of the annular seal relative to one another to form a gas tight seal. In fact, Sha discloses that the pressure difference across the split seal caused by any gas leaks into the joint above a threshold level pushes one seal section relative to the other section along the inclined abutting surfaces to form a gas tight seal. *See* Sha ¶¶ 27, 41.

[2] Indeed, as discussed above, Sha appears to use a split ring seal comprising two separate and distinct sections for similar reasons. *See* Sha ¶ 27.

In responding to the Examiner's citation of Koleilat (US 2005/0242519 A1) and Synott (US 2004/0219014 A1) in the Advisory Action as evidence that forces other than rotation may bias a split wedge to drive wedge action, Appellant submits that Koleilat and Synott disclose a biasing spring and a resilient energizer to apply a resilient biasing force, respectively, to maintain the seal, and argues that "the Examiner has not identified any part of Sha or Glynn that suggests such an additional biasing spring might be used with those sealing arrangements." Appeal Br. 4. This argument is incorrect. Gas pressure activates Sha's seal by biasing one section against the other section, such that an additional biasing spring is not required for proper operation of Sha's seal, as evidenced by the embodiments of Sha's Figures 7 and 8, for example. *See, e.g.*, Sha ¶ 27 (disclosing a sliding seal that is "biased by gas pressure to form a gas tight seal in a joint between a casing or casing segments"). However, Sha's Figure 14 embodiment, which is one of the embodiments that the Examiner cites (Final Act. 3), includes deformable seal 138, such as a flexible rod, rope, or cord. Sha ¶ 48. Sha discloses that "[t]he deformable seals enhance the sealing between the seal and the walls of the chambers and thereby assist in preventing leakage of pressurized gas from the turbine casing." *Id.*

For the above reasons, Appellant does not apprise us of error in the rejection of claim 1 as unpatentable over Sha and Glynn. Accordingly, we sustain the rejection of claim 1, and of claims 7, 10–13, 15, 16, 21, and 22, which fall with claim 1, as unpatentable over Sha and Glynn.

Obviousness—Sha, Glynn, and Lutjen

Appellant argues claims 2 and 17 together, and relies on the arguments for claims 2 and 17 in contesting the rejection of claims 3–6 and

18–20. Appeal Br. 4–5. We decide the appeal of this rejection on the basis of claim 2, with claims 3–6 and 17–20 standing or falling with claim 2. *See* 37 C.F.R. § 41.37(c)(1)(iv).

The Examiner finds that Sha does not teach that the seal assembly separates a first pressurized area from a second pressurized area. Final Act. 7; *see* Appeal Br. 4 (citing paragraphs 36–37 of Sha discussing a static gas pressure on the front 77 of the seal and atmospheric pressure on the back 78 of the seal, once the seal sections shift to enhance sealing). The Examiner finds that Lutjen teaches that "[i]t is necessary to provide effective sealing between BOAS [(blade outer air seal)] structures." Final Act. 7 (citing Lutjen, Fig. 2). The Examiner further takes official notice that "it is extremely well-known in the art[] that BOAS structures [are] located opposite turbine blades, and that the downstream element following such BOAS would also be a turbine blade outer platform surface." Final Act. 7–8 (citing Zelesky (US 2015/0345319) and Synott (US 2004/0219014) as examples). Further, the Examiner notes that Synnott discusses the shortcomings of non-dynamic or non-biased seals, which may not create effective seals between structures that may shift unequally during thermal expansion. *Id.* at 8 (citing Synnott ¶¶ 1, 2). The Examiner also finds that Sha recognizes this issue and discloses seals designed to address this issue by means of their sliding interface and biasing from air pressure from high pressure regions to low pressure regions. *Id.* (citing Sha ¶¶ 7, 26–27). The Examiner determines it would have been obvious to apply the dynamic, sliding seals (i.e., the annular split seals comprising first and second seal sections) at locations between BOAS and adjacent vane platforms in Sha's engine identified by Lutjen as areas needing sealing to handle pressure

leakage from the core flow toward a lower pressure cooling flow area, in order to accommodate, through biasing action, for imperfect sealing due to shifting of structures from unequal thermal expansion. *Id.*

Appellant argues that "Sha's seal would be unsuitable for Lutjen's application" because Sha's seal "relies on the [pressure] difference between a sealed space and the atmosphere to bias its sections 48, 50 into a closed sealing position." Appeal Br. 4–5.

In response, the Examiner observes that Appellant has provided no evidence to support the assertion that the pressure force needed to bias the sliding seal sections into sealing position must be the pressure differential between the pressure in a pressurized region and atmospheric pressure, rather than the difference between the pressure in a high pressure pressurized region and a lower pressure pressurized region. Ans. 7. The Examiner also points out that Glynn teaches that the seal uses "the differential pressure between cavities to assist in seal sealing" and permits adjusting the seal parameters, such as the angle of the abutting faces of the sections and size of the seal elements relative to the sealing space in which they move, to seal over a wider range of pressures and achieve lower leakage rates. Ans. 4, 5, 7–8 (citing Glynn 1:16–22). Further, the Examiner emphasizes that Sha teaches making a determination as to the threshold difference in gas pressure acting along the front and back of the seal that will cause the first seal section to slide over the second seal section and determining the optimal inclined slope of the opposing surfaces in the seal based on the threshold gas pressure differential determination. *Id.* at 8 (citing Sha ¶ 37).

We agree with the Examiner that Appellant's assertion that Sha's seal would work only for sealing a pressurized region from atmospheric pressure

and would be unsuitable for sealing between two pressurized regions lacks evidentiary support in the record before us. To the contrary, Sha's teachings of adjusting the parameters of the seal, including the angle of the abutting faces of the first and second seal sections, and Glynn's teaching of using such split ring seals with first and second sliding seal sections to seal between pressurized cavities, provide ample evidentiary basis to establish a reasonable expectation of success in using Sha's/Glynn's sliding seal arrangement to separate one pressurized area from another, as called for in claim 2.

For the above reasons, Appellant does not apprise us of error in the rejection of claim 2 as unpatentable over Sha, Glynn, and Lutjen. Accordingly, we sustain the rejection of claim 2, and of claims 3–6 and 17–20, which fall with claim 2, as unpatentable over Sha, Glynn, and Lutjen.

Obviousness—Sha, Glynn, and Nakaoka

In contesting the rejection of claims 8, 9, 14, and 23, Appellant argues only that "[t]he addition of the teachings of [Nakaoka] does not overcome the deficiencies with respect to Sha and Glynn and base claim 1." Appeal Br. 5. For the reasons discussed above, Appellant's arguments do not apprise us of error in the rejection of claim 1 as unpatentable over Sha and Glynn, and, likewise, fail to apprise us of error in the rejection of claims 8, 9, 14, and 23 as unpatentable over Sha, Glynn, and Nakaoka, which we thus sustain.

DECISION SUMMARY

In summary:

Claims Rejected	35 U.S.C. §	Reference(s)/Basis	Affirmed	Reversed

1, 7, 10–13, 15, 16, 21, 22	103	Sha, Glynn	1, 7, 10–13, 15, 16, 21, 22	
2–6, 17–20	103	Sha, Glynn, Lutjen	2–6, 17–20	
8, 9, 14, 23	103	Sha, Glynn, Nakaoka	8, 9, 14, 23	
Overall Outcome			1–23	

TIME PERIOD FOR RESPONSE

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a). *See* 37 C.F.R. § 1.136(a)(1)(iv).

AFFIRMED