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| EXAMINER | |
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| SUTHERLAND, STEVEN M | |

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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*Ex parte* JOHN R. OTTO

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Appeal 2020-000508
Application 14/894,567
Technology Center 3700

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Before EDWARD A. BROWN, BENJAMIN D. M. WOOD, and BRETT C. MARTIN, *Administrative Patent Judges.*

MARTIN, *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 1–12, 14–17, and 19. *See* Final Act. 1. 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, assignee of the present invention. Appeal Br. 1.

## CLAIMED SUBJECT MATTER

The claims are directed to over speed monitoring using a fan drive gear system. Claim 1, reproduced below, is illustrative of the claimed subject matter:

> 1. A method of controlling a turbofan engine, the turbofan engine including a rotating shaft coupling a turbine to a compressor and driving a fan through a geared architecture, the method comprising:
>
> measuring a first speed of the rotating shaft at a first location aft of the geared architecture;
>
> measuring a second speed of a fan drive shaft driven by the geared architecture and rotating at a speed different than the rotating shaft;
>
> calculating an expected difference in speed of the rotating shaft and the fan drive shaft based on a gear ratio of the geared architecture;
>
> determining that one of the rotating shaft and the fan drive shaft are outside predefined deformation limits responsive to a difference between an actual difference between the first and the second speed and the calculated expected difference; and
>
> initiating a remedial action to protect the gas turbine engine responsive to a determination that one of the rotating shaft and the fan drive shaft are outside the predefined deformation limits.

## REFERENCES

The prior art relied upon by the Examiner is:

| **Name** | **Reference** | **Date** |
|---|---|---|
| Cunliffe | US 752,009 | July 4, 1956 |
| Witte | US 5,067,355 | Nov. 26, 1991 |
| Hayess | US 6,494,046 B1 | Dec. 17, 2002 |
| McVey | US 2010/0011740 A1 | Jan. 21, 2010 |
| Drnevich | US 5,802,875 | Sept. 8, 1998 |

REJECTIONS

| Claims Rejected | 35 U.S.C. § | Reference(s)/Basis |
|---|---|---|
| 2, 12, 17 | 112(a) | Written Description |
| 1–7, 9–12, 15–17 | 103 | Hayess, McVey, Cunliffe |
| 8, 14, 19 | 103 | Hayess, McVey, Cunliffe, Drnevich Witte |

OPINION

*Written Description*

The Examiner rejects claims 2, 12, and 17 as lacking proper written description because the claimed gear ratios have no upper bounds. As Appellant points out, "numerical ranges 'must be considered in the context in which is being applied,' here within a gas turbine engine." Reply Br. 2 (citing *Ex parte Fulner*, Appeal No. 2013-010469 at pp. 8–9). We agree with Appellant that "[o]ne skilled in the art would recognize that there is an inherent upper limit to the gear ratio applicable to a gas turbine engine" and that the lack of a claimed upper bound does not render the claims as lacking proper written description. Reply Br. 3. Accordingly, we do not sustain this rejection.

*Obviousness*

Appellant argues claims 1–7, 9–12, and 15–17 as a group. We select claim 1 as representative and the remaining claims stand or fall with claim 1. Appellant argues that "[t]he proposed combination is not supported by a rational reason and therefore the references are not properly combinable." Reply Br. 3. In general, Appellant argues that there is no reason to combine the various features of Hayess, McVey, and Cunliffe and that doing so

"would require a complete redesign and change of the intended operation of Hayess." Reply Br. 6. Appellant asserts an understanding "that bodily incorporation is not necessary to establish a *prima facie* case of obviousness," but then makes arguments that essentially amount to deficiencies in the bodily incorporation of the various features of the references at issue. Reply Br. 4.

Taking a step back from the physical device resultant from the Examiner's combination, it is helpful to understand both what the claims require at a conceptual level and what the prior art also teaches at a conceptual level. Claim 1 requires a turbofan engine with a fan coupled via geared architecture. The claim also requires sensors both fore and aft of the geared architecture to measure rotational speeds of the shafts and utilizing those speeds to determine whether one of the shafts is outside of the deformational limits.

Hayess is a turbofan engine similar to the recited turbofan engine, but lacks the geared architecture. Hayess teaches a very similar sensing system that detects rotations speeds at either end of the direct-drive shaft to determine if a potential failure might occur, similar to the claimed invention. Hayess teaches a delta in the two rotational speeds indicative of a potential failure, but because it is a direct drive shaft, the speeds are expected to be the same and so essentially any delta that is detected would indicate the potential for a failure. Therefore, what is lacking from Hayess is an understanding of how such a sensing system would operate if the two ends of the shaft were already operating at differing speeds due to the presence of a geared architecture between the drive shaft and the fan.

The Examiner thus points to McVey for teaching a turbofan more similar to the claimed turbofan in that it has a geared architecture, but is

silent regarding any sensing system. Essentially, the Examiner just uses McVey to point out that geared turbofans were known in the art and could operate in a similar fashion to Hayess turbofan engine with a direct-drive architecture. In our view, the Examiner could have satisfactorily rejected the claims with these two references alone. Hayess teaches all of the key sensing features in that it senses rotational speeds at two ends of a rotating shaft and utilizes the difference therebetween in order to determine if a failure event is imminent. Simply applying the logic of Hayess to McVey would convey to one of skill in the art that in a geared architecture, accomplishing the same sensing would simply require sensing at both ends of the shaft mechanism such that sensors are fore and aft of the geared architecture and then accounting for the fact that the shafts in a geared architecture already rotate at differing speeds. As such, the important thing to sense is a change in the delta, not just the delta itself as is done in Hayess.

The Examiner, however, went a step further and included teachings of the Cunliffe reference into the rejection to show that it was known that in a similar structure, those skilled in the art were already aware of the need to sense and compare the differing rotational speeds involved in a geared architecture between a drive shaft and fan shaft rotating at differing speeds. Appellant protests that "Cunliffe does not disclose sensors, but devices that act like sensors" because Cunliffe teaches, in the Examiner's interpretation, "a three phase alternator 21 as a first sensor and a three-phase induction machine 23 as another sensor." Reply Br. 5.

We first note that Appellant admits *supra* that Cunliffe teaches devices that act like sensors. We do not ascribe such a narrow meaning to the term sensor such that it could not include devices such as the alternator and induction machine taught in Cunliffe. The important teaching in

Cunliffe is that in a geared architecture, as found in the claims and in McVey, one of skill in the art already knew that it was desirable to sense the speeds of the shafts on either side of the gear mechanism to then compare the speeds and determine if a failure is imminent. Even though we consider Cunliffe to teach sensors according to the broadest reasonable interpretation of the term, this teaching is cumulative because Hayess already teaches sensors more in line with Appellant's disclosure, it just does not teach their use in a geared architecture.

Again, from a conceptual standpoint, the Examiner has clearly shown that sensing either end of a shaft to detect potential failure was known as disclosed in Hayess. The Examiner then showed that geared turbofan engines were known as disclosed in McVey and the Examiner also showed that in a similar architecture as disclosed in McVey and found in the claims, Cunliffe teaches that it was known to sense speeds of two shafts rotating at different speeds and separated by a geared architecture with sensors (or even sensor-like devices) located as claimed. Combining all of those teachings together, the Examiner's combination meets all of the claimed features.

Although Appellant asserts an understanding that bodily incorporation is not necessary, its arguments amount to faulting the Examiner for just such a bodily incorporation without looking at the higher-level of teachings found in the prior art. Given that all of the claimed features are present and that the combination naturally flows from a conceptual standpoint, we are not apprised of error in the Examiner's combination.

Regarding claims 8, 14, and 19, Appellant merely relies on their dependency from other independent claims subject to the group above represented by claim 1. Having found Appellant's arguments with regard to

claim 1 as not persuasive, we likewise sustain the Examiner's rejection of claims 8, 14, and 19.

## CONCLUSION

The Examiner's rejection is AFFIRMED.

More specifically,

## DECISION SUMMARY

| **Claims Rejected** | **35 U.S.C. §** | **Reference(s)/Basis** | **Affirmed** | **Reversed** |
|---|---|---|---|---|
| 2, 12, 17 | 112(a) | Written Description | | 2, 12, 17 |
| 1–7, 9–12, 15–17 | 103 | Hayess, McVey, Cunliffe | 1–7, 9–12, 15–17 | |
| 8, 14, 19 | 103 | Hayess, McVey, Cunliffe, Drnevich, Witte | 8, 14, 19 | |
| **Overall Outcome** | | | 1–12, 14–17, 19 | |

## 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