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**Datasheet for the decision
of 26 March 2021**

Case Number: T 1555/18 - 3.4.02

Application Number: 16153773.3

Publication Number: 3051267

IPC: G01M13/04, F16C19/52

Language of the proceedings: EN

Title of invention:

SYSTEMS AND METHODS FOR DETECTING WHEEL BEARING WEAR WITH
MOUNTED ACCELEROMETERS

Applicant:

Goodrich Corporation

Headword:

Relevant legal provisions:

EPC Art. 56

Keyword:

Inventive step - main request (no) - auxiliary request (no)

Catchword:



Beschwerdekammern
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Case Number: T 1555/18 - 3.4.02

D E C I S I O N
of Technical Board of Appeal 3.4.02
of 26 March 2021

Appellant: Goodrich Corporation
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Decision under appeal: **Decision of the Examining Division of the
European Patent Office posted on 1 February 2018
refusing European patent application No.
16153773.3 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman R. Bekkering
Members: C. Kallinger
T. Karamanli

Summary of Facts and Submissions

- I. The applicant lodged an appeal against the decision of the examining division refusing European patent application No. 16 153 773.3.
- II. The appellant requested that the examining division's decision be set aside and that a patent be granted on the basis of the claims according to the main request or the auxiliary request, both filed with the statement setting out the grounds of appeal dated 11 June 2018. As a further auxiliary measure the appellant requested oral proceedings.
- III. On 21 February 2020, a summons to oral proceedings was issued. In a communication according to Article 15 (1) of the Rules of Procedure of the Boards of Appeal in the revised version of 2020 (RPBA 2020, OJ EPO 2019, A63) dated 22 June 2020, the board provided its preliminary opinion according to which the subject-matter claim 1 of the main request and the auxiliary request lacked an inventive step inter alia in view of document D2.
- IV. By letter dated 3 December 2020 the appellant withdrew its request for oral proceedings, requested a decision according to the state of the file and did not present any further arguments with respect to inventive step.
- V. By communication dated 10 November 2020, the registrar of the board informed the appellant that the oral proceedings scheduled for 8 December 2020 had been cancelled.

VI. In this decision the following documents will be referred to:

D2 WO 2013/146501 A1

D2a EP 2 833 114 A1

VII. Claim 1 of the main request reads as follows:

"A wheel monitoring system of a landing gear of an aircraft, comprising:
a wheel (156);
a bearing (100) mechanically coupled to the wheel;
an axle of the landing gear mechanically coupled to the bearing;
a landing gear strut (162) mechanically coupled to the axle;
a vibration monitoring device disposed in the axle and comprising a wheel speed transducer, WST (304) and a housing (412) comprising an accelerometer and thermometer array (414) in contact with a portion of the housing proximate the bearing (100), wherein the accelerometer is configured to detect vibrations; and
a brake control unit (302) in electronic communication with the wheel speed transducer to monitor the bearing;
and further comprising a non-transitory memory communicating with the brake control unit (302), the non-transitory memory having instructions stored thereon that, in response to execution by the brake control unit, cause the brake control unit to perform operations comprising:
measuring, by the brake control unit, the vibrations using the WST;
comparing the vibration of the bearing to at least one of a predetermined value or spectra indicative of bearing wear; and

estimating a remaining useful life of the bearing based on a result of the comparison using the brake control unit."

- VIII. Claim 1 of the auxiliary request corresponds to claim 1 of the main request with the following features added at the end of claim 1:

"... wherein measuring the vibration of the bearing further comprises measuring an amplitude at a predetermined frequency, and further comprising comparing the amplitude at the predetermined frequency to a baseline amplitude at the predetermined frequency."

Reasons for the Decision

1. Decision in written proceedings

After the appellant's withdrawal of its request for oral proceedings, the appointed oral proceedings were cancelled. Therefore, the present decision is taken in written proceedings in accordance with Article 12(8) RPBA 2020, with due regard for the appellant's procedural rights under Articles 113 and 116 EPC. In particular, the principle of the right to be heard under Article 113(1) EPC is fully respected, since the appellant has presented arguments on the merits and the board has based its decision on those arguments. The case is ready for decision on the basis of the contested decision to be reviewed and the appellant's written submissions.

2. Main Request - Inventive step - Article 56 EPC

2.1 Document D2 as closest prior art

In the following, it will be referred to D2a, a family member of D2 in English.

Document D2a (see abstract and paragraphs [0011], [0014], [0022], [0060], [0065], and Figures 1 and 2) discloses a monitoring system for a bearing comprising:

- a bearing (1),
- a vibration monitoring device (3) comprising a transducer and a housing including a thermometer and an accelerometer in contact with a portion of the housing proximate the bearing, wherein the accelerometer is configured to detect vibrations and
- a unit (2) in electronic communication with the transducer to monitor the bearing and further comprising a non-transitory memory communicating with unit, the non-transitory memory having instructions stored thereon that, in response to execution by the unit, cause the unit to perform operations comprising:
 - measuring, by the unit the vibrations using the transducer,
 - comparing the vibration of the bearing to at least one of a predetermined value indicative of bearing wear, and
 - determining, by the unit, a remaining useful life of the bearing in response to the vibrations measured.

2.2 Differences

Document D2 fails to disclose that

- (a) the monitoring system is used for a bearing of a wheel of a landing gear of an aircraft and is mounted to an axle of the landing gear and
- (b) the calculation is carried out by the brake control unit.

2.3 Lack of inventive step

The individual differentiating features a) and b) as identified above do not produce a synergistic effect and are therefore treated separately in the following.

(a) Landing gear of an aircraft

The technical effect of this feature is to allow monitoring of a bearing of a wheel of a landing gear of an aircraft. The objective technical problem to be solved by this feature is therefore to find a specific application for a bearing monitoring system.

Document D2 discloses a general bearing monitoring system which can readily be used for a vehicle bearing system, e.g. the wheel bearing of a landing gear of an aircraft. When applying the monitoring system of D2 to the wheel bearing of a landing gear of an aircraft, the placement of the monitoring system is merely a straightforward implementation for the skilled person in order to measure the vibration of the bearing.

The appellant argued that document D2 was concerned with a portable hand-held monitoring device where the sensor was applied to the rotating component when the

measurement was required. Therefore, in the context of aircraft landing gear measurements, the monitoring system of D2 could only be used when the aircraft was on the ground and required additional monitoring equipment.

There would also be the issue that different maintenance personnel might place the sensor at slightly different positions in relation to the bearing and, therefore the possibility of human error that did not arise in the present invention, which ensured continuity and consistency of vibration monitoring.

The appellant's arguments are not convincing because the skilled person is aware of the fact that vibrations in the bearing of a landing gear have to be measured in use and would therefore permanently place the device of D2 on the landing gear. Furthermore, the skilled person would permanently place the sensor in the stationary part of the landing gear, i.e. in the axle, in order to simplify the electrical connection and provide reproducible and consistent measurements.

Finally, no unexpected technical effect is present, which could justify that this arrangement is not obvious to the skilled person.

(b) Brake control unit

The technical effect of this feature is that the computing power of the brake control unit is used for the monitoring of the bearing. The problem to be solved by this feature is therefore the provision of a suitable calculation unit for the bearing monitoring system.

The appellant argued that the comparison of the vibrations with the predetermined vibrations was performed by the brake control unit which was an existing part of the aircraft. Therefore, it was not necessary for a maintenance engineer to come to the aircraft and perform a measurement, as would be the case with D2.

This argument is not convincing because document D2 (see paragraphs [0046], [0058], and Figure 2) already discloses that the measured vibration data are processed by a software within a calculation unit (2). When integrating the system of D2 into an aircraft, the skilled person would use a calculation unit provided in the aircraft which has sufficient processing power available. Therefore, the choice of the brake control unit is considered an obvious choice, in particular, as there is no further technical relationship to any other function of the brake control unit, other than the mere integration of the bearing control unit into the brake control unit.

Again, no unexpected technical effect is present, which could justify the assumption that this implementation is not obvious to the skilled person.

- 2.4 In conclusion, the subject-matter of claim 1 of the main request is obvious to a person skilled in the art in view of document D2 and therefore lacks an inventive step.

3. Auxiliary request - Inventive step - Article 56 EPC

3.1 Claim 1 of the auxiliary request differs from claim 1 of the main request in that the following features have been added at the end of the claim:

"... wherein measuring the vibration of the bearing further comprises measuring an amplitude at a predetermined frequency, and further comprising comparing the amplitude at the predetermined frequency to a baseline amplitude at the predetermined frequency."

3.2 The appellant argued with respect to the added features that document D2 did not specifically teach that vibrations were monitored and used to determine bearing life by comparing vibration amplitude at a given frequency with a baseline amplitude at that frequency. This methodology had been found to be particularly advantageous as it was a simple comparison that could be performed quickly and reliably and could be consistently reproduced, which was crucial for aircraft safety. The values could be selected for different bearings allowing for a universal application of the method/apparatus.

3.3 The board is not convinced by the appellant's arguments for the following reasons.

Document D2 explicitly discloses to obtain numerical data of the vibration level and to compare the detected vibration level to a threshold (see paragraphs [0046] and [0058]). D2 therefore discloses implicitly to measure an amplitude (necessarily at a predetermined frequency) and to compare this amplitude to a baseline (threshold) amplitude.

With respect to the unamended features of claim 1 it is referred to the discussion of inventive step for the main request (see point 2.3 above).

3.4 In conclusion, the subject-matter of claim 1 of the auxiliary request is obvious to a person skilled in the art in view of document D2 and therefore lacks an inventive step.

4. Since none of the appellant's requests is allowable, the appeal must be dismissed.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:



H. Jenney

R. Bekkering

Decision electronically authenticated