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Datasheet for the decision of 18 April 2023

Case Number: T 0874/21 - 3.2.04

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Language of the proceedings: EN

Title of invention:
SENSOR COMMUNICATION SYSTEM AND MACHINE HAVING THE SAME

Patent Proprietor:
Rolls-Royce Corporation

Opponent:
Raytheon Technologies Corporation

Headword:

Relevant legal provisions:
EPC Art. 56

Keyword:
Inventive step - (yes)

Decisions cited:

Catchword:

Europäisches Patentamt
European Patent Office
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Beschwerdekammern

Boards of Appeal

Chambres de recours

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Case Number: T 0874/21 - 3.2.04

D E C I S I O N
of Technical Board of Appeal 3.2.04
of 18 April 2023

Appellant: (Opponent)	Raytheon Technologies Corporation Pratt & Whitney 400 Main Street East Hartford, CT 06118 (US)
Representative:	Dehns St. Bride's House 10 Salisbury Square London EC4Y 8JD (GB)
Respondent: (Patent Proprietor)	Rolls-Royce Corporation 2001 S. Tibbs Avenue, Mail Drop U27 Indianapolis, IN 46241 (US)
Representative:	Haseltine Lake Kempner LLP One Portwall Square Portwall Lane Bristol BS1 6BH (GB)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office posted on 12 April 2021 rejecting the opposition filed against European patent No. 2577023 pursuant to Article 101(2) EPC.**

Composition of the Board:

Chairman	C. Heath
Members:	S. Oechsner de Coninck
	G. Martin Gonzalez

Summary of Facts and Submissions

I. The appellant (opponent) lodged an appeal against the decision of the Opposition Division of the European Patent Office rejecting the opposition filed against European patent No. 2577023 pursuant to Article 101(2) EPC.

II. The Opposition Division held that the grounds for opposition mentioned in Article 100 (a) EPC did not prejudice the maintenance of the patent as granted having regard inter alia to the following documents:

D2: US 5,069,070
D3: EP 2 189 628 A2
D4: Linke-Diesinger, Andreas: "Systems of Commercial Turbofan Engines: an Introduction to System Functions", Springer-Verlag, 2008
D7: US 2007/0209865 A1
D8: US 2008/0054645 A1
D9: US 2,680,001

III. Oral proceedings were held on 18 April 2023 by means of videoconference.

IV. The appellant requests that the decision under appeal be set aside, and that the European patent be revoked.

V. The respondent (patent proprietor) requests that the appeal be dismissed, i.e. that the opposition be rejected (main request) or alternatively that the decision under appeal be set aside and the patent be maintained in an amended form on the basis of Auxiliary Requests 1 - 5 as filed with the reply to the grounds

of appeal, or 6 - 11 filed with letter dated 24 November 2022.

VI. The independent claims 1 and 8 according to the main request read as follows:

1."A turbine engine (10) comprising:
a first fluid passageway having an inlet (12) and an outlet (54);
at least one combustion chamber (22) positioned along said first fluid passageway between said inlet (12) and said outlet (54), wherein a primary fluid stream passes through said first fluid passageway and said at least one combustion chamber (22) for generating power;
a second fluid passageway (44) at least partially distinct from said first fluid passageway, wherein a secondary fluid stream passes through said second fluid passageway (44) to support the generation of power;
a sensor assembly having a sensor (50) operable to sense at least one condition and a transmitter (52) associated with said sensor (50) and operable to emit a signal corresponding to the at least one condition wirelessly, wherein at least part of said transmitter (52) is positioned in said second fluid passageway (44) to transmit the signal through said second fluid passageway (44); and
a receiver (56) operable to receive the signal and positioned in the second fluid passageway (44);
characterized in that said sensor assembly is further defined as being operable to emit the signal at a substantially optimized frequency relative to a cross-section of said second fluid passageway (44) such that said second fluid passageway (44) functions as a waveguide."

8."A method of operating a turbine engine (10) comprising:
directing a first fluid stream through a core of the engine to generate power;
passing a second fluid stream through a fluid passageway (44) at least partially distinct from the core of the engine (10) to support the generation of power during said directing;
sensing at least one condition within the turbine engine with a sensor (50); transmitting a signal corresponding to the at least one condition wirelessly with a transmitter (52) associated with the sensor (50);
positioning the transmitter (52) to transmit the signal through the fluid passageway (44);
locating a receiver (56) to receive the signal in the fluid passageway (44); characterized by
selecting the frequency of the signal in response to the shape of the fluid passageway (44) such that the fluid passageway (44) functions as a waveguide."

VII. The appellant argues as follows:
- Starting from either embodiment in figure 1 or figure 3 of D3, the skilled person would consider it obvious to use a passageway containing active fluid as alternative waveguide.

VIII. The respondent argues as follows:
- The skilled person would not have any reason to modify the dedicated waveguide of D3 so as to use a passageway that carries fluid instead.

Reasons for the Decision

1. The appeal is admissible.

2. Main request - inventive step

2.1 Disclosure content of D3 as starting point

2.1.1 It is undisputed that D3 as starting point discloses several embodiments of a waveguide structure in a turbine engine for transmitting signals from sensors representative of operational status of components of a turbine engine (paragraph 001 and 002).

2.1.2 In a first embodiment according to figure 1 the engine 10 incorporates a signal transmission system including transmitting electronics 30 and receiving electronics 32 (paragraph 015). The transmitting electronics 30 is mounted on the rotor 24, and rotates about the engine axis 9; the receiving electronics 32 is mounted on the engine casing, and is thus static. At the rear of the engine, the transmitting electronics 30 supplies signals along shielded wiring 34 to antennae 36, shown in details in Figure 2. A waveguide 40 distinct from the core engine flow as first fluid passageway is provided in the form of a metallic tube which extends from the transmitter housing 38 to a position close to the front of the engine, i.e. near the air intake 12. At the end adjacent the transmitter housing 38, the waveguide 40 is supported by a roller bearing 42 (paragraph 016). The waveguide does not allow passage of any fluid and is solely dedicated to the transmission of signals (paragraph 006, last sentence). The signal transmitted by this system is for example the blade pitch, paragraph 015 last sentence. It is also implicit that for the pitch signal to be received

by the receiver, this signal has to be at an optimized frequency for the metallic tube 40 to effectively operate as a waveguide, thus fulfilling the requirements of the characterising portion of claim 1.

2.1.3 The second embodiment of figure 3 from which the appellant starts, also relies on an identical configuration of the rear part of the waveguide 40, transmitting electronics 30 and antennas 36. It differs from the first embodiment by a shorter waveguide 40 and rectangular waveguide section 54 having cavity of relatively small cross-sectional area to pass through a stator vane 56 in the turbine section, paragraphs 020-021.

2.1.4 It is therefore common ground that as acknowledged in item 16.3 of the impugned decision, the subject-matter of claim 1 differs from the first embodiment of D3, as well as from the second embodiment, in that a secondary fluid stream passes through the waveguide as secondary passageway to support the generation of power.

2.2 Technical problem and skilled person

2.2.1 The technical effect provided by the above distinguishing feature is to allow other -active- passageways of the engine to be used as waveguide. Based on this effect, an associated objective technical problem may be formulated as proposed by the opposition division, namely to provide a further alternative to the waveguides of D3. This formulation is otherwise not contested by the appellant.

2.2.2 Tasked by the problem of further designing the transmission of signals in an aircraft engine, the skilled person is specialised in the field of aero

engines and is also knowledgeable in the transmission of signals between different sub systems within such engines.

2.3 Further waveguide available in D3

2.3.1 The appellant relies on the alternative possible realisations of a waveguide referred to in D3 both in paragraph 006 as well as in paragraph 023 in relation to figure 4. In the appellant's view although a single alternative option is explicitly disclosed as being a shaft, the teaching implies more options than the dedicated waveguide, this is also confirmed by claims 9 and 10 that also define either a structural component of the engine or the dedicated waveguide as alternatives.

2.3.2 The context of both the above extended teachings relied upon by the appellant indeed consider, in addition to the sole disclosure of dedicated waveguides 40 in all embodiments of figure 1, figure 3, figure 4 or figure 5 and 6, an internal cavity of a structural component of the engine such as a shaft, paragraph 006, and in the context of a waveguide made of several sections to the shaft interconnecting compressor and turbine stages. However, for the Board these further options refer only to the shaft or shaft sections as examples of non-dedicated waveguides. The description does not elaborate further with concrete realisation hints on any further adaptation required to guide radio frequencies within a rotating shaft instead of a static waveguide adapted for this sole purpose.

2.3.3 The further options that the appellant seek to derive from the quoted passages of D3 are in fact limited to an internal cavity of a structural component of the

engine in paragraph 006. Under such generic components having a structural function the skilled person rather derive a part of the engine that provide resistance to loads, this deduction is strengthened by the sole concrete cited alternative being the shaft, which obviously has this load bearing function. In the Board's view, browsing through such components the skilled person would not obviously depart from the shaft or the internal cavities of the casing, supporting struts or vanes and consider instead the fuel system, blade or bearing cooling system or lubricating system because these are not understood to have a structural function.

2.3.4 From the above, the Board is convinced that the skilled person fails a teaching or hint for a multi-purpose passageway or duct having a double function of guiding electro magnetic waves and conveying fluids used by the engine to support the generation of power. The Board is thus not convinced that any of the numerous sub-systems and components of an aircraft engine would be drawn into consideration by the skilled person as suitable candidates to modify or replace the dedicated waveguide tube, common to all embodiments to transmit the sensed blade pitch angle.

2.4 Waveguides filled with fluid

2.4.1 The appellant considers it immaterial for a waveguide whether fluid is contained in it or not, and refers to paragraph 012 of D7 for implementation of waveguide through liquid or vapor. D2, though from another field of car industry would also identify the transmission of waves in fuel. Using the general concept of passageways filled with a fluid would therefore be available for the skilled person.

2.4.2 The Board thinks otherwise, as the concept of transmission of signals through passageways filled with fluids would not further assist the skilled person seeking an alternative to the waveguide in D3. Indeed, the dedicated cavity of the tube 40 is not airtight but is also filled with air from the surroundings at local pressure. Thus the electromagnetic waves also are transmitted through fluid in this case. Therefore the further teachings available from D7 or D2 do not provide further hint for the skilled person to consider active rather than passive fluid as wave carrier candidate. Paragraph 012 of D7 explains that fluid in the confined waveguides may be liquid or vapor, in particular oil, however even if circulating in a pipeline, the teaching is specific to pipelines and the skilled person would not recognise any further use of the fluid, in particular one relating to generation of power. In D2, col 4, lines 11-14 the measurement of alcohol content or calorific content of in the fuel duct itself concerns the fuel quality itself, alteration in measured frequencies is for this single purpose, without any participation to the support of power.

2.4.3 Thus for the Board, the skilled person person would require more than the conceptual knowledge of guiding signal through a passageway filled with fluid to arrive at the subject-matter of claims 1 or 8. Some further hint that the fluid in such passageway is flowing to support the generation of power and is thus part of an active circuit would be needed. This is independent of the question of whether the waveguide is empty or filled with fluid of any kind.

2.5 Using common general knowledge from D4 or D9

2.5.1 The appellant bases their reasoning on the skilled person knowledge of ventilated shafts in the field of aircraft engines, such as shown in either D4 or D9. The skilled person would contemplate using such known ventilated tube to replace the dedicated waveguide of D3. The appellant also considers the skilled person merely needs to adopt the core concept of ventilated shaft and the specific configuration shown in either D4 or D9 would not need to be retained.

2.5.2 The Board on the contrary considers that starting from the first embodiment shown in figure 1 of D3, with its dedicated waveguide 40 on the engine axis, a modification using a shaft of the particular type which is ventilated, otherwise known from either D4 or D9 requires more considerations than the mere adoption of a broad conceptual design to modify a particular dedicated waveguide. The Board thus rather concurs with the respondent that this would require further adaptation steps going beyond the simple conceptual exchange of a dedicated wave guide tube by a portion of an actual shaft, whether ventilated or not.

2.5.3 The Board first has doubt that the skilled person person would consider departing from the cooling scheme of D3 when seeking to address the problem of finding an alternative transmission of signals in D3. D3 is a disclosure dealing especially with the signal transmitting system between aft counter rotating rotors and the engine control. It thus fails to describe how the cooling system for the compressor or turbine stages and how the bearings are cooled or lubricated. Nevertheless, lubrication and cooling systems are

provided in the engine of D3 and for the skilled person no obvious reason is apparent to depart from these and consider instead a cooling scheme that uses a ventilated shaft. This core deficiency appears independent from the question whether a commonly known ventilated shaft as disclosed in D4 or D9 would at all be compatible with the engine shaft design of D3.

2.5.4 The Board agrees with the respondent that starting from the particular embodiment of D3 some practical modification steps have to be considered by the skilled person going beyond the sole question of using a ventilated tube as waveguide as practical realisation of the shaft mentioned in D3. In fact, rather than contemplating the replacement of an empty and dedicated waveguide tube by an internal cavity of an equally inactive shaft, the Board finds it unrealistic for the skilled person to consider the additional further step of guiding cooling fluid through the internal cavity of that shaft. Whereas the practical realisation of the first step would in the Board's view already require some modification at least of the choke joint going beyond routine, the further provision of an additional function to convey fluids active for the generation of power certainly falls well beyond such routine considerations.

2.5.5 Furthermore, as observed earlier, the brief mention of the shaft in paragraphs 006 and 023 fails to contain any further explanation as concerns the necessary modification to be made. Inter alia, the Board does not find any straightforward modification to the choke joint as interface between the transmitter, the antennas and static tube located on the central axis and supported by bearings.

2.6 Turbine vane cooling passageways from D8

2.6.1 Starting from the second embodiment in figure 3 of D3, the appellant submits that the skilled person would obviously have considered the dedicated rectangular further waveguide section 54 to incorporate part of an air passageway through the stator vanes that are cooled as an obvious modification. Paragraph 021 of D8 hints at a cooling system through vanes and thus represents a useful teaching in that context.

2.6.2 For the Board, this argumentation starting from the second embodiment of D3 just like starting from the first embodiment relies on the same theoretical combination of two concepts: a first starting concept that uses a dedicated waveguide to be replaced by a passageway for coolant, this time a vane cooling passageway. The Board has explained above why this fails to convince because no suitable hint for using the same passageway for two different active purposes had been presented. D8 relied upon as illustration of air cooling through vanes does not disclose any particular cooling scheme including cooling channels because it is left unshown (see paragraph 021, last sentence). Sensors 50 detecting conditions of the vanes are connected by a connector 52 to a transmitter 54 that wirelessly transmit the data signals to a transceiver 56, paragraph 029. Thus, the skilled person is unable to derive any relationship between the unshown vane cooling scheme of D8 and the transmission of signals, and also lacks a specific pointer to use a passageway for two purposes of guiding waves and channeling cooling fluid. Missing an incentive to provide such a multipurpose passageway, the next question of compatibility to guide certain

electromagnetic frequencies in a passage channeling at high temperature flow of compressed cooling air can be left unanswered, even if the Board would consider this as a further non straightforward issue.

2.7 It follows that the Board thus confirms the Opposition Division's positive assessment of inventive step.

3. In the light of the above, the Board confirms the decision's conclusion in relation to inventive step and the Opposition Division's decision to reject the opposition under Article 101(2) EPC.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

G. Magouliotis C. Heath

Decision electronically authenticated