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Datasheet for the decision of 30 August 2022

Case Number: T 1703/18 - 3.2.06

Application Number: 12169232.1

Publication Number: 2570606

IPC: F01D5/28, F01D9/04, F02K1/04, C04B35/80

Language of the proceedings: EN

Title of invention:
Ceramic matrix composite turbine exhaust case for a gas turbine engine and corresponding gas turbine engine

Patent Proprietor:
Raytheon Technologies Corporation

Opponent:
Safran Aircraft Engines

Headword:

Relevant legal provisions:
EPC Art. 100(a), 54, 56

Keyword:
Novelty - main request (yes)
Inventive step - main request (yes)

Decisions cited:

Catchword:

Europäisches Patentamt
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Office européen des brevets

Beschwerdekammern

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Case Number: T 1703/18 - 3.2.06

D E C I S I O N
of Technical Board of Appeal 3.2.06
of 30 August 2022

Appellant: (Opponent)	Safran Aircraft Engines 2 boulevard du Général Martial Valin 75015 Paris (FR)
Representative:	Cabinet Beau de Loménie 158, rue de l'Université 75340 Paris Cedex 07 (FR)
Respondent: (Patent Proprietor)	Raytheon Technologies Corporation 10 Farm Springs Road Farmington, CT 06032 (US)
Representative:	Dehns St. Bride's House 10 Salisbury Square London EC4Y 8JD (GB)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office posted on 3 May 2018 rejecting the opposition filed against European patent No. 2570606 pursuant to Article 101(2) EPC.**

Composition of the Board:

Chairman	M. Hannam
Members:	P. Cipriano
	C. Almberg

Summary of Facts and Submissions

I. An appeal was filed by the appellant (opponent) against the decision of the opposition division rejecting the opposition to European patent No. 2 570 606. It requested that the decision under appeal be set aside and the patent be revoked. It also requested oral proceedings.

II. With its reply, the respondent (patent proprietor) requested that the appeal be dismissed or, as an auxiliary measure, that the patent be maintained according to one of auxiliary requests 1 to 6 filed therewith.

III. The following documents, referred to by the appellant in its statement of grounds of appeal, are relevant to the present decision:

D2 FR 2 699 227 A1

D9 Extract from the book "The Jet Engine", Fifth Edition, 1996, by Rolls Royce plc, pages 59-63

D10 Extract from the book "Ceramic Matrix Composites", 2008, by Walter Krenkel, pages V, 244, 338-340, 349-350

D14 US 2005/0260034 A1

IV. The Board issued a summons to oral proceedings and a subsequent communication containing its preliminary, non-binding opinion, in which it indicated *inter alia* that the subject-matter of claim 1 of the main request seemed to be novel over D2 but that its subject-matter seemed to be obvious.

V. With letter dated 24 August 2022, the respondent filed a new auxiliary request 1 moving the auxiliary requests previously on file further down the ranking.

VI. Oral proceedings were held by video link before the Board on 30 August 2022, during which the respondent withdrew its objections regarding the admittance of D9, D10 and D14.

VII. Claim 1 of the main request (patent as granted) reads as follows:

"A turbine exhaust case (70) for a gas turbine engine (20) comprising:

a CMC core nacelle aft portion (76); and
a CMC tail cone (74);

characterised in that:

the turbine exhaust case (70) further comprises a multiple of CMC turbine exhaust case struts (72) between said CMC core nacelle aft portion (76) and said CMC tail cone (74)."

VIII. The appellant's arguments relevant to this decision may be summarised as follows:

Novelty - D2

D2 disclosed all the features of claim 1. The afterburner disclosed in Figure 6 of D2 comprised an outer casing 1 ("carter externe 1") which corresponded to a core nacelle aft portion as defined in claim 1.

The subject-matter of claim 1 was not novel.

Inventive step - D9 in combination with D10

D9, Figure 6-1, disclosed a core nacelle aft portion, struts and a tail cone but it did not disclose that they were made of CMC (Ceramic Matrix Composite).

The objective problem solved by the use of CMC was to provide a lighter exhaust case as also indicated in paragraph [0013] of the published patent specification.

D10 explained on page 349, paragraph 14.3.4.2 that, for aeronautical applications, a mixer for an aircraft engine exhaust system could be made of CMC material rather than Inconel metal alloy, and that making the mixer of CMC allowed the mass of the mixer to be reduced by at least 35%. A mixer corresponds to a core nacelle aft portion. This, together with the difficulty of joining components made of CMC with components made of metal, would have prompted the skilled person to change the material of all the components of the exhaust case (including the struts and the tail cone) to CMC.

The skilled person would have combined the teaching of D9 with the teaching of D10 and arrived at the subject-matter of claim 1 without exercising an inventive step.

Inventive step - D9 in combination with D3

D3 disclosed a core nacelle aft portion and a tail cone made of CMC. This, together with the difficulty of joining components made of CMC with components made of metal, would have prompted the skilled person to change the material of all the components of the exhaust case (including the struts) to CMC.

The skilled person would have combined the teaching of D9 with the teaching of D3 and arrived at the subject-matter of claim 1 without exercising an inventive step.

IX. The respondent's arguments relevant to this decision may be summarised as follows:

Novelty - D2

D2 did not disclose a core nacelle aft portion. The skilled person understood that a 'core nacelle' was a casing that separated a turbine exhaust flow from a bypass flow of a gas turbine engine core. The outer casing 1 of D2 was an afterburner outer casing, and as such did not separate the turbine exhaust and bypass flows. Consequently it was not a part of the core nacelle but was rather attached downstream to it.

Inventive step - D9 in combination with D10

D9 did not disclose that the core nacelle aft portion, the tail cone and the struts were made of CMC.

The objective problem solved by the use of CMC was to provide a lightweight and cost reduced exhaust case as also indicated in paragraph [0013] of the published patent specification.

Figure 14.15 of D10 schematically showed an "exhaust cone" and a "casing strut" made of CMC, but it did not disclose the casing strut being an exhaust casing strut and also failed to disclose a core nacelle aft portion (of a turbine exhaust case) being made of CMC, let alone all three parts being made of CMC.

D10 also failed to provide any teaching or hint towards the use of a CMC material for the three claimed components in order to save weight and costs.

The mixer disclosed in D10 did not constitute a core nacelle aft portion or a turbine exhaust case such that there was no hint for the skilled person to change the material on all the components of the case to CMC.

The skilled person combining the teachings of D9 and D10 would therefore, when trying to make a cheaper and lighter case, not have arrived at the subject-matter of claim 1 in a obvious way.

Inventive step - D9 in combination with D3

D3 did not disclose exhaust case struts between the inner and outer structures 14, 12 made of CMC material or even an exhaust case strut at all. Starting from D9 and faced with the same technical problem as above, the skilled person would therefore not have been prompted to change the material of the claimed components of the exhaust case of D9, in particular the case struts.

The skilled person combining the teachings of D9 and D3 would therefore, when trying to reduce the case's weight and cost, not have arrived at the subject-matter of claim 1 in an obvious way.

Reasons for the Decision

1. Main request - Articles 100(a) and 54 EPC

Document D2

1.1 The appellant argued *inter alia* that the afterburner disclosed in D2 comprised an outer casing 1 ("carter externe 1") which corresponded to a core nacelle aft portion as defined in claim 1.
According to the appellant, the outer casing 1 was not part of the (turbine) core but was attached downstream of the core and therefore was a core nacelle aft portion. In addition, the function of the outer casing 1 as a core nacelle aft portion was not adversely affected by it having flanges extending radially outwardly at its up- and downstream edges. Even if this did not allow for a smooth and undisturbed airflow along its radially outer surface, this was not a requirement of a core nacelle aft portion as, for example, figure 6-4 of D9 also showed.

1.1.1 The Board does not find the appellant's arguments in respect of D2 persuasive. Whilst the Board agrees that the claimed core nacelle aft portion may have flanges extending radially outwardly and is not limited to any particular aerodynamic surface requirements, as indeed the outer surface of the nacelle in Figure 6-4 of D9 shows, the Board finds that the afterburner component described in Figure 6 of D2 is not a part of the core nacelle and therefore cannot correspond to a core nacelle aft portion.

The skilled person would have understood the aft portion of a piece to be the rear part of it and a core nacelle to include only the core components of a turbine, i.e. its compressor and turbine stages as well as the combustor. Thus, the core nacelle only houses these components and does not comprise possible additional components that are not part of the core. An afterburner suitable for being mounted downstream of

the turbine stages as in D2 is therefore not an aft portion of the core nacelle, i.e. is not a core nacelle aft portion.

1.2 At least for this reason, the subject-matter of claim 1 is novel over D2.

2. Main request - Articles 100(a) and 56 EPC

D9 in combination with D10

2.1 The Board stated in item 2 of its preliminary opinion that it considered D9 and D10 to be already in the proceedings and that the correct criteria were applied by the opposition division when exercising its discretion. In addition, during the oral proceedings the respondent withdrew its objections regarding the admittance of D9 and D10 into the proceedings by the opposition division. Consequently the Board confirms its opinion and D9 and D10 are in the proceedings.

2.2 The Board finds claim 1 to differ from D9, particularly from Figure 6-1 and 6-4 thereof, only in that the core nacelle aft portion, the tail cone and the turbine exhaust case struts are made of CMC.

This is not contested by the parties.

2.3 The respondent's argument that the objective technical problem should include the cost reduction effect disclosed in paragraph [0013] of the patent is not accepted. The disclosed cost reduction is obtained at least partially by the removal of bulky flanges and fasteners the presence of which, however, is not excluded by the wording of claim 1 of the main request, such that this problem is not solved. In addition, the

Board finds that it is not evident that the cost of making a component out of a CMC is lower than making a component out of nickel or titanium. The respondent has also not argued otherwise. Thus, simply exchanging the material out of which the core nacelle aft portion, the tail cone and the turbine exhaust case struts are made does not bring any cost advantage.

However, the use of CMC instead of the nickel or titanium disclosed in D9 provides significant weight reductions as corroborated by paragraph [0013] of the patent.

2.4 The objective problem is thus only to reduce the weight of the turbine exhaust case.

2.5 The skilled person would have looked into D10, which is a textbook dealing with ceramic matrix composites in order to look for a solution to the objective problem.

2.6 Figure 14.15 of D10 discloses that casing struts in general and a component labeled as "exhaust cone" can be made of CMC. Even if the skilled person were to understand that the casing strut shown in Figure 14.15 included the turbine exhaust case struts as defined in claim 1, from the conical shape with an open end seen in Figure 14.15 it is at least not unambiguous that the "exhaust cone" corresponds to a tail cone as defined in claim 1. It could possibly also refer, for example, to a common or integrated exhaust nozzle as seen in Figure 6-5 of D9.

2.7 D10 then explains on page 349, paragraph 14.3.4.2 that, for aeronautical applications, a mixer for an aircraft engine exhaust system could be made of CMC material rather than Inconel metal alloy and that making the

mixer of CMC allowed the mass of the mixer to be reduced by at least 35%.

2.7.1 The appellant argued that a mixer or at least its outer ring was a core nacelle aft portion and its lobes corresponded to struts extending between a core nacelle aft portion and a tail cone since they contacted the cone as seen in Figure 14.26(b) and thus bore at least some load.

2.7.2 The Board does not accept these arguments. As explained already above in item 1.1.1, the skilled person would have understood that a core nacelle houses only the core components of a turbine whereas a mixer (like the afterburner discussed above) is not a core component of the turbine. Consequently no part of the mixer corresponds to a core nacelle aft portion. Also figure 14.26(b) shows a perspective view of a mixer "integrated on a CFM56C engine", i.e. the mixer is not described as a part of the (core) engine CFM56C but as an additional component integrated with it.

2.7.3 Further, it is not unambiguous from the perspective of Figure 14.26(b) that the lobes of the mixer touch the cone. The lobes of a mixer serve to increase the mixing between hot core gases and colder bypass air and do not necessarily have to touch the cone as seen also in the mixer shown in D9, Figure 6-4. The lobes of the mixer seen in Figure 14.26 do therefore also not correspond to exhaust case struts extending between a core nacelle aft portion and a tail cone as defined in claim 1. In both Figures 14.26(b) of D10 and Figure 6-4 of D9, the mixer is attached to the core nacelle aft portion and is not a part of it.

2.7.4 Thus, D10 discloses neither a core nacelle aft portion nor a tail cone made of CMC.

2.8 According to the appellant, the skilled person would have derived from the passage on page 349 that if a single component of the exhaust system (the mixer) could display a weight benefit of 35%, then the skilled person would have considered changing all the components of the exhaust system to CMC.

The Board is not persuaded by this argument. The last paragraph of item 14.3.4.2 on page 349 states that "studies are in progress to satisfy economical and technical requirements" such that the skilled person would have recognized that changing the material of other parts might bring associated difficulties with it, such that they would not have been prompted to change the material of unrelated components, let alone of all components, of the exhaust system in an obvious way.

Thus the skilled person would not have been prompted by item 14.3.4.2 of D10 to change a core nacelle aft portion or a tail cone to CMC.

2.9 The appellant further argued that the skilled person would not have changed only some of the components since it was known that it was difficult to assemble components made of CMC to metal components due to the differing thermal expansion coefficients, as can be seen for example in paragraph [0007] of D14.

The Board does not accept this argument. Whilst it is true that paragraph [0007] of D14 mentions a problem in assembling components made of CMC to metal ones, D14 also provides a different solution to this problem by

employing a specific type of fastener. Different thermal expansion coefficients would therefore not have prompted the skilled person to change all the components to CMC.

2.10 It thus follows that, when starting from the turbine exhaust case of D9 and wishing to reduce its weight, the skilled person faced with the teaching of D10 would not have made the core nacelle aft portion, the tail cone and the turbine exhaust case struts all out of CMC without exercising an inventive step.

D9 in combination with D3

2.11 In its preliminary opinion, the Board stated in items 3.7 to 3.10 *inter alia* that the reasoning regarding the starting point D9 and the objective technical problem was the same as for the attack starting from D9 in combination with D10. It further added that, although it might require discussion whether the skilled person would also have extended the teaching of using CMC to the struts of D9, since D3 did not disclose struts at all, the Board considered that it would not.

2.12 At oral proceedings before the Board, in knowledge of the above preliminary opinion, the parties declined to provide further arguments in this regard, indicating that they relied upon their written submissions. The Board has thus no reason to deviate from its preliminary opinion and confirms the same herewith.

2.13 It thus follows that, when starting from the turbine exhaust case of D9 and wishing to reduce its weight, the skilled person faced with the teaching of D3 would not have made the turbine exhaust case struts out of CMC without exercising an inventive step.

2.14 The subject-matter of claim 1 is thus novel and involves an inventive step.

2.15 Absent any objection prejudicial to the maintenance of the patent, the appeal has to be dismissed.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

D. Grundner M. Hannam

Decision electronically authenticated