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Datasheet for the decision of 19 September 2022

Case Number:	T 1733/20 - 3.2.04
Application Number:	15194921.1
Publication Number:	3023617
IPC:	F02C7/36, F01D15/12, F02K3/04, F02C3/13, F02K3/075, F02C9/18, F01D17/10, F02C9/20, F02K1/66, F01D17/08, F01D7/00, F01D17/16
Language of the proceedings:	EN

Title of invention:
GAS TURBINE ENGINE WITH ADJUSTABLE FLOW PATH GEOMETRY AND METHOD OF OPERATING

Patent Proprietor:
General Electric Company

Opponent:
Raytheon Technologies Corporation

Headword:

Relevant legal provisions:
EPC Art. 100(a), 56, 108

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It can be changed at any time and without notic

Keyword:
Inventive step - (no)
Admissibility of appeal - statement of grounds

Decisions cited:

Catchword:

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Case Number: T 1733/20 - 3.2.04

D E C I S I O N
of Technical Board of Appeal 3.2.04
of 19 September 2022

Appellant: (Patent Proprietor)	General Electric Company 1 River Road Schenectady, NY 12345 (US)
Representative:	Hoffmann Eitle Patent- und Rechtsanwälte PartmbB Arabellastraße 30 81925 München (DE)
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)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted on 16 June 2020 concerning maintenance of the European Patent No. 3023617 in amended form.**

Composition of the Board:

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

Summary of Facts and Submissions

I. The appeals were filed by the appellant (proprietor) and appellant (opponent) against the interlocutory decision of the opposition division finding that, on the basis of auxiliary request 7, the patent in suit met the requirements of the EPC.

The division held that claim 1 the main request and auxiliary requests 1-6 lacked an inventive step while claim 1 of auxiliary request 7 involved an inventive step in the light of the cited prior art.

II. Oral proceedings were held on 19 September 2022 before the Board.

III. The appellant (opponent) requests that the decision under appeal be set aside and that the European patent be revoked.

The appellant (proprietor) requests that the decision under appeal be set aside and the patent be upheld as granted, or that the decision under appeal be set aside and the patent be maintained on the basis of one of auxiliary requests 5, filed with the grounds of appeal, or auxiliary request 7 corresponding to dismissal of the opponent's appeal.

IV. The independent claim 1 of the requests relevant to this appeal reads as follows:

(a) Main request (as granted)

"A turbofan gas turbine engine system (100) comprising:
a variable pitch fan (VPF) assembly (102) coupled to a first rotatable shaft (118);
a low pressure compressor LPC (104) coupled to a second rotatable shaft (120), said LPC (104) including a plurality of variable pitch stator vanes (130) interdigitated with rows of blades (132) of a rotor of the LPC (104);
a core engine (144) configured in series flow arrangement with said VPF (102) and said LPC (104);
a speed reduction device (128) coupled to said first rotatable shaft (118) and said second rotatable shaft (120), said speed reduction device (128) configured to drive said first rotatable shaft (118) at a rotational speed that is lower than the rotational speed of the second rotatable shaft (120);
a modulating pressure relief valve (134) positioned between an outlet (136) of said LPC (104) and a bypass duct (138); and
a controller (202) configured to schedule a position of said plurality of variable pitch stator vanes (130) and said modulating pressure relief valve (134) in response to an operational state of said turbofan gas turbine engine system (100) and a temperature associated with said LPC (104)."

(b) Auxiliary request 5

Claim 1 as in the main request with the following feature added at the end of the claim:

"...; and a fan exhaust nozzle having a fixed nozzle area."

(c) Auxiliary request 7 (as upheld by the opposition division)

Claim 1 as in auxiliary request 5 with the following feature added at the end of the claim:

"..., wherein said VPF (102) is configured to produce reverse thrust using a pitch of blades (114) of said VPF (102)".

V. In the present decision, reference is made to the following document:

(D1) US 5,042,245

VI. The appellant opponent's arguments can be summarised as follows:

The appeal is admissible. Claim 1 of all requests lacks an inventive step when starting from D1 in combination with common general knowledge.

VII. The appellant proprietor's arguments can be summarised as follows:

The opponent's appeal is not admissible. Claim 1 of all requests involves an inventive step over the cited prior art.

Reasons for the Decision

1. Admissibility of the opponent's appeal.

During the oral proceedings, the proprietor raised the issue of admissibility of the opponent's appeal for lack of substantiation of their ground of inventive step against the upheld claims, which was in fact their only ground of appeal. The proprietor argues that the opponent's case is inadmissible for being entirely based on new evidence, namely D9 and D10. The new evidence should be found inadmissible by the Board. It would follow that there is no substantiating reasoning.

As repeatedly stated in case law, an appeal invoking a ground for opposition already invoked in opposition proceedings, i.e. remaining within the same legal framework, albeit being based on a completely fresh factual framework does not *ipso facto* lead to an inadmissible appeal. The issue of a new factual framework, in the present case the admissibility of the new evidence D9 and D10, is one of fact to be determined objectively as part of the substantive examination of the appeal, see Case Law of the Boards of Appeal 10th edition 2022 (CLBA), V.A.2.6.4.a) and the cases cited in there. Thus, the admissibility of the new evidence D9 and D10 is immaterial for the issue of admissibility of the appeal. In other words, the

procedural question of admissibility cannot depend on the substantive question regarding the relevance of newly filed evidence, or the procedural question (only to be decided after determining the issue of admissibility) whether such evidence be admitted. If it were different, the question of admitting newly filed evidence could never be decided for want of an admissible appeal, which cannot be correct.

In principle, a ground is adequately substantiated if the statement of grounds enables the board and the other party to understand immediately why the decision is alleged to be incorrect and on what facts the appellant bases its arguments, Art. 108 EPC and Rule 99(2) EPC, see Case Law of the Boards of Appeal 10th edition 2022 (CLBA), V.A.2.6.3. This is undisputed for the present case.

Hence, the opponent's appeal is admissible.

2. Background.

The invention concerns a gas turbine engine with a gear driven variable pitch fan (VPF). The engine has a core flow through the gas turbine engine and a bypass duct surrounding the engine. The thrust is mainly generated by the bypass flow produced by the fan. The variable pitch fan (VPF) facilitates controlling the thrust with the fan operating at nearly constant speed. The invention aims at maximizing propulsive efficiency over a wide operational range. This is achieved by an adjustable flow path geometry, see specification paragraphs [0001]-[0002]. The flowpath geometry is modified by variable pitch stator vanes of the low pressure compressor (LPC) and a modulating pressure relieve valve between the outlet of the LPC and the

bypass duct, see paragraph [0004]. With this architecture, the system can vary the air flow pumped by the LPC to optimally match the air flow requirements of the high pressure compressor (HPC) over a wide range of operating conditions, also in combination with a VPF, see paragraph [0013].

3. Main request - Inventive step.

3.1 The appellant proprietor contests the opposition division's finding of lack of inventive step starting from D1, see impugned decision section 3. In the Board's view, the opposition division's finding in this regard was correct, for the following reasons.

3.2 D1 discloses, see embodiment of figures 1 and 4, a dual spool turbofan gas turbine engine 10 (see figure 1) having a fan 16 and a low pressure compressor (LPC) 18 driven by an LP turbine 14 with shaft 12. It also has a core engine comprising a high pressure spool 24,26,28 with shaft 24 and combustor 32. The LPC has a plurality of variable pitch stator vanes 34, see col.4, l.23-27, and an adjustable bleed valve 125 situated between the LPC 18 outlet and the fan bypass duct, see figure 1, as the claimed engine. It therefore has an adjustable flowpath geometry as the claimed engine.

As discussed in D1, column 1, line 31-43, the LPC and HPC, though turning on separate shafts, are closely coupled, amongst other things because the HPC receives the output compressed air from the upstream LPC. The LPC variable flow path geometry allows to adjust the air flow delivered to the HPC (air pressure and mass flow) over a wide range of operating conditions, see D1, column 1, line 44 to column 2, line 5, as in the claimed engine.

The engine controller of D1 (see figure 4) uses a feedback loop, see D1, column 3, lines 1-6. The known system "positions the stator vanes and bypass valve as required to establish a preferred compressor pressure ratio *responsive to currently determined operating characteristics*" (emphasis by the Board), see column 3, lines 15-34. It monitors inter alia the actual current overall compressor ratio PT_3/PT_2 (air pressure at the HPC exit to air pressure at the LPC inlet), which is used as control point, see column 7, lines 20-26. Using this control point, the control of D1 is responsive to actual engine loads and it adjusts the LPC variable geometry to the flow requirements of the downstream HPC induced by them, as is exemplarily described in column 6, line 49 to column 7, line 26 for accelerating and decelerating loads in the engine of figure 1.

3.3 The proprietor contests the division's findings, which the Board considers to be correct, as regards the disclosure of the following features by D1.

The proprietor argues that the controller of D1 is neither configured *to schedule a position* of the variable pitch stator blades, nor does it do so *in response to an operational state* of the engine system (feature 1.9 as identified by the division) or to a temperature associated to the LPC (feature 1.10).

3.4 The appellant proprietor refers to different paragraphs of the description for interpretating these features of claim 1.

As explained below, no different conclusion is derivable by reading the claims alone or in the context of the detailed description and figures.

As has been repeatedly stated in case law, the wording of the claims should typically be given its broadest technically sensible meaning, see CLBA II.A.6.1. In proceedings before the EPO, where the patentee has the opportunity to limit their claims to accord with the description, the scope of a claim should not be interpreted in a limiting manner by reading into it features which appear only in the description, as this would deprive the claims of their intended function, see CLBA II.A.6.3.4.

3.5 As regards the feature "to schedule a position", the term *to schedule* in its broad sense means to arrange for a thing to do something (see OED: schedule, v.: ...; to arrange for (a person or thing) to do something or...). From this broad definition, it cannot be derived that the term by itself necessarily implies that an absolute vane position or a predetermined position or similar must be determined, as argued by the appellant proprietor. Thus, scheduling a dynamic or a relative position is an interpretation of the term that is not excluded and moreover is a technically meaningful interpretation of the claim. The known vane command signal 80 of D1 meets this limitation.

Nor is a different conclusion derivable from the detailed description of the contested patent. The appellant proprietor argues that the patent description, mainly paragraphs [0005], [0025]-[0026], should be used to read further limitations into the claim in this respect. However, only paragraph [0025] of the description clearly describes the scheduled position as a predetermined position. This, however, belongs to the description of a specific embodiment and

thus not necessarily applicable to all embodiments possibly encompassed by the claim.

3.6 The scope of controlling in response to an "operational state" of the turbofan engine system is also in dispute. The claim does not specify what an *operational state* is. Nor does it specify how this information is used by the claimed control. The claim is silent as to which operational parameters of the operating state should be considered as control point, control variable or similar, or how it may influence the adjustment of the variable geometry. The same conclusion is derivable from the description and drawings. Neither the general part of the description, paragraphs [0004]-[0006], nor the description of the preferred embodiment, in particular paragraphs [0024]-[0025] cited by the proprietor, give any information in this respect. In addition, the claim does not require a determination of the current operational state.

The Board therefore reads this feature in accordance with the above principles of claim interpretation and in the context of an engine automatic control as requiring that the system takes into account directly or indirectly the current operational state and delivers its response accordingly. As explained above the control of D1, using the pressure ratio input PT3/PT2, takes account inter alia of the engine load, which is different for different operational states, and adjusts the variable flow path geometry accordingly. Hence, the known controller is configured to adjust the variable geometry in response to the operational state of the turbofan engine as claimed.

3.7 The appellant proprietor further argues that D1 does not disclose the above feature in connection with

operational states in the sense of the claim because the control of D1 is limited to acceleration or deceleration operations. The Board is not convinced by this argument. D1 describes in detail acceleration and deceleration, because the system advantages are most clearly perceived for these situations (i.e. compressor transient responses), see D1, column 3, lines 34-36. The system is however not restricted to these. D1 describes its control as being designed to operate continuously in all operational states, for instance with the aim of maintaining proper adjustment also in cases of wear inaccuracies, see column 2, lines 37-58 in combination with column 3, lines 1-5. This continuous operation therefore includes operational states as listed in paragraph [0024] of the contested patent with their corresponding characteristic engine loads and PT_3/PT_2 and other operating parameters that are taken into account by the control. Indeed, the background explanation of D1 indicates that also these types of operational conditions are considered in D1, see column 1, lines 23-26.

On the other hand, as argued by the division, no specific operational state is mentioned in claim 1. Thus, the overall pressure PT_3/PT_2 can also be regarded as a parameter indicative of unspecified operational states of the engine.

3.8 The known control of D1 also takes into account the temperature associated with the LPC (feature 1.10). In D1, an LPC temperature is detected and introduced into the calculation of a corrected low speed rotor rotational speed NLcorr, which is a control input, see column 5, lines 15-24, and column 9, lines 26-64.

3.9 Thus, the sole difference of the claimed engine vis-a-vis the known system of D1 is that the engine has a gear driven variable pitch fan instead of a direct driven fixed pitch fan.

As put forward by the appellant proprietor, a gear driven variable pitch fan enables a significantly higher bypass engine to be constructed and operated with greater efficiency and higher propulsive power across a range of operating conditions. The objective technical problem can thus be formulated as how to obtain a more efficient and/or powerful engine.

3.10 It is not in dispute that gear driven variable pitch fan engines at the priority date were known per-se to the skilled person. Such known systems are also known to have the advantages cited by the appellant proprietor of enabling higher bypass and operation efficiency.

Column 4, lines 4-9 of D1 is of interest in this respect. It suggests the use of the known control described for the embodiment of figure 1 also in gear driven variable pitch fan engines: "FIG. 1 shows a... having a forward fan 16 driven thereby. The forward fan 16 may equivalently be a *gear driven*, fixed or *variable pitch* ducted fan, a variable pitch unducted propeller, or the like" (emphasis by the board).

Therefore, with the aim of obtaining a more efficient and/or more powerful engine, the skilled person who is familiar with the gear driven variable pitch concept and its advantages would regard the application of the known control of D1 to such a known architecture as a matter of obviousness.

3.11 The Board is not convinced by the argument that the skilled person would not seek to modify the direct drive and fixed pitch engine of figure 1 of D1, as suggested in column 4, lines 4-9 of the same document, to convert it into a completely different architecture as a matter of obviousness. This is not the teaching or suggestion in column 4, lines 4-9 of D1. That reading would be disregarded by the skilled person as technically unreasonable. The skilled person, an engineer involved in gas turbine engines development and who is familiar with the characteristics of the different engine architectures, immediately understands by the cited expression that the control system of D1 could also have been conceived on the basis of other type of engines having other types of fan architecture, as listed. D1 therefore gives a clear incentive to adapt and use the known control system to the other types of engine architectures.

3.12 In this respect, the Board is also not convinced by the appellant proprietor's arguments that the skilled person would be prevented from adapting it to a variable pitch fan engine because these operate with the LPC at nearly constant speed. On the contrary, as further stated by D1, it is apparent to those skilled in the art that engine load changes also in an engine configuration operating within a limited speed range (as is the case of variable pitch fan engines). These will similarly require a variation in the flow path geometry in order to vary and/or balance the flow of air through the compressors, see D1 column 4, lines 45-58.

In column 11, D1 more specifically teaches the advantages and use of the known control's application for geared variable pitch fans (albeit for a propfan

system and thus unducted fans), see column 11, lines 8-42. In such systems, the LPC is required to operate at a variety of power levels without significant change of the compressor rotational speed. The control system of D1, using PT_3/PT_2, can accommodate such operation without modification, see column 11, lines 35-27 and lines 32-42.

In the light of these teachings, the skilled person would regard the immediate adaptation of the known system of D1 to geared variable pitch fan architectures as a matter of obviousness.

3.13 The Board therefore confirms the conclusion of the opposition division, section 3.2 of the impugned decision, that granted claim 1 lacks an inventive step.

4. Fifth auxiliary request - Inventive step

4.1 Claim 1 of the fifth auxiliary request, in addition to a geared variable pitch fan, further specifies that the fan exhaust nozzle has a fixed nozzle area.

4.2 The appellant proprietor argues that a VPF (as in the main request) enables a very low fan pressure ratio also without the presence of a variable area fan exhaust nozzle and so an increased engine efficiency, see specification paragraph [0013], and that a fixed nozzle exit area has an interior surface with less discontinuities such as gaps, thereby minimizing pressure losses, paragraphs [0019]-[0020]. Therefore, the claimed combination has a synergistic effect when increasing engine efficiency. Inventive step should thus be assessed for all differentiating features in combination. When taking into account this combined effect, the invention would not be rendered obvious

when starting from document D1 in combination with common general knowledge. The selection would therefore involve an inventive step.

The Board is not convinced by this argument. No synergistic effect in the sense that an efficiency increase of the combination of these two measures is more than the addition of their individual improvements is apparent from the description or from common general knowledge. In particular, the effect of the fixed nozzle area of paragraphs [0019]-[0020] cited by the proprietor is not described in connection with a variable pitch fan, but with thrust reversers having spoiler panels and deploying mechanisms stowed strictly externally to the fan cowl, see column 6, lines 19-21, and 31-36. Hence, inventive step of the additional feature can be assessed independently.

4.3 Based on the findings made for the main request that the adaptation of the system of D1 to a geared VPF engine is obvious, the additional limitation - which is unrelated in terms of technical effect - of a fan exhaust nozzle having a fixed area also lacks inventive step. Indeed, when carrying out the obvious combination of the main request the skilled person would be compelled to select either one of only two available options, a fixed nozzle area or a variable nozzle area. Both are extremely common and well-known configurations to the skilled person and thus obvious. Which one they choose depends on the particular circumstances. That choice does not render any of the options inventive.

4.4 That the resulting engine may have other possible advantageous effects as submitted by the appellant proprietor, such as an airflow within the fixed nozzle with less pressure losses for having a more continuous

interior surface, does not confer an inventive step. These would be bonus effects obtained by the skilled person without any inventive effort on their part.

4.5 The Board concludes that claim 1 of auxiliary request 5 lacks an inventive step, Article 56 EPC.

5. Seventh auxiliary request - Inventive step

5.1 Claim 1 of the seventh auxiliary request (as upheld by the opposition division) further requires that the variable pitch fan is configured to produce reverse thrust using its pitching blades.

5.2 Also here, the Board is unable to identify a synergistic effect or a purposive selection based on the combination of claimed VPF reverse thrust and the other claimed features. The appellant proprietor cites patent paragraphs [0019]-[0020] in this respect. However, as explained above for auxiliary request 5, these paragraphs do not refer to thrust reversal using a variable pitch fan. They refer to the efficiency advantages in the fixed nozzle area having deployable thrust reversers mounted on the exterior of the nozzle, see column 6, lines 19-21, and 31-36. There is no indication here or elsewhere in the patent of any embodiment in which the thrust reversal is instead provided by the variable pitch fan. The patent specification neither ascribes any particular advantages of the claimed combination of features nor describes any example embodying it. Thrust reversal using a variable pitch fan is only described in the background section, in the context of the acknowledged prior art, see paragraph [0001].

5.3 Beyond the well known and immediately evident effect to obtain reverse thrust, it is not apparent to the Board what technical effect is achieved by this feature. No synergistic effect can be determined for the problem identified above, namely to increase engine propulsive efficiency, or with the features of the known compressor flow adjustment system. Inventive step can thus be assessed independently.

5.4 That the VPF can be used to generate reverse thrust by using a pitch of the VPF is well known to the skilled person, an engineer involved in the design and development of gas turbine engines, see also the acknowledged prior art in paragraph [0001] of the patent.

5.5 The Board in this regard is not convinced by the reasons of the decision under appeal that the need to reconfigure the control system of D1 to cope with a reversed flow direction and the knock-on consequences this would have on bleed flow from the LPC would prevent the skilled person from doing so.

While a fan reverser affects the whole entering flow, it does not block it through the compressor. The compressor inlet draws a fraction of the reverse bypass air flow before it traverses the fan area. Because the air is not fully blocked and D1 has a bleed air valve, the fan reverser effect on the entering flow is easily overcome. Thus, the LPC (and bleed flows) would still be operational during reverse thrust in the same manner. There are no such knock-on consequences of reverse thrust on the bleed air flow that should prevent the skilled person from adapting the known system to a VPF with reversal thrust engine. The system

of D1 is compatible with such a system architecture without reconfiguration.

To the extent that an adaptation is required, this would lie entirely within the routine design abilities of the skilled person, who is familiar with this type of reverse thrust systems that were well known at the patent's priority date.

5.6 The Board thus concludes that claim 1 of auxiliary request 7 does not involve an inventive step in the sense of Article 56 EPC.

6. For the above reasons, the Board finds that the decision under appeal was incorrect in affirming an inventive step for the upheld claims (auxiliary request 7) and that the decision must therefore be set aside. Also the remaining requests, do not meet the requirement of the Convention. The Board must thus revoke the patent pursuant to Article 101(3)(b) EPC.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The patent is revoked.

The Registrar: The Chairman:

G. Magouliotis C. Heath

Decision electronically authenticated