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**Datasheet for the decision
of 10 February 2011**

Case Number: T 2015/08 - 3.2.03

Application Number: 97302926.7

Publication Number: 0805308

IPC: F23R 3/34

Language of the proceedings: EN

Title of invention:

Premixing dry low NOx emissions combustor with lean direct injection of gas fuel

Patentee:

GENERAL ELECTRIC COMPANY

Opponent:

Alstom Technology Ltd

Headword:

-

Relevant legal provisions:

EPC Art. 123(2), 56

Keyword:

"Extended subject-matter"
"Inventive step"
"Admissibility of late filed requests"

Decisions cited:

-

Catchword:

-



Case Number: T 2015/08 - 3.2.03

D E C I S I O N
of the Technical Board of Appeal 3.2.03
of 10 February 2011

Appellant:
(Opponent)

Alstom Technology Ltd
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CH-5400 Baden (CH)

Representative:

Dimper, D.

Respondent:
(Patent Proprietor)

GENERAL ELECTRIC COMPANY
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Representative:

Goode, Ian Roy
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Decision under appeal:

Interlocutory decision of the Opposition
Division of the European Patent Office posted
5 August 2008 concerning maintenance of
European patent No. 0805308 in amended form.

Composition of the Board:

Chairman: U. Krause
Members: C. Donnelly
K. Garnett

Summary of Facts and Submissions

- I. The appeal lies from the interlocutory decision of the opposition division, dated 5 August 2008, to maintain European Patent no. 805308 in amended form.
- II. The opponent (hereinafter: the appellant) filed a notice of appeal against this decision on 8 October 2008 and paid the appeal fee on the same day. The grounds of appeal were filed on 5 December 2008.
- III. The appellant referred to the following documents in support of its case:
- D1: US-A-4671069;
D2: EP-A-0703413;
D3: Joos, Franz et al. "The SEV Combustor: An innovative concept leading to single digit NOx levels", ABB Technical Paper, presented at the Power-Gen Asia in Singapore from 27 to 29th September 1995.
- IV. The patent proprietor (hereinafter: respondent) replied to the issues raised in the grounds by letter of 23 April 2009.
- V. In a communication dated 14 October 2010, pursuant to Article 15(1) RPBA annexed to the summons to oral proceedings, the Board informed the parties of its provisional opinion. In particular, the Board indicated that there did appear to be a need to discuss the issue of clarity and that novelty might be considered in the context of deciding upon the ground of inventive step.

VI. With letter of 6 January 2011, the respondent filed claim 1 of a new main request and claim 1 of a first auxiliary request. An indication was also made suggesting a second auxiliary request for the grant of a patent on the basis of "the claims at present on file i.e. the claims of the patent as granted".

VII. Oral proceedings were held on 10 February 2011. In particular, the respondent clarified that the second auxiliary request of 6 January 2011 was a request for the appeal to be dismissed. At the end of the debate the requests of the parties were therefore confirmed as follows:

Appellant: that the decision under appeal be set aside and that the European Patent No. 0805308 be revoked.

Respondent: that the decision under appeal be set aside and the patent maintained on the basis of the main or alternatively the first auxiliary request filed with the letter dated 6 January 2011 or alternatively that the appeal be dismissed.

VIII. Claim 1 according to the main request of 6 January 2011 reads:

"A combustor (10) for a gas turbine comprising:

a combustor casing (20) having an open end (15) and an end cover assembly (22) secured to another end thereof;

a flow sleeve (17) mounted within said casing;

a combustion liner (28) within said flow sleeve and defining a primary reaction zone (8) and a secondary reaction zone (19) downstream of said primary zone;

a primary combustion system (12) for combusting a mixture of gaseous fuel and air in the primary reaction zone (8), and operable in a plurality of gas turbine modes, said gas turbine modes being determined based on a load range of the gas turbine, said primary combustion system comprising a sleeve cap assembly (30) secured to said casing and located axially downstream of said end cover assembly, and at least one start-up fuel nozzle (24) and a plurality of premixing fuel nozzles (14) communicating with said primary reaction zone, each premixing fuel nozzle comprising:

a swirler (4) including a plurality of swirl vanes that impart rotation to entering air; and

a plurality of fuel spokes (6) that distribute fuel in the rotating air stream; and

a secondary combustion system (50) selectively operable in a high load range mode of the plurality of gas turbine modes, wherein said secondary combustion system is characterised by a lean direct injection (LDI) fuel injector assembly, said LDI fuel injector assembly comprising an air manifold (52), a gas fuel manifold (51), and a plurality of gas fuel/air injection spokes (53) communicating with said air manifold and said gas fuel manifold to inject a combination of secondary fuel and secondary air into the secondary reaction zone (19);

wherein said plurality of fuel/air injection spokes penetrate the combustion liner (28) for introducing fuel and air into said secondary reaction zone."

Claim 1 according to the first auxiliary request filed with letter of 6 January 2011 comprises the additional feature:

"wherein the secondary fuel is injected into the secondary air via a plurality of fuel orifices (57), and the combination of secondary fuel and secondary air is injected into the secondary reaction zone (19) via a plurality of air orifices (56) in each fuel/air injection spoke (53)."

Claim 1 as maintained by the opposition division reads:

"A combustor (10) for a gas turbine comprising:
a primary combustion system (12) for combusting a mixture of gaseous fuel and air in a primary reaction zone (8) and operable in a plurality of gas turbine modes, said gas turbine modes being determined based on a load range of the gas turbine; and

a secondary combustion system (50) selectively operable in a high load range mode of the plurality of gas turbine modes, wherein said secondary combustion system is characterised by a lean direct injection (LDI) fuel injector assembly, said LDI fuel injector assembly comprising an air manifold (52), a gas fuel manifold (51), and a plurality of gas fuel/air injection spokes (53) communicating with said air manifold and said gas fuel manifold to inject a combination of secondary fuel

and secondary air into a secondary reaction zone (19) downstream of the primary reaction zone (8)."

IX. The arguments of the parties can be summarised as follows:

(a) *Admissibility of respondent's requests filed on 6 January 2011.*

The appellant argued that the main and first auxiliary requests of 6 January 2011 should not be allowed into the proceedings. Claim 1 of the main request was not a simple combination of the granted claims and did not overcome the objections raised under Article 123(2) EPC. Furthermore, new features in relation to the primary combustion system had been introduced, which had not been considered hitherto in the proceedings and which might have a bearing on the question of inventive step. The first auxiliary request introduced features taken from the description which the appellant could not reasonably be expected to deal with at such short notice.

The respondent maintained that the requests should be admitted. Claim 1 of the main request was a straightforward combination of the granted claims, with the wording slightly adjusted to make the claim easier to read. The new features concerning the primary combustion system were introduced in response to the objections under Article 123(2) EPC and were standard features with no bearing on the question of the inventive step. Whilst claim 1 of the first auxiliary request might introduce information taken from the description, but this is the only possible response to

the objection raised under Articles 84 and 123(2) EPC in the grounds of appeal with respect to the term "combination".

(b) *Main Request, Second auxiliary request: Extended subject-matter, Article 123(2) EPC*

Appellant

Article 123(2) EPC is infringed since:

- (a) in comparison with the originally filed claim 1 the restriction to "gaseous" (fuel) was added during the examination proceedings. However, there is nothing in the originally filed documents which discloses that both of the primary and secondary combustion systems are set up for burning gaseous fuel;

- (b) the amendment made in the opposition proceedings comprises the feature: "a plurality of gas fuel/air injection spokes (53) communicating with said air manifold and said gas fuel manifold to inject a combination of secondary fuel and secondary air....."

However, the term "combination" covers both the mixed and unmixed states of air and gas fuel in the same space whereas only premixing of the air and gas fuel is disclosed.

Respondent

It could not be seen how the restriction to a gaseous fuel only, as opposed to the generic term "fuel" used in the originally filed claim 1, can constitute

extended subject-matter. In any case this was a fresh ground of opposition since the amendment was made during examination and the objection should have been raised under Article 100(c) in the notice of opposition.

The term "mixture" does not appear in the application documents as originally filed. Hence, the use of the word "combination" which is.

(c) *First Auxiliary request: Extended subject-matter Article 123(2) EPC.*

Appellant

The objections made with respect to the main request are still not overcome since the term "gaseous" remains and not all the relevant features have been introduced when specifying the fuel/air injection system, for instance, the transition piece 18 has been omitted.

Respondent

The additional feature introduced into claim 1 is the only possible response to the objection raised under Article 123(2) EPC with respect to the term "combination" since it takes the context in which the term was originally used word for word from the description. The transition piece 18 is of no relevance to the fuel/air injection system.

(d) *First Auxiliary request - Inventive step,
Article 56 EPC*

Appellant

The subject-matter of claim 1 is not inventive in view of D1 in combination with D2, D3.

The respondent had accepted that all the features of the primary combustion system were known as part of its submissions concerning the admissibility of the late filed requests. The discussion could therefore be limited to the secondary combustion system.

The feature wherein the secondary combustion system is said to be "selectively operable in a high load range mode of the plurality of gas turbine modes" only requires that the combustor possess the features necessary to make it possible for the secondary system to be selectively operated in a high load range mode.

The term "spoke" is not limited to radial elements since it is also used to describe the axially aligned injector 6. Thus, D1 shows all the elements of the secondary combustion system since figure 2 shows a lean injection element with a "spoke" 115 and fuel orifices 116. Therefore, the only remaining question is whether the term "penetrate" used in claim 1 means that the injectors extend into the combustion zone. Even if the board considered that this was the case, it would be obvious to modify the unit shown in figure 2 of D1 such that it too extended into the combustion chamber. The patent does not describe or explain any particular

technical effect associated with extending the spokes through the combustion liner.

Furthermore, D2 and D3 show similar devices for introducing an air/fuel mixture into a secondary reaction zone of a combustion chamber.

Respondent

The term "spoke" refers to a radially extending member. Figure 2 of D1 does not show such an element nor any part of the injection device penetrating the combustion liner.

D1 does not disclose a two-stage combustion chamber wherein the lean direct injection is only employed in the high-load range. The phrase "selectively operable" used in claim 1 is limiting in this sense.

D2 and D3 both describe systems with two turbines, in contrast to the two-stage combustion chamber of the contested patent. For this reason there would also be no incentive for the skilled person to combine either D2 or D3 with D1 since they relate to different types of system.

By using the claimed lean direct injection system the NOx emissions are considerably reduced.

Reasons for the decision

1. The appeal is admissible.
2. *Admissibility of respondent's requests filed with letter of 6 January 2011.*
 - 2.1 Claim 1 of the main request is a combination of the granted claims 1 to 5. Although the wording has been slightly altered, it is a relatively easy task to check that no substantive amendments have been made. The features concerning the primary combustion system are a response to the objections raised under Article 123(2) EPC. The respondent has admitted that these are standard features with no bearing on the question of the inventive step. The additional features introduced into claim 1 of the first auxiliary request are taken from the description. This amendment is in response to the objection raised under Articles 84 and 123(2) EPC for the first time in the grounds of appeal with respect to the term "combination".
 - 2.2 Under these circumstances the requests can be admitted into the proceedings.
3. *Main request, Second auxiliary request: Extended subject-matter, Article 123(2) EPC.*
 - 3.1 The word "combination" is only used once in the application as originally filed, at page 8, line 9 of the description. From the context it is clear that a secondary fuel/air mixture is meant since the gas fuel is fed into the air stream via orifice 57 and the resulting stream which is inevitably mixed is then fed

into the reaction zone via orifice 56. Thus, the use of the term "combination" instead of "mixture" constitutes an extension since it covers not only the delivery of a mixed stream into the reaction zone, but also the injection of two separate feeds; i.e. both pre-mixing and mixing in the zone are covered whereas only pre-mixing is originally disclosed.

3.2 Thus, claim 1 of the main request and the second auxiliary request does not meet the requirements of Article 123(2) EPC.

4. *First auxiliary request - Extended subject-matter, Article 123(2) EPC.*

4.1 The basis for the additional feature introduced into claim 1 of the first auxiliary request can be found at page 8 lines 1 to 11 of the description as originally filed. This amendment places the term "combination" back into its originally disclosed context.

4.2 When specifying the fuel/air injection system, it is not necessary to include distantly associated features, such as the transition piece 18, which the skilled person would recognise as having no immediate bearing on the injection system performance.

4.3 Thus, claim 1 of the first auxiliary request meets the requirements of Article 123(2) EPC.

5. *First auxiliary request: Inventive step, Article 56 EPC.*

5.1 D1 constitutes the most relevant prior art since it discloses a gas turbine combustor comprising primary

and secondary combustion systems with lean burn conditions in the latter for the purpose of reducing NOx emissions. Both parties agree that all the characteristics of the primary combustion system are either known from D1 or conventionally known in the art; the difference of opinion lays in the disclosure as concerns the secondary combustion system.

5.2 In this respect, the board considers that D1 discloses:

a secondary combustion system (15) selectively operable in a high load range mode of the plurality of gas turbine modes (see figure 4), wherein said secondary combustion system is characterised by a lean direct injection (LDI) fuel injector assembly (115,24 see figure 2, column 3, lines 16 to 18 and column 4, lines 39 to 57), said LDI fuel injector assembly comprising an air manifold (25), a gas fuel manifold (115), and a plurality of gas fuel/air injection ports (24) communicating with said air manifold and said gas fuel manifold to inject a combination of secondary fuel and secondary air into the secondary reaction zone (15); wherein the secondary fuel is injected into the secondary air via a plurality of fuel orifices (116), and the combination of secondary fuel and secondary air is injected into the secondary reaction zone (19) via a plurality of air orifices (24 - see figure 2).

5.3 The board does not accept the respondent's argument that the secondary combustion system of the device according to D1 is not selectively operable at high-loads. Figure 1 shows that fuel feeds to the primary and secondary combustion zones are separate and equipped with their own valves which would allow

selective independent operation of the secondary combustion system. This is borne out by figure 4 of D1 which shows that fuel flow i_f to the head chamber is independent of fuel flow ii_f to the rear chamber (also see column 5, lines 9 to 13). Hence, the secondary combustion system of D1 is capable of being selectively operated in a high load range mode of the plurality of gas turbine modes.

5.4 The board does not accept the appellant's argument that figure 2 of D1 discloses a "spoke" since in the board's opinion this term means some kind of elongate rod-like component.

5.5 Therefore the subject-matter of claim 1 essentially differs from the apparatus disclosed in D1 in that:

- a plurality of fuel/air injection spokes penetrate the combustion liner and the combination of secondary fuel and secondary air is injected into the secondary reaction zone via a plurality of air orifices in each fuel/air injection spoke.

5.6 The purpose of these particular distinguishing features is not disclosed in the contested patent. In particular, information with respect to any possible further reduction of NOx emissions over and above that already achieved by the injection system of D1 is not given. Therefore, it can only be assumed that the technical effect is the generally known one of distancing the introduction of the air/fuel mixture away from the combustion wall and any associated boundary conditions which could negatively influence combustion.

- 5.7 The objective technical problem can therefore be taken to be a general one of how to minimise the boundary effects occurring at the combustion chamber wall and improve combustion.
- 5.8 It is part of the skilled person's general knowledge that the influence of the conditions (such as wall temperature, airflow speed, type and uniformity.) prevailing at a certain boundary such as a combustion chamber wall will become less with increasing distance. Thus, faced with the above problem it would be obvious for the skilled person, whatever the type of fuel/air combination, to employ an injector in the form of a spoke to space the introduction of the fuel/air mixture from the combustion chamber wall.
- 5.9 The skilled person faced with this problem would also find support for adopting this solution in documents D2 and D3. Although an intermediate turbine is present, hot gases are fed from the primary chamber into the secondary chamber (see D2, column 3, lines 41 to 42, column 4, lines 9 to 14 and D3, page 5, last paragraph) in a similar manner to D1 and the contested patent.
- 5.10 D2 suggests the use of an injector in the form of a spoke ("*lanzenförmige Brennstoffeindüisungen 2*": see column 3, lines 56 to 57 and figure 1). Figure 4 of D3 shows a fuel injector which penetrates the combustion liner.
- 5.11 Thus, both of these documents provide the skilled person with a direct teaching regarding spoke-like injection means which penetrate the combustion liner

and introduce air/fuel combinations away from the combustion chamber wall.

5.12 Thus, the subject-matter of claim 1 according to the first auxiliary request does not involve an inventive step.

6. Since claim 1 of the first auxiliary request is not allowable under Article 56 EPC there is no need to investigate further whether the objection concerning the use of the term "gaseous" falls under Article 100(c) EPC, thus constituting a fresh ground of opposition.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The patent is revoked.

Registrar:

Chairman:

A. Counillon

U. Krause