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Datasheet for the decision of 10 September 2013

Case Number: T 0183/11 - 3.2.03

Application Number: 02258733.1

Publication Number: 1321713

IPC: F23R 3/00, F23R 3/06, F23R 3/54

Language of the proceedings: EN

Title of invention:
An improved flame tube or liner for a combustion chamber of a gas turbine with low emission of pollutants

Patent Proprietor:
Nuovo Pignone Holding S.P.A.

Opponent:
Siemens Aktiengesellschaft

Headword:
-

Relevant legal provisions:
EPC Art. 54, 56, 84, 123(2)
RPBA Art. 12(4), 13(3)

Keyword:
"Novelty (yes)"
"Inventive step (no)"
"Added subject-matter (yes)"
"Admissibility of auxiliary requests (no)"

Decisions cited:
-

Catchword:
-

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Case Number: T 0183/11 - 3.2.03

D E C I S I O N
of the Technical Board of Appeal 3.2.03
of 10 September 2013

Appellant: (Opponent)
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Respondent: (Patent Proprietor)
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Decision under appeal:
Interlocutory decision of the Opposition Division of the European Patent Office posted 11 November 2013 concerning maintenance of European patent No. 1321713 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 decision of the opposition division, posted on 11 November 2010, maintaining European Patent no. EP-B-1321713 in amended form.

II. The opponent (hereinafter: the "appellant") filed a notice of appeal on 11 January 2011 and paid the fee on the same day. The grounds of appeal were received on 11 March 2011.

In support of its case, the appellant referred in detail to the following documents:

S1: EP-A-0589520
D4: GB-A-2309296.

III. The patent proprietor (hereinafter the "respondent") presented its initial counter-arguments in letter of 15 July 2011.

IV. In a communication dated 29 April 2013, 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 D4 was a very relevant document since it appeared to disclose exactly the same idea as that of the contested patent.

V. With its reply of 5 August 2013, the respondent filed auxiliary requests 1 to 7.

VI. Oral proceedings were held on 10 September 2013. The final requests of the parties were as follows:

The appellant requested that the decision under appeal be set aside and the patent be revoked.

The respondent requested that the appeal be dismissed, alternatively that the decision under appeal be set aside and the patent be maintained on the basis of one of the first to seventh auxiliary request filed with its letter dated 5 August 2013.

VII. Claim 1 as maintained by the opposition division reads:

"A combustor (10) for a gas turbine, comprising: an outer wall (118), a liner (112) within the outer wall (118), said outer wall (118) and said liner (112) defining a cavity (116) there between;
a premixing chamber (114);
a combustion chamber (110) within said liner (112);
said liner comprising a first cylindrical region (122) around the main flame and a second cylindrical region (126) guiding the combustion products;
said liner (112) being positioned at the outlet of said premixing chamber (114) and being connected is (sic) said premixing chamber (114) by a truncated conical end (120), said premixing chamber (114) being supplied with air flowing along said cavity (116) in an opposite direction to a flow of combustion products through the combustor;
characterised by
said first cylindrical region (122) of said liner (112) surrounded by a cylindrical casing (136) within said outer wall (118) and forming an annular chamber (138) with said liner (112), the casing (136) having annular joints (140) at both of its ends, which connect it to

the first cylindrical region (122) and enclose the annular chamber (138), but said cylindrical casing not surrounding the second cylindrical region (126) of said liner (112), said first cylindrical region (122) of said liner (112) including a first set of apertures (134) for admitting air from said annular chamber (138) through the liner (112) into the combustion chamber (110) enabling a damping of pressure oscillations within the liner (112)."

The following feature analysis of claim 1 as maintained suggested by the appellant is referred to in this decision

M1: A combustor (10) for a gas turbine, comprising:
M2: an outer wall (118),
M3: a liner (112) within the outer wall (118),
M4: said outer wall (118) and said liner (112) defining a cavity (116) there between;
M5: a premixing chamber (114);
M6: a combustion chamber (110) within said liner (112);
M7: said liner comprising a first cylindrical region (122) around the main flame and
M8: a second cylindrical region (126) guiding the combustion products;
M9: said liner (112) being positioned at the outlet of said premixing chamber (114) and
M10: being connected is (sic) said premixing chamber (114) by a truncated conical end (120),
M11: said premixing chamber (114) being supplied with air flowing along said cavity (116) in an opposite direction to a flow of combustion products through the combustor;
characterised by

M12: said first cylindrical region (122) of said liner (112) surrounded by a cylindrical casing (136) within said outer wall (118) and
M13: forming an annular chamber (138) with said liner,
M14: the casing (136) having annular joints (140) at both of its ends, which connect it to the first cylindrical region (122) and enclose the annular chamber (138),
M15: but said cylindrical casing not surrounding the second cylindrical region (126) of said liner (112),
M16: said first cylindrical region (122) of said liner (112) including a first set of apertures (134) for admitting air from said annular chamber (138) through the liner (112) into the combustion chamber (110)
M17: enabling a damping of pressure oscillations within the liner (112).

VIII. The arguments of the parties relevant to the decision can be summarised as follows:

Appellant

Clarity, Article 84

The terms "enabling a damping of pressure oscillations" and "not surrounding the second cylindrical region" specified in the maintained version claim 1 are not clear within the meaning of Article 84 EPC.

Added subject-matter, Article 123(2)

The feature "said liner comprising a first cylindrical region (122) around the main flame and a second cylindrical region (126) guiding the combustion

products" is a generalisation since the part of original specification requiring that "the second cylindrical region 126, which is longer and is similar to that of the prior art" has been omitted.

Novelty/Inventive step, Articles 54,56

The subject-matter of claim 1 as maintained is not new in view of S1 or at least not inventive taking either S1 or D4 as representing the closest prior art, in combination with D4 and S1 respectively.

Auxiliary requests

All the objections raised were presented in the grounds of appeal. Consequently, the respondent should have filed the auxiliary requests in its reply to those grounds. No supporting arguments have been filed with the auxiliary requests so the appellant had not had time to prepare any responses. It was unfair to expect the appellant to react off the cuff in the oral proceedings to whatever arguments the respondent eventually decided to come up with.

Respondent's case

Clarity, Article 84

The alleged clarity problems were not caused by amendments made after grant and cannot be taken into consideration.

Added subject-matter, Article 123(2)

The objection concerning the need to specify that the second cylindrical region is longer and similar to that of the prior art was not made under Article 100(c) in the notice of opposition (see points B.1.1.1 and B.1.1.2). Therefore this objection should not be addressed in the appeal proceedings.

In any case, it is implicit to the skilled person that the second region 126 is longer than the first region 122 by virtue of the specification of the function of each region in the claim.

Novelty/inventive step, Articles 54, 56.

Document S1 teaches away from the cooling air being able to influence the combustion zone 4 in any way. In contrast, in the device of the contested patent the first cylindrical region 122 of said liner 112 includes a first set of apertures 134 for admitting air from the annular chamber through the liner 112 into the combustion chamber 110 enabling a damping of pressure oscillations within the liner. Since document S1 specifically explains that the cooling air is unable to influence the combustion zone 4, the skilled person would not contemplate modifying this device in any way that would detract from this fundamental teaching.

D4 does not disclose an annular chamber with features M13 and M14 since it specifies that most of the air from the annulus 117 is exhausted through the annulus to a region of lower pressure downstream of the combustor (see page 4, lines 15 to 17). The skilled

person has no incentive to modify this arrangement and is not given any by the available prior art.

Auxiliary requests

The auxiliary requests should be admitted into the appeal proceedings since they are based on the dependent claims as granted and do not introduce complex subject-matter which the appellant could not be expected to deal with in the oral proceedings. In particular, the first auxiliary request only comprises a minor amendment to overcome one of the Article 123(2) objections raised for the first time in the grounds of appeal (see point B.1.1.3).

Reasons for the decision

1. The appeal is admissible.

2. *Clarity, Article 84*

2.1 The alleged clarity problems identified by the appellant were not caused by amendments made after grant and cannot be taken into consideration.

3. *Added subject-matter, Article 123(2)*

3.1 The feature "said liner comprising a first cylindrical region (122) around the main flame and a second cylindrical region (126) guiding the combustion products" is a generalisation. As pointed out by the appellant, the original disclosure is consistent in specifying a second cylindrical region 126 which is

longer than the first cylindrical region (see for example paragraph [0051] and paragraph [0076], clause 13). The specification of the function of each region in the claim is not sufficient to make this relationship unambiguously present in the claim.

3.2 When presenting its arguments under Article 100(c) in the notice of opposition, the appellant/opponent cited the following passage from the description "a first cylindrical region 122 is located around the main flame, comprises a cylindrical casing, while the second cylindrical region 126, which is longer and is similar to that of the prior art, guides the combustion products and has a set of apertures or holes 128". Thus, at least the potential for a problem of disclosure regarding the definition of the first and second cylindrical regions and the casing was raised from the beginning. The specific issue relating to the definition of the cylindrical regions was raised in the ground of appeal. Therefore, the Board does not consider this to be a fresh objection.

4. *Novelty, Article 54*

4.1 S1 discloses:

A combustor for a gas turbine, comprising: an outer wall, a liner (8,8') within the outer wall, said outer wall and said liner (8,8') defining a cavity (5) there between;
a premixing chamber (2);
a combustion chamber (1) within said liner (8,8');

said liner comprising a first cylindrical region (8') around the main flame and a second cylindrical region (8) guiding the combustion products;
said liner (8,8') being positioned at the outlet of said premixing chamber (2) and being connected to said premixing chamber (2) by a truncated conical end (3), said premixing chamber (2) being supplied with air (6) flowing along said cavity (5) in an opposite direction to a flow of combustion products through the combustor;
wherein
said first cylindrical region (8') of said liner (8,8') is surrounded by a casing (13) within said outer wall and forming a chamber (15) with said liner (8').

4.2 Since the casing 13 shown in the figure of S1 must be connected to the liner in some way the feature of the casing having annular joints at both of its ends, which connect it to the first region (at one end) and enclose the chamber (15), is also disclosed. The feature that the casing does not "surround" the second cylindrical region of said liner is disclosed to the same extent as it is in the contested patent.

4.3 Said first cylindrical region (8') of said liner also includes a first set of apertures (17 "collector holes") for admitting air from said annular chamber (15) through the liner into the combustion chamber (1) since the combustion chamber is shown as being the whole space inside the liner.

4.4 The presence of any kind of aperture in the liner inevitably enables a damping of pressure oscillations within the space delimited by the liner since it means that excess pressure may escape through the apertures

or an influx of air may compensate for pressure drops. The contested patent itself does not offer any explanation as to how the claimed damping is actually achieved. Since it is only necessary for the apparatus to be theoretically capable of performing the claimed function and the claim does not specify that the apertures act to damp pressure oscillations in the combustion zone, feature M17 is disclosed by S1.

4.5 Thus, the device according to claim 1 differs from the device disclosed in S1 in that the casing is cylindrical and encloses a distinct annular chamber around the liner. Hence, the subject-matter of claim 1 is new with respect to S1.

5. *Inventive step, Article 56*

5.1 Taking S1 as the nearest prior art, the technical effect of altering the configuration of the cooling chamber 15 of S1 would be to influence the flow of cooling air and/or the area upon which this impinges. Therefore, the objective technical problem to be solved can be seen as one of optimising the cooling characteristics of the apparatus.

5.2 Faced with this problem it would be obvious for the skilled person to arrange for cooling air blasts through the small holes 14 to impinge only on those parts of the outer surface 8 of the combustion chamber actually requiring additional cooling. Thus, configuring the casing to form an annular cooling chamber around the cylindrical part of the combustion chamber would be an obvious response to circumstances

where the truncated conical end did not require additional cooling.

5.3 Even if the respondent's argument that the collector holes 17 of S1 do not enable a damping of pressure oscillations within the liner were accepted, the subject-matter of claim 1 would still not involve an inventive step since in this case the objective technical problem to be solved would be one of improving the combustion characteristics of the device whilst maintaining the cooling performance.

5.4 Faced with this problem the skilled person would take into consideration the teachings of D4 since this document deals with improvements that can be made to the combustion characteristics of a lean burn device similar to that described in S1 (see page 1, lines 29 to 39) which, although having adequate cooling and satisfactory emissions, suffers from combustion vibrations. D4 explains (whereas the contested patent is silent in this respect) that, surprisingly, this problem may be solved by the introduction of a small amount of air into the lean burn combustion process, which dampens the oscillations without quenching the combustion process (see page 2, lines 7 to 13). In an exemplary embodiment of the apparatus shown in figure 1A, D4 suggests that the combustor wall has a double skinned metallic construction over at least part of its extent forming a cylindrical casing.

5.5 The respondent has argued that the skilled person would not consider adapting S1 in a manner which went specifically against one of its primary principles of the cooling air not influencing the combustion zone.

However, as explained above, D4 teaches the skilled person that, surprisingly, it is possible to go against this consideration with effective results.

5.6 Thus, D4 teaches the skilled person that the combustion characteristics of the device disclosed in S1 can be improved by providing the first cylindrical region of the liner with a set of apertures for admitting air from the annular chamber through the liner into the combustion chamber thereby enabling a damping of pressure oscillations within the liner.

5.7 The respondent has also argued that since the cooling chamber of S1 extends over the conical section of the combustion chamber it is not suitable for damping of pressure oscillations within the liner because it would be difficult to control all the oscillation modes of the flame. Whilst the contested patent offers little explanation as to how the damping is achieved, D4 suggests that to be effective the small holes are located in a region of the wall adjacent the divergent flame front (106 in figure 1A). The slow moving air entering through the apertures thereby possibly acts to thicken the boundary layer, contributing to a damping effect on the combustion vibrations. Thus, D4 teaches the skilled person that the damping apertures are not necessary in the conical rear wall as shown in figure 1A since this is behind the flame front. The skilled person seeking to solve the objective problem would therefore adapt the chamber of the device disclosed in S1 accordingly by eliminating the portion around the conical rear section. There would be no need to modify the extent of the chamber in the other direction since this delimits the hotter first region

next to the combustion zone where the impingement cooling is required. For the second region guiding the combustion products, chamber cooling air 10 passing through the deflector apertures 9 is sufficient.

5.8 Alternatively D4 can be taken as the nearest prior art. This document discloses:

a combustor (100) for a gas turbine, comprising: an outer wall (not shown but implicitly present since pressurised air 114 enters from the space 140 through apertures 111 to provide impingement cooling - see page 4, lines 11 to 15), a liner (108) within the outer wall, said outer wall and said liner (108) defining a cavity (140) therebetween;
a combustion chamber (105) within said liner (108);
said liner comprising a first cylindrical region (shown in figure 1A, see page 4, lines 2 to 6 which makes reference to "at least the portion of its length....") around the main flame and a second cylindrical region guiding the combustion products (implicitly present since the liner and outer wall are shown to continue);
said liner (108) being positioned at the outlet of a combustion head (103) and being connected to said combustion head (103) by a truncated conical end (see figure 1A),
wherein
said first cylindrical region of said liner (108) is surrounded by a cylindrical casing (109) within said outer wall (not shown) and forming an annular chamber (117) with said liner, said first cylindrical region of said liner (108) including a first set of apertures (113) for admitting air from said annular chamber (117) through the liner (108) into the combustion chamber

(105) enabling a damping of pressure oscillations within the liner (108).

5.9 The subject-matter of claim 1 differs therefrom in that the combustor comprises:

(i) a premixing chamber; wherein

(ii) said premixing chamber is supplied with air flowing along the cavity between the outer wall and the liner in an opposite direction to a flow of combustion products through the combustor; and

(iii) the casing is connected to the first cylindrical region at both of its ends by annular joints to enclose the annular chamber, but said cylindrical casing does not surround the second cylindrical region of said liner.

5.10 D4 does not explicitly detail what type of fuel injector or burner assembly is provided in the head 103 (see page 3, lines 31 to 33). However, it does indicate that "in operation a fuel/air mixture from the burner assembly is introduced into the combustor head 103 and combustion is initiated there" (see page 3, lines 35 to 37). Thus, it would be an obvious choice for the skilled person to provide this mixture by means of a premixing chamber which is supplied with air flowing along the cavity between the outer wall and the liner in an opposite direction to a flow of combustion products through the combustor according to features (i) and (ii) since this is a standard arrangement.

5.11 As regards feature (iii), the question to be asked is: would the skilled person form a chamber by making a joint between the outer skin 109 and the inner skin 108? The respondent has pointed out that D4 states that most of the air from the annulus 117 is exhausted through the annulus to a region of lower pressure downstream of the combustor (see page 4, lines 15 to 17) and that the skilled person has no incentive to modify this arrangement. However, since impingement cooling is only required in the hottest region of the liner, i.e. in proximity to the combustion zone, the skilled person would consider limiting the length of the cooling chamber and using direct cooling air flow through apertures in the liner, as shown for example in S1, as part of a normal procedure to produce a more economic design.

5.12 Consequently, the subject-matter of claim 1 according to the main request, even if it had met the requirements of Article 123(2), would not have involved an inventive step taking either S1 or D4 as the nearest prior art in combination with D4 and/or common general knowledge or S1 respectively.

6. *Auxiliary requests*

6.1 All of the auxiliary requests were filed with letter of 5 August 2013, i.e. after oral proceedings had been arranged (summons of 29 April 2013). Thus, the provisions of Articles 12(4) and 13(3) RPBA both apply.

6.2 Auxiliary request 1 comprises a minor amendment to claim 1 in order to overcome the objection under Article 123(2). However, in the Board's view, this

amendment would not on its face alter the conclusions reached regarding the lack of inventive step for the main request nor has the respondent ever argued anything other than that the amendment was only a response to the Article 123(2) objection.

6.3 Auxiliary requests 2,4 and 6 all fail to meet the requirements of Article 123(2) for the same reason as the main request.

6.4 Auxiliary requests 3,5 and 7 all introduce subject-matter which hitherto had not been discussed in the appeal proceedings. Furthermore, no supporting arguments with respect to inventive step were made in the letter of 5 August 2013 meaning that these would have been heard for the first time by the appellant and the Board at the oral proceedings.

6.5 For these reasons all the auxiliary requests were not admitted into the proceedings according to the provisions of Article 13(3) RPBA.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The patent is revoked.

Registrar: Chairman:

C. Spira U. Krause