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Datasheet for the decision of 28 February 2017

Case Number: T 1049/13 - 3.2.03

Application Number: 01130662.8

Publication Number: 1221574

IPC: F23M99/00, F23R3/00

Language of the proceedings: EN

Title of invention:
Gas turbine combustor

Patent Proprietor:
MITSUBISHI HEAVY INDUSTRIES, LTD.

Opponent:
Siemens Aktiengesellschaft

Headword:

Relevant legal provisions:
EPC Art. 56
RPBA Art. 12(4)

Keyword:
Inventive step - (yes)
Consideration of documents filed for first time with grounds of appeal

Decisions cited:

Catchword:

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Case Number: T 1049/13 - 3.2.03

D E C I S I O N
of Technical Board of Appeal 3.2.03
of 28 February 2017

Appellant: (Opponent)	Siemens Aktiengesellschaft Wittelsbacherplatz 2 80333 München (DE)
Respondent: (Patent Proprietor)	MITSUBISHI HEAVY INDUSTRIES, LTD. 5-1, Marunouchi 2-chome, Chiyoda-ku Tokyo (JP)
Representative:	Henkel, Breuer & Partner Patentanwälte Maximiliansplatz 21 80333 München (DE)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted on 27 February 2013 concerning maintenance of the European Patent No. 1221574 in amended form.**

Composition of the Board:

Chairman	V. Bouyssy
Members:	C. Donnelly
	D. Prietzel-Funk

Summary of Facts and Submissions

I. The appeal lies from the intermediate decision of the opposition division that European Patent Nr. EP 1 221 574 B could be maintained in amended form.

In its decision the opposition division held that the subject-matter of claim 1 according to the main and first auxiliary requests did not involve an inventive step in view of GB 2 309 296 A (E6) in combination with either EP 0 971 172 (E10) or EP 0 892 216 A1 (E11). However, it decided that the patent could be maintained in amended form on the basis of claim 1 according to the second auxiliary request before it.

II. The opponent (hereinafter: the "appellant") filed an appeal against this decision in due form and time.

The appellant relied on the following documents already submitted during the opposition proceedings:

E6: GB 2 309 296 A;
E10: EP 0 971 172;
E11: EP 0 892 216 A1

as well as the following documents submitted with the grounds of appeal:

E12: DE 26 27 801;
E13: DE 29 50 930.

III. With its reply to the statement setting out the grounds of appeal, the respondent submitted auxiliary requests 1 to 5.

IV. The board informed the parties of its provisional opinion in a communication pursuant to Articles 15(1) RPBA, annexed to the summons to oral proceedings, which were duly held on 28 February 2017. At the end of the debate the parties confirmed the following requests:

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

The respondent requested that the appeal be dismissed, or, alternatively, that the patent be maintained in amended form on the basis of the claims of auxiliary requests 1 to 5 submitted with the letter dated 11 November 2013.

V. Both parties referred to the following feature analysis of claim 1 in the version the opposition division considered could be maintained:

"A gas turbine combustor (10)
1.1,1.2 in which a part or all of the wall (100,130,130') of the combustor (10) disposed within an induction chamber is formed with an acoustic energy absorbing member that can absorb the acoustic energy of a combustion variation generated within the combustor (10);
1.3 wherein the acoustic energy absorbing member is constructed of a perforated plate (131,131') and
1.4 a back plate (133,133')
1.4.1 disposed at the outside of the perforated plate (131,131')
1.4.2 in a radial direction at a distance from the perforated plate (131,131');
wherein
1.5 the diameters for the openings (134,134') on the perforated plate (131,131') are not uniform,

1.6 and the distance between the perforated plate (131,131') and the back plate (133,133') is not uniform."

VI. The submissions of the parties can be summarised as follows:

(a) Late filed documents E12 and E13

The appellant submitted that these documents should be considered by the board since their content was very relevant and reinforced its existing case when arguing lack of inventive step. The respondent argued that the documents should not be taken into consideration since no reasons had been given for the late filing and that, in any case, the documents were not prima facie relevant because they had not been cited against novelty.

(b) Inventive step

(i) Appellant

The subject-matter of claim 1 lacks an inventive step in view of E6 combined with E10 or E11. These documents come from the same technical field such that the skilled person would take them into consideration and have no problem to combine them.

The subject-matter of claim 1 in the version maintained differs from the device known in E6 by features 1.5 and 1.6. The objective technical problem to be solved is therefore how to modify the combustion chamber of E6 in order to absorb sound energy over a wider range of frequencies.

E10 discloses a combustion chamber for a gas turbine with a sound absorbing wall structure comprising a perforated plate spaced apart from a back-plate in order to provide a damping volume between them. Paragraph [0011] of E10 states that, in order to obtain damping over a wide range of frequencies, the dimensions of the openings in the perforated plate and the distance between the plates can be varied within a selected range. Since the openings in the perforated plate have both a length and a diameter both of features 1.5 and 1.6 are disclosed (see paragraph [0019] of E10).

E11 discloses a gas-turbine combustion chamber with a multi-cell Helmholtz resonator structure for suppressing thermal-acoustic vibrations. The resonance frequency is determined by the area and length of the entry openings as well as the cell volume (see column 2, line 58 to column 3, line 3). According to the passage at column 2, lines 50 to 55 it is possible to damp different frequencies by using resonator cells of varying sizes. Claim 5 of E11 specifies that the Helmholz resonator cells may be of different sizes and according to the passage at column 3, lines 32 to 35, these may be adjusted to specific frequencies and arranged in sets. The skilled person is therefore given a direct suggestion that it is advantageous to provide a sound absorbing structure comprising a perforated plate with holes of varying dimensions which is separated by a non-unform distance from a back plate.

Consequently, the subject-matter of claim 1 as maintained does not involve an inventive step in view of E6 in combination with E10 or E11.

Further, claim 1 does not involve an inventive step in light of E10 taken alone, in particular in view of the teaching in paragraphs 11 and 23 of E10. Indeed, in view of this teaching it is obvious to modify the embodiment of figure 2 of E10 such that the Helmholtz resonators are disposed along the peripheral wall 12 rather than on the wall segment 17. By so doing the skilled person would inevitably obtain the subject-matter of claim 1 without exercising any inventive activity.

(ii) Respondent

The skilled person would not combine these documents since E10 is concerned with another problem to E6 and its teaching as regards to the relative sizes of the holes in the combustion chamber wall is in contradiction to that of E6. In particular, the device of E6 relies on impingement, as opposed to the convection cooling used in the combustor of E10.

Therefore, in order to obtain the solution provided by claim 1 would need to make two different steps. The teachings in paragraphs 11 and 23 of E10 are too vague and abstract and do not provide the skilled person with any clear teaching about how to modify the apparatus of E6, let alone that disclosed in figure 2 of E10. The claimed solution is therefore not obvious.

The skilled person would also not combine E11 with E6 since the construction of the combustor and the cooling system in E11 are significantly different from those in E6.

Reasons for the Decision

1. Consideration of documents E12 and E13

1.1 E12 and E13 were submitted for the first time with the grounds of appeal and not taken into consideration during the opposition proceedings. It therefore must be assessed whether the board should consider them in view of Article 12(4) RPBA. The appellant has provided no reasons as to why these documents could not have been filed earlier and, in particular, has not indicated whether anything in the contested decision provoked a need for their submission for the first time at the appeal stage. The only reason given by the appellant is that the documents are very relevant and support a further line of attack against inventive step.

1.2 It is clear that these documents have only been submitted to be used in the launch of fresh inventive step attacks which have not been prompted by any surprising interpretation or reasoning of the opposition division discovered for the first time upon reading the decision. The board is therefore of the view that documents E12 and E13 could have have been filed earlier.

1.3 The board also considers that E12 and E13 both concern attenuation of sounds in the air inlet and outlet passages of the turbine rather than at the combustion chamber wall, where there is also a need to provide a cooling air supply. These documents are therefore prima facie less relevant than the documents on file.

1.4 Consequently, E12 and E13 will not be taken into consideration (Art. 12(4) RPBA).

2. Respondent's main request, Inventive step, E6 in combination with E10 or E11

2.1 Disclosure of E6

2.1.1 It is common ground between the parties that the subject-matter of claim 1 in the version as maintained differs from the device known in E6 by features 1.5 and 1.6. The board concurs that E6 does not disclose these features.

2.1.2 By making the diameters for the openings on the perforated plate and the distance between the perforated plate and the back plate non-uniform, the frequency range over which effective sound attenuation is achieved is increased (see paragraph [0014] of the patent specification).

2.1.3 The objective technical problem is therefore how to increase the frequency range over which effective sound attenuation is achieved.

2.1.4 Faced with this problem the skilled person would take E10 and E11 into consideration since both documents deal with the same problem of sound attenuation caused by pressure oscillations in the combustion chamber of a gas turbine.

2.1.5 However, when seeking solutions to this problem, the skilled person would also be aware that it is essential to maintain the cooling of the combustion chamber wall and the correct combustion conditions. The device of E6 is a lean burn combustor which is cooled by air flowing out the apertures 111 formed in the outer wall 109 impinging on the inner combustion chamber wall 108

(impingement cooling). In order to obtain a vibration damping effect, the inner wall is provided with a band of smaller holes which are not larger than about one-third the size of the apertures in the outer wall (see page 2, lines 25 to 31). The passage at page 2, line 41 to page 3, line 2 emphasises the importance of the small size of the holes 113 in order to avoid that the air flow through them does not quench the lean burn combustion process. E6 expressly indicates that effusion cooling is to be avoided in lean combustor devices (see page 1, lines 22 to 25).

2.2 E6 in combination with E10

2.2.1 Figure 1 of E10 illustrates a conventional combustion chamber arrangement in which convection cooling of the main inner combustion chamber wall 12 is effected the air-stream flowing through the cooling space between the inner wall 12 and an outer wall 11. Further effusion cooling of the inner walls 15 and 17 is provided by air flowing into the combustion zone 23 through apertures 21 and 22 (see page 4, lines 10 to 15).

2.2.2 Figures 2 and 3 of E10 illustrate a modification of the conventional arrangement of figure 1. In order to obtain an acoustic damping effect, a back plate 24, provided with apertures 25 of diameter D2, is spaced apart from the radial inner wall plate 17 of the combustion chamber, which is itself provided with apertures 27 of diameter D1.

2.2.3 As pointed out by the respondent, in contrast to the arrangement in E6, the diameter D2 of the apertures in the back plate 24 is much smaller than the diameter of the apertures D1 in the radial plate 17 (see page 4,

lines 35 to 37) since in the arrangement of E10 combustion air is also required to enter through the apertures in the radial plate 17, whereas in E6 it is imperative that the air flow through the holes 113 be limited so as not to influence the lean-burn combustion.

2.2.4 It is accepted that paragraph [0011] of E10 states that, in order to obtain damping over a wide range of frequencies, the dimensions of the openings in the perforated plate and/or the distance between the plates can be varied within a selected range. However, there is no unambiguous indication that in a single embodiment the gap between the plates 17 and 24 should be non-uniform or how this should be realised. In particular, neither of the figures 2 and 3 shows a non-uniform gap. Further, the preceding paragraph [0010] only mentions that the dimensions of the first holes and the spacing between them are the same, which would imply that these are the dimensions which are the major influence on damping and which would be changed, particularly since these dimensions are the easiest to tune.

2.2.5 Although paragraph [0023] states that the Helmholtz resonator arrangement can be used at other positions on the inner wall, the board considers that E10 contains no instructions as to how this should be achieved without disturbing or completely redesigning the convection cooling of the main inner cylindrical wall 12 around the combustion zone.

2.2.6 In view of this, the board considers that the teaching of E10 is limited to the particular case at the radial inner-wall at the burner end of the combustion chamber where it is relatively easy to fit a back plate.

2.2.7 Consequently, the skilled person faced with the above objective problem would not transfer the teachings of E10 in order to modify the arrangement and dimensions of the inner and outer combustion chamber walls of the lean burn combustor known from E6 since these are separated by a distance in a radial direction (see figure 1A and feature 1.4.2) and rely on a different cooling arrangement. In any case such a combination would not lead to the subject-matter of claim 1 without the benefit of hindsight since there is no clear and unambiguous disclosure in E10 as to how a non-uniform gap between the inner and outer walls should be implemented without disrupting the cooling and combustion of a lean-burn combustor.

2.3 E6 in combination with E11

2.3.1 The apparatus of E11 uses a series of Helmholtz resonator cells for the acoustic energy absorbing member as opposed to an arrangement with spaced apart plates. It is explicitly specified that the properties (shape, volume, length and diameter of the pipes) of each set of Helmholtz silencers are not uniform (see column 3, lines 32 to 35) and adjusted to each frequency to be attenuated. However, there is no disclosure of a stepped back plate since a series of adjacent Helmholtz cells, or cell-sets, attached to the combustor inner wall (see figure 2) does not form a single back plate, but rather a series of plates joined by a vertical wall of a separate cell, or cell-set.

2.3.2 Further, the sound absorbing arrangement of E11 is specifically intended for use in effusion cooled combustion chambers (see column 2, lines 2 to 5), whereas E6 expressly indicates that effusion cooling is

to be avoided in lean combustor devices (see page 1, lines 22 to 25). The skilled person is therefore immediately dissuaded from combining the arrangement of E11 with that of E6 since it would mean changing the combustion and/or cooling regime of the lean combustor of E6.

2.4 Embodiment of figure 2 of E10 in combination with suggested modifications out of the description

2.4.1 The embodiment shown in figure 2 of E10 discloses:

a gas turbine combustor in which a part or all of the wall (12,17) of the combustor (23) disposed within an induction chamber is formed with an acoustic energy absorbing member that can absorb the acoustic energy of a combustion variation generated within the combustor; wherein the acoustic energy absorbing member is constructed of a perforated plate (17) and a back plate (24) disposed at the outside of the perforated plate (17) at a distance from the perforated plate (17).

The subject-matter of claim 1 differs from this known apparatus in that:
- the back plate is disposed at the outside of the perforated plate in a radial direction; and
- the diameters for the openings on the perforated plate are not uniform,
- and the distance between the perforated plate and the back plate is not uniform.

2.4.2 As already reasoned above, the board considers that the teaching of E10 is limited to a configuration at the radial inner wall of the combustion chamber where it is relatively easy to fit a back plate without disrupting the cooling arrangement of the main cylindrical inner

wall around the combustion zone. The vague remark in the description of E10 at paragraph [0023] that it is possible to position the configuration at other positions on the combustion chamber inner wall without any clear indications as to how this should be achieved is not sufficient to render the distinguishing features obvious. Without the benefit of hindsight the skilled person has no incitation to try and adapt the arrangement at the radial inner wall 17 to the cylindrical inner wall 12 around the combustion zone.

2.5 In conclusion, the subject-matter of claim 1 in the version the opposition division decided could be maintained involves an inventive step and meets the requirements of Article 56 EPC.

3. Since the appeal is not allowable there is no need to address the auxiliary requests.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

C. Spira V. Bouyssy

Decision electronically authenticated