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Datasheet for the decision of 1 December 2009

Case Number: T 1344/07 - 3.2.03

Application Number: 01128924.6

Publication Number: 1213539

IPC: F23M 13/00

Language of the proceedings: EN

Title of invention:
Gas turbine combustor, gas turbine, and jet engine

Patentee:
MITSUBISHI HEAVY INDUSTRIES, LTD.

Opponent:
Alstom Techology Ltd CHTI-Intellectual Property

Headword:
-

Relevant legal provisions:
EPC Art. 54, 56

Relevant legal provisions (EPC 1973):
-

Keyword:
"Admission of late filed document (yes)"
"Novelty (yes)"
"Inventive step (no)"

Decisions cited:
T 0267/03

Catchword:
-

Case Number: T 1344/07 - 3.2.03

D E C I S I O N
of the Technical Board of Appeal 3.2.03
of 1 December 2009

Appellant: (Opponent)
Alstom Technology Ltd CHTI-Intellectual Property
Brown Boveri Strasse 7/699/5
CH-5401 Baden (CH)

Representative:
-

Respondent: (Patent Proprietor)
MITSUBISHI HEAVY INDUSTRIES, LTD.
5-1, Marunouchi 2-chome
Chiyoda-ku
Toyko (JP)

Representative:
Henkel, Feiler & Hänzel
Patentanwälte
Maximiliansplatz 21
D-80333 München (DE)

Decision under appeal:
Interlocutory decision of the Opposition Division of the European Patent Office posted 19 June 2007 concerning maintenance of European patent No. 1213539 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, posted on 19 June 2007, to maintain European Patent No. 1213539 in amended form.

II. The opponent (hereinafter - the "appellant") filed a notice of appeal against this decision on 4 August 2007 (letter of 29 July 2007) and paid the fee the same day. The grounds of appeal were filed on 18 October 2007.

The patentee (hereinafter - the "respondent") replied to the appellant's objections by letter of 3 March 2008 and requested that the appeal be dismissed.

Both parties made subsidiary requests for oral proceedings.

III. The appellant's case refers principally to the following state of the art:
D1: US-A-4036324;
D2: EP-A-985882;
D3: JP6173711, Patent abstracts of Japan;
D4: EP-A-576 717;
D7: JP-A-20000145479 (together with English abstract, computer translation into English, and certified translation into German).

IV. In a communication dated 30 June 2009, 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 it appeared the opposition division had correctly exercised its discretion in not admitting D7 into the

proceedings, but that the matter required further discussion.

V. By letter of 2 November 2009 the respondent filed auxiliary requests 1 and 2.

VI. Oral proceedings before the Board were held on 1 December 2009.

In conclusion of its case the appellant confirmed its request for the impugned decision to be set aside and the patent revoked.

The respondent confirmed its requests for the appeal to be dismissed, alternatively that the patent be maintained on the basis of auxiliary requests 1 or 2.

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

"A gas turbine combustor comprising:
a cylinder (2) having a combustion region (11) inside of the cylinder (2);
a resonator (16) having a cavity (15) and provided around the surface of the cylinder (2);
sound absorption holes (14) formed in the cylinder (2) and having an opening end on the cylinder (2); and
a plurality of fluid grooves (13) provided at intervals on the cylinder (2), wherein the sound absorption holes (14) are formed among the fluid grooves (13)."

Claim 1 according to the first auxiliary request (modifications with regard to the main request are shown in italics) reads:

"A gas turbine combustor comprising:
a cylinder (2) having a combustion region (11) inside of the cylinder (2);
a resonator (16) having a cavity (15) and provided around the surface of the cylinder (2);
sound absorption holes (14) formed in the cylinder (2) and having an opening end on the cylinder (2); and
a plurality of fluid grooves (13) provided at intervals on the cylinder (2), wherein the sound absorption holes (14) are formed *in the intervals between* the fluid grooves (13)."

Claim 1 according to the second auxiliary request (additional modifications with respect to the first auxiliary request are underlined) reads:

"A gas turbine combustor comprising:
a cylinder (2) having a combustion region (11) inside of the cylinder (2);
a resonator (16) having a cavity (15) and provided around the surface of the cylinder (2);
sound absorption holes (14) formed in the cylinder (2) and having an opening end on the cylinder (2) and opening into the cavity (15) such that the air in the sound absorption holes (14) and the air in the cavity (15) constitute a resonance system; and
a plurality of fluid grooves (13) provided at intervals on the cylinder (2), wherein the sound absorption holes (14) are formed *in the intervals between* the fluid grooves (13)."

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

(a) *Admission of D7*

Appellant

D7 should be allowed into the proceedings since it was filed as a reaction to the amended claims filed after expiry of the oppositon time limit. Furthermore, it is immediately apparent from the figures and computer translated text that D7 is prima facie extremely relevant for the question of inventive step since it is the only document showing cooling grooves - precisely this feature was added by the amendment to claim 1. Finally, a certified translation of D7 has now been filed with the grounds of appeal. The content of D7 cannot come as a surprise to the respondent since it originates from the respondent itself.

Respondent

D7 should not be admitted into the proceedings since the opposition division exercised its discretion correctly. Thus, according to EPO case law e.g. T267/03 such a late submission is not to be admitted by the Board. Furthermore, the argument that the submission was made in response to amendments made to claim 1 is not convincing since claim 1 as maintained by the opposition division is a straight combination of claims 1 and 4 as granted and was submitted more than one year before the oral proceedings at which D7 was finally produced. The argument that D7 stems from the respondent itself and, hence, could not come as a surprise is also not convincing since in a large corporation with an extensive intellectual property portfolio it cannot be expected that each employee is

aware of the content or even the existence of every single patent.

(b) *Novelty- Main Request Claim 1 as maintained by the opposition division*

Appellant

Claim 1 as maintained by the opposition division is not new in view of D2. In particular, the passage from line 34 to line 43 of column 9 gives a direct indication that the fluid distribution device can comprise channels in the form of grooves. The term "grooves" is used very loosely in the patent and in view of figure 4B must be deemed to cover all manner of closed channel sections as well as the open ones which such a term would normally suggest. Since the embodiments according to figures 1 and 2 of D2 both comprise cavities with connecting holes to the combustion chamber it must be assumed that some kind of resonance effect also comes into play.

Respondent

The subject-matter of claim 1 as maintained in amended form is new. D2 describes the possibility of an alternative fluid supply device comprising a plurality of individual tubes only with respect to the embodiment of Figure 1. Such a structure is not shown in the drawing. However, since the main purpose of the tubes is to supply air to the burner and cooling is a "side effect", the tubes can only be understood to be separate and independent tubes that are not integrated with the cylinder and in any case do not provide any

cooling function of the cylinder. D2 does not address how the recirculation openings are to be combined with such alternative tubes. Hence, the embodiment of figure 1 fails to disclose either the cooling grooves or the resonator as specified in claim 1. Additionally figure 1 does not disclose "sound absorption holes" in the sense of the claim since nozzles are employed.

The embodiment according to figure 2 of D2 also fails to disclose the resonator, the fluid grooves and the sound absorption holes.

In figure 6, the recirculation holes 320 and 320' open into the damping volumes 330, 330'. However, the fact that the two openings traverse the ring-shaped space does not modify it to correspond to the plural fluid grooves within the meaning of the invention. Thus, in addition to the resonator being of a different conception, figure 6 fails to show the cooling grooves and that the sound absorption holes are formed among the fluid grooves.

(c) *Inventive step*

Appellant

Claim 1 is not inventive in view of a combination of either D3 or D4 with either D7 or the skilled person's common general knowledge.

Both D3 and D4 show all the features of claim 1 as maintained by the opposition division except that of a plurality of fluid grooves provided at intervals on the

cylinder, wherein the sound absorption holes are formed among the fluid grooves.

This distinguishing feature has the technical effect of providing enhanced cooling of the cylinder wall. Thus, the objective technical problem can be seen to be one of how to prevent overheating of the cylinder wall.

Faced with this problem, the skilled person would consult D7 which describes an identical type of apparatus and shows cooling grooves provided in a combustor wall to enhance cooling. Alternatively, it is also part of the skilled person's common general knowledge that combustor wall cooling can be improved by providing fluid grooves. The word "among" places no restriction on the relative positions of the sound absorption holes and grooves and accordingly the skilled person would obtain the subject-matter of claim 1 merely by placing fluid grooves anywhere in the cylinder wall.

Respondent

D7 is not to be considered for the reasons given above. Furthermore since it only deals with cooling of the combustor wall it does not provide any hint or information with respect to the problem of damping vibrations in a combustor.

The invention goes beyond a simple combination in that it provides efficient cooling not only of the cylinder wall in general, but also of the sound absorption holes in particular which are exposed to considerably higher

thermal loads than other wall portions due to the hot air oscillating thereat.

The use of fluid grooves for cooling structures subjected to extreme conditions of heat may be generally known but it is one of a myriad of possibilities open to the skilled person. In the present case there is no indication whatsoever that fluid grooves must inevitably be used or are the only alternative. In the case of the structure according to D4 since cooling is provided by impingement and film cooling it would be difficult to change the structure of the combustor wall to provide fluid grooves in addition.

The skilled person could only arrive at the conclusion that it is obvious to provide fluid grooves with a knowledge of the invention.

(d) *First auxiliary request*

Appellant

Placing the sound absorbing holes in-between the grooves is implicit in D2 and is the obvious place to position them in D3 and D4 so as not to disturb the performance of the resonator.

Respondent.

The amendment made to claim 1 merely clarifies the position of the sound absorbing holes. The argumentation presented in support of the main request already assumed this position thus, no further comments are necessary.

(e) *Second auxiliary request*

Appellant

The cavities in D2 will also act as resonators as reasoned above in connection with the main request. Both the gas turbines of D3 and D4 show this feature since it is explicitly stated that they are fitted with resonators.

Respondent

This amendment clarifies that the cavity must be part of a resonator system. This is not the case for the turbine shown in D2.

Reasons for the decision

1. *Admission of D7*

1.1 The opposition division exercised its discretion correctly in not admitting D7 since, as set out by the respondent, this document:
(i) was only introduced at the oral proceedings;
(ii) was submitted in the form of a Japanese abstract and a computer translation (which comprises an explicit indication that it should not be relied upon) and not in the form of the application itself;
(iii) is exclusively concerned with the effect of cooling and does not mention combustion vibrations.

1.2 However, reason (ii) no longer applies since a certified translation has been filed with the grounds of appeal, and thus the Board is faced with a different situation. As regards the technical relevance of D7 it is immediately apparent from the figures that this document deals with the cooling of the combustor walls by means of fluid grooves. It can therefore be seen as prima facie relevant to the subject-matter of claim 1 since the discussion regarding inventive step revolves essentially around this type of feature.

1.3 In view of this, the Board can only conclude that D7 should be admitted into the procedure. As regards decision T0267/03 cited by the respondent, it should be noted that the Board in that case came to its conclusion not to admit the late filed document not only because the opposition division had exercised its discretion correctly, but also because the opponent withdrew the request to admit it (see reasons 2.2.2.).

2. *Novelty - Main request, claim 1 as maintained*

2.1 D2, with particular reference to the two distinct embodiments shown in figures 1 and 6 (which depict a "Ringbrennkammer" (annular combustion chamber, see column 9, lines 28 to 30), describes:

a gas turbine combustor comprising:
a cylinder (113) (ring volume formed by the inner surfaces of the combustion chamber 112;312) having a combustion region (101;301) inside of the cylinder (see column 9, lines 19 to 23);
a cavity provided around the surface of the cylinder (in figure 1 the cavity is defined by the cylinder and the outer wall of the fluid delivery device (110) surrounding it and in figure 6 by the volume 330);
sound absorption holes (in figure 1 - 120,120' "Rezirkulationsöffnungen"; and in figure 6 - 320) having an opening end on the cylinder (see column 3, lines 4 to 15).

2.2 The cavities of the embodiments shown in both figures 1 and 6 have a considerable air-flow passing through them such that it must be doubted whether there is sufficient volume of standing air to act as a resonator even in the manner of a through-flow resonator such as shown in figure 3 of D4. Further, it is expressly stated in D2 at column 2, lines 34 to 44, that the idea behind the invention is to avoid the problem of restricted bandwidth associated with Helmholtz resonators. Thus, it is not directly and unambiguosly derivable that either of the cavity

arrangements according to the embodiments of figures 1 and 6 is adapted to act as a resonator.

2.3 Further, D2 also does not show the feature of :

- a plurality of fluid grooves provided at intervals on the cylinder, wherein the sound absorption holes are formed in the cylinder among the fluid grooves.

2.4 Although the term "grooves" is used loosely in the patent to cover a wide range of geometries comprising both open and closed channels, it is a common characteristic of all of these variations that they are formed in the body of the structure to be cooled. Thus, whilst the term "grooves" might fall into the category of "cooling channel" ("Kühlkanal") the same does not apply to "individual pipe conduits" ("einzelnen Rohrleitungen") which are mentioned as one possibility for configuring the fluid delivery device at column 9, lines 35 to 36 of D2. On the contrary, the term "einzelnen Rohrleitung" leads away from the idea of having grooves since it implies that individual pipes are laid around the outside of the combustion chamber to lead the air into the mixing chamber.

2.5 The passage from lines 37 to line 43 of column 9 of D2 states that for the case of an annular combustion chamber a plurality of "ring-shaped flow channels" ("ringkreisförmiger Strömungskanäle"), in order to ensure an even flow over the whole of the combustion chamber, is the preferred arrangement. However, this refers to a configuration whereby two concentric ring-shaped channels are provided around an annular combustion chamber, one being on the hub-side and the

other around the exterior of the cylinder. Such an arrangement cannot be qualified as being "a plurality of fluid grooves provided at intervals on the cylinder" required by the claim since the channels are not formed in the cylinder nor provided at intervals on it, but rather on either side.

2.6 In conclusion a plurality of fluid grooves is also not clearly, directly and unambiguously disclosed by D2.

2.7 Thus, the subject-matter of claim 1 according to the main request meets the requirements of Article 54 EPC.

3. *Inventive step*

3.1 For the purposes of examining inventive step D3 is considered to be the most relevant prior art since this document describes the basic arrangement of a gas turbine combustor fitted with a sound absorbing resonator.

3.2 D3 (see Abstract) describes:

a gas turbine combustor comprising:
a cylinder (3) having a combustion region inside of the cylinder (cylinder 3 is the tail cylinder of a combustor 2);
a resonator (7) having a cavity (8) and provided around the surface of the cylinder (3);
sound absorption holes (9) formed in the cylinder (3) and having an opening end on the cylinder (2).

3.3 The subject-matter of claim 1 differs therefrom in that it comprises:

- a plurality of fluid grooves provided at intervals on the cylinder, wherein the sound absorption holes are formed among the fluid grooves.

3.4 The technical effect of providing fluid grooves on the cylinder is to enhance cooling. Thus, the objective technical problem can be taken to be one of how to prevent overheating of the cylinder.

3.5 Faced with this problem occurring in the apparatus according to D3, the skilled person would realise that some kind of cooling to supplement that provided by the air flowing through the cooling air leading holes is required.

3.6 It is generally known in the art that the cooling of combustor walls can be enhanced by providing such structures with cooling grooves. The fact that the use of fluid grooves provided at intervals on gas-turbine wall structures requiring cooling is conventional and forms part of the skilled person's general knowledge is confirmed for example by D7, German translation, paragraph [0009].

3.7 Accordingly, the Board is of the view that the solution to the above problem consisting of a plurality of fluid grooves provided at intervals on the cylinder is merely a conventional response to a classic problem which the skilled person would resort to without the need to exercise any inventive skill.

3.8 The additional specification imposed by the claim for the "sound absorption holes to be formed among the fluid grooves", only requires that the sound absorption holes be situated in the region of the grooves and not necessarily between them. Such a configuration would inevitably follow when forming fluid grooves in the apparatus of D3.

3.9 It would then also follow that efficient cooling not only of the cylinder wall in general, but also of the sound absorption holes, is achieved at least to the same extent as in the device claimed.

3.10 Thus, the subject-matter of claim 1 according to the main request does not meet the requirements of Article 56 EPC.

4. *First auxiliary request*

4.1 In the first auxiliary request the word "among" is replaced by the term "*in the intervals between".* This amendment makes clear that the sound absorbing holes are not positioned either in or overlapping with the fluid grooves. The technical effect of this is to maintain the fluid flowing in the groove separate from that in the sound absorbing holes. However, this configuration is also obvious since the skilled person faced with the task of deciding where to place the fluid grooves would take care not only to ensure efficient cooling, but also to avoid upsetting the vital and necessary functioning of the Helmholtz resonator. This would require that the fluid in the grooves does not disturb the resonating effect of the air connecting the sound absorbing holes with the

cavity which can only be ensured by keeping the two fluids separate. It therefore ensues that the skilled person would have no alternative other than to place the sound absorbing holes in the intervals in between the fluid grooves. It may be that there is additional cooling of the sound absorbing holes, but this would merely be a bonus effect resulting from the obvious configuration of the grooves so as to maintain the principal functions of both the cooling fluid and the resonator.

5. *Second auxiliary request*

5.1 Claim 1 of the second auxiliary request comprises the additional features compared to claim 1 according to the first auxiliary request in order to clarify that the sound absorption holes formed in the cylinder and having an opening end on the cylinder are also:

"opening into the cavity (15) such that the air in the sound absorption holes (14) and the air in the cavity (15) constitute a resonance system"

5.2 However, the gas turbine disclosed in D3 also shows this feature since it is stated in the abstract that "A resonance system of Helmholts (sic) consists of the space 8 and the multiple cooling holes 9".

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

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