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**Datasheet for the decision  
of 11 January 2019**

**Case Number:** T 1847/15 - 3.2.03

**Application Number:** 03757573.5

**Publication Number:** 1546608

**IPC:** F23C15/00, F23M5/08, F24H1/43

**Language of the proceedings:** EN

**Title of invention:**  
MULTIPLE PLATE COMBUSTOR

**Applicant:**  
Fama Holdings Ltd.

**Headword:**

**Relevant legal provisions:**  
EPC Art. 56

**Keyword:**  
Inventive step - (yes)

**Decisions cited:**

**Catchword:**



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Case Number: T 1847/15 - 3.2.03

**D E C I S I O N**  
**of Technical Board of Appeal 3.2.03**  
**of 11 January 2019**

**Appellant:** Fama Holdings Ltd.  
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**Decision under appeal:** **Decision of the Examining Division of the  
European Patent Office posted on 3 February 2015  
refusing European patent application No.  
03757573.5 pursuant to Article 97(2) EPC.**

**Composition of the Board:**

**Chairman** G. Ashley  
**Members:** C. Donnelly  
G. Weiss

## **Summary of Facts and Submissions**

- I. The appeal lies from this decision to refuse European application no. 03757573.5, issued by the examining division on 3 February 2015.
- II. In a communication dated 14 July 2014 the examining division had informed the applicant (hereinafter: the "appellant") of the reasons why the application did not meet the requirements of the European Patent Convention. The appellant filed no comments or amendments in reply to this communication, but requested a decision according to the state of the file by a letter of 18 December 2014.

In the communication of 14 July 2014 referred to in the contested decision, the examination division argued that the subject-matter of claim 1 submitted on 16 April 2014, did not involve an inventive step starting out from US6035810 (D1) in combination with WO-A-0012934 (D2).

- III. The following documents were cited in the International Search report:
- D1: US 6 035 810;
  - D2: WO-A-0012934;
  - D3: WO-A-0153750;
  - D4: US 6 000 930;
  - D5: EP 0 950 853;
  - D6: US 4 968 244;
  - D7: US 6 379 146;
  - D8: JP-A- 58 052908 and Patent Abstracts of Japan vol. 0071, no. 37 (M-222);
  - D9: US 4 492 562;
  - D10: US 4 702 691;
  - D11: DE 565 470 C;

D12: DE 10 41 888 B.

IV. The appellant requests that the decision under appeal be set aside and that a patent be granted on the basis of the set of claims submitted 16 April 2014.

V. Claim 1 as submitted on 16 April 2014 reads as follows:

"A pulse combustor of the type having

a. a first outer plate (23) having a central hub (11) and a conical region (74) inside a flat outer region;

b. a second outer plate (30) having a central hub and a conical region (14) inside a flat outer region;

c. a combustion chamber (70) defined by the volume between the conical regions (14,74) of the first and second outer plates (23, 30);

d. a burner assembly (64) coupled to one of said hubs (11), said burner assembly (64) operative to ignite a fuel/air mixture in said combustion chamber (70); and

e. characterised in that a plurality of intermediate plates (24, 26, 28) is located between the first outer plate (23) and the second outer plate (30), wherein said intermediate plates (24, 26, 28) are spaced apart to form tailpipe regions (41,42) therebetween and between said outer plates (23, 30) and adjacent ones of said intermediate plates (24, 26, 28), wherein said first and second outer plates (23, 30) comprise spiral coolant passageways, and wherein said pulse combustor is further characterised by

said intermediate plates (24, 26, 28) comprising spiral coolant passageways therein for conducting coolant through said intermediate plates."

Dependent claims 2 to 11 define preferred embodiments of the pulse combustor according to claim 1

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

D2 describes a very simple pulse combustor. It comprises an outer housing formed of a pair of outer jackets enclosing a stack of annular plate elements, the annular plate elements being spaced apart from one another. The function of the annular plate elements in D2 is not described in detail. In D2, the annular plate elements are of solid, annular plate like construction. No teaching regarding cooling of the annular plate elements, or the benefits associated therewith is given.

It is incorrect to suggest that the combination of D1 with D2 renders obvious the feature that the intermediate plates comprise spiral coolant passageways for conducting coolant therethrough.

The act of incorporating intermediate plates comprising spiral coolant passageways into the arrangement of D1 is complex since the radially inner ends of the these passageways are difficult to access, being located adjacent the combustion chamber.

## **Reasons for the Decision**

### *1. Inventive step*

The examining division refused the application since it considered that the subject-matter of claim 1 submitted 16 April 2014 did not involve an inventive step starting out from D1 in combination with D2.

### *2. Nearest prior art*

- 2.1 The board agrees with the examining division that D1 can be taken as the nearest prior art. Documents D7 to D12 concern the construction of the burner assembly defined in claims 10 and 11 as filed, and which is not claimed in the present request. Documents D3, D4 and D5 do not relate to pulse combustors. D6 discloses a two-plate pulse combustor with a cooled casing, but is no more relevant than D1.

The examining division considered D1 to disclose:

- a) a first outer plate (12) having a central hub and conical region (82) inside a flat outer region,
- b) a second outer plane (13) having a central hub and a conical region (82) inside a flat outer region,
- c) a combustion chamber (20) defined by the volume between the conical regions (82) of the first and second outer plates, and

d) a burner assembly (19) coupled to one of said hubs, said burner assembly operative to ignite a fuel/air mixture in said combustion chamber (20).

2.2 In the board's judgement, D1 also discloses that:

said first and second outer plates comprise spiral coolant passageways (see D1, column 4, lines 10 to 12).

2.3 Therefore, the subject-matter of claim 1 differs from the device disclosed in D1 in that:

- a plurality of intermediate plates is located between the first outer plate and the second outer plate,

- wherein said intermediate plates are spaced apart to form tailpipe regions therebetween and between said outer plates and adjacent ones of said intermediate plates,

- and wherein said intermediate plates further comprise spiral coolant passageways therein for conducting coolant through said intermediate plates.

3. *Technical effect of distinguishing features*

3.1 By providing intermediate plates it is possible to increase the heat generation compared with that of a two plate system (see application, page 8, lines 17 to 20). The provision of spiral coolant passageways for conducting coolant through the outer plates enhances the pressure drop after passage of the pressure wave and is known to improve the functioning of a two-plate pulse combustor (see page 1, lines 15 to 17).



- 3.2 According to the application itself (see page 3, lines 8 to 12) there is a need for a combustor that is scalable to achieve an increased power output and therefore the object of the invention is "to provide a pulse combustor that has a scalable power output".
- 3.3 The application also states that a two plate combustor cannot be simply scaled up to increase power generation (see page 8, lines 15 to 20). No precise reason is given for this, but as explained in D2 (see below), the heat transfer area is proportional to the tail-pipe length which influences the resonance and stability characteristics of the combustor and consequently can only be increased up to a certain limit.
4. *Objective technical problem*
- 4.1 Therefore, the objective technical problem to be solved can be seen as one of how to obtain an increase in power output whilst maintaining a correctly functioning pulse combustor in terms of flame stability, reliability and noise.
5. *Disclosure of D2*
- 5.1 The board agrees with the examining division that faced with this problem the skilled person would have consulted D2, since it too discloses a pulse combustor and is concerned with a similar problem of obtaining an increase in power output for a given space by providing a compact construction (see D2, page 3, lines 18 to 21).
- 5.2 The intermediate plates of D2 are intended to allow the heat output of the apparatus to be increased without a corresponding increase in the length of the tail-pipes

such that the creation of low pitched noise resulting from low frequency pulsating combustion is avoided (see D2, page 3, lines 4 to 9 and page 4, lines 1 to 4).

5.3 The heat transfer of the apparatus according to D2 is not explicitly detailed, but it appears that it will take place at the periphery of the apparatus via a suitable housing or manifold for receiving combustion gases emerging from the passages, which is not shown (see also D2, Abstract and page 7, lines 5 to 7). By stacking intermediate plates the size of this housing or manifold can be scaled up and the power output of the device increased. Since the exhaust gases are present on both sides of the solid intermediate plates, these play no direct role in heat-transfer to the water or other fluid to be heated.

5.4 The skilled person seeking to increase the power output of the device according to D1 would learn from D2 that a solution could be obtained by stacking solid intermediate plates to increase the vertical height of the apparatus whilst maintaining a tail-pipe length commensurate with correct functioning of the combustor. However, D2 does not give a clear teaching of how heat is transferred to water or other cooling fluid of the resulting device, but does show that the intermediate plates do not necessarily need to be cooled.

6. *Obviousness of claim 1 with respect to a combination of D1 and D2*

6.1 The examining division contended that, in view of the passage in D1, col 6, lines 59 to 62, the skilled person would see it as obvious to implement a set of fluid cooled intermediate plates comprising spiral coolant passageways in order to create an optimal

pressure drop, not only in the outer plates, but also in each tailpipe.

- 6.2 The examining division also asserted that the constructional modifications necessary to connect said intermediate spiral coolant passageways to the coolant circuits fell within the realm of standard design activity.
- 6.3 However, the board agrees with the appellant that the task of incorporating intermediate plates comprising spiral coolant passageways into the arrangement of D1 is not straightforward.
- 6.4 It is accepted that providing connections to the radially outer ends of all the passageways, and to the radially inner ends of the passageways of the outer plates is relatively simple since these are readily accessible. By contrast, providing connections to the radially inner ends of the spiral passageways of the intermediate plates is not so simple, since these are located adjacent the combustion chamber and are consequently difficult to access, as well as being subject to severe operating conditions.
- 6.5 Therefore, on the basis of the teachings of D1 and D2, the skilled person would be discouraged from implementing intermediate plates comprising spiral coolant passageways. In view of this the skilled person would rather deploy solid intermediate plates as taught by D2, in combination with a heat transfer means comprising more easily accessible inlet and outlet connection means in order to exploit the extra power provided by the combustion gases emerging from the intermediate tail-pipes. For example, such means could be arranged around the periphery of the tail-pipes in

the manner also implied by D2, such a means could even employ tubing connected to that of the outer plates.

- 6.6 It also appears that once the decision has been taken to increase power output by providing additional tail-pipes through the implementation of intermediate plates, the provision of plate cooling is less important as compared to the two-plate device, since tuning of the pulse combustor can be obtained by the configuration and number of intermediate plates.
- 6.7 Against this background, in order to obtain the subject-matter of claim 1 starting out from D1, the skilled person would have to consult D2 and decide to transfer the feature of the intermediate plates to D1, whilst modifying them so as to comprise spiral coolant passageways therein for conducting coolant and, in order to do this, devise a way of overcoming the difficulties of connecting the cooling circuit of the so modified intermediate plates.
- 6.8 Such a course of action is only possible with the benefit of hindsight. Thus, the subject-matter of claim 1 and of the dependent claims is considered to involve an inventive step.

7. *Further objections*

No further objections against the subject-matter of claim 1 were raised by the examining division in its communication of 14 July 2014. The board sees no reason to deviate from this position. In particular, the subject-matter of claim 1 is considered to be clear and based on claim 1 as originally filed as thoroughly discussed by the examining division during the first

instance proceedings. Thus, the requirements of Articles 84 and 123(2) EPC are met.

8. In conclusion, the board considers the subject-matter of claim 1 and that of dependent claims 2 to 11 to meet the requirements of the EPC.

## Order

### **For these reasons it is decided that:**

1. The decision under appeal is set aside.
2. The case is remitted to the examining division for the grant of a patent on the basis of claims 1 to 11 filed with letter of 16 April 2014, together with a description and figures to be adapted as necessary.

The Registrar:

The Chairman:



C. Spira

G. Ashley

Decision electronically authenticated