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**Datasheet for the decision  
of 3 September 2021**

**Case Number:** T 0610/18 - 3.2.03

**Application Number:** 12151964.9

**Publication Number:** 2481982

**IPC:** F23C7/00, F23R3/14, F23R3/28

**Language of the proceedings:** EN

**Title of invention:**  
Mixer assembly for a gas turbine engine

**Patent Proprietor:**  
Raytheon Technologies Corporation

**Opponent:**  
Safran Aircraft Engines

**Headword:**

**Relevant legal provisions:**  
EPC Art. 54, 56  
EPC R. 103(1) (a)

**Keyword:**

Novelty - (yes)

Inventive step - (yes)

Reimbursement of appeal fee - (no)

**Decisions cited:**

T 2044/09

**Catchword:**



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Case Number: T 0610/18 - 3.2.03

**D E C I S I O N**  
**of Technical Board of Appeal 3.2.03**  
**of 3 September 2021**

**Respondent:** Raytheon Technologies Corporation  
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**Decision under appeal:** **Interlocutory decision of the Opposition  
Division of the European Patent Office posted on  
22 December 2017 concerning maintenance of the  
European Patent No. 2481982 in amended form.**

**Composition of the Board:**

**Chairman** C. Herberhold  
**Members:** B. Goers  
E. Kossonakou

## **Summary of Facts and Submissions**

- I. European Patent 2 481 982 ("the patent") concerns a mixer assembly for a gas turbine engine for mixing fuel and air in an annular cavity.
- II. An opposition was filed against the patent on the grounds under Article 100(c) EPC, Article 100(b) EPC and Article 100(a) EPC in conjunction with Articles 54 and 56 EPC. The opposition division decided to maintain the patent as amended on the basis of the first auxiliary request submitted during the oral proceedings before the opposition division.
- III. Both the opponent and the patent proprietor appealed against this decision.
- IV. With the parties' consent, oral proceedings were held on 3 September 2021 by videoconference using the Zoom platform. At the end of the oral proceedings, the proprietor withdrew its appeal. For the further course of the oral proceedings, reference is made to the minutes.
- V. At the end of the oral proceedings, the parties' requests were as follows:

The opponent (hereinafter: "appellant") requested that the decision under appeal be set aside and the patent be revoked.

The appellant also requested reimbursement of the appeal fee due to a substantial procedural violation during the opposition proceedings.

The patent proprietor (hereinafter: "respondent") requested that the appeal be dismissed.

VI. The following prior art documents submitted with the notice of opposition are relevant to the decision.

D1: EP 2 093 489 A2  
D2: US 5,816,049  
D3: US 2007/0028624 A1  
D4: US 6,799,427  
D6: US 3,703,259  
D7: GB 2 456 753 A  
D11: US 6,609,377 B2

VII. Independent claim 1 according to auxiliary request 3 corresponds to auxiliary request 1 considered in the impugned decision and on the basis of which the opposition division decided to maintain the patent. It reads as follows (feature notation in "[ ]" as introduced by the appellant).

*"[a] A mixer assembly (200) for a gas turbine engine comprising:*

*[b] a main mixer (220) comprising:*

*[c] an annular inner radial wall (219);*

*[d] an annular outer radial wall (222) surrounding at least a portion of the annular inner radial wall (219), wherein the annular outer radial wall (222) incorporates a first outer radial wall swirler (240) with a first axis (248) oriented substantially radially to a center line axis (218) of the mixer assembly (200);*

*[e] a forward wall (224) substantially perpendicular to and connecting the annular inner radial wall (219) and the annular outer radial wall (222) forming an annular cavity (228),*

*characterised in that*

*[f] the forward wall (224) incorporates a first forward wall swirler (230) with a second axis oriented substantially axially to the centerline axis (218) of the mixer assembly (200);*

*[g] and in that the mixer assembly comprises a plurality of fuel injection holes (226) in the forward wall (224) between the first outer radial wall swirler (240) and the first forward wall swirler (230), wherein the first outer radial wall swirler (240) is on a first side of the plurality of fuel injection holes (226) and the first forward wall swirler (230) is on a second side of the plurality of fuel injection holes (226);*

*[h] wherein the plurality of fuel injection holes (226) are oriented substantially perpendicularly to the first axis (248)."*

VIII. The appellant's arguments relevant to the present decision may be summarised as follows.

(a) Auxiliary request 3 - Novelty

The subject-matter of claim 1 was not novel over the disclosure of D1. The embodiments in Figures 3 and 5 of D1 disclosed a forward wall comprising a number of radial elements with an integrated forward swirler. The forward wall further comprised fuel channels having a number of holes ("fuel swirl slots") between the radial and the forward swirler. The disclosure of the patent did not provide a basis for a narrow interpretation of the features "forward wall" and "perpendicular to the inner and outer radial wall" which would exclude the embodiments of D1. The radial structural elements in Figures 3 and 5 of D1 therefore constituted a forward wall as per claim 1. Moreover, the radial parts could still be construed as a forward wall despite their

axial extension being larger than their radial extension. In paragraph [0024] D1 further disclosed that the fuel holes were formed by circumferentially distributed slots which could be oriented at a zero angle with respect to the axis of the mixer, thereby also anticipating feature [h].

(b) Auxiliary request 3 - Inventive step

The subject-matter of claims 1 and 13 did not involve an inventive step starting from the fuel mixer disclosed in Figure 3 of D2. The locations of the fuel injection holes in claim 1 were not specified as being in proximity of the radial swirler, so claim 1 did not guarantee the function of a perpendicular interaction between fuel and a radial air flow. As a consequence the sole (allegedly) distinguishing feature [h] could not provide a technical effect and therefore did not solve a technical problem. Under established case law, e.g. T 2044/09, an inventive step could thus not be acknowledged. Furthermore, the mere alternative of a fuel supply perpendicular to the airflow was obvious to the skilled person from the common general knowledge and the teaching of D4.

Additionally, the subject-matter of claims 1 and 13 did not involved an inventive step starting from the fuel mixer disclosed in D3, Figure 13, or, equivalently, from D7, Figure 3 and the disclosure of D1 or D4 or the general teaching of documents D2, D6 or D11. Various disclosures rendered the sole distinguishing feature [h] obvious. D1, D2, D4 and D6 disclosed the general principle of double shearing of the fuel since they provided the fuel within the two swirlers and perpendicularly to the air flow, while D11 disclosed axially oriented fuel injection holes. The provision of

axially oriented fuel injection holes, i.e. holes oriented substantially perpendicularly to the first axis, in the forward wall of the annular cavity in-between the two swirlers of the embodiment in Figure 13 of D3 was therefore obvious to the skilled person.

(c) Reimbursement of the appeal fee

The decision under appeal was not sufficiently reasoned with respect to the inventive step discussion on page 7 using D2 or D3 as the starting point. Furthermore, the appellant's arguments with respect to the absence of an effect were not refuted. This amounted to a substantial procedural violation and justified reimbursement of the appeal fee.

IX. The respondent's arguments relevant to the present decision may be summarised as follows.

(a) Auxiliary request 3 - Novelty

D1 was not novelty-destroying for claim 1. The structural elements extending between the upper and lower radial wall could not be considered a clear and unambiguous disclosure of a forward wall in the sense of claim 1. The "agglomerated" structural elements between the radial walls did not qualify as a "forward wall" as defined in the claim. Furthermore, since the axial extension of these elements was larger axial than their radial extension, the skilled person would not construe them as a wall structure substantially perpendicular to the radial walls. The fuel swirler structure in D1 did not anticipate the fuel injection holes either. It had not been demonstrated that this structure was suitable for fuel injection, nor were distinct holes provided. Moreover, D1 only disclosed



issuing the fuel radially inwardly. The angle of zero according to paragraph [0024] related to a tangential angle, i.e. to the fuel swirl angle, rather than to a radial one.

(b) Auxiliary request 3 - Inventive step

The subject-matter of claim 1 involved an inventive step.

In addition to the axial orientation of the fuel injection holes, D2 also failed to disclose a forward wall that included these holes and was perpendicular to the radial walls. The technical problem was to improve atomisation and the mixing of the fuel in the air. Since D2 provided specific teaching with respect to the orientation of the fuel injection, which was disclosed as "directly into and against the radial air stream", the skilled person would at least not consider changing the injection orientation (feature [h]), whether in view of the common general knowledge or the teaching of D4.

The distinguishing feature [h] was not disclosed in either D3 or D7 nor rendered obvious by any of D1, D2, D4, D6 or D11. D1, D2 and D6 did not disclose axially oriented fuel injection holes. D11 only taught axial fuel injection holes in combination with axial swirlers. Furthermore, in the annular chamber of Figure 13 of D3, there was no space left to provide the fuel injection holes in the forward wall, so complex modifications of the fuel mixer would be necessary, e.g. rearranging the fuel supply. Therefore, the skilled person would not consider any such modification even in view of the teaching of D4. Moreover, all these documents provided complete fuel/air mixer designs with

various functionally and structurally related features. Without the benefit of hindsight, it was not obvious to extract a single feature from them, such as the location or orientation of the injection holes. Rather, the skilled person would apply the complete teaching of these documents.

## **Reasons for the Decision**

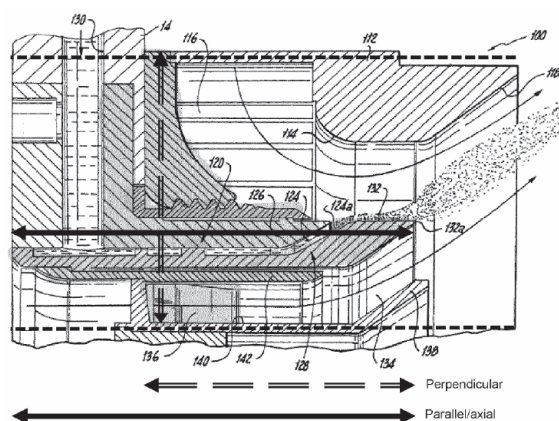
### *Auxiliary request 3 - Novelty*

1. The novelty of the subject-matter of claim 1 of auxiliary request 3 was challenged on the basis of D1. The subject-matter is novel for the following reasons.
  - 1.1 It was common ground between the parties that the embodiment in Figures 3 and 5 of D1 (Figure 5 is referred to hereinafter) disclosed a mixer assembly with an annular inner wall and an annular outer radial wall including a radial swirler ("outer radial air swirler 316") oriented radially to the centerline axis (the rotational symmetry having a centerline is best seen in Figure 2). The inner and outer air passage/circuit (314 and 334) are in fluid communication within the limits of the inner and outer radial wall and form an annular cavity. This cavity is further delimited by structural elements extending between the upper and lower radial wall comprising a number of different parts, among which there is also a forward swirler ("inner axial air swirler 336") oriented axially to the centerline. The structural elements further include a "fuel swirling passage" for supplying fuel to the inner cavity.
  - 1.2 However, it was a matter of dispute whether:
    - the structural elements extending between the upper and lower radial wall in Figures 3 and 5 could be considered a forward wall that was substantially perpendicular to and connected the annular inner and outer wall as per feature [e] (see figure below);

- the fuel swirler structure in D1 comprised fuel injection holes as per feature [g];
- the fuel injection holes were oriented substantially perpendicularly to the first axis as per feature [h].

1.3 Feature [e]: "substantially perpendicular forward wall"

1.3.1 The structural elements in question are highlighted in grey in the following annotated Figure 3 of D1, which was provided by the respondent and referred to by both parties. For the embodiment of Figure 5 the corresponding structural elements were discussed.



1.3.2 Terms used in patent documents should be given their normal meaning unless the description gives them a special meaning (Case Law of the Boards of Appeal of the European Patent Office, 9th edition, 2019, II.A. 6.3.3). Reading the whole content of claim 1 with this in mind, the skilled person first learns that a "forward wall substantially perpendicular to and connecting the annular inner radial wall and the annular outer radial wall forming an annular cavity" (feature [e]) is provided. A normal reading of this feature teaches the skilled person that the forward wall is a structure whose function is to

connect the annular inner and outer radial walls perpendicularly in order to delimit, together with the radial walls, an annular cavity. In this way, the incoming air can enter the cavity through the radial and forward swirler. There are no further limitations, such as number of parts forming the wall, and the wording of the claim does not exclude a radial extension or portions which are not perpendicular. Furthermore, this understanding is in line with the description and embodiments of the patent, for which the claims are intended to provide a generalised concept (see below).

1.3.3 The interconnected structural elements between the inner and outer radial wall in the fuel mixer in Figures 3 and 5 of D1 (see figure above) fulfil the functional requirements of feature [e]. They connect the inner and outer radial walls in order to form a cavity such that the incoming radial and axial air streams are directed into this chamber. They thus constitute a forward wall as claimed. Selecting distinct structural elements in Figures 3 or 5 of D1 as being part of and forming the forward wall is merely based on the contribution made by these elements to the functional concept of the forward wall. Doing so is therefore not arbitrary or in contradiction to the teaching of the patent.

1.3.4 Indeed, the patent does not specify whether the forward wall is formed by different portions of a single integral forward wall part or by multiple connected parts. In particular, according to Figures 3 and 4 of the patent the forward wall 224 is a composite of structurally distinct portions including (as seen radially from the outside to the inside) a vertically oriented outer portion, a central portion with a V-

shape extending radially, and the first forward wall swirler 230. The opposition division's argument that the fuel mixer in D1 was a "complex structure" and that it was not "obvious which component was to be considered as the perpendicular forward wall" (decision under appeal, page 4, last paragraph) is therefore not persuasive.

1.3.5 The respondent's argument that the forward wall may not comprise portions extending "far downstream", and in particular may not comprise portions having a larger axial extension than a radial extension, is not persuasive either. There is no reason to read this limitation into feature [e] since it does not contradict the requirements of the claim wording, i.e. to connect the inner and outer radial wall to form a cavity. Any axial extension of this wall neither contributes to the above function nor hinders it. Furthermore, the axially extending curved section of the forward wall facing the inner cavity of the structure in Figure 5 of D1 has the same inherent function as the curved portion of the forward wall in Figure 3 of the patent, namely to guide the radial inflow to a point where it mixes with the axial inflow. A possible difference in the absolute dimension does not justify a different interpretation with respect to feature [e].

1.4 Feature [g]: "fuel injection holes"

1.4.1 Contrary to the decision under appeal (paragraph bridging pages 4 and 5) the "number of circumferentially disposed fuel swirl slots formed in the fuel swirler" according to paragraph [0024] of D1 is an unambiguous disclosure of a plurality of fuel injection holes. The term "holes" includes openings in

general with no restriction as to a particular cross-sectional shape. A "slot" is thus an embodiment of a hole. In D1, the slots/holes enter the annular chamber between the inner and outer air circuits, which are connected, respectively, to the forward and radial swirlers as required by feature [g].

1.4.2 The respondent's argument that, for want of any supporting evidence, the fuel swirler was not clearly and unambiguously suitable for injecting fuel is not convincing either. It is evident from D1 that discrete fuel jets are "issued" from the fuel swirl slots (see e.g. Figure 5 and paragraph [0028]). The respondent argued that the term "fuel injection" implies the use of a pressure difference as the driving force. However, D1 implicitly discloses such a pressure difference. The skilled person knows that a pressure difference is inherently required to transport fuel in "discrete fluid jets" from the swirl chamber into the annular cavity, be it a suction pressure caused by negative pressure in the annular cavity or positive pressure provided in the fuel supply line. No further supporting evidence is necessary for this well-known technical principle.

1.5 Feature [h]: "oriented substantially perpendicularly"

1.5.1 The fuel injection holes in D1 are not disclosed as being oriented substantially perpendicularly to the first axis as required by feature [h]. The "slot angles" of the fuel holes mentioned in paragraph [0024] refer to "fuel swirl slot angles" measured tangentially to the axis of the spin chamber of the fuel mixer as shown in Figures 3 and 5 of D1, and not, as argued by the appellant, to an angle measured radially to this axis. This becomes evident from the disclosure in

paragraph [0024], which states that small swirl angles result in "discrete jets" of fuel extending from the "circumferentially disposed" fuel swirl slots, while angles of 60° and higher result in a "single sheet of fuel". The latter is the result of the mixing of the discrete jets by means of a tangential injection direction.

1.5.2 Furthermore, paragraph [0028] teaches that the "fuel issuing from the fuel swirler flows radially outward". In this context it is noted that for an angle extending radially from the axis, D1 uses the axially extending prefilming surface 232 as a reference (see paragraph [0032] describing the embodiment of Figure 4).

1.5.3 Indeed, the appellant's interpretation is not supported by any of the embodiments, which all have radially inclined fuel injection holes at angles substantially different from zero.

1.6 To conclude, the subject-matter of claim 1 is novel since feature [h] is not clearly and unambiguously disclosed in D1.

*Auxiliary request 3 - Inventive step*

2. The subject-matter of claim 1 involves an inventive step when considering any of prior art documents D2, D3 or D7 as the starting point, for the following reasons.

3. D2 as the starting point

3.2 Distinguishing features

3.2.1 D2 is related to the problem of mixing fuel and air in a fuel mixer of a gas turbine (see column 1, "Field of



the invention") and therefore qualifies as a starting point for assessing of the requirements of Article 56 EPC. It was common ground between the parties that D2 did not disclose at least feature [h]. In addition, the respondent contested that D2 disclosed a "forward wall" which was "perpendicular to the inner and outer radial wall" as required by feature [e].

3.2.2 In Figures 2A and 3, D2 discloses a fuel mixer with an outer radial wall including a radial swirler (30) and an inner radial wall (98). The inner and outer radial walls are connected by a "holder" (48), with the holder further including a forward swirler (26). Fuel injection holes 66 are located between the swirlers (30 and 26). The "holder" connects the annular inner and outer radial walls in order to delimit, together with the radial walls, an annular cavity (50). It thus qualifies as a forward wall as per of claim 1 since it fulfills the function as described in the patent (see also point 1.3).

3.2.3 Furthermore, the conclusion in the decision under appeal that this forward wall in D2 extends substantially perpendicularly to the inner and outer radial wall (see page 5, penultimate paragraph) is correct. This is true even though the wall includes a portion with a radial, oblique offset. This interpretation is consistent with the teaching of the patent, in which the forward wall in Figure 3 also has an oblique portion with the same function of redirecting the incoming radial flow. The respondent argued that "the start and end points of the wall should substantially be in the same axial position". However, the patent does not explicitly restrict the feature to any such construction, nor is this apparent from the embodiment (see Figure 3) of the patent. With

respect to the forward wall, also no inherent functional need for any such restrictive interpretation is apparent either.

3.2.4 It is not persuasive either that the fuel injection holes 66 in the surface 60 cannot be construed as being located in the forward wall. The patent describes an example (which is not encompassed by the subject-matter of claim 1) having a forward wall in which fuel holes are oriented perpendicularly to the second axis (see patent, paragraph [0015]), i.e. oriented according to the holes 66 in D2. Therefore, the scope of the term "forward wall" cannot be construed in the restricted way presented by the respondent.

3.2.5 With respect to D2, the only distinguishing feature over the subject-matter of claim 1 is thus feature [h] according to which the fuel injection holes are oriented substantially perpendicularly to the first (radial) axis. Conversely, D2 discloses that the fuel injection holes (66) are oriented radially with respect to the centerline, i.e. in parallel with to the first axis.

### 3.3 Objective technical problem

In the decision under appeal (see page 7, paragraph 2), the opposition division argued that "document D2 related to a complicated structure and the skilled man would not have any reasons to change its design". It is, however, not apparent which objective technical problem the opposition division relied on in this context.

3.3.1 The appellant's argument that the distinguishing feature is not linked to a technical effect and would

not solve any problem is not persuasive. In paragraph [0015], lines 23 et seq. of the patent, the interaction of the orientation of the fuel injection holes with the further features is described as follows: "... the fuel is injected through the fuel injection holes that are oriented substantially perpendicularly to axis 248 and the flow of air from the radial first outer radial wall swirler, which atomizes and disperses the fuel. The fuel then is atomized and dispersed again by the flow of air from the axial first forward wall swirler, thus atomizing the fuel by airflow from two sides".

3.3.2 Since the fuel injection holes are arranged between the radial and axial swirler inlets (feature [g]), it is apparent that the selected orientation of the holes perpendicular to the first axis always promotes turbulent mixing with the radial air flow (at least to a certain extent) before mixing with the axial air stream. An orientation perpendicular to the second axis (according to a second example described in paragraph [0015]) would accordingly promote turbulent mixing with the axial air stream first, followed by mixing with the radial stream.

3.3.3 The effect brought about by the perpendicular orientation of the injection holes is therefore to intensify the atomisation and mixing of the fuel within the air stream. Given that this feature does bring about this technical effect, the conclusion in decision T 2044/09, Reasons 4.6, referred to by the appellant, according to which a novel feature could not render the subject-matter inventive if it has no demonstrated technical effect, is not applicable.

3.3.4 It was neither argued nor demonstrated that the technical effect according to the distinguishing

feature was superior to the mixing effect achievable with the mixer design disclosed in D2. Therefore, the objective technical problem is to provide an alternative solution for increasing the degree of atomisation of the fuel and improving its mixing with air (see the patent, paragraph [0007]).

### 3.4 Obviousness of the distinguishing features

3.4.1 In assessing whether the skilled person would consider changing the orientation of the fuel injection holes, D2's teaching with respect to this orientation has to be considered. According to column 4, lines 58 to 62 " ... liquid fuel is injected through openings 66 directly into and against radial air stream 38. This permits larger drops of the liquid fuel to better interact with such air stream instead of being injected at an angle thereto". The radial orientation of the fuel injection in counter-current to the air flowing in through the radial swirler, i.e. in parallel with the first axis, thus has the purpose of atomising the fuel and mixing it with the air. This explicitly discourages the skilled person from modifying the orientation of the fuel injection holes relative to the air flow. D2 does not disclose an embodiment deviating from this teaching, nor does the disclosure of D2 as a whole disclose any alternative.

3.4.2 In view of this clear discouragement, the skilled person is led away from modifying the orientation of the fuel injection holes according to D2, even if it were assumed that the perpendicular orientation was part of the common general knowledge. For the same reasons, the skilled person would rather replace the fuel mixer in D2 with that in D4 than modify the orientation of the fuel injection holes as taught in

D4, i.e. perpendicular to the air flow. Therefore, the subject-matter of claims 1 and 13 is not obvious and involves an inventive step when using D2 as the starting point.

4. D3 or D7 as a starting point

4.1 The fuel mixers disclosed in D3 (Figure 13) and D7 (Figure 3) both qualify as a starting point for the inventive step discussion as they are directed towards an improved fuel/air mixture in a fuel mixer and exhibit considerable structural similarities to the fuel mixer of the patent. Both D3 and D7 disclose an inner chamber delimited by inner, outer and forward walls which receive air streams from a radial and a forward swirler and fuel from fuel injection holes. The disclosures of the fuel mixers in D3 and D7 are structurally and functionally similar to the extent that an analogous problem-solution approach applies. This was not disputed by the appellant, so it is sufficient to assess inventive step using D3 as the starting point.

4.2 Distinguishing features and technical problem

4.2.1 Figure 13 of D3 discloses a fuel mixer with a radial swirler (308) and an axial swirler (304) integrated in a forward wall, which extends perpendicularly between an inner (138) and outer (134) annular wall, thereby forming an inner cavity.

4.3 It was common ground that the distinguishing features with respect to claim 1 were that the fuel injection holes (128) are neither located between the radial and forward swirler as required by feature [g], nor

oriented substantially perpendicularly to the first axis as required by feature [h].

4.4 The technical effect of these distinguishing features according to the patent is to promote atomisation of the fuel and its mixing with air. D3 likewise addresses this object (see paragraph [0008], "intense mixing of the fuel"). According to paragraph [0108], the radial and forward swirler and the fuel injection holes of the embodiment in Figure 13 interact to provide an "intense mixing region 354" with "enhanced total kinetic energy". The same technical problem as in the patent is thus addressed using an alternative arrangement of the fuel injection holes and the swirlers. There is no evidence that arranging the elements according to claim 1 enhances the mixing even further. Therefore, the objective technical problem is to provide an alternative solution for improved atomisation of the fuel and its mixing with air.

4.5 Obviousness of the distinguishing features

4.5.1 The appellant correctly observed that any one of the embodiments in **D1** (Figures 3 and 5), **D2** (Figure 3) and **D6** (Figure 7) discloses a sequential radial/axial atomisation and mixing as also performed by the mixer according to D3. However, none of these documents teaches orienting the fuel injection holes in the substantially axial direction (i.e. perpendicularly to the first axis). Therefore, none of these disclosures can render feature [h] obvious.

4.5.2 The appellant argued that documents D1, D2 and D6 disclosed the general concept of providing sequential mixing, which implied the teaching of providing the fuel injection holes between the two air swirlers. In

applying this teaching to the mixer of D3, the person skilled in the art would move the injection holes into the forward wall above the axial swirler (i.e. above reference sign 306 in Figure 13). This argument is not convincing for several reasons. Firstly, as pointed out by the respondent, there is simply not enough place at that location for an injection hole as used in D3. Secondly, any such modification would require a complete redesign of the fuel supply. Thirdly, relocating the injection holes would change the orientation of the injection such as to create a different mixing arrangement from that in the prior art D1, D2 and D6.

- 4.5.3 The location of the holes and their orientation relative to the air flow are, moreover, in a close functional and structural relationship with the other parts of the mixing chamber, all of which would need to be changed if the appellant's approach were followed. Without any incentive or general recognition of the alleged general concept in the documents, any such isolated extraction of individual technical features has to be considered to be hindsight-based and would require a redesign beyond the level of modifications that a person skilled in the art would perform without exercising any inventive skill.
- 4.5.4 The fuel mixers disclosed in **D11** in the embodiments of Figures 4, 6 and 7 have fuel injection holes which are oriented axially. However, D11 only discloses swirlers in an axial orientation. Therefore, D11 does not provide any teaching to arrange a fuel injection port such that the fuel is injected perpendicularly to a radial stream in order to promote mixing. Without the benefit of hindsight, D11 would not prompt the skilled person to modify the mixer in D3 by arranging axial

fuel holes between the forward and the radial swirlers. The axial orientation of both the air flow and the fuel injection in D11 also casts further doubt on the appellant's above-mentioned argument that a sequential mixing by double-crossing of the respective flow directions was a general principle derivable from the prior art.

4.5.5 **D4** describes arranging the fuel injection holes perpendicularly to separate axial and radial air flows (see e.g. column 4, lines 8 to 23). However, D4 relies on a different mixing concept in which the radial and axial fuel mixing zones are distinct, whereas D3 specifies a common fuel mixing zone that receives both the axial and radial air streams. It is not apparent which information in D4 the skilled person would use to conclude that it would be more beneficial to provide further axial fuel injection holes in the mixing zone (inner cavity) of D3. Even if the skilled person did consider doing so, there are various possibilities for arranging the further fuel injection holes, and not all of these are in line with feature [g]. Such locations include the forward wall below the forward swirler or the wall opposite the forward wall. Furthermore, the respondent correctly observed that a location according to features [g] and [h] does not leave any space for additional fuel injection holes in the embodiment of Figure 13. This would require a redesign of the forward wall and a different concept for the fuel supply. For these reasons, the skilled person would not provide fuel injection holes in accordance with features [g] and [h] for the embodiment of Figure 13 of D3 without the benefit of hindsight (see above).



5. To conclude, the subject-matter of claim 1 involves an inventive step when using D2 or D3 as the starting point.
6. Since the subject-matter of claim 1 complies with the requirements of patentability, the appeal is not allowable.

*Request for reimbursement of the appeal fee*

7. Since the appellant's appeal is deemed not to be allowable, reimbursement of the appeal fee cannot be granted under Rule 103(1)(a) EPC. The request is therefore refused.

**Order**

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

1. The appeal is dismissed.
2. The request for refund of the appeal fee is rejected.

The Registrar:

The Chairman:



C. Spira

C. Herberhold

Decision electronically authenticated