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**D E C I S I O N**  
**of 3 May 2006**

**Case Number:** T 0500/04 - 3.2.04

**Application Number:** 95110170.8

**Publication Number:** 0690223

**IPC:** F02M 61/16

**Language of the proceedings:** EN

**Title of invention:**

Fuel injector and method of adjusting the travel of a fuel injector shutter

**Patentee:**

ROBERT BOSCH GMBH

**Opponent:**

Siemens AG

**Headword:**

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**Relevant legal provisions:**

EPC Art. 100a), 108, 114(1)

RPBA Art. 10a(2), 10b(1)

**Keyword:**

"Inventive step - claim 1 (no) - claim 8 (no)"

"Piecemeal submission of auxiliary requests during oral proceedings"

"Last third auxiliary request filed during oral proceedings (rejected as inadmissible)"

**Decisions cited:**

T 0037/82, T 0153/85, T 0074/96

**Catchword:**

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Case Number: T 0500/04 - 3.2.04

**D E C I S I O N**  
of the Technical Board of Appeal 3.2.04  
of 3 May 2006

**Appellant:** Siemens AG  
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**Representative:**

**Respondent:** ROBERT BOSCH GMBH  
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**Representative:** Möldner, Peter  
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**Decision under appeal:** Decision of the Opposition Division of the  
European Patent Office posted 5 February 2004  
rejecting the opposition filed against European  
patent No. 0690223 pursuant to Article 102(2)  
EPC.

**Composition of the Board:**

**Chairman:** M. Ceyte  
**Members:** C. Scheibling  
C. Heath

## Summary of Facts and Submissions

- I. By its decision dated 5 February 2004 the Opposition Division rejected the opposition, of which the Appellant was notified only on 17 February 2004. On 6 April 2004 the Appellant (opponent) filed an appeal and paid the appeal fee simultaneously. The statement setting out the grounds of appeal was received on 23 June 2004.
- II. The following documents played a role in the present proceedings:
- D3: EP-A-0 548 916
  - D4: DE-A-42 25 805
  - D11: Montage im Maschinenbau, VEB Verlag Technik, Berlin, 1978, especially pages 49 to 51
- III. The opposition was filed on the grounds based on Article 100a) EPC (novelty and lack of inventive step) and 100(b) EPC. Novelty and sufficiency of disclosure have no longer been disputed in the statement setting out the grounds of appeal.
- IV. Independent claims 1 and 8 as granted read as follows:
- "1. A fuel injector comprising a shutter, wherein the shutter is in form of a needle (19) travelling axially for opening and closing a nozzle (10, 11); comprising a control rod (8) coaxial with said needle (19) and axially slidable to control the travel of said needle (19) via a substantially cylindrical plate (47); said plate (47) and said control rod (8) being mutually engaged by a first pair of mating surfaces (54, 56), said plate (47) and said needle (19) being mutually

engaged by a second pair of mating surfaces (57, 58); a hollow body (6) having an axial cavity (7) in which slide said control rod (8) and said plate (47), said axial cavity (7) including a sleeve (30) for precision-fit guiding an end portion (31) of said control rod (8), and a coaxial seat (51) for guiding said plate (47), said sleeve (30) forming a control chamber (32) defined by a terminal surface (33) of said end portion (31); and an electromagnetic metering valve (24) including an electromagnet (26) controlling an armature (27), so that when said electromagnet (26) is energized the fuel is drained from said control chamber (32) and the fuel pressure in an injection chamber (18) causes said needle (19) to open said nozzle (10, 11), and when said electromagnet (26) is de-energized the control chamber (32) is closed to cause the fuel pressure inside said control chamber (32) to act on said terminal surface (33) thus holding said needle (19) as to close said nozzle (10, 11);

characterized by the combination of the following features:

- said coaxial seat (51) is machined accurately as to present a very small clearance with respect to the cylindrical surface of said plate (47); and
- one mating surface (54, 58) of each of said pairs is flat and the other mating surface (56, 57) of each of said pairs is convex;
- whereby said plate (47) absorbs any transverse components of the forces exchanged between said control rod (8) and said needle (19) and due to misalignment of said control rod (8) and said needle (19)."

"8. A method for adjusting the travel of a fuel injector shutter, wherein the shutter is in form of a

needle (19) travelling axially for opening and closing a nozzle (10, 11), and is controlled by an axially slidable control rod (8) coaxial with said needle (19) via a substantially cylindrical plate (47); said control rod (8) and said plate (47) being housed in an axial cavity (7) of a hollow body (6) including a sleeve (30) for precision-fit guiding an end portion (31) of said control rod (8), and a coaxial seat (51) for guiding said plate (47), said sleeve (30) forming a control chamber (32) defined by a terminal surface (33) of said end portion (31); an electromagnetic metering valve (24) including an electromagnet (26) controlling an armature (27) so that when said electromagnet (26) is energized the fuel is drained from said control chamber (32) and the fuel pressure in an injection chamber (18) causes said needle (19) to open said nozzle (10, 11), and when said electromagnet (26) is de-energized the control chamber (32) is closed to cause the fuel pressure inside said control chamber (32) to act on said terminal surface (33) thus holding said needle (19) as to close said nozzle (10, 11); characterized by providing said plate (47) in different modular classes in terms of height (h), and by selecting the class of said plate (47) to be fitted in each case between said control rod (8) and said needle (9), so that said height (h) of the plate (47) selected corresponds to the required travel of said needle (19) to conform with the required opening of said nozzle (10, 11)."

Claim 1 according to the first auxiliary request comprises all the features of claim 1 according to the main request, as well as the following additional feature "the cylindrical surface of the plate (47)

presents a flat portion (52) defining a passage for the fuel seeping from the injection chamber (18)."

Independent claim 8 according to the first auxiliary request is identical with claim 8 of the main request.

The set of claims according to the second auxiliary request is restricted to the device claims 1 to 7 of the main request by deleting method claim 8.

V. Oral proceedings before the Board took place on 3 May 2006.

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

He mainly argued as follows:

The subject-matter of claim 8 (main and first auxiliary request) does not involve an inventive step with respect to D3 when taking into account the common knowledge of a skilled person. Indeed as illustrated by D11 it is common knowledge to adjust a distance in order to compensate for tolerances, by providing a plate in different modular classes in terms of height and by selecting a plate out of a class of plates so that the required distance is obtained. The fact that D3 does not explicitly disclose a coaxial accurately machined seat for guiding the plate with respect to its cylindrical surface is irrelevant, since this feature does not contribute to the solution of the problem of adjusting the travel of a fuel injector shutter and thus, is to be disregarded when assessing inventive step.

The injector of claim 1 according to the second auxiliary request differs mainly from the injector according to D3 in that one mating surface of each of said pairs is flat and the other mating surface of each of said pairs is convex. From D4 it is known to have a pair of mating surfaces, one of the surfaces being flat and the other one convex. A skilled person would realise that the configuration of these mating surfaces contributes to reduce or to eliminate any transverse force transmitted by the plate to the needle and thus, it would be obvious to him to apply the teaching of D4 to the injector of D3. Furthermore, it would be obvious to apply the teaching of D4 to all pairs of mating surfaces of D3. Therefore, the subject-matter of claim 1 does not involve an inventive step either.

The Respondent (patentee) countered the Appellant's arguments and mainly argued as follows:

D3 does not disclose a coaxial seat for guiding the plate, which is accurately machined as to present a very small clearance with respect to the cylindrical surface of the plate. D11 does not address to the problem of selecting a part such as to conform to a quantitative result, but solely relates to selecting parts according to their geometrical dimensions. Therefore, a skilled person would not consider D11 for solving the problem of the invention and even if he would take D11 into account, the combination of D3 and D11 would not anticipate all features of claim 8 of the main and first auxiliary requests, which therefore involves an inventive step.

D3 does not disclose mating surfaces wherein one surface is flat and the other convex. D4 discloses a pair of mating surfaces between the plate and the needle, one of the surfaces being flat and the other convex. Thus when applying the teaching of D4 to D3 a skilled person would only provide the mating surfaces between the plate and the needle with a flat and a convex shape but not the surfaces between the rod and the plate and therefore, would not arrive at an injector according to claim 1 of the second auxiliary request.

The Respondent requested that the appeal be dismissed (main request) or alternatively that the decision under appeal be set aside and the patent be maintained on the basis of one of the set of claims according to the first auxiliary request, filed with letter dated 3 March 2006 or according to the second or third auxiliary requests submitted at the oral proceedings.

### **Reasons for the Decision**

1. The appeal is admissible.

The decision of the Opposition Division was notified to the Appellant on 17 February 2004; thus the statement setting out the grounds of appeal, received on 23 June 2004 has been filed within four month after the date of notification of the decision as stipulated in Article 108 EPC. This point has not been disputed by the Respondent.



2. *Main request and first auxiliary request - Inventive step of claim 8:*

2.1 D3 is the closest prior art document.

2.2 D3 (figure 1) discloses a fuel injector comprising a shutter, wherein the shutter is in form of a needle (28) travelling axially for opening and closing a nozzle (9, 11); and is controlled by an axially slidable control rod (8) coaxial with said needle (28) via a substantially cylindrical plate (36); said control rod (8) and said plate (36) being housed in an axial cavity (7) of a hollow body (6) including a sleeve (54) for precision-fit guiding an end portion (68) of said control rod (8) (implicit, and column 3, lines 52 to 56), and a coaxial seat for guiding said plate (36), said sleeve (54) forming a control chamber (56) defined by a terminal surface (71) of said end portion (61); an electromagnetic metering valve (41) including an electromagnet (42) controlling an armature (48), so that when said electromagnet (42) is energized the fuel is drained from said control chamber (56) and the fuel pressure in an injection chamber (19) causes said needle (28) to open said nozzle (9, 11), and when said electromagnet (42) is de-energized the control chamber (56) is closed to cause the fuel pressure inside said control chamber (56) to act on said terminal surface (71) thus holding said needle (28) as to close said nozzle (9, 11).

2.3 Thus subject-matter of claim 8 differs in essence from the subject matter of D3 in that:

in order to adjust the travel of the fuel injector shutter, said plate is formed in different modular classes in terms of height, and a plate in one of said classes is selected for fitment between said control rod and said needle, so that said height of the plate selected corresponds to the required travel of said needle to conform with the required opening of said nozzle,

and in that

the fuel injector comprises a coaxial seat for guiding said plate.

2.4 Starting from D3 as closest prior art, the problem to be solved can be seen in setting the travel of a fuel injector shutter.

2.5 The fact that the fuel injector according to claim 8 comprises a coaxial seat for guiding said plate does not contribute to solve the problem of setting the travel of the shutter.

According to the established case law of the Boards of Appeal, features which do not contribute to the solution of the problem set in the description are not to be considered in assessing the inventive step of a combination of features (see T 37/82, EPO OJ 1984, 71).

2.6 D11 has been filed one month before the date of the oral proceedings. As is apparent from the following discussion hereinafter it is evident that D11 is highly relevant in the sense that it prejudices the maintenance of the patent as amended on the basis of the respondent's main request and first auxiliary request. Moreover, in view of the fact that D11 is

cited as evidence of common knowledge of a skilled person; that reference is made only to two pages of D11 (i.e. pages 50 and 51), that the introduction of these pages would not delay the proceedings and that the Respondent has agreed to having these two pages taken into consideration, the Board, using its discretionary power under Article 114(1) EPC decided to admit document D11 into the proceedings.

2.7 D11 (page 50, Figure 2.19, method (a)) shows that it was common knowledge at the priority date of the patent in suit to adjust a distance so as to compensate for tolerances, by providing a plate in different modular classes in terms of height and by selecting a plate out of a class of plates so that, due to the height of the selected plate, the required distance is obtained.

2.8 The Respondent stated that according to claim 8, the plate was selected so that the travel of the needle conforms to the required opening of the nozzle. In the light of paragraph [0019] of the description of the patent in suit, "required opening" had to be understood as meaning "maximum delivery of the injector" and that therefore, the plate had to be selected in order to obtain a quantitative result, i.e. the required opening in terms of the quantity of fuel to be delivered, whereas D11 did solely relate to selecting parts according to their geometrical dimensions.

2.9 This point of view cannot be shared. On the one hand claim 8 refers to the "travel of the needle" and the "opening of the nozzle", thus to geometrical dimensions not to quantities; on the other hand D11 clearly indicates that the therein disclosed method is not only

suitable for selecting geometric dimensions but also for adjusting physical magnitudes within given functional limits (see D11, page 50, lines 15 to 18).

2.10 Accordingly, the subject-matter of claim 8 does not involve an inventive step and therefore, the main request and the first auxiliary request must fail.

3. *Second auxiliary request - Inventive step of claim 1:*

3.1 D3 is the closest prior art document.

3.2 D3 (figure 1) discloses a fuel injector comprising a shutter, wherein the shutter is in form of a needle (28) travelling axially for opening and closing a nozzle (9, 11); comprising a control rod (8) coaxial with said needle (28) and axially slidable to control the travel of said needle (28) via a substantially cylindrical plate (36); said plate (36) and said control rod (8) being mutually engaged by a first pair of mating surfaces, said plate (36) and said needle (28) being mutually engaged by a second pair of mating surfaces; a hollow body (6) having an axial cavity (7) in which slide said control rod (8) and said plate (36), said axial cavity (7) including a sleeve (54) for precision-fit guiding an end portion (68) of said control rod (8) (implicit, and column 3, lines 52 to 56), and a coaxial seat for guiding said plate (36), said sleeve (54) forming a control chamber (56) defined by a terminal surface (71) of said end portion (61); and an electromagnetic metering valve (41) including an electromagnet (42) controlling an armature (48), so that when said electromagnet (42) is energized the fuel is drained from said control chamber (56) and the fuel

pressure in an injection chamber (19) causes said needle (28) to open said nozzle (9, 11), and when said electromagnet (42) is de-energized the control chamber (56) is closed to cause the fuel pressure inside said control chamber (56) to act on said terminal surface (71) thus holding said needle (28) as to close said nozzle (9, 11).

3.3 Thus the fuel injector according to claim 1 differs from that of D3 in that:

- (a) said seat for guiding said plate is coaxial with respect to the control rod and is machined accurately as to present a very small clearance with respect to the cylindrical surface of said plate;
- (b) one mating surface of each of said pairs is flat and the other mating surface of each of said pairs is convex;
- (c) whereby said plate absorbs any transverse components of the forces exchanged between said control rod and said needle and due to misalignment of said control rod and said needle.

Feature (c) is a functional feature and is a direct consequence of feature (b). Thus, the presence of feature (b) implies the presence of feature (c).

3.4 The problem to be solved by the patent in suit is defined in the description, paragraphs [0003] and [0005] and consists inter alia in reducing or eliminating any transverse force transmitted by the control rod to the needle.

3.5 There is no mention in D3 that the plate is guided.

3.6 From D4 figure 3, it is known in the technical field of fuel injectors to provide a cylindrical plate that transmits axial forces to a needle through mating surfaces, with respectively flat and convex shaped surfaces. Furthermore, it is indicated in D4 column 2, lines 6 to 9 that the plate is guided and tightly fitted in a seat and in column 2, lines 40 to 44 that the needle is received in the bore of the plate so as to present a clearance.

3.7 The Respondent objected that D4 relates to another type of injector and that therefore, a skilled person would not have taken D4 into consideration.

This view cannot be shared since the injector according to D4 relates to the same technical field and since the problem of eliminating any transverse force likewise occurs in this type of injector.

3.8 In D3, the plate (36) and the control rod (8) are mutually engaged by a first pair of mating surfaces, and the plate (36) and the needle (28) are mutually engaged by a second pair of mating surfaces. Accordingly, it would be obvious for a skilled person confronted with the problem of transverse forces transmitted between the control rod (8) and the needle (28) to provide each pair of mating surfaces with a flat shaped surface facing a convex shaped surface as is disclosed in D4.

The Respondent argued that even if applying the teaching of D4 to D3, the plate would still be guided on the smaller diameter portion of the needle and not

with respect to the cylindrical surface of the plate as claimed.

However, applying the teaching of D4 would also imply to have the plate guided in the seat with respect to the cylindrical surface of the plate as disclosed in D4, otherwise transmission of transverse forces would obviously not be avoided.

The Respondent further argued that even if a skilled person would try to apply the teaching of D4 to D3 he would only apply it to the pair of mating surfaces between the plate and the needle, since D4 only discloses one pair of mating surfaces.

However, it is obvious for a skilled person that transverse forces can also be generated between the plate and the control rod. Consequently, he would obviously apply the same solution, i.e. also shape the second pair of mating surfaces between the plate and the control rod in accordance with the teaching of D4.

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

4. *Further auxiliary request:*

At the end of the oral proceedings, when the Board would otherwise have been ready for taking a decision, the Respondent asked the Board to allow the preparation and introduction of a further auxiliary request.

It is well established by the jurisprudence of the Boards of Appeal that the admissibility of amended claims into appeal proceedings, particularly when the amendments are first submitted at oral proceedings, is at the discretion of the Board; see for instance T 153/85, OJ EPO 1988, 1 and T 74/96 of 21 November 2001, not published. Reference is also made to Article 10b(1) of the Rules of Procedure of the Boards of Appeal (RPBA), OJ EPO 2003, 89, according to which any "amendment to the party's case after it has filed its grounds of appeal or reply may be admitted and considered at the Board's discretion", wherein the "discretion shall be exercised in view of inter alia the complexity of the new subject-matter submitted, the current state of the proceedings and the need for procedural economy".

In the present case this further (third) auxiliary request would have been submitted towards the end of the oral proceedings after the second auxiliary request had already been exhaustively discussed. It is also observed that the second auxiliary request was submitted at the last possible moment in the course of the oral proceedings, namely after the main request and the first auxiliary request had been debated at length by the parties. The second auxiliary request was restricted to the device claims 1 to 7 of the main request by deleting method claim 8. Thus, the fate of this second auxiliary request was entirely dependent on whether the subject-matter of claim 1 of the main request was patentable over the cited prior art. The Appellant did not object to the admissibility of the second auxiliary request and although the Respondent entirely ignored the Board's express invitation in its



communication pursuant to Article 11(1) RPBA dated 12 October 2005 to file amended claims at least one month before the date fixed for the oral proceedings, the Board decided to admit the second auxiliary request into the proceedings mainly because its content was the same as that of the main request without claim 8. Thus, the Respondent's second and third auxiliary requests were both late filed during the oral proceedings before the Board.

Article 10a(2) RPBA clearly requires that the reply to the statement of grounds of appeal shall contain the Respondent's complete case, that is in particular all the requests made, which should not be submitted piecemeal in the course of the oral proceedings before the Board.

Accordingly, in view of the fact that the third auxiliary request would have been the second one to be filed during the oral proceedings without any proper justification for such late filing, the Board in exercising its discretion *inter alia* under Article 10b(1) RPBA decided during the oral proceedings to reject the third auxiliary request as inadmissible.

**Order**

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

1. The decision under appeal is set aside.
2. The patent is revoked.

The registrar:

The Chairman:

G. Magouliotis

M. Ceyte