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**Datasheet for the decision  
of 27 September 2023**

**Case Number:** T 2143/21 - 3.2.04

**Application Number:** 13754886.3

**Publication Number:** 2821631

**IPC:** F02M55/00, F16L19/025

**Language of the proceedings:** EN

**Title of invention:**

TERMINAL STRUCTURE OF HIGH-PRESSURE FUEL PIPE FOR DIRECT  
INJECTION ENGINE

**Patent Proprietor:**

Usui Kokusai Sangyo Kaisha Ltd.

**Opponent:**

TI Automotive (Heidelberg) GmbH

**Headword:**

**Relevant legal provisions:**

RPBA 2020 Art. 13(2)

EPC Art. 56

**Keyword:**

Amendment after summons - exceptional circumstances (no)  
Inventive step - (no)

**Decisions cited:**

**Catchword:**



**Beschwerdekammern**  
**Boards of Appeal**  
**Chambres de recours**

Boards of Appeal of the  
European Patent Office  
Richard-Reitzner-Allee 8  
85540 Haar  
GERMANY  
Tel. +49 (0)89 2399-0  
Fax +49 (0)89 2399-4465

Case Number: T 2143/21 - 3.2.04

**D E C I S I O N**  
**of Technical Board of Appeal 3.2.04**  
**of 27 September 2023**

**Appellant:** Usui Kokusai Sangyo Kaisha Ltd.  
(Patent Proprietor) 131-2, Nagasawa  
Shimizu-cho  
Sunto-gun  
Shizuoka 411-8610 (JP)

**Representative:** Ipside  
7-9 Allées Haussmann  
33300 Bordeaux Cedex (FR)

**Appellant:** TI Automotive (Heidelberg) GmbH  
(Opponent) Dischinger Strasse 11  
69123 Heidelberg (DE)

**Representative:** Andrejewski - Honke  
Patent- und Rechtsanwälte Partnerschaft mbB  
An der Reichsbank 8  
45127 Essen (DE)

**Decision under appeal:** **Interlocutory decision of the Opposition  
Division of the European Patent Office posted on  
6 October 2021 concerning maintenance of the  
European Patent No. 2821631 in amended form.**

**Composition of the Board:**

**Chairman** A. de Vries  
**Members:** G. Martin Gonzalez  
C. Heath

## **Summary of Facts and Submissions**

- I. The appeals were filed by the appellant proprietor and the appellant opponent against the interlocutory decision of the opposition division to maintain the patent in amended form.
  
- II. The opposition division held that claim 1 as granted (main request) was not new over D1. It also held inter alia that claim 1 of the auxiliary request (corresponding to granted independent claim 2) involved an inventive step starting from D1 in combination with common general knowledge and maintained the patent accordingly.
  
- III. In preparation for oral proceedings, the Board issued a communication setting out its provisional opinion on the relevant issues.

Oral proceedings were held before the Board in the form of a videoconference on 27 September 2023.

- IV. The appellant proprietor requests cancellation of the decision under appeal and maintenance of the patent according to a new main request filed during the oral proceedings before the Board on 27 September 2023, alternatively dismissal of the opponent's appeal and thus maintenance of the patent in the version upheld (first auxiliary request).

The appellant opponent requests that the decision under appeal be set aside and the patent revoked.

V. Independent claim 1 of the requests relevant to this appeal reads as follows:

(a) Main request - filed during oral proceedings before the Board

Claim 1 as in the granted version with the following amendment (emphasis by the Board to indicate added or ~~deleted~~ text):

"A terminal structure of a high-pressure fuel pipe for a direct injection engine where a connection head (2) is brazed to an end of a fuel pipe (1) composed of a steel pipe or a stainless pipe, the connection head having a spherical or a curved-face pressing seat face (2-1) at a distal end thereof and a fuel pipe insertion portion (2-3) on the opposite side of the pressing seat face, wherein the end of the fuel pipe continued to the fuel pipe insertion portion of the connection head is provided with a one-stage drawn portion (1-1), an outer diameter  $D_1$  of the drawn portion (1-1) relative to a fuel pipe diameter  $D$  satisfying  $0.8D \leq D_1 \leq 0.9D$ , characterized in that the drawn portion has a straight pipe portion (1-1a) satisfying that a length  $L_1$  of the drawn portion (1-1) having the outer diameter  $D_1$  from an end of the fuel pipe insertion portion in an axial direction of the pipe satisfies  $L_1 \geq \underline{0.25D}$ , and in that a linear length  $L_2$  in the axial direction of the pipe from a terminal end, on the opposite side to the connection head, of the length  $L_1$  of the drawn portion having the outer diameter  $D_1$  in the axial direction of the pipe, to a drawing-termination end, is  $0.14D$  or more, and an entire length ( $L_1 + L_2$ ) of the drawn portion is  $1.5D$  or less."

(b) First auxiliary request - as upheld

Corresponds to granted independent claim 2

"A terminal structure of a high-pressure fuel pipe for a direct injection engine where a connection head (12) is brazed to an end of a fuel pipe (11) composed of a steel pipe or a stainless pipe, the connection head having a spherical or a curved-face pressing seat face (12-1) at a distal end thereof and a fuel pipe insertion portion (12-3) on the opposite side of the pressing seat face, wherein the end of the fuel pipe continued to the fuel pipe insertion portion of the connection head has a two-stage drawn portion (11-1, 11-2), an outer diameter  $D_1$  of a first-stage drawn portion located on the side of the connection head, relative to a fuel pipe diameter  $D$ , satisfying  $0.8D \leq D_1 \leq 0.9D$ , characterized in that the first-stage drawn portion has a straight pipe portion (11-1a) satisfying that a length  $L_1$  of the first-stage drawn portion having the outer diameter  $D_1$  from an end of the fuel pipe insertion portion in an axial direction of the pipe satisfies  $L_1 \geq 0.06D$ , in that a second-stage drawn portion continued to the first-stage drawn portion has a straight pipe portion (11-2a) having an outer diameter  $D_2$  larger than the outer diameter  $D_1$  of the first-stage drawn portion, and in that a linear length  $L_2$  in the axial direction of the pipe from a terminal end, on the opposite side to the connection head, of the length  $L_1$  of the first-stage drawn portion having the outer diameter  $D_1$  in the axial direction of the pipe, to a drawing-termination end, is  $0.14D$  or more, and an entire length ( $L_1 + L_2$ ) of the drawn portion is  $1.5D$  or less."

VI. In the present decision, reference is made to the following evidence:

(D1) US 2010/0194096 A1

VII. The appellant proprietor's arguments can be summarised as follows:

The new main request should be admitted. Upheld claim 1 is new and involves an inventive step over the prior art.

VIII. The appellant opponent's arguments can be summarised as follows:

The new main request, submitted during the oral proceedings before the Board, is late filed and not admissible. Upheld claim 1 does not involve an inventive step, starting from D1 in combination with common general knowledge.

### **Reasons for the Decision**

1. The appeals are admissible.
2. Background

The invention is directed at a high pressure fuel feed pipe for a direct injection engine. It more specifically relates to the fuel pipe end structure where a connection head is brazed to an end of the steel pipe, cf. para [0001] of the granted patent. The steel pipe has a reduced diameter portion (drawn portion or drawn stage in the claim language) at its end. The drawn portion is inserted and brazed in the connection head. The invention is aimed at preventing

stress concentration at the pipe's brazing area, cf. paras. [0008]-[0009]. To this end, the steel pipe end structure geometry must be within certain parameters, cf. Figures 1 and 2 of the patent, all defined in relation to the pipe regular diameter  $D$ . Thus, the diameter of the drawn portion  $D_1$  must satisfy  $0.8D \leq D_1 \leq 0.9D$ ; the drawn portion must have a minimum straight (constant diameter) length  $L_1$  outside the connection head of  $L_1 \geq 0.06D$ ; and the axial length  $L_2$  of the tapered (Fig. 1) or double tapered (Fig. 2) portion, has a minimum with  $L_2 \geq 0.14D$ . Finally, the combined length  $L_1+L_2$  has an upper limit of  $L_1+L_2 \leq 1.5D$ . A minimum free straight pipe length  $L_1$  outside the connection head ( $L_1 \geq 0.06D$ ), in combination with pipe diameters satisfying  $0.8D \leq D_1 \leq 0.9D$ , is said to result in the reduction of stress concentration at the brazing area. The double-stage drawn portion of the second embodiment is further said to provide a stress dispersion effect on the fuel pipe and thus to further prevent stress concentration, cf. para [0013].

3. New main request - Admission

This new main request was filed by the appellant proprietor during the oral proceedings before the Board. It is therefore an amendment to the proprietor's case and its admission at the discretion of the Board, Art 13(2) RPBA. According to this rule, the Board should in principle not take such an amendment into account unless there are exceptional circumstances which have been justified with cogent reasons by the party concerned.

Asked by the Chairman during the oral proceedings, the appellant proprietor refrained from giving any reasons for the late filing of this request. The Board also



sees no apparent reason for filing such a request at this late stage of the proceedings. The new request seeks to overcome the finding of lack of novelty by further amending claim 1 that was already part of the contested decision, see sections 12 and 13 finding lack of novelty of claim 1 of the previous amended main request over D1.

In the light of the above, the Board decided not to admit the new main request into the proceedings, Art 13(2) RPBA.

4. First auxiliary request - Inventive step

4.1 The appellant opponent contests the opposition division's positive conclusion of inventive step for claim 1 of this request which is identical to granted claim 2 starting from D1 in combination with common general knowledge, cf. impugned decision section 15. Granted claim 2 differs from granted claim 1, which is deleted from this request, in that it has a two stage drawn portion with L2 now defining the axial length of the two-stage drawn portion, see figure 2, not that of a one-stage drawn portion, see figure 1, as in granted claim 1. Otherwise, all parameters and the claimed ranges are identical.

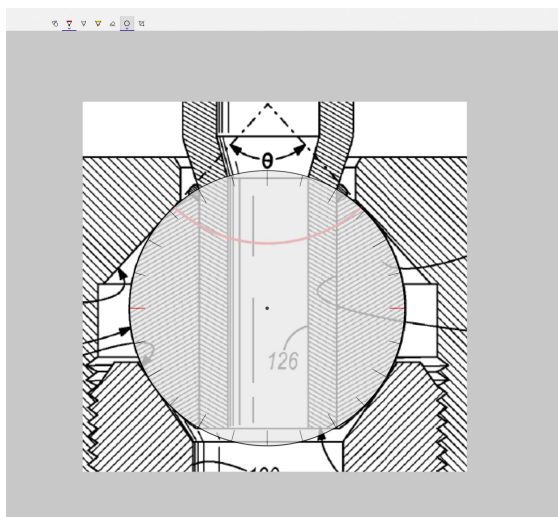
4.2 It is undisputed that Figure 2 of document D1 discloses a terminal structure of a high-pressure fuel pipe with a connection head 132 brazed to an end of a fuel pipe 124A in the sense of the contested claim. The known fuel pipe has a drawn portion (portion inserted in connection head 132) and a main fuel pipe body with larger diameter. In the claim wording the insertion portion diameter is D1 and the main pipe portion diameter or pipe diameter is D.



4.2.4 It is readily apparent when considering the figures of D1 in the context of the whole disclosure that the figures 1-3 of D1 are not mere schematic drawings (defined as "an illustrative figure which gives an outline or general scheme of an object" (OED)). D1 is concerned with details of a high pressure fuel fitting, and how to provide a metal-to-metal seal that allows for a limited amount of axial misalignment. In that context, the shape and relative dimensions of the contact surfaces are central. The figures are intended to illustrate the core concepts of this fitting and may thus be taken to be much more representative than a purely schematic drawing. This is borne out by their level of detail and the fidelity of representation of the shapes of the different elements described so that figures 1-3 can be considered much closer to a technical drawing (defined as "a precise and detailed drawn representation or plan" (OED)). Though exact measurements may not be possible (no scale is shown), it can certainly be used to infer relative dimensions of the different elements.

4.2.5 The Board is also not convinced by the appellant proprietor's arguments that the figures' measurements of D1 contradict the teaching of its description. Figure 2 shows a circle with a substantially constant radius and thus represents a "generally spherical-shaped exterior surface 132 having a single, constant radius", as is described in para [0022] of D1. The manual three point method using a compass to find the centre of circle used by the proprietor is not accurate enough to prove that this is so. Using the Windows 10 Snip & Sketch tool, for example, a more accurate determination of the cross-sectional shape of exterior surface can be made and it is found to be circular as expected for a "generally spherical" surface as stated

in D1, see screen-shot below. The figure in the screen-shot shows a circle fitting practically perfectly the cross-section of the spherical surface in Fig. 2. The Board adds that the Snip & Sketch tool is a standard, well known feature of the Windows operating system, and has been so at least from Windows 10 onwards. Insofar as the appellant proprietor is unfamiliar with the tool, instructions as to its use are freely available on the Internet. Insofar as the appellant proprietor's query at the oral proceedings before the board as to its functioning is meant to question or call into doubt its accuracy, such doubts, leaving aside the fact that they are late, constitute nothing more than unsubstantiated allegation and must fail.



Using the same Snip&Sketch tool the angle  $\theta$  of Figure 2 is found to be  $83^\circ$ . This again does not contradict para [0025] of D1 where it states "[F]or example... can be about 80 degrees" (emphasis added).

4.2.6 Thus, within the minor tolerances inherent in any reproduction, the skilled person can directly infer from the figures of D1 approximate proportions, as those defined in claim 1. Taking the values measured by

the appellant proprietor themselves for Figure 2, cf. grounds of appeal p. 8, and expressing them with the same significance, i.e. the same number of significant figures or decimal places, for the purpose of comparison to the same number of decimal places as in the contested claim, it can be concluded that this figure anticipates the disputed features:

- $D1$  (measured by the appellant proprietor) =  $0.771D$ , expressed with the same significance as in the claim 1, i.e. with one significant figure or one decimal place  $D1 = 0.8D$  corresponding the lower value of the claimed range  $0.8D \leq D1 \leq 0.9D$
- $L1$  (measured by the appellant proprietor) =  $0.057D$ , expressed again with a single significant figure or decimal place  $L1 = 0.06D$ , corresponding again to minimum of the claimed range  $L1 \geq 0.06D$ .

4.2.7 Upheld claim 1 corresponding to granted claim 2 differs from the known structure in that the drawn portion is a *two stage* drawn portion, with the relevant range requirements now referring to  $L2$  as the length of the *two stage* drawn portion. In granted claim 1, now deleted, it referred to  $L2$  as the axial length of the one stage drawn portion. Otherwise, all range requirements are the same as in granted claim 1. If  $L2$  is defined generally as the *axial length of the drawn portion*, whether one or two stage, then, as explained above,  $D1$  is already seen to disclose values within all claimed ranges, none of which are new also for claim 1 of the auxiliary request.

4.3 The appellant proprietor argues that this sole difference of a two-stage drawing rather than one stage drawing produces a dispersion effect of stresses acting on the fuel pipe, cf. paras. 0013, 0025 and 0035 of the patent specification, which would be different from the

effect of one stage drawing. This effect would be apparent from the example 3 of a two-stage specimen described in paragraphs 0033-0035, when compared to the one-stage embodiments of examples 1 and 2 of the preceding paragraphs 0027-0032.

- 4.3.1 However, the Board is unable to see such a special effect in the two stage drawing *per se*. "Dispersion of stress" is another way of stating that stress concentration is avoided or reduced. This effect is described in paragraphs 0013, 0025 and 0034 as an effect that is over and above that resulting from spacing the drawn portion from the brazing by a minimum distance  $L1 \geq 0.06D$ . That feature prevents stress concentration in the drawn portion due to brazing, see paragraph 0013, lines 47 to 49, one of the main problems addressed by the patent, paragraph 0009, but, as explained above, is already disclosed in D1.
- 4.3.2 Thus, the two stage drawing is meant to *further* reduce or avoid stress concentration in the drawing area compared to the one step drawing embodiment. In the Board's understanding, however, further reduction of stress concentration is only possible if the two stage drawing is over a *greater* length compared to single step drawing. If drawing length  $L2$  and start and end diameters  $D$  and  $D1$  are the same, stress distribution will be more gradual and spread out, i.e. *less* concentrated, in single step drawing. In two step drawing, for the same drawing distance  $L2$  stress will be less evenly distributed and more concentrated around the two steps, at least one of which must have a taper angle  $(\theta2, \theta3)$  larger than one step taper  $\theta1$  for the same drawing length, thus resulting, if anything, in *more* localized and thus *greater* stress concentration.

4.3.3 The patent does not state anywhere, let alone in claim 2, that the drawing length L2 is larger than for one step drawing. Claim 2 rather includes the very same constraints and ranges for all parameters, in particular those relating to the length L2 of the drawn portion, as in claim 1. It is also not apparent from the examples that the drawing length would be larger for two step drawing. Though example 3 of paragraph 0033 to 0035, which is meant to illustrate the dispersion effect of two stage drawing, gives values for L2 (6mm), no such values are given for the two single stage examples 1 and 2 discussed in the previous paragraphs. Nor is the dispersive effect quantified in any way, so that no meaningful comparison between the two modes can be made.

Last but not least, the known terminal structure of D1 has parameter values within the claimed ranges, see sections 4.2.1 to 4.2.6 above, and thus in particular has a drawing portion length L2 which is the same as claimed.

4.3.4 The Board adds that it thus does not agree with the decision, section 15.2, where it is generally stated that the two-stage drawing or diameter change involves less material deformation in each step and thus less stress is generated. This is so, if at all, only if the drawing is effected over a larger distance L2.

4.3.5 The Board therefore considers that there is no conclusive evidence for associating any special effect with the two-stage drawing alone over and above that associated with the known one-stage drawing of D1. Absent any other technical effect, the Board therefore considers that the effect of this difference is merely to provide an alternative to a single stage drawing.

- 4.4 The Board has no compelling reason to believe that the skilled person would not be familiar with multi-step tube drawing, as argued by the appellant proprietor. The skilled person in this case is an engineer designing high pressure fuel injectors who must have a good knowledge of metal workpiece forming processes such as for example tube drawing in all its variants. That they must have knowledge in this area is evident already from D1 which, as explained above, indisputably shows drawn tube sections in the figures 1 to 3. When seeking to provide an alternative to the one-stage drawing of D1, the skilled person would draw on their knowledge of drawing and thus consider also multi-stage drawing, for example two-stage drawing, as an obvious alternative to the single stage drawing disclosed in D1.
- 4.5 Consequently, the Board holds that, contrary to the conclusions of the opposition division, the subject-matter of upheld claim 1 does not involve an inventive step, Art 56 EPC.
5. In conclusion, the appellant proprietor's main request is not admitted. The Board finds that the decision was wrong in affirming inventive step for the upheld claim and therefore must be put aside. Consequently, taking into consideration the amendments made by the appellant-proprietor, the patent and the invention to which it relates do not meet the requirements of the Convention and the patent must be revoked pursuant to Article 101(3)(b) EPC.



**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

A. de Vries

Decision electronically authenticated