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D E C I S I O N
of 18 June 2003

Case Number: T 0108/03 - 3.2.6

Application Number: 98106600.4

Publication Number: 0870565

IPC: B23F 21/16

Language of the proceedings: EN

Title of invention:

Gear cutting method, apparatus and coated hob

Applicant:

Mitsubishi Heavy Industries, Ltd.

Opponent:

-

Headword:

-

Relevant legal provisions:

EPC Art. 111(1), 56, 123(2)

Keyword:

"Evidence of knowledge of the skilled person introduced in the proceedings by the Board"

"Inventive step (no)"

"Amendments - broadening of claim (yes)"

Decisions cited:

T 0039/93

Catchword:

-



Case Number: T 0108/03 - 3.2.6

D E C I S I O N
of the Technical Board of Appeal 3.2.6
of 18 June 2003

Appellant:
(Applicant)

Mitsubishi Heavy Industries, Ltd.
5-1, Marunouchi 2-chome
Chiyoda-ku
Tokyo 100-0005 (JP)

Representative:

Kern, Ralf M., Dipl.-Ing.
Hansastraße 16/II.
D-80686 München (DE)

Decision under appeal:

Decision of the Examining Division of the
European Patent Office posted 5 September 2002
refusing European application No. 98106600.4
pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: P. Alting van Geusau
Members: G. Pricolo
R. T. Menapace

Summary of Facts and Submissions

I. European patent application No. 98 106 600.4 published under No. 0 870 565 was refused by the Examining Division by decision dated 5 September 2002.

II. The Examining Division held that the subject-matter of claim 1 as filed did not involve an inventive step having regard to the teaching of the closest prior art disclosed by document

D2: DE-A-195 17 120,

and that of document

D1: VDI Berichte Nr. 1230, 1996, pages 509 to 523,
F. Klocke et al: "Dry Hobbing - Efficient and Ecological".

Furthermore, also the subject-matter of claim 1 of the auxiliary request filed at the oral proceedings held on 9 August 2002 did not involve an inventive step having regard, additionally, to the disclosure of document

D3: US-A-5 105 697.

III. On 30 October 2002 the appellant (applicant) lodged an appeal against this decision. The payment of the prescribed appeal fee was recorded on 31 October 2002. The statement setting out the grounds of appeal was received on 30 December 2002.

IV. In an annex to the summons for oral proceedings pursuant to Article 11(2) Rules of Procedure of the Boards of Appeal the Board expressed its preliminary opinion that the question to be considered in the assessment of inventive step was whether it was obvious to perform the known gear cutting method disclosed by the closest prior D2 in the absence of cutting oil, ie to carry out a dry cutting method.

V. With letter dated 23 May 2003, the appellant filed a claim 1, corresponding to original claim 1, and new claims 1a, 1b, 1b-1, 1c, 22, 22a and 22b. It also filed an expert opinion of Professor Ariura of Kyushu University, dated 22 January 2002.

VI. Oral proceedings took place on 10 April 2003.

The appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of one of the requests filed with the letter dated 23 May 2003, the main request including claim 1 and the auxiliary requests including, respectively, one of the independent claims 1a, 1b, 1b-1, 1c.

During the oral proceedings, the Board of Appeal introduced in the proceedings the following document which was not cited in the search report:

D4: WO-A-96/34720,

as evidence of the knowledge of the skilled person in the relevant technical field. After handing over a copy of the document to the representative of the appellant and drawing her attention to the passage on page 2,

lines 24 to 27, referring to dry hobbing processes using tools made of high speed steel coated with titanium aluminum nitride, and to the passage on page 11, last paragraph, referring to an air nozzle for cleaning fine chips from the workpiece, the chairman asked the representative of the appellant whether time was needed to study the new document and/or to reconsider the requests put forward up to that moment and the chairman expressed concerns under Article 123(2) EPC in respect of claim 1b-1.

In response, the representative stated that no additional time was needed and requested that the case be decided on the basis of the requests and submissions as presented so far in writing.

VII. The independent claims 1, 1a, 1b, 1b-1 and 1c according to the main and first to fourth auxiliary requests read as follows:

"1. A gear cutting method for teeth generation by a hob having a cutting edge portion made of a high-speed tool steel, comprising: coating said hob with at least one layer of film having a composition including $(Ti_{(1-x)}Al_x)$ $(N_yC_{(1-y)})$ where $0.2 \leq x \leq 0.85$ and $0.25 \leq y \leq 1.0$; and generating the teeth by dry cutting at a speed in the range of 80m/min to 400m/min."

"1a. A gear cutting method for teeth generation by a hob having a cutting edge portion made of a high-speed tool steel, comprising: coating said hob with at least one layer of film with a thickness of 0.5 μ m to 10 μ m having a composition including $(Ti_{(1-x)}Al_x)$ $(N_yC_{(1-y)})$ where $0.2 \leq x \leq 0.85$ and $0.25 \leq y \leq 1.0$; and generating the

teeth by dry cutting at a speed in the range of 80m/min to 400m/min."

"1b. A gear cutting method for teeth generation by a hob having a cutting edge portion made of a high-speed tool steel, comprising: coating said hob with at least one layer of film having a composition including $(Ti_{(1-x)}Al_x) (NyC_{(1-y)})$ where, $0.2 \leq x \leq 0.85$ and $0.25 \leq y \leq 1.0$; and generating the teeth by dry cutting at a speed in the range of 80m/min to 400m/min and blowing air against a cutting portion during said generating step."

"1b-1. The gear cutting method of claim 1b, wherein the blown air includes mist".

"1c. A gear cutting method for teeth generation by a hob having a cutting edge portion made of a high-speed tool steel, comprising: coating said hob with at least one layer of film with a thickness of 0.5 μ m to 10 μ m having a composition including $(Ti_{(1-x)}Al_x) (NyC_{(1-y)})$ where $0.2 \leq x \leq 0.85$ and $0.25 \leq y \leq 1.0$; and generating the teeth by dry cutting at a speed in the range of 80m/min to 400m/min and blowing air against a cutting portion during said generating step."

VIII. In essence, the Appellant's arguments in support of the requests, as set out in the written submissions, are as follows:

D2 disclosed a gear cutting method utilizing a hob made of high-speed tool steel coated with a layer of film, wherein the composition of the layer and the cutting speed fell within the respective ranges referred to in claim 1. However, D2 did not mention dry cutting. In

fact, when using hobs made of high-speed steel "common sense" consisted in performing wet cutting. D1 disclosed a dry cutting method, but only in connection with hobs made of cemented carbide. By proposing to perform dry cutting with a high-speed steel hob, the claimed invention went in a direction different from that which was "common sense" before the relevant date of the patent application. Accordingly, the subject-matter of claim 1 involved an inventive step.

As regards D3, it disclosed to blow air onto the workpiece after cutting rather than during cutting as in the patent application.

Furthermore, the claimed invention had been a commercial success and even obtained an award.

IX. During the oral proceedings the appellant did not submit further arguments but only noted that what was meant in claim 1b-1 with the term "mist" was a mixture of air and water.

Reasons for the Decision

1. The appeal is admissible.
2. *Main request*
 - 2.1 Novelty

None of the available prior art documents discloses a gear cutting method comprising all the features quoted

in the claim 1. Thus, in the Board's view, the subject-matter of this claim is novel.

2.2 Inventive step

2.2.1 The appellant essentially based its argument in support of inventive step on the "common sense" of the skilled person, according to which only a wet cutting process would be taken into consideration when using a hob having a cutting edge portion made of a high-speed tool steel coated with at least one layer of film of a titanium aluminium nitride.

Pursuant to Article 111(1), the Board of Appeal may exercise any power within the competence of the department which was responsible for the decision appealed. From this it follows, in combination with the provision of Article 114(1) EPC according to which the European Patent Office is not restricted to the facts, evidence and arguments provided by the parties, that the Board, as the Examining Division, may consider conducting its own investigations in the relevant technical field in order to gain a better overview of the relevant technology, ie the gear hobbing technology in the present case. It is in the course of such investigations that the Board has come across the PCT publication represented by document D4 (published on 7 November 1996, and therefore state of the art according to Article 52(4) EPC), of which corresponding US patent publication (No. US-A-5 586 848) is one of the references cited in the US patent No. US-A-6 116 828, granted in respect of the corresponding US patent application filed in respect of the same

invention referred to in claim 1 of the present patent application.

The relevance of document D4 is immediately apparent from the text in the section "Background of the Invention" on page 2, lines 24 to 27, which refers to dry hobbing processes using tools made of high speed steel coated with titanium aluminum nitride. According to this discussion of prior art, high speed steel coated with titanium aluminum nitride has demonstrated some success at withstanding dry hobbing process conditions. This statement clearly refutes the appellant's statement in respect of "common sense". Since the evidence of the knowledge of the skilled person disclosed in D4 is highly relevant to the present appeal proceedings, the Board introduces D4 into the proceedings.

2.2.2 In the description of the present patent application it is stated that the technical problem underlying the invention is to provide a gear cutting method capable of greatly improving the cutting speed without using a tool of cemented carbide (see column 2, lines 28 to 32 of the published patent application).

2.2.3 Using the wording of claim 1, D2 discloses (see example 3, pages 9 and 10) a gear cutting method for teeth generation by a hob having a cutting edge portion made of a high-speed tool steel (page 9, line 58), comprising: coating said hob with a layer of film having a composition including $(Al_{0.6}Ti_{0.4})N$ (see table 3 on page 10, example No. 3; the composition is in the claimed range $(Ti_{(1-x)}Al_x)(N_yC_{(1-y)})$ where $0.2 \leq x \leq 0.85$ and $0.25 \leq y \leq 1.0$ because it corresponds to a selection of x

and γ to be, respectively 0.6 and 1); and generating the teeth by cutting at a speed of 100 m/min (page 10, line 27; the value of 100 m/min falls within the claimed range of 80 m/min to 400 m/min).

In the cited passage of D2 (example 3) there is no mention of whether wet or dry cutting is carried out.

A dry cutting method is actually disclosed by D2, (see example 2, pages 8 and 9; see line 11 of page 9), but only in connection with a coated twin-blade endmill made of carbide.

Therefore, the subject-matter of claim 1 is distinguished from the gear cutting method of D2 in that dry cutting is performed.

2.2.4 The method of D2 already solves the problem of providing a high cutting speed (100 m/min as disclosed by D3 is indeed a high speed since it is in the range of 80 to 400 m/min which is aimed at by the present invention) without using a tool of cemented carbide (since it uses a tool of high-speed steel). Thus, since it already solves the above mentioned technical problem, D2 represents a closer state of the art than that mentioned in the patent application. As a consequence, it is necessary to establish what objective technical problem is solved by the claimed method (see eg T 39/93, OJ 1997, 134), having regard to the prior art disclosed by D2.

2.2.5 As already stated above, in example 3 of D2 there is no mention of whether the gear cutting method is carried out as a wet (lubricated) or as a dry process. However,

in the broad technical field of metal machining which is addressed by D2 (see in particular page 1, first paragraph), and in particular also in the specific case of gear hobbing referred to in example 3, both possibilities are known and used, depending on further circumstances (for example the material to be cut). Thus, the teaching of claim 1 can be seen in the indication of a necessary machining parameter for the specific case of example 3 of D2. Consequently, the technical problem solved by the method of claim 1 can be seen in the provision of a necessary machining parameter for carrying out the method of example 3 of D2.

- 2.2.6 The skilled person knows, because this forms part of his common general knowledge in the art, that in the conventional metal wet cutting process the liquid (eg cutting oil) provides a cooling and lubricant action which is absent in the dry cutting process, whereby in the latter process higher tool wear and higher cutting temperatures are normally expected which impose restrictions to its use. However, the fact that a cooling lubricant is not needed is an evident advantage of the dry cutting process, in particular in terms of costs and environmental requirements (see eg D1, page 509, first paragraph). Thus, in the absence of any specific directions given by D2 in this respect, the skilled person seeking to put into practice the method of example 3 would obviously consider whether the two known possibilities, dry or wet hobbing, are suitable so that, depending on circumstances, the machining parameter can be selected in the most appropriate manner. Accordingly, the skilled person would carry out investigations aimed at establishing what possibilities

are available, and would find that for hobs having a cutting edge portion made of a high-speed tool steel coated with titanium aluminium nitride a dry cutting process is indeed one possibility, as disclosed by D4 on page 2 lines 24 to 27, which passage is in the portion of D4 dealing with the general technical background relating to hobbing processes.

It is true that document D1, for instance, discloses that when using gear hobbing tools made of coated high-speed steel cooling lubricants are obligatory (page 509, first paragraph after "Introduction"). However, D1 does not specify the coating used (which is therefore not necessarily a titanium aluminium nitride, but could equally well be a titanium nitride or carbide - see D2, page 2, lines 9 to 12), and thus cannot constitute an indication for the skilled person that what is said in D4 should or could not be applied in practice.

2.2.7 Therefore, the skilled person would regard the selection of dry cutting in the method of example 3 of D2 as one possibility directly suggested by the prior art, as exemplified by D4, in addition to the other obvious possibility of selecting wet cutting. Thus, the skilled person would select one or the other alternative depending on circumstances, without the exercise of an inventive activity, but rather in the normal process of determining the optimum machining parameters for a given hobbing method to be carried out under given conditions.

Accordingly, the subject-matter of claim 1 does not involve an inventive step. Thus, the patent application does not meet the requirements of Articles 52(1) and 56 EPC.

3. *First auxiliary request*

3.1 Claim 1a includes all the features of claim 1 and additionally the feature of dependent claim 5 of the patent application as filed that the layer of film has a thickness of 0.5 μm to 10 μm . Therefore, the claim as amended does not give rise to objections under Article 123(2) EPC.

3.2 However, the added feature does not provide a further distinction over the method of D2. This document discloses that the layer of the coating should have a thickness which, most preferably, falls within the range of 2 to 8 μm (see page 5, lines 35 to 39). As a consequence, it is clear that the thickness of the coating of the hob used in the method of example 3 of D2 should preferably fall within this range of 2 to 8 μm , and thus, within the range referred to in claim 1a of the present patent application.

Therefore, since no further distinguishing features are contained in claim 1a of the first auxiliary request compared with claim 1 of the main request, the subject-matter of claim 1a lacks inventive step for the same reasons given above in respect of claim 1.

4. *Second auxiliary request*

4.1 Claim 1b includes all the features of claim 1 and additionally the feature of dependent claim 8 of the patent application as filed that air is blown against a cutting portion during the generating step. Therefore, the claim as amended does not give rise to objections under Article 123(2) EPC.

4.2 However, the subject-matter of claim 1b does not involve an inventive step.

D2 does not disclose to blow air against a cutting portion and therefore the subject-matter of claim 1b is distinguished from the gear cutting method of D2 in that

(i) dry cutting is performed;

(ii) air is blown against a cutting portion during the generating step.

The technical effect achieved by means of distinguishing feature (ii) is to blow off and remove chips resulting from the cutting operation (see column 9, lines 25 to 29, of the patent application as published). Thus, the technical problem solved by means of the distinguishing features can be seen in the provision of a necessary machining parameter for carrying out the method of example 3 of D2 and in ensuring that no chips are included in the cutting portion.

As soon as the skilled person has made the obvious choice of selecting a dry cutting process (see above section 2), the problem of avoiding that any chips remain in the working area naturally arises. However, as pointed out by the Examining Division (see point 3 of the decision under appeal), blowing air against a cutting portion to remove chips is common practice. Such practice is moreover illustrated by document D4 (see page 11, last paragraph). Thus, the skilled person seeking a solution to the further problem of ensuring that no chips are included in the cutting portion would obviously consider the possibility of blowing air against a cutting portion during the generating step, thereby arriving at the subject-matter of claim 1b without the exercise of an inventive activity.

5. *Third auxiliary request*

Claim 1b-1, although formulated as a claim dependent from claim 1b, is to be regarded as an independent claim including all the features of claim 1b and, additionally, the feature that the blown air includes mist.

In the patent application as filed there are disclosed only two possibilities: either air is blown (see eg claim 8) or a mixture of cutting oil into air is blown as mist against the cutting portion (see column 9, lines 29 to 31 of the patent application as published). However, the use of the term "mist" in claim 1b-1 without any reference to the presence of a cutting oil leaves open more possibilities than the two above-mentioned, and in particular implies the possibility - expressly indicated by the appellant to be the one

intended - that the mist consists of water particles dispersed in air, for which there is absolutely no disclosure in the patent application as filed.

It follows that claim 1b-1 contains subject-matter which extends beyond the content of the patent application as filed, contrary to the requirements of Article 123(2) EPC.

6. *Fourth auxiliary request.*

6.1 Claim 1c includes all the features of claim 1 and additionally the features of dependent claims 5 and 8 of the patent application as filed that the layer of film has a thickness of 0.5 m to 10 m and that air is blown against a cutting portion during the generating step. Therefore, the claim as amended does not give rise to objections under Article 123(2) EPC.

6.2 The feature that the layer of film has a thickness of 0.5 μm to 10 μm does not provide a further distinction over the method of D2 (see above section 3). Thus, the subject-matter of claim 1c is distinguished from the method of D2 by the same features (i) and (ii) distinguishing the subject-matter of claim 1b (second auxiliary request, see above section 4) therefrom. Thus the subject-matter of claim 1c lacks an inventive step for the same reasons already given above in respect of claim 1b.

7. Therefore, none of the appellant's requests can be allowed.

8. *Procedural considerations.*

The Board is aware of the fact that evidence of the knowledge of the skilled person in the form of the prior art document D4 was cited for the first time during the oral proceedings. In view of this circumstance, the chairman requested the representative of the appellant whether time was needed or whether an interruption of the oral proceedings was appropriate to study the new document and/or to reconsider the requests made.

However, the representative of the appellant clearly stated that no further time was needed and then requested a decision on the basis of the current state of the file. On this basis, there was no reason for the Board to further delay the proceedings and to refrain from giving a decision at the oral proceedings after deliberation.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:

M. Patin

P. Alting van Geusau

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Case Number: T 0108/03 - 3.2.6

D E C I S I O N
of the Technical Board of Appeal 3.2.6
of 30 September 2003 correcting the Decision of 18 June 2003

Appellant: Mitsubishi Heavy Industries, Ltd.
(Applicant) 5-1, Marunouchi 2-chome
Chiyoda-ku
Tokyo 100-0005 (JP)

Representative: Kern, Ralf M., Dipl.-Ing.
Hansastraße 16/II.
D-80686 München (DE)

Decision under appeal: Decision of the Examining Division of the
European Patent Office posted 5 September 2002
refusing European application No. 98 106 600.4
pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: P. Alting van Geusau
Members: G. Pricolo
R. T. Menapace

