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D E C I S I O N
of 26 September 2002

Case Number: T 0991/99- 3.2.6

Application Number: 88120817.7

Publication Number: 0320881

IPC: B23B 51/02

Language of the proceedings: EN

Title of invention:
Twist drill

Patentee:
MITSUBISHI MATERIALS CORPORATION

Opponent:
Gühring oHG

Headword:
-

Relevant legal provisions:
EPC Art. 100(c), 123(2), 83, 56

Keyword:
"Opposition grounds - extension of subject-matter"
"Disclosure - enabling"
"Inventive step - (yes) after amendment"

Decisions cited:
T 0288/92, G 0002/95, T 0823/96, T 0206/83, T 0564/89,
T 0479/00

Catchword:
-



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Chambres de recours

Case Number: T 0991/99 - 3.2.6

D E C I S I O N
of the Technical Board of Appeal 3.2.6
of 26 September 2002

Appellant:
(Opponent)

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Decision under appeal:

Decision of the Opposition Division of the
European Patent Office posted 10 August 1999
rejecting the opposition filed against European
patent No. 0 320 881 pursuant to Article 102(2)
EPC.

Composition of the Board:

Chairman: P. Alting van Geusau
Members: G. Pricolo
M. J. Vogel

Summary of Facts and Submissions

- I. The appeal is from the decision of the Opposition Division posted on 10 August 1999 to reject the opposition against European patent No. 0 320 881 granted in respect of European patent application No. 88 120 817.7.
- II. The Opposition Division held that claim 1 as granted was based on the combination of features of independent claim 1 and dependent claims 2, 6, 8, 13, 14 and 15 of the application as filed, that the European patent disclosed the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art, that the subject-matter of claim 1 was novel, and that it also involved an inventive step when starting from the closest prior art disclosed by document:

D1: EP-A-127 009,

and having regard to the prior art on file, including a number of alleged prior uses cited by the opponent.

- III. The appellant (opponent) lodged an appeal, received at the EPO on 20 October 1999, against this decision. The appeal fee was paid simultaneously with the filing of the appeal. The statement setting out the grounds of appeal was received at the EPO on 20 December 1999.
- 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 informed the parties that, when having regard to the objections raised in respect of Article 123(2) EPC, it had to be discussed whether the specific combination of features of granted claim 1 was originally disclosed in such combination or whether

it concerned an intermediate generalisation which lacked sufficient support. Furthermore, the Board expressed its preliminary opinion that the invention appeared to be sufficiently disclosed, that none of the available pieces of prior art disclosed the subject-matter of claim 1, so that further discussion would concentrate on the question whether the claimed subject-matter involved an inventive step.

V. Oral proceedings took place on 26 September 2002.

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

The respondent (patentee) requested that the appeal be dismissed and the patent be maintained as granted, or that the patent be maintained in amended form on the basis of the fourth, fifth or sixth auxiliary request filed during oral proceedings.

In addition to D1, the following documents from the opposition proceedings played a role in the oral proceedings:

D10: "Technische Rundschau - Bohreranschliffe," K. Häuser, Bern, Nr. 40, 2 October 1979, pages 41-60;

D14: Article: "Perçage en CNC: nécessité d'une pointe de foret correcte" from "Mach'Pro", Nr. 37, 18 November 1983.

VI. Granted claim 1 reads as follows:

"1. Twist drill comprising a cylindrical body (10) having an axis (O) of rotation therethrough, having a forward end which contacts a workpiece and having a web thickness (T) of 0.2D to 0.35D, wherein D is a diameter of said body (10); said body (10) having a spiral flute

(11) formed in an outer peripheral surface thereof so as to extend spirally along a length thereof to said forward end; a land (10a) disposed adjacent to said flute (11), said flute (11) having a first wall facing in the direction of rotation of said body (10) and a second wall extending from an inner end of said first wall to the outer periphery of said body (10), said first wall terminating at said forward end in a first cutting lip (12) having a radially outermost end (Q) disposed on the outer periphery of said body (10), said second wall being concavely shaped when viewed from said forward end; the wall of said flute (11) having an arcuately shaped portion which contacts an imaginary cylinder inscribing a web portion of the drill; characterized in that:

(a) assuming a first line (L) extending from said radially outermost end (Q) perpendicular to a second line (N) which connects said radially outermost end (Q) and said axis (O) of said body (10), said second wall is formed so that the maximum distance (W) between said first line (L) and said second wall is set to range between 0.45D and 0.65D;

(b) said arcuately shaped portion has a radius of curvature (R) of between 0.15D to 0.2D;

(c) the drill has a ground surface (15) creating a second cutting lip (13a) extending away from said axis (O) of rotation of said body (10) with a rake surface (16) along said second cutting lip (13a); a valley line (17) between said ground surface (15) and said rake surface (16) along said second cutting lip (13a); and in which an angle (ϕ) defined by said axis (O) of rotation of said body (10) and said valley line (17) is set between 30° and 40°; and

(d) that the axial distance (l) between the radially outermost end (Q) of said first cutting lip and a forward end (H) of a heel (11b) is set between 0.3D and 1.0D".

Claim 1 of the fourth auxiliary request reads as follows:

"1. Twist drill comprising a cylindrical body (10) made of a material selected from the group consisting of cemented carbide and cermet, the body (10) having: an axis (O) of rotation therethrough and a forward end which contacts a workpiece; a spiral flute (11) formed in an outer peripheral surface thereof so as to extend spirally along a length thereof to said forward end, and said body (10) having a web thickness (T) of $0.2D$ to $0.35D$, wherein D is a diameter of said body (10); said body (10) further having a land (10a) disposed adjacent to said flute (11), said flute (11) having a first wall facing in the direction of rotation of said body (10) and a second wall extending from an inner end of said first wall to the outer periphery of said body (10), said first wall terminating at said forward end in a first cutting lip (12) having a radially outermost end (Q) disposed on the outer periphery of said body (10), said second wall being concavely shaped when viewed from said forward end, and said first cutting lip (12) having a radial rake angle (δ) of -10° to -20° at said outermost end (Q); the drill having a ground surface (15) creating a second cutting lip (13a) extending away from said axis (O) of rotation of said body (10), each of said first (12) and second (13a) cutting lips being formed to be linear as viewed from said forward end; the wall of said flute (11) having an arcuately shaped portion which contacts an imaginary cylinder inscribing a web portion of the drill, the ratio of arc length (A1) of said flute (11) to arc length (B1) of said land (10a) at a cross section taken perpendicular to the axis (O) of said body (10) being 0.9 to 1.2; a point P being defined by the intersection of a line tangential to said first cutting lip (12) with a line tangential to said second cutting lip (13a), the ratio of a distance (L1) between said axis

(O) of said body (10) and said point P to a distance (L2) between said outermost end (Q) of said first cutting lip (12) and said point P being set to range between 0.4:1 and 0.7:1; the axial rake angle (θ) for said second cutting lip (13a) being set to be between 0° and -5° ; in which twist drill: assuming a first line (L) extending from said radially outermost end (Q) perpendicular to a second line (N) which connects said radially outermost end (Q) and said axis (O) of said body (10), said second wall is formed so that the maximum distance (W) between said first line (L) and said second wall is set to range between $0.45D$ and $0.65D$; said arcuately shaped portion has a radius of curvature (R) of between $0.15D$ to $0.2D$; a rake surface (16) is formed along said second cutting lip (13a), and a valley line (17) between said ground surface (15) and said rake surface (16) along said second cutting lip (13a); and in which an angle (ϕ) defined by said axis (O) of rotation of said body (10) and said valley line (17) is set between 30° and 40° ; and the axial distance (l) between the radially outermost end (Q) of said first cutting lip and a forward end (H) of a heel (11b) is set between $0.3D$ and $1.0D$ ".

Claim 1 of the fifth auxiliary request reads as follows:

"1. Twist drill comprising a cylindrical body (10) made of a material selected from the group consisting of cemented carbide and cermet, the body (10) having: an axis (O) of rotation therethrough and a forward end which contacts a workpiece; a spiral flute (11) formed in an outer peripheral surface thereof so as to extend spirally along a length thereof to said forward end, and said body (10) having a web thickness (T) of $0.2D$ to $0.35D$, wherein D is a diameter of said body (10); said body (10) further having a land (10a) disposed adjacent to said flute (11), said flute (11) having a

first wall facing in the direction of rotation of said body (10) and a second wall extending from an inner end of said first wall to the outer periphery of said body (10), said first wall terminating at said forward end in a first cutting lip (12) having a radially outermost end (Q) disposed on the outer periphery of said body (10), said second wall being concavely shaped when viewed from said forward end, and said first cutting lip (12) having a radial rake angle (δ) of -10° to -20° at said outermost end (Q); the drill having a ground surface (15) creating a second cutting lip (13a) extending away from said axis (O) of rotation of said body (10), each of said first (12) and second (13a) cutting lips being formed to be linear as viewed from said forward end; the wall of said flute (11) having an arcuately shaped portion which contacts an imaginary cylinder inscribing a web portion of the drill, the ratio of arc length (A1) of said flute (11) to arc length (B1) of said land (10a) at a cross section taken perpendicular to the axis (O) of said body (10) being 0.9 to 1.2; a point P being defined by the intersection of a line tangential to said first cutting lip (12) with a line tangential to said second cutting lip (13a), the ratio of a distance (L1) between said axis (O) of said body (10) and said point P to a distance (L2) between said outermost end (Q) of said first cutting lip (12) and said point P being set to range between 0.4:1 and 0.7:1; the axial rake angle (θ) for said second cutting lip (13a) being set to be between 0° and -5° ; said forward end including a first planar relief surface (18) provided with a relief angle (β_1) of 7° to 15° and extending along said first cutting lip (12), and a second planar relief surface (19) provided with a relief angle (β_1) greater than that of said first relief surface (18) so as to range from 15° to 25° and extending along said first relief surface (18), the intersection of said first relief surface (18) with said second relief surface (19) being parallel to said

first cutting lip (12) and intersecting said axis (O) of said body (10); the angle (λ) defined between the ground surface (15) creating the second cutting lip (13a) and a rake surface (16) along said second cutting lip (13a) being 95° to 115° ; in which twist drill: assuming a first line (L) extending from said radially outermost end (Q) perpendicular to a second line (N) which connects said radially outermost end (Q) and said axis (O) of said body (10), said second wall is formed so that the maximum distance (W) between said first line (L) and said second wall is set to range between $0.45D$ and $0.65D$; said arcuately shaped portion has a radius of curvature (R) of between $0.15D$ to $0.2D$; a valley line (17) is formed between said ground surface (15) and said rake surface (16) along said second cutting lip (13a); and in which an angle (ϕ) defined by said axis (O) of rotation of said body (10) and said valley line (17) is set between 30° and 40° ; and the axial distance (l) between the radially outermost end (Q) of said first cutting lip and a forward end (H) of a heel (11b) is set between $0.3D$ and $1.0D$ ".

VII. In support of its requests the appellant relied essentially on the following submissions:

The features of granted claim 1 were not disclosed in combination in any of the embodiment described but were taken from two different embodiments. Furthermore, although claim 1 as granted included all the features of independent claim 1 and features taken from dependent claims 2, 6, 8, 14 and 15 of the application as filed, the latter features were disclosed, both in the description and in the claims of the application as filed, only in combination with other functionally interrelated features which were not present in claim 1 as granted. No basis could be found in the application or was otherwise apparent to the skilled person for selecting the features of the application in the manner

as now claimed. This applied also to claim 1 of the fourth auxiliary request, and it was only in claim 1 of the fifth auxiliary request that the complete combination of features disclosed in the application as filed was defined for the first time. Therefore, the subject-matter of the European patent as granted and also of claim 1 as amended according to the fourth auxiliary request extended beyond the content of the application as filed.

According to the disclosure of the patent in suit the technical problem to be solved consisted in improving chip formation and discharge during cutting, so as to obtain a series of advantages, in particular a reduction of the thrust load. However, an essential parameter determining the manner in which chip formation and discharge took place was the helix angle of the drill, which was not defined in claim 1. Thus, the mere selection of a drill geometry in accordance with claim 1 was not itself sufficient to achieve an improvement in chip formation and discharge; for this objective to be achieved it was also necessary to select a specific helix angle. Since no mention of the helix angle was made in the whole patent, the invention was not disclosed in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art.

Since there was no mention of the helix angle, the claimed combination of features was not complete to solve the technical problem as stated in the patent in suit. As a consequence, the subject-matter of claim 1 could not be seen as a combination of features being in functional inter-relationship but merely as an agglomeration of features, each being independent from the other. Therefore, starting from the twist drill known from D1, the objective technical problem could only be seen in providing an alternative twist drill.

In order to solve this problem, the skilled person would consider each feature of claim 1 independently from the others, and select appropriate values for the parameters referred to in claim 1 so as to correspond to known values. In respect of claim 1 of the fifth auxiliary request such known values were all disclosed in either D1, D10 or D14, with the exception of the range of $0.15D$ to $0.2D$ for the radius of curvature R of the arcuately shaped portion of the wall of the flute. However, although the prior art was silent about any measurements thereof, a radius of curvature falling within the claimed range was the inevitable consequence of the provision of a flute having a smooth shape. Therefore, the skilled person would arrive at the subject-matter of claim 1 of the fifth auxiliary request without exercising an inventive activity.

VIII. The respondent essentially argued as follows.

In the application as filed, the ranges for the web thickness of $0.2D$ to $0.35D$ and of $0.15D$ to $0.3D$ were explicitly disclosed in combination with a material of the body being, respectively, cemented carbide or cermet and high speed steel or sintered metal high speed steel. However, the skilled person knew that twist drills formed of cemented carbide or cermet necessitated a greater web thickness than those made of high speed steel, because the first material was harder and therefore more prone to breakage than the second material. Hence, the skilled person reading the application as filed would have considered that if the lower value of $0.2D$ applied for a twist drill made of cemented carbide or cermet, it certainly also applied to a twist drill made of high speed steel. Furthermore, the skilled person knew that the upper limit of the range for the web thickness corresponded to the geometrical requirement that sufficient space had to be available in the flute for properly discharging chips,

which requirement was independent from the material of the twist drill. The skilled person would therefore recognize that if the upper limit applied for drills made of cemented carbide or cermet it would apply equally to drills made of high speed steel. Therefore, by defining in claim 1 as granted a range of $0.2D$ to $0.35D$ for the web thickness independently from the material of the twist drill, no subject-matter extending beyond the content of the application as filed was introduced.

The fact that only some of the features of each claim 6, 7 and 8, respectively, were included in granted claim 1 did not constitute an unallowable extension because there was no functional or structural relationship between the features taken from these claims and those left out.

The features of original claims 14 and 15 were integrally included in granted claim 1. Original claims 14 and 15 were dependent from the combination of original claims 13, 12, 11, 10, 9 and 8. The fact that the features of claims 9 to 13 were not included in granted claim 1 did not constitute an unallowable extension because there was no functional or structural relationship between the features of each dependent claims 9 to 13 and the other features of claims 14 and 15. In particular, the angle ϕ referred to in original claim 14 was acknowledged to be advantageous for reducing the thrust load on the twist drill, and the axial distance l referred to in original claim 15 for ensuring the passage of lubricating fluid towards the cutting part. The selection of the angle λ according to claim 13 did not contribute to either a reduction of the thrust load, nor to the provision of a fluid passage, but in assisting in the chip removal. Original claim 11 claimed a selection of particular relief angles which was acknowledged in the description to be

advantageous for an HSS drill only. Since the invention was not limited to this particular material, it was clear that this selection was not an essential one.

Therefore claim 1 as granted, and consequently also claim 1 of the auxiliary requests, did not contain subject-matter extending beyond the content of the application as filed.

Furthermore, the interpretation of Article 123(2) EPC by the Boards of Appeal evolved during the several years since the filing of the application in 1988, and it would not be fair to apply actual criteria stricter than those of the past.

As regards the question of sufficiency of disclosure, the fact that claim 1 did not mention the helix angle did not imply that the invention could not be carried out. As a matter of fact, the skilled person was generally aware of what helix angles to use and indeed helix angles were usually not mentioned when describing the tool geometry, as shown for instance by the German norm DIN 1414 relating to twist drill geometries.

Furthermore, the absence of the helix angle did not imply that the technical problem underlying the patent in suit was not solved. Indeed, the skilled person would select the helix angle in relation to the material to be cut. Moreover, a modification of the helix angle only had an influence on the rake angle of the primary cutting lip, not on the other parameters referred to in claim 1. Since the combination of features of claim 1 provided a synergetic effect and moreover one of these features, namely that concerned with the radius of curvature of the arcuately shaped portion of the wall of the flute, was not shown in any of the cited documents, the subject-matter of claim 1 request was not obvious.

Reasons for the Decision

1. The appeal is admissible.
2. *Main request - Article 100(c) EPC*
 - 2.1 In assessing whether the subject-matter of the European patent extends beyond the content of the application as filed (Article 100(c), Article 123(2) EPC), the decisive question is whether it can be directly and unambiguously deduced from the application as filed (see T 288/92, point 3.1), on the basis of the overall disclosure of the whole specification (G 2/95, OJ 1996, 555, point 4).

Claim 1 as granted defines a twist drill having a web thickness within the range of $0.2D$ to $0.35D$, wherein D is a diameter of the twist drill's cylindrical body.

In the application as filed, the range of web thickness of $0.2D$ to $0.35D$ is disclosed exclusively in combination with the feature that the material of the body is either cemented carbide or cermet. Reference is made to claim 2, and to the passages on page 25, first paragraph and page 34, lines 17 to 20 of the application as filed.

If the body is made of a material selected from the group consisting of high speed steel and sintered metal high speed steel, then the application as filed exclusively discloses that the web thickness is to be selected in the range of 0.15 to $0.3D$. Reference is made to claim 3 and to the passages on page 7, lines 2, 3, 17 to 19 and page 20, lines 2 to 5 of the application as filed.

Therefore, it cannot be deduced directly and unambiguously from the application as filed that the range of web thickness of 0.2D to 0.35D applies to twist drills made of any materials. In particular, a twist drill made of high speed steel or sintered metal high speed steel and having a web thickness of eg 0.35 D is clearly and explicitly encompassed by the subject-matter of claim 1 as granted, although such a twist drill is not disclosed in the application as filed.

2.2 The respondent did not dispute that the application as filed exclusively discloses the range of web thickness of 0.2D to 0.35D in combination with the feature that the material of the body is either cemented carbide or cermet. However, he submitted that the skilled person, on the basis of the disclosure of the application as filed and of common general knowledge, would recognize that if the lower value of 0.2D applies for a twist drill made of cemented carbide or cermet, it certainly also applies to a twist drill made of high speed steel, and that if the upper limit of 0.35D applies for drills made of cemented carbide or cermet it equally applies to drills made of high speed steel.

In the Board's view, the respondent's submission is rather concerned with what is rendered obvious by the disclosure in the light of common general knowledge, than with the disclosure of the application as filed. It is to be noted that there is no basis in the application as filed for a twist drill made of high speed steel with a web thickness of 0.35D, for instance. Therefore a drill having these features is not obtained as the clear and unambiguous consequence of what is mentioned in the application as filed (see T 823/96, point 4.5).

2.3 Since for this reasons the subject-matter of the European patent extends beyond the content of the application as filed, the respondent's main request has to be rejected.

3. *Fourth auxiliary request - Article 123(2) EPC*

3.1 Claim 1 as amended includes all the features of claims 1, 2, 6, 8 to 10, 12, 14, 15 of the application as filed. Original claims 14 and 15 are dependent from original claims 8 to 13, each of claims 9 to 13 referring back to the preceding claim, and claim 8 refers back to claim 6. Thus, the combination of features as disclosed in the application as filed is that corresponding to the combination of original claims 1, 2, 6 and 8 to 15. In the Board's view, the omission of the features of original claims 13 and 11 in granted claim 1 constitutes an infringement of Article 123(2) EPC, because there is no basis in the application as filed to conclude that the particular selection of the range of 30° and 40° for the angle ϕ referred to in original claim 14 and the particular selection of the range of 0.3D to 1.0D for the axial distance l referred to in original claim 15 are independent from the features of claims 11 and 13. As a matter of fact, although the skilled person is generally able to predict the effects obtainable by a modification of a single parameter of a twist drill's geometry, the optimal range for a given parameter is normally found on an empiric basis by varying the given parameter whilst keeping substantially constant the other parameters. Thus, once an optimal range for a given parameter has been found, it is normally to be seen in combination with a specific selection of the other parameters of the drill's geometry. Since in the present case the specific selections of ranges according to claims 14 and 15 are consistently presented throughout the application as filed, both in

the claims (as explained above) and in the original description (see pages 15 to 18), only in combination with the features of claims 11 and 13, the skilled person would not directly and unambiguously derive from the application as filed the information that the features of original claims 11 and 13 can be omitted from the subject-matter of granted claim 1 which includes the features of original claims 14 and 15.

- 3.2 The respondent submitted that the fact that the features of claims 11 and 13 were not included in granted claim 1 did not constitute an unallowable extension because there was no functional or structural relationship between the features of these dependent claims and the features of claims 14 and 15.

In the application as filed, the features of claim 11, in particular the selection of the ranges of 7° to 15° and 15° to 25° , respectively, for the relief angles β_1 and β_2 , are described to be advantageous in terms of flank wear, drill resistance to chipping, sufficient passage of cutting oil, and sufficient rigidity at the cutting lip (see page 17, lines 14 to 25 of the application as filed). Yet also the feature of claim 15 is described to be advantageous at least in terms of sufficient passage of cutting oil (see page 16, lines 14 to 17 of the application as filed). Therefore, the features of original claims 11 and 15 contribute to obtaining the same technical effect and cannot be seen as totally independent.

The feature of claim 13, that the angle λ is in the range of 95° to 115° , is described as being advantageous in terms of chip formation and reduction of the thrust load (see page 15, lines 11 to 24 of the application as filed). But also the feature of claim 14 is described as effectively contributing to a reduction of the thrust load (see page 16, first paragraph, of

the application as filed). It is true, as submitted by the respondent, that the effect of the feature of claim 13 is described, in the application as filed, only in respect of a twist drill made of high speed steel. However, the skilled person would consider that this effect is due to the selection of a particular geometry and is substantially independent from the material of the twist drill. Hence, also the features of original claims 13 and 14 contribute to obtaining of a same technical effect and cannot be seen as totally independent.

3.3 It follows that the fourth auxiliary request does not meet the requirements of Article 123(2) EPC and must be rejected.

3.4 Although the Board does not consider valid the argument of the respondent that an interpretation of the EPC different from the current one should be applied in view of the number of years since the filing of the application, it is not aware of any previous interpretations of the requirements of Article 123(2) EPC by the Boards of Appeal that would lead to different conclusions in the present case. Moreover, the respondent has not made any specific reference to a decision of the Boards of Appeal in support of this allegation.

4. *Fifth auxiliary request*

4.1 Amendments - Article 123(2) and (3) EPC

Claim 1 includes all the features of independent claim 1 and of dependent claims 2, 6 and 8 to 15 of the application as filed.

The amendments do not extend the protection conferred by the patent since claim 1 is amended over claim 1 as

granted only by way of addition of further limiting features, such as the feature relating to the material, cemented carbide or cermet, from which is made the twist drill.

Dependent claims 2 to 17 correspond respectively to claims 16 to 29, 4 and 6 (part) of the application as filed.

The description of the patent in suit is adapted to be consistent with the claims as amended.

Therefore, no objections under Articles 123(2) and (3) EPC arise.

4.2 Sufficiency of disclosure - Article 83 EPC

4.2.1 In the Board's view, the definition of claim 1 of the patent in suit, that the arcuately shaped portion of the wall of the flute which contacts an imaginary cylinder inscribing a web portion of the drill has a radius of curvature of between $0.15D$ to $0.2D$, clearly refers to an arcuately shaped portion as seen in a cross-section taken perpendicular to the axis (see eg Figures 20 and 21 of the patent in suit). Furthermore, the maximum distance W between the line L and the second wall is clearly to be measured in an end view of the drill (see eg Figure 6 of the patent in suit).

Considering that the other parameters referred to in claim 1 are of immediate implementation, the Board comes to the conclusion that the skilled person would have no difficulties in reproducing a twist drill having all the features of claim 1.

4.2.2 The appellant submitted that the invention is not disclosed in a manner sufficiently clear and complete for it to be carried out by a person skilled in the

art, because no mention of the helix angle is made in the whole patent and the mere selection of a drill geometry in accordance with claim 1 does not solve the technical problem underlying the patent in suit, to achieve an improvement in chip formation and discharge.

However, the selection of the helix angle is an usual task for a skilled person, and merely requires application of common general knowledge (see in this respect T 206/83, OJ 1987). Since the skilled person knows that the helix angle must be selected in function of the material to be cut, he would select an appropriate helix angle depending on the intended use of the twist drill. Once an helix angle is selected, the skilled person would have no difficulties in reproducing a twist drill having all the features of claim 1.

In the Board's view, the argument of the appellant is rather concerned with inventive step than with sufficiency of disclosure. As a matter of fact, the appellant has not questioned the reproducibility of a twist drill in accordance with claim 1 of the patent in suit, but the fact that the problem as stated in the patent in suit is solved by the claimed combination of features. Assuming that the mentioned problem is effectively solved only in correspondence of a limited range of the helix angle, this would not directly imply that the claimed twist drill cannot be reproduced, but only that a twist drill having an helix angle lying outside such a limited range would not represent a solution of the technical problem. This would have as a consequence a reformulation of the technical problem which is fundamental for the assessment of inventive step (see eg T 564/89, unpublished, point 4 of the reasons).

4.2.3 It follows that the patent as amended meets the requirements of Article 83 EPC.

4.3 Novelty

None of the available prior art documents discloses a twist drill comprising in combination all the features of claim 1. In particular, none of the cited documents discloses a twist drill of the kind having a first cutting lip, a ground surface creating a second cutting lip, and a valley line between said ground surface and the rake surface of said second cutting lip, wherein the first cutting lip has a radial rake angle of -10° to -20° at its outermost end in combination with the second cutting lip having an axial rake angle between 0° and -5° .

Novelty was in fact not disputed.

4.4 Inventive step

4.4.1 The technical problem underlying the patent in suit consists in providing a twist drill which can reduce the cutting resistance substantially by curling chips easily, and ensuring a smooth discharge of the chips through the flutes during the drilling operation.

4.4.2 Document D1, acknowledged in the patent in suit (see page 1, line 24) and which undisputedly represents the closest prior art, discloses (see Figures 4 to 7), when compared to the claimed subject-matter, a twist drill comprising a cylindrical body made of cemented carbide (page 9, line 23), the body having: an axis of rotation (O) therethrough and a forward end which contacts a workpiece; a spiral flute (2) formed in an outer peripheral surface thereof so as to extend spirally along a length thereof to said forward end, and said body having a web thickness (T) of $0.25D$ to $0.35D$

(page 10, lines 6 to 9), wherein D is a diameter of said body; said body further having a land (3) disposed adjacent to said flute (2), said flute (2) having a first wall facing in the direction of rotation of said body and a second wall extending from an inner end of said first wall to the outer periphery of said body, said first wall terminating at said forward end in a first cutting lip (4) having a radially outermost end (P1) disposed on the outer periphery of said body, said second wall being concavely shaped when viewed from said forward end; the drill having a ground surface (10) creating a second cutting lip (8) extending away from said axis (O) of rotation of said body (see page 11, lines 9 and 10), said second cutting lip (8) being formed to be linear as viewed from said forward end; the wall of said flute (11) having an arcuately shaped portion which contacts an imaginary cylinder inscribing a web portion of the drill; the axial rake angle for said second cutting lip (8) being set to be between -5° to $+5^{\circ}$ (see page 11, lines 21 to 23; this range includes the range of 0° to -5° referred to in claim 1 of the patent in suit); the angle defined between the ground surface (10) creating the second cutting lip (8) and a rake surface along said second cutting lip (8) being 90° to 110° (see claim 11; this range overlaps the range of 95° to 115° referred to in claim 1 of the patent in suit); in which twist drill: a rake surface (9) is formed along said second cutting lip (8), and a valley line (12) between said ground surface (10) and said rake surface (9) along said second cutting lip (8); and in which an angle defined by said axis (O) of rotation of said body and said valley line (12) is set between 25° and 60° (this range includes the range of 30° and 40° referred to in claim 1 of the patent in suit).

4.4.3 The above mentioned problem is solved, in accordance with the subject-matter of claim 1, by the provision of the following distinguishing features:

said first cutting lip (12) has a radial rake angle of -10° to -20° (δ) at said outermost end (Q); said first cutting lip (12) is formed to be linear as viewed from said forward end; the ratio of arc length (A1) of said flute (11) to arc length (B1) of said land (10a) at a cross section taken perpendicular to the axis (O) of said body (10) being 0.9 to 1.2; a point P being defined by the intersection of a line tangential to said first cutting lip (12) with a line tangential to said second cutting lip (13a), the ratio of a distance (L1) between said axis (O) of said body (10) and said point P to a distance (L2) between said outermost end (Q) of said first cutting lip (12) and said point P being set to range between 0.4:1 and 0.7:1; said forward end including a first planar relief surface (18) provided with a relief angle (β_1) of 7° to 15° and extending along said first cutting lip (12), and a second planar relief surface (19) provided with a relief angle (β_1) greater than that of said first relief surface (18) so as to range from 15° to 25° and extending along said first relief surface (18), the intersection of said first relief surface (18) with said second relief surface (19) being parallel to said first cutting lip (12) and intersecting said axis (O) of said body (10); assuming a first line (L) extending from said radially outermost end (Q) perpendicular to a second line (N) which connects said radially outermost end (Q) and said axis (O) of said body (10), said second wall is formed so that the maximum distance (W) between said first line (L) and said second wall is set to range between 0.45D and 0.65D; said arcuately shaped portion has a radius of curvature (R) of between 0.15D

to $0.2D$; and the axial distance (l) between the radially outermost end (Q) of said first cutting lip and a forward end (H) of a heel ($11b$) is set between $0.3D$ and $1.0D$.

The appellant submitted that the mentioned technical problem was not solved by a twist drill having the features of claim 1, because claim 1 failed to mention the helix angle of the twist drill. Indeed, the helix angle was an essential parameter determining the manner in which chip formation and discharge took place. The definition of the helix angle was therefore, according to the appellant's submissions, essential for the solution of the technical problem.

In order to decide whether the claimed twist drill actually solves the stated problem, comparison should be made with the prior art under similar conditions (see eg T 479/00, point 3.4 of the reasons). Since the closest prior art D1 also does not mention the helix angle, the comparison should be made between a drill of D1 and a drill according to claim 1 of the patent in suit having similar helix angles, selected for cutting similar materials.

Since there is no evidence that a drill according to claim 1 of the patent in suit does not always provide a reduction of the cutting resistance and a smooth discharge of the chips when compared with a drill in accordance with D1 having a similar helix angle, but selected to be within the usual ranges for cutting similar materials, the Board accepts that the twist drill according to claim 1 actually solves the problem raised.

- 4.4.4 In view of the above, the subject-matter of claim 1 cannot be regarded as a mere agglomeration of features, as argued by the appellant, but as a combination of

features in which the functional inter-relationship between the features contributes to the solution of the technical problem underlying the patent in suit.

In order to assess whether the subject-matter of claim 1 involves an inventive step, the decisive question is therefore, whether the prior art suggests combining the various features as defined in claim 1.

Document D10 discloses different possibilities of grinding the tips of twist drills. A twist drill of the kind referred to in D1, with a first cutting lip, a ground surface creating a second cutting lip, and a valley line between said ground surface and the rake surface of said second cutting lip, is disclosed in section 8 ("Kreuzanschliff") of D10. From the picture 8.6 of D1 it can be deduced that the maximum distance W between the line which extends from the radially outermost end of the first cutting lip and which is perpendicular to a second line which connects said outermost end and the axis of rotation of the body, and the second wall of the flute which extends from an inner end of the first wall facing in the direction of rotation of the body to the outer periphery of said body, is between 0.45D and 0.65D. However, there is no indication in D10 that the selection of a maximum distance within this range has any particular technical contribution, and therefore there is no apparent reason for the skilled person to select, for the twist drill of D1, a maximum distance W as in picture 8.6 of D10. Similar considerations apply for the feature, allegedly shown in picture 10.2 of D10, that the axial rake angle of the first cutting lip is within the range of -10° to 20° . Furthermore, picture 10.2 of D10 shows a twist drill which has four ground surfaces ("Vierflächenanschliff"), and is therefore of a kind different from that of D1 and of picture 8.6 of D10. In

view thereof, the skilled person would not be inclined to combine isolated and arbitrarily selected features taken from the twist drills of pictures 8.6 and 10.2.

D14 also generally relates to a twist drill of the kind referred to in D1 and discloses (see Figure 2) to provide a first planar relief surface with a relief angle of 10° (within the range of 7° to 15° referred to in claim 1 of the patent in suit) and extending along the first cutting lip, and a second planar relief surface provided with a relief angle greater than that of said first relief surface so as to range from 17° to 27° (overlapping the range of 15° to 25° referred to in claim 1 of the patent in suit) and extending along said first relief surface. However, the intersection of the first relief surface with the second relief surface is not parallel to the first cutting lip, contrary to the definition of claim 1. There is no indication that would lead the skilled person to extract from the disclosure of D14 only the features relating to the inclination of the ground surfaces. Anyway, even in such a case D14 would still not suggest combining all the features which distinguish the subject-matter of claim 1 from D1.

Since the other cited pieces of prior art also do not suggest the combination of features of claim 1, its subject-matter is found to involve an inventive step.

4.5 Therefore, the independent claim 1 together with the dependent claims 2 to 17 and the description as amended during the oral proceedings, and the figures as granted, form a suitable basis for maintenance of the patent in amended form.

5. Since the fifth auxiliary request is considered allowable, the sixth auxiliary request need not to be considered.

Order

For these reasons it is decided that:

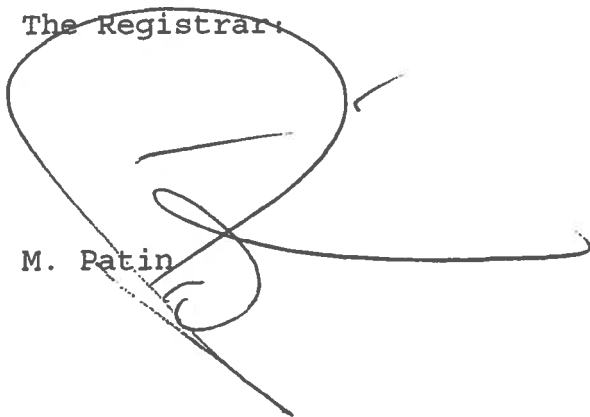
1. The decision under appeal is set aside.
2. The main and fourth auxiliary request of the respondent are rejected.
3. The case is remitted to the department of first instance with the order to maintain the patent on the basis of the following documents in accordance with the fifth auxiliary request:

claims: 1 to 17 filed during oral proceedings;

description: pages 3 to 19 filed during oral proceedings;

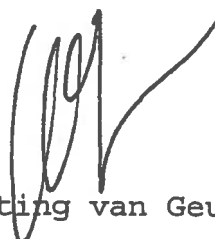
drawings: Figures 1 to 38 as granted.

The Registrar:



M. Patin

The Chairman:



P. Alting van Geusau

