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Datasheet for the decision of 21 October 2019

Case Number: T 1943/15 - 3.2.05

Application Number: 09796619.6

Publication Number: 2366075

IPC: F16L15/00, F16L15/06, E21B17/042

Language of the proceedings: EN

Title of invention:
Tubular connection with self locking threading used in the oil industry

Patent Proprietor:
Vallourec Oil and Gas France
Nippon Steel & Sumitomo Metal Corporation

Opponent:
Hydril Company

Relevant legal provisions:
EPC Art. 100(b), 54(1), 56

Keyword:
Sufficiency of disclosure (yes) - open-ended range (point 2.5)
Novelty (yes) - dimensions from drawings (point 4)
Inventive step (yes)

Decisions cited:

T 1811/13, T 0487/89, T 0129/88, T 1018/05, T 0204/83, T 1488/10, T 1664/06, T 0451/88, T 0748/91, T 0422/95, T 1200/05, T 0169/83, T 1313/04, T 0857/91

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Case Number: T 1943/15 - 3.2.05

D E C I S I O N
of Technical Board of Appeal 3.2.05
of 21 October 2019

Appellant: (Opponent)	Hydril Company 2200 West Loop South, Suite 800 Houston, TX 77027 (US)
Representative:	EP&C P.O. Box 3241 2280 GE Rijswijk (NL)
Respondent: (Patent Proprietor 1)	Vallourec Oil and Gas France 54 rue Anatole France 59620 Aulnoye-Aymeries (FR)
Respondent: (Patent Proprietor 2)	Nippon Steel & Sumitomo Metal Corporation 6-1, Marunouchi 2-chome Chiyoda-ku Tokyo 100-8071 (JP)
Representative:	Cabinet Netter 36, avenue Hoche 75008 Paris (FR)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office posted on 10 August 2015 rejecting the opposition filed against European patent No. 2366075 pursuant to Article 101(2) EPC.**

Composition of the Board:

Chairman	M. Poock
Members:	T. Vermeulen
	C. Brandt

Summary of Facts and Submissions

I. The opponent appealed against the decision of the opposition division rejecting the opposition filed against the European patent No. 2 366 075.

II. The opposition was filed against the patent as a whole on the basis of Article 100(a) EPC (lack of novelty and lack of inventive step) and Article 100(b) EPC (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).

III. The oral proceedings before the board of appeal took place on 21 October 2019.

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

The respondents (joint patent proprietors) requested that the appeal be dismissed (i.e. that the patent be maintained as granted - main request), or alternatively, that the decision under appeal be set aside and the patent be maintained in amended form according to any of auxiliary requests 5, 1', 1'', 2', 4', 3' or 1 to 4; auxiliary requests 1 to 4 were filed with letter dated 3 April 2015, auxiliary requests 1', 1'', 2', 3' and 4' were filed with letter dated 26 June 2015, auxiliary request 5 was filed with letter dated 26 April 2016 (response to the statement of grounds of appeal).

V. The following documents were mentioned in the appeal proceedings:

D1 EP 1 046 779 A1;

D2 US 6,270,127 B1;

D3 WO 01/29475 A1;

D4 US 6,206,436 B1;

D5 US 6,976,711 B2;

D6 WO 2007/149673 A1;

D7 US Re. 34,467;

D8 "Wedge Thread™ Field Handbook", Fourth Edition, ©2001 Hydril Company;

D9 "Hydril Wedge Thread™ Drill Pipe Tool Joint", Bulletin 9402-E, ©2005 Hydril Company LP;

D10 "Series 500TM Wedge Thread™ Drill Pipe Tool Joint", Bulletin 9402-D, ©2000;

D11 "High Performance Tubular Products", Catalog 971, ©1997 Hydril Company;

D12 "High Performance Tubular Products and Service", Catalog 861, ©1986 Hydril Company;

D33 "Numerical and experimental distribution of temperature and stress in API round threaded connection", Yuan Guangjie et al, "Engineering Failure Analysis", vol. 13, 2006, pages 1275 to 1284.

VI. Claim 1 of the main request reads as follows (the feature references used by the board are introduced in square brackets):

"[**A**] A threaded connection comprising a first and a second tubular component, each being provided with a respective male (1) and female (2) end, [**B**] the male end (1) comprising, on its external peripheral surface, at least one threaded zone (3) and finishing in a terminal surface (7) which is orientated radially with respect to the axis (10) of the connection, [**C**] the

female end (2) comprising, on its internal peripheral surface, at least one threaded zone (4) and finishing in a terminal surface (8) which is orientated radially with respect to the axis (10) of the connection, [**D**] the male threaded zone (3) having a first portion in which the width of the teeth, CWTp, increases from a value CWTpmin corresponding to the width of the tooth which is closest to the terminal surface (7) of the male end (1) to a value CWTpmax corresponding to the width of the tooth which is furthest from said terminal surface (7), [**E**] while the width of the teeth CWTb of the female threaded zone (4) decreases from a value CWTbmax corresponding to the width of the tooth which is furthest from the terminal surface (8) of the female end (2) to a value CWTbmin corresponding to the width of the tooth which is closest to said terminal surface (8), [**F**] such that the threaded zones (3, 4) cooperate in accordance with self-locking make-up, characterized in that [**G**]

$$\frac{CWTpmin}{CWTbmax} \geq 0.2$$

and [**H**]

$$\frac{CWTbmin}{CWTpmax} \leq \frac{CWTpmin}{CWTbmax}.$$"

VII. The appellant essentially argued as follows:

Sufficiency of disclosure

i) Feature G

The patent failed to disclose why the ratio of feature G should be greater than or equal to 0.2. No positive effect was indicated, nor were any test results provided. The absence of an upper limit of the ratio gave way to embodiments with a very fragile threaded connection, which would be without any positive effect.

Therefore the skilled person would not know from the description of the patent how to construct the threaded connection of claim 1 in order to create the suggested positive effect over the whole range claimed.

ii) Feature H

The patent provided no arguments or test results as to why a positive effect was reached within and not outside the extremely broad range of feature H. The skilled person would not know from the description of the patent how to construct a threaded connection according to claim 1 in order to create the suggested positive effect over the whole range claimed.

iii) Unfeasible embodiments

As the skilled person was required to carry out the invention over the full scope of the claimed range, claim 1 should only cover feasible embodiments. On the basis of paragraphs [0036], [0037], [0039] and [0040] of the description, claim 1 had to be limited so as to only cover feasible embodiments.

iv) Figures 3 and 4

Measuring the dimensions of the corresponding teeth in Figures 3 and 4 of the patent resulted in the desired inequality of feature G and in the "=" variant of feature H. When trying to construct a threaded connection according to claim 1, the skilled person would therefore be at a loss as to how to create the suggested positive effect over the prior art.

v) Total length

It was confusing that the total length of the threaded zones in Figures 5 and 6 differed from that shown in Figures 3 and 4, when the aim of the patent in paragraph [0008] was not to modify the total length. The skilled person would not know how to construct a connection according to the "=" variant of feature H without modifying the total length in order to achieve the suggested positive effect. In addition, feature H failed to indicate how the terms of the inequality must be related in order to conserve the total length.

vi) First portion

Feature E implied that the width of the teeth in the female threaded zone decreased along its total length, while Figure 6 would suggest that this was only the case for a first portion VPEST of the female threaded zone. Hence, the skilled person would not know from the description of the patent how to construct the threaded zone of the female end of a threaded connection according to claim 1 in order to achieve the suggested positive effect.

vii) Wedge ratio

The patent did not teach the skilled person the essential features required to reach the objective of not modifying the wedge ratio. Claim 1 failed to disclose anything about the wedge ratio. The different wedge ratios shown in Figures 6 and 8 contradicted the aim set out in paragraph [0008] of the patent description. The skilled person would not know from the description of the patent how to construct the threaded zone of the male and female ends of a threaded connection according to claim 1 in order to achieve the suggested positive effect.

viii) Claim 3

Considering that claim 3 only referred to the width of the roots without giving information on the width of the teeth or on the structure of the teeth in the corresponding female threaded zone, the measures described in the claim were meaningless. Furthermore, claim 3 failed to give a value for CWRpthreshold. This was only done in claim 8, albeit with reference to an unclear tooth height. Hence, the technical terms used in claim 3 were unclear and the open-ended limitation of claim 8 led to entirely impossible connection structures.

ix) Claim 6

The objections made in respect of claim 3 and claim 8 also applied to claim 6, which also lacked any technical meaning and covered technically impossible structures.

x) Claim 14

The patent did not provide information on the meaning of "the tangent of the peak half-angle of the tapered surface" in claim 14 and failed to teach the skilled person how this should be measured.

Novelty

i) Dimensions from drawings

According to decisions T 204/83, T 1488/10 and T 1664/06 there was no general rule for deriving features from drawings, since it was not possible to treat the drawings of each document in the same way. There was no

general ban on measuring elements from drawings. In particular, it should be established whether the skilled person would derive any technical teaching from the drawing of a document involving the features in question. In fact, in each of the documents relied upon in opposition, the threads commonly played a relevant role.

When taking account of the relevance of elements shown in a drawing, the quality of the drawing and the background knowledge of the skilled person, it could be appropriate to measure the dimensions of the elements in order to determine the ratio of two dimensions. In that case, the measurements would only be taken to establish whether two dimensions were in proportion to each other. Sometimes, it sufficed for the skilled person to have a perception of a ratio from a drawing without requiring accurate measurements. This was confirmed by decisions T 748/91, T 422/95 and T 1200/05, according to which clearly essential elements may be derived even from schematic drawings.

ii) Novelty with respect to document D3

The embodiment shown in Figures 1, 2 and 3 of document D3 disclosed a threaded connection with claim features A to F: a tip 1, a box 2 and threaded zones on both box and tip, which finished in respective radial terminal surfaces and which comprised wedge threads according to the definition given on page 2, lines 13-19. This embodiment also disclosed feature G since, similarly to the embodiment of Figure 7, the largest female tooth was smaller than five times the smallest male tooth. For feature H, the ratios in the embodiment of Figures 1 and 2 were equal due to the symmetrical design of the threads, the plane of symmetry being in the middle of

the threaded zones. The wording of claim 12 of document D3, which, due to the reference signs 9 and 12, must refer to the embodiment of Figures 1 and 2, not only led to the conclusion that the width of the smallest tooth on the male end was equal to the width of smallest tooth on the female end, but also entailed that the widths of the largest male and the largest female teeth were equal. The definition of the term "wedgethread" on page 2 of document D3 mentioned namely that stab and load flanks contact and wedge against their respective mating flanks. This required the stab flank axial pitch length and the load flank axial pitch length to be constant, which in turn meant that the width of the largest teeth on the male and the female ends was the same. The use of "crest" in claim 12 did not change this conclusion, because the load and stab flank angles in Figures 1 and 2 were 90°. The expression "axial length of a thread crest" in claim 12 should be looked at as a synonym for the term "tooth width", irrespective of the actual shape of the teeth. The argument that gaps were visible in Figure 2 of document D3 should be read in the context of the definition on page 2, according to which the stab and load flanks contacted against their respective mating flanks. The "=" variant of feature H corresponded to the condition that the smallest teeth were equal and the largest teeth were equal.

The other figures of document D3 also showed accurate line drawings of threaded connections. In patent documents where the invention concerned wedge threads, it was common to properly present major dimensions of the teeth in proportion to each other. The width of the teeth could therefore be measured from Figure 7, which was described as a section of the assembled connection and therefore fairly represented the dimensions in

their relative proportions, with ratio G being around 0.33 and ratio H around 0.2, in compliance with the constraints of features G and H. Furthermore, it was even possible to perceive the conditions G and H just from looking at the drawings of document D3. The skilled person would immediately recognise from Figure 7 that the width of the largest female tooth was about three times - hence smaller than five times - the width of the smallest male tooth. Without having to resort to any form of measurement, the skilled person would also see from Figure 7 that the width of the smallest female tooth was about equal to the width of the smallest male tooth, and that the width of the largest male tooth was much greater than the width of the largest female tooth. This directly led to feature H.

iii) Novelty with respect to the other documents

Figures 3 and 4 of the patent reflected prior-art threaded connections; they were detailed views and more accurate than diagrammatic drawings. The width of the teeth was explicitly referred to in paragraphs [0030] to [0033] of the patent in the context of these figures. Therefore, it was clear to the skilled person that the drafter of the patent used a proportional representation of the width of the teeth in the figures. As a consequence, the skilled person would measure the different widths, which yielded a ratio G and a ratio H of around 0.3.

Figures 1-3 of document D1 showed accurate line drawings of threaded connections, with the teeth being clearly indicated. Measuring the teeth width resulted in a ratio G and a ratio H of around 0.3 for each of the figures.

The whole of document D2 was directed to the form and dimension of the teeth of the threads, which therefore played a very important role in the prior-art invention. The figures were very detailed drawings in which the measurement of the width of the teeth yielded a ratio G and a ratio H of around 0.5.

Since in a wedge thread the load and stab flanks of the box member and the pin member were in contact with each other, the skilled person knew that the width of the teeth of the pin member of document D4 was equal to the width between the teeth of the box member shown in Figure 4. Figure 4 was a proportional representation in which the dimensions could be measured. This would result in a ratio G equal to around 1 and a ratio H equal to around 0.7 in the first step of the connection. In the second step, it would be clearly visible even without measuring that the conditions of features G and H were fulfilled.

Figures 1A-C of document D5 showed accurate line drawings, in which the form and dimensions of the teeth played an important role. A value for the ratio G and the ratio H of around 0.2 resulted from measuring the different teeth widths in Figure 1B.

The form and the dimensions of the teeth shown in Figures 1a-b of document D6 were discussed in detail and played an important role in the claimed invention. Figure 1A was an accurate line drawing of a threaded connection that allowed the dimensions of the teeth to be measured, leading to a ratio G of around 0.4 and a ratio H of around 0.3.

Figures 2, 3 and 6 of document D7, in which the width of the threads played a very important role, also

disclosed a wedge thread with dimensions complying with the conditions of features G and H. Both ratios G and H would be around 0.5 in Figure 6 and around 2.5 and 5, respectively, in Figure 2. With respect to Figure 3, the document indicated that the width of the largest pin thread was in the range of approximately four times the width of the smallest pin thread. As this corresponded to the ratio of the measured dimensions, it must be concluded that not only Figure 3 but also the other figures of the document showed a proportional representation of the width of the threads. In addition, all figures showed a symmetrical wedge thread, so ratios G and H in Figure 3 must both amount to approximately 0.2.

The figure on page 10 of the prior-art handbook D8 showed the details of a threaded connection with specific form, dimensions and location of the teeth. Measuring the teeth width would yield a ratio G and a ratio H of around 0.5.

Bulletin D9 showed the teeth of the wedge thread in detail. The skilled person would derive technical meaning from the figures. The figure on page 2 disclosed a ratio G and a ratio H of around 0.5. In addition, the photo on the front page, which was an unmanipulated independent reproduction of an object taken at a right angle and which permitted the skilled person to derive measurements from it, in accordance with decision T 857/91 (Reasons 3.2 and 3.4), would yield the same ratios.

Document D10 was another prior-art bulletin showing threads on the upper side of the figure on page 2 with dimensions resulting in a ratio G and a ratio H of around 0.7. The photo on the front page yielded ratios

of around 0.5 each. According to the figure on page 16 of the prior art catalogue D11 a wedge thread with a ratio G of around 0.5 and a ratio H of around 0.5 was known. The figures shown on pages 9, 14, 16, 18, 20, 21, 24, 26, 28 and 29 all showed the form, dimensions and location of the teeth in an accurate manner. Each of these figures disclosed all features of claim 1.

Page 18 of catalogue D12, as well as pages 22, 26, 28 and 29, showed a threaded connection according to claim 1. Measuring the thread widths in the figure on page 18 led to a ratio G of around 0.7 and a ratio H of around 0.5.

Inventive Step

The subject-matter of claim 1 differed from the embodiment of Figures 1-3 of document D3 only by features G and H. Regarding feature G this meant that the width of the smallest male tooth should be at least $1/5^{th}$ of the width of the largest female tooth. As to feature H, it was sufficient for the smallest teeth on the male and female ends to have an equal width and for the largest teeth on the male and female ends to have an equal width. The technical effect of feature G was to avoid a particularly thin male tooth, whereas feature H had the technical effect of maximising the number of thread turns of the mating wedge threads within a desired length of the threaded zone for a given tooth width.

Following the partial-problems approach, the objective technical problem was to (i) strengthen the smallest pin tooth against the high shear forces created by the largest box teeth and (ii) enhance the strength and sealability of the wedge thread. There was no need to

look at the patent for the objective technical problem, but rather it was sufficient to look at the differences with respect to the prior art and their technical effects.

Starting from Figure 1 of document D3, the skilled person would set a lower limit for the width of the smallest male tooth as a matter of routine. The skilled person knew in particular from document D33 that the region with the smallest male tooth was subjected to high stresses and was at the highest risk of being torn. Changing the width of a tooth so that it could better withstand the shear forces acting on it, fell within the normal practice of the skilled person. This was confirmed by the Case Law of the Boards of Appeal of the European Patent Office, 8th edition 2016, I.D. 9.15, the third paragraph of which stated that "*it was part of the activities deemed normal for the skilled person to optimise a physical dimension in such a way as to reach an acceptable compromise*".

In order to maintain the constant wedge ratio, the skilled person would also change the rest of the male threads in the same manner and adapt the female thread accordingly.

From claim 12 of document D3 the skilled person further learns that the number of thread turns within the mating wedge thread could be maximised for a given tooth width by dimensioning the width of the smallest male tooth to be substantially equal to the width of the smallest female tooth. This would also enhance the strength and sealability according to the passage from page 9, line 49 to page 10, line 9 of document D3. The skilled person would contemplate testing the situation where the widths of the smallest male and female teeth

were equal and where the lead of the stab flanks and the load flanks were constant, as this was the most logical design. On a diagram showing the "unwrapped" male and female thread, it could easily be seen that the widths of the largest male and female teeth would also be equal in such a case, which led to the "=" variant of feature H.

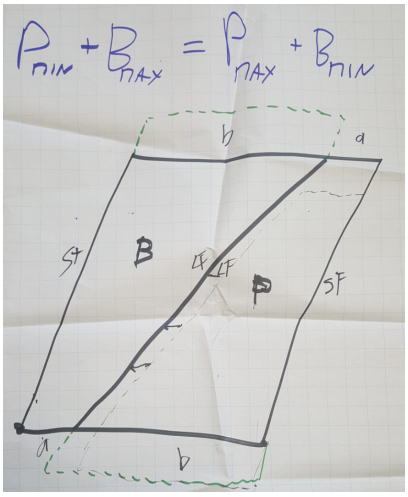

Diagram drawn by the appellant during the oral proceedings before the board

The arguments provided by the respondents in respect of the lack of obviousness with regard to feature H only applied to the inequality. The "=" variant, however, did not imply an imbalance. Most of the wedge threads of the prior art, such as those of documents D1, D2, D5 and D7 to D12, were symmetrical. The "=" variant of feature H was therefore already known. Paragraphs [0005] to [0007] of the patent related to a method rather than to a device. Because of the reference signs used, claim 12 did not apply to the embodiment of Figure 7.

VIII. The respondents' submissions were essentially as follows:

Sufficiency of disclosure

i) Feature G

The explanations required to carry out the invention with respect to the threshold value 0.2 could be found in paragraphs [0036] and [0037] of the patent, according to which the optimal value of the ratio would be around 1. Even if the effect did not persist beyond a certain value, this would not hinder the skilled person's ability to reproduce the invention. The appellant's unrealistic counter-examples were devoid of any technical sense.

ii) Feature H

With respect to the constraint of feature H, the invention was sufficiently described in paragraphs [0039] and [0040] of the patent. The "=" variant did not imply symmetry of the thread because it was the ratios and not the individual dimensions that were compared. The plane of symmetry 100 in the patent merely reflected that widths of neighbouring threads were identical. The skilled person would know from the description of the patent how to construct a threaded connection according to claim 1 in order to create the suggested positive effect over the whole range claimed.

iii) Unfeasible embodiments

Paragraphs [0036], [0037], [0039] and [0040] of the patent only served as a guide for how to carry out the invention.

iv) Figures 3 and 4

By definition, Figures 3 and 4 did not pose a problem regarding sufficiency of disclosure. The appellant sought to introduce invalid arguments to support the objection.

v) Total length

Nowhere did it say that Figures 5 and 6 could be compared with Figures 3 and 4. This objection was completely artificial and showed the ineffectiveness of carrying out measurements in patent drawings.

vi) First portion

The appellant had correctly determined the first portion of the male thread in the grounds of appeal. This did not pose any problems for the skilled person when carrying out the invention.

vii) Wedge ratio

The wedge ratio was defined in paragraph [0007] of the patent, but also in the appellant's patent publications, such as in claim 1 of document D4. The appellant's publications D4, D5, D6 and D8 mentioned the expression "wedge thread". In addition, the expression "wedge ratio" was not included in the claims.

viii) Claim 3

The skilled person would know how to manufacture a threaded connection with a constant width of the roots on the male thread in combination with a decreasing width of the teeth on the female thread. The last sentence of paragraph [0041] of the patent defined the

threshold. The tooth height was a common term for the skilled person and was also used in the appellant's patent publications.

ix) Claim 6

The skilled person would have no difficulties in producing a threaded connection as in claim 6. The increasing width of the roots on the male thread should be considered in combination with the decreasing width of the teeth on the female thread.

x) Claim 14

The tangent of the peak half-angle of the tapered surface was a mathematical expression representing the degree to which a surface is conical. This was known to the skilled person.

Novelty

i) Measurements from drawings

Patent drawings could not disclose any information on dimensions unless this was explicitly indicated. Dimensions resulting from rough measurements taken from schematic drawings in a document were not part of its disclosure.

ii) Novelty with respect to document D3

The figures of document D3 were schematic because the majority of the features of the 28 claims were not visible from the document.

In the embodiment of Figure 2 of document D3, gaps were visible between some of the teeth, which implied that the threaded connection was not entirely self-locking. Document D3 did not disclose the constraint of feature G, nor did it provide support for any such assumption. Symmetry was not a requirement for complying with the condition of feature H. According to the patent, the plane of symmetry 100 merely reflected that the width of the adjacent teeth was equal. The position of the plane of symmetry was independent of the width of the smallest or largest teeth. Both the total length of the thread and the wedge ratio also influenced the position of the plane of symmetry. As an example, if male teeth having a width ranging from 1 to 8 mated with female teeth ranging from 3 to 4, then the thread had symmetry within the meaning of the patent and feature H was given because 1/4 < 3/8. Therefore, symmetry did not necessarily imply that the ratios of feature H were equal. Conversely, the "=" variant of feature H did not mean that the thread was symmetrical. So even if it were shown that the threads of document D3 had symmetry, this was not proof that feature H was disclosed. The appellant was determining the vocabulary of the claim, but only the patent could do that. Claim 12 of document D3 did not refer to CWTbmin or CWTpmin, but used the expressions "crest width". No information could be found in document D3 on the width of the largest teeth. In practice, these widths also depended on the arrangement of the flanks and of the different angles. Document D3 did not even mention the tooth width, let alone the maximum or minimum tooth width.

The thread shown in Figure 7 of document D3 would be impossible to make up in view of the variation of the lead close to surfaces 93 and 95. Feature B was not disclosed in that embodiment either.

iii) Novelty with respect to the other documents

The description in paragraphs [0031]-[0035] of the patent failed to give any dimensional or relative values. Figures 3 and 4 of the patent did not disclose features G and H.

The disclosure of document D1 hinged on a torque shoulder in combination with a progressive thread; D1 did not disclose any dimensions. It was probable that the draughtsman used the same basic drawing to develop the different embodiments of document D1.

Document D2 did not disclose any dimensions or ratios between dimensions either.

Document D4 did not disclose any dimensions. In this prior art threaded connection, a gap must have been present between the thread flanks. Figure 4 failed to show the complementary part.

The threaded connection disclosed in document D5 was used in expandable conduits, which was a different category of pipe joints. The wedge thread had varying leads along the threaded zone. No dimensions were disclosed.

The wedge ratio in document D6 varied for the male and the female threads. No dimensions could be derived from the document.

Document D7 did not disclose any symmetric configuration of the threaded zone. Its hyperstatic construction was not realistically feasible.

The dimensions of the thread shown on page 10 of document D8 were not reliable. Industrial construction drawings were not included. The photograph put on the cover of document D8 for marketing reasons was not an independent reproduction which the skilled person would use for measurements. The same applied to documents D9 and D10.

Document D11 appeared to use rather promotional language. Schematic representations were included without any indication of the width of the teeth.

Page 18 of document D12 merely disclosed a schematic representation of a threaded connection without any scale. The promotional text on page 19 contained numerical data, but no data concerning the width of the teeth.

Inventive Step

Given distinguishing features G and H, the objective technical problem would be to improve the resistance of the thread to tension and compression, while taking account of the disadvantages of the prior art mentioned in paragraphs [0005] to [0007] of the patent. The second partial problem raised by the appellant was taken from document D3 and not from the patent, which mentioned improved resistance in paragraphs [0037] and [0039].

The patent was the first to propose both the improved measures on the smallest tooth in the male threaded zone and the accentuated disproportion at the opposite side of the thread. Starting from these considerations, features G and H were constructed in the patent. The

measures of features G and H were counter-intuitive because an imbalance was created.

Document D33 merely disclosed the stress distribution in an API non-wedged threaded connection during make-up, not during actual use. There was no hint to design a threaded connection with a ratio G not smaller than 0.2.

When starting from the embodiment of Figure 1 in document D3, claim 12 would not lead the skilled person to any conclusion regarding the width of the largest teeth, or to a lower limit for the ratio in feature G. According to paragraph [0003] of the patent, the symmetry of a thread involve the sum of the smallest pin tooth and the largest box tooth equalling the sum of the smallest box tooth and the largest pin tooth (Pmin + Bmax = Pmax + Bmin). This had nothing to do with the symmetry alleged by the appellant.

Because of the common problems with machining wedge threads, it was not clear where exactly the threads of document D3 started or ended. The diagram of the "unwrapped" male and female threads sketched by the appellant during the oral proceedings could therefore not realistically reflect the real length of the thread, so D3 did not disclose the values for the width of the largest teeth on the male and female ends.

Therefore, features G and H were not obvious from the prior art.

Reasons for the Decision

1. Terminology

1.1 Helical threads are said to be "wedged" or "self-locking" when the axial width of the threads (also called teeth) varies progressively in opposite directions on the pin and the box members, causing the male and female threads to engage with mutually contacting or wedging load and stab flanks at final make-up.

The “lead” of a helical thread refers to the distance a point on the thread travels in one revolution.

The "wedge ratio" defines the measure at which the teeth of a wedged thread change in width along the threaded zone. It corresponds to the difference between the lead of the stabbing flanks and the lead of the load flanks of the respective teeth.

1.2 For the sake of concision, the expressions "ratio G" and "ratio H" will be used hereinafter to depict the respective ratios appearing on the left-hand side of the dimensional constraints of features G and H: ratio G is the ratio between the width CWTpmin of the tooth closest to the terminal surface of the male end and the width CWTbmax of the tooth furthest from the terminal surface of the female end

$$ratio\,G = \frac{CWTpmin}{CWTbmax},$$

whereas ratio H is the ratio between the width CWTbmin of the tooth closest to the terminal surface of the female end and the width CWTpmax of the tooth furthest from the terminal surface of the male end

$$ratio\ H = \frac{CWTbmin}{CWTpmax}\ .$$

2. Sufficiency of disclosure

2.1 In the statement setting out the grounds of appeal the appellant raised ten objections for lack of sufficiency of disclosure. Most of those are word-for-word identical to the points made on pages 8 to 13 of the notice of opposition. No further arguments were submitted during the oral proceedings before the board.

2.2 The subject-matter of a patent must be sufficiently disclosed on the basis of on the entire teaching of the patent and taking into account the common general knowledge of the skilled person. It is not sufficient to establish a lack of clarity of the claims for establishing lack of sufficiency of disclosure; it is necessary to show that the lack of clarity affects the patent as a whole (i.e. not only the claims) and that it is such that the skilled person - who can avail themselves of the patent description and of their common general knowledge - is hindered from carrying out the invention (cf. T 1811/13, Reasons 5.1).

2.3 Regarding **feature G**, the board concurs with the opposition division that the patent mentions at least one way in which the skilled person can carry out the invention. According to paragraph [0037], a ratio G approaching 1, i.e. a condition where the width of smallest male tooth comes close to the width of the largest female tooth, is preferred because it provides a better "resistance to alternating tensile/compressive stresses".

2.4 In paragraph [0038] of the patent the constraint of **feature H** is linked to the aim of conserving the total length of the prior-art threaded zone in order to maintain the make-up torque. When starting from a given ratio G, the skilled person will therefore know from looking at the total length of a prior-art threaded zone how to determine the widths of the smallest female tooth and the largest male tooth in order to comply with the condition of feature H.

The board notes that the "=" variant of the condition is a mathematical proportion which should not be interpreted narrowly in the sense that the width of the smallest pin tooth CWTpmin equals the width of the smallest box tooth CWTbmin and the width of the largest box tooth CWTbmax equals the width of the largest pin tooth CWTpmax. For the ratios G and H to be equal it suffices that they are proportional.

2.5 According to established case law, an open-ended range in a claim does not necessarily result in a lack of sufficiency of disclosure due to the absence of a second boundary to the range. Where it is clear for a skilled person that an open-ended range is limited in practice, depending on the surrounding circumstances, such that the claimed values should be only as high as can be attained above the lower limit, then such open-ended ranges are normally not objected to (cf. T 487/89, Reasons 3.5; T 129/88 OJ 1993, 598, Reasons 2.2.4; T 1018/05, Reasons 2.3).

The board acknowledges that threaded connections with a small width CWTbmax and a large width CWTpmin, corresponding to a ratio G substantially larger than 1, would fall under the literal wording of the claim and could possibly give rise to what the appellant calls

"unfeasible embodiments". Yet, the skilled person would immediately recognise that such variants are not within the scope of practical application for self-locking type threads, particularly since feature E requires the width of the female threads CWTb to decrease with distance from the male terminal surface to values well below CWTbmax. Reducing the marked disproportion close to the end of the male threaded zone by creating a similar disproportion at the end of the female threaded zone would run counter to common sense for a skilled person.

2.6 The board cannot see how the disclosure of **Figures 3 and 4** of the patent would impede the skilled person in constructing a threaded connection according to claim 1. According to paragraphs [0030] to [0040] of the patent, the problem of large shear stresses occurring at the male tooth with the smallest width in a prior-art threaded connection such as the one shown in Figures 3 and 4, is solved by constructing a threaded connection with more equilibrated tooth widths at the male end and more disproportionate tooth widths at the female end. The dimensions of the teeth shown in Figures 3 and 4 are not given in the description, nor can they be measured from the drawings (cf. point 4 hereinafter). Consequently, the constraints of features G and H distinguish the subject-matter of claim 1 from the threaded connection shown in Figures 3 and 4.

2.7 The appellant objects that the reference in Figure 6 to the width "VPEST" of the **first portion** is confusing. Furthermore, there would be an alleged contradiction between the statements in regard to the **"total length"** and the **"wedge ratio"** in paragraph [0008], on the one hand, and the embodiments of Figures 3 to 8 of the patent, on the other hand.

The board observes that none of these expressions appears in the wording of claim 1 as granted. The appellant has not convincingly shown how a reference in a drawing and a statement in the description can hamper the skilled person in manufacturing a threaded connection according to claim 1, particularly since an objection for insufficient disclosure cannot legitimately be based on an argument that the patent would not enable a skilled person to achieve a non-claimed technical effect (cf. Case Law of the Boards of Appeal of the European Patent Office, 9th edition 2019, II.C.3.2).

Besides, the skilled person will understand from the description in paragraph [0041] how the male and female ends of Figures 5 and 6 are conceived. Whereas the reference to "VPEST" in Figure 6 may not reflect the actual demarcation on the female threaded zone between a first portion with a self-locking profile and a second portion with a constant tooth and root width, it is perfectly plausible that this reference points out where the first and second portions of the male threaded end will meet in the made-up joint. Similarly, Figure 9 shows the axial position along the threaded zone at which the lead of the stabbing flanks SFPp increases suddenly to a value equal to the lead of the load flanks LFPp.

The phrase "without modifying either the total length of the threaded zone or the wedge ratio" in paragraph [0008] of the patent refers to the prior art from which the patent starts in order to define the invention. As the respondents rightly pointed out, the starting point is not necessarily the threaded connection shown in Figures 3 and 4, which are only mentioned in the detailed description of the patent. Regardless of the

starting point, however, the skilled person will avail themselves of their common general knowledge and of the description of the patent to carry out the invention of claim 1 without undue difficulty. Paragraph [0038] of the patent is particularly helpful to the skilled person because it explains how feature H ensures that the total length of a threaded zone characterised by condition G is conserved without the need to change the wedge ratio.

2.8 Claims 3 and 6 define the embodiments described in paragraphs [0041] and [0044] of the patent. In each of these variations, feature D of claim 1 is further limited by introducing a threshold value CWRpthreshold, below which the width of the roots may not fall. As the skilled person knows from Figures 3 and 7 that the lead LFPp is the sum of the tooth width CWTp and the width of its neighbouring root CWRp, the width of the teeth in the second portion of claim 3 must amount to LFPp - CWRpmin = CWTpmax, as depicted in Figure 5. Following page 6, lines 7-8 of the patent, the female threads remain as before. Similarly, the skilled person will be aided by Figure 11 and paragraph [0044] in determining the width of the male and female teeth for the variation of claim 6.

Whether claims 3 and 6 are unclear due to a missing value of CWRpthreshold is in fact a matter of clarity rather than sufficiency of disclosure. This also applies to the term "peak half-angle" in claim 14.

2.9 In the light of the above, the board sees no reasons to depart from the opposition division's finding that the patent discloses the invention in a manner sufficiently clear and complete for it to be carried out by a person

skilled in the art. The appellant's objections under Article 100(b) EPC are therefore rejected.

Novelty

3. The contentious issue is whether the dimensional constraints of features G and H

$$\text{ratio G} \geq 0.2 \quad \text{and} \quad \text{ratio H} \leq \text{ratio G}$$

are disclosed in conjunction with features A to F. The parties do not dispute that none of the cited documents expressly mentions the ratios G and H or the relevant dimensions necessary to calculate the ratios. Consequently, the issue in question hinges on the disclosure of the dimensional constraints in the drawings of the documents submitted by the appellant.

4. Dimensions from drawings

4.1 In the statement setting out the grounds of appeal the appellant referred to various decisions concerning the measurement of dimensions in drawings, most of which built on the conclusions of decision T 204/83 (OJ EPO 1985, 310) that "*When a feature is shown solely in a drawing without any other clarifying description a careful check should be made to establish whether the mere diagrammatic representation enables a person skilled in the art to derive a practical technical teaching therefrom*" (Reasons 4) and that "*Dimensions obtained solely by measurements carried out on a diagrammatic representation forming part of a document do not constitute part of the disclosure and cannot, therefore, be regarded as complementing the teaching obtained in the description*" (Reasons 7). This led the board in case T 204/83 to deny that a patent drawing

showing a coating apparatus in cross-section disclosed a height-to-diameter ratio larger than 0.5 and smaller than 0.66.
Similarly, the board in decision T 1488/10 decided that a length ratio between 0.5 and 0.75 did not form part of the disclosure of a patent drawing showing a cross-section of an ultrasonic transducer (Reasons 3.5).

In decision T 1664/06, with regard to various ratios between diameters and thickness values in a constant velocity joint, the board came to the conclusion that the prior-art document "*discloses neither the dimensions of the outer and inner diameters of the cage specified in the present claim nor their size relative to other features and therefore cannot serve either directly or indirectly as a basis for determining the claimed ratios*" (Reasons 2.1.2).

In decision T 451/88 (Reasons 2.4) the board referred to decision T 204/83 to conclude that the drawing of a prior-art tyre in a patent had to be distinguished from a scaled construction drawing such that it could not be derived from the prior-art drawing whether a ratio between two distances was between about 0.25 and 0.40.

In contrast, in T 748/91 (Reasons 2.1.1) in the context of an objection against added subject-matter, the board found that the feature whereby the profile depth of an intermediate layer was smaller than the thickness of a superposed surface layer could be read from a schematic cross-sectional view of a bearing, taking into account that the thicknesses of the layers and the ratio of these thicknesses to each other clearly formed essential items of the invention.

Likewise, in T 422/95 (Reasons 2.1.4) an amendment concerning the relative size of a gap and the thickness of a wall was considered to be clearly recognisable from a drawing in the patent application, considering that the patent drawing resembled a construction drawing.

In T 1200/05 (Reasons 2.2), the feature whereby an axle was fixed asymmetrically between two spring elements was deemed to be disclosed in a prior-art drawing that was quite precise.

4.2 According to established case law, it is a prerequisite for the acceptance of lack of novelty that the claimed subject-matter is "directly and unambiguously derivable from the prior art". This is no different when deriving dimensions from prior-art drawings, which are to be regarded as an integral part of a prior-art patent publication (T 169/83, OJ 1985, 193). Features can therefore be taken from the drawings of a patent publication if their structure and function are clearly, unmistakably and fully derivable from the drawings.

4.3 The board observes that patent drawings in the field of mechanical engineering, especially cross-sectional views, often reveal the complete structure of a device to a high degree of detail and go beyond a mere schematic representation of the essential features. Yet this does not mean that such drawings are to be regarded on a par with construction drawings, which may generally be relied on to show dimensions and proportions of elements to scale.

Therefore it stands to reason that the conclusion of

T 204/83 that dimensions obtained solely by measurements carried out on a diagrammatic representation do not constitute part of the disclosure also applies to patent drawings that accurately portray an invention but do not qualify as construction drawings.

4.4 However, the question arises as to whether the relative size of dimensions or of ratios between dimensions can be inferred from patent drawings merely by visual perception.

The board concurs with decision T 204/83 (Reasons 4) that it would be impossible to lay down general rules and that each case will depend on the knowledge of the person skilled in the art and the way in which the feature in question is shown in the drawing.

4.5 In the present case, the dimensional constraints at issue set a lower limit for a ratio between two dimensions x and y ($x/y \geq 0.2$ or $y \leq 5x$) and compare two ratios of four dimensions x, y, u and v with each other ($x/y \leq u/v$), respectively.

The board is not persuaded that the "=" variant of either constraint can be derived directly and unambiguously from a patent drawing, irrespective of the degree of detail it shows, without actually measuring the respective dimensions. Inferring from a visual perception only that a dimension y equals five times a dimension x or that four dimensions have the proportional relationship $x/y = u/v$ verges on speculation and does not correspond to the standard of clear and unmistakable disclosure.

This is different when a strict inequality is claimed, which essentially defines an open-ended range. The board acknowledges that a detailed cross-sectional view may in some circumstances directly imply that one dimension is much larger than a second dimension (cf. T 748/91, T 422/95 or also T 1313/04, Reasons 2.2 and 2.3). Nevertheless, these cases pivot on the direct comparison of two dimensions ($x > y$ or $x/y > 1$). This cannot be placed on an equal footing and judged in the same manner as a constraint that compares a first dimension with a multiple of a second dimension ($x/y > 0.2$ or $y < 5x$). Deducing how often a tooth width fits into a second tooth width from merely looking at a patent drawing is not straightforward and therefore tends to be ambiguous. Furthermore, any such comparison includes the mental step of apportioning a length in particular quantities, which can be considered as a way of measuring that length.

5. Novelty in view of document D3

5.6 Figures 1 to 11 of document D3 are cross-sectional views of a prior-art self-locking threaded connection. They show some details of the threaded zones, but clearly do not qualify as construction drawings. The board is not convinced that the drawings are to scale or that they present all the major dimensions of the threads in proportion. The dimensions or ratios obtained by measuring the teeth on these drawings therefore do not constitute part of the disclosure (see point 4 above)

5.7 Figures 1 and 2 show a fragmentary section of a box and pin of the connection stab position and at full make-up, respectively (see page 11 of document D3). No

information is given on the circumferential position of the pipe joint at which these sections were taken. There is therefore no way of telling whether the figures actually show the teeth closest to the male or female terminal surface. Even assuming that this is the case, the drawings are not detailed enough to conclude without ambiguity that the width CWTbmax of the female tooth furthest from the terminal surface 26 of the female end (the bottom tooth on the left-hand component in Figure 2 reproduced alongside) is smaller than five times the width CWTpmin of the tooth closest to the terminal surface 27 of the male end (the bottom tooth on the right-hand component). Similarly, the skilled person would not clearly and unmistakably derive from the drawings alone that the dimensions close to the terminal surface 26 are such that ratio H is smaller than ratio G, let alone that ratio H equals ratio G.

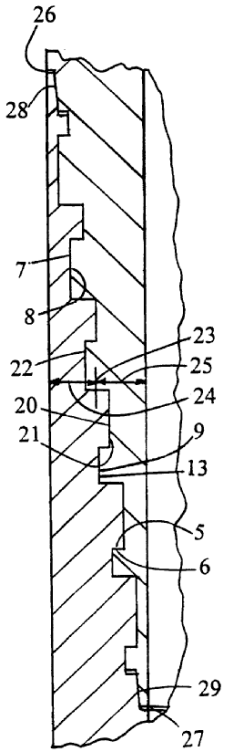

FIG. 2

5.8 From the wording of claim 12 of document D3 "*the least axial length of the first pin thread crest (9) being dimensioned substantially the same magnitude as the least axial length of the first box thread crest (16)*" the board notes that it is not the width of the teeth that is compared, but rather the width of the thread crests at opposite ends of the male and female threaded zone. Even if this were interpreted to mean that the width CWTpmin was substantially equal to the width CWTbmin, and further assuming that the skilled person could deduce from the definition on page 2, lines 13-19 of document D3 that the threaded zone was symmetric so

that the width CWTbmax substantially equalled the width CWTpmax, this would merely imply that the ratio H is *close to* the ratio G. There is, however, no direct and unambiguous disclosure that leads to the conclusion that ratio H is not larger than ratio G.

5.9 The board arrives at the same conclusion in respect of the embodiment shown in Figure 7 of document D3. Despite the *impression* Figure 7 may convey, namely that the width CWTpmax is larger than the width CWTbmax, there is no direct and unambiguous disclosure of the proportion of the smallest and largest teeth width, let alone that the teeth can be measured to determine the respective ratios.

5.10 Features G and H are therefore not disclosed by document D3.

6. Novelty in relation to Figures 3 and 4 of the patent

Regardless of the question whether the threaded connection of Figures 3 and 4 actually belongs to the state of the art according to Article 54(2) EPC, the board finds that the description of the figures does not mention or suggest the dimensions of the various tooth widths or the (relative size of the) ratios G and H. Moreover, such information cannot be clearly and unmistakably inferred from the drawings, which do not qualify as to-scale construction drawings. As remarked in point 4.5 above, the compliance of the "=" variant of feature H cannot be concluded on the basis of estimated values for the four different widths visually inferred from the drawings.

Therefore, features G and H are not disclosed by Figures 3 and 4.

7. Novelty in relation to documents D1, D2, D4, D5, D6 and D7

With regard to documents D1, D2 and D4-D7, the board also has no reason to depart from the finding of the impugned decision that they do not disclose features G and H.

None of these patent documents discloses any dimensions, dimensional ratios or other geometrical information that would lead the skilled person to draw a conclusion on the relative widths of the respective teeth.

The drawings are mostly schematic cross-sections of the structure of a prior-art thread that are unable to serve as a basis for measuring the minimum and maximum tooth widths close to the terminal surface of the male and female ends (see point 4 above). The appellant has also failed to convince the board that it was evident that the ratios between the minimum and maximum widths corresponded to a meaningful technical teaching that could be inferred without ambiguity by merely looking at the drawings.

This also applies to Figures 3 and 6 of document D7, in respect of which the appellant argued that relevant values for ratios G and H can be measured since the description contains two confirmations that the drawings proportionally represent the thread widths. Even if the passage in column 4, lines 53 to 66 of document D7 gave the ratio of the width CWTpmin to the width CWTpmax for the embodiment of Figures 2 and 3, the skilled person would not be able to derive the ratios G and H from this. The board is not persuaded by

the appellant's argument that the skilled person would measure the very small teeth in Figures 2 and 3 to an accuracy of one tenth of a millimetre, calculate the ratio CWTpmax to CWTpmin from this and conclude from comparing this ratio with the values given in the description that all drawings of document D7 are to scale.

8. Novelty in relation to documents D8 to D12

8.1 The board judges that the numerous drawings included in documents D8, D9, D10, D11 and D12 are of a schematic nature. They show some details of the threaded zones but do not qualify as detailed or accurate drawings, let alone as to-scale construction drawings.
Given that there is no indication of the teeth dimensions in the accompanying text and tables, the skilled person is not in a position to conclude from the teaching of the documents whether the constraints of features G and H are met.

8.2 The appellant argued additionally that the illustrations on the front page of brochures D9 and D10 are photographs of an actual pin member and that the skilled person could measure the threads on these photographs in accordance with decision T 857/91.

The board agrees with the finding of the impugned decision (point 4.11 on page 11) that there is no evidence that the photographs are independent reproductions of a real threaded pin as opposed to, for example, a stage prop used so as not to endanger the actor with a suspended full-length pipe. Even assuming that the illustrations are photographs and not merely a montage of a real pin, the angle at which the photographs were taken is unclear - unlike the

situation in T 857/91 where "*as is given by Photo 1, at the bottom of which it is expressly indicated that transverse cross sections are shown and not only shapes*" (Reasons 3.2). Furthermore, reasonable doubts arise as to whether the teeth which are closest to and furthest from the terminal surface, respectively, can actually be seen on the photographs. In addition, the female part of the threaded connections is absent from the photographs.

As mentioned above in respect of document D3, even if it were possible to measure the respective widths with sufficient precision, and the result of the measurements were that the width CWTpmin substantially equalled the width CWTbmin and the width CWTpmax substantially equalled the width CWTbmax, this would only imply that the ratio H is *close to* the ratio G. There is, however, no direct and unambiguous disclosure in the photographs of documents D9 and D19 that ratio H is not larger than ratio G.

9. In view of the above, the subject-matter of claim 1 is novel (Article 54(1) and (2) EPC).

Inventive Step

10. In order to assess the inventive step of the subject-matter of claim 1, the appellant started from the embodiment shown in Figures 1-3 of document D3. The respondents did not object to this choice of starting point. The board does not see any reason to deviate from this.

11. As explained under 'Novelty' (see point 5 above), the subject-matter of claim 1 differs from the starting

point in that ratio G ≥ 0.2 (feature G) and in that ratio H ≤ ratio G (feature H).

12. The board is not persuaded by the appellant's argumentation that features G and H are not functionally interdependent and give rise to two partial problems.

According to paragraphs [0033] and [0037] of the patent, the constraint of feature G lowers the risk of deterioration due to shear and improves the resistance of the smallest tooth on the male threaded zone to alternating tensile/compressive stresses. Increasing the width CWTpmin of the smallest male tooth relative to the width CWTbmax of the largest tooth on the female end, however, also means that the length of the engaged threaded zone will be shortened for the same wedge ratio or that the wedge ratio has to be increased for the same thread length.

According to paragraphs [0038] and [0039], the constraint of feature H overcomes this hurdle by accentuating the disproportion between the width CWTbmin of the smallest female tooth and the width CWTpmax of the largest male tooth. As a consequence, the threaded zone can extend over the same thread length without the wedge ratio changing.

These considerations show that features G and H are more than a mere aggregation of distinguishing features; they have a combinative effect beyond the sum of their individual effects.

13. The board shares the appellant's view that the objective technical problem should not necessarily be taken from the patent specification. In particular,

where the issue of inventiveness is considered against a piece of prior art which comes closer than that mentioned in the patent specification, it is often expedient to reformulate the original technical problem defined in the specification. Conversely, this does not mean that a reformulation is imperative when a new starting point is fixed.

From the combinative effect of the distinguishing features, it follows that the objective technical problem is to strengthen the threaded connection close to the end of the male threaded zone without modifying the total length or the lead of the threaded zone.

14. The board notes that the objective technical problem is not discussed or touched upon in any of the prior-art documents.

The academic publication D33 submitted by the appellant indicates that the equivalent stress at the outermost ends of the male and female part of a specific, API-type threaded connection with a constant tooth width reaches high values. However, the board concurs with the respondents that this analysis is of minor relevance to a self-locking threaded connection.

15. It may be assumed that the activities deemed normal for a skilled person seeking to strengthen a threaded connection include the optimisation of the teeth dimensions. The appellant has nonetheless failed to convincingly demonstrate why the skilled person would strengthen the weakest zone close to the terminal surface on the male end while weakening the opposite zone close to the terminal surface on the female end. In this respect, the reasoning given in point 5.4 of the impugned decision convinces the board: the skilled

person has various options at hand, other than adapting the thread width, when seeking to solve the objective technical problem. Page 7, lines 36-43 of document D3, for example, gives a long list of dimensional parameters, including the angle of the stab and load flanks, their radial width, their lead, etc. In a complex construction subject to high performance requirements, such as a pipe joint, every dimensional parameter of the threaded connection is important and needs to be controlled within tight tolerance limits.

16. Under 'Novelty' it was established that none of the pieces of prior art cited by the appellant discloses a threaded connection having a width CWTbmax of not more than five times the width CWTpmin (see points 5 to 8).

In spite of the routine practice of the skilled person, which would make it plausible to tweak the width CWTpmin of the smallest male tooth so as to strengthen the male threaded zone, the board cannot find any incentive in the prior-art documents to fix a minimum width as a function of the width of the largest female tooth, let alone to exclude ratios below 0.2.

17. Regarding feature H, the appellant argued that claim 12 of document D3 implied that the width of the smallest male tooth was substantially equal to the width of the smallest female tooth.

The board notes that both claim 12 and the passage in lines 2 to 4 on page 10 of document D3 refer to the axial length of the *crest*, i.e. the length of the top surface of a tooth. As teeth of threaded connections often have a trapezoidal cross-sectional shape, the crest width does not automatically correspond to the width of the tooth.

By virtue of a diagram showing the male and female threads in their unwrapped configuration, the appellant has credibly argued that the tooth widths CWTbmax and CWTpmax would be substantially equal in the theoretical case where CWTpmin was substantially equal to CWTbmin and where the leads of both the stab flanks and the load flanks were kept constant.

Yet this would entail a ratio H substantially *close to* - but not necessarily equal to - a ratio G. The appellant has not convinced the board why the skilled person would be prompted to select the width of the respective teeth in such a way that ratio H was *not larger than* ratio G.

18. Hence, the board concludes that the appellant has failed to show that the claimed subject-matter is obvious in the light of the cited prior art. Claim 1 therefore involves an inventive step (Article 56 EPC).

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

N. Schneider M. Poock

Decision electronically authenticated