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Datasheet for the decision of 21 June 2007

Case Number: T 0856/04 - 3.2.03

Application Number: 97930490.4

Publication Number: 0907822

IPC: E21B 43/10

Language of the proceedings: EN

Title of invention:
Method for expanding a steel tubing and well with such a tubing

Applicant:
SHELL INTERNATIONALE RESEARCH MAATSCHAPPIJ B.V.

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step (yes) - remote technical field"

Decisions cited:
-

Catchword:
-

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0856/04 - 3.2.03

D E C I S I O N
of the Technical Board of Appeal 3.2.03
of 21 June 2007

Appellant: SHELL INTERNATIONALE RESEARCH MAATSCHAPPIJ B.V.
Carel van Bylandtlaan 30
NL-2596 HR Den Haag (NL)

Representative: -

Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 18 February 2004 refusing European application No. 97930490.4 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: U. Krause
Members: E. Frank
K. Garnett

Summary of Facts and Submissions

I. The appellant lodged an appeal, received at the EPO on 26 April 2004, against the decision of the Examining Division notified by post on 18 February 2004, refusing the European patent application No. 97 930 490.4 filed as an international application PCT/EP97/03489 and published under the international publication number WO 98/00626. The appeal fee was paid simultaneously and the written statement setting out the grounds of appeal was filed on 9 June 2004.

II. The Examining Division held that the subject-matter of claim 1, filed with letter of 3 June 2002, lacked inventive step (Article 56 EPC) having regard to the state of the art as disclosed in the following documents:
D1 = US 5 366 012 A
D3 = US 3 901 063 A

III. The appellant had not requested oral proceedings, but in order to expedite matters, the Board of its own volition appointed oral proceedings in accordance with Article 116(1) EPC. A communication pursuant to Article 11(1) of the Rules of Procedure of the Boards of Appeal was issued, together with a summons to attend oral proceedings on 21 June 2007. The communication set out the provisional view of the Board on the clarity of claim 1, novelty of claim 16 and inventive step of claims 1,15 and 16 (Articles 84, 54 and 56 EPC, respectively).

Oral proceedings were duly held on 21 June 2007. During the oral proceedings the appellant filed a new set of

claims and requested as its sole request that the decision under appeal be set aside and a patent be granted on the basis of the following documents:

- claims 1 to 15 as submitted during the oral proceedings of 21 June 2007

- description pages 1,2,4,5,5A received on 25 June 1998
- description pages 6,8,9 filed during the oral proceedings of 21 June 2007
- description pages 3,7,10 and 11 as published

- figure sheet 1/1 as published.

IV. The wording of the independent claims 1 and 15 of the sole request is as follows:

"1. A method of expanding a steel tubing (4) which is made of a formable steel grade, the method comprising the step of moving an expansion mandrel (5) having a tapering expansion section (6) through the tubing (4) thereby plastically expanding the tubing, characterized in that an at least partly solid tubing (4) is expanded which is made of a formable steel grade which is subject to strain hardening without incurring any necking and ductile fracturing as a result of the expansion process and that the tapering expansion section (6) of the expansion mandrel (5) has a tapering ceramic outer surface."

"15. A well provided with a tubing (4) which is expanded using the method of any preceding claim, wherein the tubing (4) serves as a production tubing through which hydrocarbon fluid is transported to the

surface and a reelable service and/or kill line passes through at least a substantial part of the length of the interior of the tubing (4), through which line fluid can be pumped towards the bottom of the borehole while hydrocarbon fluid is produced via the surrounding production tubing (4)."

V. The Appellant's arguments submitted in writing with respect to claim 1 can be summarized as follows:

D1 concerns the completion of an uncased section of a borehole in an underground formation. The method of claim 1 was distinguished from the disclosure of D1, in that the tapering surface of the expansion mandrel is ceramic. Document D3 discloses a ceramic mandrel. However, that mandrel was used in a tube drawing process, where a tube is pulled through a die on a drawing bench in order to reduce the diameter of the tube. Thus, D3 related to a different field of technology. Moreover, D3 did not address the problem of reducing frictional forces between the ceramic plug described therein and the tubing, since there was no disclosure in D3 that, by virtue of movement during the drawing process, the tube contacted the tapering portion of the ceramic plug. Therefore claim 1 was not obvious over D1 in view of D3.

Reasons for the Decision

1. The appeal is admissible.

2. *Inventive step*

2.1 Claim 1

D1 deals with the expansion of a steel tubing, and hence can be considered as closest prior art.

D1 discloses:

A method of expanding a steel tubing ("slotted liner 11") which is made of a formable steel grade (cf.col.3, "Table" and footnotes of the table), the method comprising the step of moving an expansion mandrel ("15") having a tapering expansion section (cf. figs.1,5,6) through the tubing ("slotted liner 11") thereby plastically expanding the tubing (cf.fig.2).

Any cold deformation of steel, such as the plastic expansion of the slotted liner (11) of D1, requires a formable steel material and results in strain hardening. Moreover, as acknowledged by the Appellant in its letter of 15 November 2000, the term "formable" is generally understood to mean that the tubing is able to maintain its structural integrity while being plastically deformed, and therefore such deformation will not incur any necking or ductile fracturing. The term "at least partly solid", which is used to define the tubing, can be understood in a broad sense to include any tubing having solid or partially solid walls, such as solid tubes or tubes made of a solid material, but comprising apertures of any shape, for example the slots of D1.

Thus, the subject-matter of claim 1 on file differs from the disclosure of D1 only in that the tapering outer surface of the mandrel is made of ceramic material.

Since the tapering ceramic surface of the mandrel reduces friction forces during the expansion process, the underlying objective problem of the provision of a tapering ceramic surface can be seen in a further reduction of expanding forces between the steel tubing and the expansion mandrel.

The Examining Division held that the claimed solution was obvious in view of document D3 disclosing a plug having a ceramic tapering portion for reducing friction in tube drawing.

The Appellant argues that there was no disclosure in document D3 that, by virtue of the tube movement during the drawing process, the tube contacted the tapering portion, viz. the "frusto-conical portion 12" of the "plug 10". However, it is generally known in the art of tube drawing that a conical plug mounted at the tip of a plug bar was first used in tube drawing processes so as to have an effect on the deformation of the inner surface of the tube (i.e. in contact with the tube) at a position earlier than was previously possible with a plug which is cylindrical throughout. D3 explicitly describes in column 2, lines 12-21 how the inherent weakness of a ceramic plug in tension will be obviated since the plug described there will be pre-stressed, and therefore a desirable property of ceramic material, namely the low frictional forces that are generated in use, can be utilised. If the ceramic material of the

"plug 10" of D3 is actually exposed to tensile stress during the tube drawing process, this tensile stress must be caused by the frictional forces between the tapered outer ceramic surface of the plug and the inner surface of the tube to be drawn.

However, in determining whether or not a skilled person, striving to solve the problem encountered in one document would take the other document into consideration as expecting to find a solution in the latter, first of all it has to be considered whether the documents, viz. D1 and D3, come from similar, neighbouring technical fields. D1 concerns the technical field of drilling a borehole to produce hydrocarbons from a hydrocarbon-containing formation. The expansion of the "slotted liner 15" described in D1 takes place at the location of the hydrocarbon-containing formation, where the upper end of the liner is fixed to the lower end of the casing arranged in the borehole, i.e. at a considerable depth. Since D1 deals with a non-stationary process "in situ" deep in a borehole, it does not seem that any precise or defined application of force onto the "slotted liner 15" by means of the "expansion mandrel 15" could be achieved. Moreover, pressure of fluids from the formations penetrated by the well is applied to the outside of the "slotted liner 15" and onto the "expansion mandrel 15". In contrast thereto, D3 relates to the technical field of tube drawing operations. Such a tube drawing operation requires the arrangement of a stationary drawing bench, on which precision tubes with a relatively small diameter, such as cardan shafts, steering linkages, etc., are usually produced. The tube is pulled through a (conical) converging die to

decrease the outer diameter. A better control over the inner surface of the tube can be provided by placing a cylindrical mandrel inside the tube at the throat of the die. The mandrel determines the wall thickness and inner diameter, as well as producing a smooth, mirror-like surface finish inside the tube. A stationary mandrel or plug bar is clamped to the frame of the draw bench and a conical plug can be mounted at the tip of the stationary mandrel or plug bar in order to have an effect on the inner surface at a position earlier than is possible with a cylindrical plug. The tension exerted on the plug depends on the friction between the plug and the tube, and on the cone angle of the plug. The stationary drawing bench comprises (hydraulically) movable grips which pull the tube in several passes through several appropriate stationary dies and plugs, whereby substantial forces will be applied to the tube, the die and the plug. As a result, the tube diameter will be reduced and strain-hardening of the tube takes place. Consequently, D3 concerns a stationary precision process comprising a clearly defined pass reduction schedule of specific die angles, cone angles of the plug, friction values, drawing forces etc.

It is evident from the foregoing description that the documents D1 and D3 belong to different technical fields each involving specific problems. Therefore the skilled person, starting from the in situ expansion of a slotted liner at the deepest point of a fluid-penetrated underground borehole as described by D1, would not have any incentive to consider the remote technical field of the stationary precision process of the tube drawing disclosed in D3, which serves to reduce a tube diameter. In the decision of the

Examining Division, it is argued that the way in which the plug and the tube interact was not relevant because claim 1 of the present application on file did not mention how the expansion section interacts with the tube. This argument cannot be accepted by the Board, since if D1 and D3 were to be combined, the skilled person would be bound to the respective teachings of D1 and D3 with regard to how the plug and the tube interact therein. A combination of the two teachings would appear to lead to an incompatible arrangement of the plug of D3 with the tube of D1.

Thus, faced with the objective problem, there is nothing that would prompt the skilled person to combine documents D1 and D3.

From the above the Board concludes that the method according to claim 1 involves an inventive step in the sense of Article 56 EPC, as required by Article 52(1) EPC.

2.2 Claim 15

Claim 15 is directed to a well provided with a tubing which is expanded using the method of "any preceding claim", including claim 1. Apart from the use of a formable steel for the expanded tubing, this reference to the expansion method cannot define the well because, as outlined above in connection with claim 1, any expanded, at least partially solid tubing made of formable steel will be subject to strain hardening without incurring any necking or ductile fracturing as a result of the expansion process, irrespective of the type or shape of mandrel which is used for expansion.

The expanded tubing cannot, therefore, be distinguished by the method of producing it.

Bearing this in mind, document D6 (US 5 014 779 A), which is cited in the present application and has also been cited in the International Search Report, represents the closest prior art because it discloses pipes (15) having been run into the borehole and expanded into tight engagement with the wall of the borehole by means of an expanding member (see column 4, lines 12 to 28). Although it is not explicitly said that the pipes are made of formable steel, steel pipe material is common and the initial profiled shape of the pipe requires the material to be formable during expansion.

The subject-matter of claim 15 therefore differs from the disclosure of D6 in that the tubing serves as a production tubing, through which hydrocarbon fluid is transported to the surface, and in that a reelable service and/or kill line, which passes through at least a substantial part of the length of the interior of the tubing, through which line fluid can be pumped towards the bottom of the borehole while hydrocarbon fluid is produced via the surrounding production tubing, is foreseen.

The objective problem is considered to lie in the efficient use of the wellbore during production, whilst enabling a smooth insertion of the production tubing even if the well is deviated (see present application, page 9, lines 17-25 as published).

Although the apparatus described by D6 might be suitable for an expansion process of a production tubing, due to the rotating "spherical segment 9" which is screwed onto and rotated by the "drill string 18", no hint is derivable from D6 that a well could actually be provided with an expanded production tubing. Documents D4(= US 3 203 483 A) and D5 (= US 3 191 677 A), both dealing with the expansion of short steel liners within casings, are less relevant, since the expansion devices disclosed therein apparently cannot be used for an expansion of a production tube having any length. Furthermore, the provision of a service line (or a kill line) within the tubing of a well, in order to facilitate injection of kill and /or treatment fluids, which is normally done via the annulus between the production tubing and the well casing, is not derivable from the prior art documents on file. Thus, faced with the objective problem, there is no indication in the prior art that would have led the skilled person to the subject-matter of claim 15.

Therefore claim 15 meets the requirements of Article 52(1) EPC.

2.3 Finally, the dependent claims 2 to 14, which concern particular embodiments of the invention also meet the requirements of Article 52(1) EPC.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the first instance with the order to grant a patent on the basis of the following documents:

- claims 1 to 15 as submitted during the oral proceedings of 21 June 2007

- description pages 1,2,4,5,5A received on 25 June 1998
- description pages 6,8,9 filed during the oral proceedings of 21 June 2007
- description pages 3,7,10 and 11 as published

- figure sheet 1/1 as published.

The Registrar The Chairman

A. Counillon U. Krause