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D E C I S I O N
of 24 October 2002

Case Number: T 0150/00 - 3.4.2

Application Number: 95118200.5

Publication Number: 0717272

IPC: G01H 5/00

Language of the proceedings: EN

Title of invention:
Method for measuring the propagation velocity of ultrasonic acoustic waves through rock fragments

Patentee:
ENI S.p.A.

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step - yes"

Decisions cited:
-

Catchword:
-

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0150/00 - 3.4.2

D E C I S I O N
of the Technical Board of Appeal 3.4.2
of 24 October 2002

Appellant: ENI S.p.A
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 16 November 2002 refusing European patent application No. 95 118 200.5 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: E. Turrini
Members: A. G. M. Maaswinkel
V. Di Cerbo

Summary of Facts and Submissions

I. The appellant lodged an appeal, received on 16 December 1999, against the decision of the examining division, dispatched on 16 November 1999, refusing the European patent application 95 118 200.5. The fee for the appeal was paid on 16 December 1999 and the statement setting out the grounds of appeal was received on 2 February 2000.

The ground for the refusal was that the subject-matter of the claims then on file lacked an inventive step (Articles 52(1) and 56 EPC) having regard to the teaching of document D1 combined with D2, D3 and D4 for the subfeatures of claim 1 not known from D1, the numbering of the documents being:

D1: US-A-3 995 501

D2: US-A-4 933 911

D3: US-A-4 365 516

D4: ASTM Designation D 2845-90, "Standard Test Method for Laboratory Determination of Pulse Velocities and Ultrasonic Elastic Constants of Rock", pages 362 to 366.

II. Oral proceedings were held on 24 October 2002. The appellant requested that the decision under appeal be set aside and a patent be granted on the basis of the following documents:

Claims: 1 to 4 filed at the oral proceedings;
Description: pages 1 to 8, 8a, 9 to 12 filed at the

oral proceedings;

Drawings: Figures 1 to 4 as originally filed.

III. The wording of claim 1 reads as follows:

"Method of mechanically characterizing rock formations while drilling a well in the oil industry, comprising the following steps:

- collecting a rock cutting which arrives on the surface during the drilling, the cutting having dimensions of even less than one centimeter and an average pore radius of even more than 50 µm,
- grinding two flat parallel sides on the cutting and measuring the thickness,
- introducing the cutting into a pair of piezoelectric transducers with a coupling fluid between the cutting and the transducers,
- passing ultrasonic waves through the cutting, said waves being generated by a pulse generator with a pulse width varying from 0.1 µs to 20 µs,
- visualizing the obtained electric signals by an oscilloscope with a resolution of at least 10^{-2} µs, and
- measuring the transit time of the waves through the cutting for getting a real time measurement of the propagation velocity without interrupting the drilling."

Claims 2 to 4 are dependent on claim 1.

IV. The arguments of the appellant may be summarised as follows:

The invention concerns a method of characterizing the properties of rock formations while drilling a well in

the oil industry. One prior art method for characterizing these properties involves recording sonic logs which is carried out by lowering a probe inside the well. A second known method includes measuring in a laboratory the velocity of compressional and shear ultrasonic waves through the core samples which are collected from the well after stopping the drilling. Therefore these processes suffer from the problem that in order to position the probe in the well or to collect a core sample from the well the drilling operations have to be interrupted which is very time consuming and costly. The applicant has discovered that the so-called cuttings, small particles or rock fragments which are collected from the circulating fluid return during the drilling process, can be analysed by measuring their acoustic velocity and has demonstrated that the velocities measured in this way are very similar to the velocities measured on a large reference core. This result is surprising, because so far in this technical field the conviction had prevailed that the microstructure properties of these cuttings are strongly altered during the drilling process because of the applied stress and the transport in the slurry, and that they would therefore not provide useful data. This view is, for instance, expressed in document D4, page 364, paragraph 5.1, where it is emphasised that care should be exercised "in core drilling, handling, sawing, grinding and lapping the test specimen to minimize the mechanical damage caused by stress and heat". This technical prejudice had existed for over 40 years. Since the cuttings are obtained *during* the drilling process, which therefore does not need to be interrupted and the cuttings can be measured following the claimed method with 10 to 12 determinations per hour the claimed

process also provides a considerable economic advantage, which is also documented in its application nowadays at drilling platforms throughout the world. Hence the claimed method fulfils a number of criteria showing its contribution to inventive step (technical prejudice, long-felt want, considerable economic profit). From the prior art on file, none of the cited documents relating to the measurement of velocities in rock samples discusses or suggests that these samples may be obtained *during* drilling. Furthermore in the prior art only documents D1 and D4 relate to determining pulse velocities in core samples, which, however, have much larger dimensions than those of cuttings and which cannot be obtained during the drilling, but only by taking samples after the drilling has stopped.

Reasons for the Decision

1. The appeal is admissible.

2. *Amendments*

2.1 Article 84 EPC

The board is satisfied that the newly introduced term "cuttings" in claim 1 has an unambiguous and general accepted meaning in the technical field of drilling of oil wells, as explained on page 3, lines 4 to 5 of the application documents. Hence, the expression "the cutting having dimensions of even less than one centimeter and an average pore radius of even more than 50 µm" is clear to the skilled person in this technical field.

2.2 Article 123(2) EPC

Furthermore to the introduction of the term "cuttings", which find its support in the original disclosure (*point 2.1 supra*), claim 1 is now directed to a "method of mechanically characterizing rock formations while drilling a well in the oil industry", whereas claim 1 as originally filed defined a "method for measuring the propagation velocity of ultrasonic waves through rock fragments, coming directly from the drilling of wells in the oil industry". This new definition reflecting the general technical field is supported by page 2, lines 2 to 3 of the original application which in the subsequent paragraphs discusses the prior applied methods (sonic logs and laboratory measurement of velocities of core samples). Other minor amendments of the claims and the description are equally not objectionable under Article 123(2) EPC.

3. *Patentability.*

3.1 Novelty

The method of claim 1 is related to mechanically characterizing rock formations in the oil industry while drilling a well. The claimed method defines that this characterization should be carried out *during* the drilling process. The available prior art teaches methods which can only be carried out *after* the drilling has stopped. This equally applies to the sonic log method, referred to on page 2, line 20 to page 3, line 1 of the patent application as filed; and to the measurement in the laboratory of rock cores addressed in documents D1 and D4. Document D2 is related to the method of determining seismic velocities of a general

"sample of the earth" as a function of applied pressure. Document D3 discloses the composition of a couplant gel providing a suitable coupling between an ultrasonic transducer and a component to be tested.

Therefore the subject matter of claim 1 is not anticipated by any of the prior art citations on file.

3.2 Inventive step

3.2.1 As discussed in point 3.1, the subject matter of claim 1 differs from the prior art methods in the requirement that the material (rock cuttings) obtained *during* the drilling process is used for the determination of velocities. Furthermore by virtue of the way it is collected this material has a size which is typically much smaller than the size of core samples from the well. For instance, document D1, column 9, lines 23 to 27, discloses to use a "3/4-inch diameter core cut from a larger core. The cores are cylindrical and approximately 13/8 inch long". Document D4, Section 5.1 refers to the test specimen coming from "core drilling"; Figure 3 shows a schematic test specimen between two transducers, its width (C) apparently having a lateral dimension of more than 20mm. Also Figure 4 of D4 shows a graph wherein the specimen diameter is in a range from 0 to 4 inch and has a length between 0 and 20 inch. Therefore the board finds the arguments of the appellant credible, that the dimensions of the test samples used in the prior art are typically much larger than those of the cuttings which are analysed in the claimed method.

3.2.2 The board furthermore observes that in none of the prior art documents a teaching or a suggestion is found

which would lead the skilled person to characterise rock formations by using the cuttings which arrive at the surface *during* the drilling of a well. It would rather appear that the prior art emphasised that in preparing a test specimen care should be exercised that its properties should not be altered, see document D4, chapter 5.1. In the same chapter it is recommended that liquids other than water should be prevented from contacting the specimen, which cannot be excluded in the case of cuttings, which are transported through a slurry or brine. Furthermore documents D1 and D2 emphasise the importance of applying during the velocity measurement an external pressure to the specimens (cores) in order to correctly simulate the *in situ* effective pressure conditions. Hence it appears that the skilled person would not have expected that useful data could be obtained by analysing the cuttings and that the prior art rather taught against an use of specimens of smaller size and collected during the drilling under harsh external conditions .

3.2.3 In summary, the available prior art does not discuss the problem underlying the present patent application, namely to mechanically characterise rock formations in a well without having to interrupt the drilling. Since, furthermore, the rock specimens in the prior art are typically much larger in size than the cuttings used in the claimed method, and since, moreover, the prior art emphasises the importance of measuring samples in their original physical and material conditions, it cannot be seen why and how the skilled person would be lead to modify the prior art measurement methods.

3.2.4 For these reasons, the subject matter of claim 1 involves an inventive step within the meaning of

Article 56 EPC. Claims 2 to 4 are dependent on claim 1 and therefore, their subject matters also involve an inventive step.

4. For the above reasons, the Board finds that the request of the appellant meets the requirements of the EPC and that a patent can be granted on the basis thereof.

Order

For these reasons it is decided:

1. The decision under appeal is set aside.

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

Claims: 1 to 4 filed at the oral proceedings;

Description: pages 1 to 8, 8a, 9 to 12 filed at the oral proceedings;

Drawings: Figures 1 to 4 as originally filed.

The Registrar: The Chairman:

P. Martorana E. Turrini