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DECISION
of 15 October 2003

Case Number: T 0649/01 - 3.4.3

Application Number: 95302295.1

Publication Number: 0677754

IPC: G01V 5/10

Language of the proceedings: EN

Title of invention:

Method and apparatus for well logging using an accelerator
neutron source

Applicant:

SCHLUMBERGER LIMITED, et al

Opponent:

-

Headword:

-

Relevant legal provisions:

EPC Art. 56

Keyword:

"Inventive step (yes)"
"Could-would approach"

Decisions cited:

-

Catchword:

-



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Boards of Appeal

Chambres de recours

Case Number: T 0649/01 - 3.4.3

D E C I S I O N
of the Technical Board of Appeal 3.4.3
of 15 October 2003

Appellant:

SCHLUMBERGER LIMITED
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Representative:

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Decision under appeal:

Decision of the Examining Division of the
European Patent Office dated 14 July 2000
refusing European application No. 95302295.1
pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: R. K. Shukla
Members: V. L. P. Frank
B. Günzel

Summary of Facts and Submissions

I. The appeal lies from the decision of the Examining Division dated 14 July 2000 refusing the European patent application No. 95 302 295.1 on the ground that the application did not meet the requirement of inventive step in the sense of Article 56 EPC. In the decision reference was made to the following prior art documents:

D1: Nuclear Instruments and Methods, vol. 100, 1972,
pp. 453-457

D4: GB-A-828 917

II. The appellant (applicant) lodged an appeal on 11 September 2000, paying the appeal fee the same day. The statement setting out the grounds of appeal was filed on 17 November 2000. Oral proceedings were requested as an auxiliary measure.

III. At the oral proceedings held before the Board on 15 October 2003 the appellant filed amended claims and pages of the description and requested that the decision under appeal be set aside and a patent be granted on the basis of the following patent application documents:

Claims: 1 to 30 filed during the oral proceedings

Description: pages 1 and 5 to 9 as originally filed
pages 2 to 4 filed during the oral proceedings

Drawings: Sheets 1/9 to 9/9 as originally filed.

The wording of the independent claims is as follows:

"1. A method of determining a characteristic of an underground formation through which a borehole passes comprising using a tool (30) comprising a high-energy neutron source (32) and neutron detectors, the method comprising irradiating the underground formation with neutrons from the neutron source (32), detecting neutrons passing to the detectors from the formation so as to produce a signal and using the signal to determine the characteristic of the underground formation, characterised in that the detectors comprise a high pressure ⁴He proportional counter (38) which detects neutrons having energies of about 1 MeV which have passed from the source (32) to the counter (38) via the formation and produces a signal from which the characteristic of the underground formation is determined."

"16. Apparatus for determining a characteristic of an underground formation through which a borehole passes comprising a high energy neutron source (32) for irradiating the underground formation with neutrons when the apparatus is positioned in the borehole, and neutron detectors arranged to detect neutrons arriving from the formation so as to produce a signal related to the characteristic of the underground formation, characterised in that the detectors comprise a high pressure ⁴He proportional counter (38) including ⁴He at a pressure of about 40 atm for detecting neutrons originating from the source (32) arriving from the formation."

IV. In the decision under appeal the Examining Division argued as follows:

Document D4 discloses an apparatus for determining a characteristic of an underground formation through which a borehole passes, comprising a neutron source and a neutron detector whereby neutrons having energies above epithermal are detected and a signal thereof is used to determine the characteristic. Therefore, it is known to generate and use a signal indicative of neutrons having energies above epithermal for analysing a formation matrix. The method of claim 1 additionally defines 'a high pressure ³He proportional counter' as neutron detector for neutrons 'having energies of about 1 MeV'. However, ... no particular inventive step can be seen in making use of the results regarding the details of a ³He proportional counter as discussed in document D1, where it is stated that 'the purpose of calculating proportional counter recoil spectra is to allow the experimenter to design a detector having suitable response characteristics for particular applications of interest'.

- V. The arguments of the appellant in favour of inventive step can be summarized as follows:

The present application addresses the problem of measuring fast neutrons in borehole logging tools. The motivation for this is the realisation by the inventor that the transport of neutrons from high energy in the formation provides information about the matrix effects of the formation. This is very different from the normal use of neutron logging which provides information about the porosity of the matrix formations surrounding the borehole. Although document D4 considers the irradiation of the formation with high energy neutrons and the determination of the matrix characteristics from this, all the examples described therein utilize the detection of the radiation produced by the inelastic scattering of the neutrons in the formation and not of the fast neutrons that have

interacted with the formation. As acknowledged in the application in suit and as can be seen from the disclosure in document D1, 'He proportional counters are per se known in the art. However, the skilled person would not consider their use as appropriate for borehole logging due to the strong resonance of these detectors at about 1 MeV and their sharp cutoff below this energy. From this, it becomes evident that the argumentation of the Examining Division is based on hindsight.

Reasons for the Decision

1. The appeal is admissible.
2. *Amendments*

In the decision under appeal, there were no objections raised against the claims under Article 123(2) EPC, and the Board is also satisfied that the claims as amended during the examination proceedings complied with Article 123(2) EPC.

Claims 1 and 16 have been amended in the course of the appeal proceedings to clarify that more than one neutron detector is used for determining the characteristic of the formation and that the 'He proportional counter detects neutrons which have passed from the source to the counter via the formation. The Board is satisfied that there is a clear basis for these amendments in the application as filed.

The description was amended for consistency with the claims.

The Board is, therefore, satisfied that the amendments fulfill the requirement of Article 123(2) EPC.

3. *Inventive step (Article 56 EPC)*

The only issue in this appeal is that of inventive step.

3.1 Document D4 represents the closest state of the art. It discloses an apparatus for logging earth formations traversed by a borehole comprising a source of high energy neutrons and a detection system. The detection system includes means responsive to nuclear phenomena resulting from the irradiation of earth formations by neutrons of high and low energy. The detector types disclosed in document D4 include Geiger type detectors, proportional counters, ionization chambers or scintillation detectors (cf. D4, page 1, lines 35 to 53; page 4, lines 22 to 25).

The porosity of the formation is determined in the conventional method by detecting thermal or epithermal neutrons with energies well below 1 MeV. A ^3He gas proportional counter is usually employed for detecting these neutrons (cf. the application in suit, column 2, lines 12 to 24).

3.2 The Examining Division argued that document D4 discloses detection of neutrons having energies above epithermal energy (cf. page 2, lines 1 to 12; page 4, lines 22 to 25, 75 to 77 and 103 to 129). However, it is clear when the corresponding passages are read in their context that neutrons with energies above epithermal energy are not detected in document D4, but beta and gamma rays produced in the formation as a result of the inelastic scattering of these neutrons are detected (cf. page 4, lines 26 to 30, 49 to 53, 71 to 80; page 5, lines 1 to 5). Moreover, the examples in

document D4 relating to the identification of clay, sand, bauxite and limestone do not disclose the detection of fast neutrons, but only of gamma or beta rays produced by the inelastic scattering of the fast neutrons in the formation (cf. D4, pages 5 to 7).

3.3 Claim 1

3.3.1 The method according to claim 1 of the application in suit differs, therefore, from the method disclosed in document D4 in that

(i) fast neutrons having energies of about 1 MeV are detected,

(ii) a ^4He proportional counter is used to detect these neutrons which have passed from the source to the counter via the formation, and that

(iii) the characteristic of the underground formation is determined from the detected signal.

The use of a ^4He proportional counter provides, according to the application in suit information about the nature of the formation matrix and indicates the presence of gas in the formation by the detection of 1 MeV neutrons having interacted with the formation (cf. the application in suit, page 3, 4th paragraph).

3.3.2 In consequence, the objective problem addressed by the application in suit corresponds to the one formulated in the application as filed, namely to avoid the use of a chemical source of γ -rays, typically a ^{137}Cs isotopic source, which is conventionally used for determining the formation density by measuring the Compton scattering of γ -rays by electrons and which is known to

pose problems in its handling and shipping (cf. *ibid*, page 1, lines 12 to 15; page 2, 1st paragraph).

- 3.3.3 Document D1 is a Monte Carlo calculation of the recoil spectra of ^4He proportional counters for incident neutron energies from 0.4 to 14.0 MeV. This calculation allows to adapt the response characteristics of the ^4He detector to a particular application. The particular interest in employing ^4He proportional counters is for neutron spectroscopy with bare and slightly moderated neutron spectra from spontaneous fission, neutron induced fission (α, n) sources, and linac driven phot-nuclear production (cf. Abstract; page 453, left column, 'Introduction').

The Examining Division argued in the decision under appeal that document D1 discloses the use and design of ^4He proportional counters. It would, therefore, have been obvious to a skilled person to use such counters to detect 1 MeV neutrons.

- 3.3.4 The Board, however, concurs with the appellant that there is no pointer in document D1 or document D4 suggesting that the detection of 1 MeV neutrons in a borehole environment would provide any useful information on the formation matrix. The fact that such detectors were available, a fact already acknowledged in the application in suit, is insufficient in itself to substantiate an objection of lack of inventive step. This issue has been addressed in the case law as the 'could-would' approach which essentially states that the relevant question to be answered is not whether the skilled person could have carried out the invention, but whether he would have done so in the hope of solving the underlying technical problem or in the

expectation of some improvement or advantage (cf. Case Law of the Boards of Appeal of the EPO, 4th edition 2001, I.D.6.1).

3.3.5 In the present case, the state of the art documents cited in the European Search Report do not contain any indication that the detection of neutrons having energy of about 1 MeV would provide useful information on the nature of the matrix formation. There is, therefore, no reason why a skilled person would use a ^4He proportional counter in a borehole for determining the characteristic of a formation.

3.4 Claim 16

The apparatus for determining a characteristic of an underground formation according to claim 16 differs from the apparatus disclosed in document D4 in that it comprises a high pressure ^4He proportional counter adapted for detecting neutrons originating from the source and arriving via the formation.

The reasons presented above also apply *mutatis mutandis* to the apparatus according to claim 16 in respect of the detection of neutrons having energies around 1 MeV.

Moreover, as there is a strong resonance at 1 MeV in the detection of neutrons by the ^4He proportional counter its response is highly energy dependent with a cutoff below 1 MeV. Thus, a ^4He proportional detector is insensitive to thermal or epithermal neutrons (ie. the neutron energy region from 0.025 to about 10 eV) which are conventionally detected in the measurement of the porosity of the formation by a ^3He proportional counter (cf. the application in suit, page 3, 2nd paragraph).

A skilled person would, consequently, not have provided a He proportional counter in such an apparatus.

3.5 For these reasons, it is the Board's judgment that the method and apparatus according to claims 1 and 16, respectively, involve an inventive step within the meaning of Article 56 EPC.

The dependent claims concern further particular embodiments of the invention which are patentable for the same reasons.

Order

For these reasons it is decided that:

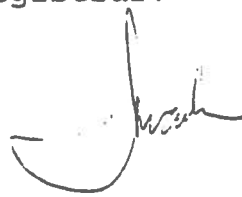
1. The decision under appeal is set aside.
2. The case is remitted to the first instance with the order to grant a patent with the following documents:

Claims: 1 to 30 filed during the oral proceedings

Description: pages 1 and 5 to 9 as originally filed
page 2 to 4 filed during the oral proceedings

Drawings: as originally filed.

The Registrar:

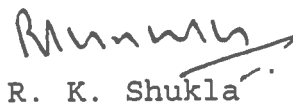


P. Martorana

2948.D



The Chairman:


R. K. Shukla

