BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS

BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE

CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

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File Number: T 135/91 - 3.4.1

Application No.: 86 402 808.9

Publication No.: 0 231 693

Title of invention: Methods and apparatus for borehole gamma-ray spectroscopy and like measurements

Classification: G01T 1/202

D E C I S I O N
of 4 December 1992

Applicant: (01) Schlumberger Limited
(02) Société de Prospection Electrique Schlumberger

Headword:

EPC Article 56

Keyword: "Inventive step (denied)"

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number : T 135/91 - 3.4.1

D E C I S I O N
of the Technical Board of Appeal 3.4.1
of 4 December 1992

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Decision under appeal : Decision of Examining Division 061 of the European Patent Office dated 8 June 1990 refusing European patent application No. 86 402 808.9 pursuant to Article 97(1) EPC.

Composition of the Board :

Chairman : G.D. Paterson
Members : Y. van Henden
U. Himmler

Summary of Facts and Submissions

I. European patent application No. 86 402 808.9 (publication No. 0 231 693) was refused by decision of the Examining Division.

The reason given for the refusal was that independent Claims 1 and 16 received on 27 February 1990 with an Applicant's letter dated 21 February 1990 could not be considered as inventive having regard to the state of the art disclosed in documents

D1: US-A-3 413 466,
D2: WO-A-85/00665.

II. The Appellant lodged an appeal against the decision of the Examining Division.

With his Statement of Grounds of Appeal, he submitted a set of claims numbered 1 to 19 forming the basis of a main request, and a set of claims numbered 1 to 17 forming the basis of an auxiliary request. Affidavits by Dr C.L. Melcher and Prof T.A. Tombrello were concurrently supplied and relied upon to support the Appellant's requests.

III. Claims 1 and 16 according to the Appellant's main request are independent ones and read

"1. Apparatus for investigation of subsurface earth formations, comprising:

a sonde (10) adapted for movement through a borehole (12);

a scintillator (28) carried by said sonde for detecting radiation;

means (40, 42, 44) coupled to said scintillator for generating and recording a signal representative of at least one characteristic of said detected radiation; and

means for rendering said scintillator selectively responsive to a desired type of radiation;

characterized in that said scintillator includes a gadolinium orthosilicate scintillator for detecting photon radiation.

16. A method for investigation of subsurface earth formations, comprising:

passing a sonde through a borehole;

detecting radiation with a scintillator;

generating and recording signals representative of at least one characteristic of said detected radiation; and

rendering said scintillator selectively responsive to a desired type of radiation;

characterized in that said detecting step includes detecting photon radiation with a gadolinium orthosilicate scintillator."

Claims 2 to 15 are dependent on Claim 1, whereas Claims 17 to 19 are dependent on Claim 16.

Claim 14 of the auxiliary request submitted with the Statement of Grounds of Appeal is independent and reads

"14. A method for investigation of subsurface earth formations, comprising:

passing a sonde through a borehole;

irradiating material in a region of said borehole with penetrating neutrons capable of interactions with said material resulting in radiation having characteristics carrying information about said material;

detecting said radiation; and

generating and recording signals representative of at least one characteristic of said detected radiation;

characterized in that said detecting step includes detecting photon radiation with detector means including a gadolinium orthosilicate scintillator and rendering said scintillator selectively responsive to said radiation by a layer of neutron absorbing material."

Claims 15 to 17 of said auxiliary request are dependent on Claim 14, whereas Claims 2 to 13 are dependent on Claim 1.

IV. In a communication dispatched on 11 May 1992, the Board took the provisional view that, starting from the state of the art known from (D1) and bearing in mind basic teachings disclosed in document (D2), as well as in the documents

D3: K. Takagi et al. "Cerium-activated Gd_2 Si O_5 single crystal scintillator", Appl. Phys. Lett., volume 42, No. 1 (January 1983), pages 43 to 45,

D4: DE-A-3 303 166,

already cited in the patent specification, a skilled person would not have to display inventive talent to arrive at the subject-matter defined by any one of the independent claims submitted with the Statement of Grounds of Appeal.

V. In a reply dated 11 September 1992, the Appellant maintained the view that independent Claims 1 and 16 according to his main request are allowable, as well as Claims 1 and 14 of his auxiliary request. Nevertheless, he amended Claim 1 of his auxiliary request, which claim now reads

"1. Apparatus for investigation of subsurface earth formations, comprising:

a sonde (10) adapted for movement through a borehole (12);

a source (26) for irradiating material in the region of said borehole with penetrating neutrons capable of interactions with said material resulting in radiation having characteristics carrying information about said material;

a scintillator (28) carried by said sonde for detecting said radiation;

means (40, 42, 44) coupled to said scintillator for generating and recording a signal representative of at least one characteristic of said detected radiation; and

shield means for rendering said scintillator selectively responsive to said radiation;

characterized in that said scintillator includes a gadolinium orthosilicate scintillator for detecting photon radiation and said shield means includes a layer (58) of material for absorbing neutrons scattered by the formations.

With said reply, the Appellant also filed a new description.

VI. The Appellant requests a European patent to be granted on the basis of the following documents:

Description: pages 1 to 21 filed with letter of 11 September 1992;

Claims: 1 to 19 according to the main request submitted with the Statement of Grounds of Appeal;

Drawings: sheets 1/8 to 8/8 as originally filed.

Subsidiarily, he requests the patent to be granted on the basis of the new Claim 1 received with his reply of 11 September 1992 and of Claims 2 to 17 of the auxiliary request submitted with the Statement of Grounds of Appeal, the description and drawings being the same as above.

VII. In support of his requests, the Appellant argues substantially as follows:

Though it is superior to the light output of BGO crystals, the yield of GSO crystals is comparatively low. Furthermore, because of the extremely large neutron capture cross-section of gadolinium, GSO detectors are highly sensitive to neutrons. Consequently, a skilled person would think that a GSO crystal has to be surrounded by a very thick shield. Considering, however, that the borehole diameter is limited, the necessity of providing a thick shield would entail reducing the crystal size, whereby said crystal would then be too small to ensure an efficient detection of gamma rays. Therefore, despite the mention of advantageous characteristics of GSO scintillators in documents (D2) to (D4), the skilled person would be discouraged from using them for well logging. Besides, the fact that (D1) describes a shield for protecting a particular neutron detector against thermal neutrons does not make it obvious to shield a gamma ray detector to prevent all kinds of scattered neutrons from reaching said detector. As a matter of fact, document (D1) does not state that any type of gamma ray detector can be substituted for the described neutron detector without shielding problems.

Reasons for the Decision

1. The only matter at issue was that of inventive step.

2. Document (D1) pertains to an apparatus for investigation of subsurface earth formations - see column 1, lines 9 to 15 - comprising:

(a) a sonde (12) adapted for movement through a borehole - see Figure 1 and column 2, lines 30 to 37;

(b) a source (20) for irradiating material in the region of said borehole with penetrating neutrons capable of interactions with said material resulting in radiation - namely back scattered thermal or epithermal neutrons - having characteristics carrying information about said material - see column 2, lines 37, 38 and 47 to 51;

(c) scintillators (26, 28, 30) carried by said sonde for detecting said radiations - see column 2, lines 52 and 53 - and

(d) means - namely: a photomultiplier tube (32), an amplifier (40), a demodulator (44), a discriminator circuit (46) and a recorder (48) - coupled to said scintillators for generating and recording a signal representative of at least one characteristic of said detected radiation - see from column 2, line 52, to column 3, line 15.

One or more of the detectors (26, 28, 30) may comprise a scintillation crystal (56) completely encased within a thermal neutron shield comprising a cadmium cup (64) and a transparent window (66) made of a cadmium fluoride crystal - see Figure 2 and column 3, lines 16 to 37. Only

epithermal neutrons thus strike the crystal (56) and are counted. Therefore, bearing in mind that shield means do not modify the properties of a scintillator, but are actually provided for intercepting unwanted radiations liable to perturb the measurements, it appears that the apparatus known from (D1) furthermore comprises

(e) shield means (64, 66) for rendering the scintillators selectively responsive to the detected radiation,

as stated in Claim 1 according to each of the Appellant's requests, and that

(f) said shield means includes a layer of material for absorbing neutrons (namely the thermal ones) scattered by the formations.

3. It is furthermore stated in document (D1) that the system disclosed there

(a) is capable of measuring either thermal or epithermal neutrons, as well as any other radiation counts which are detected by photon pulses or approximately uniform amplitudes - see from column 4, line 73 to column 5, line 3 - and

(b) may also be used in gamma ray detection work by using conventional and well-known subtracting networks in the surface equipment to subtract the overlapping low energies from one modulated channel from the energies of interest of the other modulated channels - see column 5, lines 3 to 8.

Therefore, according to particular embodiments of the invention disclosed in (D1), the detectors (26, 28, 30) of said system include a scintillator for detecting photon radiations.

4. Therefore, the subject-matter of Claim 1 according to the Appellant's auxiliary request is distinguished over the prior art which can be derived from (D1) in that

"the scintillator (28) includes a gadolinium orthosilicate scintillator".

5. Document (D1) finally teaching that various changes, substitutions and alterations can be made in the system to which it relates - see column 5, lines 9 to 13 - the skilled person readily understands that the choice of scintillator materials is not limited to the examples given there.

In his reply to the Board's communication, the Appellant laid stress on the sensitivity of GSO crystals to neutron irradiation and submitted that the skilled person would be led away from envisaging the use of GSO crystals as scintillators in gamma ray logging devices, the reason therefor being that said skilled person would hold a much more efficient neutron shielding than the one mentioned in (D1) to be necessary.

The application as originally filed, however, does not exclude the opportunity of providing a shield which simply reduces the generation of gamma rays within the GSO crystal upon irradiation with neutrons. Furthermore, as an alternative solution, it even proposes not to provide any shield at all and, during processing by the surface equipment (24), to treat the signal generated in response to neutron irradiation as a background signal and to remove it - see the second paragraph on page 13. This latter teaching, however, is equivalent to the one disclosed in column 5 of (D1), lines 3 to 8, and already mentioned in section 3(b) of the present decision. On the other hand, document (D1) reveals that the neutrons going

through the shielding means (64, 66), i.e. the epithermal neutrons, only represent a tiny fraction of the flux of back scattered neutrons, there being usually one thousand thermal neutrons or more for one epithermal neutron - see column 3, lines 58 to 63. To a skilled person, it was thus clear that the need for neutron shielding is far from being as acute as the Appellant now submits, hence that no unacceptable reduction of scintillator size had to be expected, even in case of a GSO crystal.

Therefore, in the Board's judgment, the skilled person carrying out the invention disclosed in (D1) would not have been deterred from envisaging the use of a GSO scintillator crystal.

6. Said skilled person knows the physical properties of cerium activated GSO, in particular those reported in documents (D2) to (D4).

From document (D4), the reader learns that the absorption of gamma radiations by a scintillator material is proportional to the density (ρ) of said material and to the fourth power of its effective atomic number (Z) - see page 5, lines 21 to 29. From document (D3), he learns that cerium activated GSO has a relatively high density - to wit 6.71 g/cm^3 as disclosed in Table I - and a high effective atomic number of 59 - see Table I again and page 44, second paragraph of the right-hand column. Combining above teachings of (D3) and (D4), a high coefficient of gamma rays absorption may be expected from a cerium activated GSO crystal, what document (D4) actually confirms - see page 4, lines 3 to 7 - and is furthermore consistent with the statement in (D3) that cerium activated GSO exhibits strong luminescence - see page 44, second paragraph of the right-hand column.

The latter statement in (D3) is contrary to the Appellant's view that the light output of GSO crystals would be low. The application as filed reveals, however, that the light output of cerium activated GSO crystals is about 18% that of sodium iodide - see the third paragraph of page 12 - i.e. 1.5 times the yield of bismuth germanate (BGO), which, because of the drawbacks bound to the use of sodium iodide as scintillator material - see the second paragraph on pages 3 and 10 - had previously been investigated as replacement material. Furthermore, this teaching is consistent with that of documents (D2) to (D4) - see: fourth line of the table on page 8 of (D2); fourth line of Table I in (D3); first column of Table I in (D4). In the Board's judgment, therefore, it may not be contended that the difference in light output between sodium iodide and cerium activated GSO would have deterred the skilled person from envisaging, before the priority date of the application, to use the latter scintillator material in a logging apparatus.

7. From document (D3), the skilled person also learns that cerium activated GSO exhibits fast decay, is non-hygroscopic and easy to grow to a single crystal - see page 44, second paragraph of the right-hand column - that it does not decompose at its melting point, i.e. about 1800°C - see the right-hand column of page 43 - and that the light it emits has a wavelength comparable to that of the radiations emitted by most scintillator materials - see Table I. Therefore, bearing in mind that moisture and high temperatures are characteristic of borehole environment, an incentive to use a cerium activated GSO scintillator was given to the skilled person envisaging, in order to detect and measure gamma radiations instead of neutrons, to modify the apparatus described in (D1).

This conclusion, which the affidavits of Prof Tombrello and Dr Melcher do not negate, finally entails that, although neutron shielding was found to be more efficient than these experts expected, choosing a GSO scintillator did not require from a skilled person the exercise of inventive ingenuity.

8. Therefore, in the Board's judgment, Claim 1 according to the Appellant's auxiliary request lacks an inventive step. The subject-matter of said claim being furthermore included within the scope of protection defined by Claim 1 according to the Appellant's main request, the latter claim too lacks an inventive step.

9. For the same reasons, Claim 16 according to the Appellant's main request and Claim 14 according to the Appellant's auxiliary request also lack an inventive step.

10. Therefore, none of the independent claims forming the respective bases of the Appellant's main and auxiliary request is allowable - Article 52(1) EPC in relation to Article 56 EPC.

Order

For these reasons, it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

M. Beer G.D. Paterson