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Publication in the Official Journal ~~Yes~~ / No

File Number: T 869/90 - 3.4.1

Application No.: 84 301 562.9

Publication No.: 0 121 359

Title of invention: Electromagnetic borehole logging apparatus and method

Classification: G01V 3/30

D E C I S I O N
of 1 July 1992

Applicant: Texaco Development Corporation

Headword: Electromagnetic borehole logging | TEXACO

EPC Art. 56

Keyword: "Inventive step - (no)"
"Objective formulation of the technical problem"



Case Number : T 869/90 - 3.4.1

D E C I S I O N
of the Technical Board of Appeal 3.4.1
of 1 July 1992

Appellant : Texaco Development Corporation
2000 Westchester Avenue
White Plains
New York 10650 (US)

Representative : Wood, Anthony Charles
Urquhart-Dykes & Lord
91 Wimpole Street
London W1M 8AH (GB)

Decision under appeal : Decision of Examining Division 038 of the
European Patent Office dated 30 May 1990 refusing
European patent application No. 84 301 562.9
pursuant to Article 97(1) EPC.

Composition of the Board :

Chairman : G.D. Paterson
Members : R.K. Shukla
U.G. Himmler

Summary of Facts and Submissions

- I. European patent application No. 84 301 562.9 was refused by the Examining Division in its decision dated 30 May 1992. A notice of appeal was filed on 31 July 1990. A statement of grounds was filed on 10 October 1990, that is, after the expiry of the time limit for filing the statement of grounds of appeal according to Article 108 EPC and Rules 78(3) and 83(4) EPC.
- II. Following an application for re-establishment of rights under Article 122 EPC, the present Board decided (see the interlocutory decision T 869/90) that the rights of the Appellant were re-established in connection with the filing of an admissible appeal, and the statement of appeal shall therefore be considered as having been filed within the four-month time limit provided by Article 108 EPC.
- III. The application was refused on the ground that the claimed subject-matter did not involve an inventive step having regard to the disclosure in the prior art document D1, US-A-4 185 238.
- IV. The Appellant requested that the contested decision be set aside and that a patent be granted on the basis of the following application documents:
 - pages 3-9 of the description as originally filed;
 - pages 1 and 2 of the description received on 24.09.88 with page 1 amended according to Applicant's request dated 14.12.89 and page 2 amended according to Applicant's request dated 10 October 1992;
 - Claims 1-5 received on 24.09.88;
 - drawing sheets 1/2 and 2/2 received on 24.09.88.

As an auxiliary request, oral proceedings were requested by the Appellant. These were duly appointed. At the end of the oral proceedings, a decision was announced that the appeal is dismissed.

V. The only independent Claim 1 has the following wording:

"Apparatus for determining the dielectric constant and/or resistivity of an earth formation (15) in the vicinity of a borehole (13), the earth formation being subject to invasion of fluid (14) from the borehole, said apparatus comprising:

means (16, 17) for transmitting electromagnetic energy into the earth formation from a first location in the borehole at a frequency which permits the electromagnetic energy to propagate through the surrounding earth formation;

means (22, 23, 24) for receiving electromagnetic energy at a plurality of locations in the borehole spaced at different distances longitudinally apart from the transmitting means (16, 17) and for providing signals representative of the received electromagnetic energy at those locations;

amplitude ratio means (140) and phase difference means (130) for respectively deriving an amplitude ratio signal and a phase difference signal from selected said representative signals; and

means (54, 100) for determining the dielectric constant and/or resistivity of said earth formation in accordance with said amplitude ratio and phase difference signals;

characterised in that:

said means (22, 23, 24) for receiving electromagnetic energy comprises only three receiving means disposed respectively at three locations in the borehole spaced successively longitudinally apart from the transmitting means (16, 17);

said amplitude ratio means (140) is operative to derive the ratio of the amplitudes of said signals provided by the receiving means (22, 23) at the two of the three locations nearest the transmitting means; and

said phase difference means (130) is operative to derive the phase difference between said signals provided by the receiving means (23, 24) at the two of the three locations furthest away from the transmitting means."

VI. The arguments presented by the Appellant in favour of an inventive step can be summarised as follows:

The technical problem addressed by the present invention is to determine dielectric constant and resistivity of the earth formations around a borehole where fluid from the borehole has invaded the earth formation in the vicinity of the borehole. As compared with the prior art logging apparatus disclosed in US-A-4 107 598, which employs only two receivers, the apparatus of the present invention provides a more accurate determination of dielectric constant.

The prior art document D1 relied upon by the Examining Division is concerned solely with determination of dielectric constant and resistivity so that measurements used for such determination are "looking at" substantially the same earth formations; i.e., having substantially the same depth of investigations. Moreover, in document D1 the

borehole being investigated may be filled with air or is cased, so that the problem of fluid invasion addressed by the present invention does not occur in document D1.

Moreover, the logging apparatus in D1 consistently employs two pairs of receivers (R1,R2 and R3,R4), one being "close" so as to measure relative attenuation and the other being "far" so as to measure phase shift, the receivers being so located in relation to the transmitter that mainly "uninvaded" earth formations are investigated. Although in the method of operation described at column 19, lines 28 to 47 with reference to Figure 12 in D1, signals from three receivers R1, R2 and R3 forming two receiver pairs R1,R2 and R2,R3 are utilised for computing the dielectric constant and resistivity, signals from the receiver pair R3,R4 are in fact needed to trigger a threshold detector, and only in the event that the latter signals are not sufficiently strong that the signals from the receiver pairs R2,R3 and not R3,R4, are utilised. Thus, in D1 four receiver coils are always utilised, and there is no hint in the document that a useful logging apparatus for investigating a fluid-invaded earth formation could be constructed having only three receiver coils. The present invention, by using only three receiver coils, saves considerable space in an art where physical space is severely restricted.

Reasons for the Decision

- 1 The only issue which is to be considered in the present appeal is the question of inventive step.
 - 1.1 In the Board's view, the prior art coming closest to the claimed invention is the logging apparatus as disclosed in D1, for determining the dielectric constant and/or

resistivity of earth formations surrounding a borehole. The apparatus as described with reference to Figure 12 at column 16, line 51 to column 19, line 47 comprises a sonde which carries a transmitter T and four receivers R1,R2,R3 and R4 located at different distances from the transmitter. The electrical circuitry (290,390,490) illustrated is for the generalised case so that means (e.g. ratio circuit 226 and difference amplifier 224) are provided whereby amplitude ratio, that is, attenuation, and phase difference measurements are available for each of the three receiver pairs R1,R2; R2,R3 and R3,R4. Typically, attenuation measurement, $Atten_{1,2}$ between receiver pair R1,R2, and phase difference measurement $\Delta\phi_{3,4}$ between receiver pairs R3,R4 are utilised by a computing module (100) to determine the dielectric constant and the resistivity. Nonetheless, when the amplitude signal either from R3 or R4 is weak and exceeds a predetermined threshold, a phase difference measurement $\Delta\phi_{2,3}$, and not $\Delta\phi_{3,4}$, is combined with $Atten_{1,2}$ to derive the above-mentioned parameters (see, column 19, lines 28 to 47).

In view of the above, the Board concurs with the Appellant that although the method of determining dielectric constant and resistivity described in D1 utilises signals only from three receivers in the event that the amplitude signal from the receiver R4 is weak, the apparatus disclosed is provided with four receiver coils and, as mentioned earlier, with ratio circuits (e.g. 226) and difference amplifiers (e.g. 224) for deriving attenuation and phase difference for each of the three receiver pairs R1,R2; R2,R3 and R3,R4.

- 1.2 The apparatus according to the invention as claimed thus differs from the above prior art only in that it is provided with only three receiver coils.

In this connection, the Appellant submitted that according to the wording of the claim, the apparatus as claimed is intended for determining dielectric constant and/or resistivity of an earth formation which is subject to invasion of fluid from the borehole; the apparatus and method disclosed in D1, on the other hand, are concerned with investigating an earth formation which is not invaded by such a fluid, so that the receivers are necessarily located further away from the transmitter, so as to receive signals from the deeper "non-invaded" earth formation, than is the case in the apparatus of the present invention. The Board, however, is of the view that the intended use of the apparatus according to the invention does not uniquely define the transmitter-receiver spacing, since the area or the diameter of the invaded zone to be investigated can vary considerably so that the distance between the transmitter and each of the receivers would also vary accordingly.

- 1.3 In the application in suit (see page 4, lines 5 to 20 and Figure 3) and in the Statement of Grounds of Appeal, the technical advantage of the apparatus according to the present invention is discussed in relation to a prior art logging apparatus, as disclosed in US-A-4 107 598 (D2), using only two receiver coils. The Appellant argued on the basis of this technical advantage that whereas the present invention seeks to provide higher accuracy in the determination of the dielectric constant, the technical problem addressed by D1 is to determine dielectric constant etc. with assurance that the measurements used for such determination are "looking" at substantially the same formations, i.e. having substantially the same depth. The Appellant further submitted that the problem addressed in D1 was therefore not the same as the one addressed by the present invention, so that in an unpredictable art

such as the present one, a teaching of a solution to one problem cannot necessarily be expected to apply to solve an overlapping or neighbouring problem.

The Board accepts that the dielectric constant determined by the present invention is more accurate than that determined by the apparatus employing only two receiver coils. However, it is the established jurisprudence of the Boards of Appeal that for an objective assessment of inventive step, the technical problem to which the invention provides a solution is to be formulated in the light of the closest state of the art. In the present case, therefore, it is essential that the technical problem is formulated having regard to the disclosure in D1, and not the prior art document US-A-4 107 598 (D2) discussed in the application. Since in D1 the method of determining dielectric constant uses signals only from three receiver coils as in the present invention, it must be presumed to provide an accurate determination of the dielectric constant as well. This technical effect, that is, an accurate determination of the dielectric constant, is, therefore, to be left out of consideration while formulating the objective problem.

- 1.4 Having regard to the prior art apparatus described in D1, therefore, the objective problem confronting a skilled person can be regarded simply as providing a more compact apparatus for determining dielectric constant and/or resistivity of an earth formation, whereby considerable saving in space is achieved.

- 1.5 As mentioned earlier in paragraph 1.1 above, although in the embodiment of Figure 12 in D1, attenuation and phase difference measurements are available at each of three receiver pairs R1,R2; R2,R3 and R3,R4, when the amplitude signal from receiver R3 or receiver R4 is not sufficiently

strong, the document teaches to use only the attenuation measurements at the receivers R1,R2 (Atten_{1,2}) and the phase difference measurement ($\Delta\phi_{2,3}$) at the receivers R2,R3 for the calculation of dielectric constant or resistivity. Also it is suggested that in such a situation, portions of the circuitry providing the information, in other words the circuitry in channel 290, which is not utilised, may be omitted (see, in particular, column 17, lines 6 to 12). Thus, when the problem confronting a skilled person was to provide a compact logging apparatus for investigating an earth formation which was not deeply located, he would have regarded the omission of the receiver R4 as a logical extension of the teaching of D1.

- 1.6 For the foregoing reasons, in the Board's judgment, the subject-matter of Claim 1 lacks an inventive step within the meaning of Article 56 EPC.

- 1.7 The Appellant referred, inter alia, to the Technical Board of Appeal Decisions T 20/84, T 9/86 and T 109/87, and a Decision of the US Federal District Court in the case of Deering Milliken Research Corporation v. Beaunit Corporation (182 USPQ 421) to support his proposition that a seemingly simple solution may disguise an inventive step, and that there is a danger in assessing apparently simple solutions with hindsight. The Board accepts that an omission of a feature may, under certain circumstances, as illustrated by the above Technical Board of Appeal Decisions, involve an inventive step. However, each case has to be examined on its own merit taking into consideration the relevant technical facts, and ultimately the essential question which needs to be considered in each case is whether an omission of a feature is rendered obvious by the prior art having regard to the objectively formulated problem, as has been done in the present case.

Order

For these reasons, it is decided that:

The appeal is dismissed.

The Registrar:



M. Beer

The Chairman:



G.D. Paterson

RM
Jm