PATENTS ACT 1977

IN THE MATTER OF
Application No. GB 9915203.5
In the names of Institut Français du Pétrole &
ELF EP

DECISION

Introduction

1. Patent application number GB 9915203.5 entitled "Method for gradually deforming a stochastic model of a heterogeneous medium such as an underground zone", was filed on 29 June 1999 in the name of Institut Français du Pétrole & ELF EP. The application claims priority from an earlier French application with a date of 1 July 1998.

2. The application concerns a method for "building an optimized Gaussian or Gaussian related stochastic model of a distribution of a parameter in a heterogeneous medium such as an underground zone". The examples in the specification refer to modelling of a permeability field. It is not explicitly stated in the specification that this relates to oil production, but the specification refers to "well test" data and "reservoirs", which together with the identity of the applicants carries the strong implication that it is oil production that is of interest. The Agent's letter of 30 October 2002 makes this connection explicit, referring to the use of the modelling method in oil production. However the method is a general one, not limited to oil production, permeability nor even necessarily to an underground zone. It is clear from the specification that the invention is concerned with a modelling method.

3. On 14 July 1999, before the application was due for search under section 17 of the Patents Act 1977 ("the Act"), the examiner wrote to the applicant advising him that the invention appeared to be unpatentable since it related to a mathematical method and/or a computer program. The examiner offered the opportunity for the application to be withdrawn but the applicant elected to continue with it. When the application became due for examination under section 18 of the Act, the examiner objected that the invention related to a mathematical method and was therefore excluded from patentability under section 1(2)(a) of the Act. The applicant's agent disagreed and replied arguing that a mathematical method implies handling of abstractions which do not relate to the "real" world. He said the model relates to the distribution of a physical quantity, such as permeability, in an underground zone under production. It is optimised to fit a set of measured production data, and the method generates an image which represents the modelled distribution. Consequently, his view was that from data in the real world, through several processing steps, a technical result is obtained easily and rapidly which is very advantageous to oil engineers.

4. The applicant and the examiner exchanged a number of letters each maintaining their positions. The disagreement was not resolved, and the matter came before me at a hearing on 27 June 2003 at which the applicant was represented by Mr Simon Black of Fitzpatricks, assisted by Mr Iain MacLean. Mr Dean Parry, the examiner also attended.

The Invention

5. In an introductory section, the specification explains that the invention is concerned with constructing statistical "realizations" that is representations, of a particular parameter of the heterogeneous medium. The examples given relate to the permeability of an underground zone. I take permeability to be a parameter which determines the ease with which oil can move through oil bearing strata in order to be produced at a well. The specification gives two examples of journal papers which it says provides; "Examples of use of Gaussian models for modelling the subsoil structure", and goes on to describe the invention in relation to such models. It appears from this that the starting point for modelling processes of this kind is a generalised representation of underground structures, not a representation of the specific underground zone under consideration. At the hearing, Mr Black said "these realizations are achieved by applying physical laws to synthesised data ... you know the physics of these regions. You have synthesised data and you combine them and you get realisations". I believe this confirms that the starting point is a generalised representation.

6. The specification then explains that the invention is concerned with constraining such a statistical model with "non-linear data" and that the constraint process can be considered to be "an optimization problem with definition of an objective function assessing the accordance between data measured in the medium to be modelled and corresponding responses of the stochastic model, and minimization of this function." It is apparent that this process involves comparing the model with real data in order to refine it so that it is representative of the zone in question.

7. The specification gives examples of prior methods of this type. The first involves exchanging values "at two points of a realization of the stochastic model" in a method known as "simulated annealing". This technique has the disadvantage that it involves a labourious optimization process. Another method known as the "pilot point method" is said to lead in some circumstances to "an undue change in the variogram". I take this to mean that this method can sometimes produce an inaccurate outcome.

8. Considering the method of the invention, the specification says that it involves gradual deformation of the realization of the stochastic model. It is said to be "founded on a more solid theoretic basis for stochastic model deformation" (than prior systems), it "makes it possible both to modify the parameters (often a priori uncertain values) of variograms and to deform a realization of a stochastic model", and "thanks to the possibility of individual deformation of various parts of the model, the method according to the invention gives greater flexibility and efficiency to the operator for adjustment of the stochastic model to the field reality." The specification explains that

the method "thus allows to establish a connection between stochastic model adjustment and deterministic model adjustment by zoning conventionally used by reservoir engineers."

9. The method involves generating two or more (p) independent realizations of the selected model and making a linear combination of the p realizations with p coefficients such that the sum of the squares of the coefficients is equal to 1. The specification explains; "This linear combination constitutes a new realization of the stochastic model and it gradually deforms when the p coefficients are gradually modified."

10. The realizations resulting from the method are compared with real data to determine how well each successive realization of the model fits the real data. To do this, a set of "non-linear production data" is generated from each realization and compared with some real "well test" data from the underground zone. The data generated from each realization is said to form the response of that realization. As described in the "validation example" section of the description, the response data to be compared is a "pressure curve" (representing, I presume, the production of oil at the well) and its logarithmic derivative. In fact in the example the "real" well test data is produced synthetically, but in a practical application the method would no doubt use data obtained from the physical zone under consideration.

11. The process of combining realizations can be repeated, with several iterative stages of gradual deformation and comparing the response of the newly formed realization at each stage with the real well test data. This process is repeated to minimize the difference between response data and real data in order to arrive at a realization whose response corresponds with the measured well test data.

12. The result of the iteration and optimization process is an "image", which Mr Black explained meant a pictorial representation, of the stochastic model which best represents the underground zone.

13. Claim 1 which is the only independent claim has been amended during prosecution and now reads:

1) A method for building an optimized Gaussian or Gaussian related stochastic model of a distribution of a parameter in a heterogeneous medium such as an underground zone, fitting best a set of measured non linear production data or parameters forming a response of the medium, comprising:

a) generating a first realization of at least a part of the stochastic model and deducing therefrom a first set of non linear production data forming a response of the model;

b) generating at least one other realization of the same part of the stochastic model independent from the first realization and deducing therefrom corresponding sets of production non linear data as a response of the model;

c) building a realization of the stochastic model by linearly combining the first realization and the at least one other realization, with coefficients of this combination being such that the sum of their squares is equal to 1 and deducing therefrom a corresponding set of non linear data as a response of the model;

d) forming an objective function that measures the misfit between the sets of non linear production data deducted from step c) with the corresponding non linear production data measured from the medium; and

e) minimizing the objective function with respect to said coefficients (a_1) until obtaining an optimized realization of the stochastic model, said optimized realization corresponding to an image of the underground zone consistent with the measured production data.

The law

14. The provisions in the Act relating to excluded matter are in section 1(2) which reads:

Section 1(2)

It is hereby declared that the following (among other things) are not inventions for the purposes of this Act, that is to say, anything which consists of -

(a) a discovery, scientific theory or mathematical method;

(b) a literary, dramatic, musical or artistic work or any other aesthetic creation whatsoever;

(c) a scheme, rule or method for performing a mental act, playing a game or doing business, or a program for a computer;

(d) the presentation of information;

but the foregoing provision shall prevent anything from being treated as an invention for the purposes of this Act only to the extent that a patent or application for a patent relates to that thing as such.

15. These provisions are ones which by virtue of section 130(7) of the Act are so framed as to have as nearly as practicable the same effects in the UK as the corresponding provisions of, inter alia, the European Patent Convention. Consequently decisions in the EPO Boards of Appeal relating to excluded matter, and patentability in general are of persuasive value in considering these matters under the Act.

16. It has been established by the Courts that an invention will not be excluded from patentability by this provision if it involves a technical effect or makes a technical contribution. It is this technical aspect which saves an invention from being regarded as excluded matter "as such" and therefore confers patentability. In *Fujitsu Limited's*

Application [1997] RPC 608 in the Court of Appeal, Aldous LJ said:

> "However it is and always has been a principle of patent law that mere discoveries or ideas are not patentable, but those discoveries and ideas which have a technical aspect or make a technical contribution are. Thus the concept that what is needed to make an excluded thing patentable is a technical contribution is not surprising. That was the basis for the decision of the Board in Vicom. It has been accepted by this Court and by the EPO and has been applied since 1987. It is a concept at the heart of patent law."

Discussion

17. The examiner has objected that the invention relates to a mathematical method and that it is therefore excluded by section 1(2)(a) of the Act. It seems clear that the new development lies in the particular method used to manipulate the data having the characteristics set out in the claims, which is a mathematical method. I consequently need to investigate whether the system in which the method is embodied involves a technical effect and therefore confers patentability on the invention. In letters sent during prosecution of the application, the agent argued that the method produced manipulatable models representative of a distribution in the reservoir of a physical quantity such as the permeability field. He said that this provides a functional tool which is helpful to reservoir engineers operating a production process. Also that the method operated on data from the real world and that the obtained result was without doubt a technical result in terms of savings in time, cost, flexibility and efficiency when used for example in operating or evaluating a production process, and therefore, the invention should be considered to relate to subject matter of a technical nature which should not be excluded from patentability. The issues of the use of real data, the development of a model which represents information specific to the zone under investigation, and the production of an image containing information representing the zone seem particularly pertinent to the investigation of technical effect.

18. During the hearing, Mr Black explained that the purpose of the invention was to make improvements in the veracity of the imaging. He said that the prior art systems did not provide a very good representation; the engineer could not actually see what was in the underground zone, and that the present method was intended to give as true an image as possible. As a preliminary matter, I have some difficulty with these comments since I don't think what Mr Black said is precisely consistent with the discussion of the prior art in the specification. It seems from the specification that the present system may improve on prior systems in a number of ways, but that improvement is not necessarily in all cases in the veracity of the image. In addition expressions such as; "you get something that looks more like the actual physical characteristics of that particular medium", and "... see an image of what is down there", imply that the image provides a spatially mapped representation, whereas according to the description, it appears to be a representation of statistical, not spatial, information. I consequently think Mr Black's comments may have exaggerated the prominence of the image in the inventive method, and I need to have in mind its more restrained role described in the specification. However even if the images produced by the system did have the

characteristics suggested, it would not change my conclusion.

19. Mr Black referred to three EPO decisions to support the proposition that the present invention involves a technical effect. The first of these was *Koch & Sterzel/X-ray apparatus* [1988]1-2 OJEPO19 (T26/86). Mr Black made the point that the Koch & Sterzel decision found that an invention could involve both technical and non-technical means, and still be patentable. The EPO Board of Appeal said:

> "The Board holds that an invention must be assessed as a whole. If it makes use of both technical and non-technical means, the use of non-technical means does not detract from the technical character of the overall teaching. The European Patent Convention does not ask that a patentable invention be exclusively or largely of a technical nature; in other words, it does not prohibit the patenting of inventions consisting of a mix of technical and non-technical elements."

20. I agree that this is the correct approach and that patentable inventions can and do involve new developments in areas excluded per se by section 1(2). If, when such a new development is embodied in a physical system it gives rise to a new technical result it will not be excluded from patentability. That appears to me to be the critical issue in assessing an invention of this sort. If a new mathematical method when embodied in a physical system produces a result that does not involve a technical aspect or technical contribution, then the development lies solely in the area of the mathematical method.

21. Mr Black next referred me to *John Bradford Georges/A method of functional analysis* (T953/94). This involves a method of generating, with a digital computer, a data analysis of the cyclical behaviour of a curve represented by a plurality of plots which relate one parameter to another. The claims were initially concerned solely with numerical analysis, which the Board of Appeal considered to be a mathematical method excluded from patentability. However the fifth auxiliary request for amendment filed by the applicant related to "a method of controlling a physical process" and included the feature that the outcome of the method which involved the "prolongation of the curve" was "for use in the control of said physical process". The Board of Appeal considered this to relate to a technical process and found that it was not excluded from patentability.

22. This case is an example of the situation envisaged in Koch & Sterzel. The new development is a mathematical method, but when applied to the control of a physical process, the Board of Appeal considered it to be patentable. The decision in relation to the fifth auxiliary request was concerned with the degree to which the claims could be considered to relate unequivocally to control of a physical system. Where, in the third and fourth auxiliary requests, the claim was limited simply to "controlling an industrial process", it was found to be insufficiently directed to a technical process to be patentable since there was no step in the method which directed or would contribute to an actual step of controlling the industrial process. In the fifth auxiliary request however, the limitation to "a method of controlling a physical process", and critically

in the Board's view the limitation of the claim to the method being "for use in the control of said physical process" restricted the claim to the actual control of a physical process. It could not therefore be excluded matter. The critical point appears to be that the invention as set out in the fifth auxiliary request involves a functional link to a physical process. The link is functional in that the outcome of the mathematical process directly affects the physical system.

23. The Board of Appeal saw no distinction, in this particular case at least, between a system of this sort which operated automatically and one which operated through human intervention. I can envisage situations in which such a distinction might be pertinent to patentability, but I don't think it is necessary to make this distinction in order to assess the present invention in the light of this decision.

24. In the present case, the results of the mathematical modelling process are produced as an image. This provides the engineer with statistical information about the permeability or other parameter of the zone of interest. The closest the specification comes to describing the eventual use of the information are such statements as; "the method according to the invention finds applications notably in the construction of a stochastic model of an underground formation." and "the method allows to establish a connection between stochastic model adjustment and deterministic model adjustment by zoning conventionally used by reservoir engineers." These do not in my view link the method to a physical process in the way the Board of Appeal found to be patentable. The specification in fact gives no explanation as to the use of the information in any physical process. The arguments put forward in letters and at the hearing indicate that the information is useful in saving time, cost, flexibility and efficiency in operating or evaluating a production process. However even accepting, in the absence of any such information in the specification, that the information produced by the method might be used in this way, this does not amount to a functional link to a physical process, whether automatic or via human intervention. Accordingly, the present invention does not appear, on this assessment, to involve a technical effect.

25. Mr Black next referred me to *Vicom/Computer-related invention* [1987] 1 OJEPO 14 (T208/84). He drew a parallel between it and the present invention in that Vicom concerned the use of a mathematical method to produce an image. The Board of Appeal said that a mathematical method or algorithm is only an abstract concept prescribing how to operate on numbers. If by contrast a mathematical method is used in a technical process and is carried out on a physical entity, which as in this case could be an image, and if it results in a certain change in that entity, then it does not relate to a mathematical method as such.

26. In Vicom, the process was a method for digitally filtering image data by operating on it in the form of a two-dimensional data array of picture elements. The method was concerned with the manner in which pixels were processed, that is to say how the image was constructed. In the present case, the result of the modelling method is also an image, but by contrast it is the information content of the image which is of concern; that is to say what the image shows, not how it is constructed. This appears to me to be a fundamental distinction. The decision in Vicom was based on the

proposition that the method operated on a physical entity, and that manipulation of the data pixels of an image in a particular way could be regarded as operating on a physical entity. The same does not apply to a mathematical method which results in a new representation of the information relating to a zone of interest. This method is not concerned with the physical properties of the image but, its information content. The present method does not therefore appear to have a physical connection comparable to the Vicom case, and it appears to me to remain a mathematical method.

27. There is an argument, not directly addressed so far, that the fact that the method operates on real data shows that it involves a technical effect. Mr Black emphasised the point that the optimised realisation resulting from the method produces a result that is consistent with the production data and thus is representative of the zone. It seems to me that this point can not determine whether a method such as the present one is or is not patentable. A system which manipulates data and presents information resulting from the manipulation to an operator does not appear to me to become patentable simply because the data represents data from the real world. In fact I would imagine that any system that carries out data manipulation in the practical sciences will be working on data from the real world. This is certainly true of the inventions in the Georges and Vicom cases, but there it was the embedding of the method in a physical system which provided a technical effect, not the meaning of the data. Consequently, unless there is a functional link to a physical system, or conceivably some internal technical feature, such systems will be unpatentable since they simply manipulate data and the fact that data may represent physical parameters in the real world does not in my view, on its own, confer patentability on such systems.

Summary

28. Having considered all these points, it is my view that the present invention relates to a mathematical method as such and is therefore excluded from patentability. I hereby refuse the application for failure to comply with section 1(2)(a) of the Act.

29. I have read carefully through the specification and can find no indication that any amendment could be made which might confer patentability on the invention. The specification does not disclose any connection with a physical system, or any other technical aspect which might serve this purpose. Consequently I am not allowing the applicant the opportunity to file amendments.

30. I note that the examiner has deferred examination of other aspects of the application pending resolution of the patentability issue. In the event that this decision is reversed on appeal, the application will need to be referred back to the examiner for those other aspects to be addressed.

Appeal

31. Any appeal against this decision must be filed within 28 days of the date of this decision.

Dated this 11th day of July 2003

P M MARCHANT
Deputy Director, acting for the Comptroller

THE PATENT OFFICE