

COMMISSIONER'S DECISION

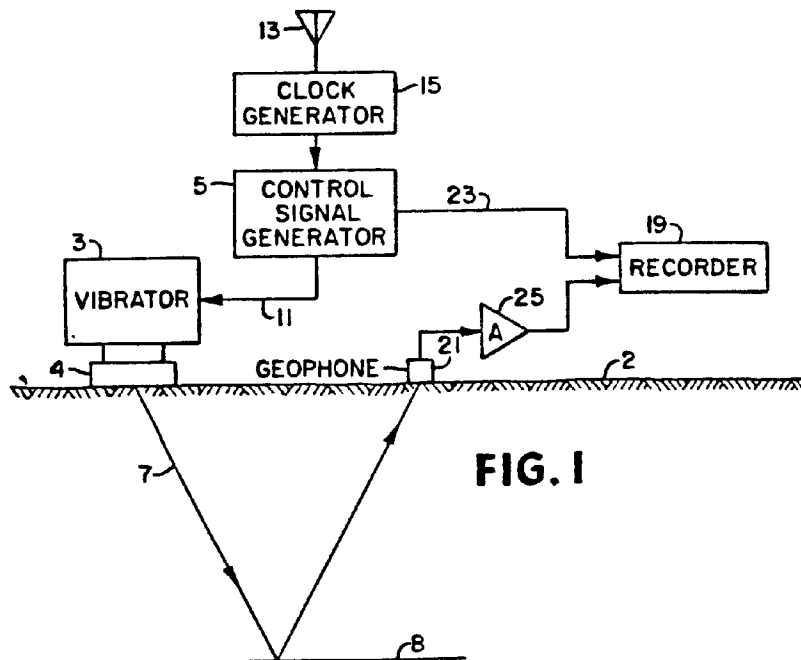
Sec. 2; Sec. 28(3): Reducing Monochromatic Interference in Seismic Prospecting

Electrical transmission lines cause an interference signal in the area where seismic prospecting is carried out. A system for reducing this interference signal is considered patentable.

Final Action: Reversed, claims 13 to 19 are acceptable.

Patent application 259,915 (Class 349-17), was filed on August 26, 1976 for an invention entitled METHOD OF REDUCING MONOCHROMATIC INTERFERENCE IN CONTINUOUS WAVE SEISMIC PROSPECTING. The inventor is Allen B. Cunningham, assignor to Exxon Production Research Company. The Examiner in charge of the application took a Final Action on November 5, 1979 refusing to allow it to proceed to patent. In reviewing the rejection, the Patent Appeal Board held a Hearing on November 10, 1982, at which the Applicant was represented by Mr. H.C. Baker.

The subject matter of this application relates to the field of seismic prospecting and to a means of reducing interference signals such as from electrical transmission lines in the area where the test is located. Figure 1 shown here shows the components of the application.



Antenna 13 detects the interference signal and directs it through clock generator 15 to the control signal generator 5. Generator 5 directs a control signal to the vibrator 3 and to the recorder 19. Reflected seismic energy from the subsurface reflecting interfaces is detected by geophone 21. By selecting a signal pattern in the control generator such that the frequency will have a time-phase relationship with the detected interference signal the Applicant is able to eliminate the effects of the interference signal at the geophone detecting location.

In the Final Action the Examiner rejected the application as being directed to non patentable subject matter contrary to Section 2 and Section 28(3) of the Patent Act. That action stated (in part):

Applicant argues that this is a new and patentable method. A new seismic signal is produced, therefore the method may be considered to be different; however, the method is not patentably new. Each element of the disclosed apparatus operates in its known and intended mode. The clock generator provides a timing signal, the control signal generator (programmed in a conventional manner) provides a desired control signal, the vibrator injects the desired signal under control of the control signal, etc. Each element operates according to its designed parameters. The sole novelty is the information content of the injected signal and perhaps the algorithm by which the control signal generator operates. This algorithm and information content must be ignored since the novelty of the algorithm is not a determining factor and must be treated as though it were a familiar part of the prior art. Considered in this light, the disclosed and claimed method contains no patentable invention.

The method cannot be characterized as a new method for operating an old apparatus. As stated above the apparatus is old and each element operates according to its design parameters and for its intended purpose. Applicant's method shows neither novelty of operation nor novelty of purpose. There is no unexpected result, but rather the result is completely within the capability of the apparatus. The Office does allow method of use claims for this type of apparatus, but only when accompanied by claims of the same scope directed to novel and patentable apparatus, or for new uses for old apparatus which yields unexpected results.

Applicant has discovered a mathematical relationship (an abstract theorem or scientific principle), i.e. the necessary relationship between the injected seismic signal and the monochromatic interference signal to provide a cross correlation output signal free from interference frequencies. This abstract theorem or scientific principle has not then been reduced to an invention, but has instead been embodied in the form of prior art apparatus.

The only difference between the prior art method of operating this apparatus and applicant's method is the algorithm by which the control signal generator operates and thus the information content or mathematical form of the resulting injected seismic signal. The Patent Appeal Board (see CPOR 1 Aug. 1978 pages XIX and XXIV) held that algorithms are merely sets of rules or processes for solving problems in a finite number of steps, and in general can be equated to an abstract theorem which is not patentable under Section 28(3) of the Patent Act. The Board also stated that the novelty of an algorithm lies solely in intellectual connotations and is not patentable under Section 2 of the Patent Act.

The content of this application is directed to an abstract theorem or scientific principle and since the method differs from the prior art merely by the algorithm by which the control signal generator operates and thus ultimately the information of the injected seismic signal; the application is rejected as being directed to non patentable subject matter contrary to Section 2 and Section 28(3) of the Patent Act.

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In response to the Final Action the Applicant stated (in part):

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The applicant has developed an ingenious method for reducing the effects of the monochromatic interference signal on the signal resulting from the cross-correlation by perceiving that the problems encountered with filters can be neatly sidestepped by transmitting into the earth a seismic signal having a substantially null component within its power spectrum substantially at the frequency of the interference signal. This method then produces a correlation signal for which any energy at interference frequency in the received signal becomes multiplied by zero (absent frequency in the transmitted signal band) and therefore does not affect such correlation signal.

Applicant's invention is significant because it permits a seismic signal to be transmitted into the earth having a power spectrum with significant power over a frequency range which includes the interference signal frequency without requiring filtering of the received data to remove the interference. Thus a severe problem in seismic exploration is cleverly solved by a novel and unobvious method.

A wide variety of possibilities for the transmitted signal can be envisaged, for instance one method would be to transmit a repeating swept sine wave signal whose spectrum includes the interference frequency but in which such frequency and its closely adjacent frequencies are absent from the transmitted signal by appropriate construction and cancellation in the transmitter.

In a preferred embodiment of applicant's invention, a signal pattern corresponding to a properly structured binary coded sine wave is transmitted, the pattern being nonrepetitive for at least as long as the longest travel time of the seismic wave from the transmitting

location to the detecting location. A signal pattern that is particularly useful is the binary coded sine wave of maximal length, in which any sequence of "n" bits does not repeat during any sequence of $2^n - 1$ bit intervals.

It is not contended that the use of a binary coded sine wave in seismic exploration is novel per se; however, it has not previously been suggested that such a signal could be structured to solve the seismic data distortion problem caused by an interference signal, such as 60 Hz power line interference.

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The consideration before the Board is whether or not the application is directed to patentable subject matter under Sections 2 and 28(3) of the Patent Act and also whether the subject matter is obvious.

Section 2 defines "invention" while Section 28(3) specifies that no patent shall issue for "any mere scientific principle or abstract theorem". Before we consider these sections of the Act let us review the application in order to determine what is described therein.

From the disclosure we find that the Applicant describes a "system for reducing the effects of a monochromatic interference signal on seismic data records." In other words signals of the 60 c.p.s. type in electrical power distribution lines in the area of the seismic test interfere with the reflected signal at the geophone. According to the application, prior art means for removal of this interference signal involved various filtering techniques which "included filters incorporated into field systems and computer programs that remove interference signal during data processing". This required use of additional hardware in the seismic field equipment or additional computer programming during data processing. As stated on page 3 at line 10 of this application the monochromatic interference signal effects are reduced by selecting a signal pattern "such that the frequency of the interference signal is closer to the frequency of the null component than to either of the two components in said power spectrum adjacent said null component." Advantages of this system are described at the bottom of page 3 where it outlines how it avoids the distortion in seismic data at frequencies near the interference frequency caused by most previously used systems and how it reduces the amount of hardware needed by the prior art systems.

A description of the preferred embodiment begins at page 4 where "apparatus useful to practicing this invention is illustrated in Figure 1." As described on page 5, a control signal generator generates the electrical input control signal for the vibrator positioned on the earth's surface. This control signal "will have a bit period related to the period of the monochromatic interference signal present in the area where seismic exploration is to be conducted. The interference signal may be detected by antenna 13 which is shown coupled to the control signal generator through clock generator 15".

After listening to Mr. Baker's presentation at the Hearing the Examiner's director indicated that he considers claims 13 to 19 acceptable because they are directed to a combination not found in the art. But he maintained the view that the remaining claims are unacceptable because they define the operation of prior art apparatus with merely a change in the information content of the transmitted signal, so essentially they are directed to a method of data processing which, in its broadest sense, is reduced to an algorithm, thereby failing to comply with Sec. 2 and 28(3) of the Patent Act.

In the Final Action it is stated that the "content of this application is directed to an abstract theorem or scientific principle" and the application was rejected as being directed to non patentable subject matter contrary to Section 2 and Section 28(3) of the Patent Act. After reviewing the specification we find that it does describe a system for reducing the effect on seismic data records of a monochromatic interference signal present in the area in which the seismic prospecting is conducted. Also, since it is now acknowledged that certain claims are directed to a combination not found in the art, we cannot support a rejection of the application under Sec. 2 and Sec. 28(3) of the Patent Act and recommend withdrawal of the rejection.

As some discussion with respect to the claims took place at the Hearing we make the following comments with respect to claims 13 and 1. Claim 13 reads:

In a system for seismic prospecting wherein a vibrator is utilized to transmit a continuous wave of seismic energy in response to an electrical input control signal into the earth from a first location and reflections of the signal from the subsurface are thereafter detected at a second location and cross-correlated with the transmitted signal, the method of reducing the effects on the signal resulting from the cross-correlation of a monochromatic interference signal present in the area in which seismic prospecting is conducted comprising:

- generating said input control signal in the form of a binary coded sine wave having a substantially null component in the power spectrum thereof;

- detecting said interference signal present in the area in which seismic prospecting is conducted;

- generating a clock signal at the frequency of said interference signal;

- controlling the frequency of said binary coded sine wave with said clock signal so that said null component is substantially at the frequency of said interference signal.

This claim specifies the combination by which a monochromatic interference signal is removed from seismic data records by transmitting into the earth a seismic signal having a null component in its power spectrum.

In the absence of cited art we have no objection to this claim since it meets the requirements of Sec. 36(2) of the Patent Act.

Turning now to claim 1 which is shown below:

In a continuous wave method of seismic prospecting wherein a seismic signal is transmitted into the earth from a first location and reflections of the signal from the subsurface are thereafter detected at a second location and cross-correlated with the transmitted signal, the method of reducing the effect of a monochromatic interference signal on the signal resulting from the cross-correlation which comprises:

- transmitting a seismic signal having a power spectrum containing a substantially null component therein at a frequency nearer to the interference signal frequency than either of the frequencies of the components in said power spectrum adjacent said substantially null component are to said interference signal frequency.

Means of overcoming the interfering signals originating in power lines in the seismic test area is discussed by a number of patents referred to in the disclosure. These patents utilize filtering techniques in which "nulling signal frequency, phase and amplitude characteristics are adjusted to match the interference signal manually" or by feedback loops. On page 5 the disclosure of this application indicates that the interference signal is

obtained by antenna 13 and on page 7 line 16 it states that one of the advances in the seismic prospecting art disclosed herein is in the use of a transmitting signal having a null in the power spectrum thereof substantially at the frequency of the interference signal.

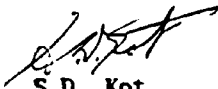
It is necessary to detect the interference signal present in the area where seismic prospecting is conducted and subsequent processing of this signal is required to achieve the objectives described in the application. As the method recited in claim 1 does not incorporate any detecting means we find it not sufficiently distinct and explicit as required by Sec. 36(2) of the Patent Act.

Claims 13 to 19 define the arrangement of components for conducting seismic wave prospecting shown in figures 1 and 2 of the application. Since these claims are now considered acceptable and no art has been cited, we find no basis for the rejection on the grounds of obviousness.

In summary, we recommend the rejection of the application as obvious and as directed to non patentable subject matter contrary to Section 2 and Section 28(3) be withdrawn, and that the application be returned for continued prosecution.



A. McDonough
Chairman
Patent Appeal Board



S.D. Kot
Member



M.G. Brown
Member

I have reviewed the prosecution of this application and concur with the reasoning and findings of the Board. Accordingly, I withdraw the Final Action and I am returning the application to the Examiner for further prosecution.



J.H.A. Gariépy
Commissioner of Patents

Dated at Hull, Quebec

this 1st. day of June, 1983