COMMISSIONER'S DECISION

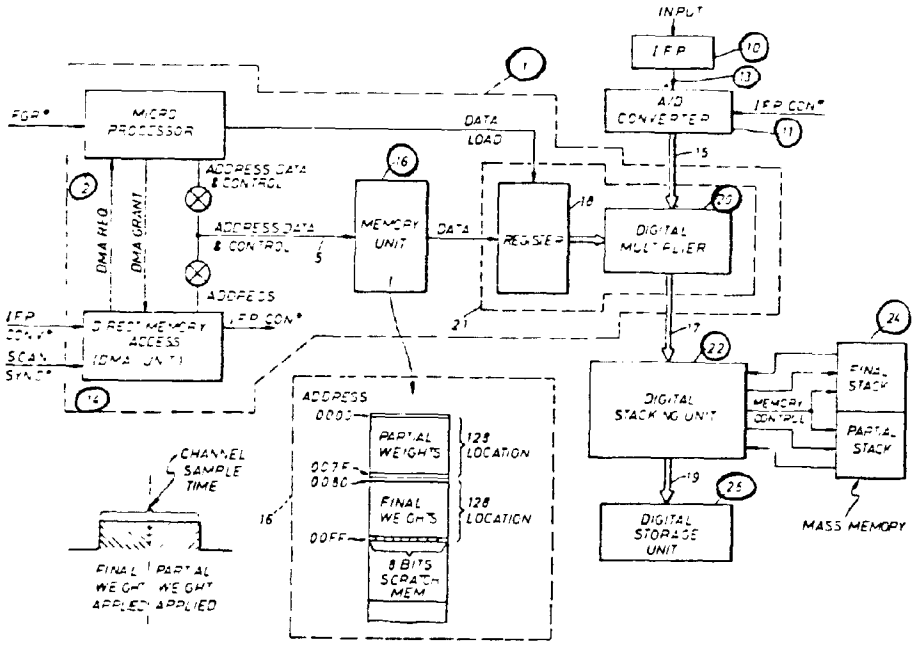
Section 2. Seismic Signal System Responsive to Variable Source Array

The application is directed to an arrangement of apparatus to produce continual signals of subsurface formations. Certain claims sufficiently define the system to stack the signals. Rejection withdrawn.

This decision deals with Applicant's request for review by the Commissioner of Patents of the Final Action on application 335,245 (Class 349-17) filed September 10, 1979, assigned to Geosource, Inc., entitled METHOD AND APPARATUS FOR OBTAINING A COMPOSITE FIELD RESPONSE TO A VARIABLE SOURCE ARRAY USING WEIGHTING COEFFICIENTS. The inventors are T.A. Khan, John W. Kiowski and Douglas G. Lang. The Examiner in charge issued a Final Action on December 30, 1982, refusing to allow the application.

This application relates to a multi-channeled digital seismic signal stacking system which provides weighted signals in a partial stack and a final stack based on signals received from an energy source. The energy source moves from one station to the next releasing at the center of each, in succession, a shot which produces the same number of impulses on each side of center, i.e. a first half and a second half, to form a set. This roll-along effect results in an overlapping of the signals received at each channel, for example, the last half of impulses from a leading station overlaps the first half from a following station. The first half of impulse samples forms a partial stack and the second half of impulse samples forms a final stack. The system provides for weighting coefficients to be applied to the samples forming the two stacks of signals, and for summing of the partial stack with the final stack. In this manner, the effect of the system is to decrease the source array spacing and increase spatial density, thereby enhancing signals received from subsurface formations.

The block diagram in figure 5(a) reproduced below, illustrates the digital stacking system used to process the analog output signals received from the various seismic channel locations.




The analog signal 13, obtained from amplifier 10 which receives the seismic signals from the various channels, is converted to a digital signal in converter 11. Then it is input into the weighting coefficient multiplying unit 1 for multiplication with a weighting coefficient. The resulting weighted signal is fed to stacking unit 22.

In unit 1, prior to each impulse or signal, the microprocessor 12 loads the weighting coefficients required by each channel to make a summation, both for the partial and the final stack, into the bottom of the memory locations of memory unit 16. A function generator reset signal, generated at the start of each sum number, initiates the microprocessor to transfer the weighting coefficients from the bottom to the higher memory locations in the memory unit. During each impulse, a direct memory access 14 is permitted to address the memory unit. A weighting coefficient for each impulse is strobed into register 18 by a signal from the microprocessor for storage. Data stored in the register is in 8-bit digital words and these are sent to digital multiplier 20 as are 15-bit samples from converter 11. A sample of each produces the weighted digital sample sent to the stacking

unit which sums both the final and the partial stack samples and sends them for storage in separate locations in memory 24. The stacking unit 22 performs the transfer of the contents of either of the stacks to the digital storage unit 26.

In making his rejection, the Examiner said, as follows:

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> The rejection of claims 1 to 23 as well as the remainder of the application is maintained. The invention defines non-statutory subject matter under Sections 2 and 28(3) of the Patent Act.
>
> The invention discloses a digital field stacking system that adjusts the amplitude of digitized seismic signals according to predetermined weighting coefficients. The received seismic signal is amplified, digitized, multiplied by the weighting coefficient and summed before recording. Apparatus claim 13 defines the improvement by means for multiplying each digital sample.
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> . . .
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> However, amplification can be likened to the mathematical operation of multiplication. (See reference of interest). In accordance with the guidelines on computer related inventions published in the Canadian Patent Office Record of August 1, 1978, page 26, patentable subject matter does not exist unless there is novel structural apparatus. Since the present method consists of manipulating reflected seismic data in order to convert it into more meaningful data there is no novel apparatus. Accordingly the rejection is maintained.
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The Applicant, in responding to the Final Action, argues, in part:

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> ...The present invention is able to modify the source array lengths at different distances to conform to the horizontal velocities of the source generated surface noise at those distances; to generate, in the field, two sets of data representing the data from two differently weighted source arrays from one set of impulses with no loss in surveying time; and to implement source-geophone array combinations offering greater and more constant attenuation.
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> . . .
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> ...The novel apparatus is the digital field stacking system as described in the specification, drawings and defined in the claims. The newly discovered idea is the idea of cancelling noise in the seismic adjustments to the digital seismic samples before the stacking operation occurs thereby obtaining a response to a variable source array. Additionally, the present invention increases the efficiency with which these variable source array field records are created by using each seismic sample in creating two digital stacks, a partial stack and a final stack.

The issue before the Patent Appeal Board is whether the application and the claims define statutory subject matter in view of Sections 2 and 28(3) of the Patent Act. Claim 1 reads:

> A multi-channeled digital seismic field stacking system for producing seismic signals to form a stack of summed together receiver array responses to a preselected number of energy impulses applied to the ground at selected impact points, thereby to obtain a composite seismic response to a variable source array, said seismic system comprising:
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> (A) at least one amplifier, for amplifying said seismic signals from selected points on the ground to obtain a sampled analog output signal, each seismic channel of said multi-channeled system having a multiplexer sample time interval;
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> (B) an analog-to-digital converter, for converting said sampled analog output signal to a digital sample;
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> (C) means for applying pre-selected weighting coefficients to said digital sample in real time to obtain weighted samples;
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> (D) a digital stacking unit, for summing said weighted samples with the summed-together weighted samples of the seismic signals from the preceding ones of the preselected number of impulses which have occurred for a stack, said summed-together weighted samples in each of said channels obtained from seismic signals measured at the same point on the ground; and
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> (E) a digital storage unit, for storing said stacked seismic signals as a record when a portion of said preselected number of impulses have occurred, said records representing composite seismic responses to variable source arrays, each source array varied in accordance with said preselected weighting coefficients.

In a Supplemental Submission, the Applicant explains further that the invention relates to controlling the energy source array in the field while the data is being generated in order to enhance the signal-to-noise ratio. He discusses claims 1, 13 and 21, pointing out how they are directed to obtaining a composite response to a variable source array which produces a useful end result. He draws attention to Canadian patents 1,160,334, 1,163,353 and 1,190,311 related to seismic prospecting, issued January 10 and March 6, 1984, and July 9, 1985, respectively, and the results of Commissioner's Decisions thereon. The Applicant identifies the importance of looking to 'what' has been discovered in an application to determine the inventive subject matter, and quotes from Schlumberger Canada Ltd. v. The Commissioner of Patents 56 C.P.R. (2d) 204, as follows:

> I am of opinion that the fact that a computer is or should be used to implement discovery does not change the nature of the discovery.

We agree that the above passage provides guidance in determining 'what' has been advanced as the invention. We are impressed by the description of the various parts of a seismic system functioning to produce, transform and store signals from an array of seismic channels including a moving surface energy source applying energy to the center of each station. When the source reaches a station, the energy impulses are generated so that the last half of the impulses from a first station overlaps the generation of the first half of the impulses from the next station in an array. We read that the system applies weighting coefficients to each seismic sample, a partial and a final weighting, to produce a partial stack and a final stack of information from the impulses. Means are provided to record and sum these stacks as the roll-along occurs. In effect, the arrangement decreases the spacing of the effective source array and increases the spatial density of the subsurface mapping. We find a system of components producing enhanced signals of subsurface formations.

We see that a microprocessor, one of many parts used in the weighting coefficient multiplying unit, combines with the other parts, namely a memory unit for storing partial and final weights, a weight register, and a digital multiplying assembly, to produce continual signals to a stacking unit. A memory control associated with the stacking unit effects the transfer of final stack and partial stack signals to a storage unit. We are aware that the signals obtained in the field are analysed elsewhere. We cannot, however, ignore the system that obtains the signals. The application refers to improving on prior art systems, and we note that no art was applied during prosecution. We are impressed by the arrangement described in the application which obtains a stacking of signals not previously attainable, and consider this to be the 'what' that has been discovered in a patentable art area. We do not, therefore, support the rejection of the application and the claims in view of Sections 2 and 28(3) of the Patent Act.

In reviewing claims 1, 13 and 21, discussed by the Applicant, we are hard pressed to find in any of them all of the features set out in the application which contribute to the formation of summed samples to form a final stack and a partial stack. In claims 1 and 13, reference is made to summing weighting coefficients in a stacking unit and this is included in claim 21 as a summing procedure. We doubt, however, that these three claims define all of the parts of the digital stacking unit that combine to form and store the final and partial stacks of recorded information. It may be, however, that claims like claim 8 and claim 15 contain sufficient definition of the invention set out in the application.

In summary, we find the subject matter disclosed is acceptable in view of Sections 2 and 28(3) of the Patent Act. We are satisfied the rejection of the application should not be maintained. We are not persuaded, however, that all the claims define Applicant's system. We observe that the discussion of the claims during prosecution was concerned primarily with the nature of the subject matter, not its definition. In the Supplemental Submission, Applicant expresses agreement to a return of the application for further prosecution. Following from our finding of subject matter, we believe a full discussion of the claims should be permitted to develop the scope of the claimable subject matter. In this manner, should there be defined an issue with respect to the scope of claimed subject matter, Applicant's request for a Hearing will be of significance.

We recommend, therefore, the rejection of the application be withdrawn, and that the application be returned for prosecution of the claims.

M.G. Brown
Acting Chairman
Patent Appeal Board

S.D. Kot
Member

I concur with the findings and the recommendation of the Patent Appeal Board. Accordingly, I withdraw the rejection of the application and remand it for prosecution of the claims consistent with the findings.

J.H.A. Gariépy
Commissioner of Patents
Dated at Hull, Québec
this 14th day of April 1986

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