cement evaluation logs as the source still lacked azimuthal directivity to effectively detect the existence of small channels between the cement and the rock formation.

SUMMARY

[0007] An aspect of the present invention ~~is to~~ provides a method for investigating cement bonding or rock formation structure near a borehole. The method includes generating an acoustic wave by an acoustic source; directing at one or more ~~inclination and~~ azimuthal angles the acoustic wave towards a ~~target~~ seletected location in a vicinity of a borehole; receiving at one or more receivers an acoustic signal, the acoustic signal originating from a reflection, ~~or~~ a refraction or a surface wave propagation, or any combination thereof, of the acoustic wave by a material at the ~~desired~~ selected location; and analyzing the received acoustic signal to characterize features of the material around the borehole.

[0008] Another aspect of the present invention ~~is to~~ provides a system for investigating cement bonding or rock formation structure near a borehole. The system includes an acoustic source configured to generate an acoustic ~~wave~~ beam and to direct the acoustic ~~wave~~ beam at one or more azimuthal angles towards a ~~desired~~ selected location in a vicinity of a borehole. The system also includes ~~one or more~~a receivers configured to receive an acoustic signal, the acoustic signal originating from a reflection, ~~or~~ a refraction or a surface wave propagation, or any combination thereof, of the acoustic ~~wave~~ beam by a material at the ~~desired~~ selected location. The system also includes a processor configured to perform data processing on the received signal to analyze the received acoustic signal to characterize features of the material around the borehole.

[0009] ~~Yet another aspect of the present invention is to provide~~There is also disclosed an acoustic source for generating an acoustic beam. The acoustic source includes a housing; a plurality of spaced apart piezo-electric layers disposed with the housing; and a non-linear medium filling between the plurality of layers. Each of the plurality of piezoelectric layers is configured to generate an acoustic wave when excited with an electrical signal. The non-linear medium and the plurality of piezo-electric material layers have an acoustic matching impedance so as to enhance a transmission of the acoustic wave generated by each of plurality of layers through the remaining plurality of layers.

[0010] ~~Another aspect of the present invention is to provide~~There is also disclosed an acoustic detector that includes a cylindrical support member and a plurality of receiver elements that are disposed