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[54] **METHOD AND APPARATUS FOR ACOUSTIC LOGGING OF FLUID DENSITY AND WET CEMENT PLUGS IN BOREHOLES**

Primary Examiner—Christine K. Oda
Assistant Examiner—Anthony Jolly
Attorney, Agent, or Firm—Felsman, Bradley, Vaden, Gunter & Dillon, LLP

[75] Inventors: **Lucio Nelson Tello; Thomas Jay Blankinship; Edwin Kamm Roberts,** all of Fort Worth, Tex.

[57] **ABSTRACT**

[73] Assignee: **Computalog Research, Inc.,** Fort Worth, Tex.

A method of determining the acoustic impedance of a fluid in a borehole, by gating a reflected acoustic signal into a plurality of time slots, and comparing received energies of the signal for the time slots to obtain a value indicative of the acoustic impedance of the fluid. The value may be normalized to yield the acoustic impedance of the fluid using the acoustic impedance of, e.g., water as a calibration point. The comparison is performed by comparing a ratio of an integration of a first ring down time slot and a second ring down time slot, to an integration of an internal reflection time slot. The acoustic pulse may be generated using a transducer immersed in an intermediate fluid contained within a chamber defined in part by a plate in contact with the borehole fluid and having a thickness such that a mechanical resonance frequency of the plate in a thickness mode is substantially equal to a resonance frequency of the transducer. The sonic velocity of the fluid is also measured and, when combined with the acoustic impedance, is used to determine the fluid density.

[21] Appl. No.: **09/141,796**

[22] Filed: **Aug. 28, 1998**

[51] **Int. Cl.⁷** **G01T 1/16**

[52] **U.S. Cl.** **73/151; 73/32; 181/5**

[58] **Field of Search** **367/28; 181/102, 181/103, 105, 5; 364/509; 73/151, 24, 32**

[56] **References Cited**

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5 Claims, 7 Drawing Sheets

