Acoustic Transducer With Impedance Matching Layer

Background

[0001] Acoustic transducers are used for a variety of purposes, including in the oil field. A focused planar transducer, such as that described in United States Patent No. 5,044,462, which is owned by the assignee of the instant application, allow acoustic illumination with focus and depth of field. Transferring energy from an acoustic transducer to fluids in a borehole is a challenge.

Summary

[0001a] An aspect of the present invention provides an apparatus comprising:

a housing;

a piezoelectric transducer mounted in the housing;

an impedance matching layer provided between the piezoelectric transducer and the housing;

wherein the impedance matching device includes a plurality of slots extending therethrough, said slots also extending partially through the piezoelectric transducer.

Brief Description of the Drawings

[0002] FIG. 1 is a sectional view through an acoustic measuring tool in accordance with the teachings of the present disclosure suspended in a well borehole and which incorporates a rotatable transducer antenna for sending and receiving acoustic pulses against the sidewall of the borehole

[0003] FIGS. 2A and 2B are enlarged views of the acoustic transmitter element having several grooves cut therein to define concentric rings for transmitting purposes.

[0004] FIGS. 3A and 3B are an alternate form of an acoustic transmitter element utilizing square cuts in the ceramic member showing the square elements connected in the manner shown in FIG. 3C to closely approximate the rings of the transmitter element of FIG. 2.

[0005] FIG. 4 is an electronic schematic block diagram showing the components of the transducer system and selected waveforms.

[0006] FIG. 5 is a block diagram showing the implementation of the phase contrast imaging process using digitized data and also shows a gain curve and a processing flow chart.

[0007] FIG. 6 is a graph showing beam widths as a function of range and chosen focusing distance.

[0008] FIG. 7 is a graph showing a comparison between amplitude, travel time, and phase contrast processing of data.

[0009] FIG. 8 is a sectional view through an acoustic transmitter element having an acoustic impedance matching layer.

[0010] FIG. 9A is a sectional view through an acoustic transmitter element having an acoustic impedance matching layer, having slots cut through the acoustic impedance matching layer and into a piezoelectric ceramic disk. FIG. 9B is a plan view of the acoustic transmitter element of FIG. 9A.