Claims

~~What is claimed is:~~

1. A device comprising:

~~(a)~~ a piezoelectric transducer, the transducer having N independent transducer regions wherein N is an integer, each of the N independent transducer regions having a thickness, each of the N independent transducer regions having an acoustic impedance AIT, each of the N independent transducer regions being independently excitable to oscillate in the thickness mode when electrically excited by a potential difference applied across the thickness;

~~(c)~~ a first impedance matching layer having an acoustic impedance AI1 between AIT and a borehole fluid acoustic impedance AIBF, the first impedance matching layer being situated such that an acoustic signal emitted by the piezoelectric transducer will pass through the ~~second~~ first impedance matching layer; and

~~(b)~~ a second impedance matching layer having an acoustic impedance AI2 between AI1 and AIBF, the second impedance matching layer being situated in the device such that an acoustic signal emitted by the transducer will pass through the second impedance matching layer after it passes through the first impedance matching layer,

wherein the first impedance matching layer has N independent first impedance matching layer regions that match and overlay the N independent transducer regions.

2. The device of claim 1 wherein the second impedance matching layer comprises a housing.

3. The device of claim 1 wherein the transducer is generally circularly disk shaped.

4. The device of claim 1 wherein the N independent transducer regions are concentric and generally circumferential.

~~5. The device of claim 1 wherein the first impedance matching layer has N independent first impedance matching layer regions that match and overlay the N independent transducer regions.~~

~~6~~5. The device of claim ~~5~~ 1 wherein at least some of the N independent first impedance matching layer regions are mechanically decoupled from at least some of the other N independent first impedance matching layer regions.

~~7~~6. The device of claim ~~5~~ 1 wherein the N independent first impedance matching layer regions are separated by cuts in the second impedance matching layer.

~~8~~7. The device of claim ~~5~~ 1 wherein the acoustic impedances of the N independent first impedance matching layer regions are the same.

~~9~~8. The device of claim ~~5~~ 1 wherein the acoustic impedance of at least one of the N independent first impedance matching layer regions is different from one other of the N independent first impedance matching layer regions.

~~10~~9. A method comprising:

~~(a)~~ emitting an acoustic pulse from a piezoelectric transducer, the transducer having N independent transducer regions wherein N is an integer, each of the N independent transducer regions having a thickness, each of the N independent transducer regions having an acoustic impedance AIT, each of the N independent transducer regions being independently excitable to oscillate in the thickness mode when electrically excited by a potential difference applied across the thickness;

~~(c)~~ passing the acoustic pulse through a first impedance matching layer having an acoustic impedance AI1 between AIT and a borehole fluid acoustic impedance AIBF; and

~~(b)~~ passing the acoustic pulse that has passed through the first impedance matching layer through a second impedance matching layer having an acoustic impedance AI2 between AI1 and $AIBF_2$

wherein the first impedance matching layer has N independent first impedance matching layer regions that match and overlay the N independent transducer regions.

~~11~~10. The method of claim ~~10~~ 9 wherein the second impedance matching layer comprises a housing.

~~12~~11. The method of claim ~~10~~ 9 wherein the transducer is generally circularly disk shaped.

~~13~~12. The method of claim ~~10~~ 9 wherein the N independent transducer regions are concentric and generally circumferential.

~~14. The method of claim 10 wherein the first impedance matching layer has N independent first impedance matching layer regions that match and overlay the N independent transducer regions.~~

~~15~~13. The method of claim ~~14~~ 9 wherein at least some of the N independent first impedance matching layer regions are mechanically decoupled from at least some of the other N independent first impedance matching layer regions.

~~16~~14. The method of claim ~~14~~ 9 wherein the N independent first impedance matching layer regions are separated by cuts in the second impedance matching layer.

~~17~~15. The method of claim ~~14~~ 9 wherein the acoustic impedances of the N independent first impedance matching layer regions are the same.

~~18~~16. The method of claim ~~14~~ 9 wherein the acoustic impedance of at least one of the N independent first impedance matching layer regions is different from one other of the N independent first impedance matching layer regions.

~~19~~17. A device comprising:

~~(a)~~ a piezoelectric transducer having an acoustic impedance AIT;

~~(c)~~ a first impedance matching layer having an acoustic impedance AI1 between AIT and a borehole fluid acoustic impedance AIBF, the first impedance matching layer being situated such that an acoustic signal emitted by the piezoelectric transducer will pass through the ~~second~~ first impedance matching layer, the first impedance matching layer having N independent impedance matching layer regions separated by cuts in the first impedance matching layer; and

~~(b)~~ a second impedance matching layer having an acoustic impedance AI2 between AI1 and AIBF, the second impedance matching layer being situated in the device such that an acoustic signal emitted by the transducer will pass through the second impedance matching layer after it passes through the first impedance matching layer.

~~20~~18. The device of claim ~~19~~17 wherein:

the piezoelectric transducer comprises N independent transducer regions wherein N is an integer, each of the N independent transducer regions having a thickness, each of the N independent transducer regions having an acoustic impedance AIT, each of the N independent transducer regions being independently excitable to oscillate in the thickness mode when electrically excited by a potential difference applied across the thickness, each of the N independent transducer regions being matched and overlaid by one of the N independent impedance matching layer regions.