SUMMARY OF THE INVENTION

~~The present invention relates to a megasonic processing apparatus having two piezoelectric transducers (PZT) operating in thickness mode at fundamental resonant frequencies of at least 300 KHz. First and second transducers have corresponding first and second operating frequencies that are different. A mounting plate is provided for mounting the transducers. At the location of the first transducer the mounting plate has a first thickness and has a fundamental resonant or harmonic frequency substantially equal to the first operating frequency. At the location of the second transducer the mounting plate has a second thickness and has a fundamental resonant or harmonic frequency substantially equal to the second operating frequency. The apparatus also includes a tank containing a liquid and one or more parts to be processed. The mounting plate is operatively coupled to the tank so that the transducers provide vibrations to the tank and its contents. The apparatus also includes one or more generators coupled to the transducers for supplying driving signals at the first and second operating frequencies.~~

According to an aspect of the present invention, there is provided a megasonic processing apparatus comprising: a first piezoelectric transducer operating in thickness mode and having a fundamental resonant frequency of at least 300 KHz and having a first operating frequency; a second piezoelectric transducer operating in thickness mode and having a fundamental resonant frequency of at least 300 KHz and having a second operating frequency different from the first operating frequency; a mounting plate upon which the first and second transducers are mounted, wherein at the location of the first transducer the mounting plate has a first thickness and has a fundamental resonant or harmonic frequency substantially equal to the first operating frequency, and wherein at the location of the second transducer the mounting plate has a second thickness different from the first thickness and has a fundamental resonant or harmonic frequency substantially equal to the second operating frequency; a tank adapted to contain fluid and one or more parts to be processed, wherein said mounting plate is operatively coupled to the tank so that the transducers provide vibrations to the tank and its contents; and a generator coupled to the transducers for supplying driving signals at the first and second operating frequencies.

The mounting plate has a resonant frequency that is matched to an operating frequency of the transducers. As disclosed herein~~In one embodiment of the invention~~, the transducers all have substantially the same dimensions, but some are operated at a fundamental resonant frequency and others are operated at a third harmonic frequency. The mounting plate has a uniform thickness and has a fundamental resonant frequency that is

substantially equal to a fundamental resonant frequency of the transducers, and also has a third harmonic frequency that is substantially equal to a third harmonic frequency of the transducers. For example, the transducers have a fundamental resonant frequency of about 470 KHz and a third harmonic frequency of about 1560 KHz. Accordingly, the mounting plate has a fundamental resonant frequency of about 470 KHz and a third harmonic frequency of about 1560 KHz, to match the transducers.

This may have~~embodiment has~~ the advantage that the mounting plate has a uniform thickness and the third-harmonic transducers are the same dimensions as the fundamental resonant frequency transducers. Alternatively, the higher frequency transducers could be based on a thinner PZT that is driven at its fundamental resonant frequency instead of a higher-order harmonic. For example, a 0.23 inch thick PZT will have a fundamental resonant frequency of 470 KHz and a third harmonic of 1560 KHz, whereas the PZT thickness would have to be reduced to about 0.05 inches to obtain a fundamental resonant frequency of 1560 KHz.