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ULTRASONICS - SONOCHEMISTRY - INNOVATION

HAMMER CONVERTERS

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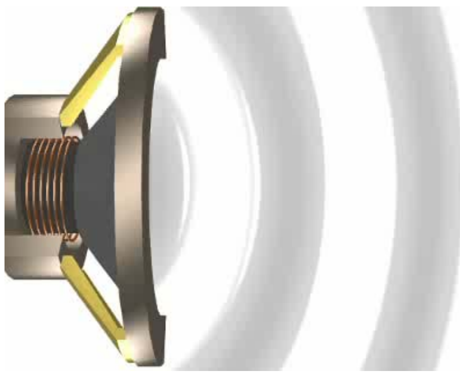
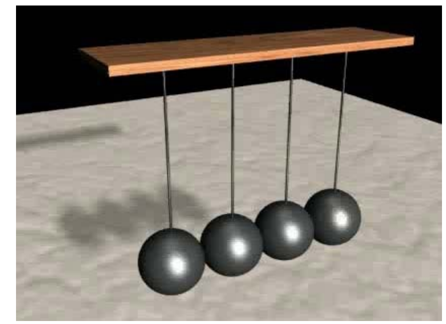
HAMMER OPERATING REGIMES

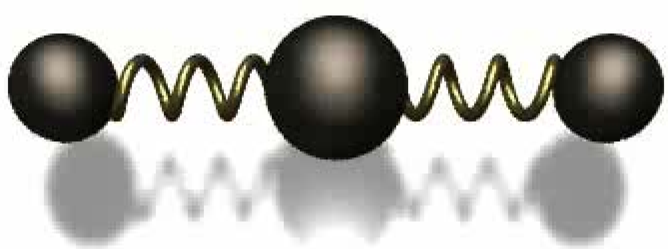


Double-piston transformed into hammer

Velocity-source

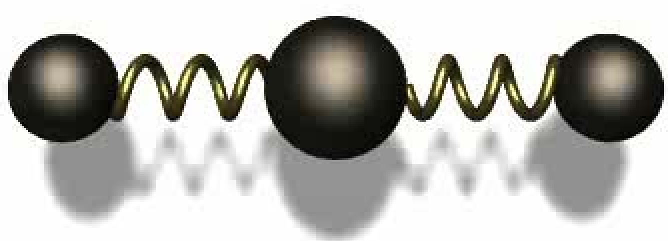
Hammer Force-transducer, Type-A





Hammer, single-piston converter

Type-B



Langevin, double-piston converter

Mechanical Configurations

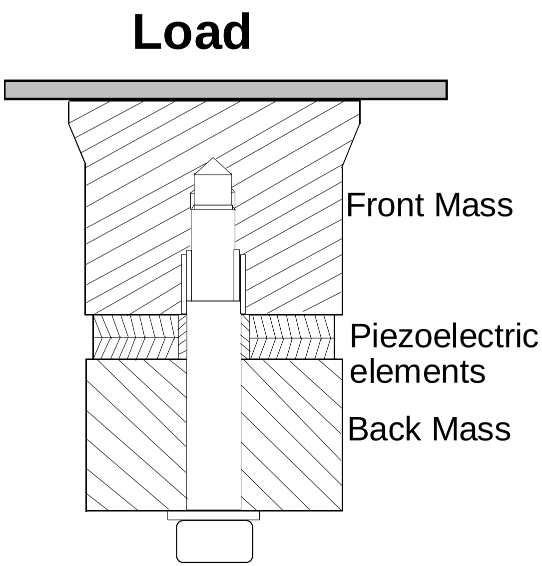


Figure 1 : Conventional Langevin transducer. The front mass is coupled to the back mass via a tensional bolt and the piezoelectric ring elements in the middle of the transducer. The load is coupled to the front mass and therefore influences the resonance response.

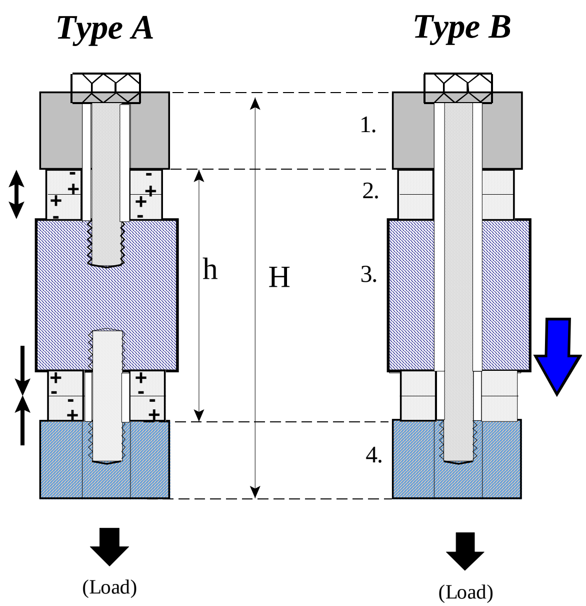


Figure 2 : Schematic of the Hammer transducer showing 1) tail mass, 2) four piezoelectric rings, 3) hammer mass and 4) front mass that is usually coupled to the load. Two configurations are possible: *Type A* - Center mass connected directly to bolt and *Type B* - Center mass moves independently of the bolt.

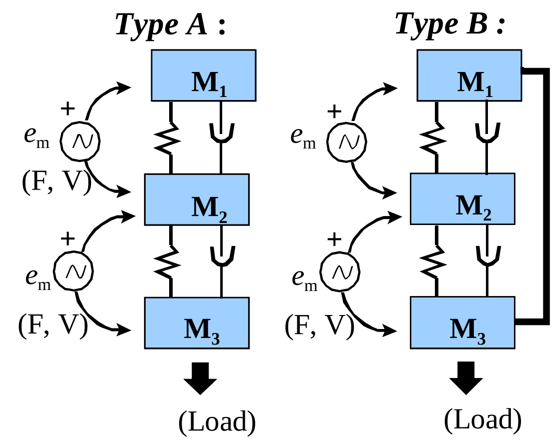


Figure 3 : Simplified equivalent oscillation system for the Hammer transducer options A and B.

Piezoelectric Hammer Transducers

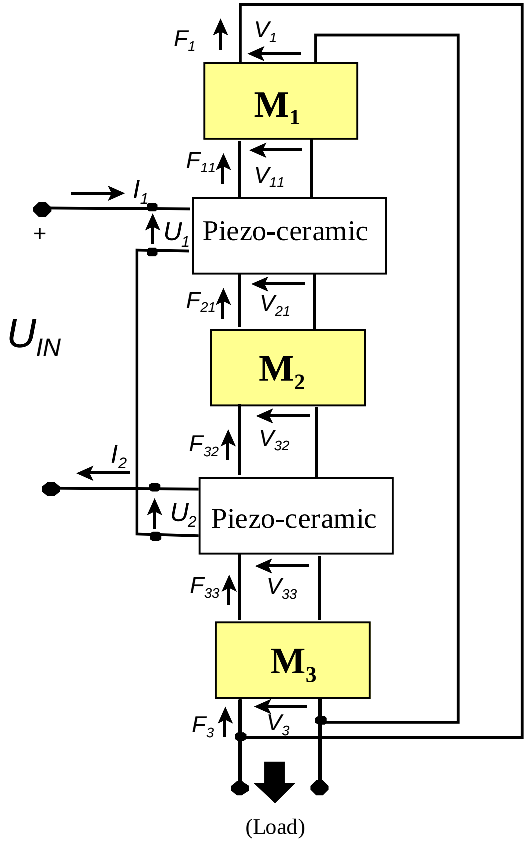
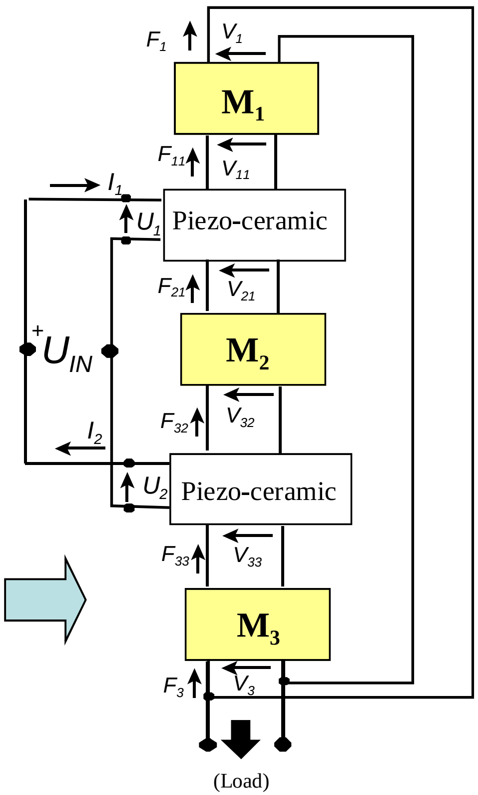


Figure 4 : Type-B; Two-port system representation showing piezoelectric elements driven in series. In this case, F1≈F3, V1≈V3, F21=F32, V21=V32, I1=I2 and U1=U2=0.5Uin

Figure 5 : Type-B; Two-port system representation of a Type B hammer transducer showing piezoelectric elements driven in parallel. In this case, F1≈F3, V1≈V3, F21=F32, V21=V32 and U1=U2=Uin



There are two basic configurations in which the hammer transducers electrical terminals can be connected; piezoelectric elements series driven and piezoelectric parallel driven. This is demonstrated by drawing the system in the format of a two-port network [6]. This is shown for the case of a hammer *Type B* with piezoelectric elements driven in series in Figure 4 and for parallel driving in Figure 5.

Hammer Design Options

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(54) **Unidirectional single piston ultrasonic transducer**

(57) Unidirectional sandwich transducer which includes a center mass (4) freely placed between two active transducer element stacks (2' and 2") and two end masses (3',3") where all of them are coupled only by rigid stress rod between two end masses and where one of two active transducer element stacks can be replaced by solid and acoustically passive isolator stack. The center mass is performing free and not attenuated single piston oscillations between two active transducer element stacks and two end masses realized by mutually opposite phase polarity of active transducer elements while driven by the same input electrical signal. The center mass is also performing free and not attenuated single piston oscillations between one active transducer element stack and one solid and acoustically passive isolator stack and two end masses. The transducer is using electrical and emitting acoustic energy only when placed in contact with some external mass and shape and size of externally contacted mass have no influence to transducer's center mass vibrations. When center mass is performing single piston movement and when transducer is not mechanically loaded the total transducer length is constant and two end masses are not oscillating. The transducer is ideal for agitating arbitrary distant and arbitrary shaped liquid and solid masses placed in different vessels or pipes transferring its vibrations via waveguide solid rod connected between the transducer and a loading mass. The single piston transducer connected perpendicularly to a solid tube can agitate different radial and circumferential tube vibration modes without the need of exciting longitudinal and axial tube modes. The transducer can also be used as vibration receiver or sensor.

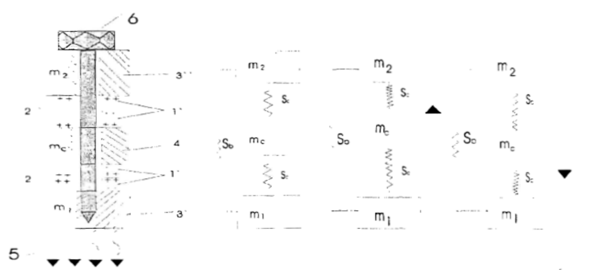

Fig.3.a Fig.3.b Fig.3.c Fig.3.d

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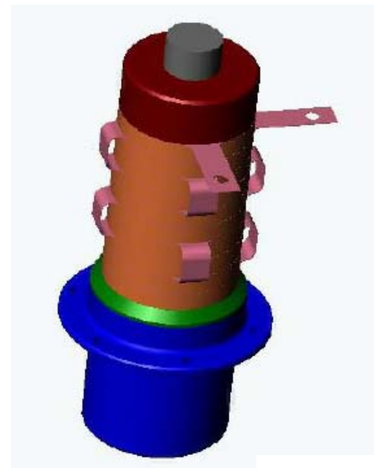

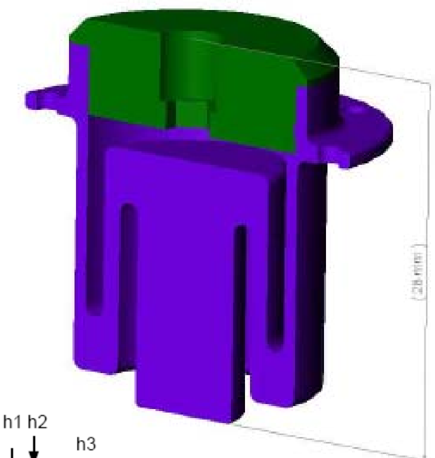

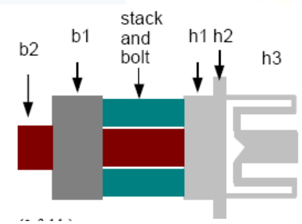

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Novel Horn Designs for Ultrasonic/Sonic Cleaning Welding, Soldering, Cutting and Drilling

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