National Aeronautics and
Space Administration

Mechanical and Fluid Systems

Sonic Transducers and Sensors Using Radial Field Diaphragms

Piezoelectric ceramic actuator device with simple mechanical fixturing

NASA Langley Research Center has developed novel piezoelectric ceramic actuators using radial field diaphragms. This invention's piezoelectric ceramic actuators have higher performance but simpler mechanical fixturing compared to other devices. The device may be used either to produce acoustic waves (speaker) or to receive them (sensor or microphone).

BENEFITS

- 3-4x greater strain than other piezoceramic actuators provides greater air movement for speaker applications
- Simple mechanical fixturing, low profile, and lightweight (compared to electromagnetic speakers)
- Much more power efficient than unimorph actuators
- Electrically isolated for underwater applications
- Similar cost as other high performance piezoceramic actuators

APPLICATIONS

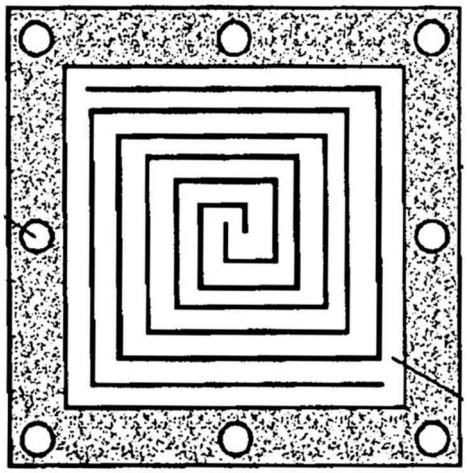
- Acoustic Sensors
- Speakers
- Microphones
- Hydrophones

technology solution

THE TECHNOLOGY

Sonic transducers such as loudspeakers, hydrophones, and microphones made from active piezo-elements typically require the mounting of these piezo-elements to hold them in place for directed mechanical action and electrical contact. In general, the mounting affects the performance of the device because it becomes an integral part of the piezo-element. More specifically, the mounting influences the piezo-element by restricting its movement and changing the mechanical resonance frequency and response of the piezo-element. Additionally, the mounting fixture and any additional mechanical elements are subjected to mechanical fatigue as the piezo-element vibrates and exerts mechanical strain on the fixture.

This invention is a piezoelectric ceramic actuator device with simple mechanical fixturing around the perimeter of the device with no effect on device performance. The device consists of a piezoceramic wafer encased in a polymer film onto which a spiral electrode pattern is etched. The novel electrode pattern induces an electric field into the piezoceramic that extends out radially from the wafer, producing a conical, or domeshaped, displacement profile. Very little strain is transmitted beyond the edges of the diaphragm.



Invention schematic

PUBLICATIONS

Patent No: 6,919,669

More Information

National Aeronautics and Space Administration

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