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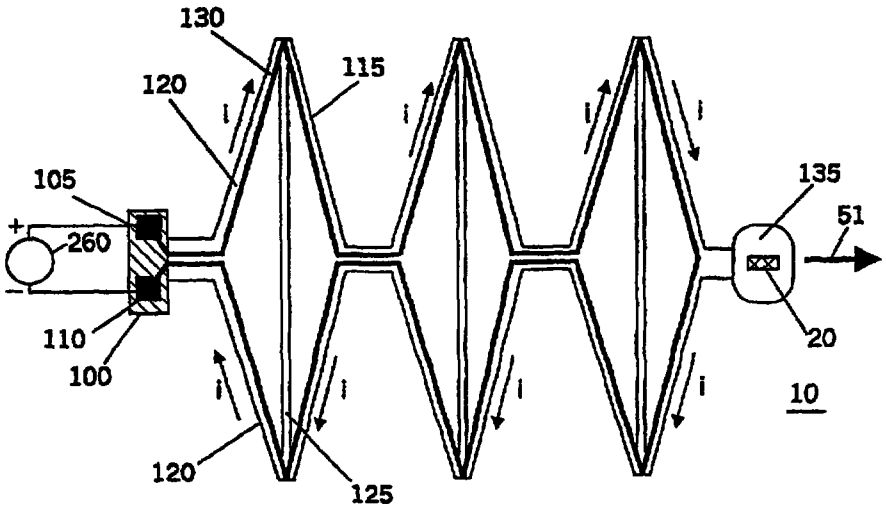
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(54) Title: MULTI-DIMENSIONAL SCALABLE DISPLACEMENT ENABLED MICROELECTROMECHANICAL ACTUATOR STRUCTURES AND ARRAYS

(57) Abstract



Microelectromechanical system (MEMS) structures and arrays that provide movement in one, two, and/or three dimensions in response to selective thermal actuation. Significant amounts of scalable displacement are provided. In one embodiment, pairs of thermal arched beams are operably interconnected and thermally actuated to create structures and arrays capable of moving in a plane parallel to the underlying substrate in one and/or two dimensions. One embodiment provides an arched beam operably connected to a crossbeam such that the medial portion arches and alters its separation from the crossbeam when thermally actuated. In another embodiment, at least one thermal arched beam is arched in a nonparallel direction with respect to the plane defined by the underlying substrate. In response to thermal actuation, the medial portion of the arched beam is arched to a greater degree than the end portions of the thermal arched beam, thereby altering the separation of the medial portion from the underlying substrate. One embodiment combines first and second thermal arched beams having medial portions arched in opposed nonparallel directions with respect to the plane defined by the underlying substrate by even greater amounts. In response to thermal actuation, the medial portions thereof arch in opposite nonparallel directions with respect to the underlying substrate, thereby altering the separation of the medial portions from the underlying substrate. Hybrid thermally actuated structures are provided that combine arrays capable of moving in-plane and out of plane, such that motion in all three dimensions may be achieved in response to selective thermal actuation.