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(54) **MULTI-LAYER, SELF-ALIGNED VERTICAL COMBDRIVE ELECTROSTATIC ACTUATORS AND FABRICATION METHODS**

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(58) **Field of Search** 310/309; 385/16, 385/18; 359/224, 291; 318/116; 324/109, 661; 73/514.32

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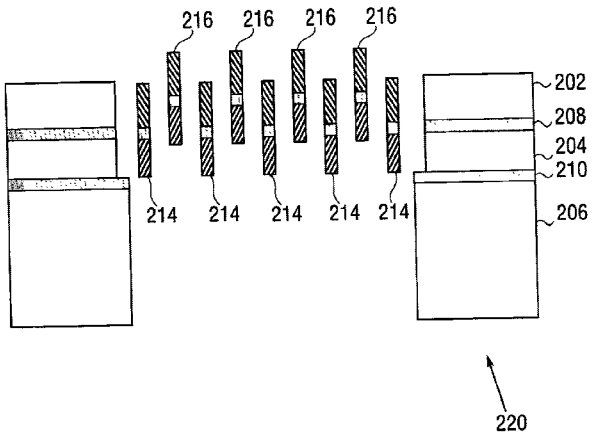
(57) **ABSTRACT**

A multi-layer vertical comb-drive actuator includes a first comb structure having a plurality of first comb fingers and a second comb structure having a plurality of second comb fingers, wherein the first and second comb fingers are substantially interdigitated. The first and second comb fingers may include two or more stacked conductive layers electrically isolated from each other by an insulating layer or an air gap. Alternatively, either the first or second comb fingers may include only one conductive layer. An application of a voltage between the first and second comb fingers causes the second comb structure to move relative to the first comb structure. The present invention includes a 2D-gimble configuration to rotate a movable element along two axis.

33 Claims, 12 Drawing Sheets