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Azarov et al.

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(54) **ORIENTATION STABILIZATION FOR MEMS DEVICES**

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(51) **Int. Cl.**<sup>7</sup> ..... **G02F 1/01; G02B 26/08**

(52) **U.S. Cl.** ..... **359/239; 359/224**

(58) **Field of Search** ..... 359/239, 212, 359/224, 223

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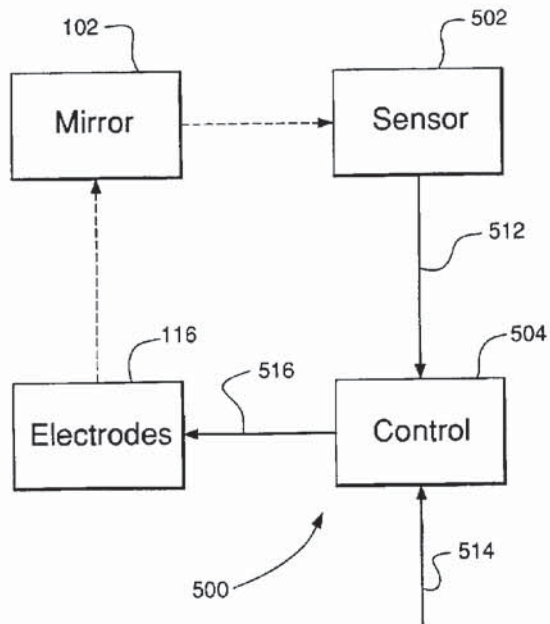
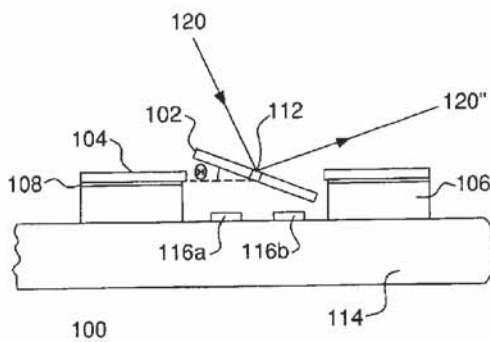
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*Primary Examiner*—David N. Spector

(57) **ABSTRACT**

A control circuit designed to control driving voltages applied to the actuating electrodes of a MEMS mirror. The control circuit is interfaced with a mirror position sensor and includes a variable gain amplifier whose output depends on a desired mirror equilibrium angle and a current mirror tilt angle determined by the sensor. The desired equilibrium angle can be changed by varying a reference signal applied to the amplifier. The control circuit can stabilize the mirror at relatively large tilt angles and, as a result, extend the available angular range beyond the snap-down angle. Since the number of MEMS mirrors that can be arrayed in an optical cross-connect is a function of the available angular range, the number of channels in a cross-connect may be substantially increased.

**19 Claims, 9 Drawing Sheets**



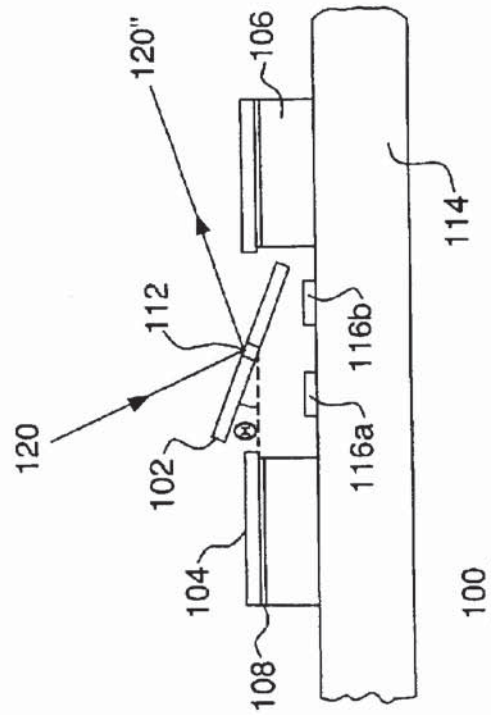


FIG. 1A

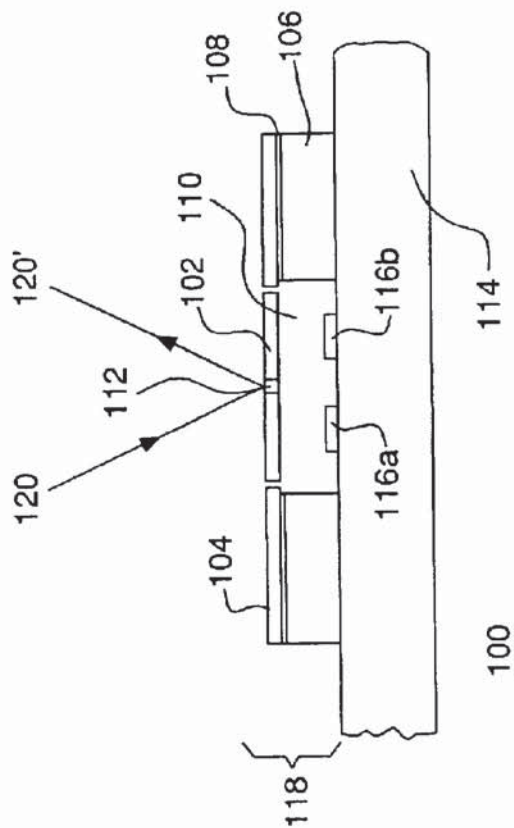


FIG. 1B

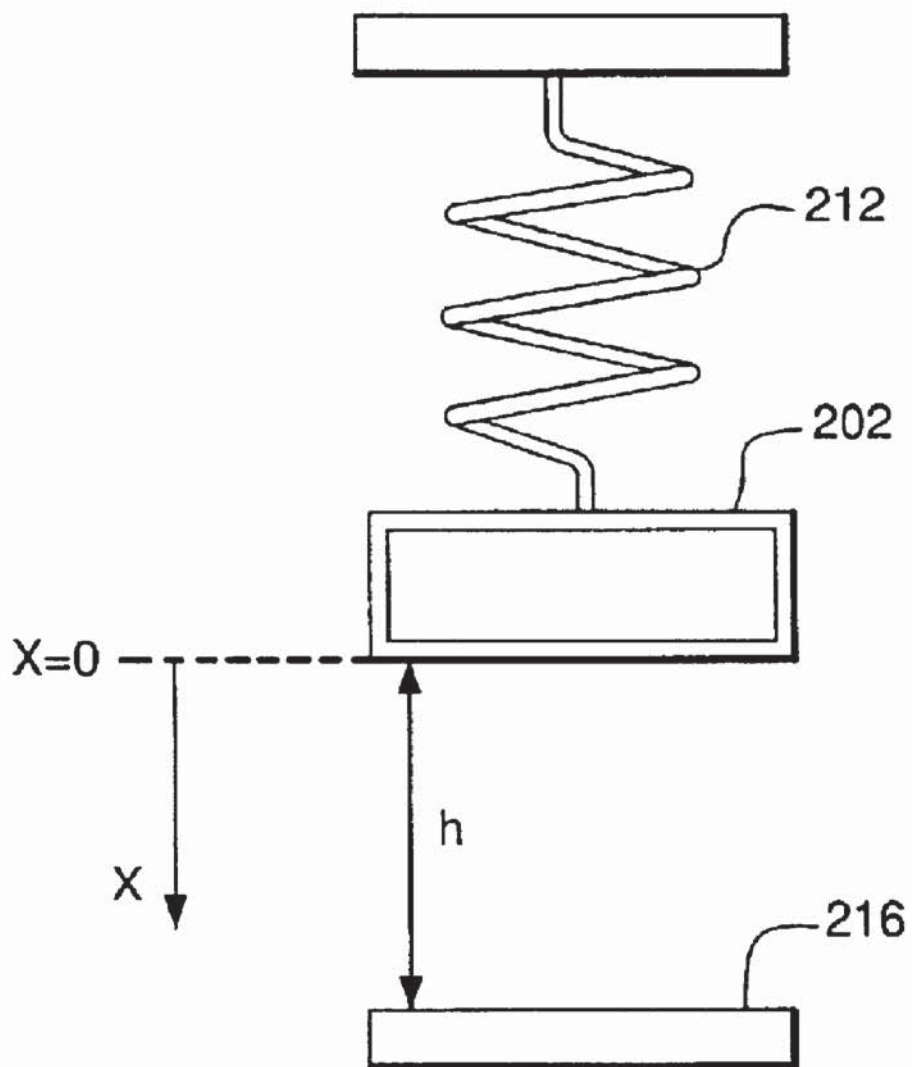


FIG. 2

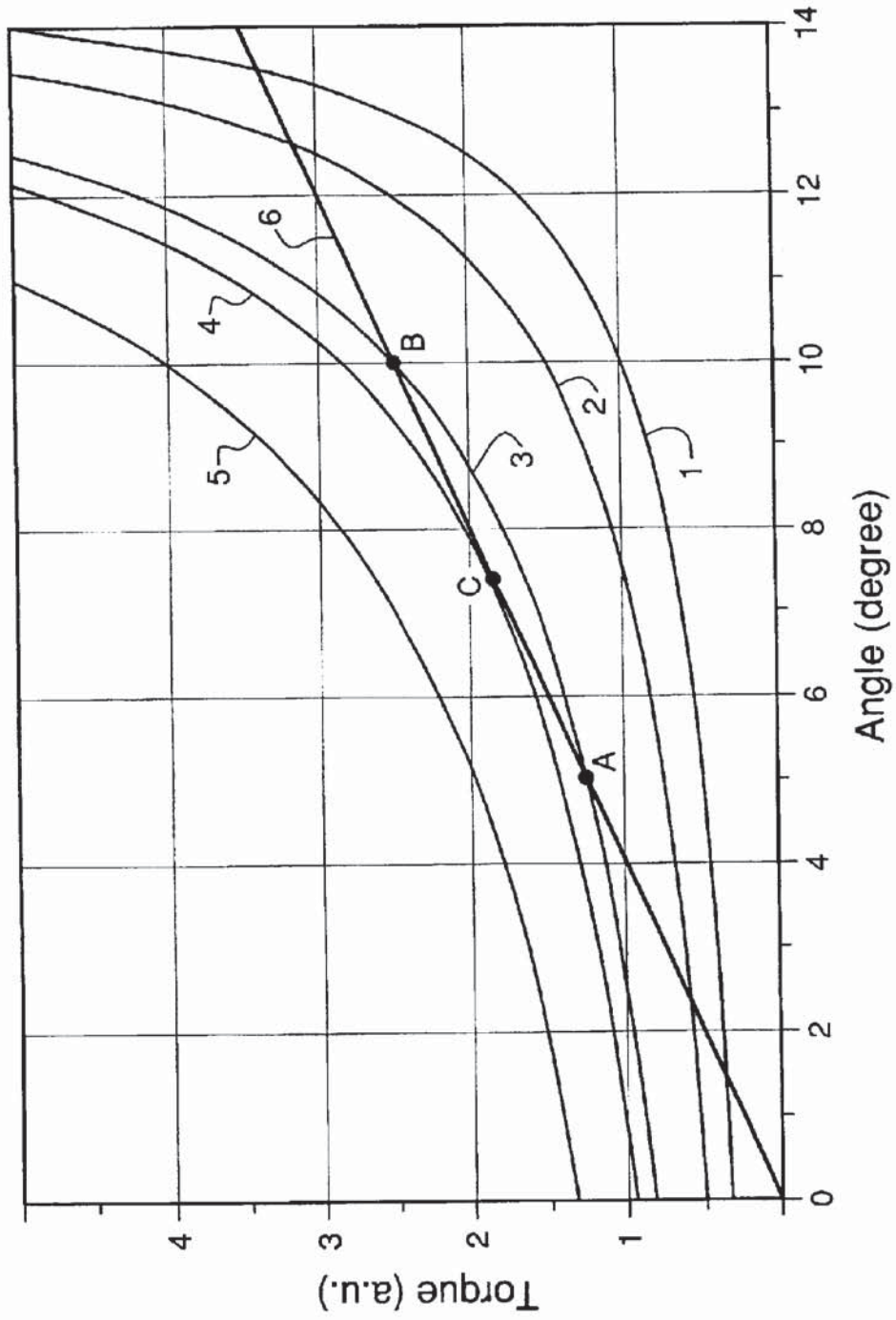


FIG. 3

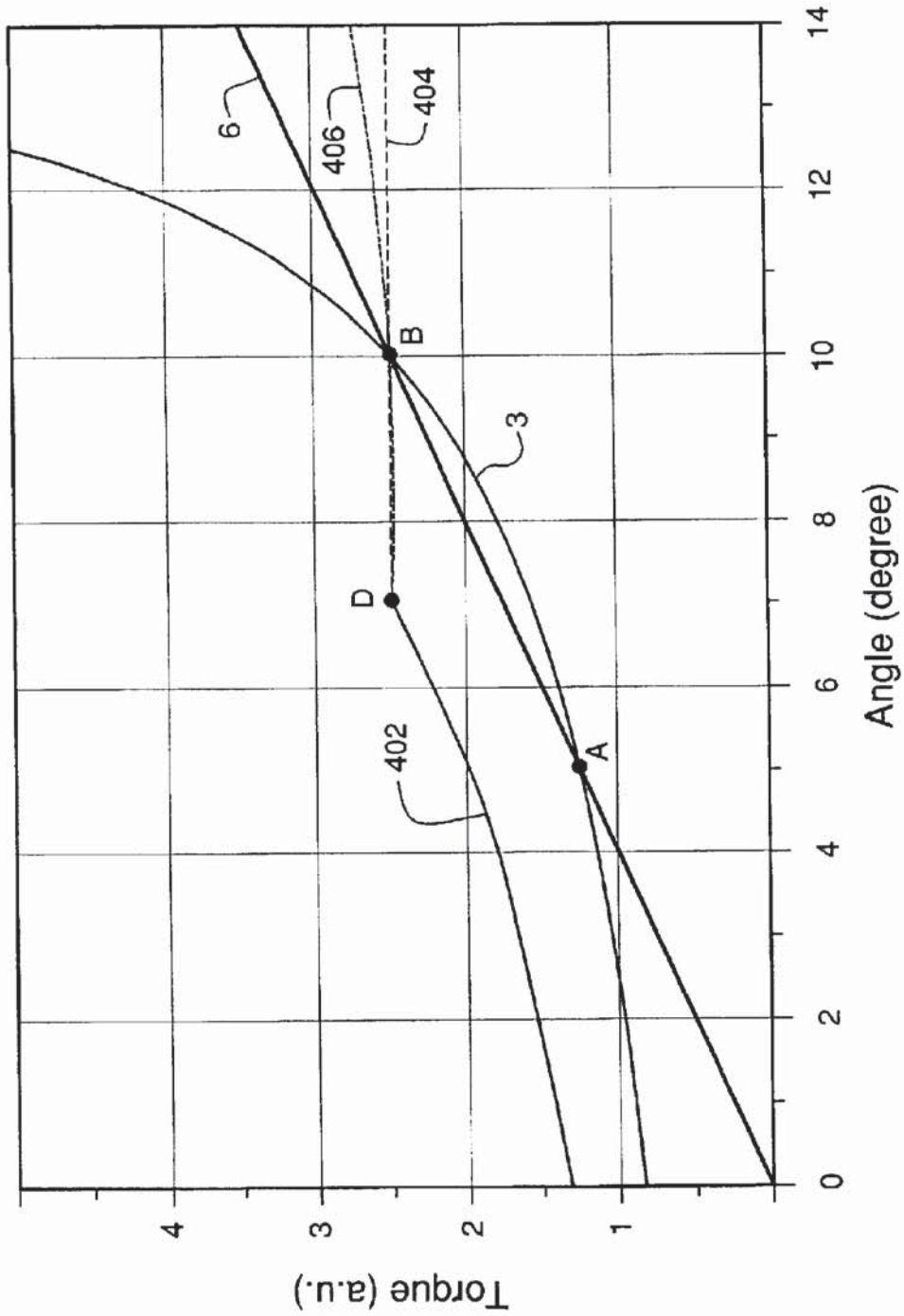


FIG. 4

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