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Garverick et al.

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(54) **HIGH FREQUENCY PULSE WIDTH MODULATION DRIVER, PARTICULARLY USEFUL FOR ELECTROSTATICALLY ACTUATED MEMS ARRAY**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/884,676**

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(65) **Prior Publication Data**

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Related U.S. Application Data

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(51) **Int. Cl.**⁷ **G01P 15/00**; G01P 15/125

(52) **U.S. Cl.** **73/514.18**; 73/514.32

(58) **Field of Search** 73/514.16, 514.18, 73/514.26, 514.32, 514.36; 361/271, 277; 310/309

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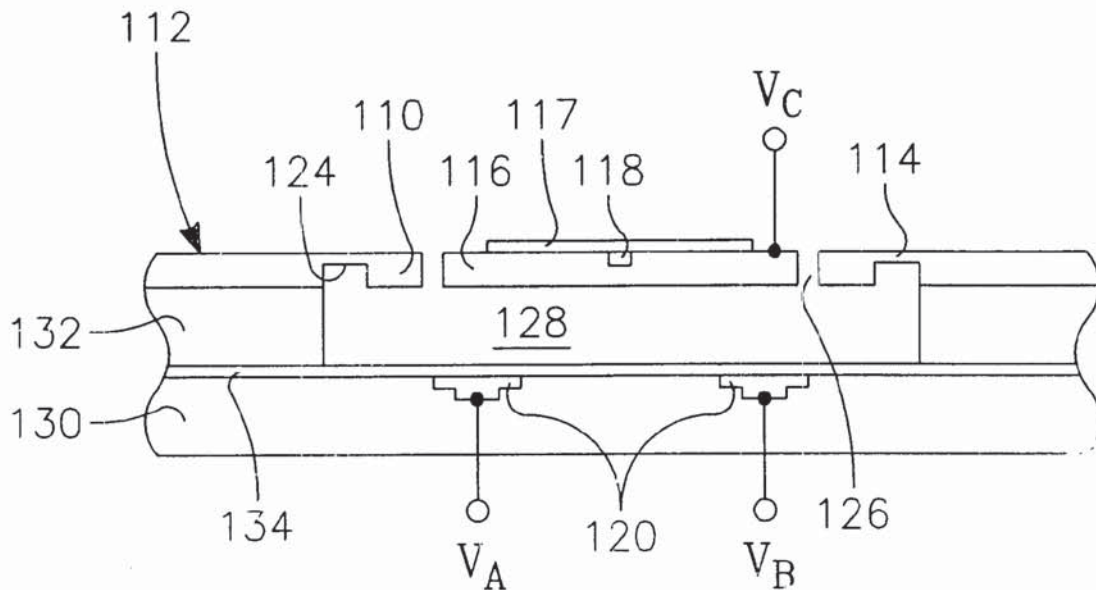
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(57) **ABSTRACT**

Pulse-width modulation (PWM) drive circuitry particularly applicable to an array of electrostatic actuators formed in a micro electromechanical system (MEMS), such as used for optical switching. A control cell associated with each actuator includes a register selectively stored with a desired pulse width. A clocked counter distributes its outputs to all control cells. When the counter matches the register, a polarity signal corresponding to a drive clock is latched and controls the voltage applied to the electrostatic cell. In a bipolar drive, one actuator electrode is driven by a drive clock; the other, by the latch. The MEMS element may be a tilttable plate supported in its middle by a torsion beam. Complementary binary signals may drive two capacitors formed across the axis of the beam. The register and comparison logic for each cell may be formed by a content addressable memory.

29 Claims, 14 Drawing Sheets



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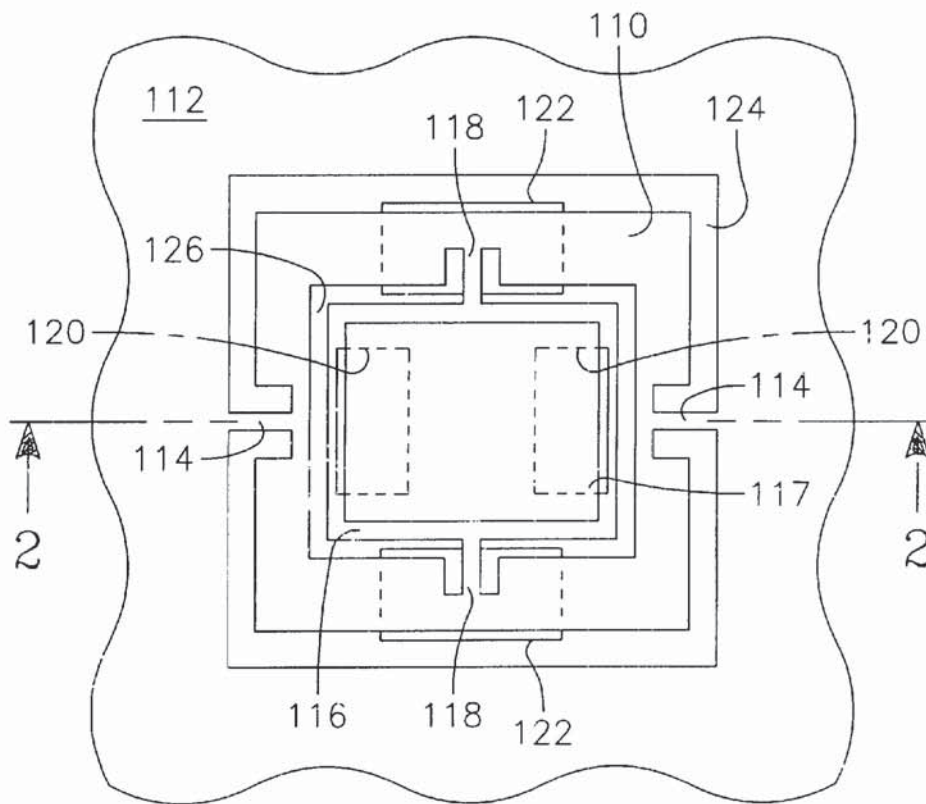


FIG. 1

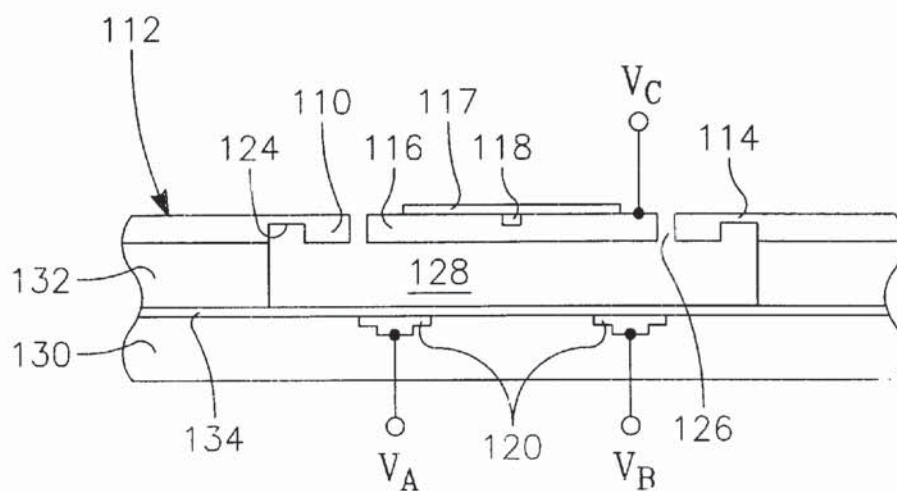


FIG. 2

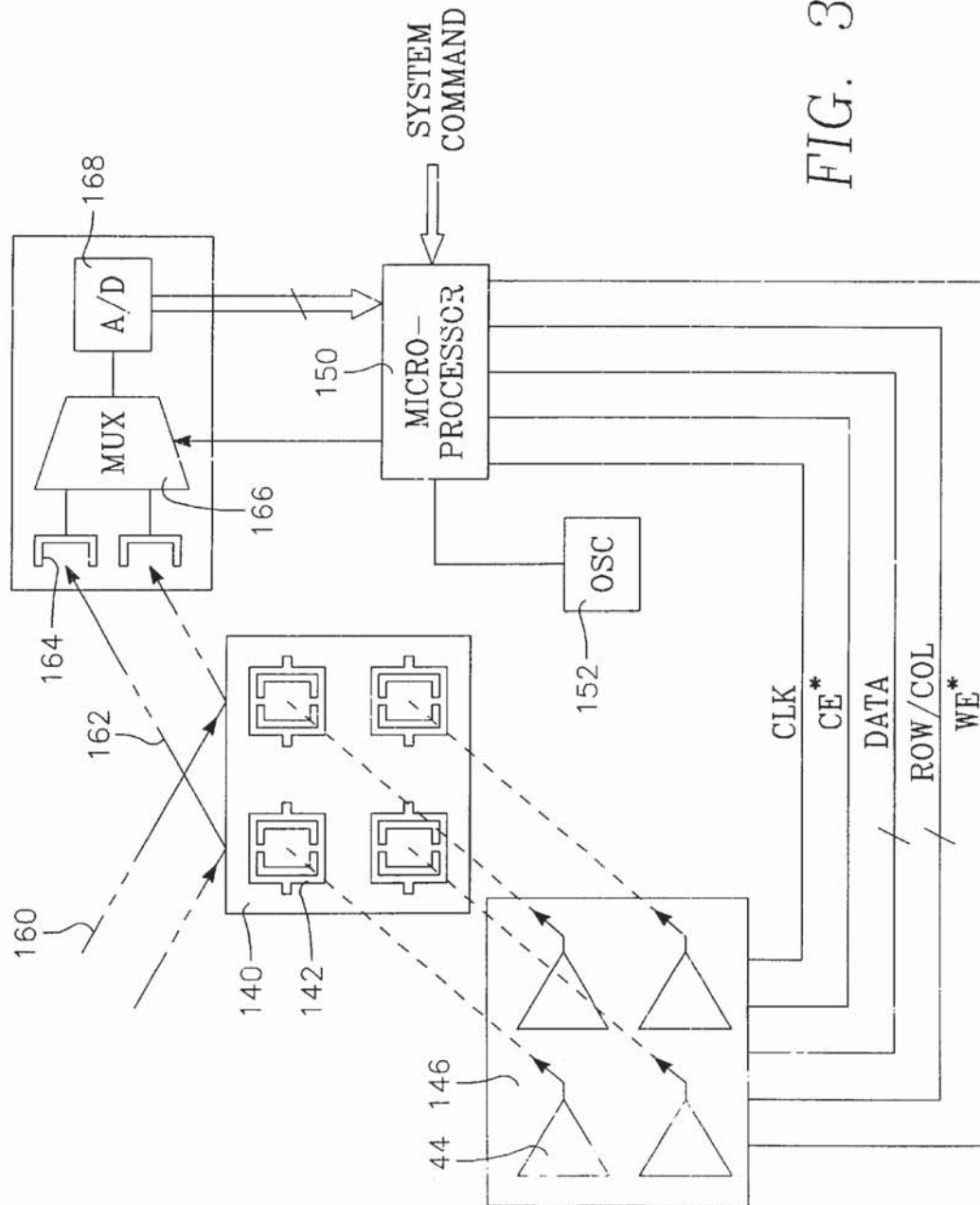


FIG. 3

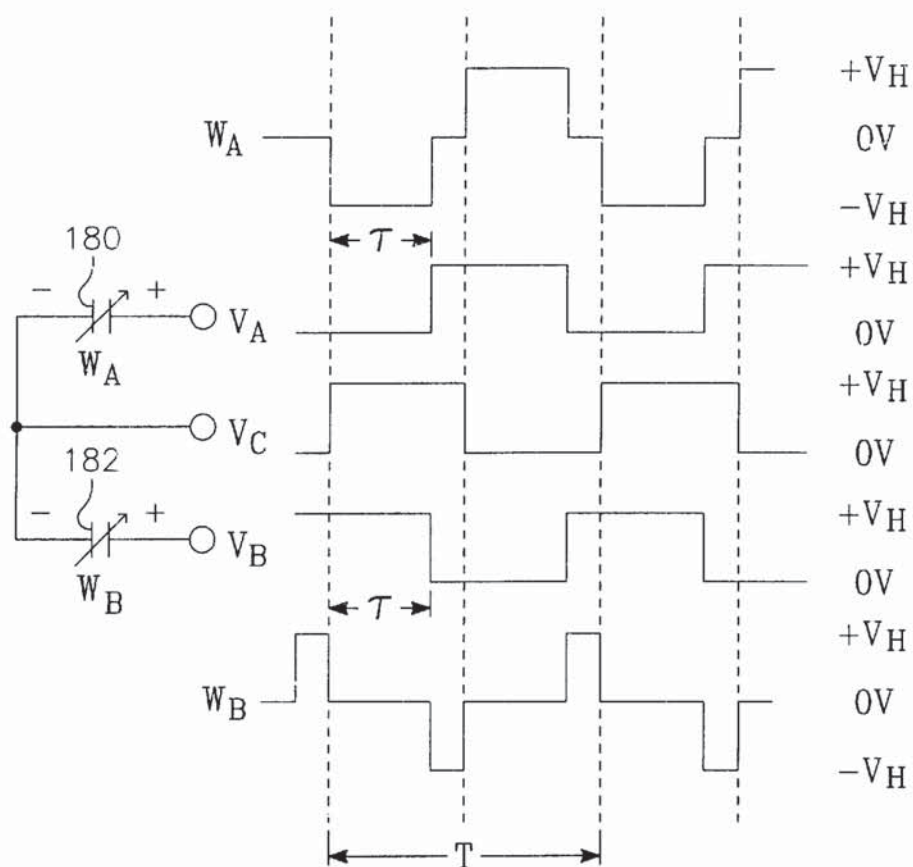


FIG. 4

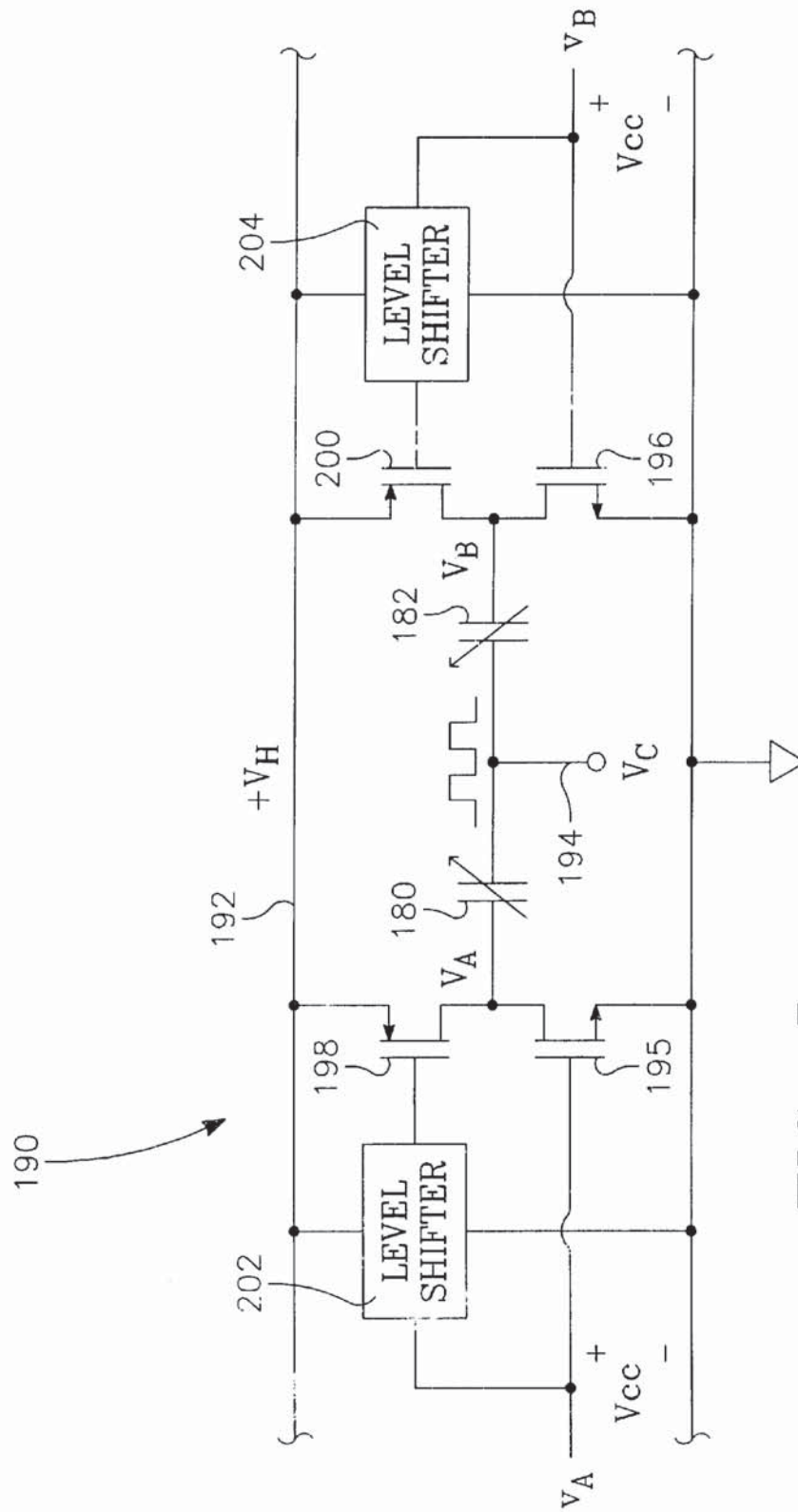


FIG. 5

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