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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.

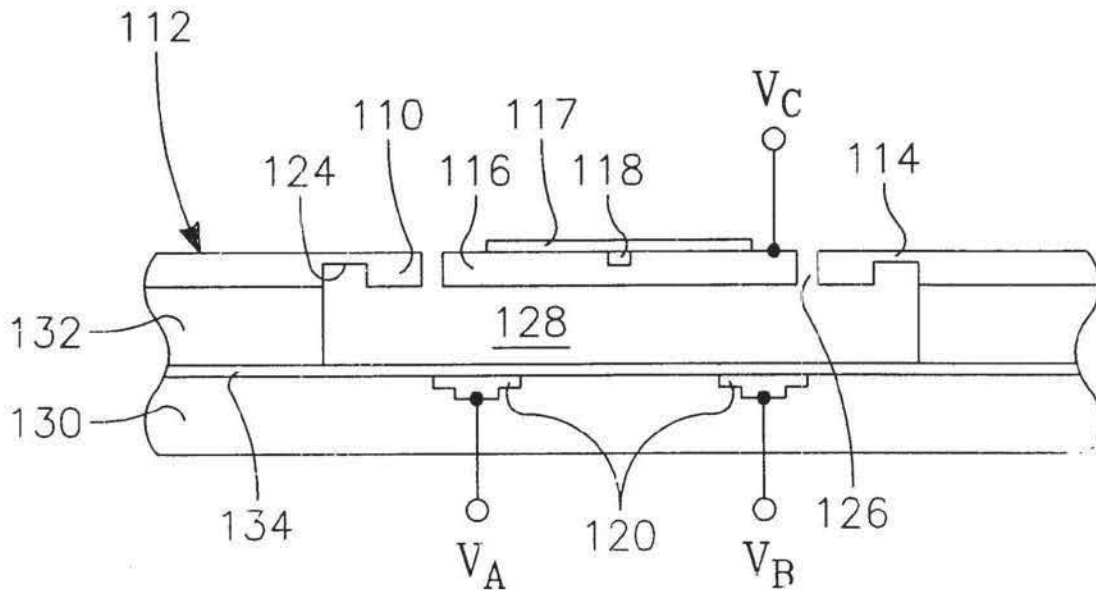
- (21) Appl. No.: **09/884,676**
- (22) Filed: **Jun. 19, 2001**
- (65) **Prior Publication Data**
US 2002/0101769 A1 Aug. 1, 2002

- Related U.S. Application Data**
- (60) Provisional application No. 60/264,267, filed on Jan. 26, 2001, and provisional application No. 60/267,285, filed on Feb. 7, 2001.
- (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**

- (56) **References Cited**
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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 tiltable 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



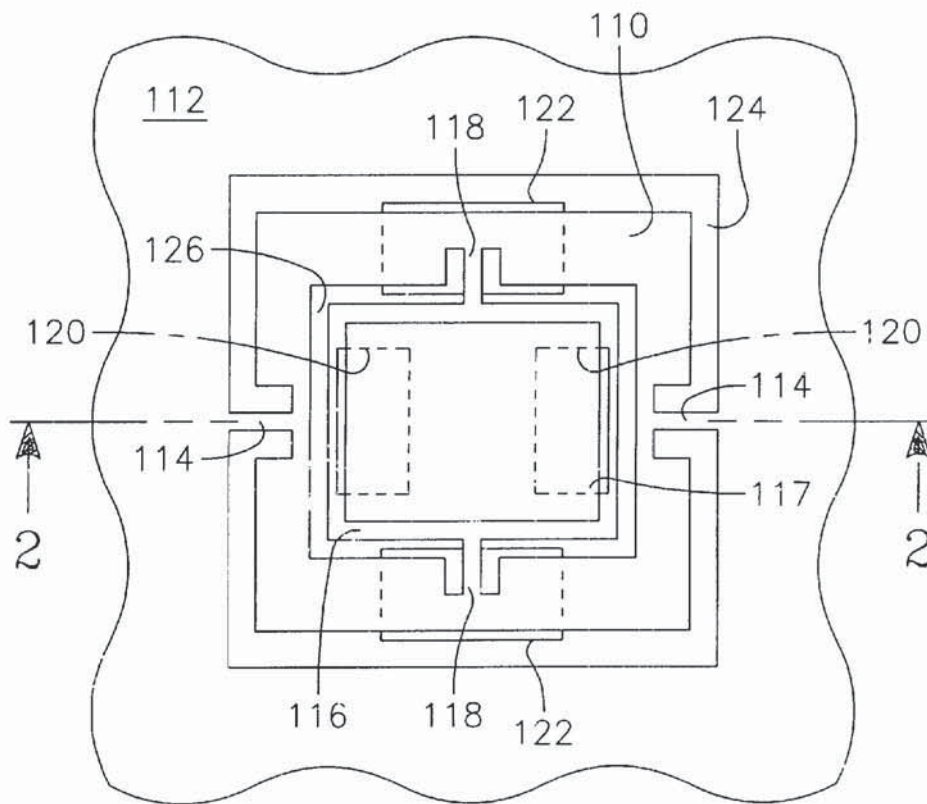


FIG. 1

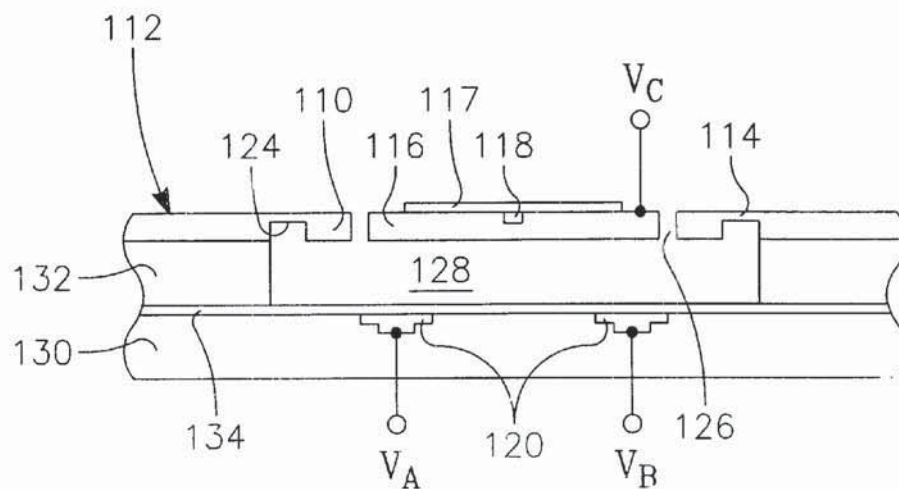


FIG. 2

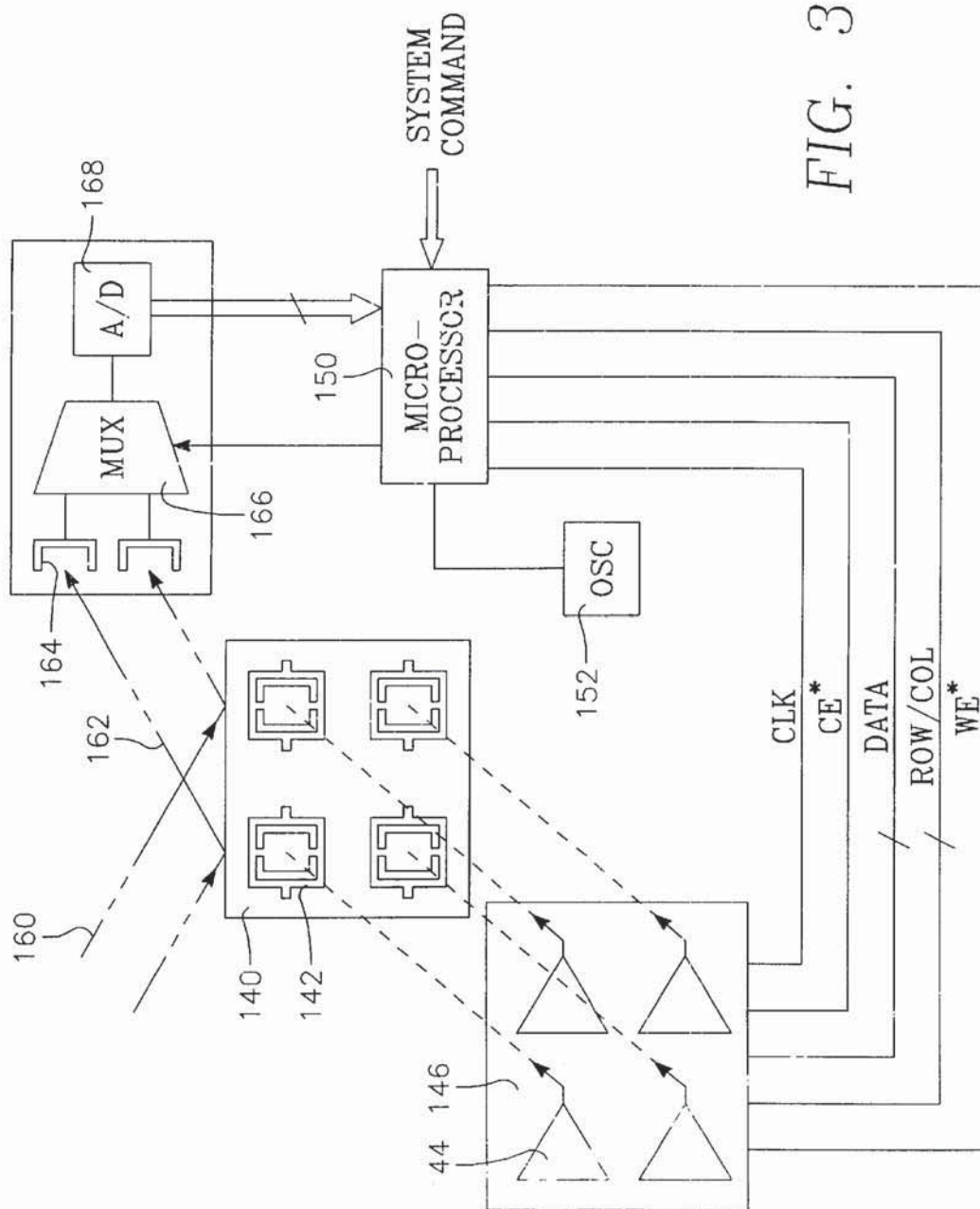


FIG. 3

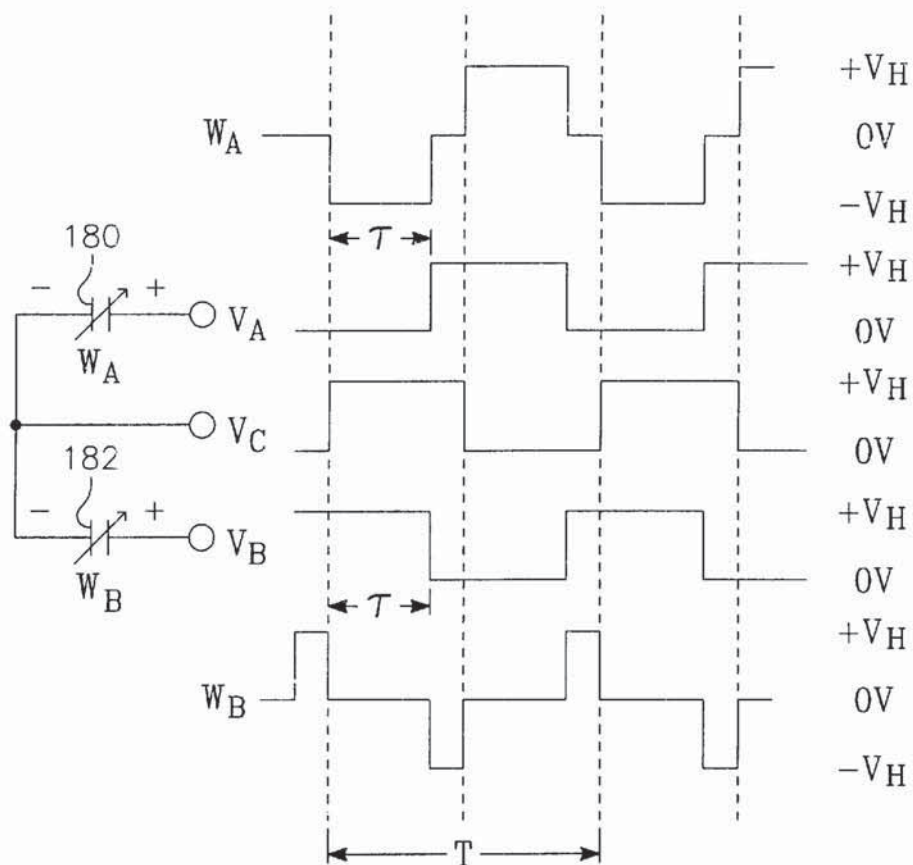


FIG. 4

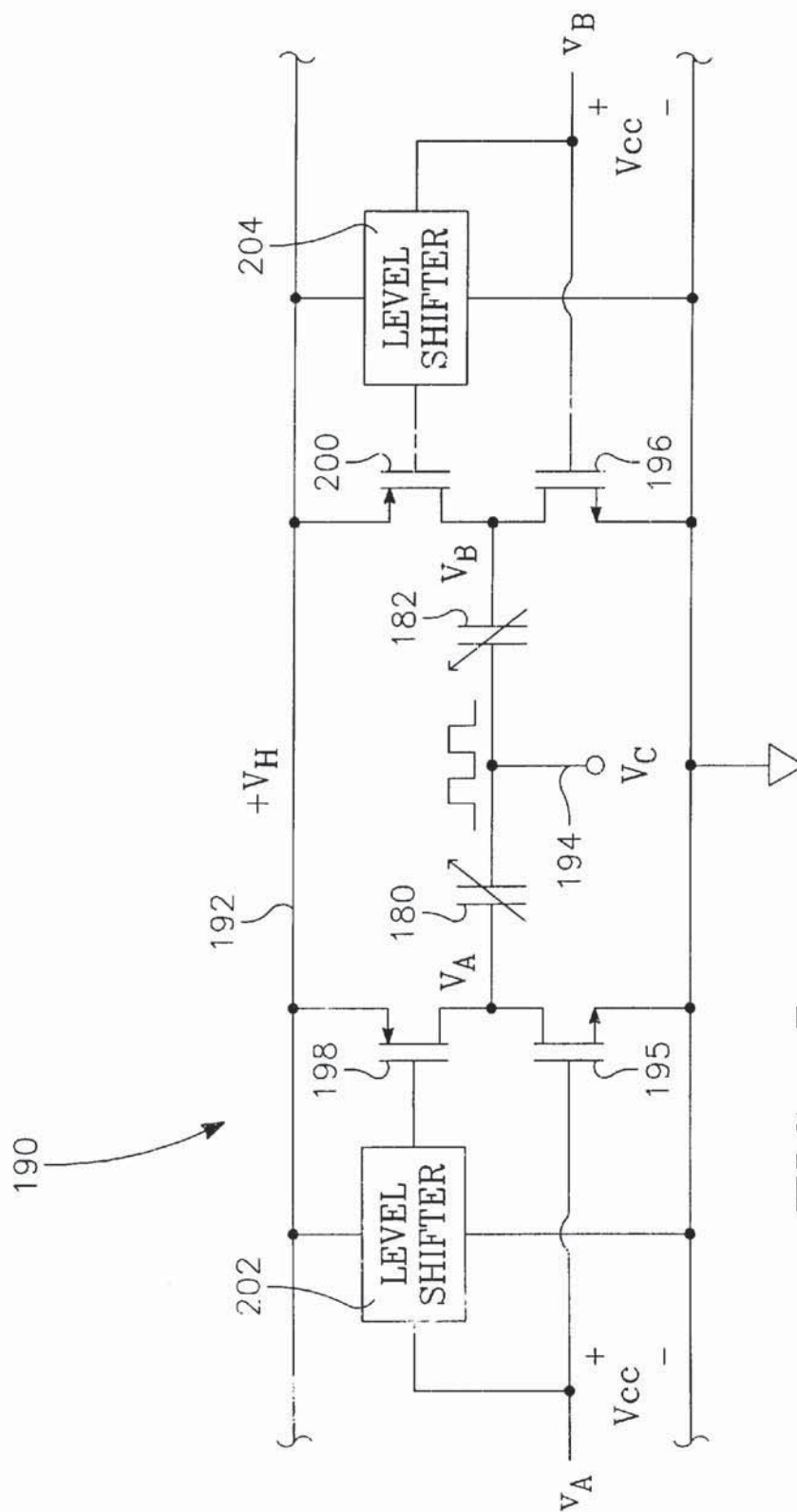


FIG. 5

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