

(12) **United States Patent**  
**Yu et al.**

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(54) **DIGITAL CAMERAS USING MULTIPLE SENSORS WITH MULTIPLE LENSES**

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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.

\* cited by examiner  
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(51) **Int. Cl.**<sup>7</sup> ..... **H04N 9/093**; H04N 9/009

(52) **U.S. Cl.** ..... **348/265**; 348/272; 348/279

(58) **Field of Search** ..... 348/272, 279, 348/265; H04N 9/090, 9/093

(57) **ABSTRACT**

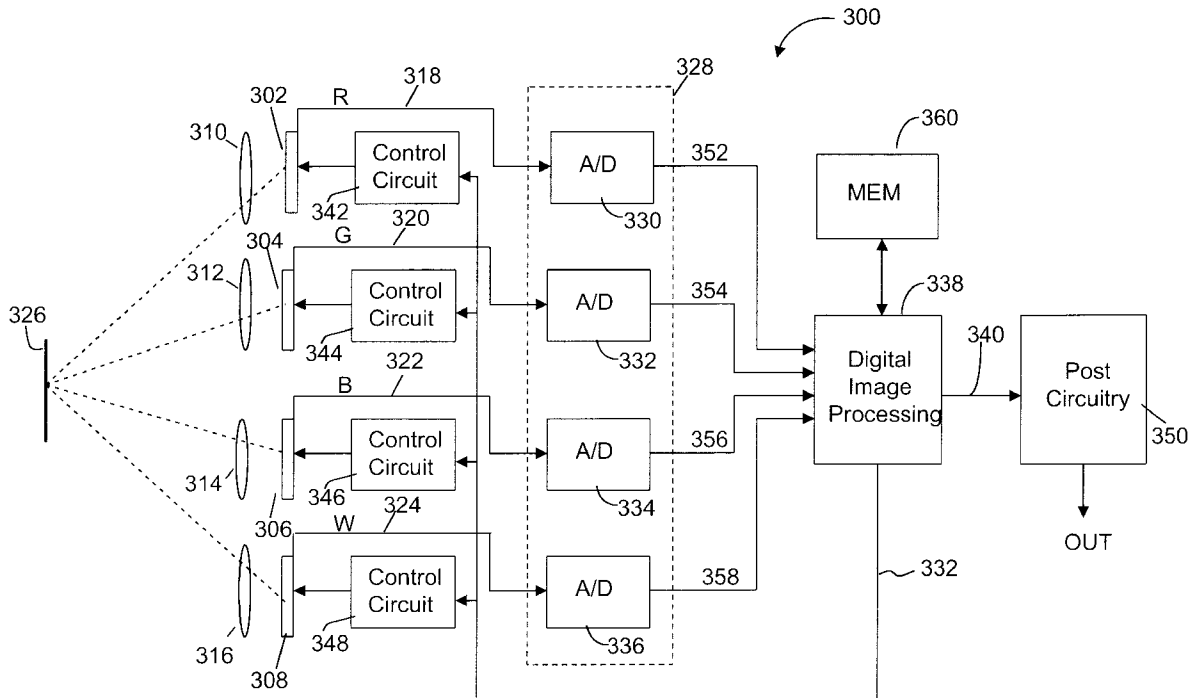
An improved digital camera that produces digital images of high qualities without using expensive image sensors and optics is disclosed. The disclosed digital cameras use multiple image sensors with multiple lenses. One of the multiple image sensors is made to be responsive to all intensity information in visible color spectrum and a (gray intensity) image resulting from the sensor is used to compensate lost information in images from other image sensors responsive to certain colors. A final color image is obtained by a digital image processing circuitry that performs pixel registration process with reference to the gray intensity image so that a true color image with true resolution is obtained therefrom.

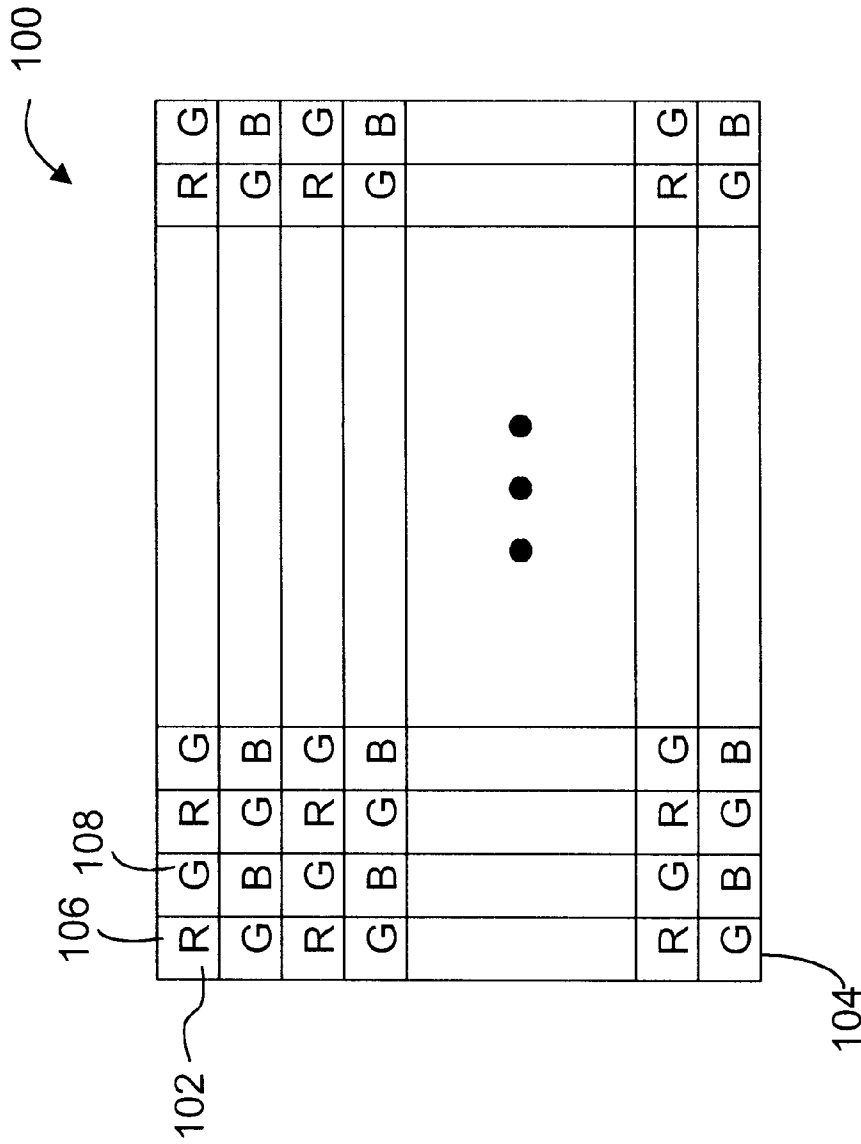
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**31 Claims, 9 Drawing Sheets**





(prior art)

Fig. 1

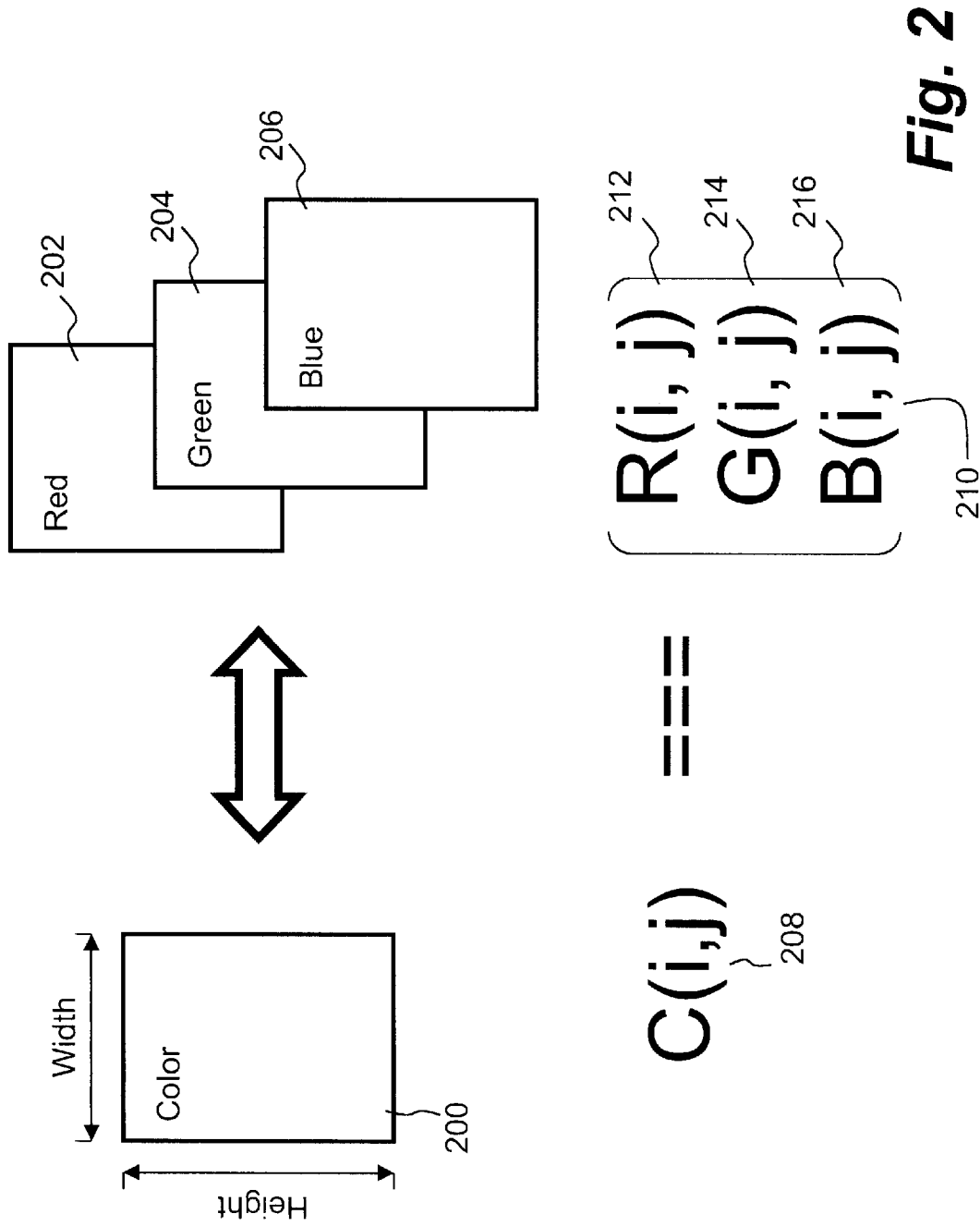


Fig. 2

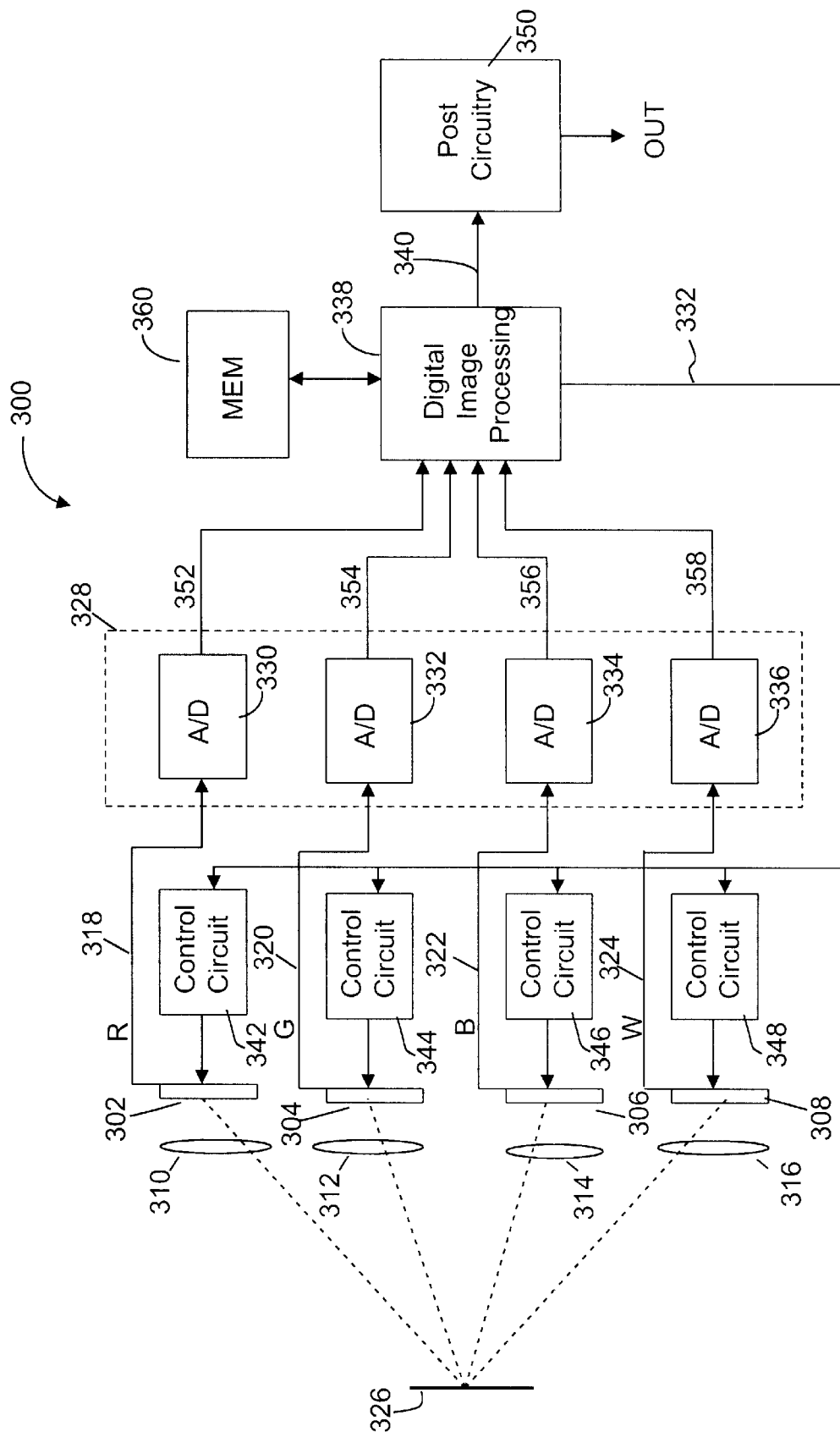


Fig. 3

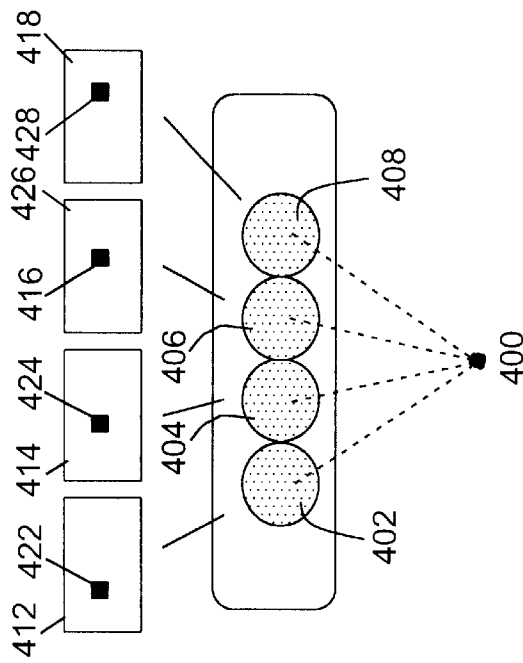


Fig. 4A

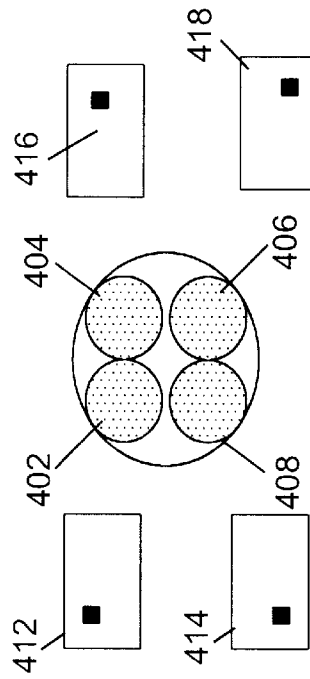


Fig. 4B

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