

**United States Patent** [19]

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**Kuwashima et al.**

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[54] **MOVING OBJECT MEASUREMENT DEVICE EMPLOYING A THREE-DIMENSIONAL ANALYSIS TO OBTAIN CHARACTERISTICS OF THE MOVING OBJECT**

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[76] **Inventors:** **Shigesumi Kuwashima**, 2-26-2-406 Chidori, Ohta-Ku, Tokyo 152; **Masao Shimizu**, 3-29-503 Kosugi-cho, Nakabara-ku, Kawasaki, Kanagawa 211; **Toru Nakamura**, 838-39 Ishibayashi, Nishinasuno-cho, Nasu-gun; **Dairoku Sekiguchi**, 2-23-3 Kakinokizaka, Meguro-ku, Tokyo 152, all of Japan

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*Primary Examiner*—Andrew W. Johns  
*Assistant Examiner*—Monica S. Davis  
*Attorney, Agent, or Firm*—Cushman Darby & Cushman IP Group of Pillsbury Madison & Sutro LLP

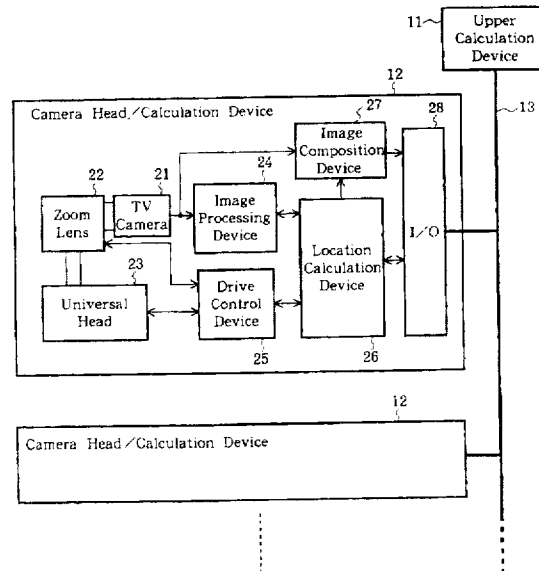
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 Jun. 10, 1993 [JP] Japan ..... 5-139629  
 Oct. 19, 1993 [JP] Japan ..... 5-261223  
 [51] **Int. Cl.<sup>6</sup>** ..... **G06K 9/00; G06K 9/36; G06K 9/32; G03B 13/18**  
 [52] **U.S. Cl.** ..... **382/107; 382/285; 382/291; 354/402**  
 [58] **Field of Search** ..... **382/107, 285, 382/291, 302; 354/402**

[57] **ABSTRACT**

The present invention defines the area where the targeted moving object can move in the three-dimensional real spatial coordinate system, then maps it to the two-dimensional area corresponding to the capturing method and the capturing range of the capturing device, and by limiting the image processing for obtaining the coordinate to that area, obtains the coordinate of the moving object in the three-dimensional real space rapidly by using the signal which is capturing the moving object. Furthermore, the present invention is able to control the capturing direction and the capturing range which correspond to the movement of the capturing target, to overlap the image signal with the data which is always changing by the capturing condition and the movement of the measurement data, to improve the detection precision, and to track automatically and smoothly.

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**38 Claims, 34 Drawing Sheets**



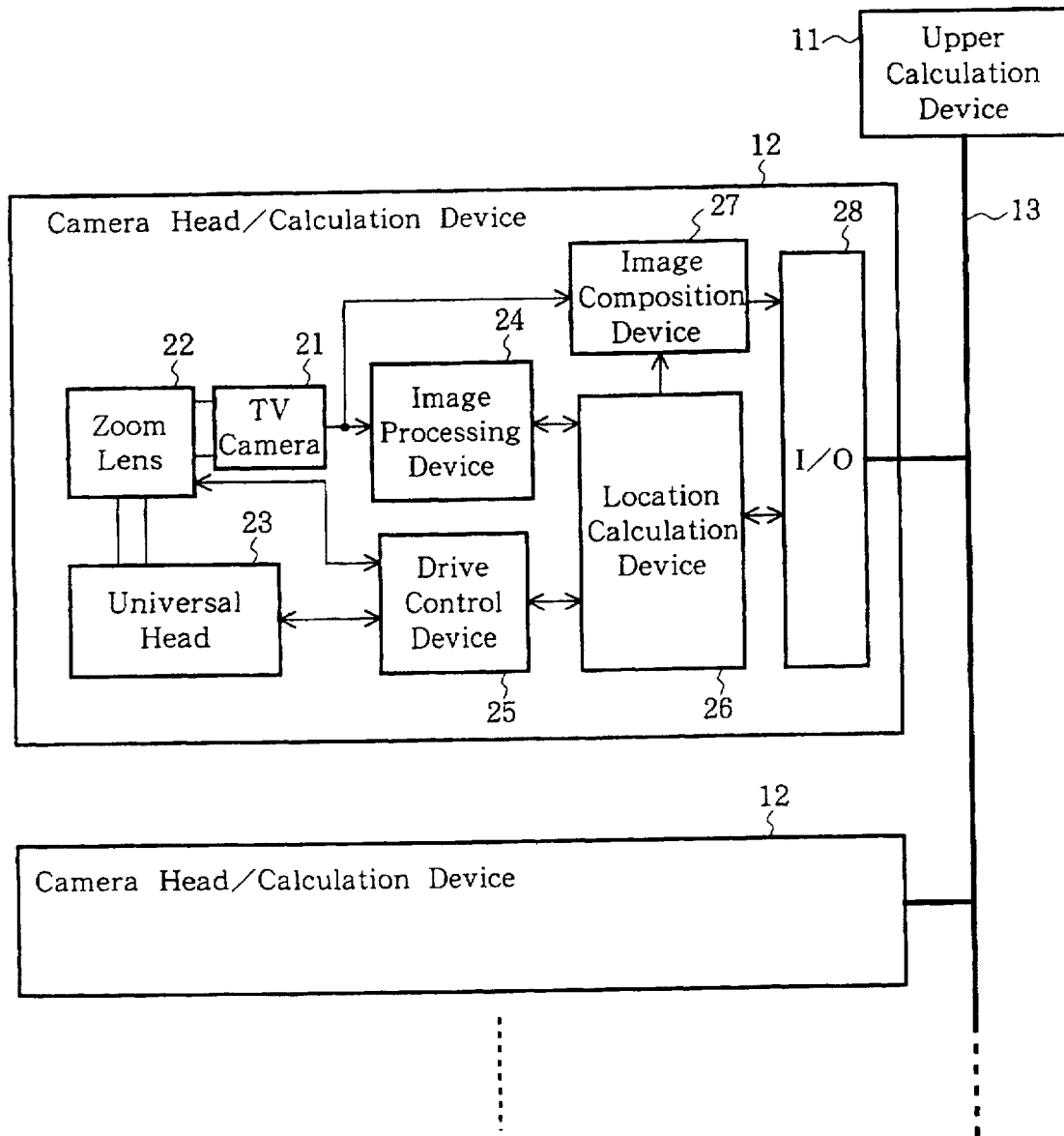


Fig. 1

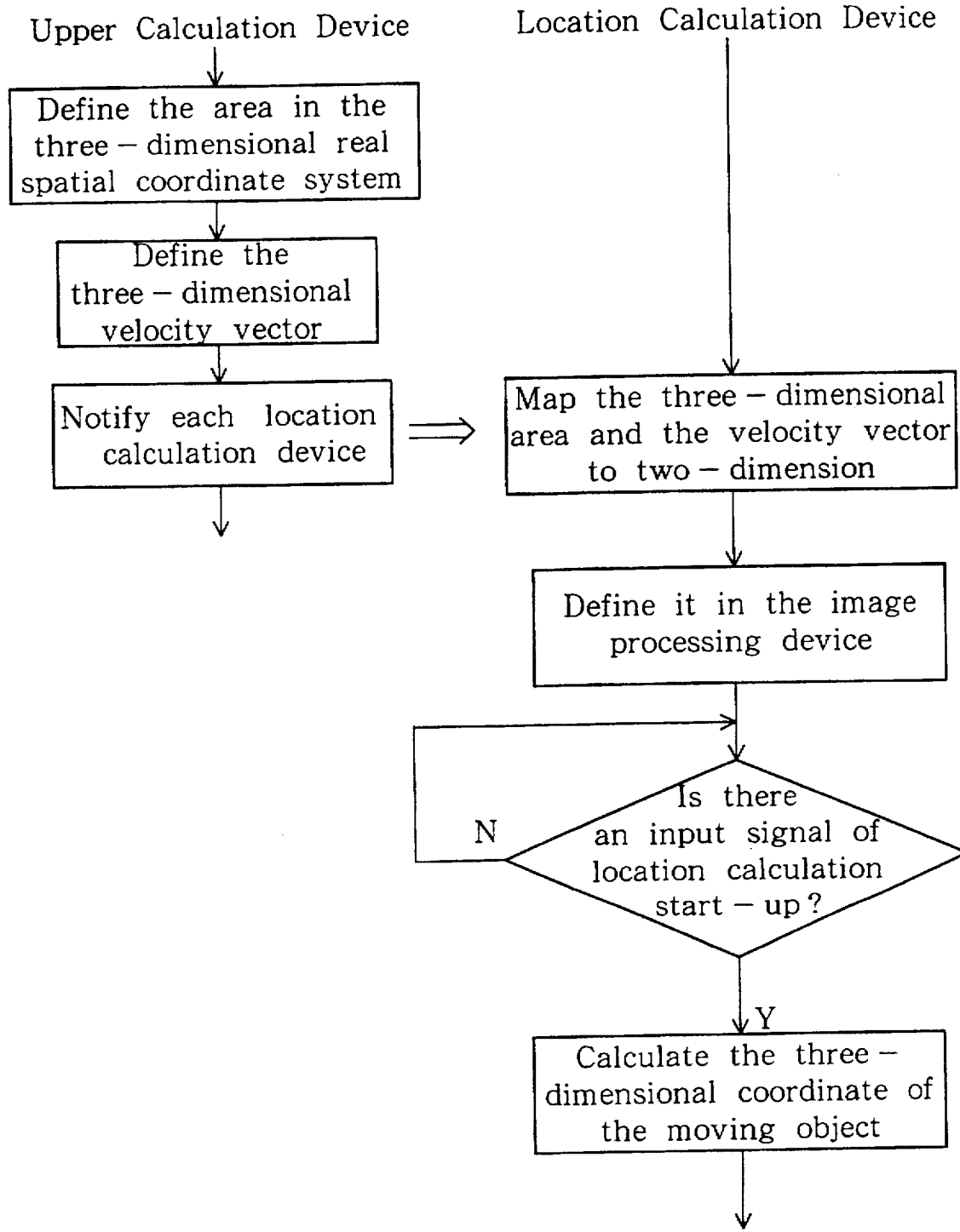


Fig. 2

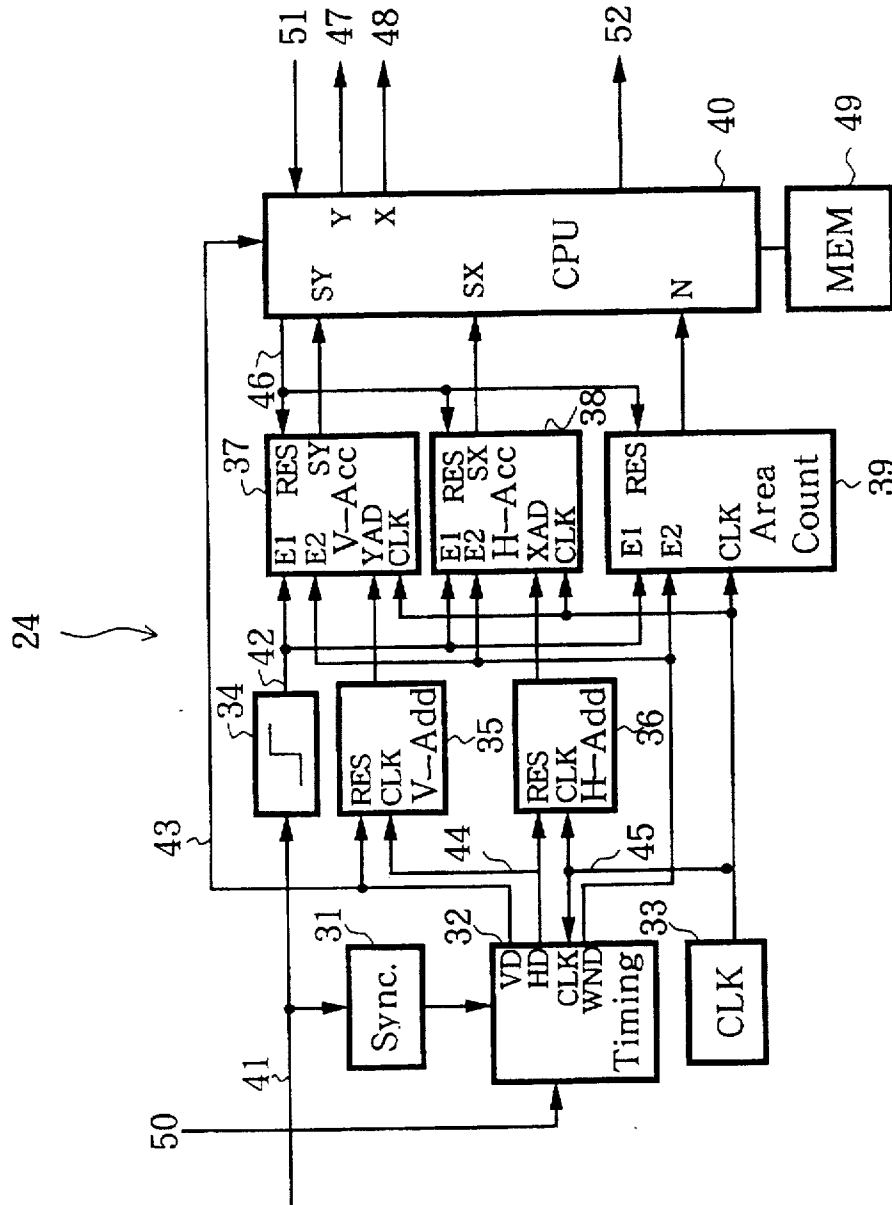


Fig. 3

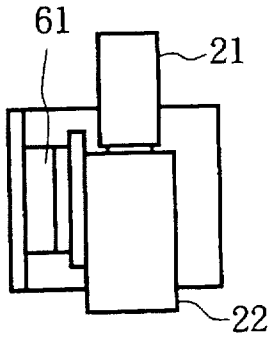


Fig. 4a

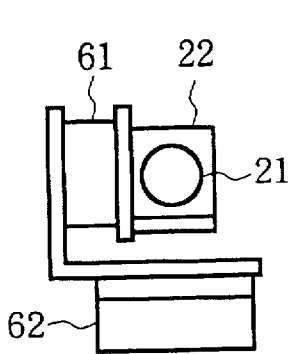


Fig. 4b

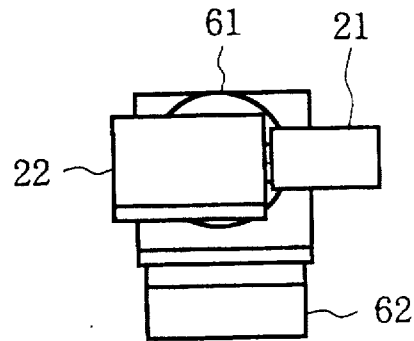


Fig. 4c

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