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# United States Patent [19]

Hashima et al.

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[45] Date of Patent: **May 28, 1996**

[54] **SYSTEM FOR AND METHOD OF RECOGNIZING AND TRACKING TARGET MARK**

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[73] Assignee: **Fujitsu Limited**, Kawasaki, Japan

[21] Appl. No.: **119,228**

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### [30] Foreign Application Priority Data

Jan. 30, 1992	[JP]	Japan	.....	4-015557
Jun. 26, 1992	[JP]	Japan	.....	4-193457
Aug. 18, 1992	[JP]	Japan	.....	4-219029
Oct. 29, 1992	[JP]	Japan	.....	4-291628
Nov. 17, 1992	[JP]	Japan	.....	4-307015

[51] Int. Cl.<sup>6</sup> ..... **G01S 15/06**

[52] U.S. Cl. .... **364/516; 340/815.54; 382/103**

[58] Field of Search ..... 364/167.01, 559, 364/516; 340/815.54, 815.57, 815.68; 382/10, 14, 18, 25, 51, 65; 250/203 CT; 33/293; 348/94

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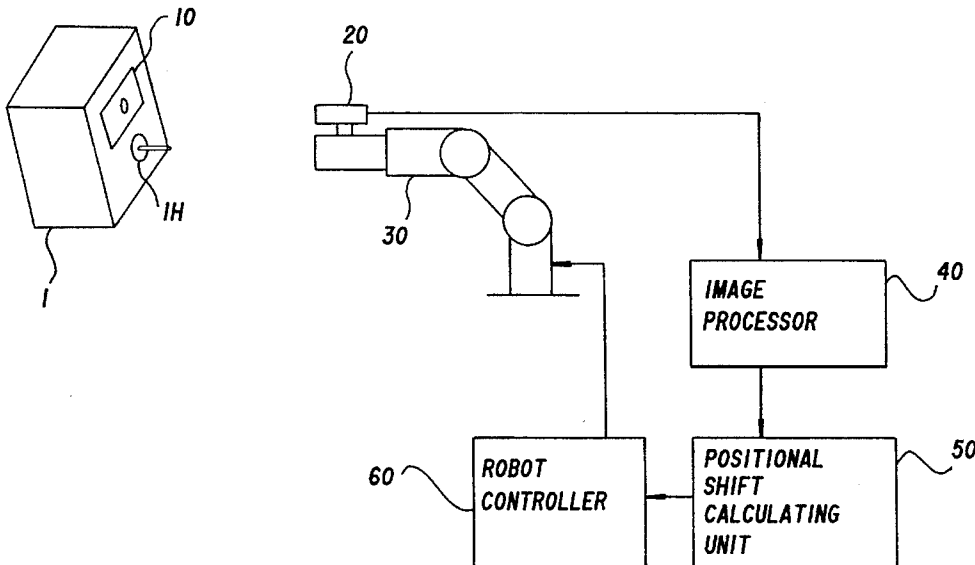
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*Assistant Examiner*—Thomas Peeso  
*Attorney, Agent, or Firm*—Armstrong, Westerman, Hattori, McLeland & Naughton

### [57] ABSTRACT

A system for and a method of recognizing and tracking a target mark with a video camera is disclosed. The system includes a target mark (10) disposed on an object (1) and composed of a black circle and a white triangle mounted centrally on the black circle and three-dimensionally shifted from the black circle, a video camera (20) for imaging the target mark (10), a robot (30) supporting the video camera (20) and movable in directions with six degrees of freedom, an image processor (40) for processing image data of the target mark which is produced by the video camera (20), a shift calculating unit (50) for detecting a shift of the target mark (10) from projected histogram information of the target mark (10) which is produced by the image processor (40), and a robot controller (60) for controlling movement of the robot depending on the shift to enable the video camera (20) to track the target mark (10). The system is capable of tracking the target mark (20) attached to the object (1) on a real-time basis. Mark recognizing apparatus capable of accurately recognizing target marks of other shapes is also disclosed.

**14 Claims, 47 Drawing Sheets**



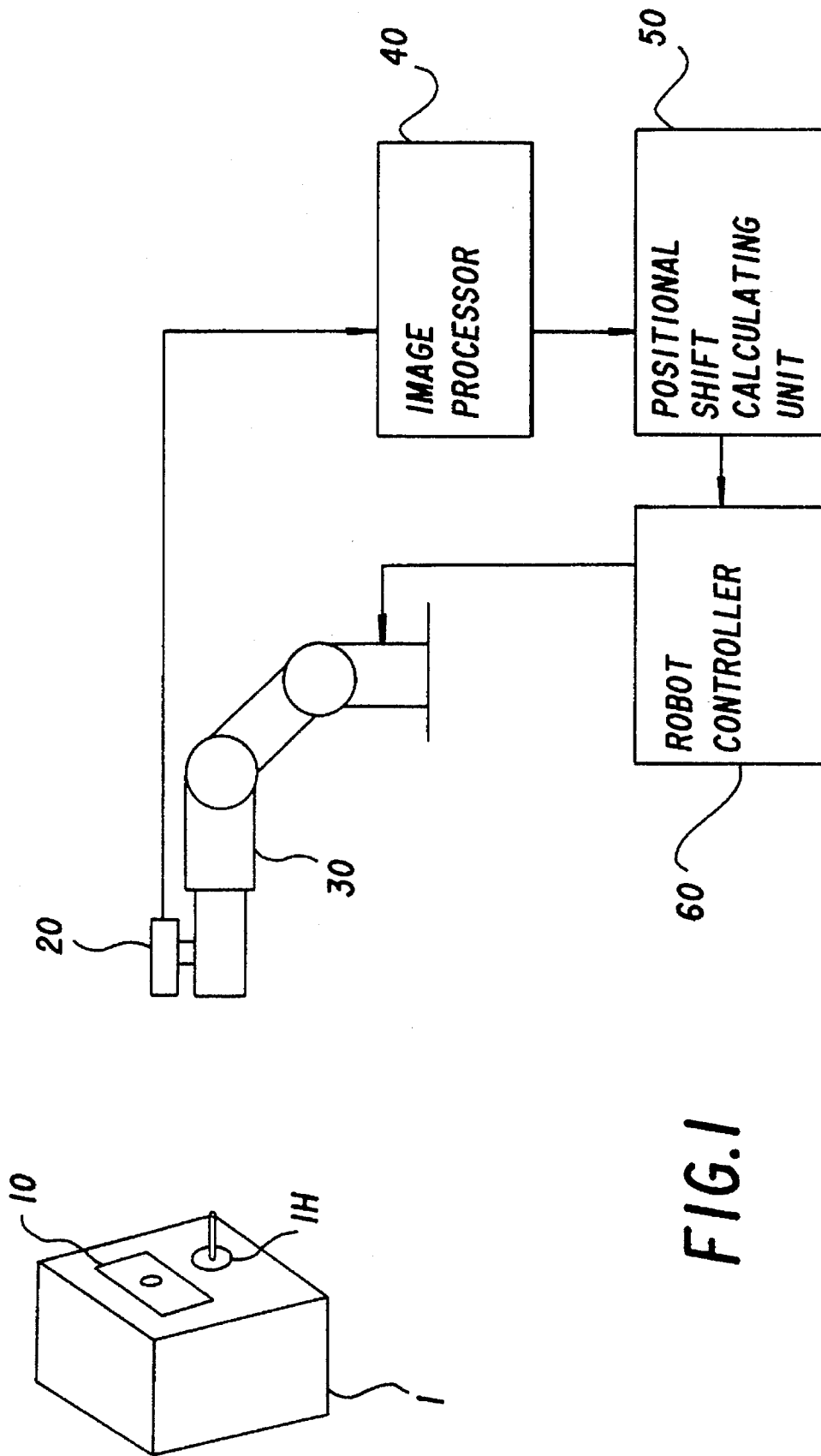


FIG. 1

FIG.2

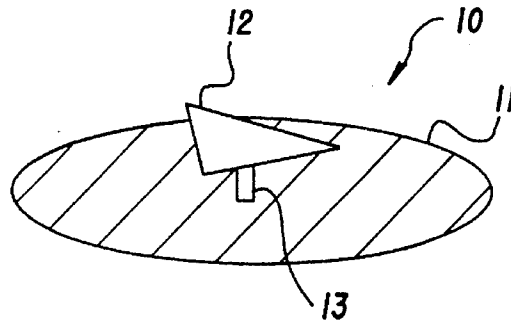


FIG.3

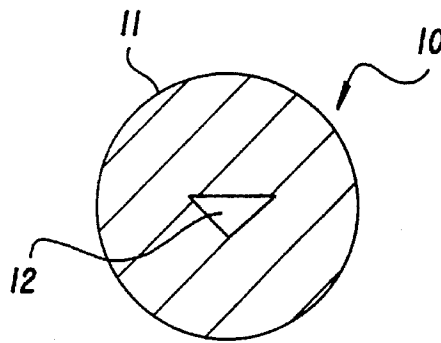
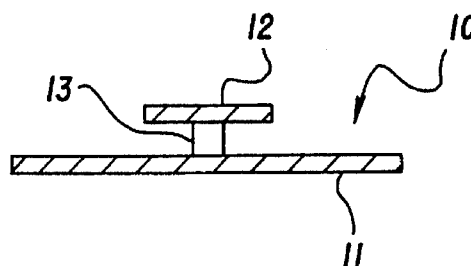


FIG.4



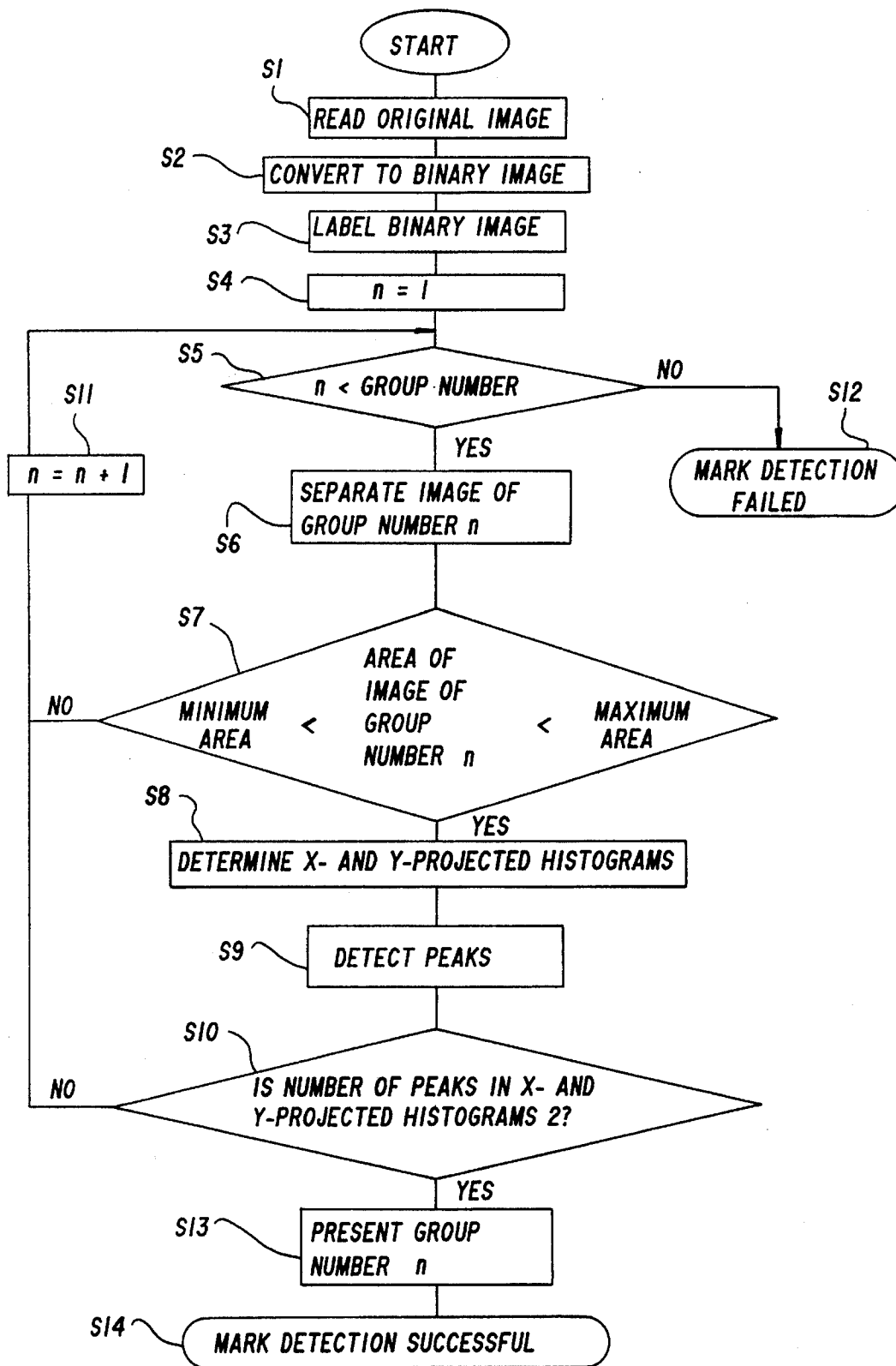
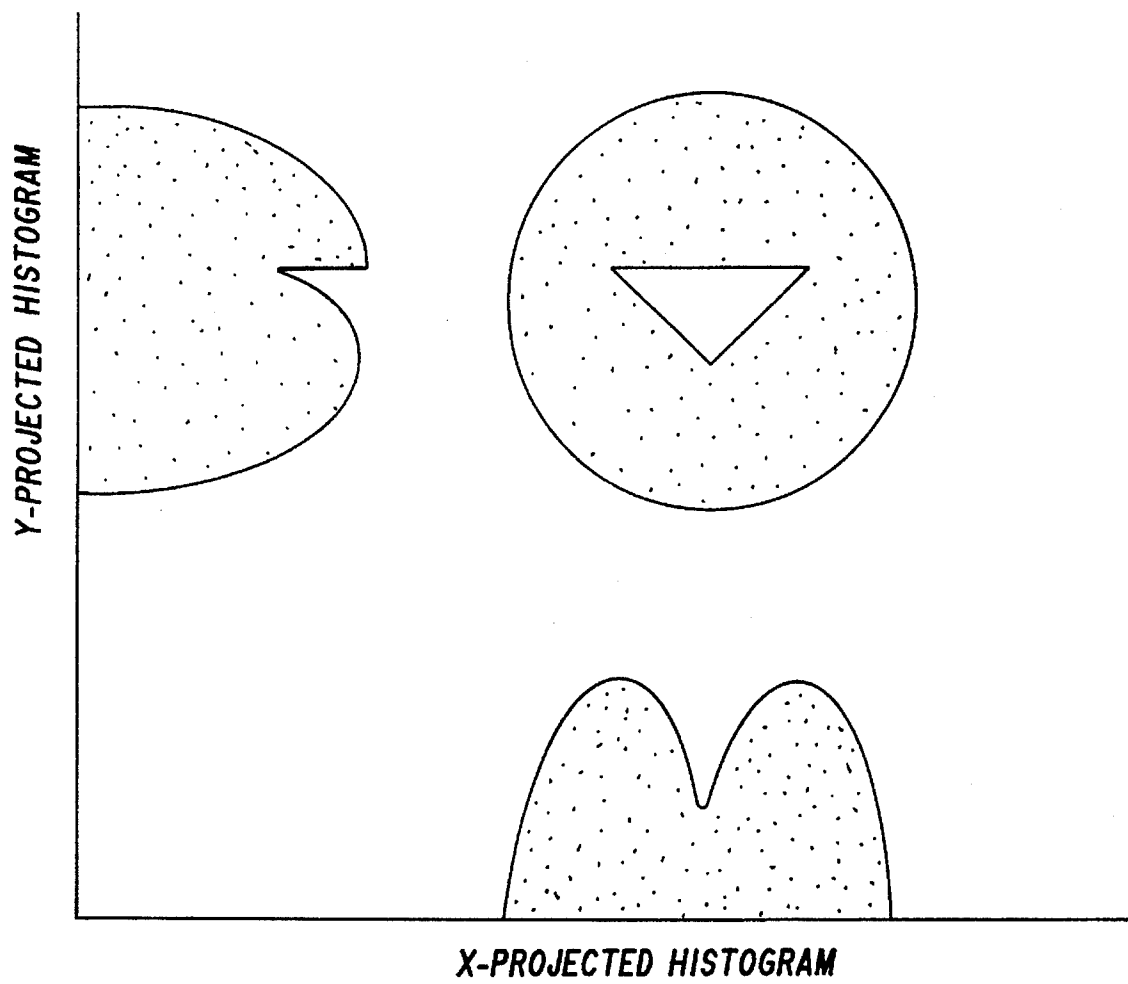


FIG.5



**FIG.6**

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