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United States Patent [19]

Sheldon

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[54] **RATE RESPONSIVE CARDIAC PACEMAKER WITH TILT SENSOR**

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[73] Assignee: **Medtronic, Inc.**, Minneapolis, Minn.

[21] Appl. No.: **08/877,427**

[22] Filed: **Jun. 17, 1997**

Related U.S. Application Data

[60] Division of application No. 08/668,524, Jun. 28, 1996, Pat. No. 5,725,562, which is a continuation-in-part of application No. 08/413,733, Mar. 30, 1995, abandoned.

[51] **Int. Cl.**[6] **A61N 1/385**

[52] **U.S. Cl.** **607/17**

[58] **Field of Search** 607/17, 19; 128/920

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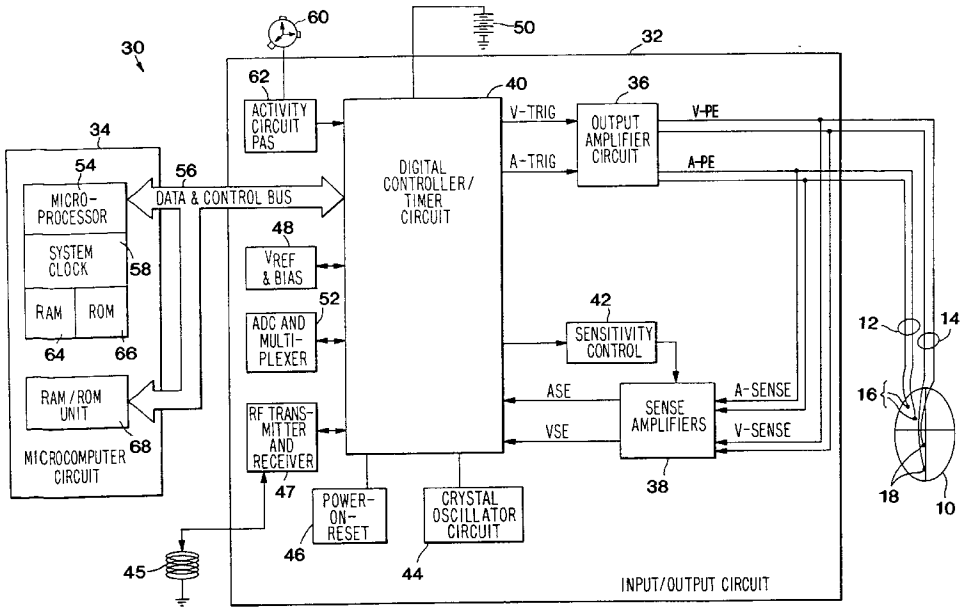
Primary Examiner—William E. Kamm

[57] **ABSTRACT**

A method of and apparatus for pacing a patient's heart at a pacing rate dependent on patient activity and posture particularly during stair climbing. A dual chamber, rate responsive pacemaker for pacing a patient's heart includes at least one DC accelerometer mounted in the pacemaker pulse generator for implantation such that the sensitive axis of the DC accelerometer is sensitive to the effects of gravity during forward lean of the patient characteristic of stair climbing posture. The DC and AC signal outputs of the accelerometer are processed to develop a tilt signal and an activity signal. A target rate control signal is derived from the activity signal dependent on the level of activity. A stair climbing rate is selected for controlling the physiologic pacing rate between a lower and an upper pacing rate in the presence of an activity signal indicative of a patient walking rate and a tilt signal value falling within a tilt window. The target rate control signal is used to control the pacing rate if the activity signal is indicative of faster patient movement, e.g. running, or if the tilt signal is outside the tilt window indicating that the patient is either upright or prone.

8 Claims, 11 Drawing Sheets



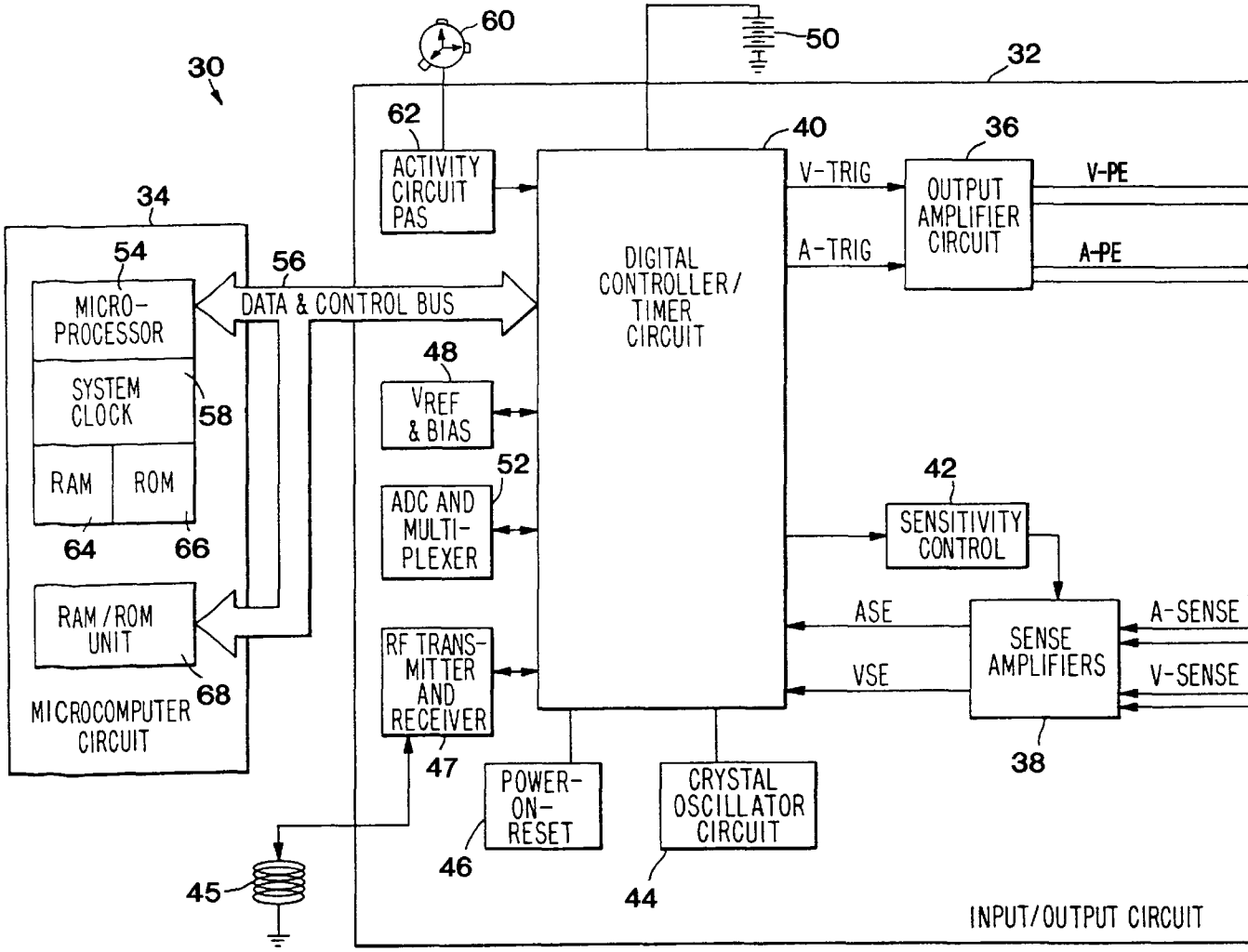


FIG. 1

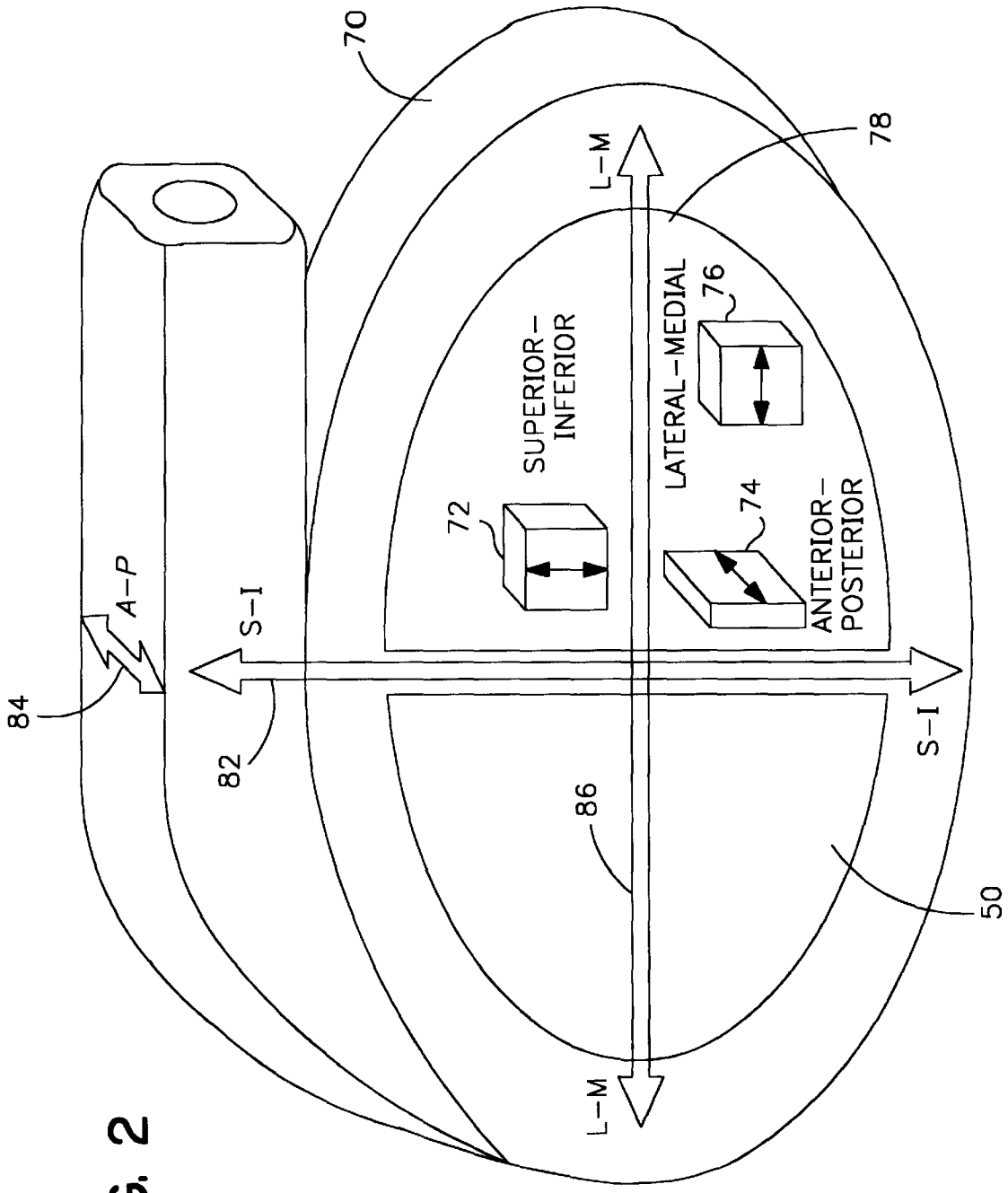


FIG. 2

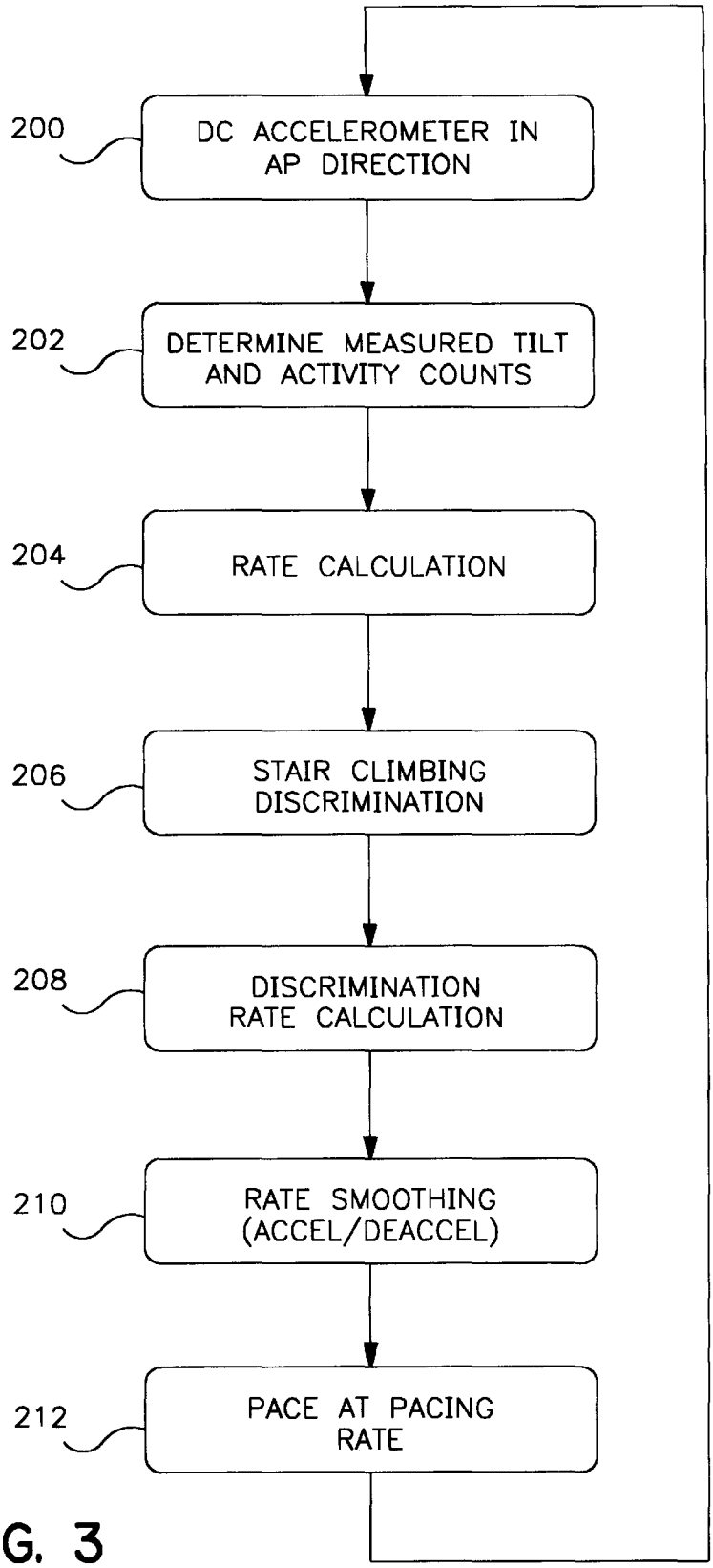
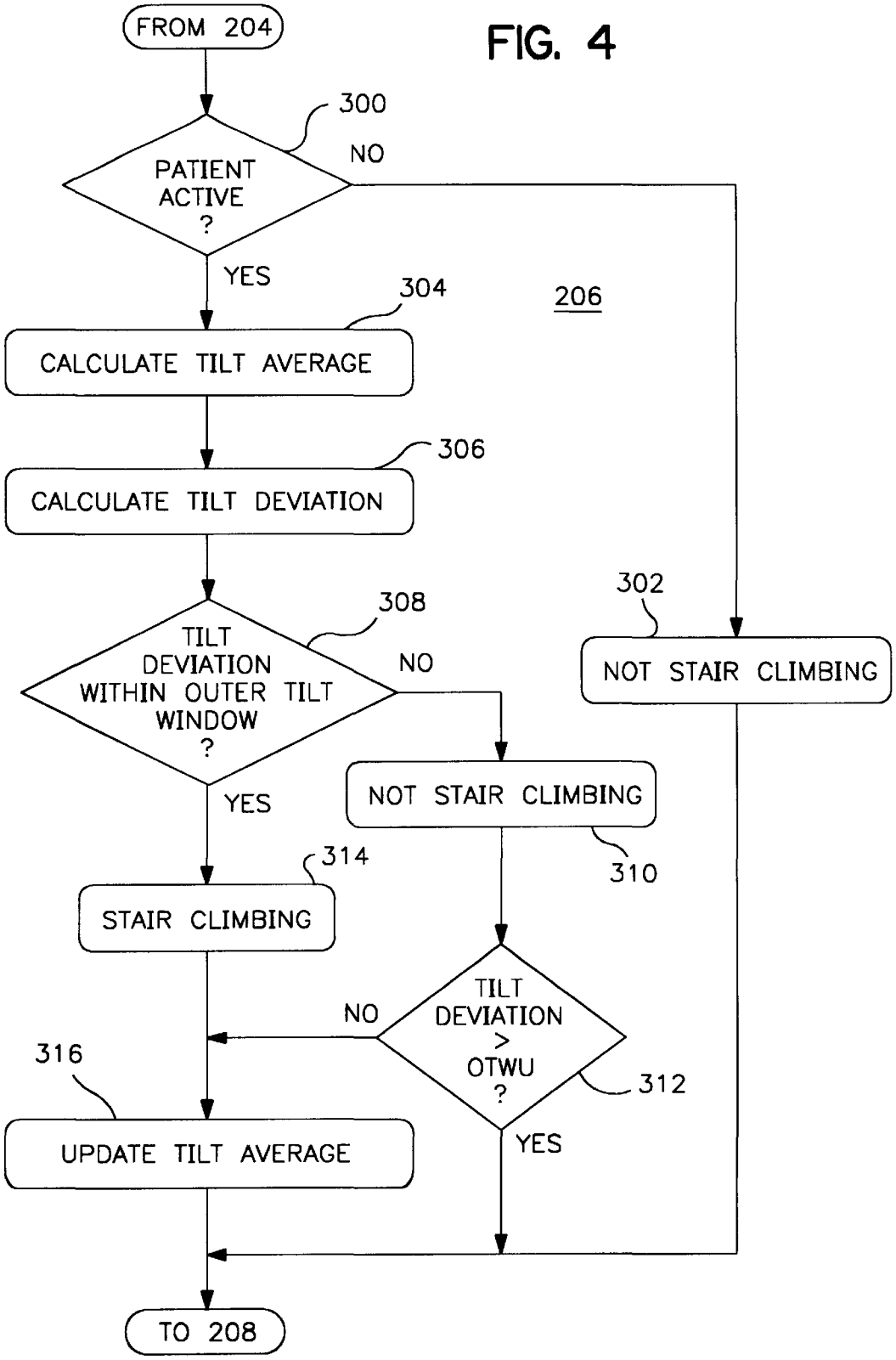


FIG. 3

FIG. 4



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