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United States Patent [19]

[11] Patent Number: **5,583,776**

Levi et al.

[45] Date of Patent: **Dec. 10, 1996**

[54] **DEAD RECKONING NAVIGATIONAL SYSTEM USING ACCELEROMETER TO MEASURE FOOT IMPACTS**

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5,117,301	5/1992	Tsumura	359/154
5,117,444	5/1992	Sutton et al.	377/24.2
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5,485,402	1/1996	Smith et al.	354/566

[75] Inventors: **Robert W. Levi, Anaheim; Thomas Judd, Fountain Valley, both of Calif.**

OTHER PUBLICATIONS

[73] Assignee: **Point Research Corporation, Santa Ana, Calif.**

Meijer, et al., *Methods to Assess Physical Activity with Special Reference to Motion Sensors and Accelerometers*, IEEE Transactions on Biomedical Engineering, Mar. 1991, vol. 38, No. 3, pp. 221-229.

[21] Appl. No.: **405,087**

"American Practical Navigator", originally by N. Bowditch, L.L.D., 1966—Corrected Print, published by the U.S. Navy Hydrographic Office.

[22] Filed: **Mar. 16, 1995**

Primary Examiner—Michael Zanelli
Attorney, Agent, or Firm—Price, Gess & Ubell

[51] Int. Cl.⁶ **G01C 22/00**

[52] U.S. Cl. **364/450; 364/443; 364/460**

[58] Field of Search **364/449, 450, 364/452, 460, 454, 443; 235/105; 340/944; 73/490**

[57] ABSTRACT

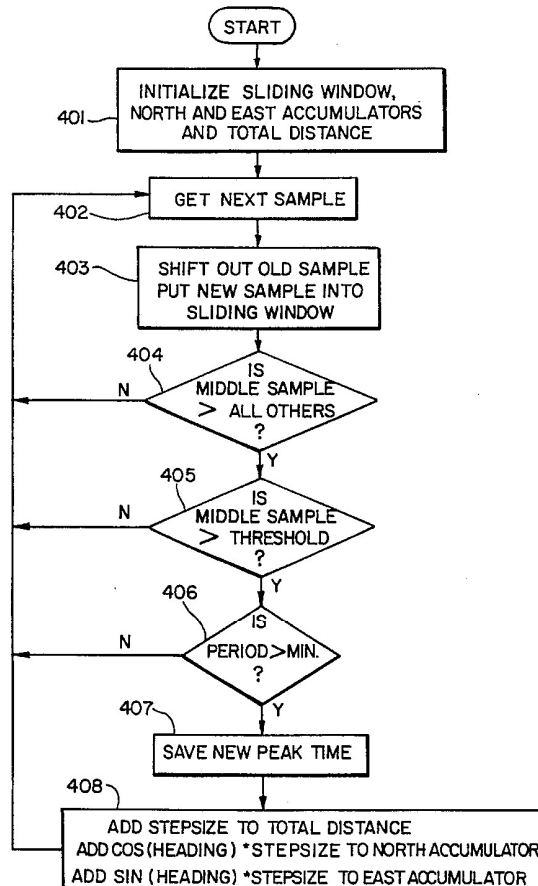
A microcomputer-assisted position finding system that integrates GPS data, dead reckoning sensors, and digital maps into a low-cost, self-contained navigation instrument is disclosed. A built-in radio frequency transponder allows individual positions to be monitored by a central coordinating facility. Unique dead reckoning sensors and features are disclosed for ground speed/distance measurement and computer-aided position fixes.

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15 Claims, 8 Drawing Sheets



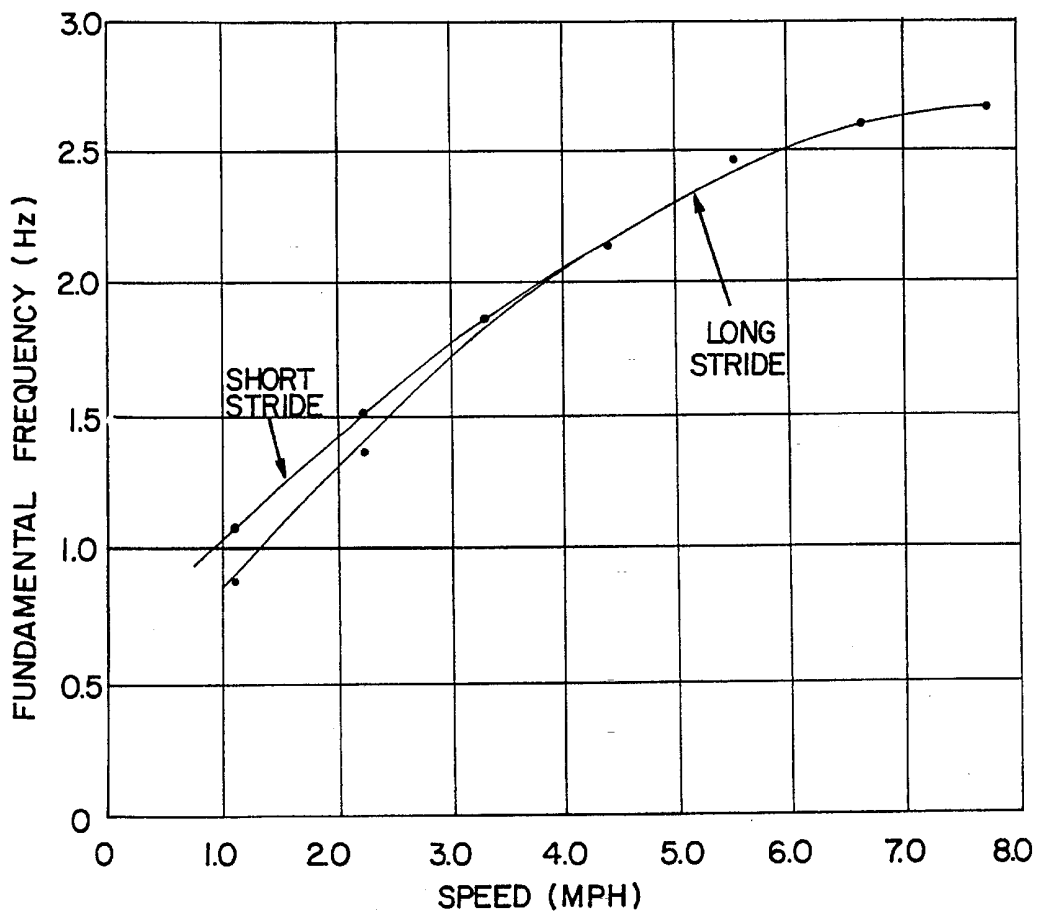


FIG. 1

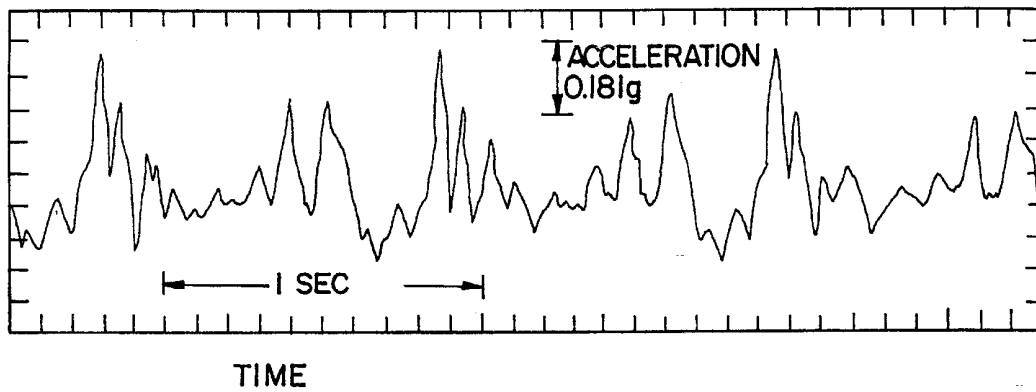


FIG. 2

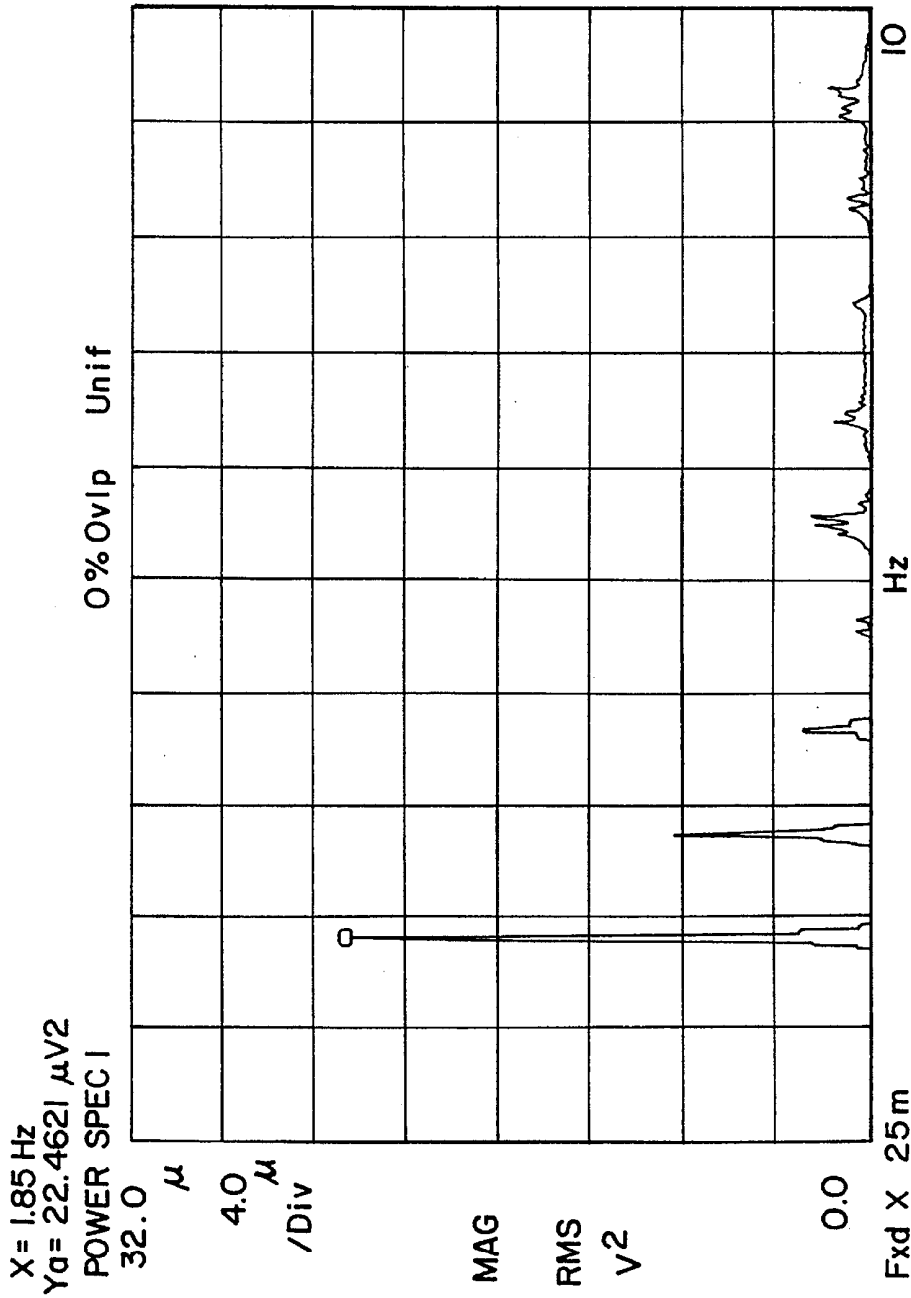


FIG. 3

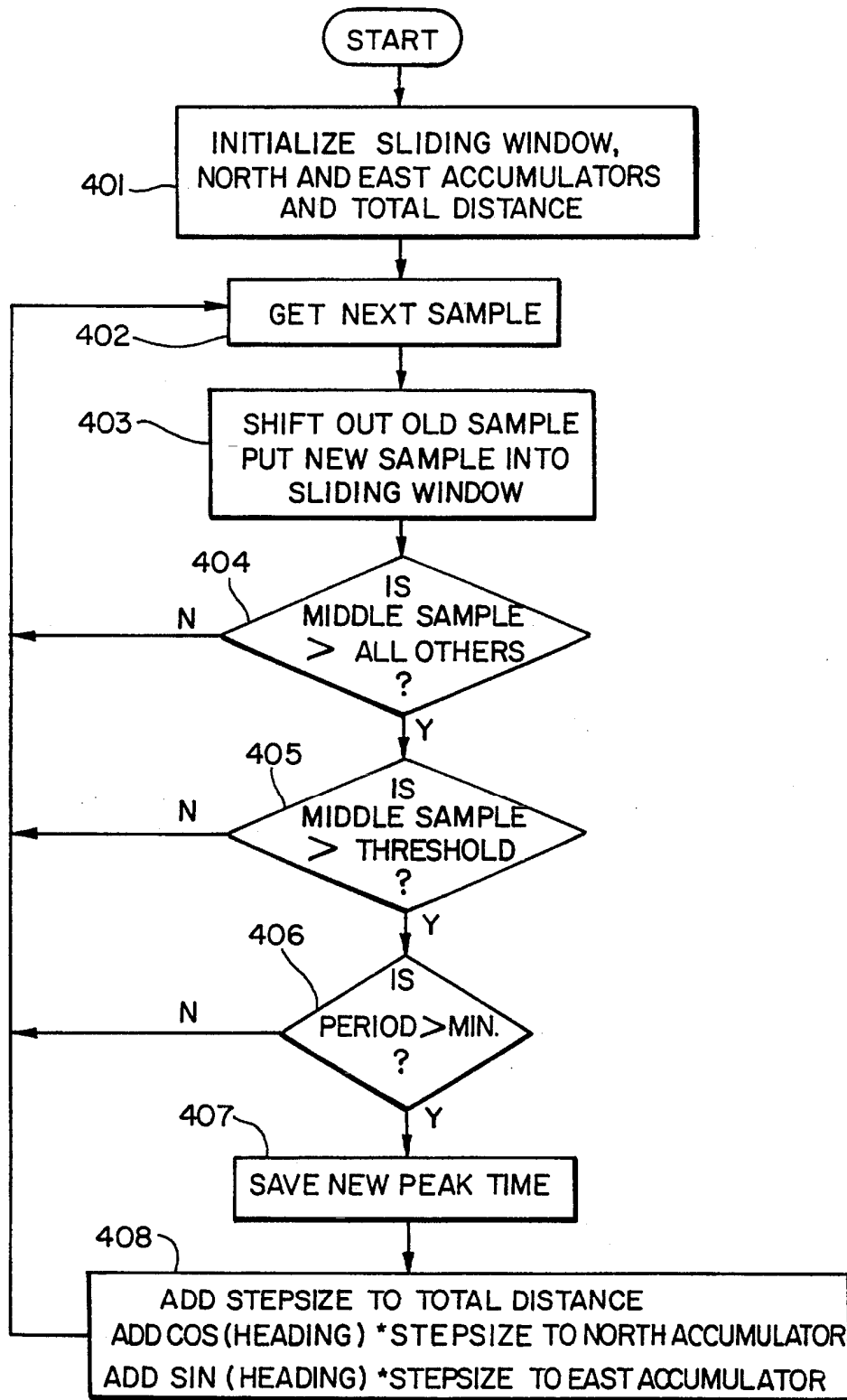


FIG. 4

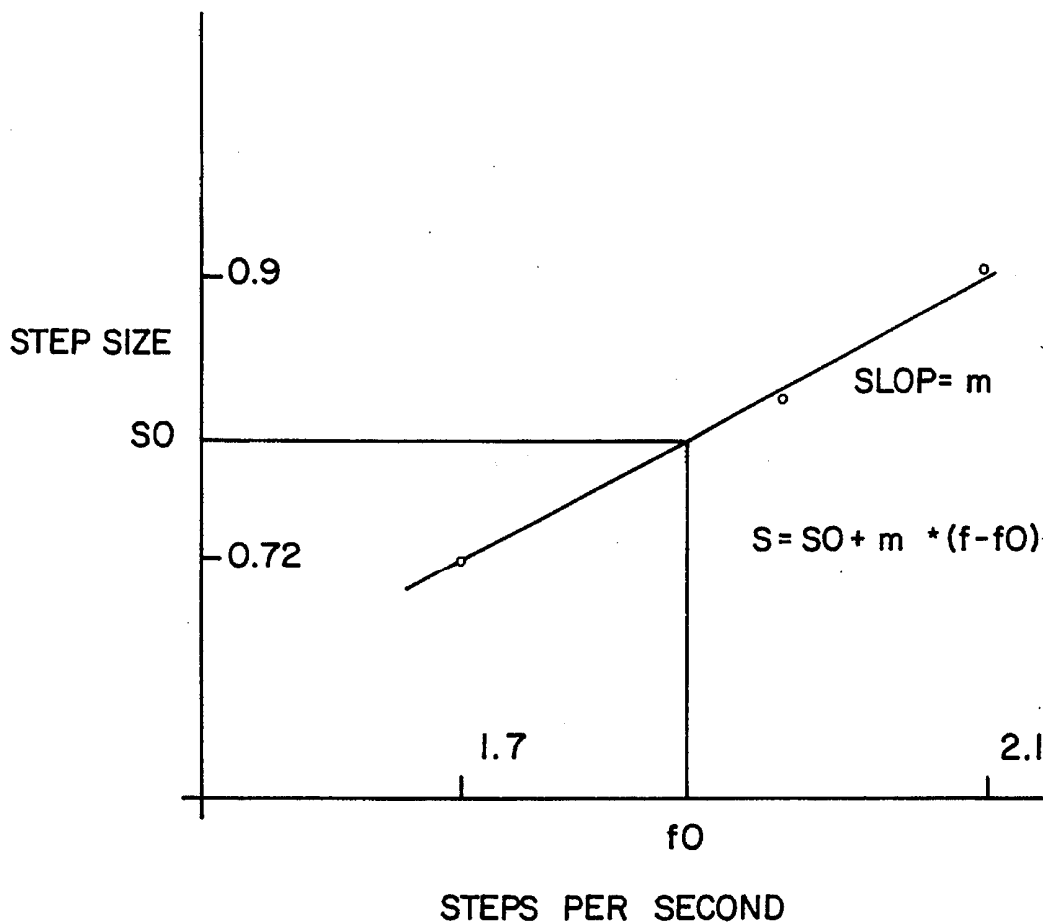


FIG. 5

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