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# United States Patent [19]

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Gaudet et al.

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[54] **MEASURING FOOT CONTACT TIME AND FOOT LOFT TIME OF A PERSON IN LOCOMOTION**

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[51] Int. Cl.<sup>7</sup> ..... **G01C 22/00; G04F 10/00**

[52] U.S. Cl. .... **702/176; 702/141; 702/160; 702/142; 368/10; 235/105**

[58] Field of Search ..... **702/160, 176, 702/144, 141, 142, 149; 368/10; 235/105**

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Primary Examiner—Marc S. Hoff

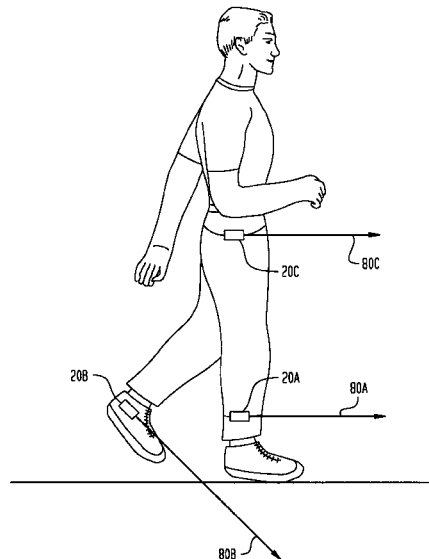
Assistant Examiner—Hien Vo

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[57] **ABSTRACT**

The time period that a foot is in contact with the ground during a stride taken by a user, and the period that the foot is not in contact with the ground between strides taken by the user are determined by processing and analyzing the output signal of an accelerometer. The accelerometer is mounted on the user such that its acceleration sensing axis senses acceleration in a direction substantially parallel to the bottom of the user's foot. The output of the accelerometer is high-pass filtered, amplified, and fed to the input of a micro-controller, which monitors the signal for positive and negative signal spikes that are indicative, respectively, of the moment that the foot of the user leaves the ground and the moment that the foot impacts with the ground. By measuring time intervals between these positive and negative spikes, average "foot contact times" and "foot loft times" of the user may be calculated. To derive the pace of the user, the average foot contact time is multiplied by a first constant if it is less than 400 milli-seconds (ms) and is multiplied by a second constant if it is greater than 400 ms. This pace value may, in turn, be used to calculate the distance traveled by the user.

**38 Claims, 13 Drawing Sheets**



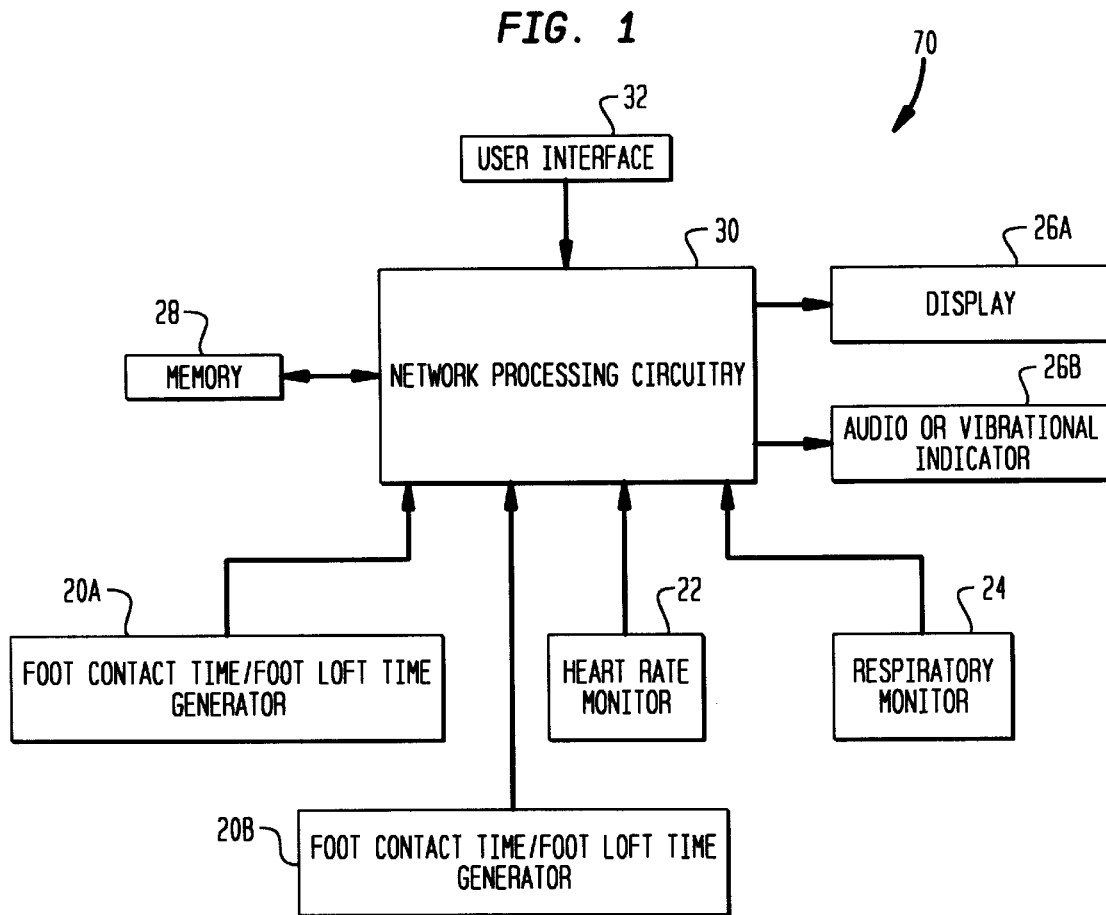


FIG. 2

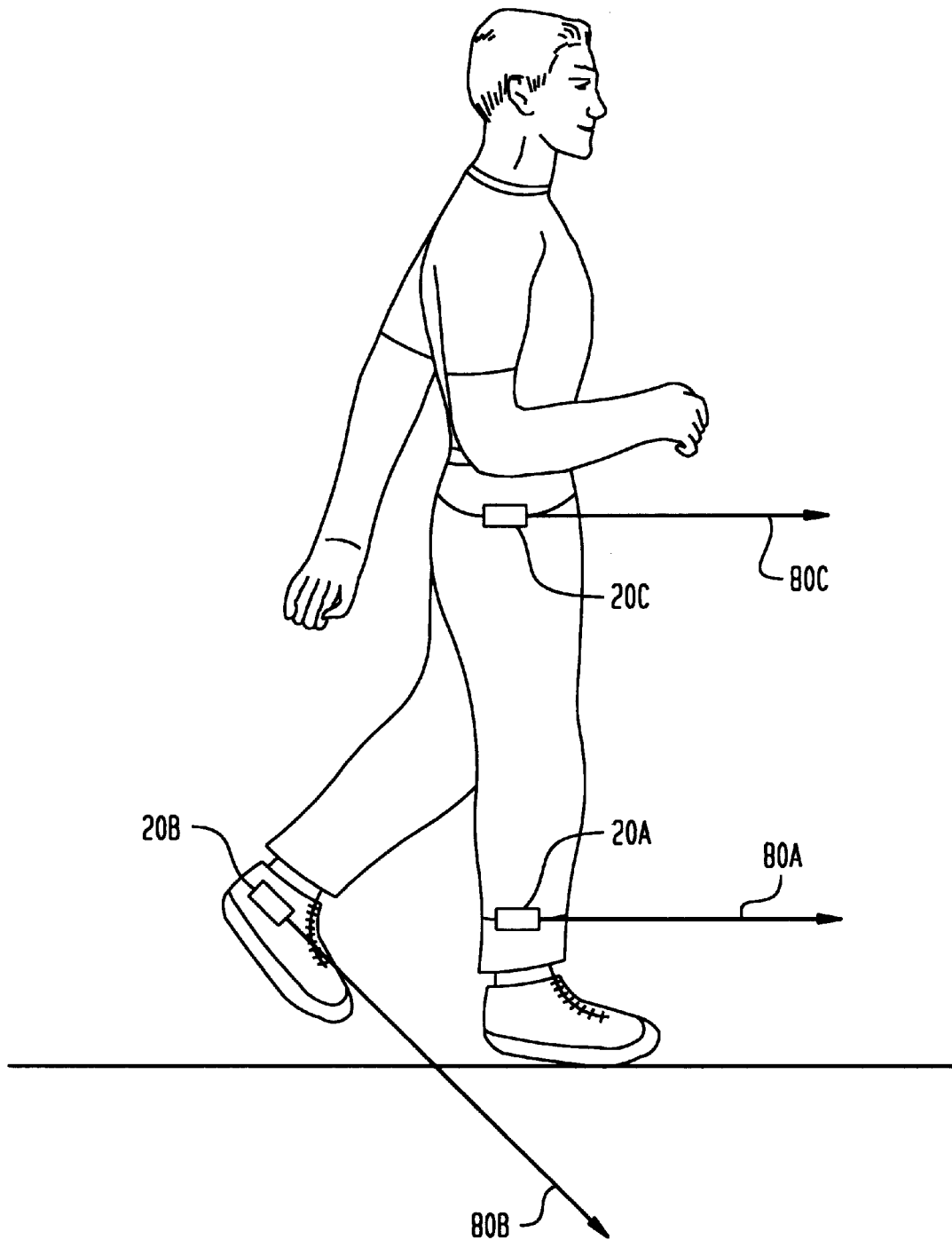


FIG. 3

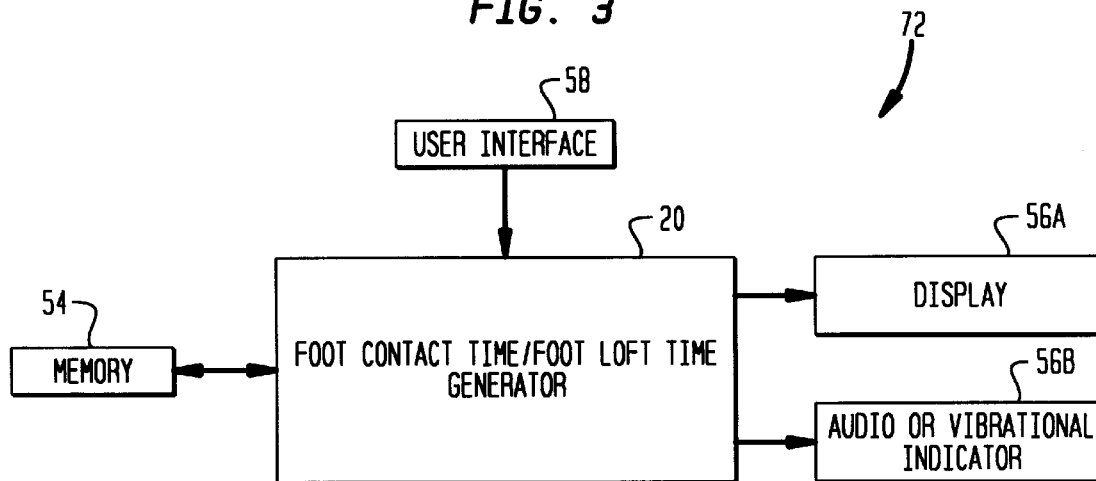


FIG. 4

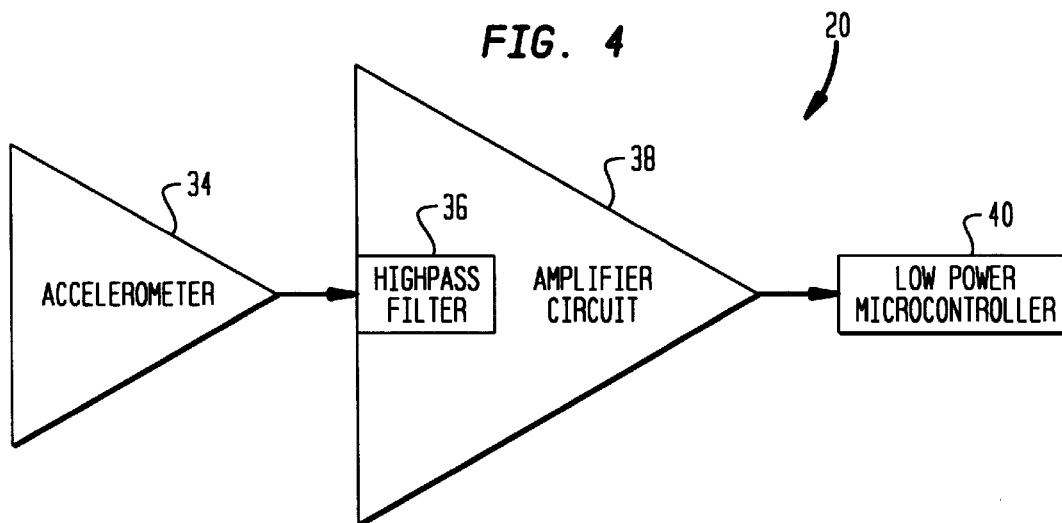
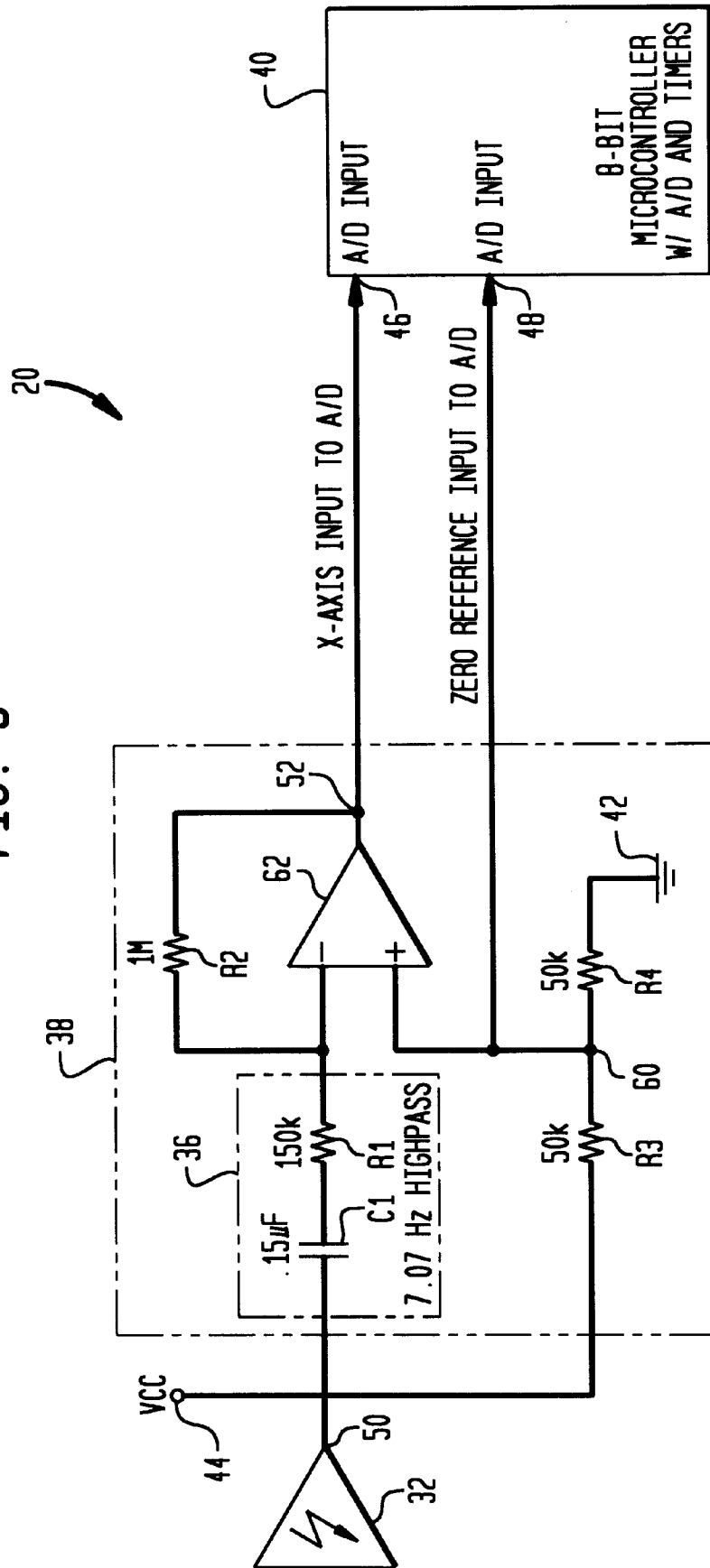


FIG. 5



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