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(12) **United States Patent**
Dekker

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- (54) **MONITORING RESPIRATION BASED ON PLETHYSMOGRAPHIC HEART RATE SIGNAL**
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- (*) Notice: **Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.**
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- (51) **Int. Cl.⁷** **A61B 5/02**
- (52) **U.S. Cl.** **600/484; 600/483; 600/500; 600/479**
- (58) **Field of Search** **600/484, 483, 600/481, 500, 501, 502, 504, 507, 508, 476, 479, 480, 473, 475, 529**

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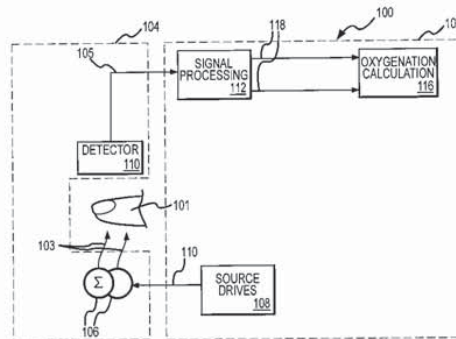
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(57) **ABSTRACT**

A pleth signal is analyzed to identify a heart rate variability parameter associated with respiration rate. In one embodiment, an associated process involves obtaining a photoplethysmographic signal, processing the pleth signal to obtain heart rate samples, monitoring the heart rate sample to identify a heart rate variability associated with respiration, and determining a respiration rate based on the heart rate variability. The photoplethysmographic signal may be based on one or more channel signals of a conventional pulse oximeter. The invention thus allows for noninvasive monitoring of respiration rate and expands the functionality of pulse oximeters.

38 Claims, 8 Drawing Sheets



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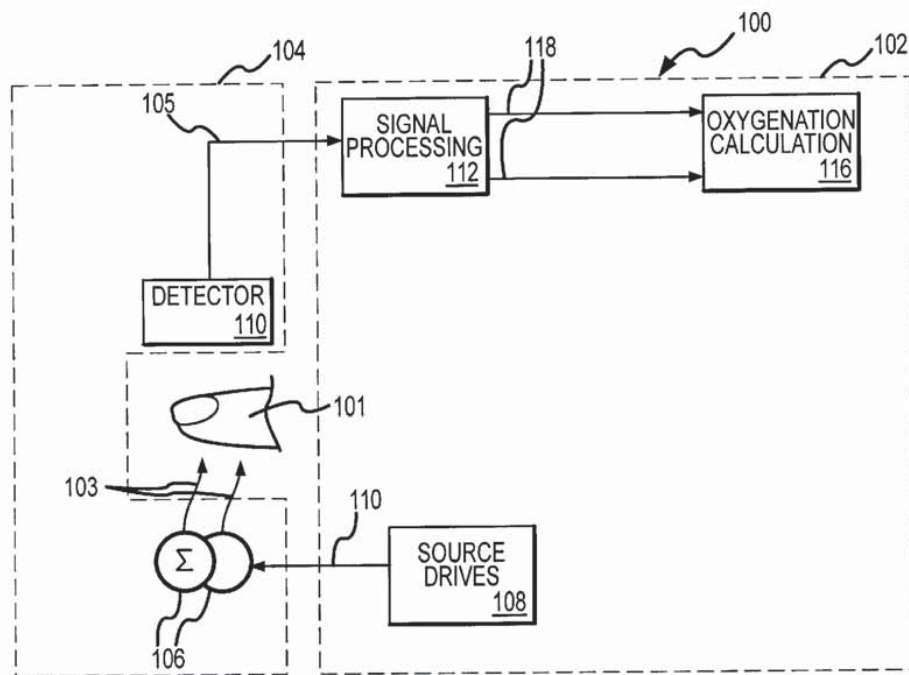


FIG. 1

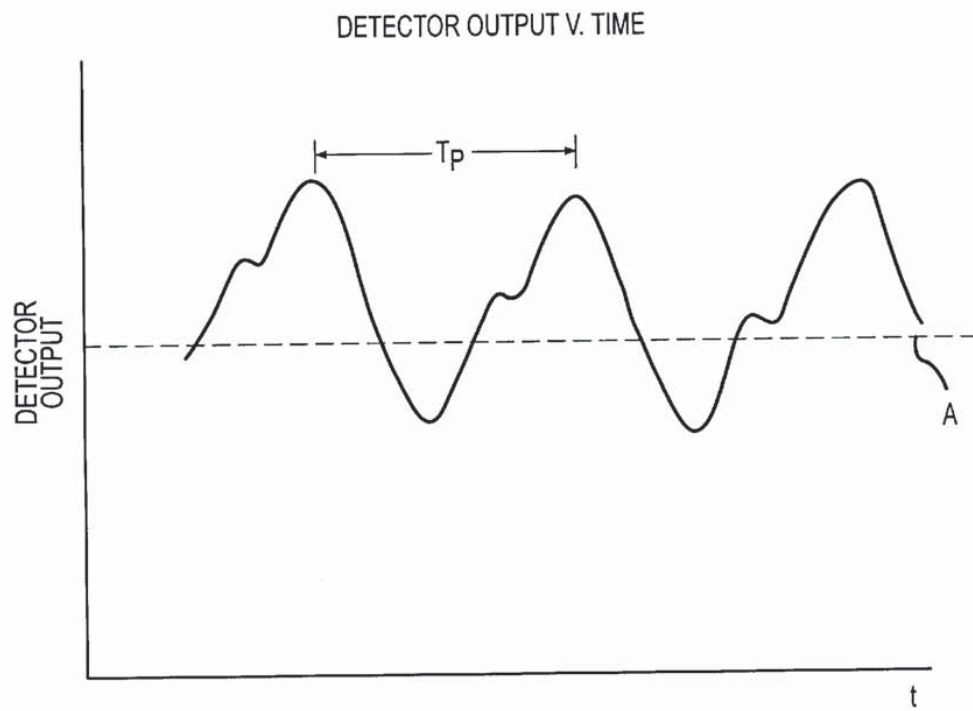


FIG.2

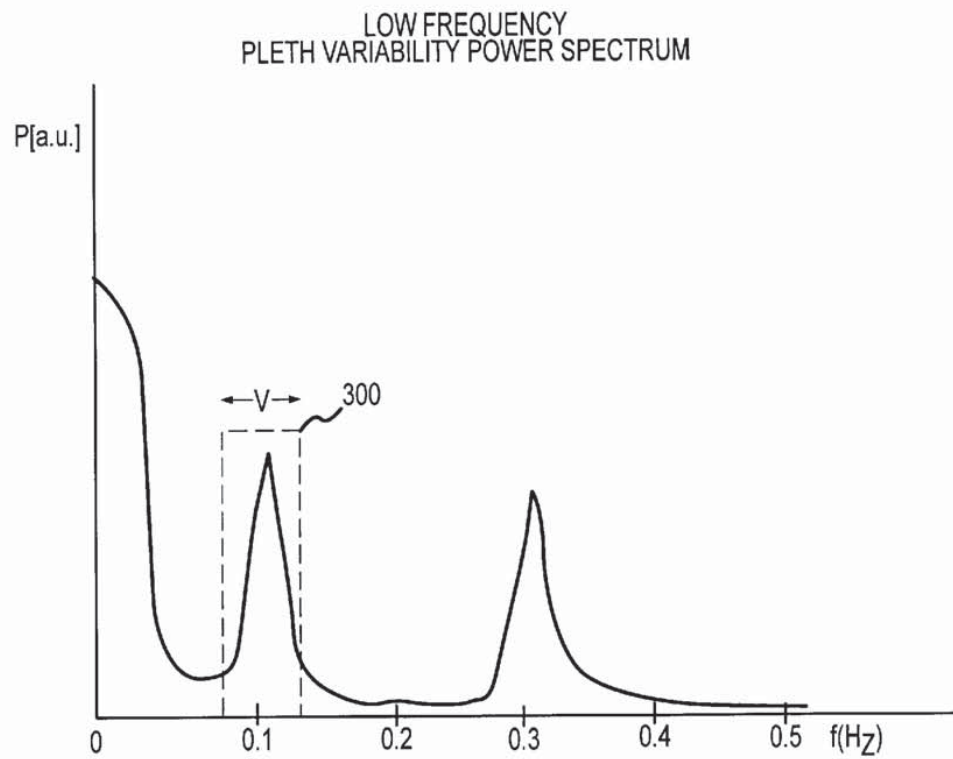


FIG.3

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