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United States Patent [19]
Diab et al.

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- [54] **SIGNAL PROCESSING APPARATUS**
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- [73] Assignee: **Masimo Corporation**, Mission Viejo, Calif.
- [21] Appl. No.: **132,812**
- [22] Filed: **Oct. 6, 1993**

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Related U.S. Application Data

- [63] Continuation-in-part of Ser. No. 249,690, May 26, 1994, which is a continuation of Ser. No. 666,060, Mar. 7, 1991, abandoned.
- [51] **Int. Cl.⁶** **A61B 5/00**
- [52] **U.S. Cl.** **128/633; 356/41**
- [58] **Field of Search** 128/633-634, 128/664-667, 672, 687-688, 716; 356/39-41

[57] **ABSTRACT**

A signal processor which acquires a first signal, including a first primary signal portion and a first secondary signal portion, and a second signal, including a second primary signal portion and a second secondary signal portion, wherein the first and second primary signal portions are correlated. The signals may be acquired by propagating energy through a medium and measuring an attenuated signal after transmission or reflection. Alternatively, the signals may be acquired by measuring energy generated by the medium. A processor of the present invention generates a primary or secondary reference signal which is a combination, respectively, of only the primary or secondary signal portions. The secondary reference signal is then used to remove the secondary portion of each of the first and second measured signals via a correlation canceler, such as an adaptive noise canceler, preferably of the joint process estimator type. The primary reference signal is used to remove the primary portion of each of the first and second measured signals via a correlation canceler. The processor of the present invention may be employed in conjunction with a correlation canceler in physiological monitors wherein the known properties of energy attenuation through a medium are used to determine physiological characteristics of the medium. Many physiological conditions, such as the pulse, or blood pressure of a patient or the concentration of a constituent in a medium, can be determined from the primary or secondary portions of the signal after other signal portion is removed.

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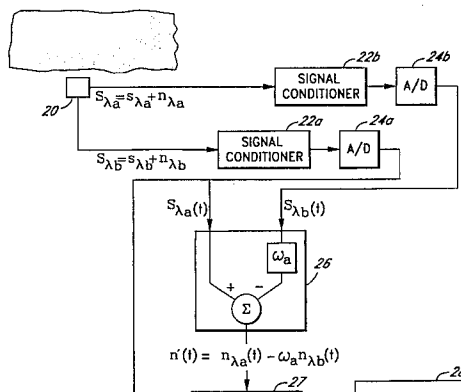
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24 Claims, 20 Drawing Sheets



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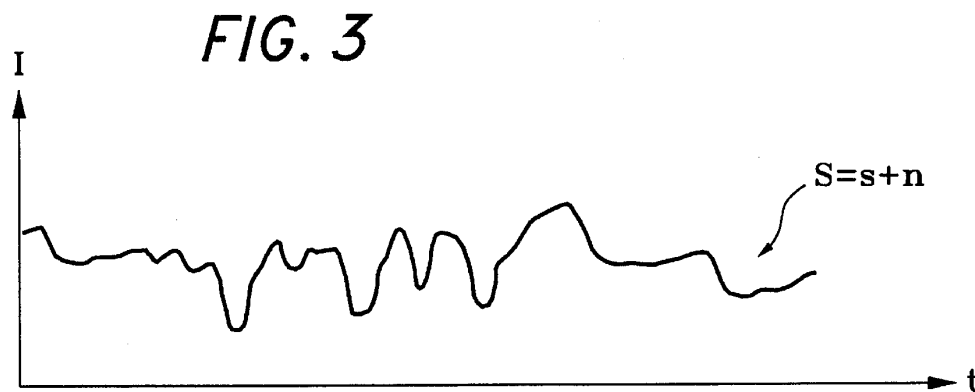
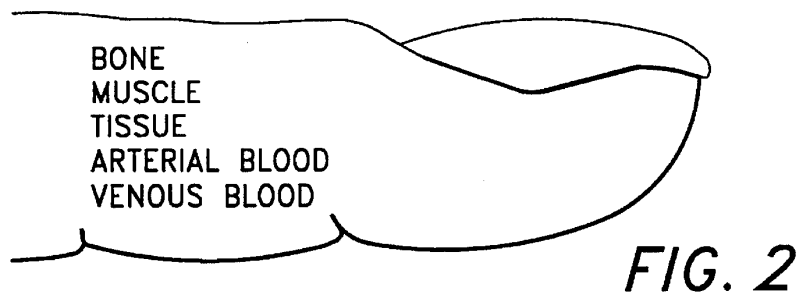
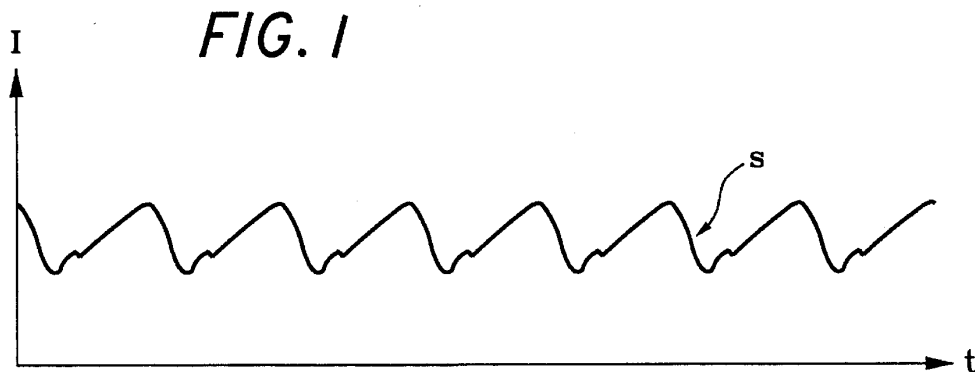
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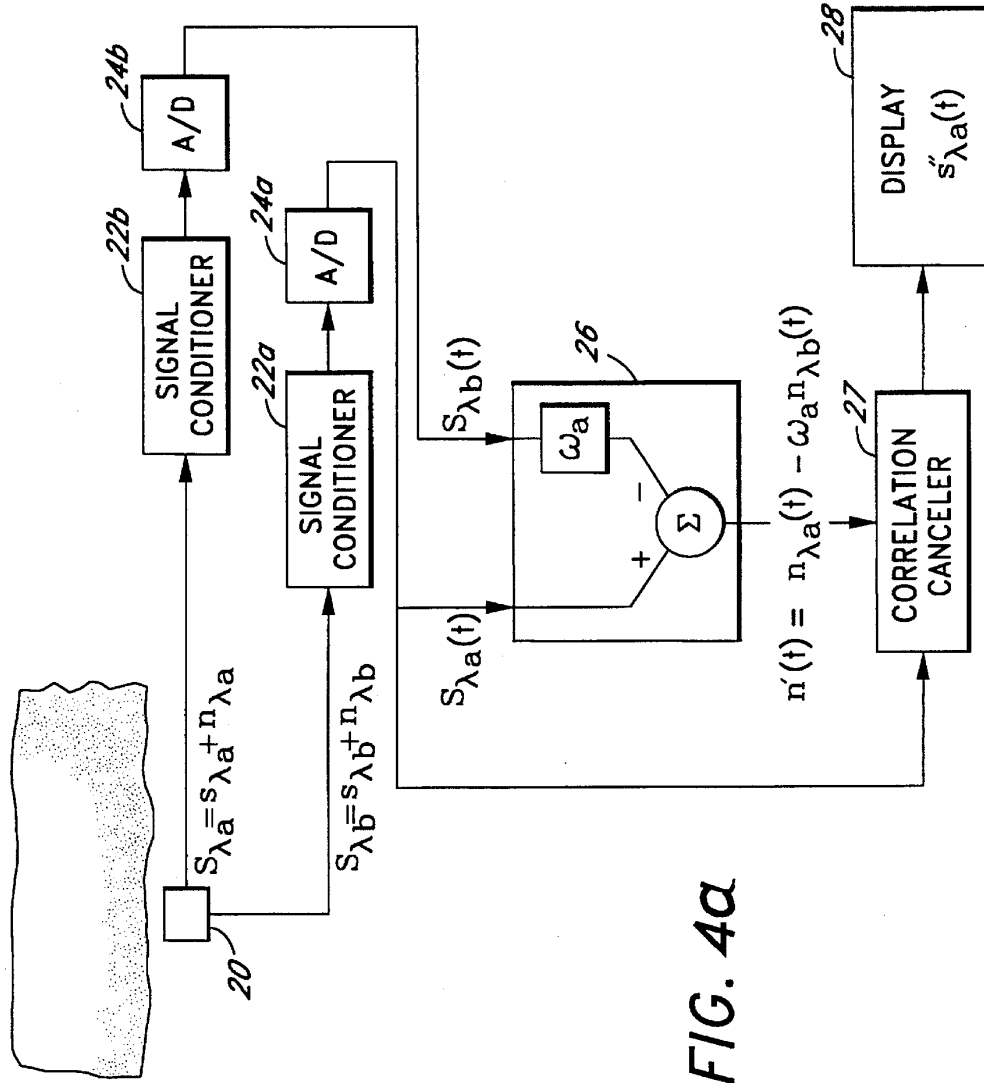
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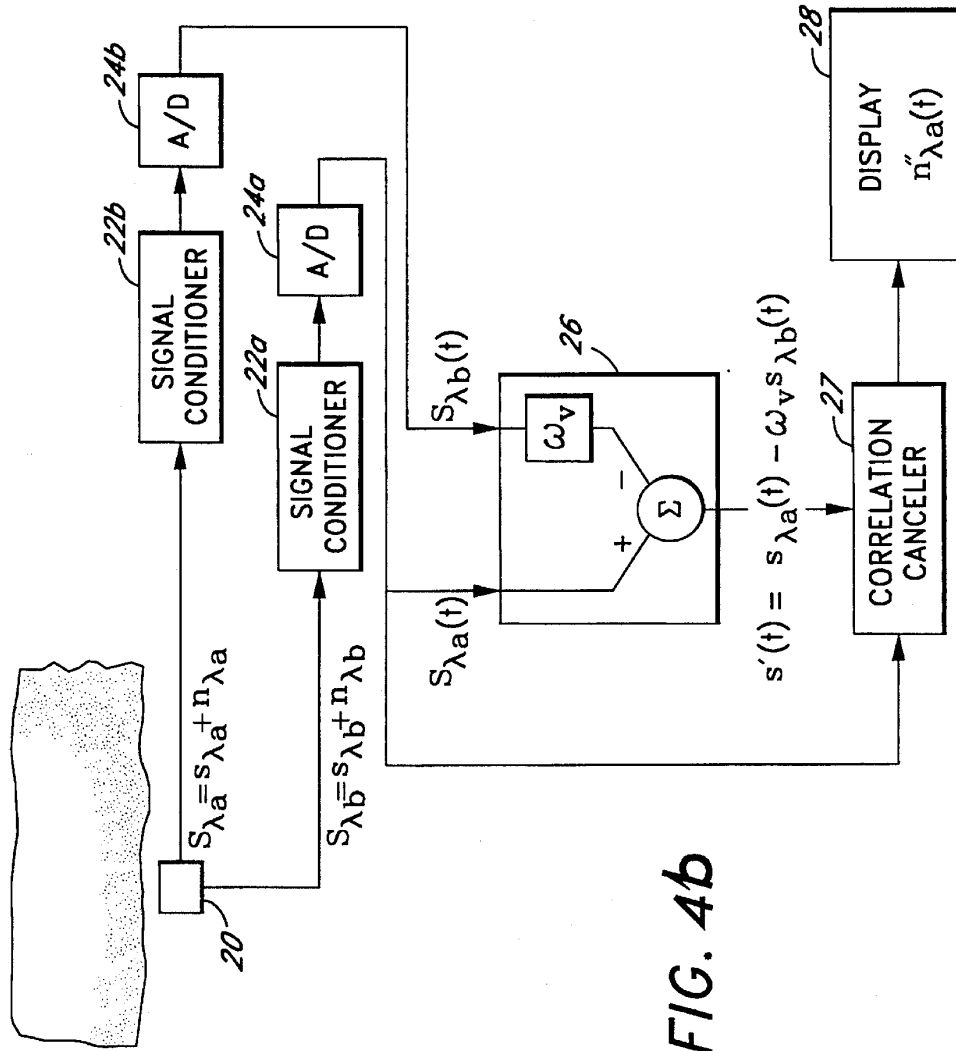


FIG. 4b

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