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United States Patent [19]

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Diab et al.

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[54] LOW NOISE OPTICAL PROBE

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[73] Assignee: **Masimo Corporation**, Mission Viejo, Calif.

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[21] Appl. No.: **333,132**

[22] Filed: **Nov. 1, 1994**

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 672,890, Mar. 21, 1991, abandoned.

[51] Int. Cl.⁶ **A61B 5/00**

[52] U.S. Cl. **128/653.1; 128/633; 128/632; 128/665; 128/666; 356/41**

[58] Field of Search **128/632, 633-4, 128/664-7, 653.1; 356/41**

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[57] ABSTRACT

An optical probe for measurements, which is particularly suited to reduce noise in measurements taken on an easily compressible material, such as a finger, a toe, a forehead, an earlobe, or a lip. The probe includes a base having an aperture which leads to a chamber. The base is placed adjacent a portion of the material, the chamber being placed directly adjacent any easily compressible portion of the material. A photodetector is located within the chamber and does not contact the material. A light emitting diode (LED) is affixed to the material, opposite the photodetector and above the chamber. The material which is supported by the aperture and therefore rests above or has intruded into the chamber is inhibited from compression since nothing comes in contact with this portion of the material, even when the material moves. Thus, light from the LED is directed through a stabilized portion of the material, i.e., the optical path length through which light travels is stabilized, even during motion of the material. This reduces noise in the signal measured by the photodetector. A scattering medium is interposed between the LED and the material, between the material and the photodetector, or between the LED and the material as well as between the material and the photodetector. The scattering medium is used to improve the signal-to-noise ratio of the received optical signal.

30 Claims, 13 Drawing Sheets

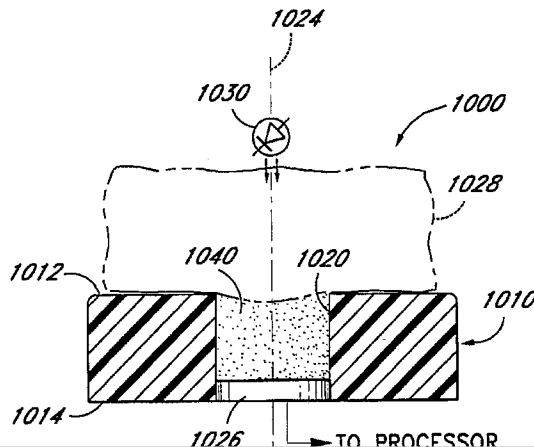


FIG. 1

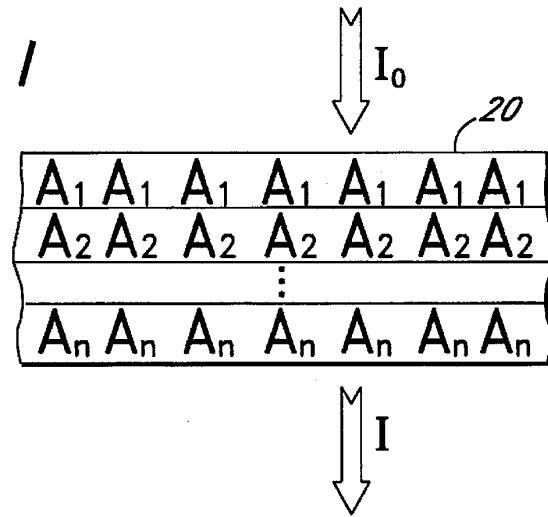


FIG. 2a

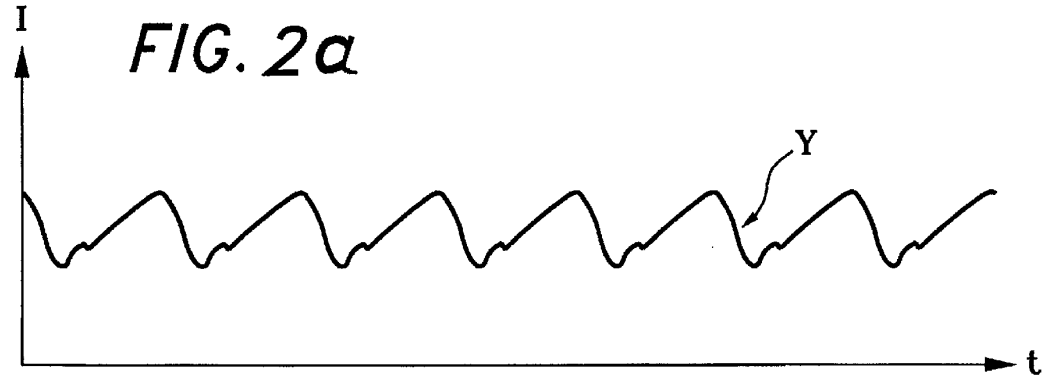


FIG. 2b

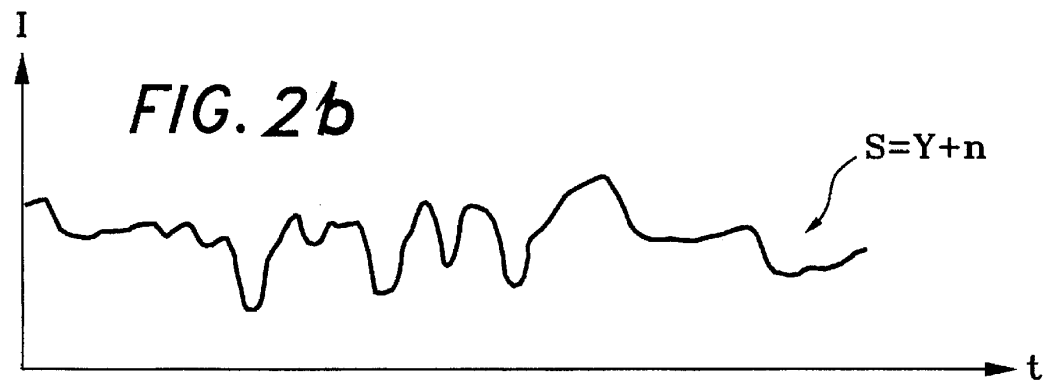


FIG. 3

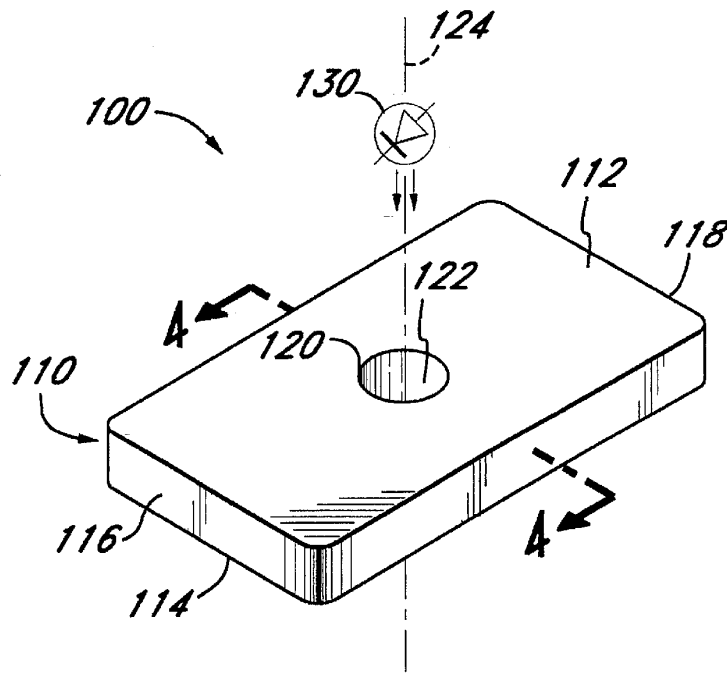


FIG. 4

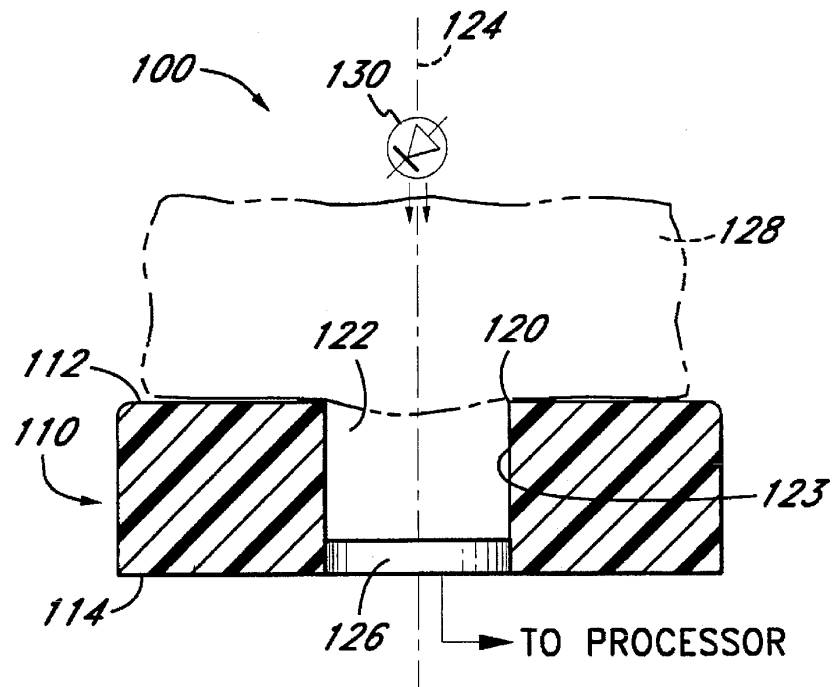


FIG. 5

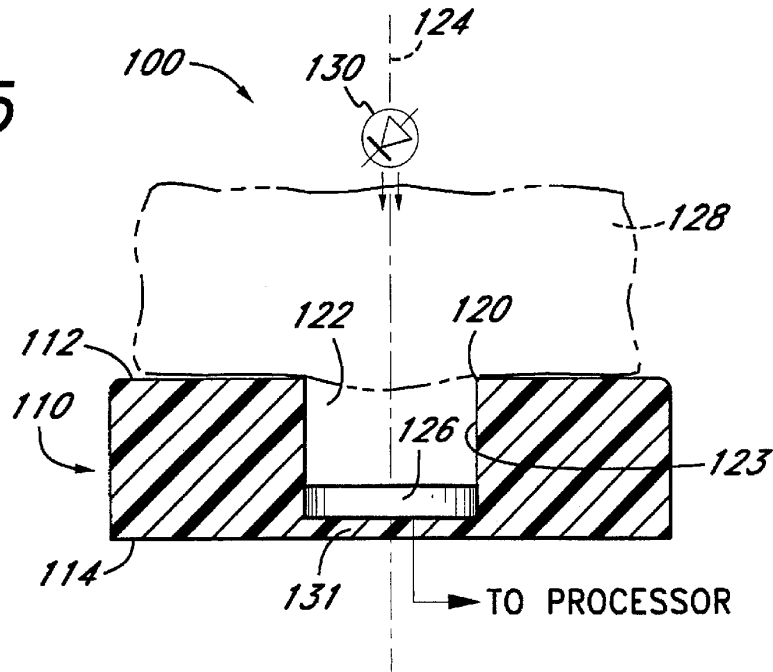
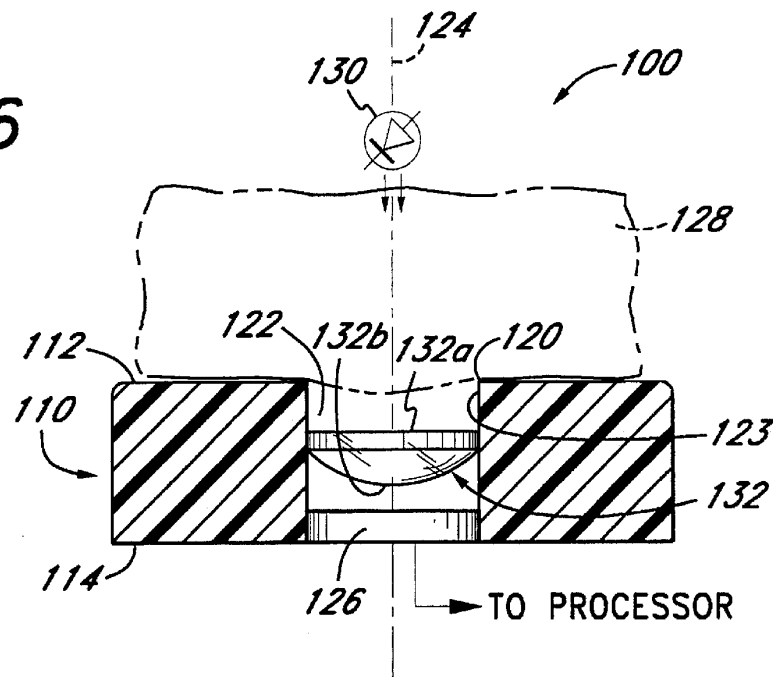


FIG. 6



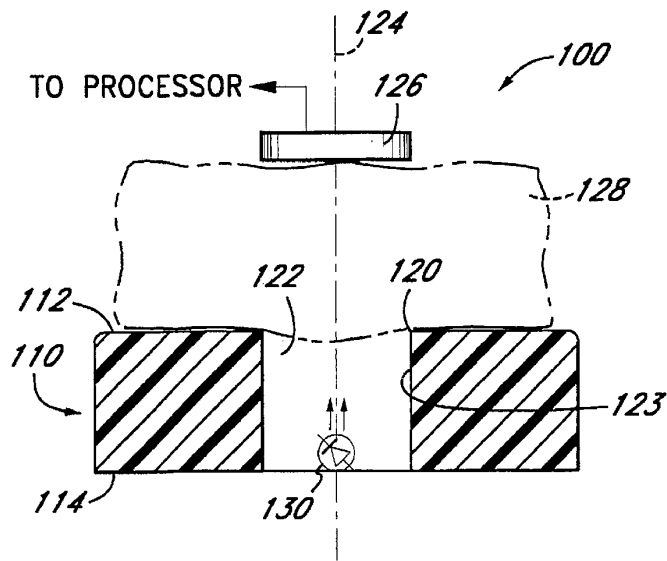


FIG. 7

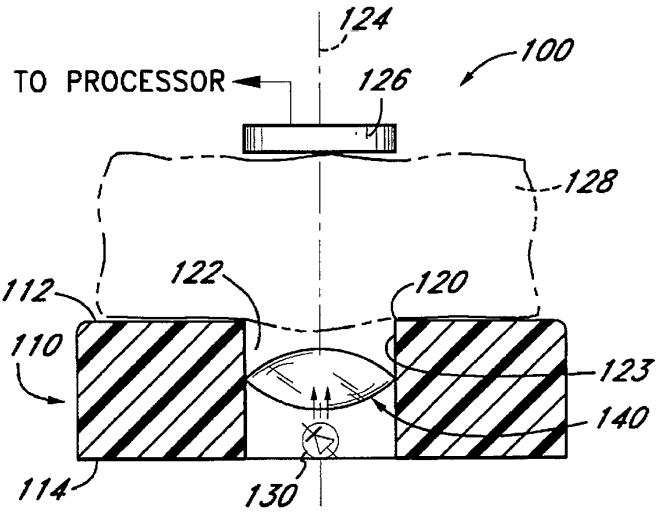
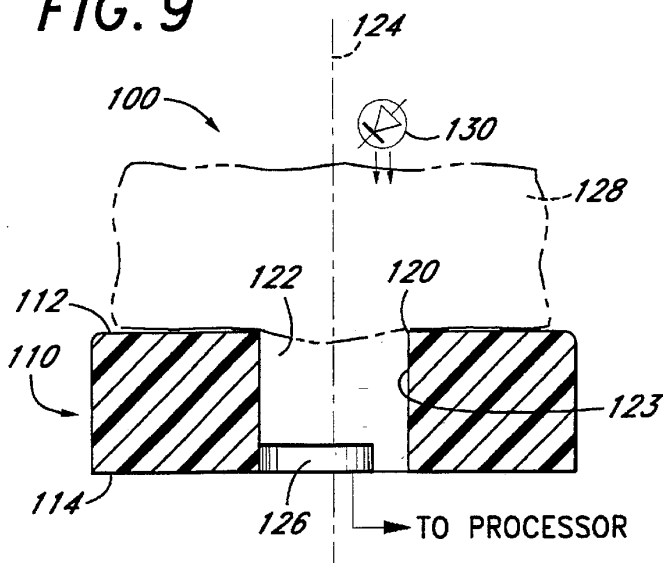


FIG. 8



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