



United States Patent [19]

[11] **Patent Number:** **5,807,267**

Bryars et al.

[45] **Date of Patent:** **Sep. 15, 1998**

[54] HEART PULSE MONITOR	5,243,992	9/1993	Eckerle et al.	128/690
	5,301,154	4/1994	Suga	128/690
[75] Inventors: John D. Bryars , Encinitas; David Cavanaugh , San Diego, both of Calif.	5,431,170	7/1995	Mathews	128/666
	5,539,706	7/1996	Takenaka et al.	128/690
	5,558,096	9/1996	Palatnik	128/687

[73] Assignee: **Advanced Body Metrics Corporation**, Rancho Santa Fe, Calif.

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Attorney, Agent, or Firm—G. Donald Weber, Jr.

[21] Appl. No.: **512,712**

[57] **ABSTRACT**

[22] Filed: **Aug. 8, 1995**

The invention herein described is intended to provide the user with a reliable heart rate monitor that is a completely self contained unit and is capable of providing accurate readings while the wearer is moving about. The use of piezoelectric sensing elements eliminates the power drain caused by LEDs and similar devices. The sensing element mounting means disclosed herein is devised to greatly reduce the noise introduced into the pulse signal by body motion. The use of optical sensors in a staring mode and optical sensors in a pulsed mode is also presented. The effects of noise are further reduced by employing digital signal processing algorithms to find the heart pulse inter-mixed with noise signals and present the heart pulse rate in beats per minute on a display. The resulting device permits the visual monitoring of the heart pulse rate in a human body in a consistent, error-free manner.

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 462,152, Jun. 5, 1995, which is a continuation of Ser. No. 252,605, Jun. 1, 1994, abandoned.

[51] **Int. Cl.⁶** **A61B 5/00**

[52] **U.S. Cl.** **600/500; 600/477; 600/479; 600/503**

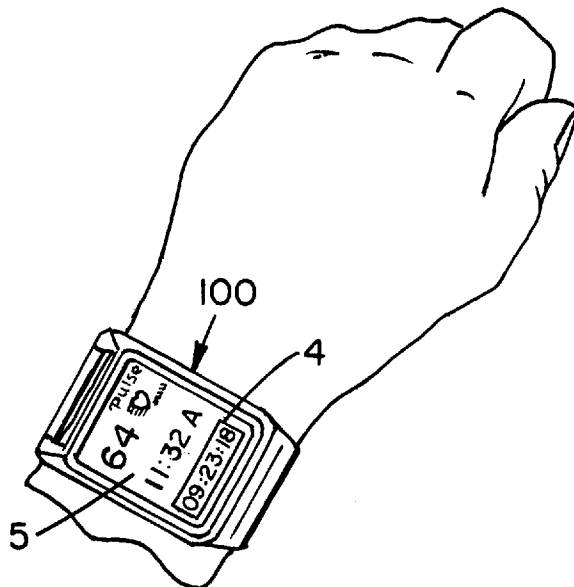
[58] **Field of Search** 128/672, 666, 128/687-690, 706, 707; 600/500-503; 5/476-475

References Cited

U.S. PATENT DOCUMENTS

5,000,188	3/1991	Kojima	128/687
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27 Claims, 4 Drawing Sheets



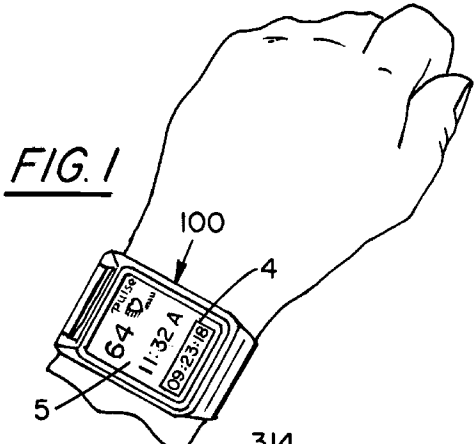


FIG. 1

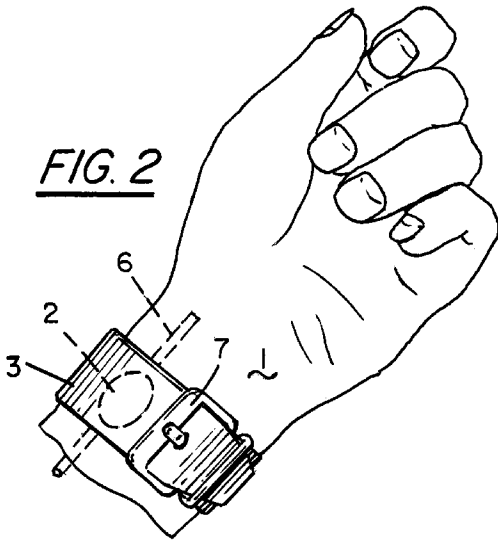


FIG. 2

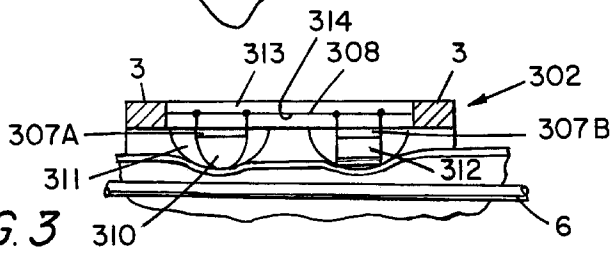


FIG. 3

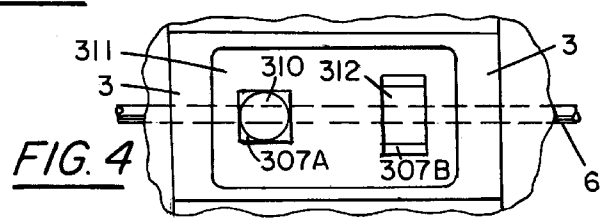


FIG. 4

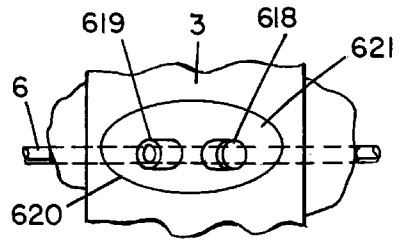


FIG. 6

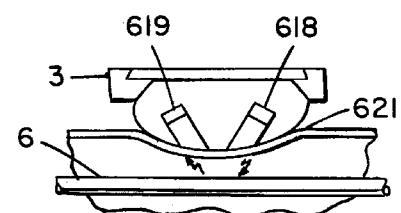


FIG. 7

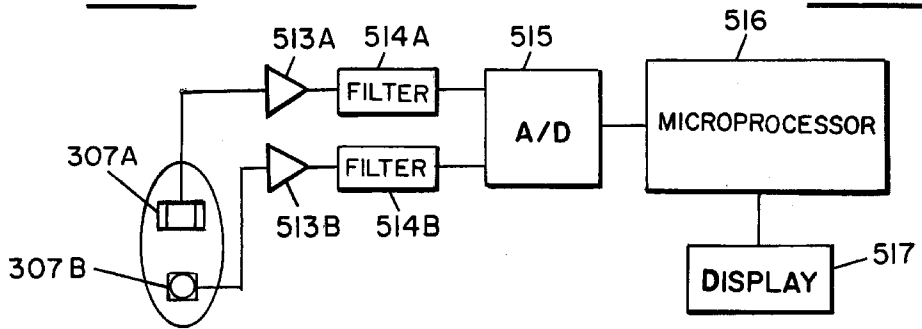


FIG. 5

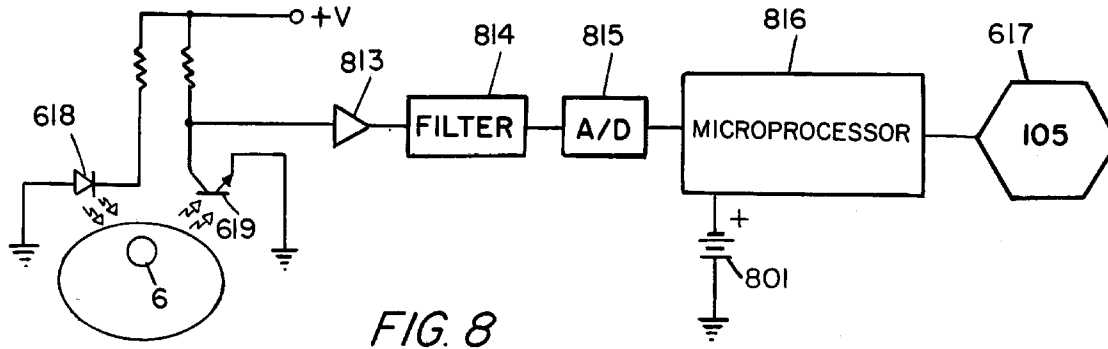


FIG. 8

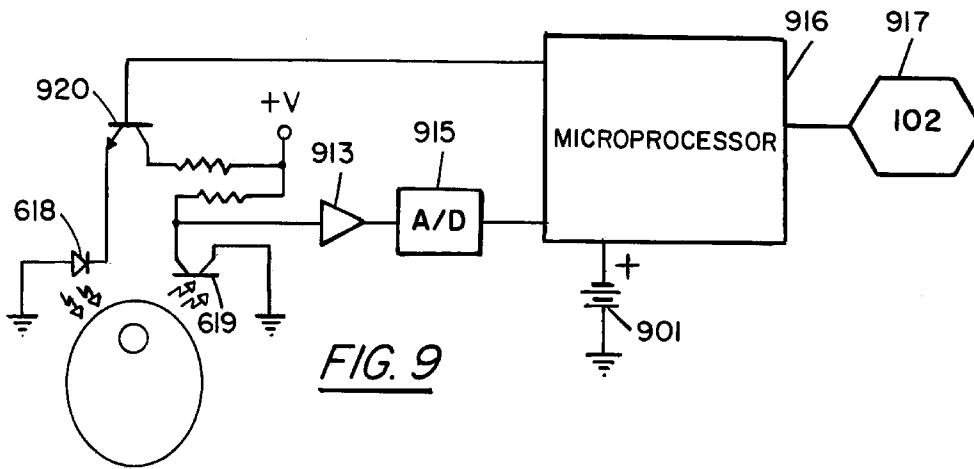


FIG. 9

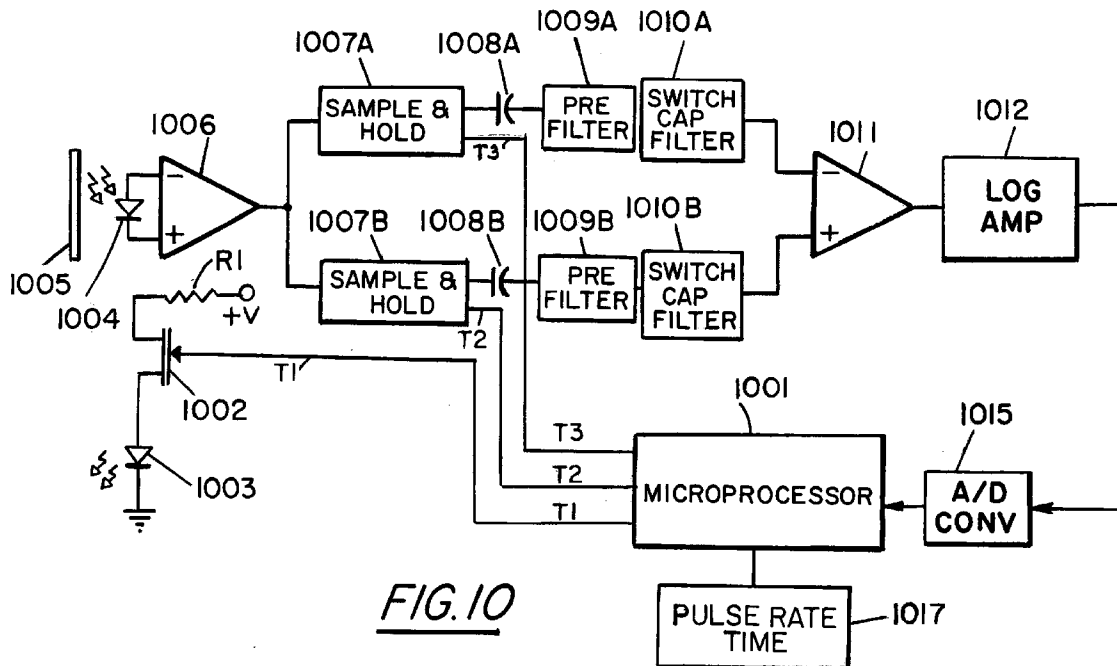
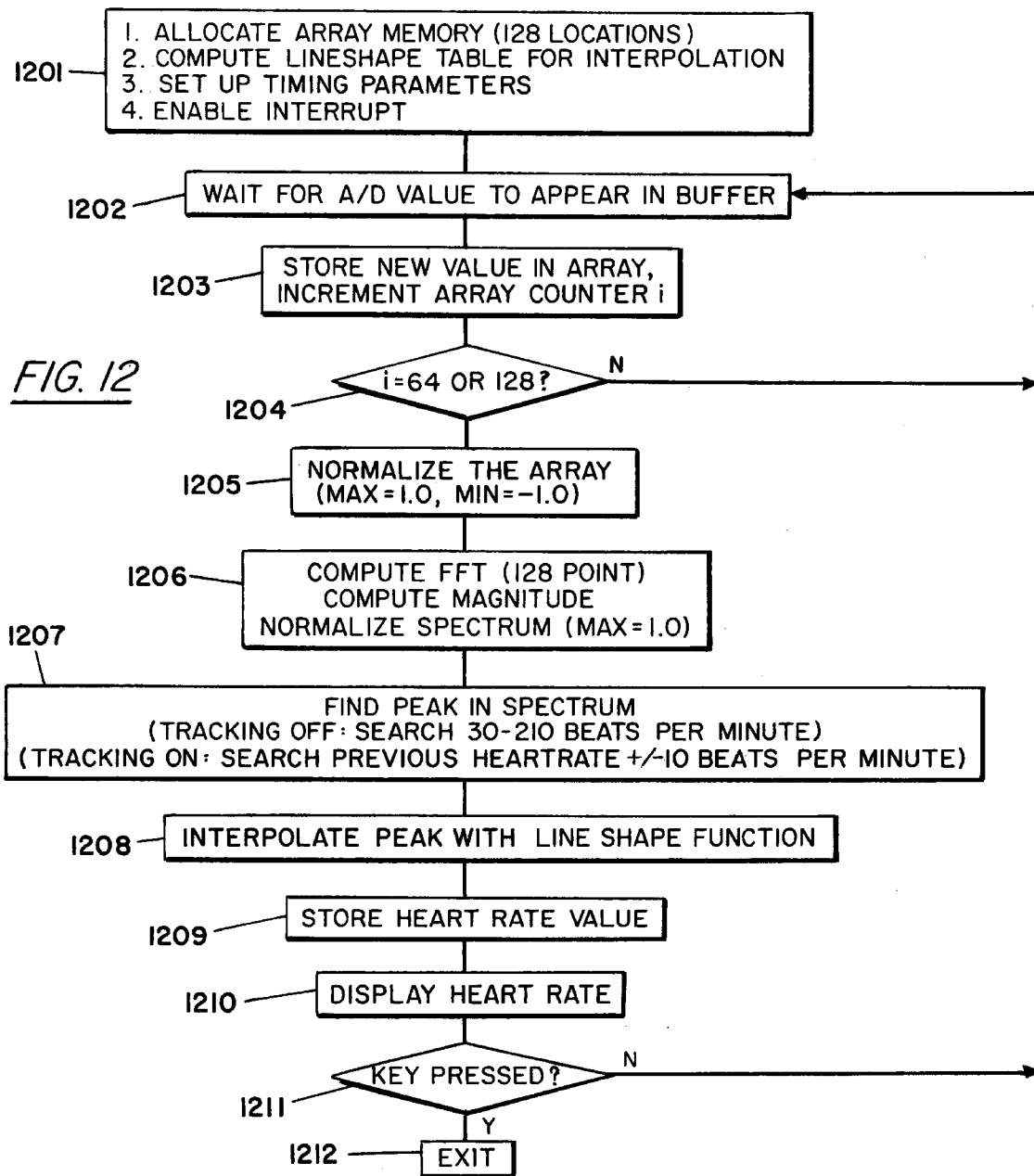
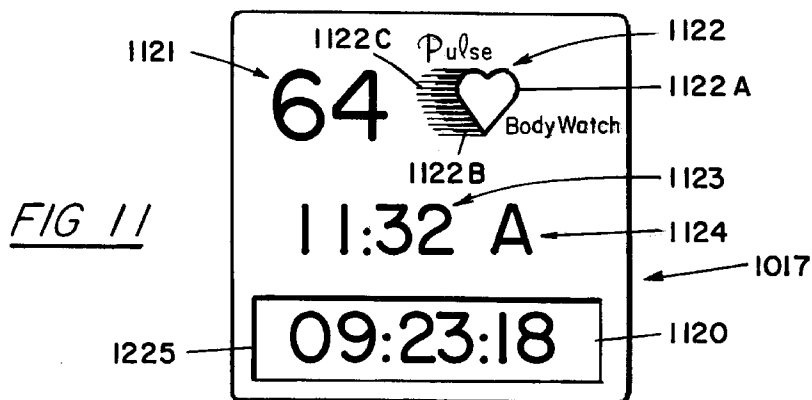


FIG. 10



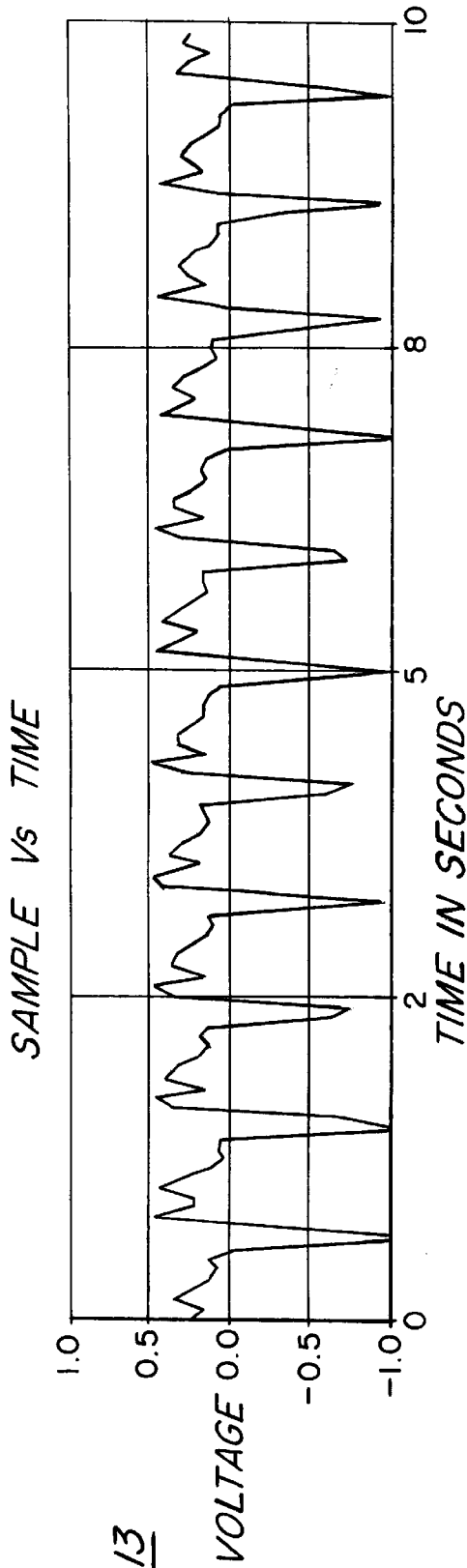


FIG. 13

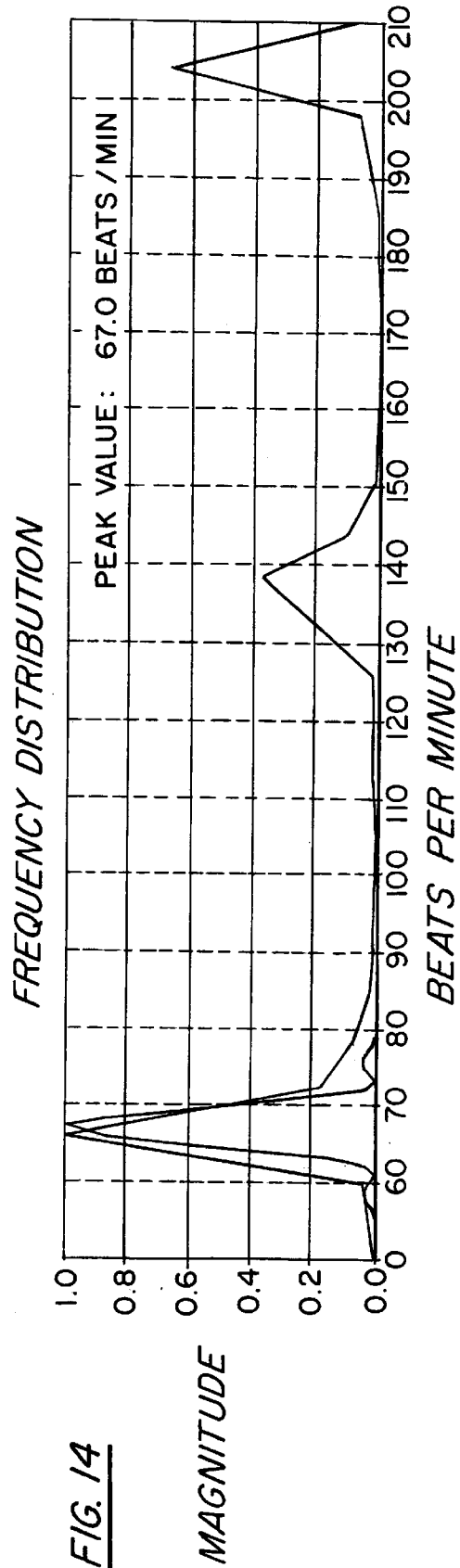


FIG. 14

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