

(12) **United States Patent**  
**Tanenhaus et al.**

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(54) **METHOD AND APPARATUS FOR LOW POWER, MICRO-ELECTRONIC MECHANICAL SENSING AND PROCESSING**

JP 09093207 4/1997  
WO WO98/00932 8/1998

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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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(57) **ABSTRACT**

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**Related U.S. Application Data**

(62) Division of application No. 09/080,038, filed on May 15, 1998, now Pat. No. 6,255,962.

(51) **Int. Cl.<sup>7</sup>** ..... **G08B 21/00**

(52) **U.S. Cl.** ..... **340/870.16; 340/870.07; 340/539; 340/690; 73/786; 73/577; 702/14; 702/16; 52/1**

(58) **Field of Search** ..... **340/870.11, 870.07, 340/870.16, 870.39, 539, 690; 73/597, 803, 786, 577; 702/16, 14, 41; 52/1**

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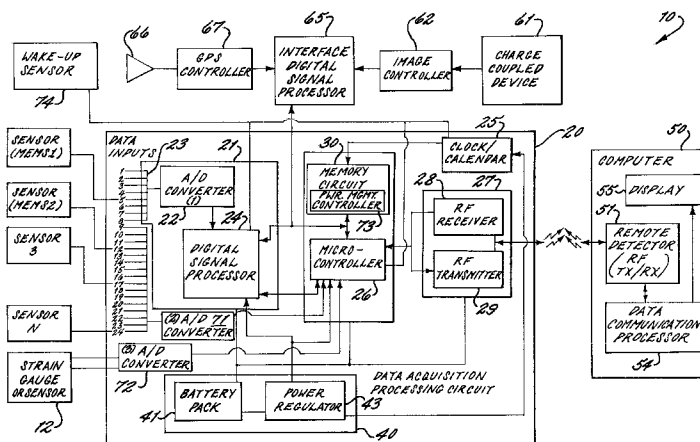
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A method and apparatus for low-power sensing and processing are provided. A method preferably includes collecting a plurality of sensor signals. The plurality of sensors include sensed data representative of at least shock and vibration. The method also includes converting the plurality of sensor signals into digital data, processing the digital data, generating a data communications protocol for communicating the digital data, and simultaneously and remotely detecting the generated communications protocol having the processed data to determined the occurrence of at least one predetermined condition. An apparatus preferably includes a low-power, data acquisition processing circuit responsive to a plurality of sensor signals representative of at least shock and vibration for acquiring and processing the sensed data. The data acquisition processing circuit preferably includes a plurality of data inputs, an analog-to-digital converter responsive to the plurality of data inputs for converting each of the plurality of sensor signals from an analog format to a digital format, a digital signal processor responsive to the analog-to-digital converter for processing the digitally formatted data, a data communications processor responsive to said digital signal processor for generating and processing data communications, a battery, and a power management controller at least connected to the battery, the digital signal processor, and the data communications processor for controlling power management of the data acquisition processing circuit.

**40 Claims, 7 Drawing Sheets**



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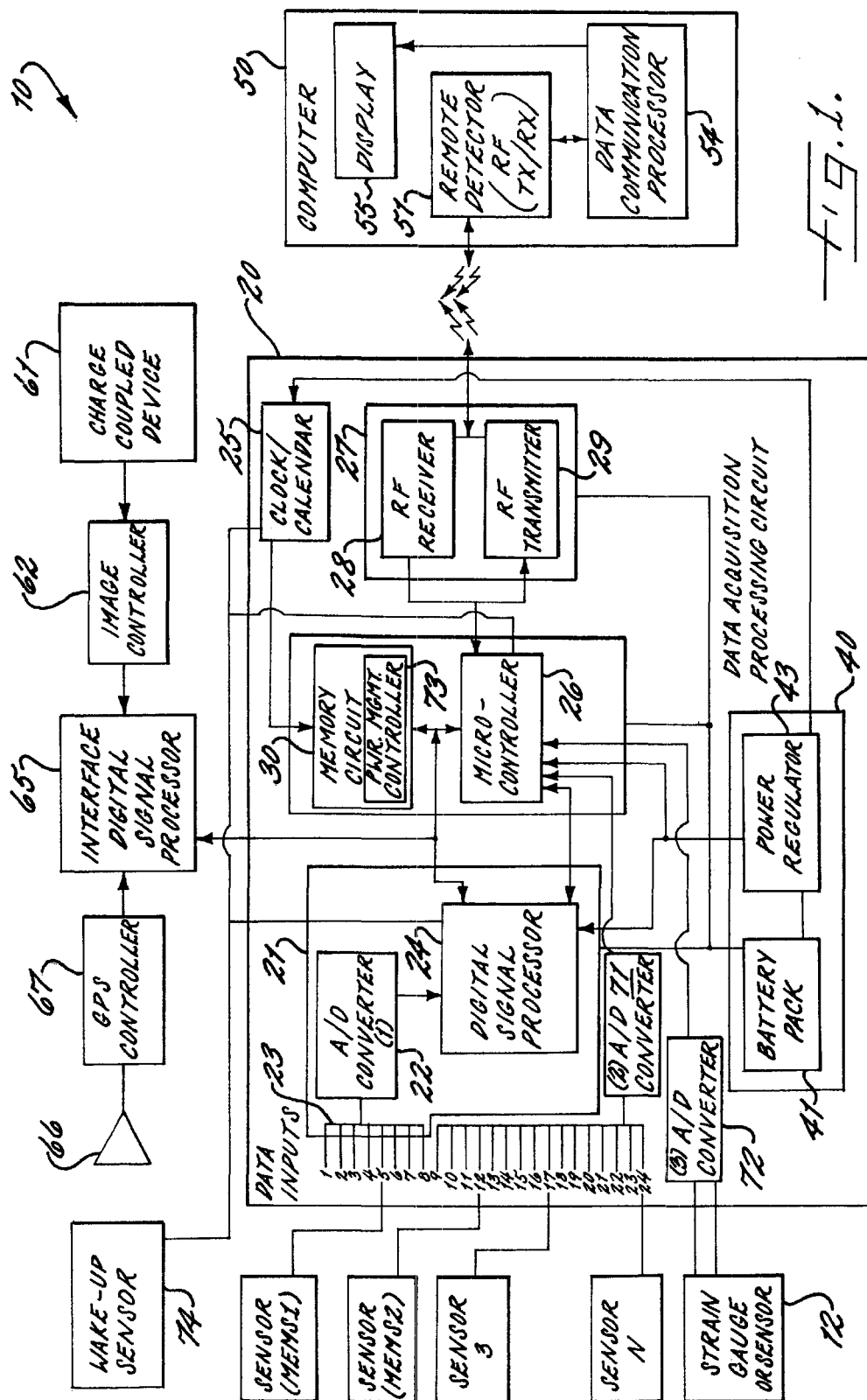


FIG. 1.

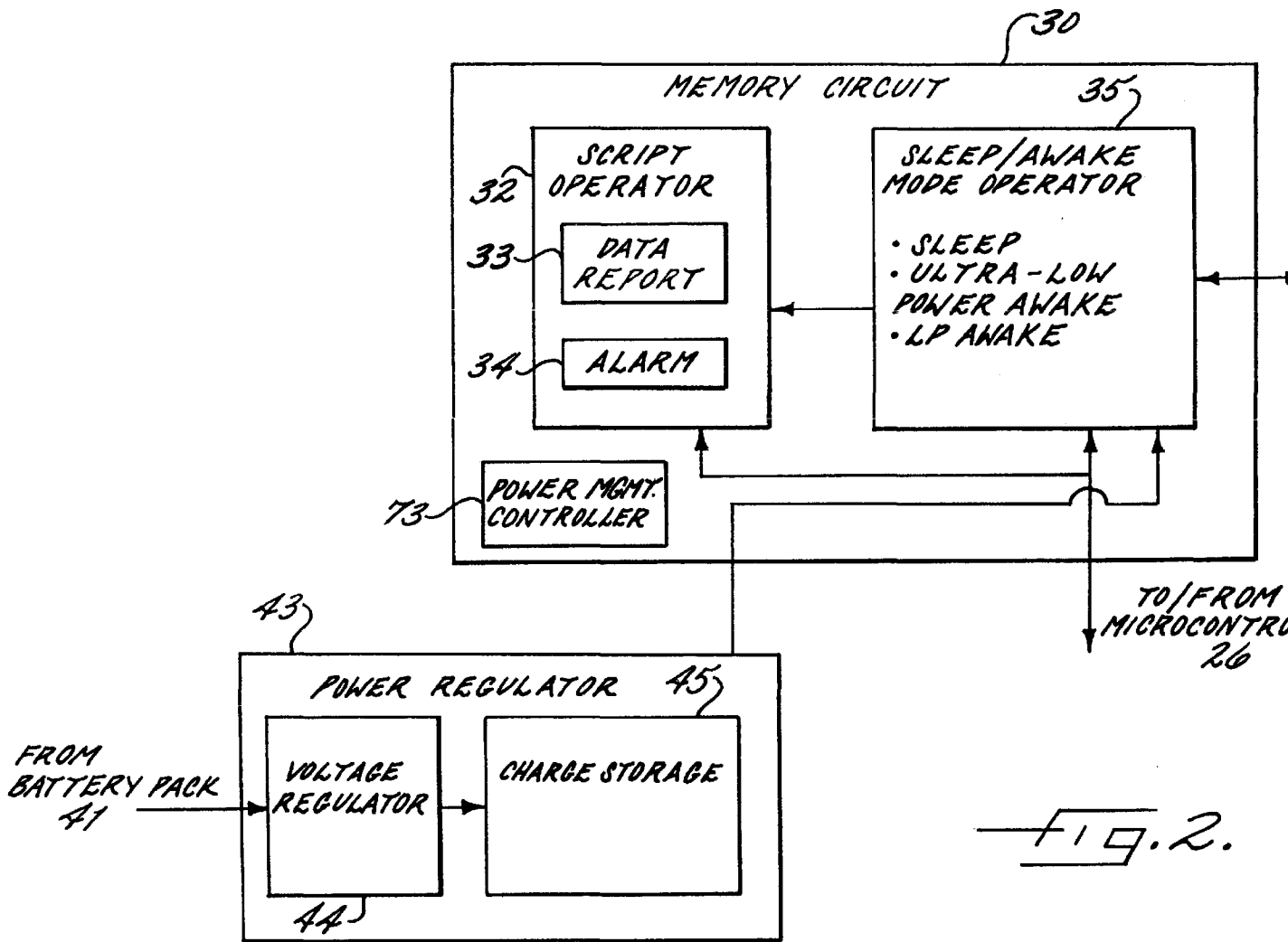


FIG. 2.

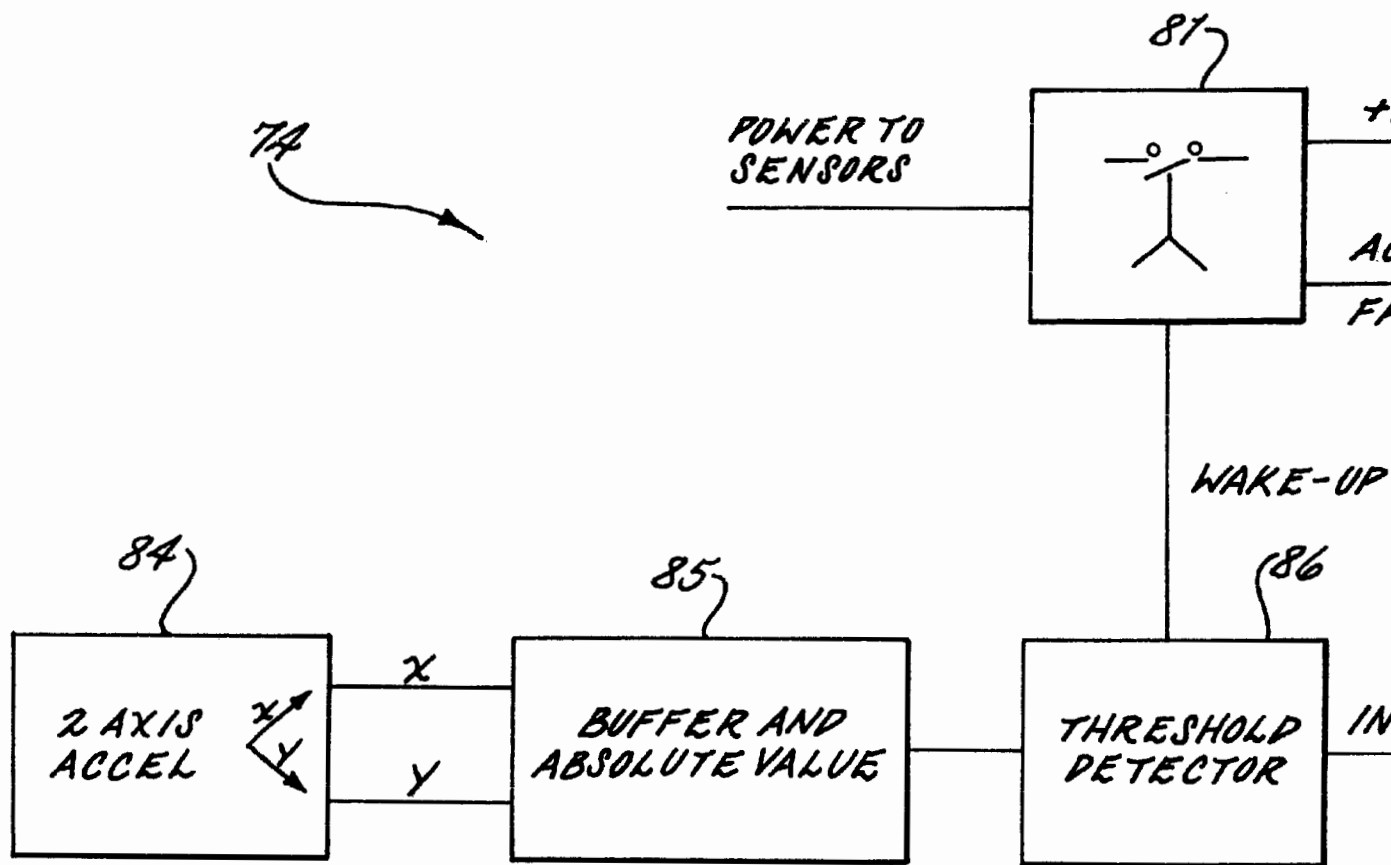


FIG. 3.

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