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Tanenhaus et al.

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

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Related U.S. Application Data

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(51) **Int. Cl.**[7] **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

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,319,241 A 3/1982 Mount
4,497,031 A 1/1985 Froehling et al.

(List continued on next page.)

FOREIGN PATENT DOCUMENTS

JP 62064804 3/1987
JP 06054910 1/1994
JP 09093207 4/1997
WO WO98/00932 8/1998

OTHER PUBLICATIONS

Dong, Michael J. et al, Low Power Signal Processing Architecture for Network Microsensor ISLPED97, International Symposium on Low Power Electronics and Design, Jan. 1998.*

(List continued on next page.)

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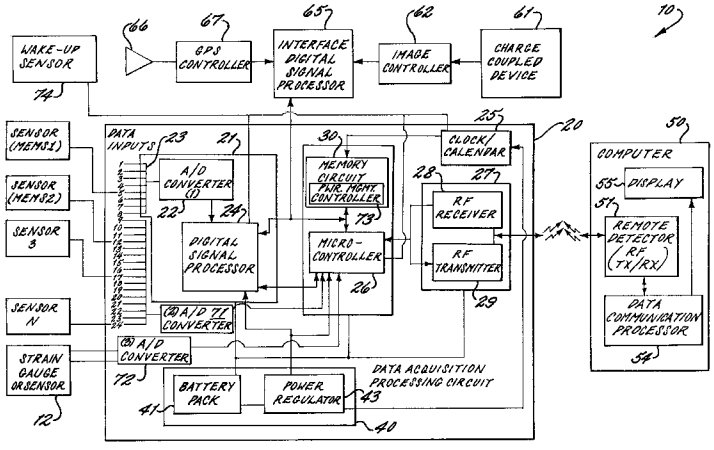
(57) **ABSTRACT**

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



U.S. PATENT DOCUMENTS

4,559,828	A		12/1985	Liszka	
4,912,471	A		3/1990	Tyburski	
4,942,386	A	*	7/1990	Willis	200/61.49
5,061,917	A		10/1991	Higgs et al.	
5,068,850	A		11/1991	Moore	
5,160,925	A		11/1992	Dailey	
5,317,620	A		5/1994	Smith	
5,428,638	A		6/1995	Cioffi et al.	
5,445,347	A		8/1995	Ng	
5,448,230	A		9/1995	Schanker et al.	
5,467,083	A	*	11/1995	McDonald et al.	340/854.4
5,481,245	A		1/1996	Moldavsky	
5,524,021	A		6/1996	Scotton et al.	
5,555,276	A		9/1996	Koenck et al.	
5,557,258	A		9/1996	Eslambolchi	
5,559,484	A		9/1996	Nowicki	
5,602,749	A		2/1997	Vosburgh	
5,604,928	A		2/1997	Hamano et al.	
5,625,882	A		4/1997	Vook et al.	
5,659,302	A		8/1997	Cordier	
5,708,417	A	*	1/1998	Tallman et al.	340/425.5
5,801,314	A		9/1998	Irwin et al.	
5,842,149	A		11/1998	Harrell	
5,897,606	A		4/1999	Miura	
6,047,380	A		4/2000	Nolan	
6,208,247	B1	*	3/2001	Agre et al.	340/511
6,255,962	B1	*	7/2001	Tanenhaus et al.	246/169 R
6,259,372	B1	*	7/2001	Taranowski et al.	340/539

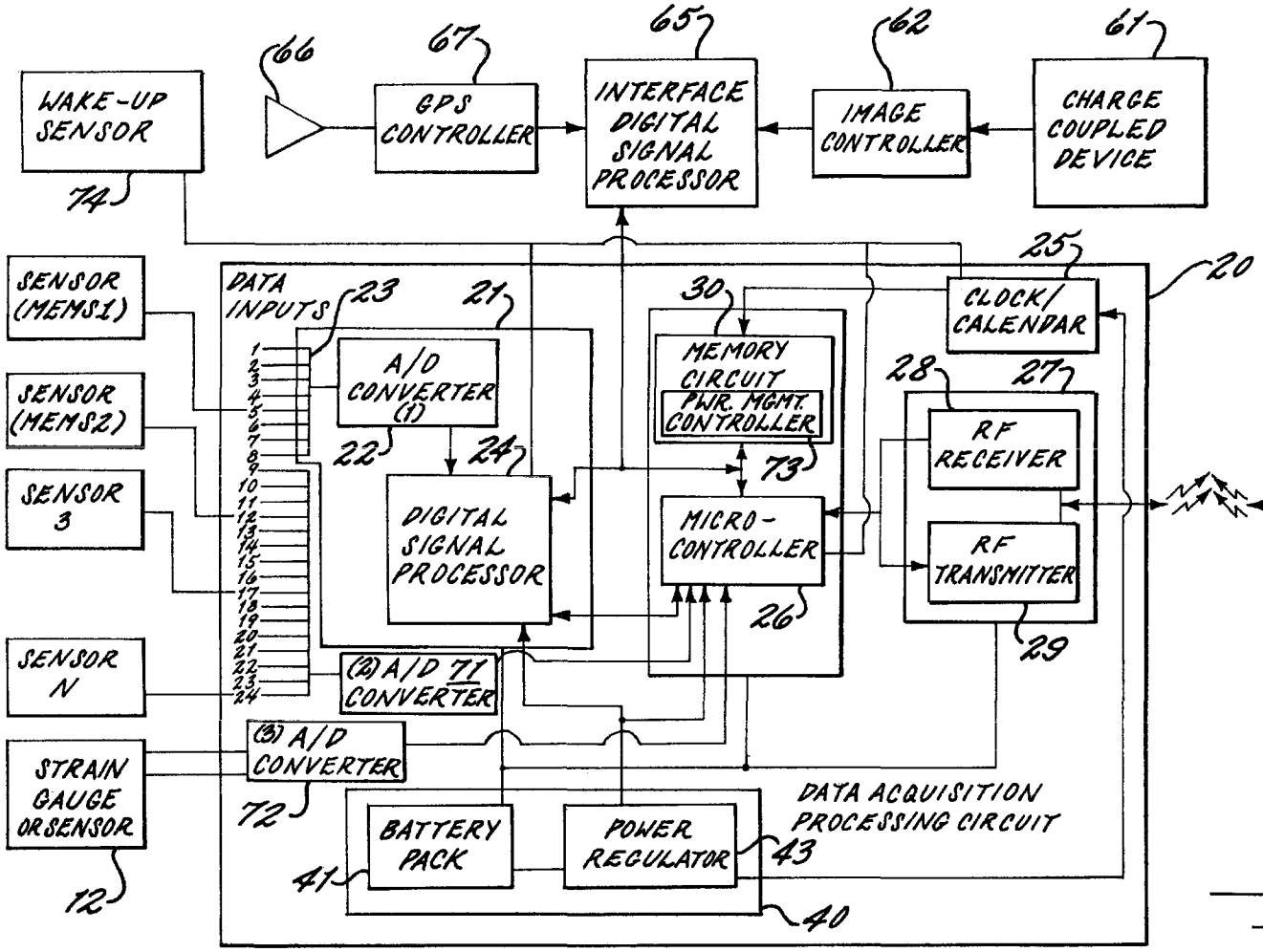
OTHER PUBLICATIONS

Lin, Tsung–Hsien et al, wireless Integrated Network Sensor for Tactical Information systems, Rockwell Science Center. Jan. 1998.*

Bult, K. et al, Low Power Systems for Wireless Microsensors, Proceedings of the International Symposium on Low Power Electronics and Design, Aug. 12–14 1996.*

Bult, K et al, Wireless Integratd Microsensors, Hilton Head Transducer Conference, Jun. 1996.*

* cited by examiner



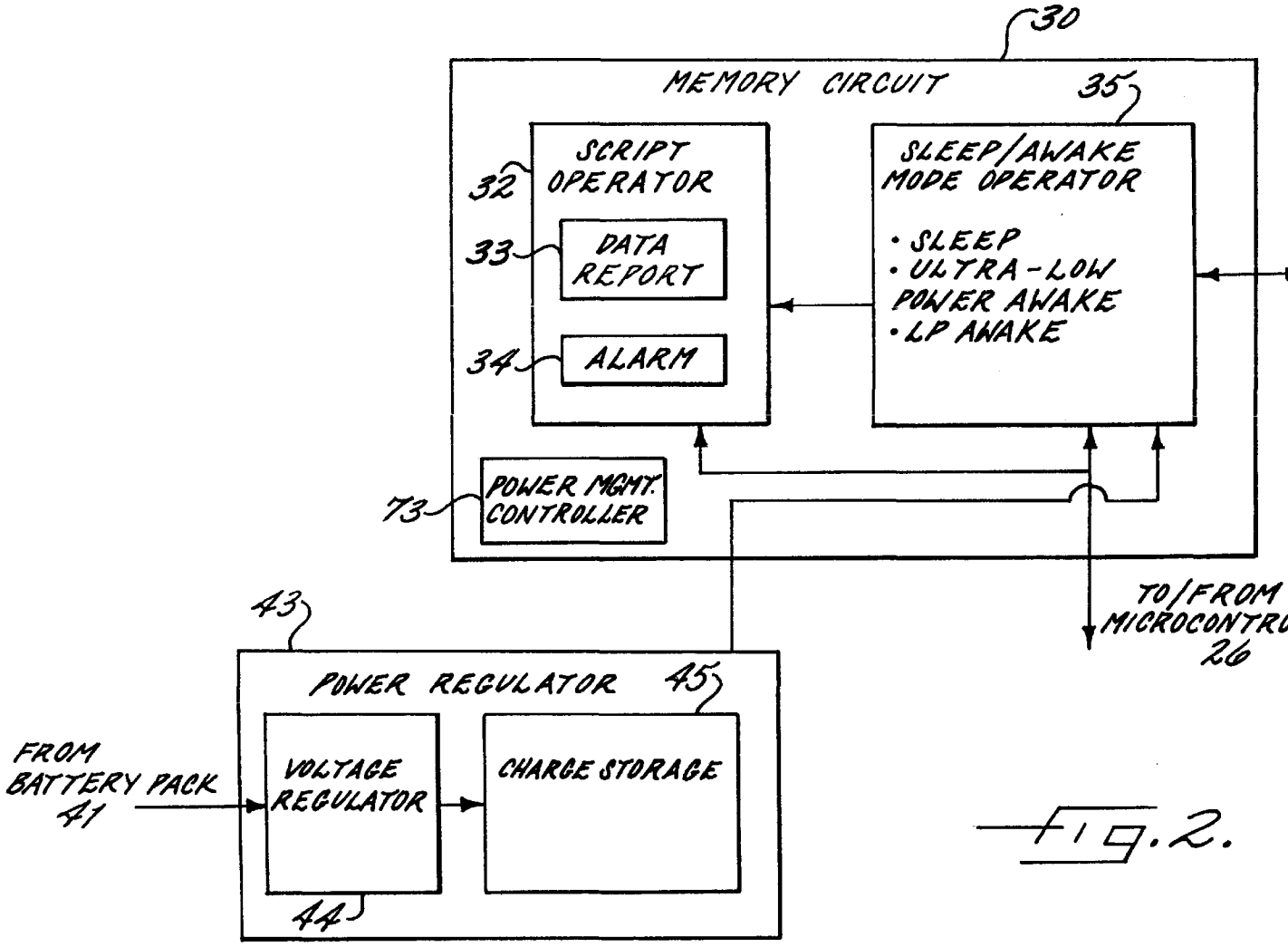


Fig. 2.

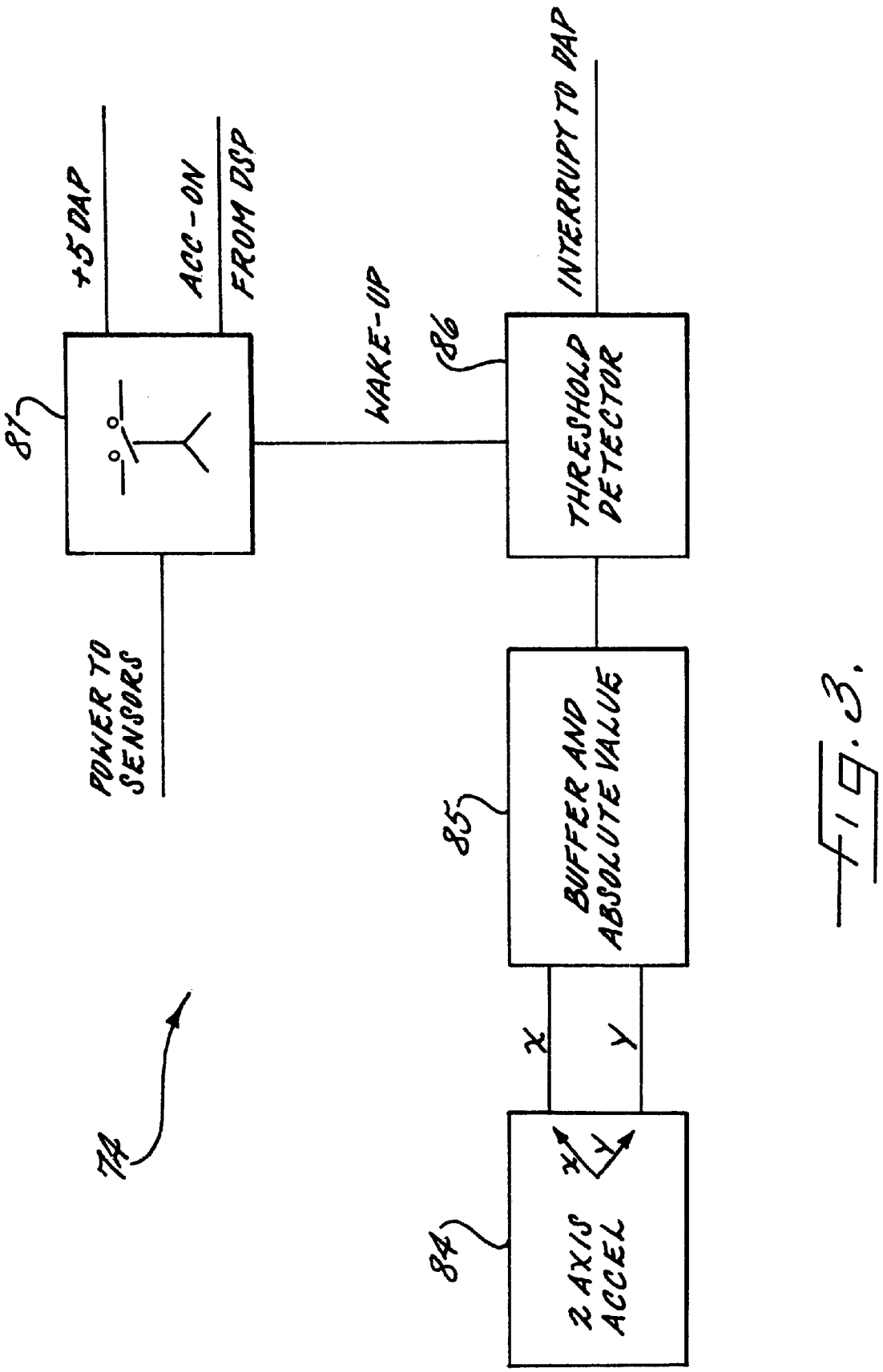


FIG. 3.

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