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Deninger et al.

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(54) **BATTERY MONITORING SYSTEM WITH LOW POWER AND END-OF-LIFE MESSAGING AND SHUTDOWN**

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(51) **Int. Cl.**
G01R 31/36 (2006.01)

(52) **U.S. Cl.** **702/63; 320/113**

(58) **Field of Classification Search** **702/57, 702/63, 64, 65, 117, 118, 122, 124, 126, 182, 702/183, 184, 134, 135, 170, 171; 320/113; 713/340; 600/300**

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,916,613	A	4/1990	Lange et al.	
5,406,266	A	4/1995	Mino et al.	
5,514,946	A	5/1996	Lin et al.	
5,684,404	A	11/1997	Millar et al.	
5,802,379	A	9/1998	Boatwright et al.	
5,845,142	A	* 12/1998	Hayasaka	713/340
5,929,601	A	* 7/1999	Kaib et al.	320/113
6,406,426	B1	* 6/2002	Reuss et al.	600/300

FOREIGN PATENT DOCUMENTS

EP	0665443	8/1995
GB	2341760	3/2000

OTHER PUBLICATIONS

Balough, Laszlo, "Implementing Multi-State Charge Algorithm with the UC3909 Switchmode Lead-Acid Battery Charger Controller", Unitrode Corporation, Texas Instruments Inc., 1999.

"Lead-Acid Fast-Charge IC", bq2031, Benchmarq Products, Texas Instruments Inc., Jun., 1999.

Fleming, Frank A. et al., "Rapid Recharge Capability of Valve Regulated Lead Acid Batteries for EV & HEV Applications", Hawker Energy Publication, 1999.

Jana, Kalyan, "Charging Pure Lead-Tin Batteries: A Guide for CYCLON and Genesis Products", Hawker Energy Publication, First Edition, pp. 8-14, Mar. 1999.

"U-510 Using the bq2031 to Charge Lead-Acid Batteries", Unitrode Corporation, Texas Instruments, Oct., 1997.

* cited by examiner

Primary Examiner—Marc S. Hoff

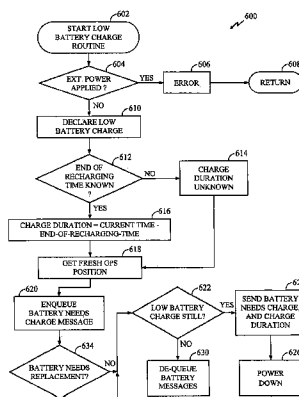
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(57) **ABSTRACT**

A battery monitoring apparatus that senses battery conditions such as low battery charge, end of battery capacity, and end of battery life, and responds by taking actions such as sending messages to a remote site and/or powering down. A rechargeable battery is coupled to one or more power-consuming electrical components, including battery monitoring equipment. The battery monitoring equipment senses battery charge. In response to a low-battery-charge condition, the battery monitoring equipment transmits a battery status message to a remote site and powers-down some of the electrical components. Whenever the battery nears the end of its capacity, the monitoring equipment powers down all electronic components and awaits the application of external power. The invention also tracks the time required for the battery charge to deplete. Charge duration decreases over time, and whenever it reaches a predetermined minimum, the battery monitoring equipment transmits a representative status message to the remote site.

28 Claims, 9 Drawing Sheets



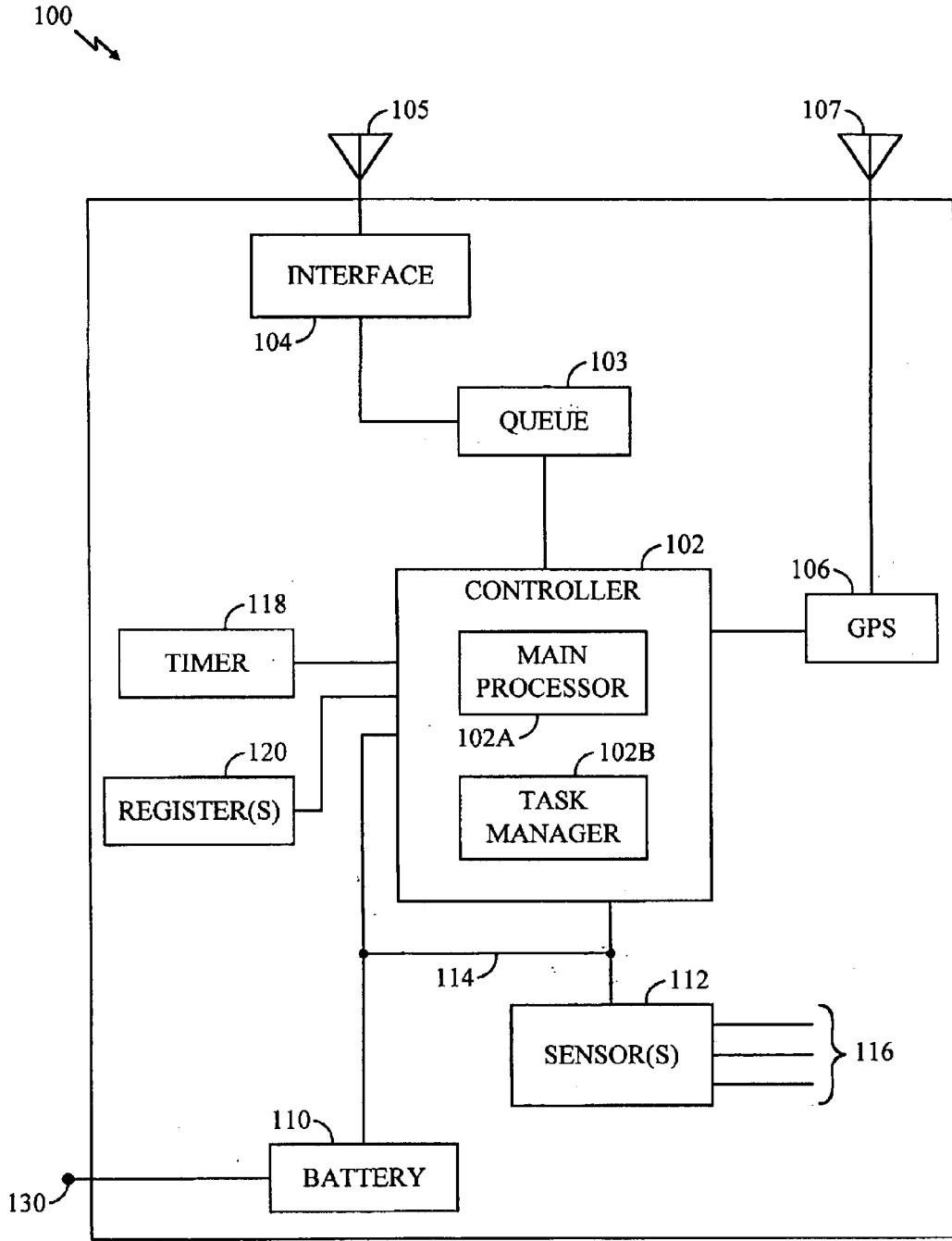


FIG. 1

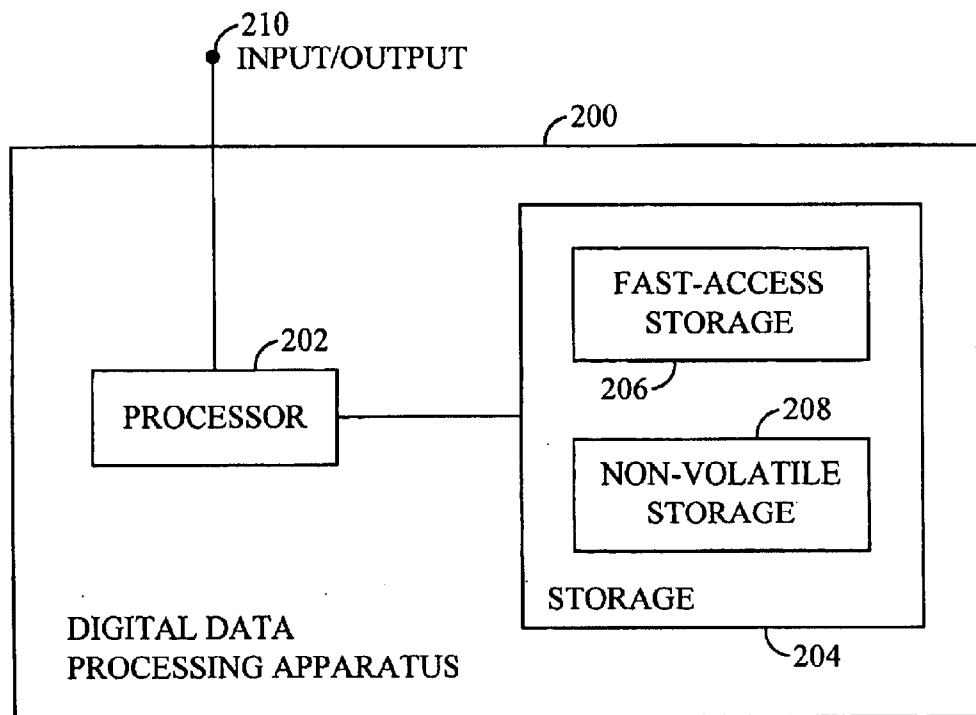


FIG. 2

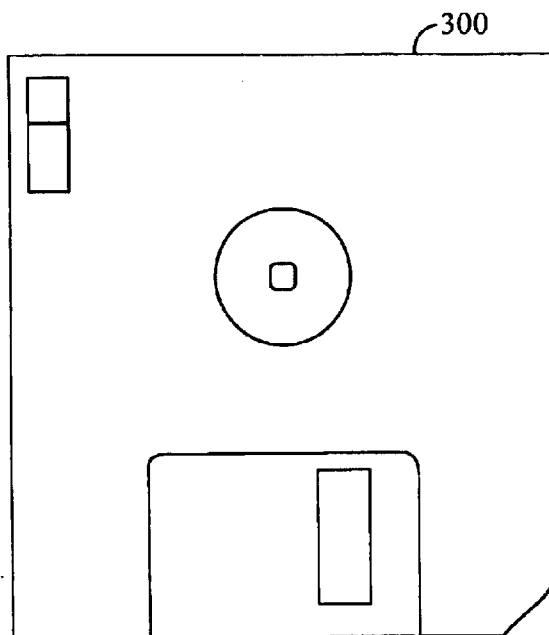


FIG. 3

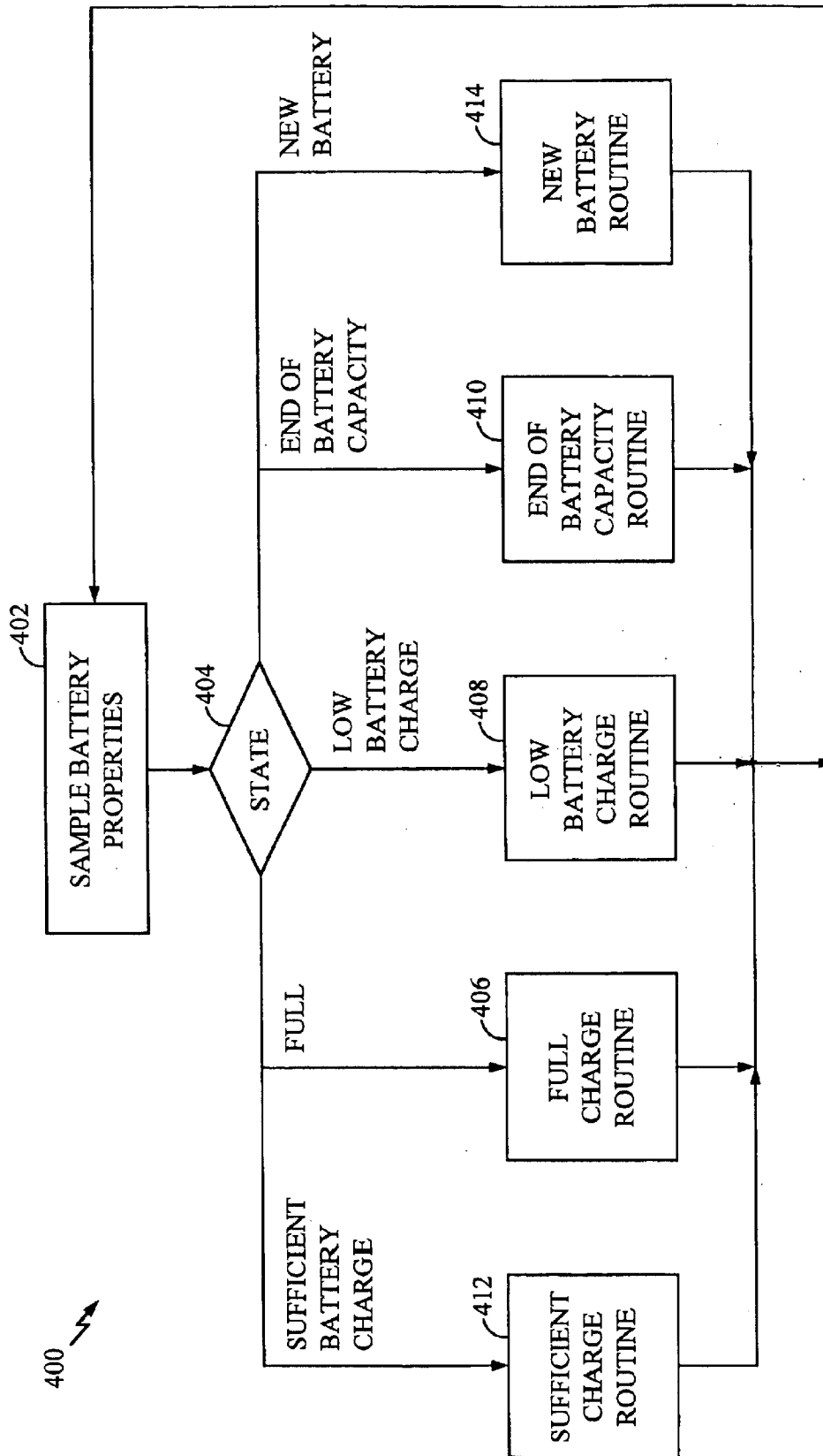


FIG. 4

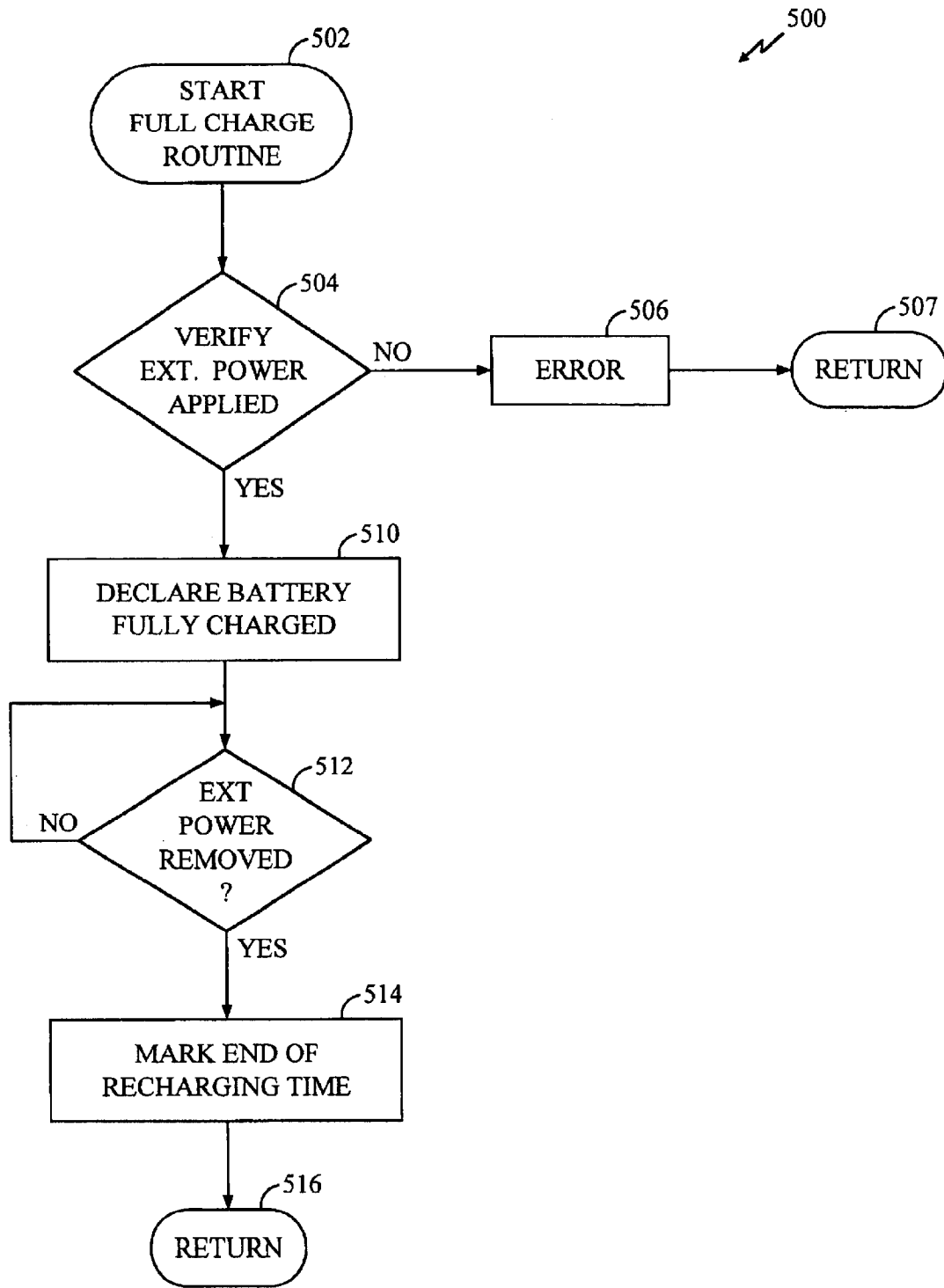


FIG. 5

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