

# United States Patent [19]

[11] **Patent Number:** 5,898,290

Beard et al.

[45] **Date of Patent:** Apr. 27, 1999

- [54] **BATTERY PACK WITH CAPACITY AND PRE-REMOVAL INDICATORS**
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- [73] Assignee: **Norand Corporation**, Cedar Rapids, Iowa
- [21] Appl. No.: **08/711,447**
- [22] Filed: **Sep. 6, 1996**

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[57] **ABSTRACT**

A battery capacity monitoring system readily indicates the remaining capacity of an uninserted battery pack upon an operator's request. Such request may involve the touching of one or more contacts disposed on the battery pack. The battery pack also includes a display and a communication means for communicating capacity information to the device in which it may be installed. The communication means may also be used to display status when the battery pack is not inserted. When inserted a device, the battery pack and device participate to determine time estimates for remaining battery life based on known device loading characteristics and current battery capacity. An operator viewing such information may more adequately determine the usage value of the current battery charge. Moreover, the battery pack and corresponding device are configured to detect the beginning of the process of removing a battery pack. In response, the device saves operational states and data before losing power. Such stored information may be restored upon insertion of another battery pack into the device, permitting the operator to continue where they left off.

**Related U.S. Application Data**

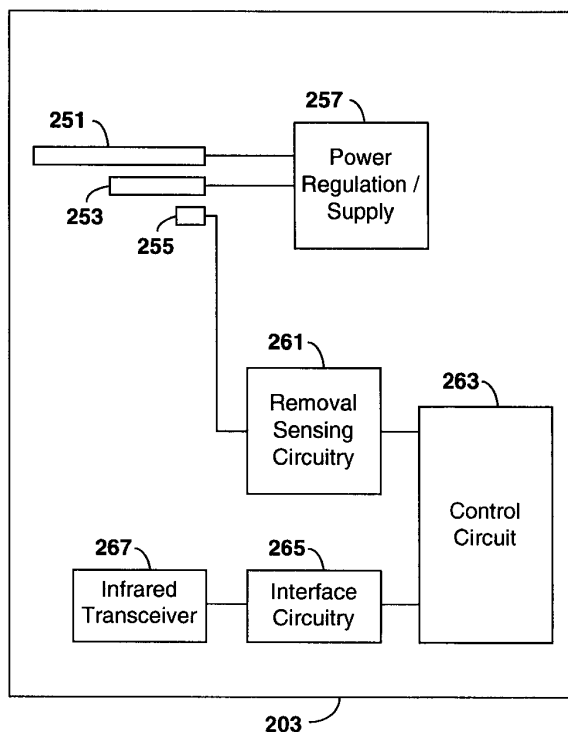
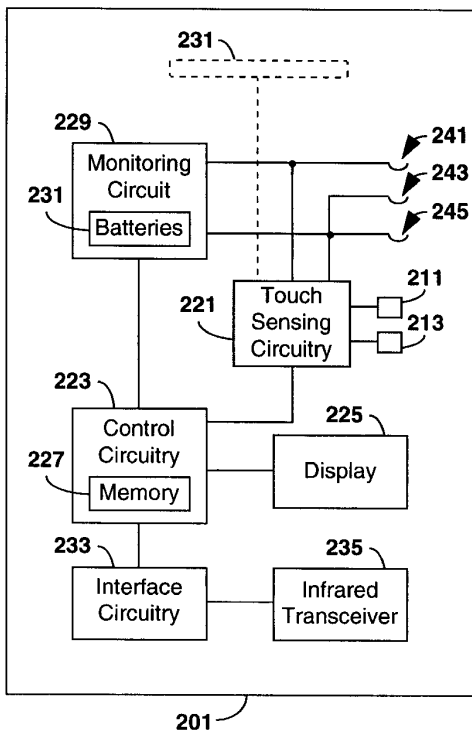
- [60] Provisional application No. 60/003,342, Sep. 7, 1995, and provisional application No. 60/003,543, Sep. 11, 1995.
- [51] **Int. Cl.**<sup>6</sup> ..... **H01M 10/48; H01M 2/10; G06F 3/02**
- [52] **U.S. Cl.** ..... **320/2; 429/97; 307/116**
- [58] **Field of Search** ..... **320/2, 48; 429/96, 429/97, 98, 99, 100; 307/116; 323/904**

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**17 Claims, 10 Drawing Sheets**



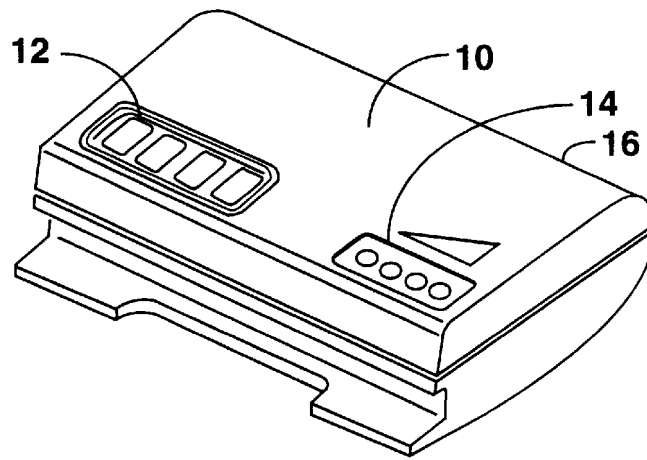


FIG. 1

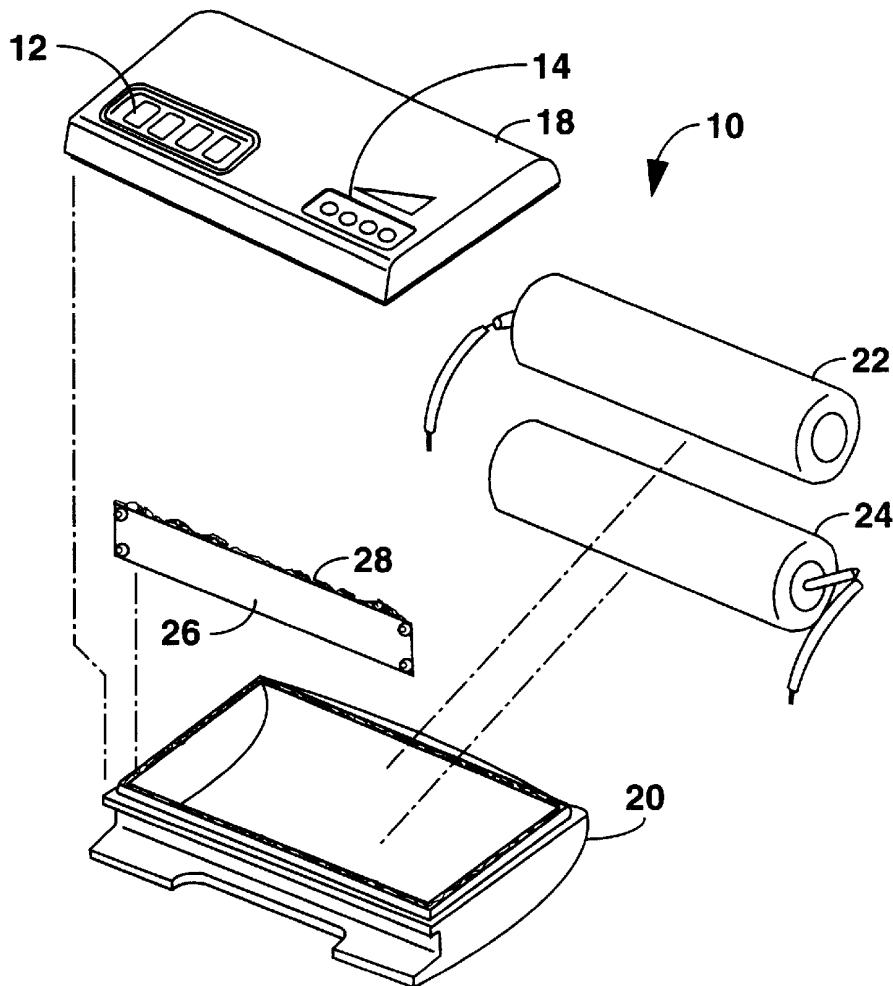


FIG. 2

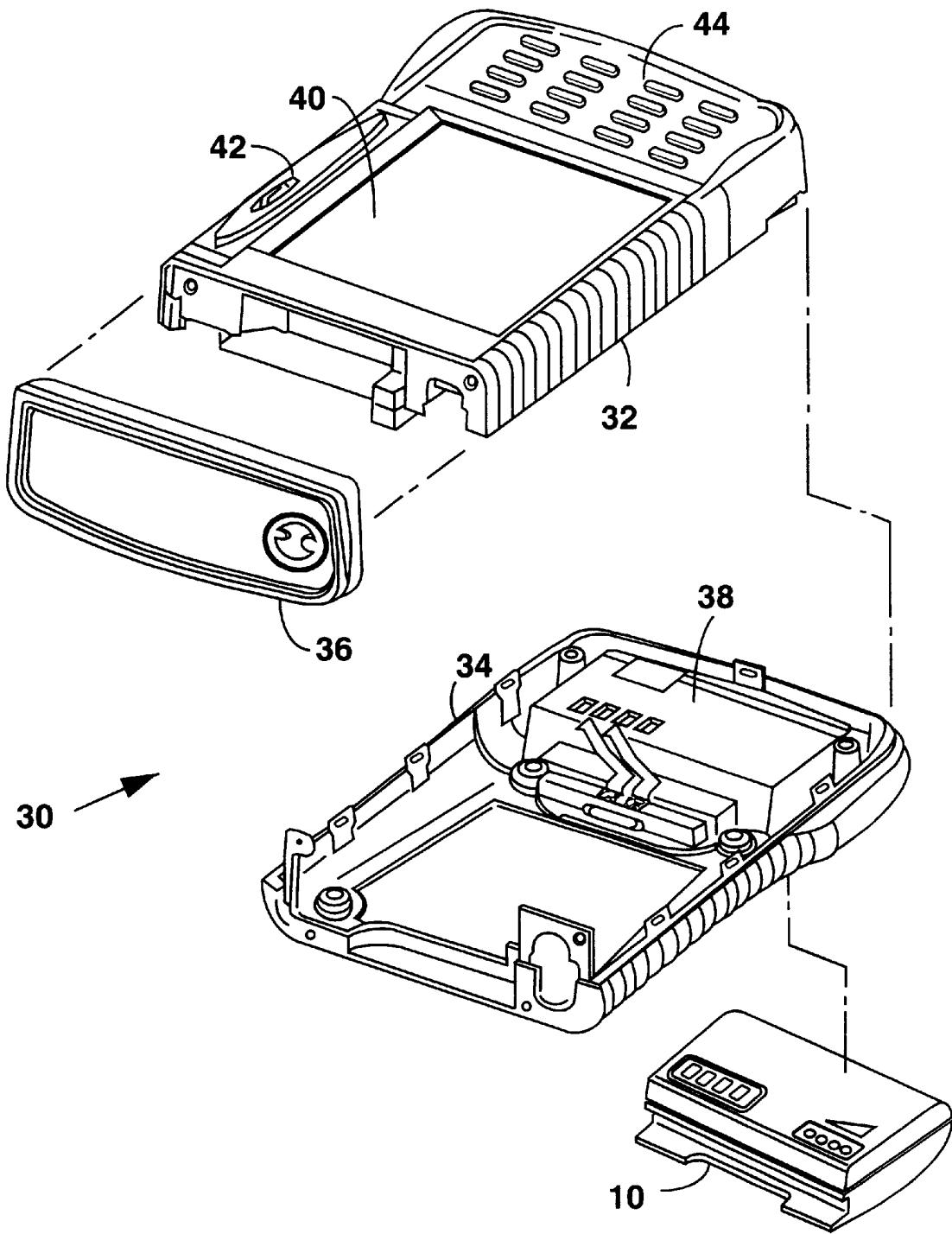


FIG. 3

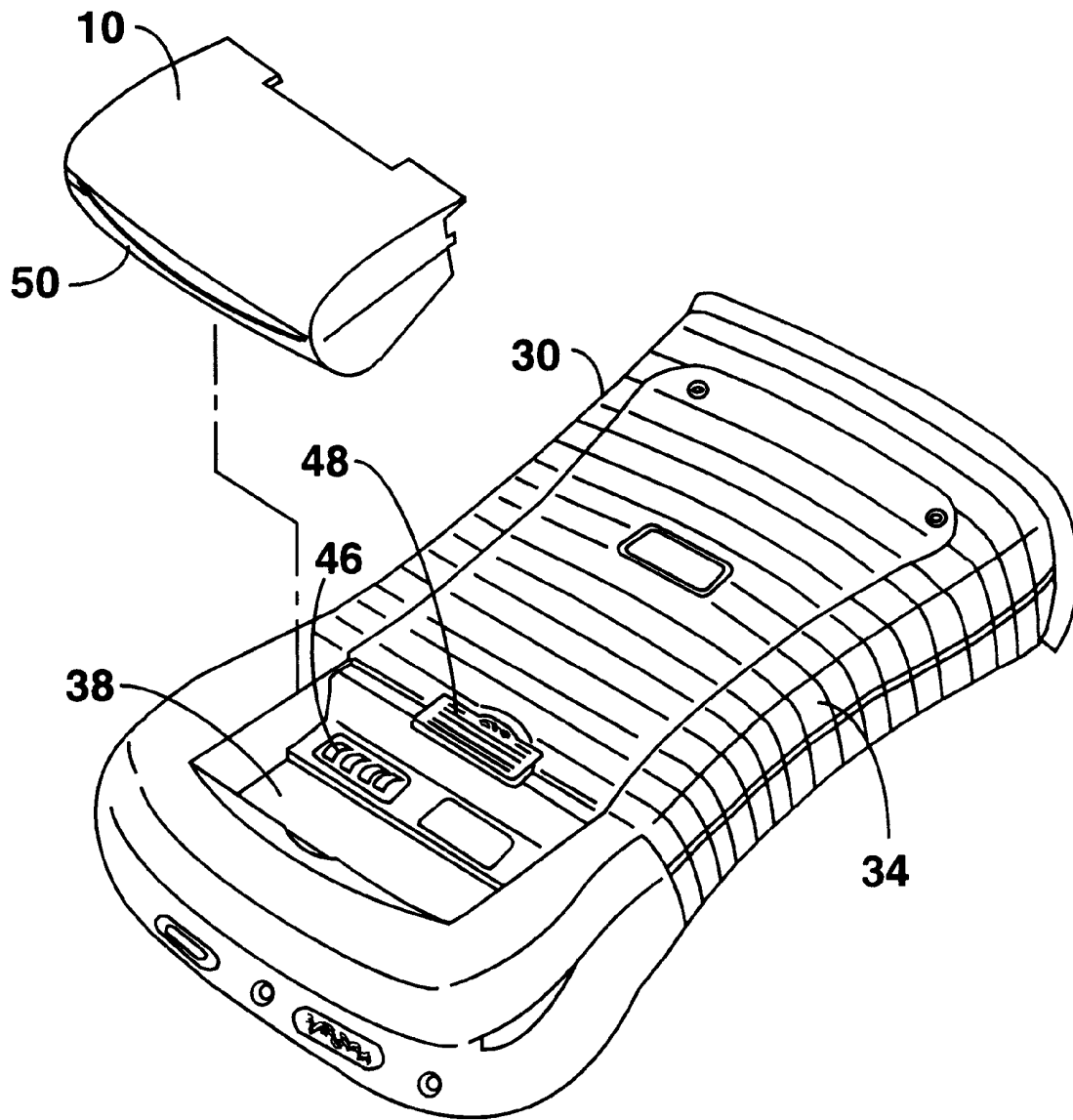


FIG. 4

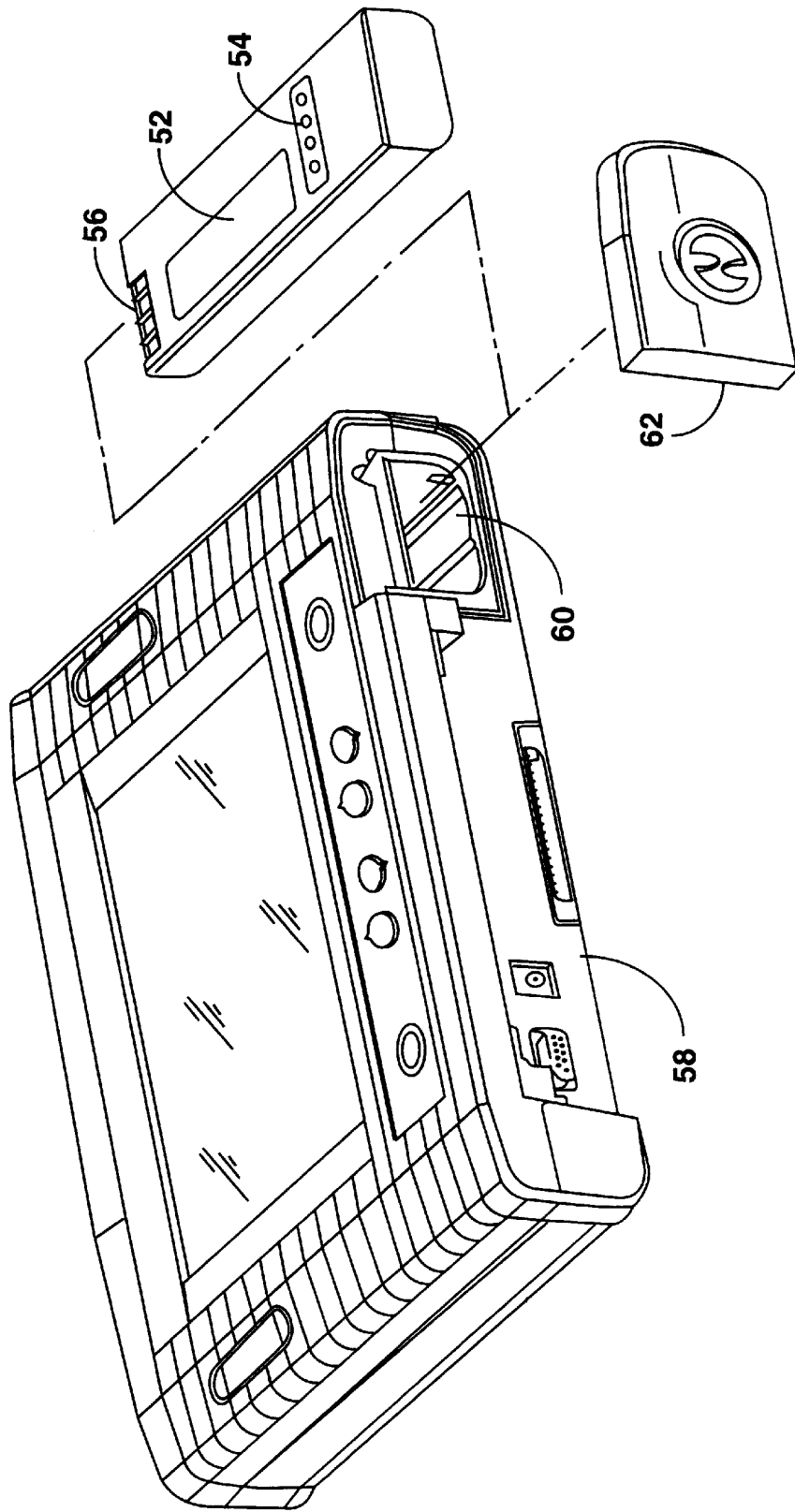


FIG. 5

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