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**Kopera**

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(54) **CIRCUIT FOR CHARGE AND/OR DISCHARGE PROTECTION IN AN ENERGY-STORAGE DEVICE**

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(51) **Int. Cl.**  
**H02J 7/00** (2006.01)

(52) **U.S. Cl.** ..... **320/136**

(58) **Field of Classification Search** ..... **320/136**  
See application file for complete search history.

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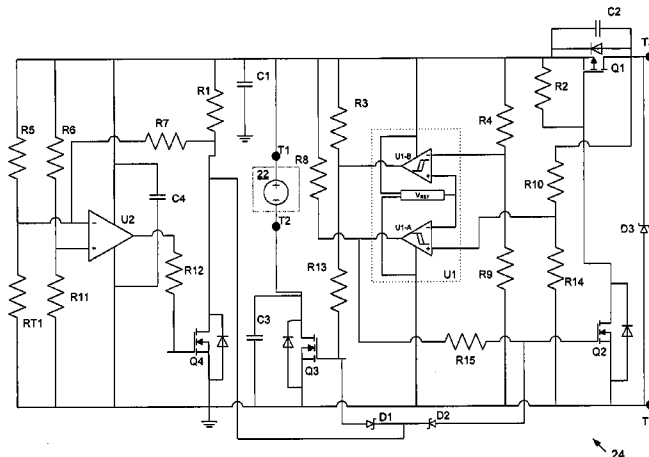
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(57) **ABSTRACT**

A method and apparatus for protecting an energy-storage device (ESD), such as a rechargeable battery, is provided. A protective circuit protects an ESD from adverse charging and loading conditions including overcharging, overdischarging, charging at an excessive rate and discharging at an excessive rate. The protective circuit selectively disables charging and discharging based on the present terminal conditions. A plurality of ESDs and protective circuits can be interconnected to protect a multi-cell ESD device. Embodiments of the protective circuit are adapted to protect a lithium cell operating around 2 volts. The protective circuit may also protect the ESD from adverse temperature conditions.

**23 Claims, 8 Drawing Sheets**

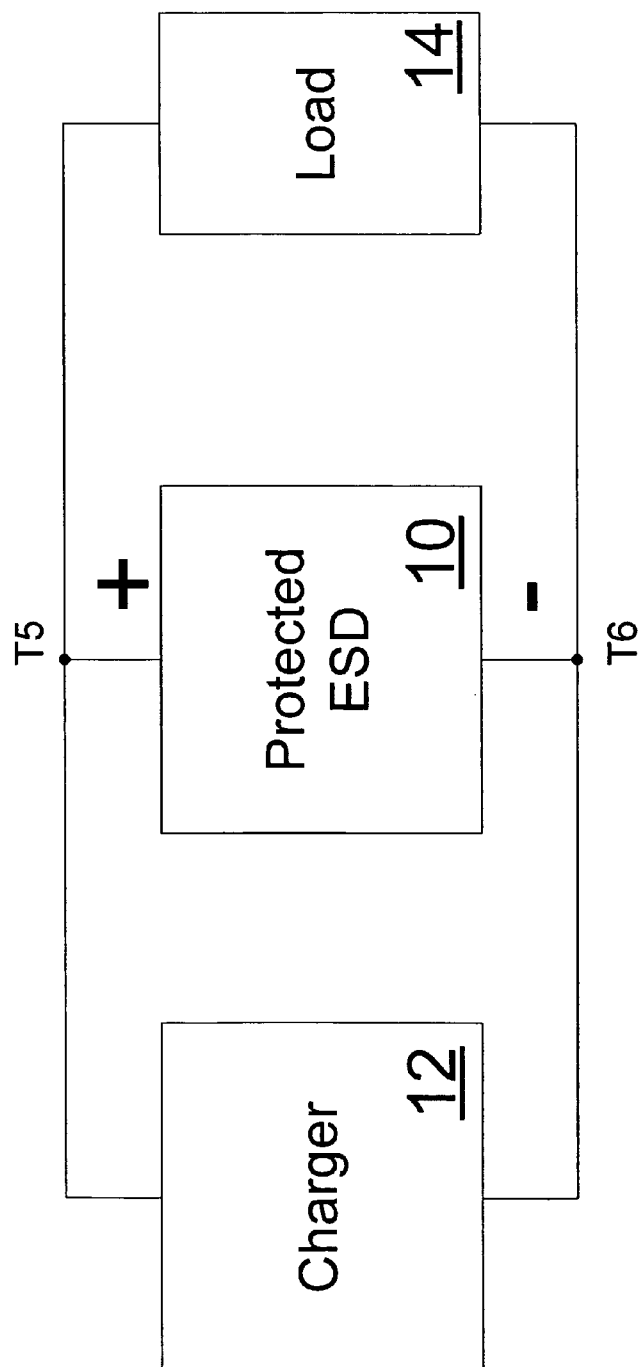


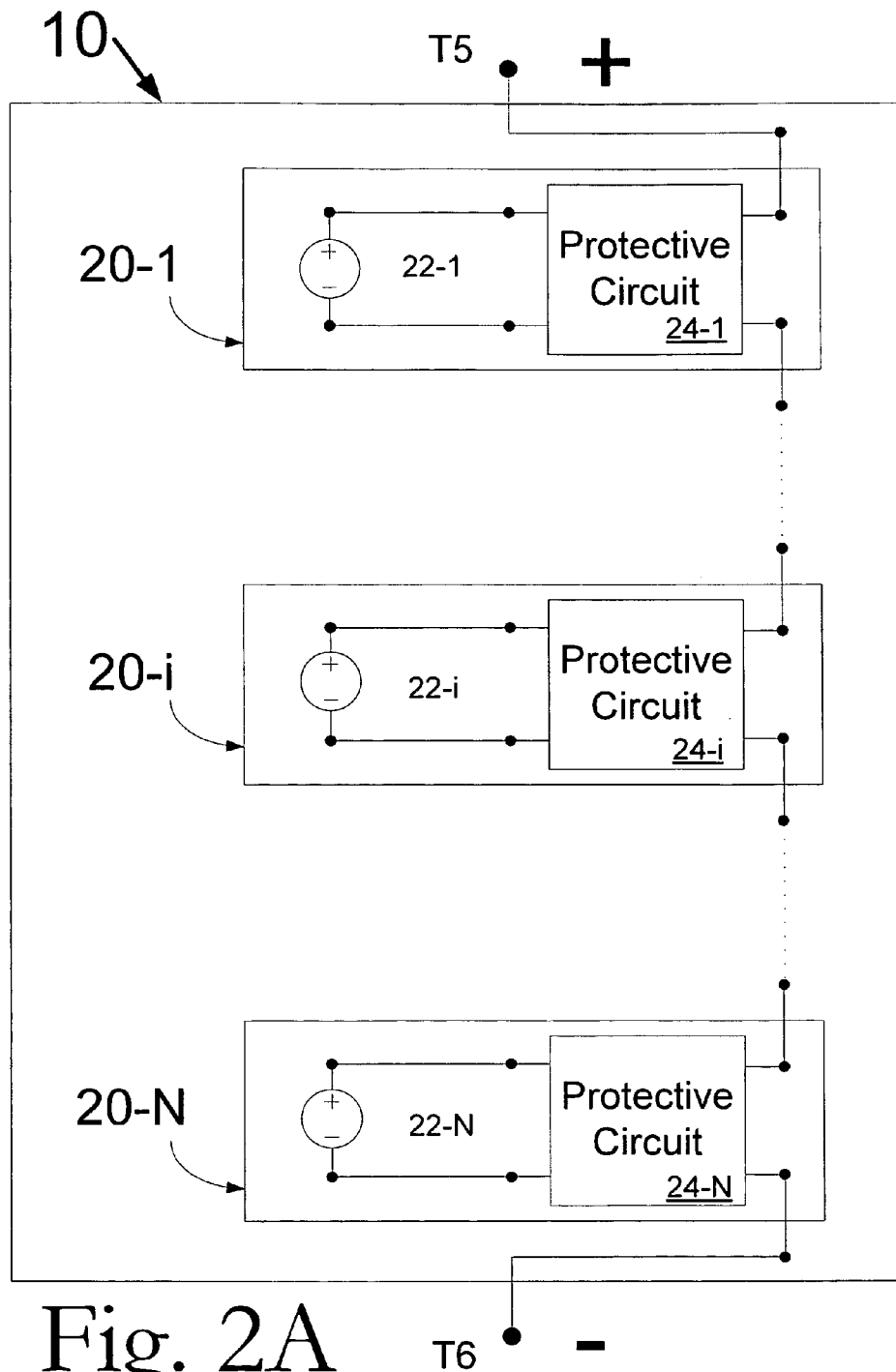
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Fig. 1





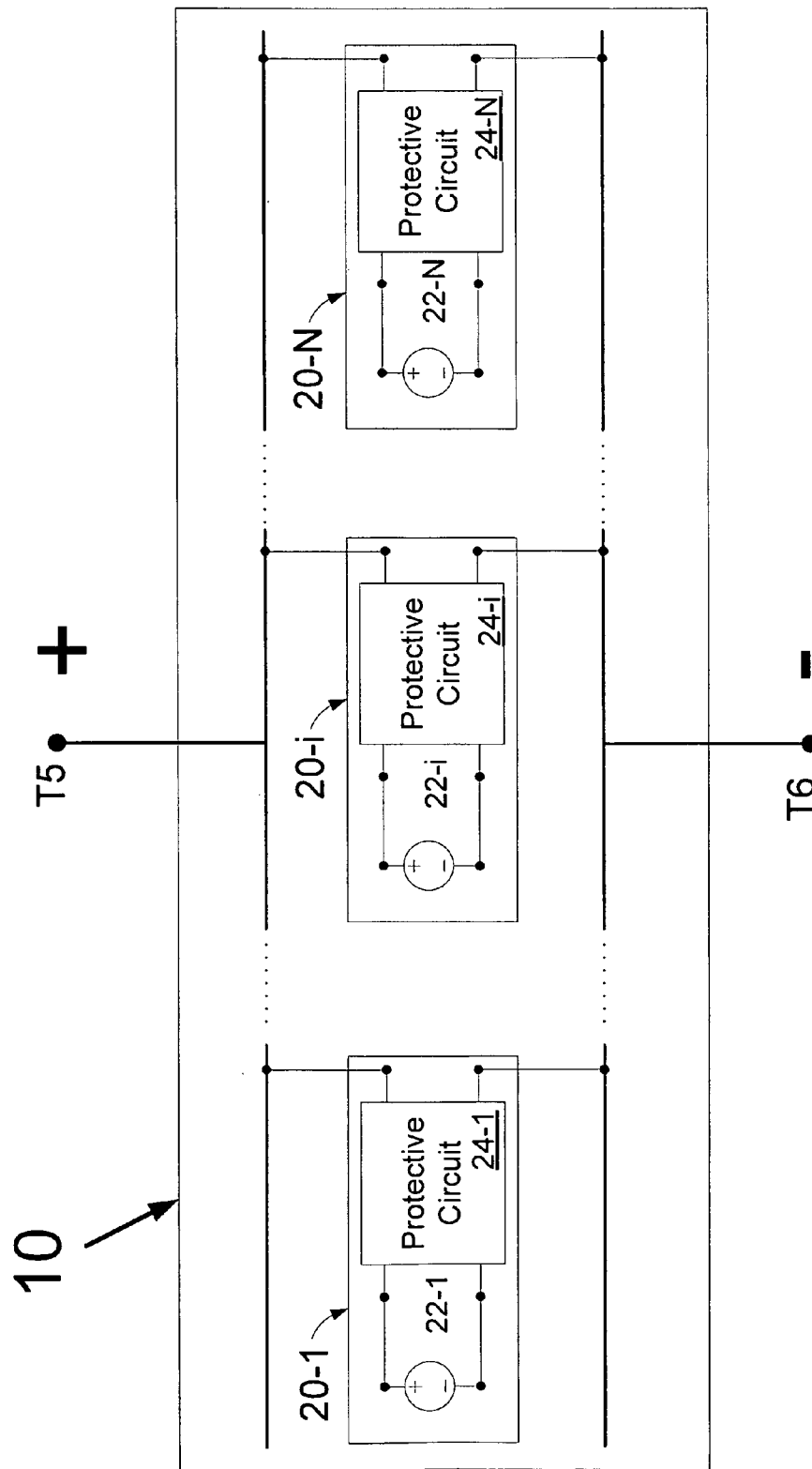


Fig. 2B

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