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(12) **United States Patent**
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- (54) **THERMALLY STABLE REFERENCE VOLTAGE GENERATOR FOR MRAM**
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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 662 days.

(58) **Field of Classification Search** 365/171, 365/185.2, 210.1
See application file for complete search history.

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§ 371 (c)(1),
(2), (4) Date: **Oct. 2, 2006**

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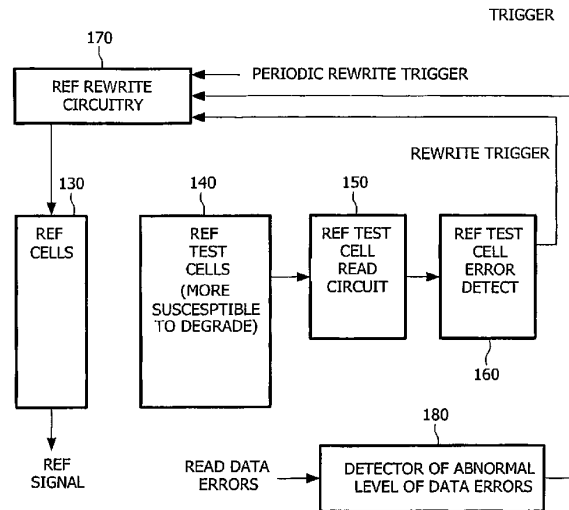
Primary Examiner—Ly D Pham

- (30) **Foreign Application Priority Data**
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(57) **ABSTRACT**
A non volatile memory device comprises memory cells such as MRAM cells, reading circuits and a reference cell for generating a reference for use by the reading circuits, and can determine if the reference is degraded by thermal instability. This can help reduce a data error rate. Detecting such degradation can prove to be more effective than trying to design in enough margins for the lifetime of the device. The reference cell can be less susceptible to degradation than other cells by using different shape of cells and different write currents. Where each reference cell is used by many memory cells, the reference cell tends to be used more often than any particular memory cell and so can be more susceptible to degradation. Another way of ensuring against longer term degradation of the reference is periodically rewriting the reference cell.

- (51) **Int. Cl.**
G11C 7/02 (2006.01)
G11C 11/34 (2006.01)
G11C 16/04 (2006.01)
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- (52) **U.S. Cl.** **365/210.1; 385/209; 385/185.2; 385/171**

5 Claims, 5 Drawing Sheets



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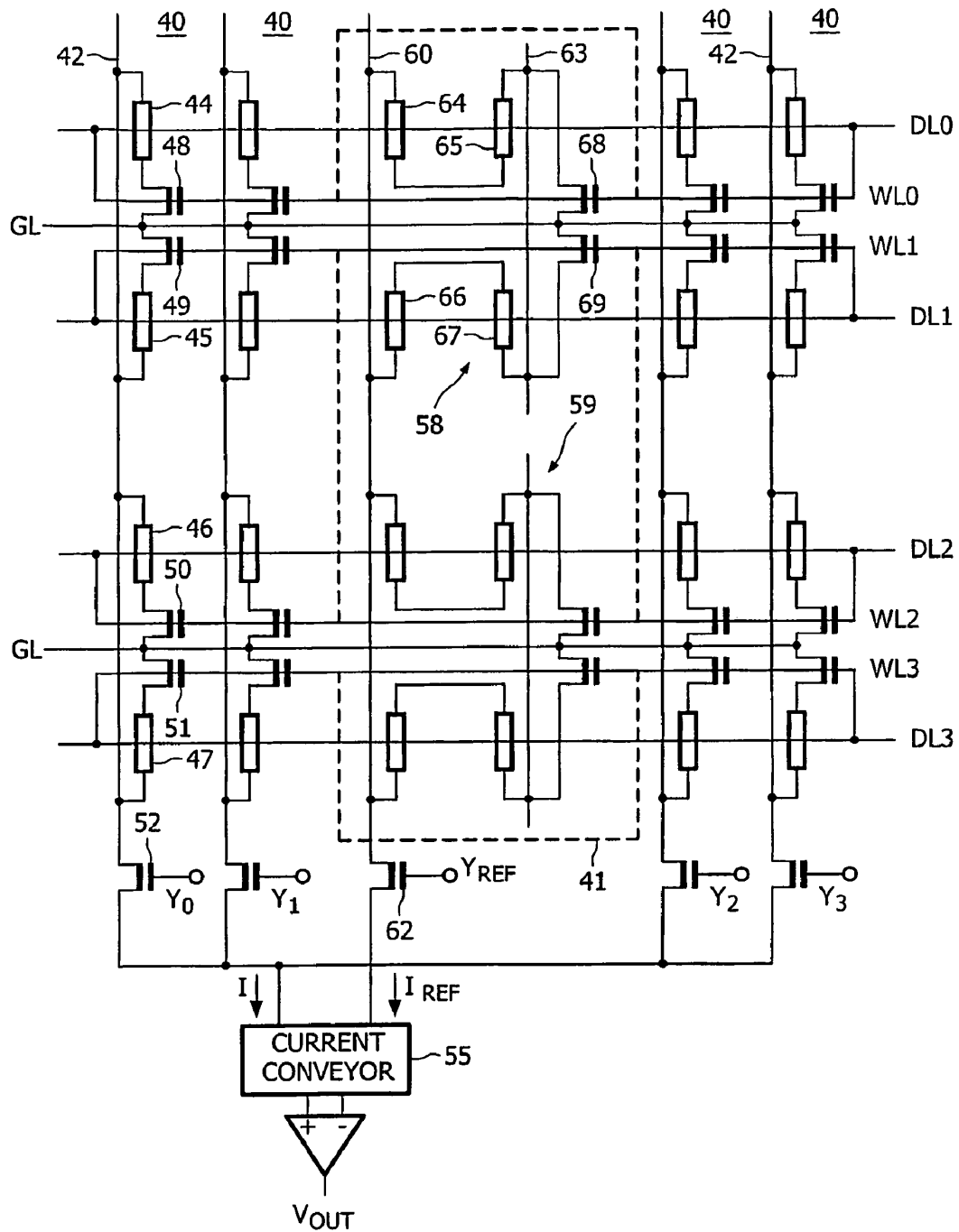


FIG. 1 PRIOR ART

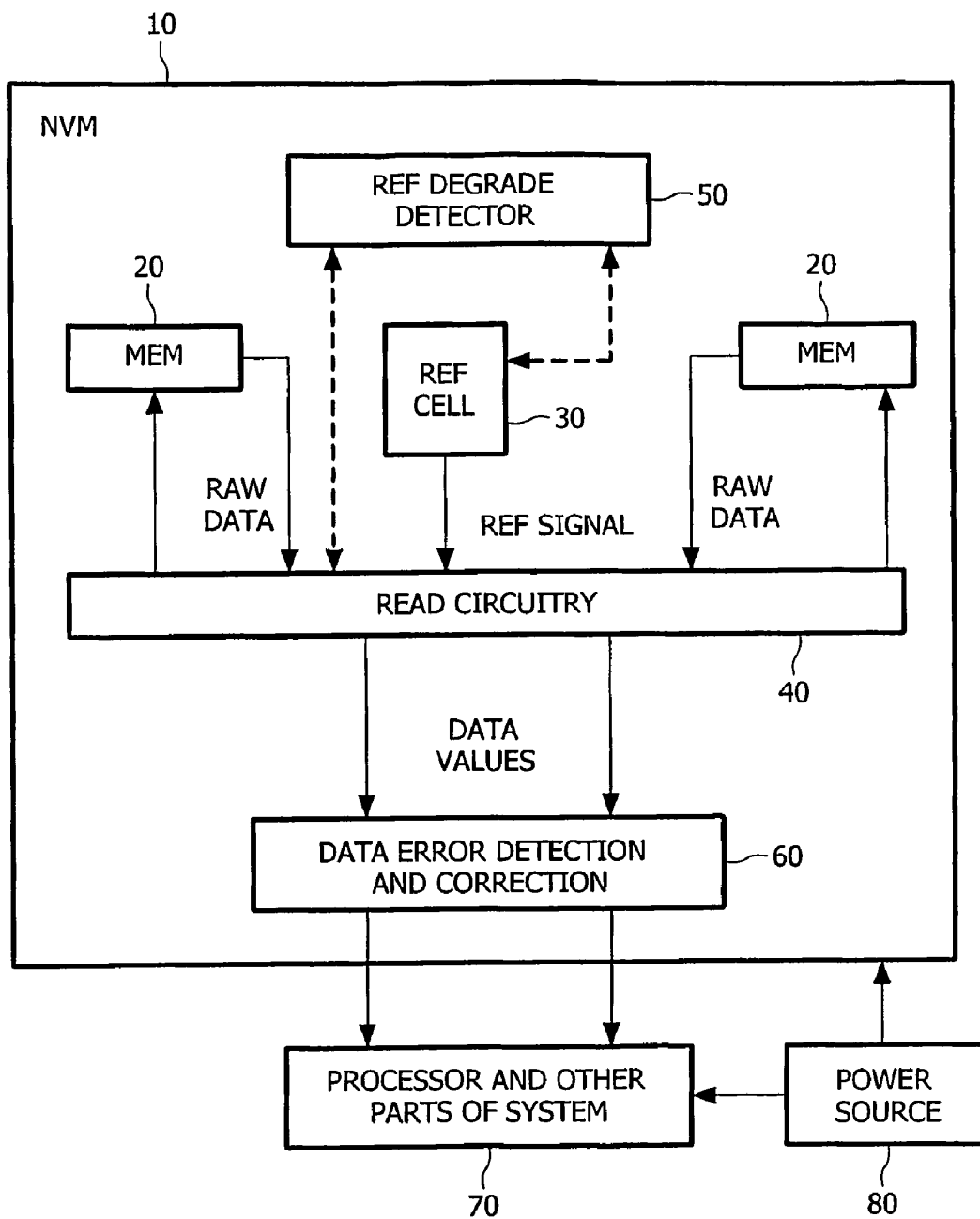


FIG. 2

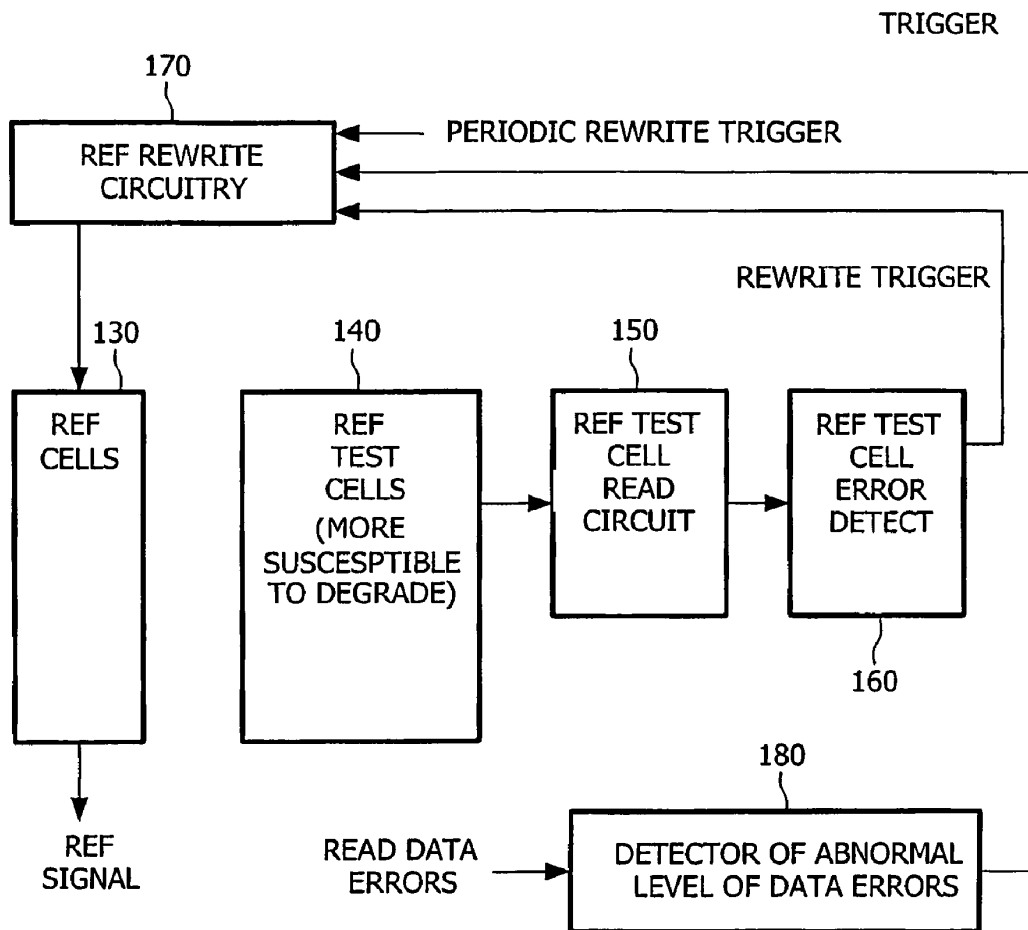


FIG. 3

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