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(54) Title: AN IMPROVED HIGH CAPACITY LOW COST MULTI-STATE MAGNETIC MEMORY

(57) Abstract: One embodiment of the present invention includes multi-state current-switching magnetic memory element including a stack of two or more magnetic tunneling junctions (MTJs), each MTJ having a free layer and being separated from other MTJs in the stack by a seeding layer formed upon an isolation layer, the stack for storing more than one bit of information, wherein different levels of current applied to the memory element causes switching to different states.

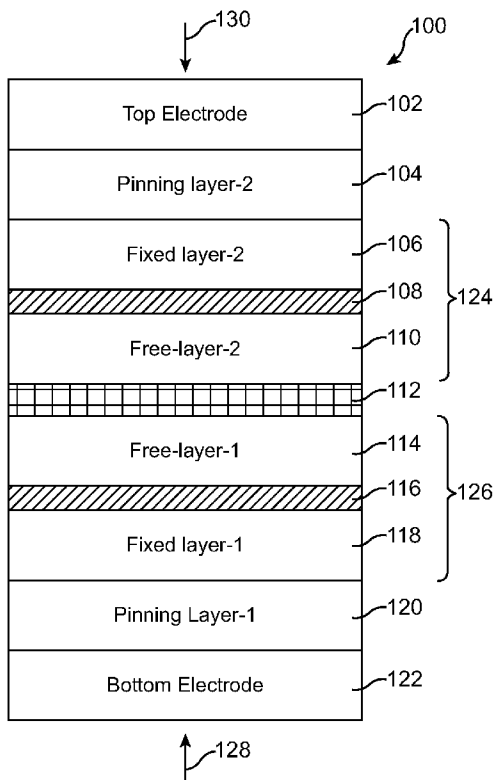


FIG. 1

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## A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - G11B 5/39 (2008.04)

USPC - 360/324.2

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
USPC: 360/324.12, 324.2; 365/55, 97, 171, 173, 232 keyword limited - see search terms below

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PubWest (PGPB,USPT,USOC,EPAB,JPAB), Google Scholar, Google Patent

Search terms: magnetic, memory, tunnel, junction, MTJ, two, second, multiple, bits, stack, multi-state, four, pinning, barrier, composition, thickness, isolation, cells, current, switching

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2005/0167657 A1 (NICKEL et al.) 04 August 2005 (04.08.2005), para [0013]-[0014], [0017], [0019]-[0023], [0025]-[0026], [0036], [0039]-[0040], Fig. 1	1-18
A	US 6,169,689 B1 (NAJI) 02 January 2001 (02.01.2001), entire document	1-18
A	US 7,109,539 B2 (LU) 19 September 2006 (19.09.2006), entire document	1-18

 Further documents are listed in the continuation of Box C.

\* Special categories of cited documents:

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