

- [54] **MAGNETIC TUNNEL JUNCTION
MAGNETORESISTIVE SENSOR WITH IN-
STACK BIASING**
- [75] Inventors: **Frederick Hayes Dill**, South Salem, N.Y.; **Robert Edward Fontana, Jr.**, San Jose, Calif.; **Tsann Lin**, Saratoga, Calif.; **Stuart Stephen Papworth Parkin**, San Jose, Calif.; **Ching Hwa Tsang**, Sunnyvale, Calif.
- [73] Assignee: **International Business Machines Corporation**, Armonk, N.Y.
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- [52] U.S. Cl. **360/113**
- [58] Field of Search 360/113; 257/421-427; 365/158, 171, 173

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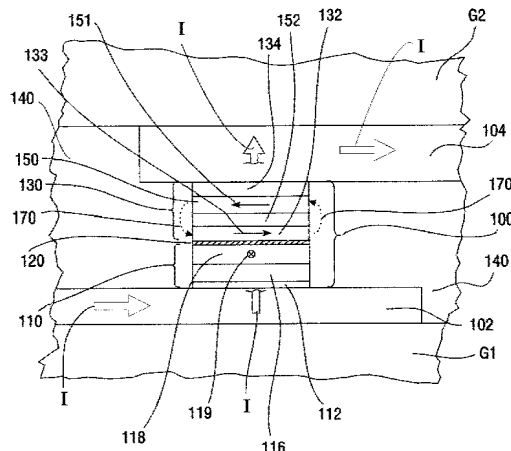
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Primary Examiner—William J. Klimowicz
Attorney, Agent, or Firm—Thomas R. Berthold

[57] **ABSTRACT**

A magnetic tunnel junction (MTJ) magnetoresistive (MR) read head has one fixed ferromagnetic layer and one sensing ferromagnetic layer on opposite sides of the tunnel barrier layer, and with a biasing ferromagnetic layer in the MTJ stack of layers that is magnetostatically coupled with the sensing ferromagnetic layer to provide either longitudinal bias or transverse bias or a combination of longitudinal and transverse bias fields to the sensing ferromagnetic layer. The magnetic tunnel junction in the MTJ MR head is formed on an electrical lead on a substrate and is made up of a stack of layers. The layers in the stack are an antiferromagnetic layer, a fixed ferromagnetic layer exchange biased with the antiferromagnetic layer so that its magnetic moment cannot rotate in the presence of an applied magnetic field, an insulating tunnel barrier layer in contact with the fixed ferromagnetic layer, a sensing ferromagnetic layer in contact with the tunnel barrier layer and whose magnetic moment is free to rotate in the presence of an applied magnetic field, a biasing ferromagnetic layer that has its magnetic moment aligned generally within the plane of the device and a nonmagnetic electrically conductive spacer layer separating the biasing ferromagnetic layer from the other layers in the stack. The self field or demagnetizing field from the biasing ferromagnetic layer magnetostatically couples with the edges of the sensing ferromagnetic layer to stabilize its magnetic moment, and, to linearize the output of the device. The electrically conductive spacer layer prevents direct ferromagnetic coupling between the biasing ferromagnetic layer and the other layers in the stack and allows sense current to flow perpendicularly through the layers in the MTJ stack.

28 Claims, 7 Drawing Sheets

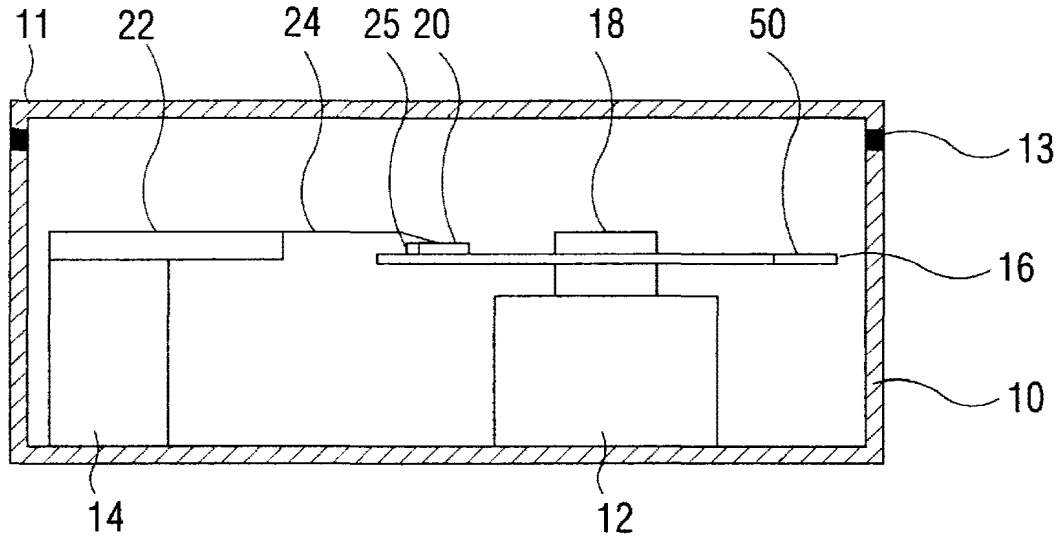


FIG. 1 (PRIOR ART)

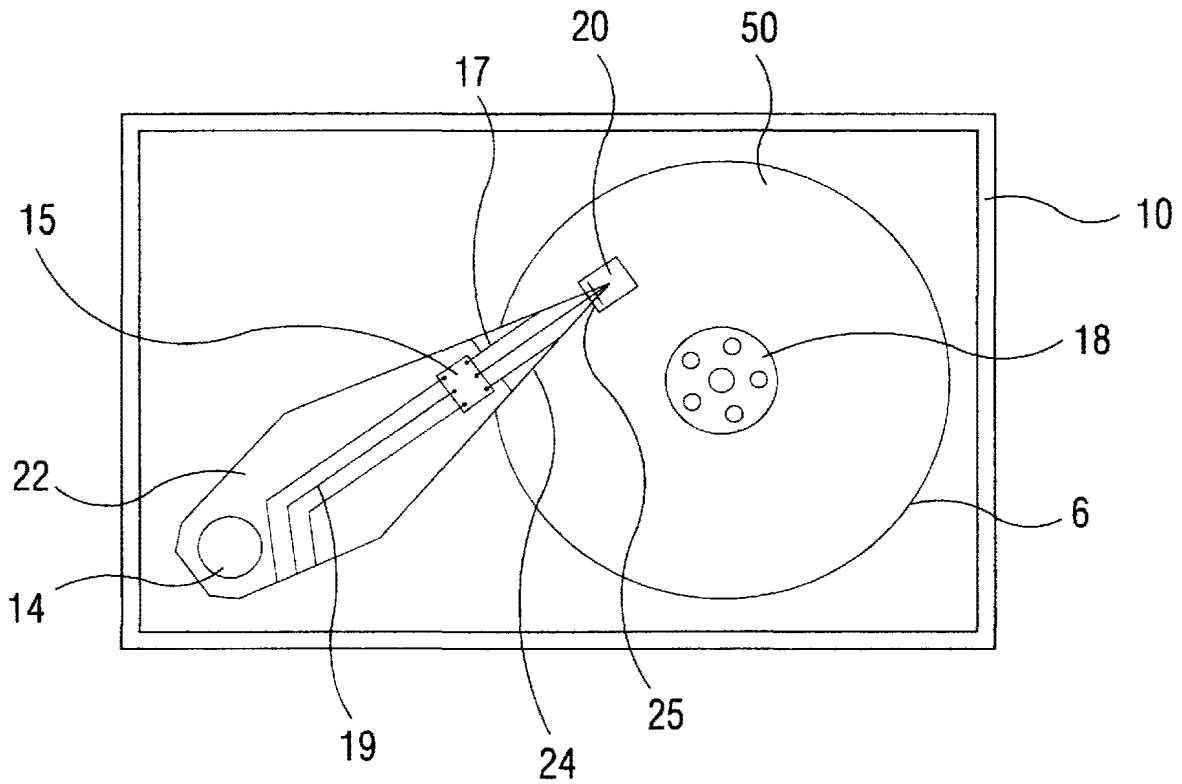


FIG. 2 (PRIOR ART)

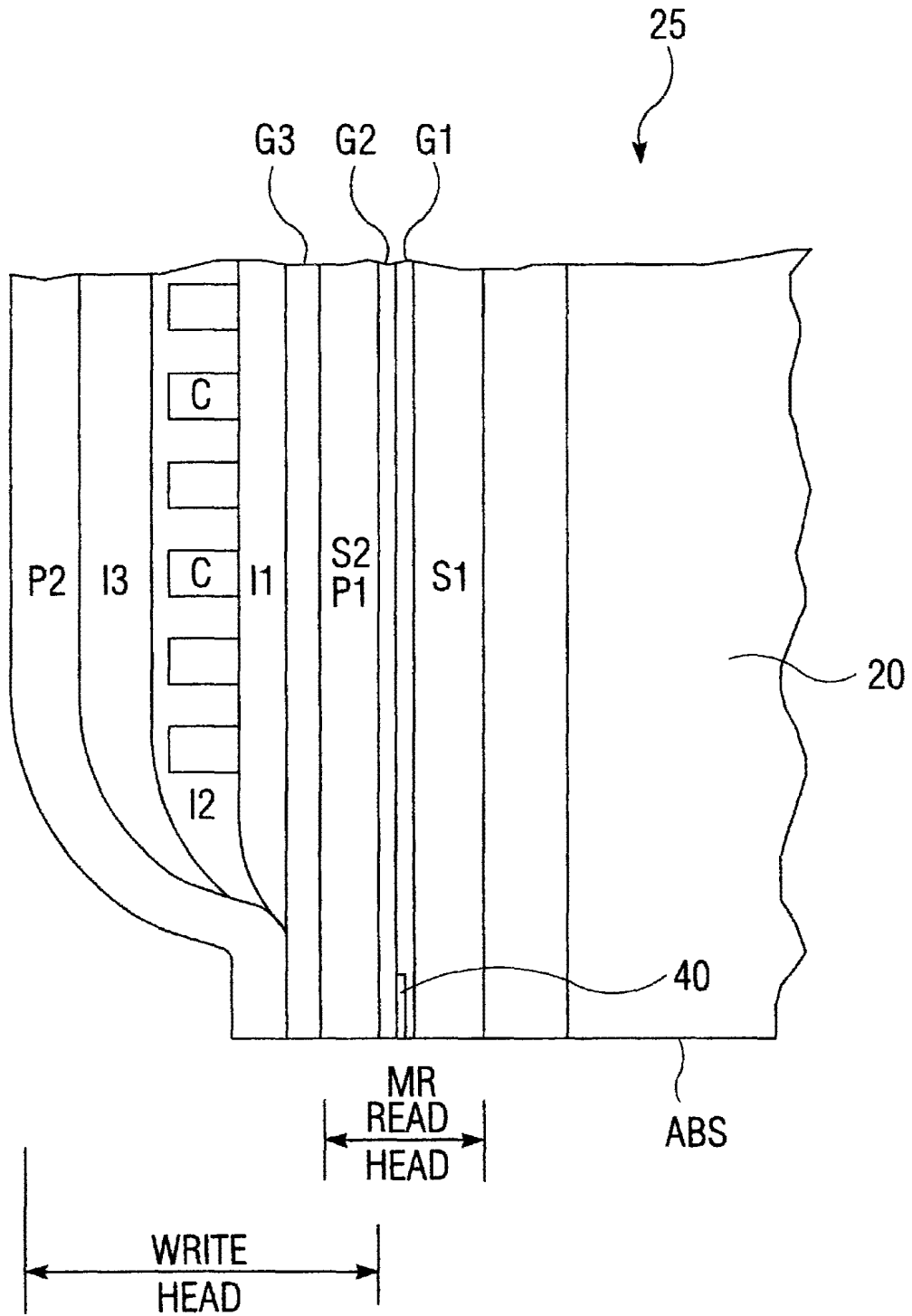


FIG. 3 (PRIOR ART)

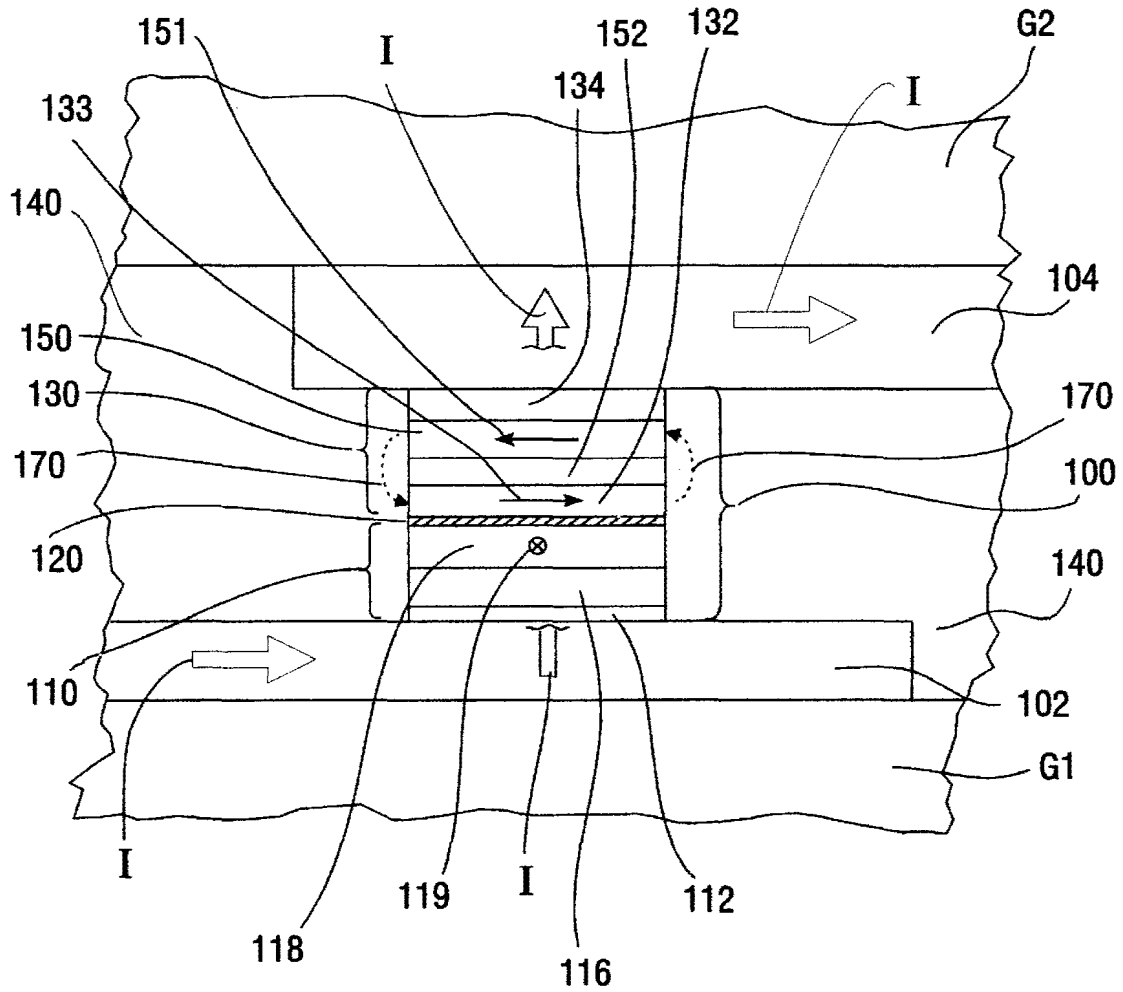


FIG. 4A

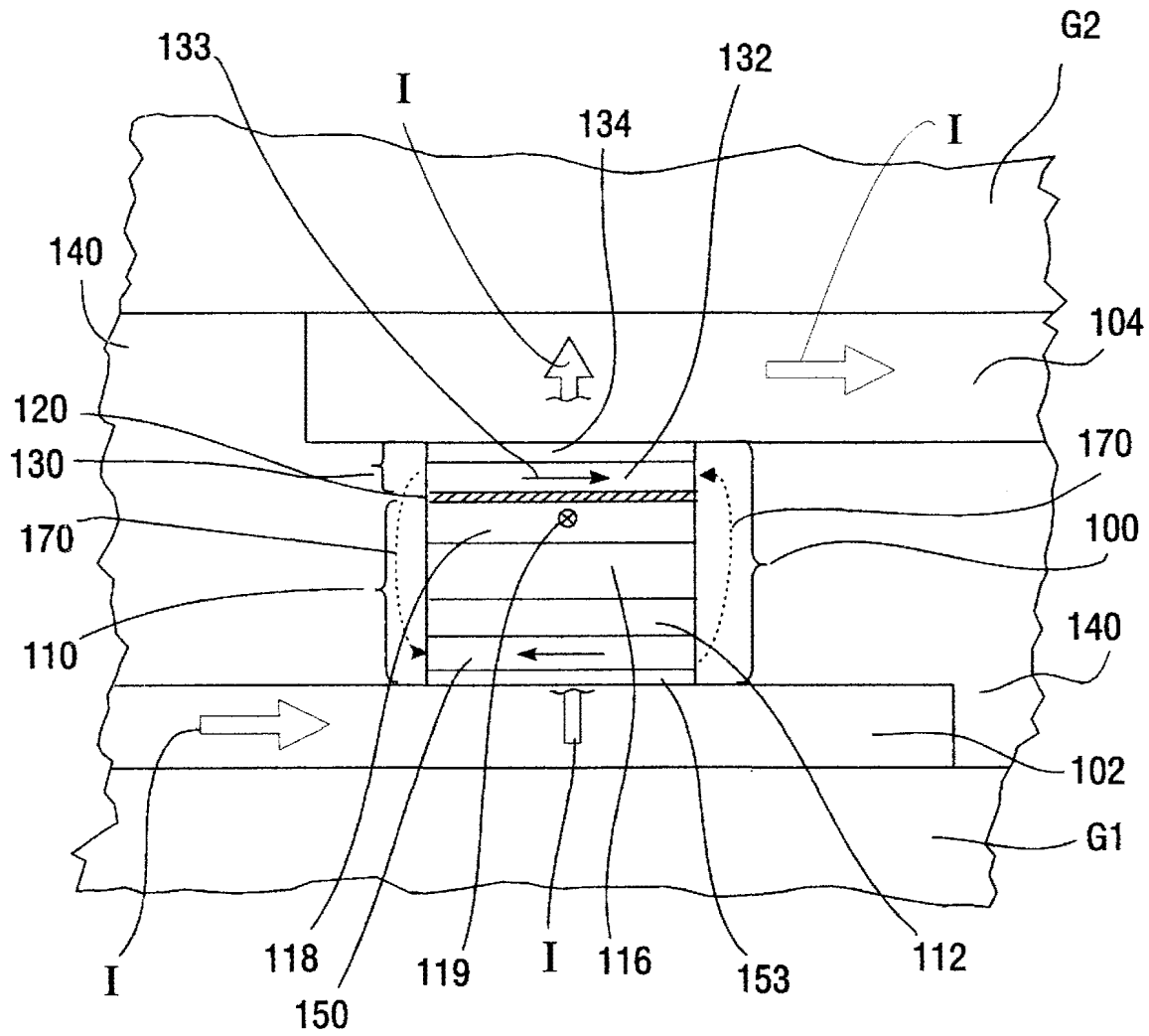


FIG. 4B

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