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(54) **MAGNETICALLY ACTUATED FLUID HANDLING DEVICES FOR MICROFLUIDIC APPLICATIONS**

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Related U.S. Application Data

(57) **ABSTRACT**

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Magnetically actuated fluid handling devices using magnetic fluid to move one or more fluids (gases or liquids or both) through microsized flow channels are provided. Fluid handling devices include micropumps and microvalves. Magnetically actuated slugs of magnetic fluid are moved within microchannels of a microfluidic device to facilitate valving and/or pumping of fluids and no separate pump is required. The magnets used to control fluid movement can be either individual magnets moved along the flow channels or one or more arrays of magnets whose elements can be individually controlled to hold or move a magnetic slug. Fluid handling devices include those having an array of electromagnets positioned along a flow channel which are turned on and off in a predetermined pattern to move magnetic fluid slugs in desired paths in the flow channel. The fluid handling devices of the present invention can handle gases and liquids simultaneously and thus can be made to be self-priming. These devices are more resistant to fluctuations in fluid input than other types of micropumps which need to be tuned to pump either liquid or gas. In a particular embodiment, a micropump having a loop channel containing a stationary magnetic slug and one or more moving slugs is provided.

(51) **Int. Cl.**⁷ **F15C 1/04**
(52) **U.S. Cl.** **137/827; 137/251.1; 417/92**
(58) **Field of Search** **137/827, 251.1; 417/92**

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26 Claims, 18 Drawing Sheets

