ELECTROTHERMAL REFRESHABLE BRAILLE CELL AND METHOD FOR ACTUATING SAME

[0001] This application claims the benefit of U.S. Provisional Application Ser. No. 60/668,809 to Smith, filed on Apr. 6, 2005.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] This invention relates to Braille cells, and more particularly to eletrothermal refreshable Braille cell apparatus and methods for actuating a refreshable Braille cell.

[0004] 2. Description of the Related Art

[0005] Tactile display allows information to be communicated by stimulating a user's sense of touch and one method for communicating information in this way is by Braille. The user touches the Braille words, with the letters communicated through a series of bumps or dots. Refreshable Braille diplays contain tactile devices for the blind and partially sighted, translating text from systems, such as a computer, into readable characters. The display systems typically include two or more lines of Braille cells, each of which corresponds to a particular symbol (e.g. letter). Such systems are "refreshable" in that the display surface may be "wiped clean" and then can display another symbol. This allows for the sequential exhibition of different Braille letters.

[0006] The patent literature contains reports of several different methods that can be used to actuate, or form, a refreshable Braille cell. U.S. Pat. Publ. No. 20020106614, for instance, discusses a display system with a flexible surface. The system typically includes: a) a plurality of microelectromechanical valves having a top surface and a bottom surface; and b) a elastomeric polymer. In some forms, it uses piezoelectric devices or microelectromechanical shape memory alloy actuated devices in place of the microelectromechanical valves.

[0007] Another application, U.S. Pat. Publ. No. 20040175676, takes a different approach. This application is directed to the hydraulic actuation of a Braille dot using the bending characteristics of electroactive polymers. The bending mechanism is transferred to the linear motion of the Braille dot according to the report.

SUMMARY OF THE INVENTION

[0008] The present invention provides a refreshable Braille cylinder, cell and display, and method for actuating a Braille cell that utilizes a medium or material that expands under heat to form a Braille dot. The Braille cell is not complex, can be fabricated using known methods, and provides for high volume production of refreshable Braille cells and displays.

[0009] One embodiment of a method for actuating a Braille cell according to the present invention comprises providing power to a microheater within a cylinder, wherein the cylinder has a membrane at one end, and a heat expandable medium. Heating the heat expandable medium with said heater, thereby causing it to expand. Bulging out the membrane under pressure from the expanding heat expandable medium, thereby forming a dot.

[0010] One embodiment of a Braille cell cylinder according to the present invention comprises a cylinder housing and a flexible membrane over one end of the cylinder housing. A heat expandable medium is within the cylinder housing; and a heater is arranged to heat the heat expandable medium causing the membrane to bulge out at the one end of said cylinder housing.

[0011] One embodiment of a refreshable Braille cell according to the present invention comprising a plurality of cylinder housings with a flexible membrane covering the openings at one end of the cylinder housings. A heat expandable medium is in each of said cylinder housings and a plurality of heaters is included, each of which is arranged to heat the heat expandable medium within a respective one of said cylinders. This causing expansion of the heat expandable medium, causing the flexible membrane at the respective one of the cylinders to bulge out to form a Braille dot.

[0012] One embodiment of a refreshable Braille display according to the present invention comprises a plurality of Braille cells arranged to allow a user to touch the surface of the cells. Each of the Braille cells comprises a plurality of cylinder housings with a flexible membrane covering the openings at one end of the cylinder housings. A mechanism is included for causing the flexible membrane at said respective one of the cylinders to bulge out to form a Braille dot.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] FIG. **1** is a sectional view of one embodiment of an electrothermal cylinder according to the present invention that can be used in a refreshable Braille cell;

[0014] FIG. **2** is a sectional view of two electrothermal cylinders according to the present invention arranged in a refreshable Braille cell;

[0015] FIG. **3***a* is a sectional view of one embodiment of three Braille cells in a line according to the present invention;

[0016] FIGS. **3***b* is a sectional view of one embodiment of two Braille cells arranged in two different lines according to the present invention;

[0017] FIG. **4** shows a plan view of three Braille cells according to the present invention actuated for the word "and";

[0018] FIG. **5** shows one embodiment of refreshable Braille computer screen method according to the present invention;

[0019] FIG. **6** shows another embodiment for actuating a refreshable Braille cell according the present invention;

[0020] FIG. **7** shows one embodiment of a method for presenting Braille text on a refreshable display according to the present invention; and

[0021] FIG. **8** shows one embodiment of a Braille touch screen method according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0022] The present invention provides electrothermal actuated refreshable Braille cells, display systems using the cells, and methods for actuating refreshable Braille cells/