[0049] Although the present invention has been described in considerable detail with reference to certain preferred configurations thereof, other versions are possible Therefore, the spirit and scope of the appended claims should not be limited to their preferred versions contained therein.

We claim:

1. A method for actuating a Braille cell, comprising:

providing power to a microheater within a cylinder, wherein the cylinder has a membrane at one end, and a heat expandable medium;

heating said heat expandable medium with said microheater, thereby causing it to expand; and

bulging out said membrane under pressure from said expanding heat expandable medium, thereby forming a dot.

2. The method according to claim 1, wherein the Braille cell is fabricated on a silicon or plastic substrate.

3. The method according to claim 1, wherein the Braille cell is fabricated on a polymer substrate.

4. The method according to claim 3, wherein said polymer substrate is polycarbonate or PMMA.

5. The method according to claim 1, wherein said heater is a microheater patterned on a printed circuit board.

6. A method for providing a refreshable Braille display, comprising:

receiving input from a central processing unit;

providing power to cylinders corresponding to the input, wherein each of said cylinders comprises a membrane and a heat expandable medium, said power causing said heat expandable material to bulge out its respective membrane;

waiting a set period of time; and

cutting power to the cylinder microheaters, thereby refreshing a display.

7. A Braille cell cylinder, comprising:

a cylinder housing;

a flexible membrane over one end of said cylinder housing;

a heat expandable medium within said cylinder housing; and

a heater arranged to heat said heat expandable medium causing said membrane to bulge out at said one end of said cylinder housing.

8. The cylinder of claim 7, wherein said heater comprises a microheater at the end of said cylinder housing opposite said membrane, said microheater generating heat in response to an electrical signal.

9. The cylinder of claim 7, wherein said heat expandable medium is arranged between said microheater and said membrane.

10. The cylinder of claim 7, wherein said heat expandable medium comprises a phase change material.

11. The cylinder of claim 10, wherein said phase change material comprises a one or more paraffin waxes alone or in combination with other materials.

12. A refreshable Braille cell, comprising:

a plurality of cylinder housings;

a flexible membrane covering the openings at one end of the cylinder housings;

a heat expandable medium in each of said cylinder housings; and

a plurality of heaters each of which is arranged to heat said heat expandable medium within a respective one of said cylinders causing its expansion, said expansion **10** causing said flexible membrane at said respective one of said cylinders to bulge out to form a Braille dot.

13. The Braille cell of claim 12, wherein each said heater comprises a microheater at the end of a respective one of said plurality of cylinder housings opposite to said membrane, each said microheater generating heat in response to an electrical signal.

14. The Braille cell of claim 13, wherein an electrical signal is applied to the desired ones of said microheaters to form a Braille character with said bulging out membrane.

15. The Braille cell of claim 12, wherein said heat expandable medium in each of said cylinder housings is arranged between its respective said microheater and said membrane.

16. The Braille cell of claim 12, wherein said heat expandable medium comprises a phase change material.

17. The Braille cell of claim 16, wherein said phase change material comprises a one or more paraffin waxes alone or in combination with other materials.

18. A refreshable Braille display, comprising:

a plurality of Braille cells arranged allow the user to touch the surface of the cells, each of said Braille cells comprising:

a plurality of cylinder housings;

a flexible membrane covering the openings at one end of the cylinder housings; and

a mechanism for causing the flexible membrane at said respective one of said cylinders to bulge out to form a Braille dot.

19. The Braille display of claim 18, further comprising a heat expandable medium in each of said cylinder housings and a plurality of heaters each of which is arranged to heat said heat expandable medium within a respective one of said cylinders causing its expansion, said expansion causing said membrane to bulge out.

20. The Braille display of claim 18, comprising a computer screen.

21. The Braille display of claim 18, wherein each of said Braille cells can be activated to form a Braille character.

22. The Braille display of claim 21, wherein each of said Braille cells is activated by electric control signals.

23. The Braille display of claim 22, wherein said electric control signals are generated by an operating system on a PC or handheld devide.

24. The Braille display of claim 18, wherein each said heater comprises a microheater at the end of a respective one of said plurality of cylinder housings opposite to said membrane, each said microheater generating heat in response to an electrical signal.