three dots appear in cell **96**, which correspond to the letter "d". The combination of the three Braille cells forms the word "and". Each of the Braille cells can be refreshed and form the dots to a different letter by removing the energy from the cylinders and then energizing the desired cylinders to form the desired dot pattern.

[**0041**] FIG. **5** shows one embodiment of computer display system **100** utilizing refreshable Braille cells according to the present invention. The system **100** comprises a computer display **102** having multiple refreshable Braille cells **104** arranged in the desired rows to allow the user to touch the surface of the cells **104**. The display **102** is coupled to controller **106** that provides the necessary electrical signals to cause the desired dots (membrane bulges) to form at the Braille cells **104**. The controller **106** can be many different devices, such as a known personal computer (PC). The Braille cell control signals transmitted to the computer display **102** can be generated using different software approaches. One is to have an operating system on the controller specifically designed to generate the Braille cell control signals. This can include known Windows®, Linux or Macintosh operating systems on a PC, or independently developed operating systems on a PC or other platform. Another approach would allow the existing operating system such as Windows® or Linux, Macintosh, or other operating system to work with translation software that translates the typical visual output to binary or Braille cell output. This allows a standard Window® screen to be translated so that only the outline of Windows® and outline of its Icons would be displayed with Braille text instead of Ascii test. For both software approaches, signals would be sent to individual cells to control which dots are actuated.

[**0042**] Braille cells according to the present invention can be used in many applications beyond computer displays. For example, the cells can be used on the steering wheel of an automobile that has the points raise to cue the driver of an emergency. The cell could be used on a hand held device carried by military, firefighters, or whomever may be working in a low or zero-visibility environment. Any kind of device that can be touched by the hand can be made to communicate or display tactily.

[**0043**] FIG. **6** shows one embodiment of a method **110** for forming Braille characters in a Braille cell according to the present invention. Although method **110** is described in series of steps, it is understood that the method steps can be in different order and can have different steps. In step **111**, an electrothermal activated Braille cell is provided, and in a preferred method the Braille cell comprises cylinders having an medium that expands under heat, a microheater, and a membrane similar to those shown in the figures and described above. In step **112**, text begins that is to be displayed by the Braille cell. In step **113**, a signal (message) is accepted having the information to activate the desired ones of the Braille dots in the Braille cell. This signal can originate from the operating system of a PC as described above. In step **114**, an electrical signal is applied to the desired ones of the Braille dots to be activated. This causes the microheater to heat the medium within the particular cylinder, which in turn causes the membrane to bulge forming a raised dot. In step **115**, after a predetermined amount of time, the electrical signal is removed from the Braille cell, causing the medium to cool and contract and causing the membrane to return to its original position over the cylinder. This is the refresh state of the Braille cell.

[**0044**] In step **116**, if the text that is to be displayed is complete, the method stops **117**. If, however, there is more text to be displayed, the method returns to step **113** and accepts another signal for displaying another character. This continues until the text is complete.

[**0045**] FIG. **7** shows another embodiment of a method **120** for using the present invention in a refreshable Braille display, and although this method is described in a series of steps, it is understood that the method steps can be in different order and can have different steps. Input is received from a CPU in step **122**, and power is provided to select cylinders that correspond with the input at step **124**. A set period of time is allowed to pass in step **126**, and power is then cut to the cylinders in **128**. This either signals the end of the display material **130**, or the need to begin the process again.

[**0046**] In certain cases, the refreshable Braille display system of the present invention includes a touch screen where the Braille cells are activated only in the area touched by the user's fingers. This can include the cells directly under the fingers or in the areas under and around the fingers. The touch screen can be part of membrane **64** described above and shown in FIG. **3***a*, or can comprise a material layered on top of membrane **64**. Different touch screen systems and methods can be used according to the present invention, including but not limited to, capacitive-based, resistive-based, infrared-based and surface acoustic wave-based systems and methods. See, for example, U.S. Pat. No. 6,741,237, which is incorporated-by-reference for all purposes.

[**0047**] FIG. **8** shows one embodiment of method **140** for using the touch screen version of the present invention. As the result of a person's touch, input is received by the CPU **142**. The input includes the location of the person's touch on the screen, as well as the area of the touch. After receiving the input, the CPU correlates it with information related to display content; further input is sent by the CPU **144**, and power is provided to select cylinders that correspond with the input **146**. Power is provided until the person moves his finger from its original location on the touch screen. If the finger glides along the surface of the touch screen, it will induce power to be provided to other, select cylinders **148** while cutting power to the originally activated cylinders **150**. If the finger is removed from the surface of the touch screen, power to cylinders will simply be cut **152**.

[**0048**] The number of cylinders receiving power as the result of a single touch varies. Typically, at least the number of cylinders associated with a single character (i.e., a single Braille cell) will be activated. In certain cases, cylinders associated with multiple characters (e.g., 2, 3, 4 or 5 Braille cells) will be activated. The activated cylinders, or Braille cells, typically relate to the same line of text on the display.