ELECTROMECHANICAL TACTILE CELL ASSEMBLY

CROSS REFERENCE TO RELATED APPLICATION

This application claims priority to Provisional Patent Application No. 60/481,979 filed, Jan. 30, 2004.

BACKGROUND OF INVENTION

A Braille display is an electromechanical device that connects to a computer by way of a serial or parallel cable. The display consists of a line of electromechanical tactile cells, each with six or eight pins that move up and down to represent the dots of a Braille cell. The display is used to represent a line of text on a computer screen. Each cell has six or eight tactile pins that are driven by electromechanical or piezoelectric effects. The user of the display is able to read a line of Braille cells by touching the pins of each cell as they are extended above a tactile surface. After a line has been read the user can refresh the display to allow for additional lines to be presented and read. Braille displays are often combined with other hardware and software to make up an integrated unit. For instance Braille displays are connected to video monitors to serve as the display unit, and many units incorporate speech output of the screen prompts.

Electromechanical tactile cells for use in refreshable Braille displays and graphical tactile displays are known in the art. An exemplary tactile cell as known in the art consists of eight piezoelectric reed elements corresponding to eight tactile pins. The necessary electrical connections and driving forces are provided to actuate the reeds, thereby causing the tactile pins to protrude above a tactile surface to allow the Braille character or graphic element to be displayed. The Braille cells known in the art have not been designed for manufacturability and ease of repair and replacement.

The present state of the art employs serial polled piezoelectric bimorph reeds to drive the tactile pins. The bimorph reeds have a common center conductor positioned between two piezoelectric transducers. Series polled bimorph reeds are used as actuators, wherein the top and bottom elements are polled towards the center element upon initial manufacturing. With this configuration, the common center point is grounded and voltage is applied to the outer strips. A simple circuit drives the center conductor and fixes the outer conductor. This series polled arrangement drives only one piezo element and the opposing element performs as a mechanical drag. This arrangement additionally requires that special metallic plating be applied to the outer piezoceramic contacts to enable soldering of the leads to the printed circuit board. The need for such special metallic plating and individual attachment of the leads increases the manufacturing costs associated with each Braille cell. Current technology requires the use of sixteen hand-soldered leads, requiring thirty two hand-soldered solder joints to establish the electrical connections for each Braille cell in the display. Precise positioning of the reeds is necessary to ensure that the tactile pins extend a definite distance beyond the tactile surface upon actuation of the reed and fully retract below the surface upon request. This precise positioning and alignment of the reeds with the upward trajectory of the tactile pins proves to be very difficult with hand-soldering manufacturing techniques. Additionally, replacement of the reeds for repair of the Braille cell is complicated due to the large number of hand-soldered leads employed in the design.

Prior art Braille cells employ one individual tactile pin cap per individual Braille cell. The tactile pin cap serves to position and align the pins, and provides the cursor control buttons. The Braille cells and associated tactile pins caps positioned adjacent to each other establish the tactile surface. The use of individual cell caps for each Braille cell increases the manufacturing cost and the cost of materials. Additional stabilizers are necessary to position and align the individual cell caps. Strict tolerances are required to provide an acceptable tactile feel for the reader. The reader is sensitive to the separation that is inherent between each cell with this design. This unevenness between each cell plagues all Braille displays known in the prior art. To tactile users, the tactility of the grooves and cell-to-cell unevenness is comparative to the noise or flicker on a computer monitor experienced by a visual user. Additionally, maintenance and replacement of the individual tactile pins is often necessary. Contaminants that build up on the pins must be removed or the pins must be replaced upon excessive wear.

Accordingly, there is a need in the art for an improved electromechanical tactile cell for use in a refreshable Braille display. Improvements in manufacturability and repair are necessary in addition to enhancements in the tactile experience of the user. There is a need for an improved means for securing the piezoelectric reeds to the printed circuit board and establishing the necessary electrical connections. There is additionally a need for an improved alignment procedure for the individual cells that enhances the user interface and allows for easy maintenance of the tactile pins.

However, in view of the prior art considered as a whole at the time the present invention was made, it was not obvious to those of ordinary skill in this field that the identified improvements should be made nor would it have been obvious as to how to make the improvements if the need for such improvements had been perceived.

SUMMARY OF INVENTION

The longstanding but heretofore unfulfilled need for an improved electromechanical tactile cell is now met by a new, useful, and non-obvious invention. The electromechanical tactile cell assembly in accordance with the present invention provides manufacturing cost reductions, improvements in reliability, and enhancements in the tactile experience for users. The electromechanical tactile cell assembly in accordance with the present invention is useful as an actuator for a refreshable Braille display, a graphic tactile display, or any of a variety of devices in which piezoelectric element reeds are utilized as actuators.

An electromechanical tactile cell assembly in accordance with the present invention, includes a plurality of piezoelectric element reeds, each one of the piezoelectric element reeds being bendable at an elongated end portion when a voltage is applied to the reed, a plurality of conductive fulcrum pins secured to a printed circuit board, and a plurality of multiple element conductive supports secured to a printed circuit board, each multiple element conductive support, in combination with the plurality of conductive fulcrum pins, adapted to secure a plurality of piezoelectric reeds, corresponding to the plurality of conductive fulcrum pins, to the printed circuit board.

The piezoelectric element reed may be characterized as a bimorph, and more particularly may be a parallel polled bimorph. In a particular embodiment, the piezoelectric element reed is a parallel polled bimorph having a top piezoelectric plate, a bottom piezoelectric plate, and a conductive strip positioned between the top plate and the bottom plate and