TACTILE DISPLAY DRIVEN BY SHAPE MEMORY WIRES

BACKGROUND OF THE INVENTION

The present invention relates to tactile displays. These displays, designed for visually handicapped people, are made of a flat reading surface comprising small holes, arranged in a regular array of rows and columns, through which electro-mechanical drivers can raise or recess the hemispherical top of small cylindrical rods, in such a way that they represent, either Braille characters, or any other dot pattern to be read by touch.

The present invention more precisely relates to tactile displays in which the tactile dots are driven by shape memory wires.

DESCRIPTION OF THE PRIOR ART

In currently available tactile displays, each tactile dot is moved up and down by its own individual driver, either electro-magnetic or piezo-electric.

When such a display comprises only a small number of rows, for example 3 or 4, as to constitute a single line of Braille characters, the drivers can be stacked horizontally in order to keep the total height of the display as low as possible, typically within about one inch. An example of such a display is described in the U.S. Pat. No. 4,664,632 dated May 12, 1987.

When more rows are necessary, to build for example more than two Braille lines, each driver must be located underneath the corresponding dot, to keep it within the horizontal area available for each dot, typically 0.01 square inch. Due to the length of the driver, the height of the display increases up to about two inches, as shown also in the U.S. Pat. No 4,664,632.

Such displays are also expensive to build, due to the individual cost of the accurately manufactured parts needed, such as piezo-electric reeds and due also to the cost of the electronic components, such as high-voltage transistors, required to drive them.

It has already been proposed to use shape memory wires to move up and down tactile dots, as shown for example in U.S. Pat. No 5,165,897. In this Patent, each tactile dot is attached to one end of a slightly curved horizontal blade, the opposite end of which is attached to the display base plate. A shape memory alloy wire has one end attached to the blade, near the tactile dot, the other end attached to the base plate.

When an electrical current of sufficient intensity flows through the wire, its temperature rises to the value at which the wire contracts to recover its memorized initial shape, thus pulling-up the tip of the blade and the tactile dot attached to it. When the current flow is shut down, the blade, acting as a spring, goes back to its initial shape, thus bringing down the tactile dot.

This solution suffers from two main defects: the horizontal space required by each blade-wire assembly prevents the construction of more than a few rows of tactile dots, and the current flow must be maintained to keep the tactile dot up, resulting in a high consumption of electrical energy and preventing the use of such a display in applications where portability is necessary. To our knowledge, the solution proposed in this U.S. Patent has not given birth to any commercial application.

Another tactile display, using shape memory wires has been described in the N.I.H. document No 2 R44 EY06512-

02 dated February 1990. In this tactile display, each dot is kept in its up position by a coil spring. A shape memory alloy wire is attached by one end to the dot, by its other end to a base plate supporting the whole assembly. When a current pulse of sufficient intensity and duration is sent through the wire, it contracts and pulls the dot down while compressing the coil spring. When the dot reaches its lower position, a spring-like lock is triggered, which keeps the tactile dot in its lower position after the end of the current pulse. This design significantly decreases the electrical power requirements of the display, but necessitates an additional mechanism to unlock all dots and bring them back to their upper position before displaying different dot pattern. The vertical height of such a display is comparable to the height of an equivalent piezo-electric display, but its power requirements are significantly higher.

SUMMARY OF THE INVENTION

It is an object of the present invention to remove the drawbacks of previous designs and to allow the construction of tactile displays providing the following advantages:

a minimal height, allowing its use in highly portable electronic devices,

a driver design allowing the juxtaposition of any number of columns and rows of tactile dots, at the standard 0.1 inch pitch used for Braille characters, to permit the construction not only of multiple Braille lines, but also of graphical tactile dot arrays.

It is a further object of the present invention to achieve portability by insuring the lowest possible bulk and electrical power requirements, through the implementation of the following features:

elastic auto-release locks to hold each tactile dot in its raised or recessed position,

use of the shortest and thinnest possible wires compatible with the required vertical dot travel and stiffness.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred embodiment of the present invention is shown in FIG. **1** to **11**.

FIG. **1**, **4** and **5** present a side view of all the parts needed to move and to keep raised or recessed any single dot of the display. In these figures, the top reading panel **21**, the horizontal support boards **4**, **5**, **25**, **31** and **34**, as well as the tactile dot **16** and the eyelets **23**, **24**, **29** and **30** are shown cut vertically.

FIG. **1** shows the moving assembly half-way between its raised and recessed positions.

FIG. **4** and **5** are similar to FIG. **1** but show the dot respectively in its raised and recessed positions.

FIG. **2** of shows a plan view of the same parts with all the support boards and the upper section of the moving assembly removed.

FIG. **3** of the same drawing shows, in another side view, how the tactile dot is elastically mounted on the upper section of the moving assembly.

FIG. **6** shows how the wires **22**, the eyelets **23** and **24** supporting the wires, the transistors **40** and the moving rods **1** are horizontally imbricated to allow the juxtaposition of the dots for a typical 8 dot Braille character.

FIG. **7** similarly shows how the positioning springs **11** and **14**, their supports **6** and **7**, and the moving rods **1**, are horizontally laid out, for the same 8 dot Braille character.

FIG. **8**, **9** and **10** in drawing **4** show the variation of the various mechanical forces involved in the vertical motion of the tactile dot.