

## BINARY INFORMATION DISPLAY APPARATUS

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

The present invention generally relates to a binary information display apparatus, which indicates or displays information expressed in terms of binary codes (such as, braille characters) by means of an array of a plurality of parallel pins which are arrayed at a predetermined spacing and which are independently projected from and retracted behind a display surface. Thus, the apparatus of the present invention is suitable, although not exclusive, for use as a braille display apparatus.

#### 2. Description of the Related Art

A typical example of this type of binary information apparatus is a braille display apparatus, which is disclosed in Japanese Unexamined Patent Publication No. 7-36376. Such conventional apparatus has a simple construction relying upon electrical pin-movement control, while reducing electrical power consumption.

More specifically, as shown in FIG. 6, such conventional apparatus has plurality of arrays of parallel pins 32, each array having three braille pins each corresponding to a raised point of a braille. Such pins 32 are slidably received in through-bores 34 formed in a tabular supporting member 33, such that they are independently slidable in the direction of their axes. A cylindrical cam 35 having an axis perpendicular to the axes of the pins 32 is arranged so as to be engageable with one end of each of the pins 32. The structural arrangement is such that the pins 32 are selectively projected from and retracted behind a surface of the supporting member, as the above-mentioned ends of the pins 32 follow concave portion 35a and convex portion 35b of the surface of the cam 35, in accordance with the rotation of the cam 35 about its axis.

In such braille display apparatus 31, the cam 35 is driven by a stepping motor 36 directly connected thereto. In this manner, different phases or steps of rotation of the stepping motor 36 provide different patterns of combination of the concave and convex portions of the cam 35 along the array of the pins, whereby different patterns of projection of the pins 32 are obtained so as to display various types of braille characters.

Thus, the typical character display (touch-feel display), for those who have sight handicaps, incorporates (as means for selectively and independently actuating the pins 32 up and down) the stepping motor 36 and the pin actuating cam 35 connected to the shaft of the motor 36. The single stepping motor 36 actuates three pins 32, and eight ( $2^3=8$ ) patterns of a combination of the states of the pins 32 are available. The stepping motor 36 operates at a  $45^\circ$  step interval so that there are eight step positions in one full rotation of the motor shaft. For allocating one pattern of the states of braille pins to each of the eight steps of motor operation, it is therefore possible to obtain eight types of pin patterns in one rotation of the motor shaft. Actually, a pair of units are used in combination side by side, each unit including the above-described elements so that six pins are used to selectively project and retract; thereby, representing different characters.

However, the state-of-art braille display apparatus usually employs an eight-point braille display in which each character is represented by a peculiar pattern of a combination of eight braille points. The eight-point braille representation

can be realized by using the above-described typical braille display apparatus provided that each motor selectively actuates four braille pins up and down, since such a structural arrangement provides sixteen ( $2^4=16$ ) different patterns of a combination of the states of the braille pins. Thus, the eight-point braille display is possible in a structural arrangement whereby the stepping motor operates at a step interval of  $22.5^\circ$  so that there are sixteen step positions in one full rotation of the motor shaft.

It is to be noted, however, that the eight-point braille representation by the known apparatus with four braille pins encounters the following problem.

The cam contour such that concave and convex portions appear for each pin at  $22.5^\circ$  interval so that the contour of the whole cam is complicated and, at the same time, the gradient of the slope of the cam surface is inevitably increased. Consequently, each braille pin is required to slide along a steep slope of the cam surface, which increases the resistance load imposed on the cam and, hence, on the stepping motor. Consequently, the risk for the stepping motor getting out of the phase is increased; thereby, resulting in a deterioration in the accuracy of the braille display.

Another problem is that since the diameter of each pin has to be reduced, the mechanical strength of the pin against the user's finger getting in touch with the pin is correspondingly reduced; thereby, resulting in deterioration of the reliability of the braille display apparatus as a commercial product.

There has, however, been proposed (although not shown in the drawings) a braille display apparatus in which, in place of the above-mentioned stepping motor, an actuator is used which is made up of bimorph-type piezoelectric elements which act on the lower ends of the respective pins. This type of braille display apparatus is free from the above-mentioned problem encountered by the apparatus employing a stepping motor and, at the same time, the dimensions in the direction perpendicular to the array of the pins is reduced to some extent.

However, driving an actuator having bimorph piezoelectric elements generally require a high voltage. In other words, it is necessary to employ a high-voltage generating circuit besides the main part of the braille display apparatus. It is therefore difficult to reduce the size and the weight of the whole apparatus. Another problem is that, for the same reason as discussed above, it is impossible to comply with the demand for easily transporting such conventional apparatus.

### SUMMARY OF THE INVENTION

Accordingly, an object of the present invention is to provide a small-sized and simple binary information display apparatus, which offers a high degree of accuracy of braille information display and which is free from the problem concerning the mechanical strength of the pins.

As such, according to the present invention, there is provided a binary information display apparatus, comprising: an array of a plurality of pins which are arrayed at a constant pitch in parallel with one another; a supporting member for supporting the pins such that the pins are independently and linearly movable along their axes; a first rotary cam engaging with ends of the pins of a group exclusive of an end pin which is at an end of the array so as to axially urge the pins of the group such that the pins are independently actuated by the first rotary cam with the result that the other ends of the independent pins of the group selectively emerge from a display surface of the supporting member; a motor for supporting the first rotary cam so as to