BINARY INFORMATION DISPLAY DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a binary information display device which displays information represented by binary numbers, such as braille, by separately extruding and retracting a plurality of pins spaced in parallel from and into a display surface.

2. Description of the Related Art

As this kind of binary information display device, there is provided a braille display device having the structure disclosed in, for example, German Published Unexamined Patent Application No. DE4333399A1.

In this braille display device **1**, as shown in FIG. **6**, a plurality of pins **2** for displaying raised portions of braille are spaced in parallel, and fitted respectively in a plurality of through holes **4** formed through a planar support member **3**, so that the pins **2** are slidable separately in the axial direction. A cylindrical cam **5** having an axis orthogonal to the pins **2** is located in contact with one end of each pin **2**. By rotating the cam **5** on the axis thereof, the pins **2** are extruded and retracted from and into the support member **3**, following recesses **5***a* and projections **5***b* formed on the surface of the cam **5**.

In the braille display device **1** having such structure, different pins **2** are extruded from the surface of the support member **3** by changing combinations of the pins **2** and the recesses and projections of the cam **5** in accordance with the rotation angle of a motor **6** directly connected to the cam **5**, so that various braille dots can be displayed.

When various braille letters are displayed by rotating the cylindrical cam **5**, it is necessary to accurately grasp the rotation angle position of the cam **5**, that is, the rotation angle position of the motor **6** is directly connected to the cam **5**.

Conventionally, a rotational position detector (not shown), such as an encoder, is attached to the motor **6** as a means for grasping the rotation angle position of the motor **6**.

An original position of the rotational position detector is reset in a state in which the cam **5** is set in a reference position selected properly, by which the rotation angle position of the cam **5** is known from the relative rotational angle of the rotational position detector with respect to the original position.

On the other hand, a stepper motor is widely and commonly used as a compact control motor having a simple structure. This stepper motor is rotated only at a predetermined rotation angle by magnetic attraction or magnetic repulsion by switching exciting current of a coil in response to each pulse signal. Therefore, the stepper motor has advantages of allowing power conversion from pulses to torque under open-loop digital control, and of achieving a low-cost drive mechanism which causes few accumulated errors.

PROBLEMS TO BE SOLVED BY THE INVENTION

However, the use of a stepper motor in the braille display device **1** having the above-mentioned structure has the following problems:

First, if a rotational position detector is used to determine the rotation angle position of the cam **5**, the advantage of the stepper motor in control without any rotational position detector is impaired, and this is undesireable. Furthermore, the structure, including mechanisms and wires for connecting the rotational position detector, is complicated, and therefore, the whole device is expensive.

Secondly, when the original position of the stepper motor is reset without using any rotational position detector in order to obviate the above-mentioned inconveniences, it is impossible to simply determine the original position.

In this case, the position where the stepper motor is stopped by the application of a pulse potential having a predetermined pattern to the coil thereof is set as the original position. In the stepper motor, more than two rotation angle positions are sometimes set relative to a pulse potential of a single pattern to be applied to the coil in order to improve the resolution.

Thirdly, since recesses and projections need to be formed in a plurality of patterns on the surface formed by a turn of the cylindrical cam **5** in the circumferential direction, if the number of patterns increases, inevitably the diameter of the cam **5** also increases. This makes it difficult to downsize the device, in particular, to reduce the dimension of the device in the adjoining direction.

Furthermore, when the cam **5** and the motor **6** are directly connected, the operation of the pins **2** highly depends on the shape of the cam **5**. Therefore, it seems that the cam **5** is required to be worked with extremely high accuracy, and thus production costs increase.

A braille display device without a stepper motor has been suggested. In particular, a braille display device has been proposed with an actuator made of bimetal for pressing the bottom ends of the pins **2** instead of the aforesaid cam **5**. According to this braille display device, the inconveniences in use of the above stepper motor are not caused, and the size of the device in the direction orthogonal to the arrangement direction of the pins **2** is limited to some extent.

However, since high-voltage power is generally needed to drive the actuator made of bimetal, a large power supply device is needed separately from the main body of the braille display device. This also makes it difficult to downsize the whole device. Furthermore, such a braille display device cannot respond to the demand for portability for the above reason.

The present invention has been made in view of the above-mentioned circumstances, and it is an object of the present invention to provide a compact and high-precision binary information display device with a simple structure at low cost without using any rotational position detector such as an encoder.

SUMMARY OF THE INVENTION

In order to achieve the above object, the present invention suggests a binary information display device comprising a plurality of pins arranged in parallel at regular intervals, a support member for supporting the pins to be movable separately and linearly along the axis thereof, and a drive mechanism for pushing one end of each of the pins to extrude and retract the other end of the pin from and into a display surface formed on the support member. The drive mechanism comprises a linear cam to be moved in a direction orthogonal to the axis of the pins. The cam includes recesses and projections on its surface to move their pins in the axial direction. A linear movement mechanism is provided for moving the linear cam linearly. The linear movement mechanism has a stepper motor for rotating a shaft on the axis orthogonal to the pins. A conversion means is