A further clockwise operation of the stepping motor **3** brings the driving projection **17** of the first cam portion **5** into contact with the driven projection **18** of the fourth cam portion **8**, as shown in FIG. **4**(*g*). Thereafter, as shown in FIG. **4**(*h*), the fourth cam portion **8** is caused to rotate together with the triplet cam **4** in order to reach the first stop position, as shown in FIG. **4**(*i*). In this state, the fourth pin **14** is held in the projected position; thus, indicating binary value "1".

For information, initialization of the stepping motor **3** is possible by causing this motor **3** to perform several clockwise steps from the state shown in FIG. **4**(*i*). Such clockwise stepping of the stepping motor **3** brings the driving projection **17** of the triplet cam **4** into contact with the driven projection **18** of the fourth cam portion **8** which has been fixed against a clockwise rotation, wherein the triplet cam **4** and, hence, the motor shaft **3***a* fixed to the triplet cam **4** is fixed against further clockwise rotation. When further driving voltage pulses are applied to the stepping motor **3** under such a condition, the stepping motor **3** is forced out of the phase so as to be initialized to the original position.

As will be understood from the foregoing description, in the described embodiments of the present invention, it is possible to obtain a binary information display apparatus which employs four pins **11**, **12**, **13** and **14**, wherein eight patterns of information, which is half of four-bit information, can be produced by seven consecutive steps of the stepping motor **3** in one direction at 45° increments, and another eight patterns of information, which is the remainder of the four-bit information, can be produced by seven consecutive steps of the stepping motor **3** in the other direction at 45° increments, wherein sixteen patterns of information, in total, are obtainable through forward and backward operations of the stepping motor.

According to the above-described structural arrangement, the resistance load imposed on the cam when lifting the braille pin is reduced in comparison to the conventional apparatus in which four cam portions are integrated to require smaller angular increments of stepping, and consequently, a greater gradient of the slope of the cam contour. The load imposed on the stepping motor **3** is also correspondingly decreased so that the tendency for the stepping motor to get out of the phase is reduced; and the accuracy of display of braille information is improved.

In addition, the described embodiments do not require reduction of the diameter of the pins contacting the cam so that the pins can have strength large enough to sustain the manual force exerted by the fingers of the users. Consequently, the reliability of the braille display apparatus, as a commercial product, is also improved.

In the above-described embodiment, the resolution or step angle of the stepping motor is set to 45° in order that sixteen patterns of information are displayed. This, however, is not exclusive and the step angle of the stepping motor may be determined in accordance with the number of patterns of information.

Furthermore, although the binary information display apparatus of the above-described embodiment is designed in order to display sixteen patterns of information by means of four pins, this is not exclusive and the invention may be carried out in a different form. For instance, the invention may be carried out so as to display sixteen patterns of information by using a suitable number of pins (e.g., 6 pins). Thus, what is required by the present invention is that an end pin which is on one end of the array of the pins is solely not directly driven by the rotary cam which is fixed to the shaft of the motor.

FIG. **3** is a schematic perspective view of a braille display apparatus incorporating the binary information display apparatus of the above-described embodiment. In this braille display apparatus, denoted by **16**, a pair of binary information display apparatus **1**, each having the structural arrangement, illustrated in FIG. **1**, are arranged side-by-side so as to form a module **15**. The braille display apparatus **16** employs such a module **15**, alone, or employs a plurality of such modules **15** to form a matrix of pins. Each triplet cam **4** in each module is rotated stepwise at 45° increments so as to have eight step positions. The eight pins of each module **15** are selectively and independently movable up and down so that **128** patterns of information are obtainable in accordance with the states of eight pins of the module **15**. The display surface can be touched by the fingers of users (such as persons whose eyes are handicapped) so that the users can read characters (such as, numerals or letters) which are displayed in the same way as those in conventional braille display systems (such as, systems using punch cards or relief plates).

As will be understood from the foregoing description, the present invention offers the following advantages.

First, according to the principal characteristic features of the present invention, the end pin which is at one end of the array of pins is not directly driven by the rotary cam which is directly connected to the motor shaft. Therefore, the gradient of the slope of the cam contour can be reduced as compared to the case where all the pins are actuated by an integral rotary cam. This significantly reduces the resistance load exerted on the cam when lifting the pins. The load applied to the motor also is correspondingly reduced so that the risk for the motor to get out of the phase is reduced; thereby, improving the accuracy of the braille display.

In addition, it is not necessary to reduce the diameter of the pins contacting the cam, as compared to the conventional apparatus, so that the mechanical strength of the pins is not decreased. Consequently, the reliability of the braille display, as a commercial product, is also improved.

The binary information display apparatus of the invention, when constructed such that the motor is rotated stepwise at a 45° increment, can display sixteen patterns of information by using four pins.

Furthermore, when a stepping motor is used as the driving motor, it is possible to easily initialize the state of the apparatus without requiring specific means (such as, an encoder for detecting rotational position). It is thus possible to obtain a small-sized binary information display apparatus having a simple, and a high degree of precision of construction.

While the invention has been particularly shown and described in reference to preferred embodiments thereof, it will be understood by those skilled in the art that changes in form and details may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. 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 said pins such that said pins are independently and linearly movable along axes thereof;

a first rotary cam engaging with ends of the pins of a group exclusive of an end pin which is at an end of said array so as to axially urge said pins of said group such