

TACTILE READING DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a tactile reading device using a bimorph piezo-electric actuating element as an actuating source.

2. Description of the Related Art

As disclosed in, e.g., Jpn. UM Appln. KOKAI Publication No. 62-164380, in a conventional braille type cell, a plurality of bimorph piezo-electric actuating elements corresponding to a number of sensing rods constituting a braille type unit of display are provided in the horizontal direction in a required number of steps, with the sensing rods being mounted on the free end portions of the piezo-electric actuating elements. When a required piezo-electric actuating element is selectively driven, the corresponding sensing rod is vertically moved by the vertical displacement of the free end portion of this piezo-electric actuating element, so that the distal end portion of the sensing rod projects from a finger touch scanning portion, thereby displaying braille type information.

In this conventional tactile reading device, since the piezo-electric actuating elements are arranged in the horizontal direction, a large horizontal space is required. In addition, since the sensing rods move in the vertical direction, the space must also be large in the vertical direction, making it difficult to downsize a braille type cell module constituted by necessary constituent elements including the piezo-electric actuating elements and the sensing rods. In order to display character information occupying a large number of lines or graphic information, sensing rods must be provided at a high density on a necessary sensing surface. However, in the conventional tactile reading device in which the piezo-electric actuating elements are arranged in the horizontal direction, it is difficult to display such information due to structural problems.

In order to solve these problems, there is provided a braille type cell in which piezo-electric actuating elements are arranged in the vertical direction, sensing rods which are driven in the vertical direction are provided above the piezo-electric actuating elements, the sensing rods being driven through a means for converting the horizontal movement of the free end portions of the piezo-electric actuating elements to a vertical movement. As a result, character information occupying a large number of lines and graphic information, to a certain degree, can be displayed.

However, a strong demand has arisen for further down-sizing of a braille type system and for fine graphic information display.

SUMMARY OF THE INVENTION

The present invention has been made to eliminate the drawbacks of the conventional tactile reading device described above. It is an object of the present invention to provide a tactile reading device which is further downsized by employing a means for converting the horizontal movement of the free end portions of piezo-electric actuating elements to a vertical movement and by improving the efficiency of mounting constituent components, and which can display character information, occupying a large number of lines, and graphic information at once.

According to the present invention, there is provided a tactile reading device having a plurality of sensing rods serving as a braille type display unit, piezo-electric actuating elements provided to respectively correspond to the sensing rods, and a frame body for mounting thereon module constituent components including the sensing rods and the piezo-electric actuating elements, for displacing the free end portion of a piezo-electric actuating element corresponding to a selected sensing rod in order to push up this sensing rod from a reset position to a set position, thereby providing required braille type information, comprising the sensing rods provided on the upper portion of the frame body and supported so as to be vertically movable, the piezo-electric actuating elements provided on the lower portion of the frame body and disposed vertically such that free end portions thereof oppose upward, and pushing-up cams having first levers which are axially and pivotally supported on support rods provided above the free end portions of the piezo-electric actuating elements, extending downward from the support rods, and having side surfaces at distal end portions thereof which are freely abutted against the free end portions of the piezo-electric actuating elements, and second levers extending laterally from the support rods and freely mounting, on mounting planes at distal end portions thereof, lower end portions of the sensing rods corresponding to the piezo-electric actuating elements.

The mounting plane of the second lever of each pushing-up cam for mounting the corresponding sensing rod thereon forms a predetermined angle or a predetermined curved surface with respect to a horizontal direction.

Portions of the first levers of the pushing-up cams which are abutted against the free end portions of the piezo-electric actuating elements may be provided with projections.

The pushing-up cams are imparted with a rotational moment so that the side surfaces at the distal end portions of the first levers are always abutted against the free end portions of the piezo-electric actuating elements by a difference in rotational moment between the first and second levers with respect to the support rods.

The piezo-electric actuating elements corresponding to the sensing rods on one side, belonging to the adjacent sensing rods on two sides that oppose each other in a direction so as to displace the free end portions of the piezo-electric actuating elements, may be disposed below the sensing rods on the other side, and piezo-electric actuating elements corresponding to the sensing rods on the other side may be disposed below the sensing rods on one side.

A cassette that integrally houses a predetermined number of pushing-up cams and the support rods supporting the pushing-up cams may be detachably mounted on the frame body.

The tactile reading device according to the present invention may have a housing for integrally holding a predetermined number of piezo-electric actuating elements. Electrodes on the front and rear surfaces of the proximal end portions of these piezo-electric actuating elements may be directly connected to the lead terminals provided to the housing. The housing may be detachably mounted on the frame body.

In the tactile reading device according to the present invention, control drive circuits for the piezo-electric actuating elements in the braille type cell module may be housed in the module.