

**[0055]** A braille graphics cell module according to the first aspect of the present invention is characterized by comprising: a unit substrate; a braille graphics display section which is extended along an upper edge of the unit substrate and holds a plurality of tactile pins movably in a vertical direction, the plurality of tactile pins displaying braille graphics; wiring part arranged at a lower end of the unit substrate so that an upper edge of the wiring part is located close to a node portion of each piezoelectric element piece for a bending operation and a lower edge of the wiring part is located close to the fixed end of the piezoelectric element piece, and having an electric circuit in which the fixed ends of the plurality of piezoelectric element pieces are electrically connected to the wiring part.

**[0056]** In the first aspect, the following modes are preferable.

**[0057]** (1) The unit substrate has at least one concave portion and at least one convex portion provided corresponding to the concave portion, the concave and convex portions being used to position a plurality of unit substrates when bases thereof are connected together.

**[0058]** (2) The unit substrate comprises a plurality of unit substrates, and the plurality of unit substrates are connected together to constitute a braille graphics apparatus.

**[0059]** A braille graphics cell module according to the second of the present invention is characterized by comprising: a unit substrate; a braille graphics display section which is extended along an upper edge of the unit substrate and holds a plurality of tactile pins movably in a vertical direction, the plurality of tactile pins displaying braille graphics; a plurality of piezoelectric element pieces each having a fixed end and a free end and arranged on a surface of the unit substrate in association with the plurality of tactile pins, the plurality of piezoelectric element pieces being bent; and pushup cams each provided pivotably between the corresponding piezoelectric element piece and tactile pin and each having a first action piece which contacts against the free end of the piezoelectric element and a second action piece having a placement surface on which a lower end of the tactile pin is placed, the pushup cams each being formed to have an obtuse angle between the first action piece and the second action piece, the pushup cams each being pivoted when the first action piece is pushed by the free end of the bent piezoelectric element piece, to push up the tactile pin placed on the second action piece.

**[0060]** In the second aspect, the following modes are preferable.

**[0061]** (1) A wiring part arranged at a lower end of the unit substrate is further provided so that an upper edge of the wiring part is located close to a node portion of each piezoelectric element piece for a bending operation and a lower edge of the wiring part is located close to the fixed end of the piezoelectric element piece, and having an electric circuit in which the fixed ends of the plurality of piezoelectric element pieces are electrically connected to the wiring part.

**[0062]** (2) The unit substrate has at least one concave portion and at least one convex portion provided corresponding to the concave portion, the concave and convex portions being used to position a plurality of unit substrates when bases thereof are connected together.

**[0063]** (3) The unit substrate comprises a plurality of unit substrates, and the plurality of unit substrates are connected together to constitute a braille graphics apparatus.

**[0064]** A braille graphics apparatus is characterized by comprising a plurality of braille graphics cell modules according to the first aspect or the second aspect, and a display screen of a predetermined size is formed to display graphical information.

**[0065]** According to an embodiment of the present invention, the wiring part has an electric circuit to which the proximal ends (fixed ends) of the piezoelectric elements are electrically connected. The wiring part is arranged at the lower end of the unit substrate so that its upper edge is located close to the node portion of each piezoelectric element piece for a bending operation, while its lower edge is located close to the proximal end of the piezoelectric element piece. This configuration eliminates the members projecting downward from the unit substrate. It is thus possible to sharply reduce the dimension of the braille graphics cell module in its height direction.

**[0066]** Further, according to an embodiment of the present invention, the pushup cam is provided between each piezoelectric element piece and the corresponding tactile pin so as to be pivotable. The pushup cam is formed to have such a large angle (obtuse angle) between the first action piece and the second action piece that the pushup cam can be slightly bent. Thus, the tactile pin is pushed up as a result of a small pivot angle associated with a bending operation of the corresponding piezoelectric element piece. This enables a reduction in the space required to pivot each pushup cam. Consequently, the spacing between the piezoelectric element pieces and the tactile pins can be reduced. It is thus possible to set a much smaller distance between the tactile pins.

**[0067]** Furthermore, according to an embodiment of the present invention, when a braille graphics tactile apparatus is configured by connecting a plurality of above braille graphics cell modules together in the horizontal direction, it is possible to sharply reduce the height and longitudinal dimension of the whole apparatus. Consequently, the braille graphics tactile apparatus can be further miniaturized.

**[0068]** The present invention is not limited to the above embodiments. The present invention may be implemented by making many variations to the above embodiments without departing from the spirits of the present invention. Furthermore, each of the above embodiments includes various levels of the invention. Accordingly, various inventions can be extracted by properly combining a plurality of constituent requirements disclosed.

**[0069]** Further, even if some of the constituent requirements shown in each embodiment are deleted, a configuration free from these constituent requirements can be extracted as an invention if it can solve the problems described above and can produce the effects described above.

**[0070]** Additional advantages and modifications will readily occur to those skilled in the art. Therefore, the invention in its broader aspects is not limited to the specific details and representative embodiments shown and described herein. Accordingly, various modifications may be made without departing from the spirit or scope of the general inventive concept as defined by the appended claims and their equivalents.