tain an electrophoresis particle and a dielectric fluid therein. A size of the electrophoresis particle may range from about 10 to about 500 nm.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] The above and other features and advantages of the present invention will become more apparent to those of ordinary skill in the art by describing in detail preferred embodiments thereof with reference to the attached drawings in which:

[0018] FIG. **1** is a perspective view of a conventional braille display device;

[0019] FIG. **2** is an exploded cross-sectional view of the conventional braille display device of FIG. **1**;

[0020] FIG. **3** is a perspective view of a braille display device using an electrorheological fluid according to an exemplary embodiment of the present invention;

[0021] FIG. **4** is a partial cross-sectional view taken along line VI-VI' of FIG.**3**;

[0022] FIG. **5** is a cross-sectional view illustrating a state of the braille display device when an electrical field is applied according to an exemplary embodiment of the present invention; and

[0023] FIG. **6** is a cross-sectional view of a braille display device using an electrorheological fluid according to another exemplary embodiment of the present invention.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0024] Hereinafter, exemplary embodiments of the present invention will be described in detail. However, the present invention is not limited to the embodiments disclosed below, but can be implemented in various forms. Therefore, the following embodiments are described in order for this disclosure to be complete and enabling to those of ordinary skill in the art.

[0025] The present invention relates to a braille display device using an electrorheological fluid phenomenon, and characteristics of an electrorheological fluid are described below.

[0026] The electrorheological fluid is a suspension in which particles having a strong polarizability are dispersed in an insulating fluid, and its Theological mechanical characteristics change when a strong electric field is externally applied. When an electric field is applied to the electrorheological fluid, dispersed particles are polarized in a direction of an electric field to form a chain structure and its viscosity is rapidly increased, compared to when an electric field is not applied, so that it is solidified. Such solidification reversibly happens according to whether there is an electric field or not, and since a response speed to an electric field is between 3 and 10 seconds, it is regarded as a material which can be applied to various industrial fields.

[0027] In order for the electrorheological fluid solidified under an electric field to flow, a stress higher than a predetermined level, i.e., an external force more than a yield stress, should be applied. In the electrorheological fluid, particles are arranged between electrodes by an electric field, i.e., a static electrical attraction is more dominant than a hydrodynamic interaction in the fluid. That is, in a situation where there is no flow, only a static electrical attraction exists between particles. In this state, when a flow starts, a chain structure of particles starts to be destroyed, and so a hydrodynamic interaction is generated in the fluid.

[0028] The electrorheological fluid solidified under an external electric field has a typical visco-elastic characteristic. Unless a particle chain structure is maintained under an electric field so that a yielding happens, the electrorheological fluid shows a linear visco-elastic characteristic, and after a yield, it shows a non-linear visco-elastic characteristic. In a linear visco-elastic area, the electrorheological fluid dominantly exhibits the elasticity, and the higher the electrical field and a density of particles the more the elasticity.

[0029] Hereinafter, exemplary embodiments of the present invention are described below with reference to attached drawings.

[0030] FIG. **3** is a perspective view of a braille display device using an electrorheological fluid according one exemplary embodiment of the present invention, and FIG. **4** is a partial cross-sectional view taken along line VI-VI' of FIG.**3**.

[0031] Referring to FIGS. **3** and **4**, the braille display device **300** comprises a base body **310** having a plurality of insulating reception grooves **311** formed therein, a substrate **320** arranged below the base body **310**, an electrorheological fluid **370** arranged in a lower portion of the reception groove **311**, first and second electrodes **330** and **335** respectively arranged above and below the electrorheological fluid **370**, a plurality of braille pins **340** arranged on the second electrode **335**, and a braille pin protection film **350** above the braille pin **340**.

[0032] Referring to FIG. **4**, a plurality of reception grooves **311** are formed in the base body **310** which constitutes the braille display device **300** using the electrorheological fluid **370**. The size of the plurality of insulating reception grooves **311** depends on the size of the braille display device, and may be in a range of millimeters to centimeters. The substrate **320** is arranged below the base body **310** having the plurality of reception grooves **311** to support the base body **310**, and the first electrode **330** and a first electrode protection film **331** for protecting the first electrode **330** are arranged on the substrate **320**. The first electrode **330** may be arranged over the entire area of the substrate **320** or may be arranged on areas corresponding to the plurality of reception grooves **311** in a pixel form. That is, the first electrode **320** may comprise one or more electrodes.

[0033] The electrorheological fluid is in a lower portion **311***a* of a groove **311**. The electrorheological fluid comprises microcapsules **371** for encircling particles **373** and **374**, which are distinctively operated by an electric field and dispersed, and an insulating dielectric fluid **372**. Preferably, particles **373** and **374** are nanosize electrophoresis particles. The insulating dielectric fluid **372** may include mineral oil, synthetic oil, plant oil, or a mixture thereof. The synthetic oil may include silicon oil, diester oil, Poly Alpha Olefin (PAO) oil, and fluorine saturated hydrocarbon oil. The plant oil may include soy-bean oil and maize oil.

[0034] In one exemplary embodiment of the present invention, the microcapsules **371** which surround the particles (e.g., electrophoresis particles) **373** and **374** are prepared, but particles **373** and **374** which are distinctly operated by an electric field may be dispersed in the electrorheological fluid **370** without using the microcapsules **371**. The first electrode protection film **331** serves not only to protect the first electrode **330** but also to separate the reception groove **311** and the electrorheological fluid **370** and to keep the microcapsules **371** from being attached to the first electrode **330** when the