freezing point, etc. The particles included in the electro-rheological fluid **130** are advantageously very fine, transparent particles having a maximum size of about 50 μm. However, the particle size is advantageously on the order of a few microns. The particles may be polymers, such as aluminosilicate, polyanilin, polypyrrole, fullerene, or any other kind of insulative materials, such as ceramics, or the like. Non-transparent ERF may also be used in some applications.

[0034] Also, spacers **136** (see FIG. **4**B) may be provided in a dispersed manner in the gap between the upper and lower substrates **120** and **110**. The spacers are elastic elements and made of small, transparent particles whose size is less than several tens of micrometers. Materials used to form the spacers are not limited, and for example, the spacers may be made of an elastomer, such as silicon rubber or the like. The spacers are used to provide the upper substrate **120** with restoring force and support the upper substrate **120** structurally. That is, the spacers operate as elastic elements between the upper and lower substrate, and allow the substrates to recover the original film shape in a very short time after a click operation, which will be described later. The spacers are advantageously spaced throughout the touch panel **100** in a uniform manner. However, other types of distribution patterns may be used as long as the spacers may provide the restoring force and structural support. For example, at the edge side of the touch panel, the film tension is stronger than that of the center portion. Thus, it may be possible use fewer spacers in the edge side region. That is, the spacer distribution may be varied depending on the location within the touch panel **100**.

[0035] The driving voltage V_d is provided, for example, by a driving circuit **250**, to drive the touch panel **100** and thus vary the viscosity of the electro-rheological fluid **130**, and may be supplied from a power supply of electronic equipment on which the touch panel **100** is mounted. The driving voltage V_d is used to delimit a button area on the user contact surface S, and provides a user with a clicking sensation when pressing a part of the button area. For this, the touch panel **100** may include a controller (not shown) to control the operation of the touch panel **100**. In this exemplary configuration, the controller is connected to a sensing unit (not shown) which senses any input from a user, and controls the driving voltage V_d to be applied to an upper electrode **144** and a lower electrode **142** of the driving electrodes **140**. That is, the controller controls the on/off state of a switch, according to an user's input signal sensed by the sensing unit. The controller may be implemented as an electrical circuit for controlling electronic equipment on which the touch panel **100** is mounted, or as a part of a microprocessor or a separate electrical circuit.

[0036] The sensing unit of the touch panel **100** senses a user's input or a degree of a user's input, and generates a signal according to the presence or amount of a user's input. The sensing unit may also sense only the presence of a user's input with respect to the button area. Alternatively, the sensing unit may sense a degree of a user's input as one level from a plurality of possible levels, in addition to the presence of the user's input. For example, thickness differences of the gap between the upper and lower substrates **120** and **110** in the button area may be divided into a plurality of levels, so that a level or amount of a user input is determined depending on how wide the gap is, that is, which level of the plurality of levels the gap width corresponds to. The gap size may be measured by the capacitance change between the upper electrode and the lower electrode.

[0037] FIG. **1**B is a cross-sectional view of the touch panel **100** in a configuration in which the driving voltage V_d is supplied by the driving circuit **250** to the driving electrodes **140** of the touch panel **100**. As described above, the driving electrodes **140** are used to delimit a button area and provide a clicking sensation to a user when the user presses a part of the button area. This process of delimiting the button area will be described in more detail later. Hereinafter, an area of the touch panel **100** on which no electric field is formed regardless of the presence or absence of the driving electrodes **140** is denoted as "a first area I" and an area of the touch panel **100** on which an electric field is formed is denoted as "a second area II".

[0038] When a driving voltage is applied to the touch panel **100**, electro-rheological fluid **130** located in the second area II reacts in response to an electric field formed between the driving electrodes **140**, so that the viscosity of the electro-rheological field **130** may increase to a maximum of about 100,000 times in a very short time period, for example, on the order of a few milliseconds. For example, a viscosity change of 100,000 times typically occurs at 1 V/μm electric field intensity and 0.00001 (1/s) shear rate. Since such variation in viscosity of the electro-rheological field **130** may happen reversibly, the viscosity of the electro-rheological field **130** is lowered to its original degree if the electric field disappears. This change similarly occurs in a very short period, for example, on the order of a few milliseconds. The viscosity of the electro-rheological field **130** changes as a function of the electric field intensity (in V/μm) and increases under an electric field because the particles **134** having a polarization behavior become aligned along the orientation of the electric field, as illustrated in FIG. **1**B.

[0039] When a driving voltage is applied to the driving electrodes **140**, the viscosity of the electro-rheological fluid **130** located in the second area II sharply increases, but the viscosity of the electro-rheological fluid **130** located in the first area I is maintained in its current state. Consequently, a significant difference in viscosity occurs between the first and second areas I and II. Due to this significant difference in viscosity, the second area II of the touch panel **100** provides a repulsive force which is proportional to a user's pressing force. Also, if the driving voltage continues to be supplied in the situation illustrated in FIG. **1** B, the fluidity of the electro-rheological fluid **130** located in the first area I is limited due to the second region II.

[0040] As such, when a driving voltage applied to the touch panel **110** is maintained, the user contact surface S of the upper substrate **120** is partitioned into the first area I and the second area II due to the local increase in viscosity of the electro-rheological fluid **130**. That is, by using the first and second areas I and II, a button area may be delimited on the user contact surface S. For example, the second area II in which the viscosity of the electro-rheological fluid **130** increases and in which the repulsive force is raised may be defined as an input button area. Alternatively, the first area I in which the viscosity of the electro-rheological fluid **130** is maintained in its original state may be defined as an input button area, or a part surrounded by the second areas II among the first areas I may be defined as a button area. Alternatively, a combination of areas in which the viscosity is raised and areas in their original state may be used to define a button area. Examples showing the delimiting of a button area using the first and second areas I and II will be provided later below.