

TOUCH PANEL, METHOD OF MANUFACTURING THE SAME, AND INPUT DEVICE USING THE SAME

FIELD OF THE INVENTION

[0001] The present invention relates to a touch panel to be used for operating various electronic devices, to a method of manufacturing the touch panel, and to an input device including the touch panel.

BACKGROUND OF THE INVENTION

[0002] As various electronic devices, such as cellular phones and car-navigation systems, have been having sophisticated functions, an input device including a light-transmittable touch panel mounted onto a front surface of a display element, such as a liquid crystal display (LCD), have been used. While looking at a display on the display element behind the touch panel, an operator pushes the touch panel with a finger or a pen for switching various functions of the electronic devices. The touch panel is required to have an excellent visibility and be inexpensive.

[0003] FIG. 11 is a sectional view of conventional touch panel 5001 disclosed in Japanese Patent Laid-Open Publication No.2005-274667. This drawing is enlarged in its thickness direction in order to illustrate its structure more understandable. Touch panel 5001 includes substrate 1 which has a film shape and is light-transmittable, substrate 2 which is light-transmittable, upper resistance layer 3 made of light-transmittable resistor, such as indium tin oxide (ITO), placed on a lower surface of substrate 1, and lower resistance layer 4 made of light-transmittable resistor, such as ITO, placed on an upper surface of substrate 2. Plural dot-spacers made of insulating resin are provided at predetermined intervals on an upper surface of lower resistance layer 4. Pair of upper electrodes are formed at both ends of upper resistance layer 3, respectively. A pair of lower electrodes are formed at both ends of lower resistance layer 4 which are arranged in a direction perpendicular to the direction in which the upper electrodes. Spacer 5 having substantially a frame shape is adhered onto respective outer peripheries of substrates 1 and 2 with adhesive layers provided on upper and lower surfaces of spacer 5, so that upper resistance layer 3 faces lower resistance layer 4 by a predetermined gap between the surfaces.

[0004] Adhesive layers 7A and 7B are provided on upper and lower surfaces of sheet 6, respectively. Adhesive layer 7A is bonded to a lower surface of substrate 2, and removable paper 8 is attached onto adhesive layer 7B.

[0005] Removable paper 8 is peeled off from touch panel 5001, and then adhesive layer 7B is bonded to a front surface of a display element, such as a liquid crystal display (LCD), thus providing touch panel 5001 mounted onto the electronic device. The upper electrodes and the lower electrodes are connected to an electronic circuit of the electronic device.

[0006] While looking at a display on the display element through touch panel 5001, an operator pushes an upper surface of substrate 1 with a finger or a pen. Substrate 1 accordingly sags and causes upper resistance layer 3 to contact lower resistance layer 4 at a pushed portion of the substrate. The electronic circuit applies a voltage to the upper electrode, and detects, via the lower electrode, a

voltage corresponding to the pushed portion of the upper electrode. Then, the circuit applies a voltage to the lower electrode and detects, via the upper electrode, a voltage corresponding to the pushed portion. The electronic device calculates the pushed portion based on the detected voltages, then switching various functions of the electronic device.

[0007] A method of manufacturing touch panel 5001 will be described below. FIGS. 12A to 12C are sectional views of touch panel 5001 for illustrating the method of manufacturing the touch panel. As shown in FIG. 12A, substrate 1 and substrate 2 are bonded to spacer 5. Then, sheet 6 is attached onto the lower surface of substrate 2 with roller 9, as shown in FIG. 12B. Roller presses the left side of substrate 2 to cause the left side of substrate 2 to sag upward and to compress air between substrates 1 and 2, accordingly causing the right side of substrate 2 to expand downward and producing swell 2C. As a result, as shown in FIG. 12C, sheet 6 is attached onto substrate 2 while air bubble 2D is produced between substrates 1 and 2. Upon being attached onto the display element with sheet 6, touch panel 5001 causes air bubble 2D to prevent the operator hard from looking at the display element.

[0008] In order to avoid the production of air bubble 2D, the pressure applied by roller 9 to sheet 6 is precisely adjusted, or roller 9 is moved slowly so as not to produce swell 2C, thus increasing labor and time to manufacture the panel.

[0009] Touch panel 5001 may be attached onto the display element with misalignments due to a positional deviation. In order to be removed from and again attached onto the display element, in the case that touch panel 5001 is removed at adhesive layer 7A from the display element, sheet 6 which remains and is attached onto the display element is necessarily peeled off again. In the case that panel 5001 is removed at adhesive layer 7B from the display element, layer 7B which remains and is attached onto the display element is necessarily peeled off. Thus, both the cases require a certain work and time for mounting panel 5001 onto the display element again.

SUMMARY OF THE INVENTION

[0010] A touch panel includes a first substrate, a first resistance layer on a surface of the first substrate, a second substrate, a second resistance layer on a surface of the second substrate, a spacer having substantially a frame shape provided between outer peripheries of the first and second substrates, a sheet having a surface attached to the surface of the second substrate with a first adhesive layer, and a second adhesive layer on the surface of the sheet. The second resistance layer faces the first resistance layer by a predetermined gap between the second and first resistance layers. The second adhesive layer has an adhesion property weaker than that of the first adhesive layer.

[0011] This touch panel can be attached onto a display element again easily.

BRIEF DESCRIPTIONS OF THE DRAWINGS

[0012] FIG. 1A is a sectional view of a touch panel in accordance with Exemplary Embodiment 1 of the present invention.

[0013] FIG. 1B is a sectional view of an input device in accordance with Embodiment 1.