

[0014] FIG. 2 is an exploded perspective view of the touch panel in accordance with Embodiment 1.

[0015] FIGS. 3A to 3C are exploded sectional views of the touch panel for illustrating a method of manufacturing the touch panel in accordance with Embodiment 1.

[0016] FIG. 4 is a sectional view of another touch panel in accordance with Embodiment 1.

[0017] FIG. 5 is a sectional view of still another touch panel in accordance with Embodiment 1.

[0018] FIG. 6 is a sectional view of a further touch panel in accordance with Embodiment 1.

[0019] FIG. 7 is a sectional view of a further touch panel in accordance with Embodiment 1.

[0020] FIG. 8A is a sectional view of a touch panel in accordance with Exemplary Embodiment 2 of the invention.

[0021] FIG. 9 is an exploded perspective view of the touch panel in accordance with Embodiment 2.

[0022] FIG. 10A is a sectional view of a touch panel in accordance with Embodiment 3 of the invention.

[0023] FIG. 10B is a sectional view of an input device in accordance with Embodiment 3.

[0024] FIG. 11 is a sectional view of a conventional touch panel.

[0025] FIGS. 12A to 12C are exploded sectional views of the conventional touch panel for illustrating a conventional method of manufacturing the touch panel.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Exemplary Embodiment 1

[0026] FIG. 1A is a sectional view of touch panel 1001 in accordance with Exemplary Embodiment 1 of the present invention. FIG. 1B is a sectional view of input device 2001 in accordance with Embodiment 1. FIG. 2 is an exploded perspective view of touch panel 1001. In FIGS. 1 and 2, sizes in its thickness direction are enlarged to be more understandable. Touch panel 1001 includes substrate 1, substrate 2, resistance layer 3, and resistance layer 4. Substrate 1 has upper surface 1A and lower surface 1B opposite to upper surface 1A. Substrate 2 has upper surface 2A and lower surface 2B opposite to upper surface 2A. Substrates 1 and 2 are made of light-transmittable insulating film, such as polyethylene terephthalate or polycarbonate. Resistance layer 3 is provided on lower surface 1B of substrate 1 and is made of light-transmittable resistance material, such as indium tin oxide or tin oxide. Resistance layer 4 is provided on upper surface 2A of substrate 2 and is made of light-transmittable resistance material, such as indium tin oxide or tin oxide. Resistance layers 3 and 4 are formed by sputtering.

[0027] Electrodes 32A and 32B made of electrically conductive material, such as silver or carbon, are provided at both ends of resistance layer 3 in along direction 1001A, respectively. Electrodes 33A and 33B made of electrically conductive material, such as silver or carbon, are provided at both ends of resistance layer 4 in direction 1001B perpendicular to direction 1001A.

[0028] Spacer 15 has substantially a frame shape, and is made of insulating material, such as non-woven fabric or polyester film. Adhesive material, such as acrylic or rubber, is applied on upper surface 15A of spacer 15, and outer periphery 1E of substrate 1 is adhered on upper surface 16A. Similarly, adhesive material, such as acrylic or rubber, is applied on lower surface 15B of spacer 15, and outer periphery 2E of substrate 2 is adhered on lower surface 15B. Lower surface 3B of resistance layer 3 faces upper surface 4A of resistance layer 4 by a predetermined gap between the surfaces. Plural dot spacers 31 made of insulating resin, such as epoxy or silicone, are formed on upper surface 4A of resistance layer 4 at predetermined intervals.

[0029] Sheet 16 is made of light-transmittable film, such as polyethylene terephthalate or polycarbonate, and has upper surface 16A and lower surface 16B opposite to upper surface 16A. Adhesive agent, such as acrylic, having a strong adhesion property is applied onto upper surface 16A, thus providing adhesive layer 17A. Sheet 16 is attached onto lower surface 2B of substrate 2 with adhesive layer 17A. Adhesive agent, such as silicone rubber, having a weak adhesion property is applied onto lower surface 16B of sheet 16, thus providing adhesive layer 17B. Removable sheet 18 made of thin film, such as paper or polyester film, is attached onto adhesive layer 17B having the adhesive property weaker than that of adhesive layer 17A.

[0030] As shown in FIG. 1B, removable sheet 18 is peeled off, and adhesive layer 17B on lower surface 16B of sheet 16 is attached onto display surface 101A of display element 101, such as a liquid crystal display (LCD), thus providing input device 2001.

[0031] A portion of spacer 15 is cut out to form opening 15C which allows inside 15D of the frame shape to communicate with outside 15E of the frame shape. Sheet 16 has tab 16C protruding outward, and tab 16C is bent upward, so that tab 16 covers and closes opening 15C of spacer 15. Tip 16D of tab 16C is attached onto upper surface 1A of substrate 1 with adhesive layer 17A having the strong adhesion property.

[0032] FIGS. 3A to 3C are exploded sectional views of touch panel 1001 for illustrating a method of manufacturing the touch panel in accordance with Embodiment 1. As shown in FIG. 3A, substrate 1 is attached onto upper surface 15A of spacer 15, and substrate 2 is attached onto lower surface 15B of spacer 15. Then, sheet 16 is attached onto lower surface 2B of substrate 2 with adhesive layer 17A. At this moment, as shown in FIG. 3B, roller 9 presses sheet 16 onto substrate 2 toward substrate 1. Roller 9 presses a portion of substrate 2 and causes substrate 2 to sag upward, namely, toward substrate 1, thus compresses air between substrates 1 and 2. The air can enter and exhaust through opening 15C provided in spacer 15. Substrate 2 does not expand downward, thus not producing a swell (swell 2C shown in FIG. 12A). This prevents an air bubble (air bubble 2D shown in FIG. 12C) from being produced due to the swell of substrate 2. In other words, even if roller 9 presses the substrate rather strongly or moves rather fast, no air bubble is produced between lower surface 2B of substrate 2 and sheet 16. This allows sheet 16 to be attached onto substrate 2 while producing no air bubble which reduces visibility of display element 101.

[0033] Then, as shown in FIG. 3C, tab 16C of sheet 16 is bent upward as to covering opening 15C of spacer 15. Tip