

[0045] In the operation of these touchpads, whether the key input has been completed is known to the user by means of the feedback sensation provided by the change in shape of the covering directly, without the need for the response from a control system to perceive whether the action of pressing and releasing the key has been completed. Unlike a smooth surface of the former touchpad, it is considerably definite and easy for the user to find out and operate the key by the use of the structure made on the key region of the cover, particularly at night.

[0046] FIG. 18 shows a top view of a touchpad according to the present invention. Each key region 44 of the cover 42 is provided thereon with a pattern representative of a key. This pattern may be not only in the form of a flat printed on the surface of the key region 44 or adhered on the key region 44, as examples, but also a solid body, such as a pattern or rugged surface shaped on the key region 44.

[0047] Except for the flat shape in each of aforementioned embodiments, the touchpad may be also formed into a curved shape. As shown in FIG. 19, the sensor 10 and cover 22 may be presented as a curved surface each, respectively, while the key region may be also formed thereon with the projecting structure or recessed structure in the above embodiments.

[0048] FIG. 20 is a diagram showing the relationship between the amount of deformation ΔD of a cover and the variance in capacitance ΔC generated by a sensor. When a key region is not pressed yet, the variance in capacitance is zero, since there is no deformation generated in the cover. The deeper the key region is depressed, the greater the amount of deformation ΔD of the cover is; i.e., the variance in capacitance ΔC is larger as the finger approaches the sensor further, as indicated by a curve 46. C1 represents a critical value regarding when the key signal is permissibly generated, and the pressing depth corresponding thereto is indicated by D1. In other words, the key signal may be generated by the sensor when the pressing depth ΔD of the key region exceeds the critical value D1. The sensitivity of the key may be adjusted by means of the adjustment of the critical value. For instance, the key signal is triggered more easily by the touchpad having a critical value set as C2 than by that having the critical value set as C1. Also, the sensitivity of the key may be affected by the flexibility of the cover. For instance, the amount of deformation of a more flexible cover may exceed the critical value D1 so as to generate the key signal under a less pressure. The operation of the sensor is well known in this art, possibly achieved by hardware, software, or firmware.

[0049] The cover may be fixed to the sensor or support member by means of gluing, screwing, insertion, or in other ways. Taking the example of the touchpad illustrated in FIG. 3, as shown in FIG. 21, an adhesive 48 is applied around the periphery of the surface of the sensor 10, so as to glue the cover 14 to the sensor 10. Taking the example of the touchpad illustrated in FIG. 12, as shown in FIG. 22, screws 50 are used to screw the cover 14 onto the support member 32 at four corners of the touchpad. Taking the example of the touchpad illustrated in FIG. 14, as shown in FIG. 23, there are provided with posts 52 at the bottom of the cover 14, and insertion holes 54 provided on the support member 32 and sensor 10. By forcing the posts 52 into the insertion holes 54, the cover 14 may be then fixed to the support member 32.

The cover is replaceable in some embodiments. For instance, a cover with different key patterns or structure may be used instead, in order to simulate different keys or change the positions of key regions. The sensitivity of the key may be changed when a more flexible or stiffer cover is used substitutively. The additional advantages, such as replacement of the dirtied or scraped one, may be obtained in case the replaceable cover is used.

[0050] In the present invention, although sensation of tactile key is induced by the deformation of the cover, the disadvantage of the mechanical key, such as demands for precise electrical contact points and for debounce mechanism, and mechanical wear, as examples, may not emerge accordingly. Therefore, the advantages of touchpad and the mechanical key may be obtained simultaneously without any disadvantage of the latter in the present invention.

[0051] While the present invention has been described in conjunction with preferred embodiments thereof, it is evident that many alternatives, modifications and variations will be apparent to those skilled in the art. Accordingly, it is intended to embrace all such alternatives, modifications and variations that fall within the spirit and scope thereof as set forth in the appended claims.

What is claimed is:

1. A touchpad having capability of inducing sensation of tactile key, comprising:

a sensor; and

a deformable cover provided over the sensor, the deformable cover having a key region.

2. The touchpad of claim 1, wherein the key region is provided with a projecting structure.

3. The touchpad of claim 1, wherein the key region is provided with a recessed structure.

4. The touchpad of claim 1, wherein the key region is provided with a flat structure.

5. The touchpad of claim 1, wherein the key region is provided thereon with a pattern representative of a key.

6. The touchpad of claim 1, wherein the deformable cover is an insulator.

7. The touchpad of claim 1, wherein the deformable cover is presented as a flat shape.

8. The touchpad of claim 1, wherein the deformable cover is presented as a curved shape.

9. The touchpad of claim 1, wherein the deformable cover is glued to the sensor.

10. The touchpad of claim 1, wherein the deformable cover is screwed onto the sensor.

11. The touchpad of claim 1, wherein the deformable cover is inserted into the sensor.

12. The touchpad of claim 1, further comprising a support member provided between the deformable cover and the sensor.

13. The touchpad of claim 12, wherein the key region is provided with a projecting structure.

14. The touchpad of claim 12, wherein the key region is provided with a recessed structure.

15. The touchpad of claim 12, wherein the key region is provided with a flat structure.

16. The touchpad of claim 12, wherein the key region is provided thereon with a pattern representative of a key.

17. The touchpad of claim 12, wherein the support member is an insulator.