

between a PC board and the plastic sheets of the keyboard. It would be another advantage to utilize the plastic sheets for the touchpad sensor electrodes of the touchpad, thereby reducing cost and complexity of the keyboard. Another advantage would be to provide a new way to mount the touchpad sensor electrodes to a keyboard case, regardless of the presence of the plastic sheets for the keyboard itself. Finally, it would be an advantage to provide the touchpad sensor electrodes on a flexible material such as the plastic or mylar sheets, to thereby enable the touchpad to conform to curved surfaces, such as the inside of a keyboard case.

### OBJECTS AND SUMMARY OF THE INVENTION

It is an object of the present invention to provide a flexible surface on which the touchpad sensor electrodes are disposed, to thereby enable the surface of the touchpad to be disposed along arcuate surfaces.

It is another object to integrate a touchpad and a keyboard in a keyboard case, wherein the touchpad replaces PC board material normally used for the touchpad sensor electrodes, with the plastic sheets used in construction of the key sensing apparatus.

It is another object to improve the connection between a PC board and plastic sheets used for the touchpad sensing electrodes.

It is another object to eliminate a pressure connector and replace it with a more reliable and less costly connection device.

It is another object to reduce the cost of manufacturing keyboards by manufacturing the touchpad sensor electrodes using the conductive ink used for the electrical traces of the keyboard circuitry.

It is another object to enable the sensor electrodes to be manufactured using a relatively imprecise silk screening process by using touchpad circuitry which has a high degree of tolerance for variations in manufacturing.

It is another object to dispose the sensor electrodes on plastic sheets and then to secure the plastic sheets directly to the underside of a keyboard cover, thereby eliminating the need to cut a hole in the keyboard cover for a user to access the touchpad.

In a preferred embodiment, the present invention is a touchpad formed from the combination of a flexible and non-conductive material used for a touch-sensitive surface, and a PC board on which is mounted the touchpad circuitry, wherein touchpad sensing electrodes are disposed on the touch-sensitive surface by creating electrical traces formed from conductive ink, the touch-sensitive surface being capable of conforming to various arcuate surfaces, and being capable of sensing through a protective housing such that the touch-sensitive surface is protected, and does not come in direct contact with the pointing object.

In a first aspect of the invention, the touchpad is disposed within a keyboard having multiple layers of plastic sheets where electrical traces are disposed thereon using a conductive ink, wherein the touchpad sensor electrodes are disposed on the same plastic sheets, but which are extended into a touchpad area.

In a second aspect of the invention, a new connector couples the electrical traces of the plastic sheets to at least one separate PC board which includes keyboard or touchpad circuitry, so as to generate data regarding keystrokes and touchpad control.

In a third aspect of the invention, touchpad sensing electrodes are disposed on the plastic sheets using a low-cost

process which inherently has low manufacturing tolerances such as silk-screening.

In a fourth aspect of the invention, manufacturing tolerances for disposing the touchpad sensing electrodes on the plastic sheets can be low because the circuitry which is driving the touchpad sensing electrodes has a significantly higher dynamic range built-in to its design.

In a fifth aspect of the invention, the touchpad sensing electrode are disposed on plastic sheets which are in turn disposed directly onto the underside of an arcuate top cover of a keyboard case.

In a sixth aspect of the invention, the touchpad circuitry and sensing electrodes are sufficiently sensitive to enable detection and tracking of a pointing object on the keyboard case directly above the touchpad sensing electrodes.

These and other objects, features, advantages and alternative aspects of the present invention will become apparent to those skilled in the art from a consideration of the following detailed description taken in combination with the accompanying drawings.

### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top elevational view of a prior art keyboard having a touchpad included therein which is representative of the prior art in touchpad surfaces.

FIG. 2 is a perspective view of a prior art keyboard having a touchpad included therein which is representative of the prior art in keyboards having integrated touchpad surfaces from Cirque Corporation.

FIG. 3 is a perspective view of three plastic sheets used in construction of sensing electrodes used in prior art keyboard designs.

FIG. 4 is a perspective view of plastic sheets used in a keyboard which is made in accordance with the preferred embodiment of the present invention, and which includes space on the sheets for touchpad sensing electrodes of the touchpad to be disposed thereon.

FIG. 5A is an elevational view of a prior art connector between plastic sheets and a PC board, wherein a pressure connector is used to secure electrical connections therebetween.

FIG. 5B is a profile view of FIG. 5A.

FIG. 6 is an elevational profile view of a PC board having solder bubbles, and a plastic sheet that is connected to the PC board using an adhesive material.

FIG. 7 is a top elevational view of FIG. 6.

FIG. 8 is a first embodiment of how a solder bubble can be used to increase the effectiveness of an electrical connection between a PC board and touchpad sensing electrodes on a plastic sheet.

FIG. 9 is a preferred embodiment of an improvement over the design shown in FIG. 8.

### DETAILED DESCRIPTION OF THE INVENTION

Reference will now be made to the drawings in which the various elements of the present invention will be given numerical designations and in which the invention will be discussed so as to enable one skilled in the art to make and use the invention. It is to be understood that the following description is only exemplary of the principles of the present invention, and should not be viewed as narrowing the claims which follow.

The presently preferred embodiment of the invention is a touchpad formed from the combination of a flexible and