FLEXIBLE TOUCHPAD SENSOR GRID FOR CONFORMING TO ARCUATE SURFACES

CROSS REFERENCE TO RELATED APPLICATIONS

This document claims priority to, and incorporates by reference, all of the subject matter included in the provisional patent application filed on Jan. 11, 2000, and having Ser. No. 60/175,586.

BACKGROUND

1. The Field of the Invention

This invention relates generally to combining computer input devices such as keyboards and touchpads. More specifically, the invention relates to combining the existing components of a keyboard and an integrally constructed touchpad, and for an improved system for coupling a PC board with touchpad circuitry to the keyboard components. The invention also relates to combining a flexible sensor portion of a touchpad, and the rigid circuit component portion of the touchpad, to each other

2. The State of the Art

The prior art includes systems which provide a computer input device having an integrated touchpad. For example, the prior art includes kiosks, computer keyboards, and information appliances that utilize touchpads as an input interface. Probably the most common device is a computer keyboard. It is well known in the art of keyboards and touchpads that they can be included within a same keyboard case or chassis. For example, FIG. **1** shows a top view of a typical QWERTY arranged keyboard **10** from the prior art which has moved the 10-key numeric pad **12** closer to the letter keys, and disposed a touchpad **14** into its place.

FIG. **2** is another keyboard **18** from the prior art which utilizes an ergonomic design. These keyboards **18** have a touchpad **20** disposed beneath the keys in a wrist resting area. This arrangement enables the 10-key keypad **22** to remain in its most familiar location in the keyboard **18**.

Unfortunately, disposing a touchpad into a keyboard is not always a straightforward task for some important reasons. For example, it is obviously desirable to make keyboards as inexpensively as possible. While touchpads also have component costs, they also have certain configuration requirements that are different and often more costly than those of keyboards. These aspects will be discussed after explaining the internal structure of a typical prior art keyboard.

FIG. **3** is provided to illustrate one method of manufacturing the internal structure of keyboards. In this figure, the internal layout of the keyboard is shown as being made using several layers of sheets made from a plastic-like material such as mylar. The sheets are generally non-conductive in nature. A first sheet **30** has a plurality of electrical traces **32** laid out using a conductive material such as carbon ink or silver ink. The electrical traces **32** intersect locations that keys make contact with on the first sheet **30** when the keys of a keyboard are depressed. The ink can also be disposed on the mylar using a simple silk screening process.

It is important to understand that this ink application process is not extremely precise, and therefore is generally used in processes where tolerances are high, such as on keyboard electrical traces. The third mylar sheet **36** also has electrical traces **38** which intersect each of the locations of the keys of the keyboard as do the electrical traces **32** of the first sheet **30**, but typically in a different axis.

The second or middle mylar sheet **40** is used to separate the first sheet **30** from the third sheet **36** when a key is not being pressed. A plurality of holes **42** are made in the second sheet **40** which also correspond to the locations of keys of the keyboard. Thus, when a key is pressed, an electrical trace **32** on the first sheet **30** is pressed into contact with an electrical trace **38** on the third sheet **36** as made possible because of a corresponding hole **42** in the middle or third sheet **36**. This pressing together of a set of electrical traces **32**, **38** at a unique location completes an electrical path which is sensed by keyboard circuitry in order to determine which key was pressed. The keyboard circuitry is at least one integrated circuit which is located on a PC board which is separate from the plastic sheets **30**, **36**, **40**.

Having explained typical internal structure and operation of a prior art keyboard, the addition of a touchpad complicates construction because touchpads typically require a rigid PC board as part of the sensing circuitry. For example, a capacitance sensitive touchpad generally requires a PC board to be used as the surface upon which sensing electrodes are disposed. The reason for using the PC board is that the relative positions of the electrodes typically require great precision because prior art touchpad sensing circuitry does not have large manufacturing error tolerances. This intolerance to manufacturing irregularities is generally a function of the touchpad circuitry itself. Touchpad circuitry is inherently sensitive to electrical noise, electrode spacing, and other factors that inhibit the ability to accurately detect and determine the location of a pointing object on the touchpad surface.

For example, X and Y electrical traces are laid out in a very precise pattern or grid. The error tolerance (dynamic range) of all touchpad circuits known to the inventors are such that without a precise grid layout that can only be consistently achieved using a PC board, the touchpads will not function. In other words prior art touchpad are generally so sensitive that it is necessary to include a PC board for the touchpad sensing electrode grids inside the keyboard case if a touchpad is to be included.

In examining the construction of prior art keyboards which include a touchpad, the plastic sheets are typically moved out of the way or minimized in size in order to make room for a PC board that is used for the touchpad sensing electrodes. This is the case with the touchpad shown in FIG. **1**. In FIG. **2**, the larger size of the ergonomic keyboard allows a PC board to be included without major modifications, but still requires the use of a large PC board for the touchpad. It is also necessary to cut an aperture through the keyboard case to thereby expose the touchpad surface to the pointing object.

In addition to the inclusion of a PC board for the touchpad sensing electrode grids, it is necessary to include some means for connecting the electrical traces **32**, **38** on the plastic sheets **30**, **36**, **40** to control circuitry. The control circuitry is mounted on PC boards inside the keyboard case. This connecter has to be relatively strong because of the nature of the materials being used.

For example, the ink used in the electrical traces can oxidize. Accordingly, a connecter is used which applies a relatively large amount of pressure to force the electrical traces against corresponding electrical traces on a PC board. This pressure typically overcomes the oxidation, but requires the extra hardware involved in making the pressure connection.

It would be an advantage over the prior art to provide a means for reducing the amount of PC board required for a touchpad that is mounted inside a keyboard case. It would be another advantage to improve the connection interface