

[0024] FIG. 4 is a cross-sectional view of the data entry panel of the invention taken along line 4-4 of FIG. 1.

[0025] FIG. 5 is a plan view of the inside surface of a portion of the upper layer of flexible material.

[0026] FIG. 6 is a plan view of the inside surface of a portion of the lower layer of flexible material corresponding to the portion of the upper layers illustrated in FIG. 5.

[0027] FIG. 7 is a cross-section of an alternative frame member.

[0028] FIG. 8 is a cross-section of a second alternative frame member having an electronic cable.

[0029] FIG. 9 is a detailed cross-section of a switching means.

[0030] FIG. 10 is a detailed cross-section of a key.

[0031] FIG. 11 is a detailed cross-section of an alternative key.

[0032] FIG. 12 is a cross-section of a second embodiment of the invention.

[0033] FIG. 13 is an inside plan view of an upper layer of flexible material of the invention taken along line 13-13 of FIG. 12.

[0034] FIG. 14 is a plan view of an intermediate layer of flexible material of the invention taken along line 14-14 of FIG. 12.

[0035] FIG. 15 is an inside plan view of a lower layer of flexible material of the invention taken along line 15-15 of FIG. 12.

[0036] FIG. 16 is a plan view of a third embodiment of the invention, illustrating a music keyboard.

[0037] FIG. 17 is a plan view of a fourth embodiment of the invention, illustrating an integrated microcomputer.

[0038] FIG. 18 is a plan view of a fifth embodiment of the invention, illustrating a personal communication device.

[0039] FIG. 19 is a plan view of a sixth embodiment of the invention, illustrating a programmable calculator.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0040] Turning now to the drawings, a collapsible date entry panel 10 of the invention is shown. The term "data entry panel" covers all types of input devices, including keyboards, key panels, pointing devices and other tactile input devices for computers, telephones, palm pilots, electronic games, and other electronic devices. The panel 10 comprises an upper layer of flexible sheet material 12, a lower layer of flexible sheet material 14, and a flexible frame 18 for holding the layers of sheet material in a substantially taut, spaced apart relationship. The data entry panel 10 of the invention is collapsible to a surface area less than $\frac{1}{2}$ and as small as $\frac{1}{3}$ of the extended panel, as shown in FIGS. 2 and 3. Specifically, by twisting the respective ends of the panel 10 in opposite directions, while applying a slight inward pressure, the frame 18 flips, twists and collapses onto itself. The collapsed panel typically comprises three lobes, thus having a surface area of about $\frac{1}{3}$ the original size. In its collapsed configuration, the panel can easily fit into a shirt

pocket. If the panel 10 is subsequently released, it will automatically spring back to its original, extended shape.

[0041] A plurality of electric circuits and switches are provided for the operation of the individual keys of the date entry panel of the invention. The circuits are at least partly held in between the upper and lower layers 12,14. More specifically, the electric circuits comprise conductive traces 26 printed on an inner surface of one or both of the layers 12,14. In the most preferred embodiment, conductive traces 26 are printed on the inner surface 24 lower layer 14. FIGS. 5 and 6 illustrate conceptually upper and lower traces, respectively, of the preferred embodiment. FIGS. 5 and 6 merely illustrate the basic concept that depression of a key completes a circuit unique to that key, which is then decoded for digital transmission. The traces or electronic circuits 26 are electrically connected to a multiple conductor cable 32. Cable 32 terminates in a plug 34.

[0042] A plurality of switching means are formed between the layers 12,14 for operation of individual keys. The switching means comprise pair of contacts, each pair being electrically connected to a respective electrical circuit. Depressing the upper layer 12 at a select location causes a pair of contacts at that location to meet, completing a circuit. The switching means may be formed in a variety of ways. In the most preferred embodiment, each circuit trace printed on the lower layer 14 includes a pair of closely spaced contact points 27a,27b. An inner surface 20 of the upper layer carries conductive contact or switch member 23. Contact 23 is preferably a metal disk to provide good contact and improved tactile feel; however, other conductive means could be used such as a spot of conductive ink. Each upper layer contact 23, corresponds to a pair of points 27a,27b, as shown in FIGS. 5, 6 and 9. The outer surface of upper layer of sheet material 12 has keys 30 or other indicia, which correspond to the contacts 23 and 27. When a user of the data entry panel of the invention depresses a key 30 the upper layer 12 depends downwardly causing contact 23 to meet and bridge the pair of contacts 27. This completes a circuit that is unique to the depressed key.

[0043] Optionally, one may provide a spacer 29 around one or both of the contacts. Spacer 29 is preferably formed of a soft electrometric material. The spacer functions to hold the upper and lower contacts in a spaced relationship. Because the material is soft, it is readily compressed by a finger (key stroke) to cause the contacts 23,27 to meet and complete the circuit for that key. The size and softness of the spacer 29 may be adjusted to provide a desired tactile feel to the data entry panel of the invention. Spacer 29 although desirable for some applications is not an essential element of the invention. Spacing between contacts is preferably provided by the cooperative relation between the frame and flexible sheet, that holds upper and lower layers taut and spaced apart one from the other. Further, the spacers 29 may provide added bulk that interferes with the collapsibility of the panel.

[0044] Decoding circuitry (not shown) converts the specific completed circuit into a signal representing the key that had been depressed for input to a microcomputer or other electronic device. Keyboard decoding circuitry is well known in the art. The decoding circuitry may advantageously be housed within plug 34, may be stitched into or otherwise held in panel 10, or may be held in a separate housing.