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# United States Patent [19]

Van Zeeland et al.

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[54] TAMPER RESISTANT MEMBRANE SWITCH

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**Robert S. Bielik**, Waukesha, Wis.

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[51] Int. Cl.<sup>6</sup> ..... **H01H 13/70; H01H 1/10**

[52] U.S. Cl. .... **200/5 A; 200/512; 200/517**

[58] Field of Search ..... **200/5 A, 159,**  
**200/292, 516, 512, 517**

### [57] ABSTRACT

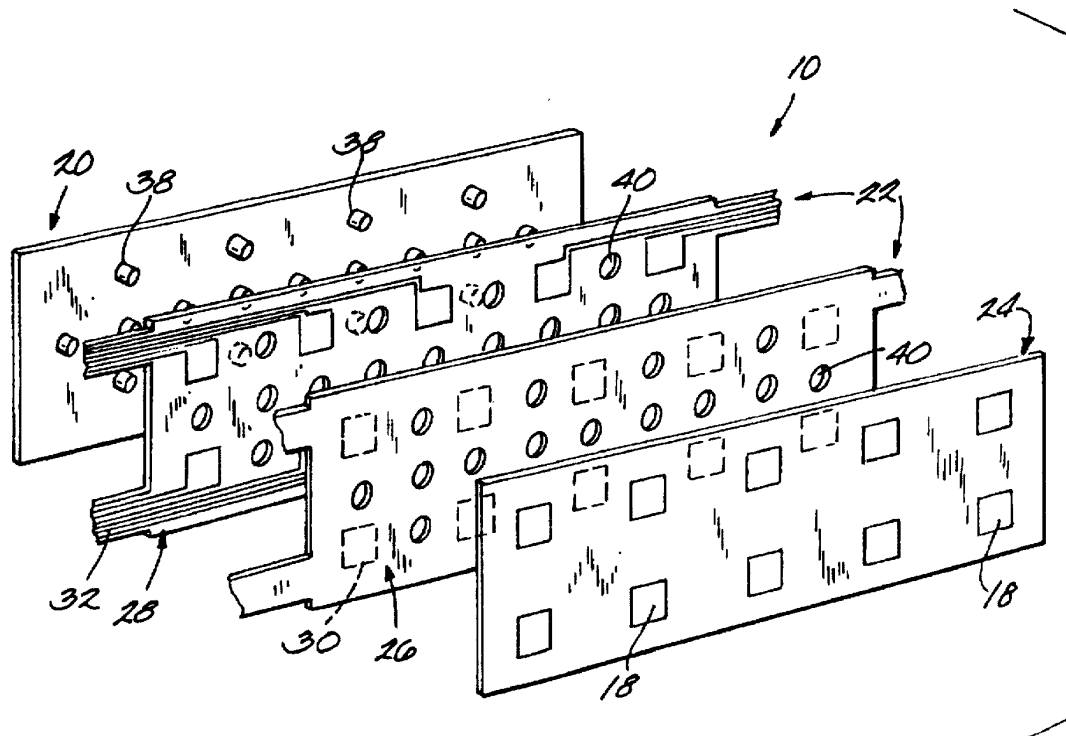
A tamper resistant membrane switch includes a backer plate and an overlying metal panel. Sandwiched between the backer plate and metal panel is a membrane switch subassembly. A plurality of spacers between the backer plate and metal panel separate the two but allow the metal panel to deflect toward the backer plate when external finger pressure is applied. Such deflection closes the underlying poles of the membrane switch subassembly to actuate the switch. The positioning and size of the spacers determines where deflection can occur and how much force is needed to actuate the switches. The overlying panel, being formed of solid metal over its entire surface, is resistant to damage from vandalism, thievery or other attack.

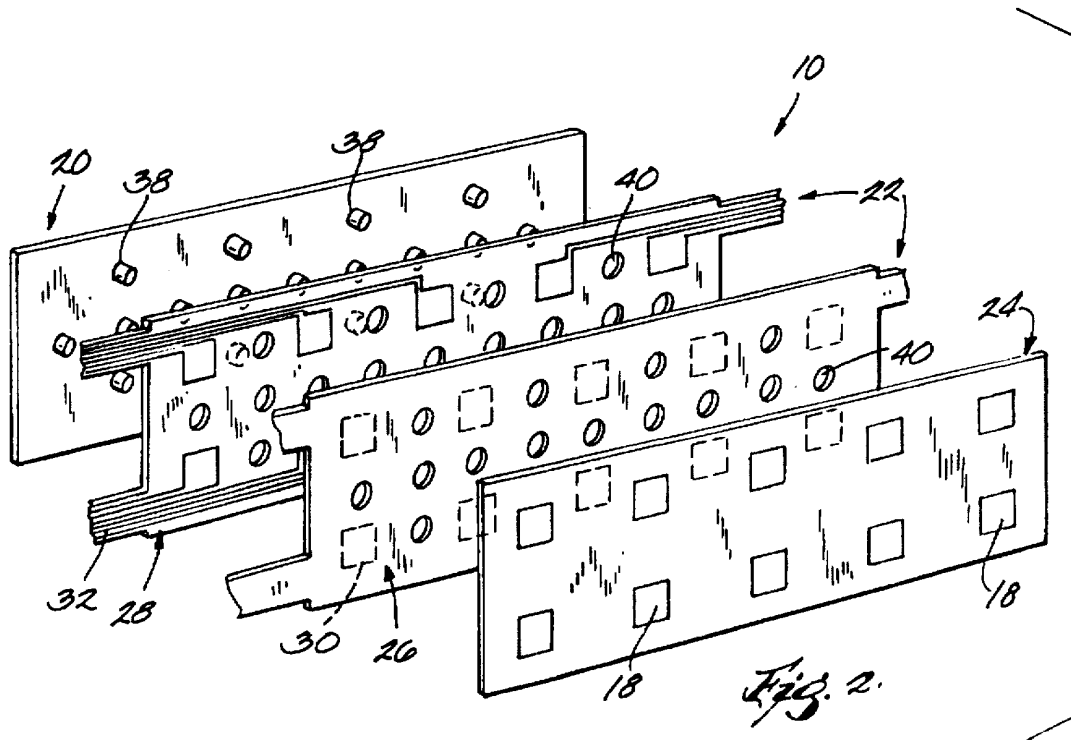
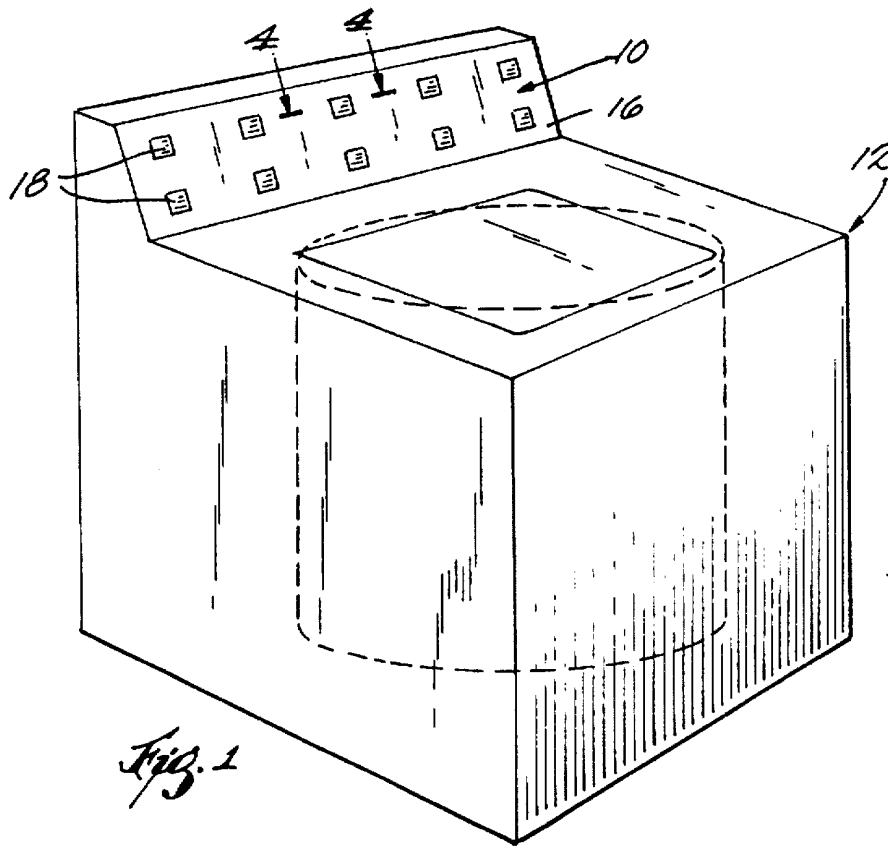
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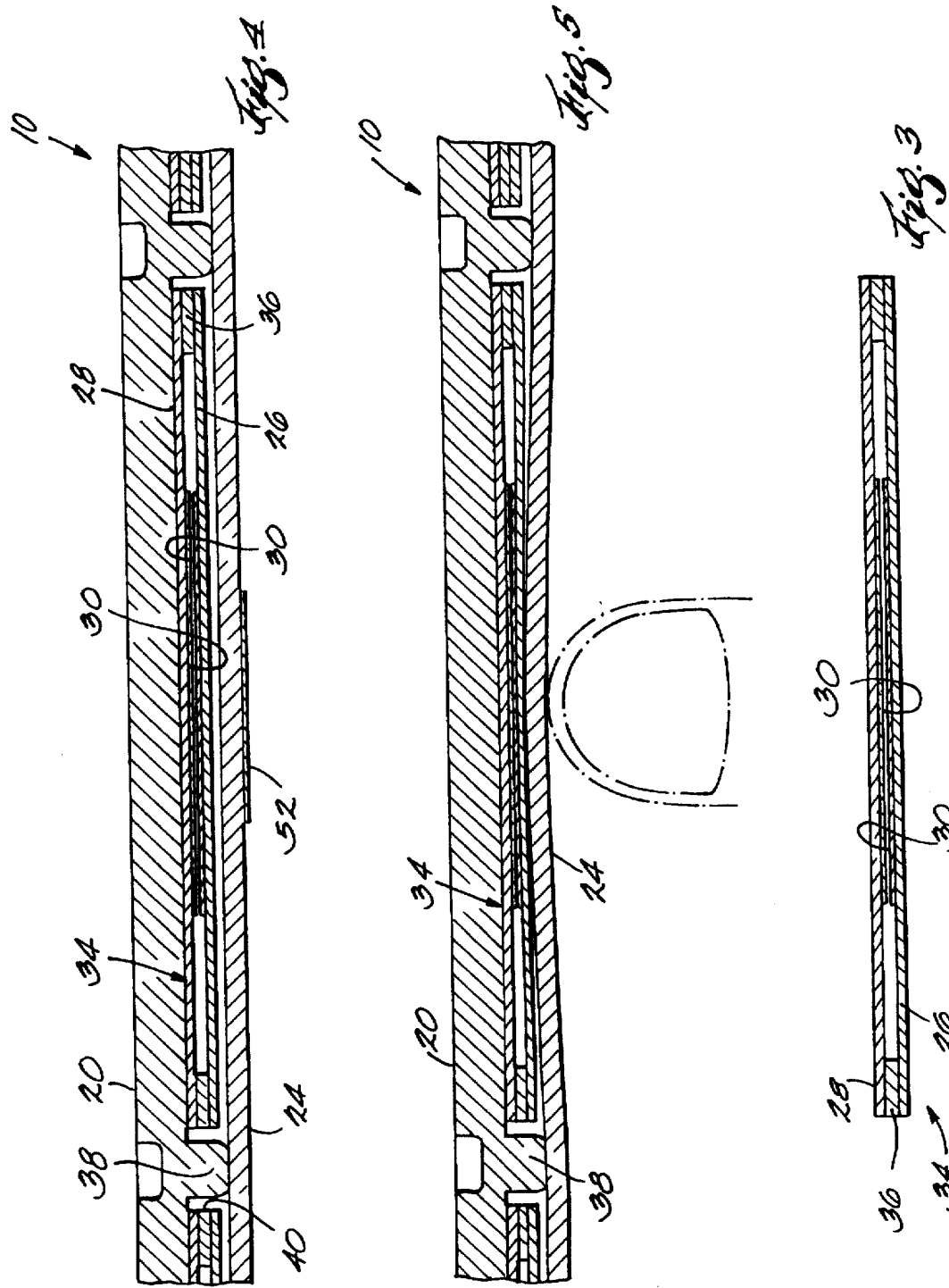
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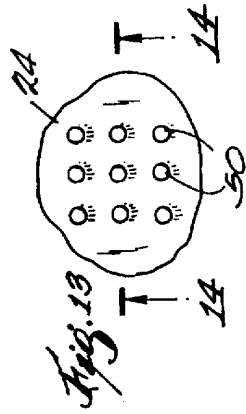
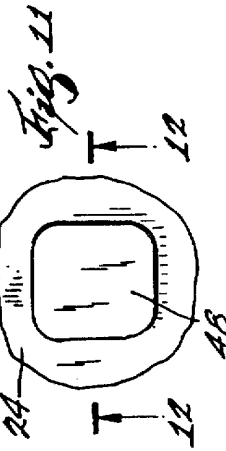
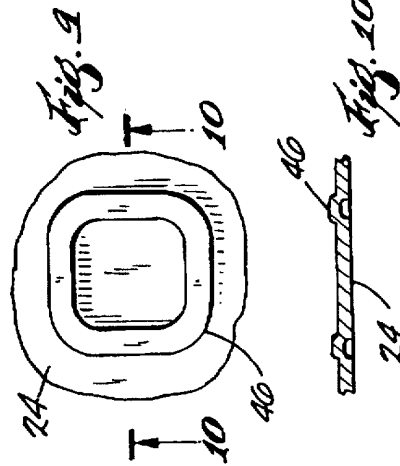
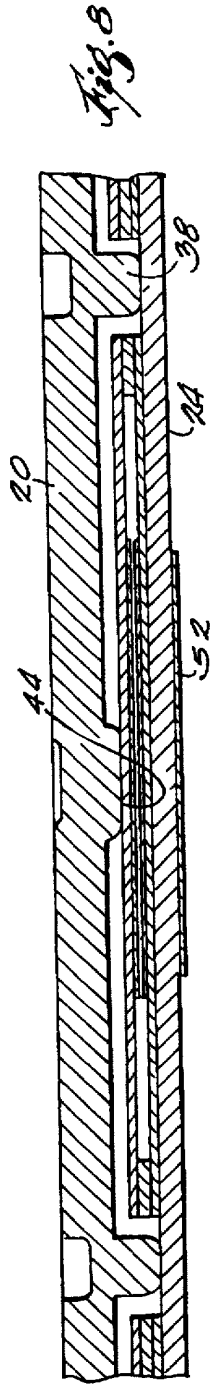
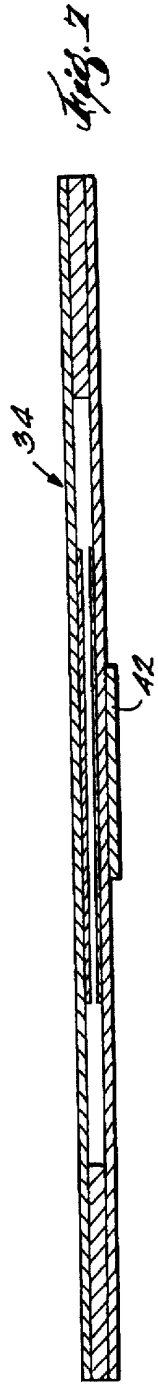
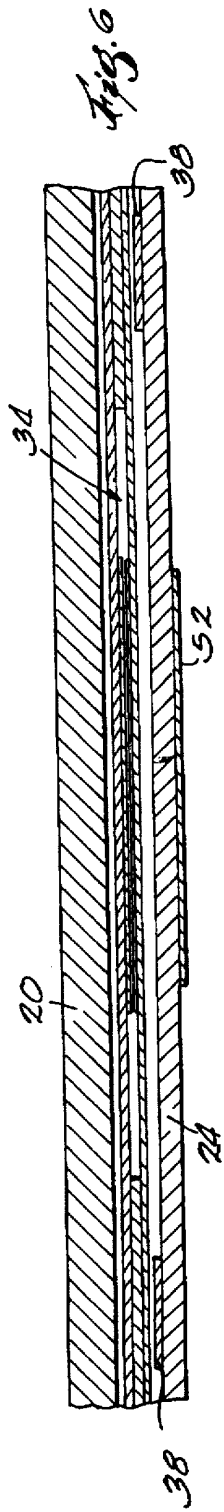
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**20 Claims, 3 Drawing Sheets**









**TAMPER RESISTANT MEMBRANE SWITCH****BACKGROUND OF THE INVENTION**

This invention relates generally to membrane switches and, more particularly, to membrane switch assemblies that are used, for example, on vending machines, washing machines or other devices made available for use by members of the public in a commercial or business setting.

Membrane switches are well-known in the electrical switch art. Such switches are frequently used in flush panel controls and typically include a membrane supported over and spaced from a substrate. Finger pressure applied to the switch pushes a conductive pad on the membrane into contact with a similar pad on the substrate. Contact between the pads closes the switch and completes the electrical circuit. Membrane switches are particularly well-suited for use in certain environments wherein it is desired to seal an electronic system against moisture, dust etc.

One application in which membrane switches have particular utility is in commercial vending machines, laundromat washing machines and the like. Such machines, which are typically left unattended in publicly accessible areas, are the frequent targets of thieves and vandals. One approach to combating thievery and vandalism centers on improving the physical integrity of the machine itself, thereby making it harder for lawbreakers to break into or otherwise physically damage the machine. Electrical switches and controls, which, necessarily, must remain responsive to relatively light input forces applied by legitimate users, are particularly vulnerable to damage by thieves and vandals. Although membrane switches are advantageous in that they eliminate protruding knobs, buttons and levers that are easily broken, such membrane switches have, until now, employed exposed plastic films and overlays that were susceptible to physical or cosmetic damage when subjected to vandalous attack. For commercial operators who lose money when machines are not in operating condition, "down time" due to vandalism or even ordinary wear and tear is a significant concern.

**SUMMARY OF THE INVENTION**

The invention provides a membrane switch assembly having a backer plate, a membrane switch subassembly disposed over the backer plate and a metallic overlay disposed over the membrane switch subassembly.

The invention also provides a membrane switch assembly including a backer plate, a membrane switch subassembly disposed over the backer plate and a protective, tamper-resistant overlay disposed over the membrane switch subassembly.

The invention also provides a tamper resistant membrane switch assembly including a substantially rigid backer plate defining a substantially planar upper surface and a plurality of standoffs adjacent the upper surface of the backer plate arranged so as to divide the upper surface of the backer plate into a plurality of switch-element receiving cells. The assembly further includes a plurality of membrane switch elements disposed over the upper surface of the backer plate and received in the switch-element receiving cells. A substantially rigid, substantially planar protective panel overlies the backer plate and the membrane switch elements. The protective panel is supported by the standoffs in the regions between the switch-element receiving cells and is unsupported in the regions over the switch-element receiving cells so as to be deformable toward the backer plate and into contact with individual ones of the membrane switch elements substantially in the regions over the switch-element receiving cells.

It is an object of the present invention to provide a new and improved membrane switch assembly.

It is a further object of the invention to provide a new and improved membrane switch assembly that is durable and free of knobs, buttons or exposed, physically delicate structures.

It is a further object of the invention to provide a new and improved membrane switch assembly that is suited for use in unattended, publicly accessible machines that are often the targets of vandalous attack.

It is a further object of the invention to provide a tamper resistant membrane switch assembly that is effective in use, that is relatively immune to false actuation and that is economical in manufacture.

**BRIEF DESCRIPTION OF THE DRAWINGS**

The features of the invention which are believed to be novel are set forth with particularity in the appended claims. The invention, together with the further objects and advantages thereof, may best be understood by reference to the following description taken in conjunction with the accompanying drawings, wherein like reference numerals identify like elements, and wherein:

FIG. 1 is a perspective view of a coin-operated, commercial-duty washing machine having a tamper resistant membrane switch assembly embodying various features of the invention.

FIG. 2 is an exploded perspective view of the tamper resistant membrane switch assembly shown in FIG. 1.

FIG. 3 is a sectional view of a typical membrane switch element used at various locations in the tamper resistant membrane switch, useful in understanding the operation thereof.

FIG. 4 is a sectional view of the tamper resistant membrane switch shown in FIG. 1 taken along line 4—4 thereof.

FIG. 5 is a sectional view, similar to FIG. 4, showing the switch in an actuated condition.

FIG. 6 is a sectional view of another embodiment of a tamper resistant membrane switch embodying various features of the invention.

FIG. 7 is a sectional view of still another embodiment of a tamper resistant membrane switch embodying various features of the invention.

FIG. 8 is a sectional view of still another embodiment of a tamper resistant membrane switch embodying various features of the invention.

FIG. 9 is a plan view of an alternate embodiment of a metal front plate or overlay used in a tamper resistant membrane switch embodying various features of the invention.

FIG. 10 is a sectional view of the metal front plate shown in FIG. 9 taken along line 10—10 thereof.

FIG. 11 is a plan view of another alternate embodiment of a metal front plate or overlay used in a tamper resistant membrane switch embodying various features of the invention.

FIG. 12 is a sectional view of the metal front plate shown in FIG. 11 taken along line 12—12 thereof.

FIG. 13 is a plan view of still another alternate embodiment of a metal front plate or overlay used in a tamper resistant membrane switch embodying various features of the invention.

FIG. 14 is a sectional view of the metal front plate shown in FIG. 13 taken along line 14—14 thereof.

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