



(11) **EP 1 883 088 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
30.01.2008 Bulletin 2008/05

(51) Int Cl.:
H01H 13/704 (2006.01)

(21) Application number: **07112822.7**

(22) Date of filing: **20.07.2007**

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IS IT LI LT LU LV MC MT NL PL PT RO SE
SI SK TR**
Designated Extension States:
AL BA HR MK YU

(72) Inventors:
• **Bervoets, Wim**
 B-2610, Wilrijk (BE)
• **De Cremer, Guy**
 B-1933, Sterrebeek (BE)
• **Leonard, Michel**
 B-1390, Archennes (BE)

(30) Priority: **28.07.2006 EP 06118033**

(71) Applicant: **Intellect International NV-SA**
1932 Zaventem (BE)

(74) Representative: **pronovem**
Office Van Malderen
Avenue Josse Goffin 158
1082 Bruxelles (BE)

(54) **Secure switchboard**

(57) The present invention is related to a switchboard comprising a PCB (10), a foil (20), at least one switch contact (11, 21) of the force-sensitive resistor type interposed between the PCB and the foil and a mesh (31) of

electrically conductive tracks for protection against tampering interposed between the switch contact and the foil. The conductive mesh adheres to the foil and to the PCB. The invention is also related to a method of manufacturing such a switchboard.

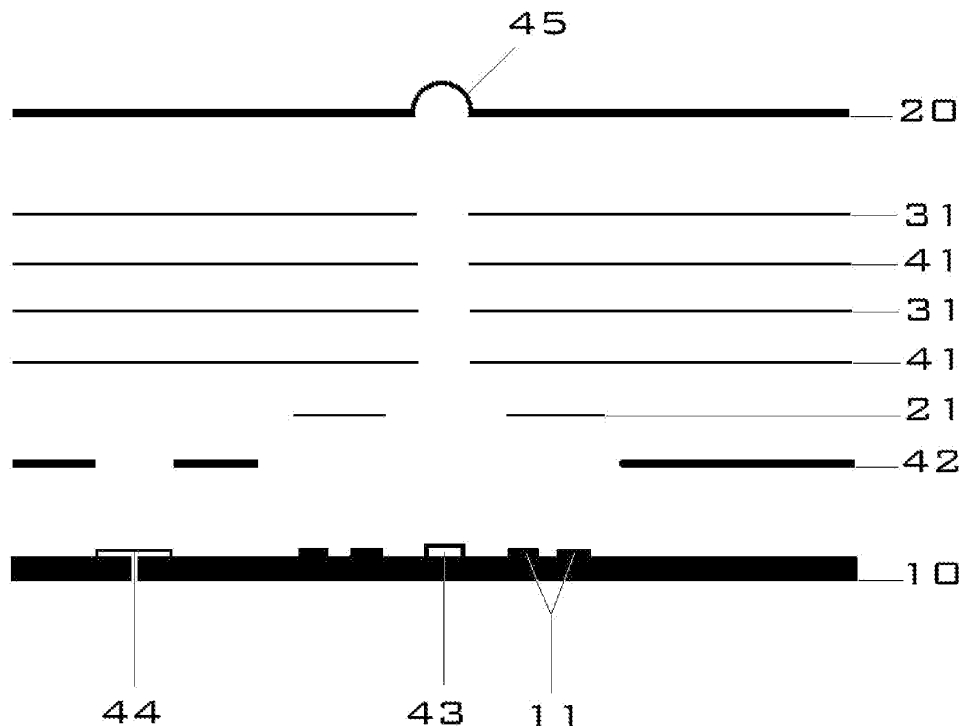


FIG 4

EP 1 883 088 A1

Description

Field of the Invention

[0001] The present invention is related to a switchboard in which the switch contacts are secured against unwanted probing or monitoring. The present invention is equally related to an apparatus incorporating such switchboard. Additionally, the present invention is related to a method of securing a switch on a switchboard.

State of the Art

[0002] Point of sale (POS) or point of interchange (POI) terminals require a high level of PIN protection. Classical POS keyboards based on ON/OFF switches with e.g. matrix scanning are quite easy to monitor even with fake key-scanning being active. In most cases it is always difficult and costly to add an extra protection layer to protect the electrical contact or "pole" of the keyboard switches from unwanted probing or monitoring. The same rule applies to security switches avoiding mechanical opening of a POS or POI terminals. For a robust (tentative) fraud detection, the appropriate security countermeasures should be taken. Hence, the present invention concerns the issue of providing highly secure keyboards, preventing probing of the key switches in order to remotely gain user PIN data inserted on the keyboard.

[0003] The state of the art does not solve the problem of ensuring, each time an extra protection layer is added (e.g. to protect the switches), that this protection layer is easily bypassed and then removed.

[0004] Document US 2003/0025617 discloses a foil keyboard built up out of two layers that are glued one on top of the other. The upper layer is a membrane comprising key contact pads. The key pads on both layers are surrounded by dashed conductive lines, such that when the two layers are joined, one shorted conductive track is formed around the keys. Any attempt to lift up the upper layer will result in the conductive track opening. The key contacts themselves are however still reachable through the membrane and are thus not secured.

[0005] Document WO 2005/086546 discloses a card reader, such as for a POS terminal, having a layered printed circuit board (PCB) with layers containing conductive serpentine tracks for tamper detection. The key contacts are provided on top of the PCB and are aligned with protrusions on a keyboard membrane. There are two sets of contact pairs: one for the keys (default open), a second set (default short) for tamper detection. An attempt to open the cover (and the keypad) is detected by an interruption in current flowing through the second set of contact pairs. Hence the terminal disclosed in the abovementioned document provides tamper detection for the cover, but not for the keys. In case that the tamper evidence switches can be bypassed, the key contacts can be easily probed.

[0006] Documents EP 1432031 and US 6438825 dis-

close PCBs with conductive serpentine tracks, either embedded into the PCB or wrapped around. Any attempt to reach to the enclosed components necessarily damages one of the conductive tracks.

[0007] In the IBM technical disclosure bulletin vol.33 no. 9 (February 1991), pp.448-449, a keyboard arrangement is disclosed in which a security mesh is printed directly on the inside of the keyboard enclosure. However, once an eavesdropper has managed to open the enclosure, the switches can be easily probed.

[0008] It is known from DE 19600768 to wrap a switchboard in a security foil comprising a mesh of resistive tracks. The foil is interposed between the switchboard and the enclosure, the latter comprising the keys for operating the switches. Due to the additional security foil however, sufficient pressure should be applied to the keys in order to generate a switch signal.

Aims of the Invention

[0009] The present invention aims at providing a secure switchboard in which the switch contacts are protected against probing and which overcomes the drawbacks of the prior art. It is an aim of the invention to provide at least an alternative secure switchboard which is better and/or cost-effective compared to secure switchboards of the prior art.

[0010] It is a further aim of the invention to provide a secure switchboard which allows to light the keys of the enclosure. It is also an aim of the invention to provide a secure switchboard with integrated tampering detection switches for the enclosure.

[0011] The present invention also aims at providing a method of manufacturing a secure switchboard.

Summary of the Invention

[0012] The present invention is related to secure switchboards, as set out in the appended claims, in which a high level of protection against unwanted probing and eavesdropping of the switch contacts is obtained by providing a mesh comprising one or more conductive tracks on top of the switch contacts. The present invention is equally related to apparatuses, such as point of sales terminals, incorporating the switchboards of the present invention. The present invention is also related to a method of manufacturing a secure switchboard as set out in the appended claims.

[0013] According to a first aspect of the invention, there is provided a switchboard comprising a carrier (e.g. a PCB), a foil on top of said carrier, at least one switch contact interposed between the carrier and the foil and a mesh of one or more electrically conductive tracks for protection against tampering. The mesh is interposed between the switch contact and the foil. The mesh adheres to the foil and to the carrier.

[0014] The adhering of the mesh to the foil and to the carrier is such that the mesh is damaged when the foil is

lifted up from the carrier. The damage is intended to be irrecoverable. The adhering may be direct or indirect, i.e. through additional interposed layers. Adhering of the mesh to the foil may be provided by printing of the mesh on the foil. Adhering of the mesh to the carrier may be provided by adhesive.

[0015] The switchboard preferably comprises an insulating layer interposed between the switch contact and the mesh. The insulating layer can extend over the foil and can also be interposed between carrier and mesh. The mesh adheres to the insulating layer and the insulating layer adheres to the carrier.

[0016] The carrier does not comprise parts of the mesh, i.e. the mesh is a unitary structure. Hence, the entire mesh adheres to the foil and to the carrier. The mesh is preferably formed of (or consists of) one continuous electrically conductive track. The mesh is preferably one unitary electrically conductive track.

[0017] The carrier preferably comprises switch-detecting circuitry. Switch-detecting circuitry is electrical circuitry arranged to detect the toggling of a switch contact.

[0018] Both the carrier and the foil are structural components of the switchboard. Each of them preferably comprises a part of the switch contact. At least one of the electrically conductive tracks of the mesh crosses (i.e. runs across) said switch contact. The carrier preferably embeds at a surface remote from the foil a second mesh of electrically conductive tracks, i.e. the one or more switch contacts can be completely enclosed by meshes of electrically conductive tracks.

[0019] Preferably, one or more additional meshes of electrically conductive tracks and one or more additional insulating layers are interposed between the foil and the switch contact. The one or more additional meshes and insulating layers adhere (either directly or through other layers) to each other, to the foil and to the carrier. More preferably, an insulating layer is interposed between two meshes.

[0020] Preferably, the one or more conductive tracks of the mesh are connected to circuitry arranged to detect a change in electrical resistance of said tracks. Preferably, the conductive tracks of the mesh are force-sensitive resistors.

[0021] Preferably, at least one switch contact is arranged to be a normal-closed contact. The switchboard preferably comprises at least one switch contact which is a normal-open contact. More preferably, the switchboard comprises both normal-open switch contacts and normal-closed switch contacts. The foil, the carrier and the switch contacts may form part of a keyboard.

[0022] The switch contact preferably comprises a force-sensitive resistor pad and a first electrically conductive pad. Preferably, said switch contact is connected to circuitry arranged for detecting a change in pressure force acting on the force-sensitive resistor pad. The force-sensitive resistor pad and the first electrically conductive pad co-operate for realising a switch contact. They are preferably in permanent physical contact. The

force-sensitive resistor pad is made of material whose electrical resistance decreases with increasing pressure force applied to it. The force-sensitive resistor pad preferably comprises ink whose electrical resistance is pressure-sensitive. The first electrically conductive pad preferably comprises at least two electrically conductive tracks.

[0023] Preferably, the switchboard according to the invention comprises at least one light emitting diode (LED) interposed between the carrier and the foil. The LED is arranged for lighting a key coupled to the switch contact. The LED is preferably arranged at a central location of the switch contact. The switch contact is preferably arranged around the LED.

[0024] Preferably, said switch contact comprises a second electrically conductive pad connected in parallel with the first electrically conductive pad. More preferably, the LED is interposed between the first and the second electrically conductive pads.

[0025] Preferably, the force-sensitive resistor pad is arranged for co-operating with the first and the second electrically conductive pads. More preferably, the switch contact comprises a second force-sensitive resistor pad arranged for co-operating with the second electrically conductive pad.

[0026] Preferably, the foil comprises a bump housing the LED. Preferably the mesh and more preferably also the insulating layer circumvent the LED.

[0027] According to another aspect of the invention, there is provided an apparatus, such as a point of sale terminal, comprising a switchboard of the invention.

[0028] The invention equally provides a method of manufacturing a secure switchboard comprising the steps of:

providing a carrier, preferably comprising switch-detecting circuitry;
providing at least one first pad on a top surface of the carrier;
providing a foil;
printing at least one electrically conductive mesh on the foil at a side thereof;
printing at said side of the foil an insulating layer on top of said mesh;
providing at said side, on top of the insulating layer, at least one second pad; and
adhering the foil onto the top surface of the carrier with said side facing the carrier, whereby said second pad on the foil corresponds to the first pad on the carrier. The mesh may be coupled to a pad providing connection to a tampering detection circuit. The first and/or the second pad is a force-sensitive resistor pad. Preferably, the step of providing at least one second pad comprises printing on top of the insulating layer at least one force-sensitive resistor pad. Corresponding first and second pads are operatively coupled. Either one of the first or the second pad may be an electrically conductive pad.

[0029] Preferably, the method further comprises the steps of providing a LED on the carrier and of embossing the foil so as to form a bump in the foil for housing the LED.

Brief Description of the Drawings

[0030] Figure 1 represents the top surface of a PCB carrier, showing electrically conductive pads of a switch contact.

[0031] Figure 2 represents a foil with force-sensitive resistor pads printed on it.

[0032] Figure 3 represents a foil printed with a mesh of conductive tracks.

[0033] Figure 4 represents an expanded cross section of a switchboard according to the invention, with the different layers visualised.

[0034] Figure 5 represents a typical plot of the electrical resistance R in function of the exerted pressure P for FSR-type materials.

Detailed Description of the Invention

[0035] In the following preferred embodiment, the secure switchboard of the invention is applied to a keyboard, such as for a point-of-sale terminal. The keyboard is of the membrane (or foil) type. The switchboard comprises switch contacts, as shown in figures 1 and 2, based on force sensitive resistor (FSR) technology. A switch contact comprises at least one contact pair. Each contact pair consists of two pads, as is explained in the following.

[0036] The switchboard comprises a PCB 10, which is a carrier of the circuitry arranged to detect key strokes of the keyboard and hence to detect whenever a switch of the switchboard is toggled. Other types of carriers are equally envisaged by the invention, such as flexible carriers, membranes, foils, etc.

[0037] Figure 1 depicts the top surface of printed circuit board (PCB) 10 comprising contact pads 11 and 12, which are electrically conductive pads. The switchboard of the invention further comprises a foil 20. Figure 2 depicts a foil (membrane) 20 comprising force-sensitive resistor (FSR) pads 21 and 22 printed on it. Pads 21 and 22 consist of an ink printed on the foil 20, whose electrical resistance changes with varying pressure (force) applied on the pads. The position of ink pads 21, 22 on the foil 20 corresponds to the position of electrically conductive pads 11, 12 on the PCB. The foil 20 is applied onto the PCB 10 with the ink pads 21, 22 faced towards the PCB. Hence, ink pads 21, 22 make contact with contact pads 11, 12 respectively. Contact pairs 11, 21 and 12, 22 may constitute a switch contact. Pads 11 and 12 may be connected to a resistor sensing circuit (not shown).

[0038] Pads 11 and 21 constitute together a switch contact pair. As can be seen in figure 1, conductive pad 11 comprises two separate tracks 111 and 112 that are bridged by ink pad 21. Upon pressing the foil at the location of pad 21, the ink is pressed and its electrical resistance changes, which can be measured by a circuitry

(not represented on the figures) connected to tracks 111 and 112. The same principle applies to the switch contact pair 12 and 22. The switch contact pairs in the present embodiment are of a FSR technology type.

[0039] A Force-Sensitive Resistor (FSR)-type switch contact does not move like a classical switch and hence does not suffer from the drawback of having a blind travel such as is the case for e.g. a classical detection switch. In contrast, a FSR-type switch gives an indication of the pressure exerted on the switch, giving the possibility to be very sensitive in the detection of attempts to tamper with e.g. the cover of a keyboard.

[0040] Pads 21 and 22 are made of a force-sensitive resistor (FSR) material (e.g. an FSR-type ink). The term "force-sensitive resistor" is also known in the art under the names of "force sensing resistor" or "pressure sensing resistor".

[0041] The electrical resistance of FSR materials varies with varying pressure exerted on the material. The resistance of FSR materials is inversely proportional to the force or pressure applied, i.e. the resistance decreases as the force increases. A typical plot of the resistance versus pressure function is given schematically in figure 5. In a first (low) range of pressures (forces) 51, the resistance of the FSR material can be very sensitive to the pressure applied. For a second (mid-)range of pressures 52, the resistance-pressure relation can be linear. In the second range 52, the sensitivity of the resistance to pressure is lower than in the first range 51. In a third (high) range of pressures 53, saturation can occur. When designing switches using FSR, use can be made of one or more of the three ranges 51, 52 and 53.

[0042] FSR materials typically comprise electrically conductive particles embedded in a matrix. The matrix can be electrically insulating. The FSR material can additionally comprise electrically insulating particles. When a force is applied on the FSR material, two aspects can be important which change the electrical resistance of the FSR material. Firstly, a force increase can compress the FSR material (the pads 21 and 22) and can bring the electrically conductive particles of the FSR material in closer contact, which decreases the resistance of the FSR material. Secondly, a force increase can increase the contact area between the FSR pad and the conductive pad 21 and 11 and 22 and 12 respectively, which additionally decreases resistance.

[0043] FSR materials are typically supplied as a polymer which can be printed (an ink). The FSR material (ink) can be applied on a film or foil by e.g. screen printing.

[0044] When the PCB carrier 10 and the foil 20 are assembled, pad 21 is so arranged to be in permanent contact with pad 11. The operation of the switch contact formed by the pair of pads 11 and 21 happens exclusively through detection of the change in electrical resistance of the electrical circuit to which the switch contact of pads 11 and 21 is connected. The change in electrical resistance is provoked by e.g. a user pressing the corresponding key on the keyboard. Hence, the electrical switch

components do not need to move anymore.

[0045] Switch contacts constituted by pads 11, 21 and 12, 22 may be employed both for normal-open and normal-closed switches, the configuration depending on the circuitry detecting the resistor change. In the present embodiment, let the switch contact pair 11 and 21 be configured to be a normal-open switch. Such a switch may be employed for a key contact of the keyboard. The resistance change of pad 21 is sensed whenever that key is pressed.

[0046] The same type of contact pair can be configured to obtain a normal-closed switch. In the present embodiment, let contact pair 12 and 22 be configured to be a normal-closed switch. The latter type of switch can be provided on the keyboard to detect mechanical tampering (e.g. opening attempt) of the terminal frame (the enclosure) in which the keyboard is mounted. The terminal frame in this case is equipped with a stud exerting a pressure (force) on the ink pad 22 when the frame (the enclosure) is closed. Any attempt of tampering with the frame (e.g. trying to open it) will cause a pressure variation, modifying the electrical resistance of ink pad 22, which is detected by the circuitry connected to pad 12.

[0047] In the configuration as depicted in figures 1 and 2, the switch contacts can be easily probed. The present invention adds a number of security measures to prevent the switch contacts from being probed (eavesdropped).

[0048] The invention provides the following method of manufacturing a secure switchboard. Before printing the ink pads 21 and 22 onto foil 20, a mesh comprising electrically conductive tracks running in serpentine lines, loops, etc. is printed at the same side of the foil. The mesh of electrically conductive tracks is printed on the same foil accommodating the ink pads 21 and 22 and at the same side thereof. A possible mesh 31 is shown in figure 3. Figure 4 depicts an expanded cross-sectional view of the assembly of PCB carrier 10 and foil 20. After printing mesh 31 on foil 20, an insulating layer 41 is printed on top of mesh 31, to insulate mesh 31 from pads 21 and 22. On top of this insulating layer, pads 21 and 22 are printed. As is clear from figure 3, the mesh 31 runs underneath the ink pads 21 and 22. The tracks of mesh 31 advantageously cross the pads 21 and 22. As the mesh 31 is printed on the foil, it adheres to the foil. Likewise, the insulating layer 41 printed on the mesh will adhere to the mesh (and by consequence to the foil).

[0049] The foil 20 is applied onto the PCB with adhering means (e.g. glue). Adhesive 42 can be applied around the pads on the foil. Adhesive 44 can also be applied directly on the PCB carrier. Thereafter, the foil 20 is applied on the PCB carrier 10, with the printed side facing the PCB. The adhesive may be a single type of adhesive. Alternatively, multiple types of adhesive (e.g. a strong type and weak type) may be employed simultaneously. Use of two different glues allows to develop a foil where any trial to lift up the foil from the PCB will ensure partial damage of the mesh allowing tampering detection.

[0050] More than one mesh 31 can be applied on the

foil in order to increase the efficiency of protection. An insulating layer 41 can be interposed in between two meshes 31, as represented in figure 4. The foil, printed with one or more meshes and insulating layers and with the ink pads on top is subsequently assembled onto the PCB, e.g. by gluing.

[0051] The method described above results in a switchboard comprising switch contacts (pairs 11, 21 and 12, 22) covered with one or more meshes of electrically conductive tracks and one or more insulating layers. The one or more meshes are interposed between the switch contacts and the foil. Hence, the mesh 31 is embedded in the switchboard, as the mesh 31 is provided on the same foil 20 which carries the pads 21 and 22. Even when the switchboard of the invention is removed from the keyboard enclosure, the switchboard still remains secure and eavesdropping of the switch contacts is not possible.

[0052] The electrically conductive tracks of each of the meshes are connected to a detection circuit through contact pads 15 on PCB 10. In case of more than one mesh, each mesh may have its own contact pads and detection circuit. Hence, as the tracks of the mesh have to be in electrical connection with contact pads 15, no insulating material may be printed on the foil where the mesh is to make contact with pads 15. Additionally, the printed layers applied on the foil, between the mesh and the PCB may comprise corresponding pads 23 (see figure 2) for ensuring electrical connection between the tracks of the mesh and contact pads 15. This is shown in figure 2, where the final printed layer with the ink pads 21 and 22 of the switch contacts comprises also pads 23 ensuring electrical contact between mesh 31 and contact pads 15.

[0053] The foil 20 comprising the mesh 31 adheres to the PCB carrier 10. An attempt to eavesdropping can be detected in two ways. Firstly, any one trying to remove the foil 20 from the carrier 10 will destroy the mesh 31, which is detected by the sensing circuit. Secondly, an attempt to removing the foil from the carrier or to reach with any device in between the foil 20 and the PCB carrier 10 will open the contact between pads 23 and 15, which can also be detected by the sensing circuit. The one or more tracks of mesh 31 can be made of any electrical conductive material (ink). They can be made of FSR material, although this is strictly speaking not necessary.

[0054] The ink used for printing the mesh and the resistive pads is preferably a resistive-type ink, such as an ink having the characteristics shown in figure 5. Such a type of ink may be easily removed. Partial damage to the mesh, e.g. when attempting to tamper with, or bridge the mesh, is immediately detected by sensing a change in one of the mesh's tracks' electrical characteristics. Shorts between consecutive meshes can also be detected.

[0055] The mesh 31 provides tamper detection when the foil is drilled through and when peeling off of the foil 20 from the PCB carrier 10 is attempted. Attempts to peel off the foil will result in the adhesive destroying part of the mesh (e.g. the ink detaches from the foil by the ad-

hesive), allowing detection.

[0056] In a further preferred embodiment of the invention, a secure switchboard is provided comprising one or more LEDs 43 for background lighting the keys of e.g. the keyboard (see figure 4). The LED 43 is provided on the PCB carrier 10, and connected to pins 14. In case the LED is placed centrally with reference to the key, the switch contact can not be placed centrally anymore, but is displaced. Different configurations are possible. Firstly, the ink and contact pads (the switch contact) can be shaped e.g. circularly around the LED. Alternatively, the switch contact may be comprised of two or more contact pairs placed around the LED. The latter configuration is depicted in figures 1 and 2, wherein two identical contact pads 11 and 13 are shown. The pads 11 and 13 are connected in parallel (not shown) to form one switch contact. Figure 2 shows the corresponding ink pads 21. Either ink pads 21 are two separate pads, or one single ink pad is provided covering both contact pads 11 and 13.

[0057] As the light emitted by the LED has to be visible by a user of the keyboard enclosing the switchboard of the invention, the foil 20 is preferably not printed on the spots corresponding to the LEDs. This can be seen in figures 3 and 4, where the mesh 31 and insulating layer 41 are made to circumvent the LED at spot 32, while still protecting the switch pads 21 and 22. In the embodiment shown in the drawings, the LED 43 is mounted on top of the PCB 10 and protrudes out of the PCB surface. In order for the foil 20 to be applied firmly onto the PCB (by adhesive 42 and 44), the foil comprises bumps 45 for housing the LEDs. The bumps are embossed in the foil 20 after the printing process. The foil encloses (covers) the LEDs, which provides an additional security protection. The LEDs are thus not provided on top of the foil, but interposed between the PCB 10 and the foil 20.

[0058] In a still further preferred embodiment of the invention, the contact pads 15 for electrical connection of mesh 31, and the contact pad 12 of the frame tamper detection switch may be merged.

[0059] The different layers printed on the foil (e.g. ink pads and mesh) can be made invisible by use of transparent ink and can be visually protected by an extra colour background (additional printed layer). The foil is preferably a polyethylene terephthalate (PET) or polyester foil. The foil thickness is preferably about 100 μm .

[0060] The hereabove described preferred embodiments provide a switchboard in which both tamper detection switch contacts 12, 22 and key switch contacts 11, 21 are secured by means of mesh 31. The present invention is equally applicable to e.g. a tamper detection switch contact pair that is secured by means of mesh 31.

[0061] According to another embodiment of the invention, there is provided a switchboard comprising a carrier (e.g. a PCB), said switchboard further comprising a foil on top of said carrier and at least one switch contact interposed between the carrier and the foil. On top of the switch contact at least one layer comprising a mesh of electrically conductive tracks is provided for protection

against tampering. Said mesh of conductive tracks covers the switch contact.

[0062] The switch contact comprises two contact pairs connected in parallel. A light emitting diode (LED) is interposed in between said two contact pairs. Preferably, the LED is connected to the carrier, and the foil covers the LED. More preferably, the foil comprises for each LED a bump accepting the LED.

[0063] The LED is preferably interposed between the carrier and the foil.

Claims

1. A switchboard comprising:

- a carrier (10),
- a foil (20) on top of said carrier,
- at least one switch contact interposed between the carrier (10) and the foil (20) and
- a mesh (31) of one or more electrically conductive tracks for protection against tampering, the mesh interposed between the at least one switch contact and the foil,

characterised in that the mesh adheres to the foil and to the carrier.

2. The switchboard according to claim 1, wherein an insulation layer (41) is interposed between said switch contact and said mesh.

3. The switchboard according to claim 1 or 2, wherein the one or more conductive tracks of the mesh are connected to circuitry arranged to detect a change in electrical resistance of said tracks.

4. The switchboard according to any one of the preceding claims, wherein at least one switch contact is a normal-closed contact (12, 22).

5. The switchboard according to any one of the preceding claims, further comprising a LED (43) interposed between the carrier (10) and the foil (20).

6. The switchboard according to any one of the preceding claims, wherein said switch contact comprises a force-sensitive resistor pad (21) and a first electrically conductive pad (11).

7. The switchboard according to claim 6, wherein said switch contact comprises a second electrically conductive pad (13) connected in parallel with the first electrically conductive pad (11).

8. The switchboard according to claim 7, comprising the LED (43) interposed between the carrier (10) and the foil (20), wherein the LED (43) is interposed in

between the first and the second electrically conductive pads (11, 13).

9. The switchboard according to claim 4 or 8, wherein the foil (20) comprises a bump (45) housing the LED. 5
10. The switchboard according to any one of the claims 5, 8 and 9, wherein the mesh (31) and preferably the insulating layer (41) circumvent the LED. 10
11. An apparatus, such as a point of sale terminal, comprising a switchboard according to any one of the preceding claims.
12. The apparatus according to claim 11, wherein the switchboard comprises a normal-closed switch contact, the apparatus comprising a frame comprising a stud for exerting a pressure on the normal-closed switch contact. 15
20
13. A method of manufacturing a switchboard comprising the steps of:
 - providing a carrier (10),
 - providing at least one first pad (11, 12, 15) on a top surface of the carrier; 25
 - providing a foil (20);
 - printing at least one electrically conductive mesh (31) on the foil at a side thereof;
 - printing at said side of the foil an insulating layer (41) on top of said mesh; 30
 - providing at said side, on top of the insulating layer, at least one second pad (21, 22); and
 - adhering the foil onto the top surface of the carrier with said side facing the carrier, whereby said second pad (21, 22) on the foil corresponds to the first pad (11, 12) on the carrier, whereby the mesh is coupled to a pad (15) providing connection to a tampering detection circuit and whereby at least one of the first and the second pad is a force-sensitive resistor pad. 35
40
14. The method according to claim 13, further comprising the steps of providing a LED (43) on the carrier and of embossing the foil so as to form a bump (45) in the foil for housing the LED. 45

50

55

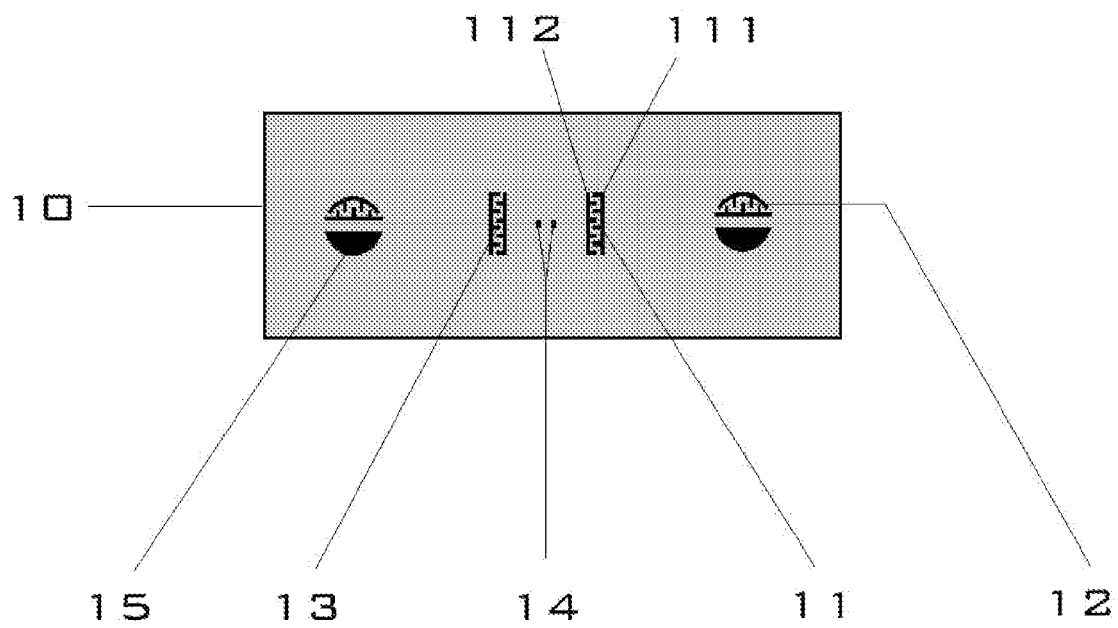


FIG 1

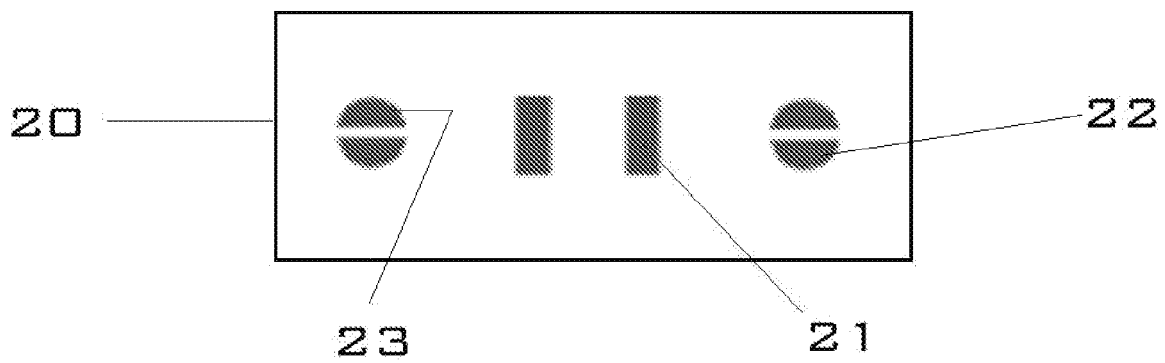


FIG 2

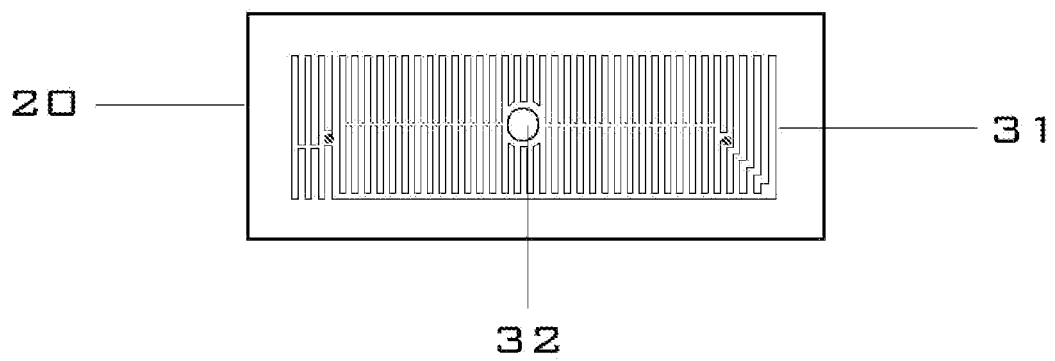


FIG 3

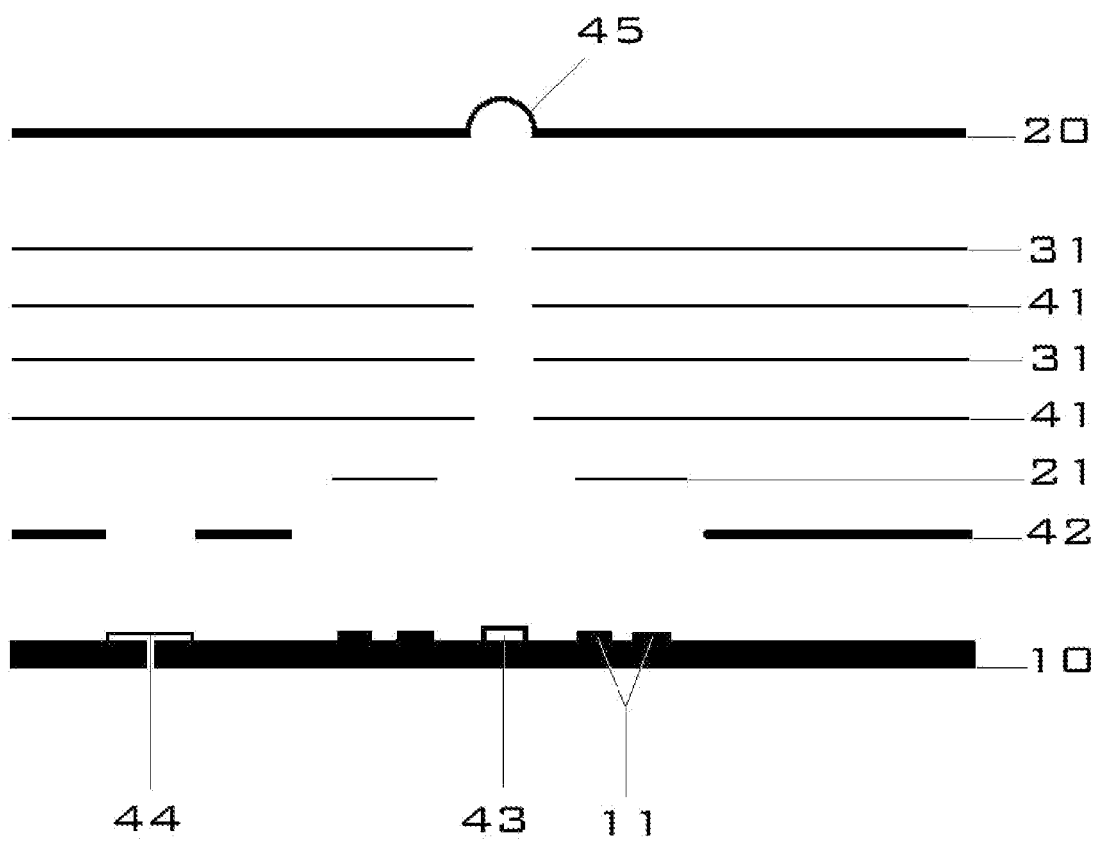


FIG 4

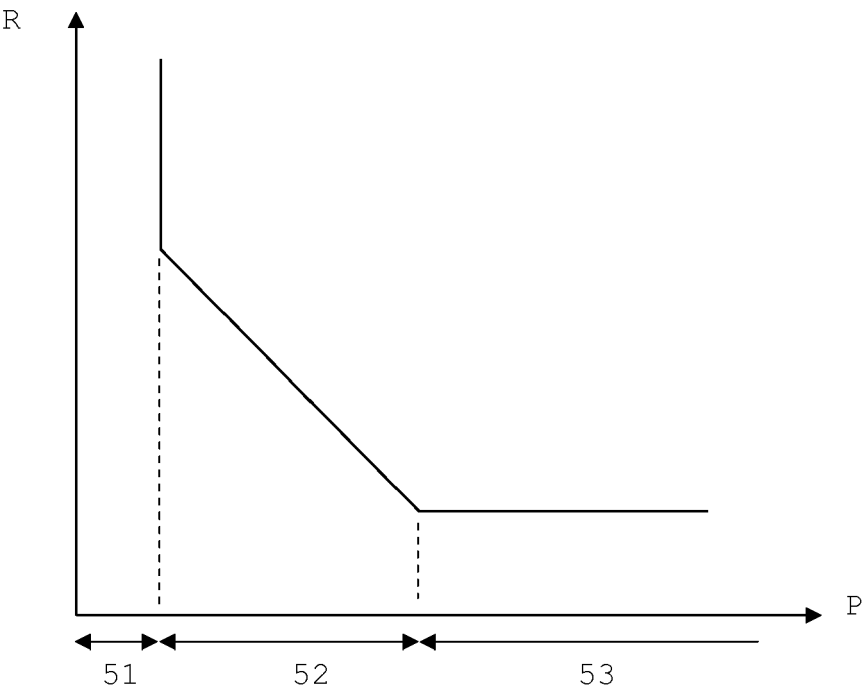


FIG 5



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 07 11 2822

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	"SECURITY GRID ARRANGEMENT TOTALLY ENCLOSING KEYBOARD SENSING ELEMENTS" IBM TECHNICAL DISCLOSURE BULLETIN, IBM CORP. NEW YORK, US, vol. 33, no. 9, 1 February 1991 (1991-02-01), pages 448-449, XP000109569 ISSN: 0018-8689 * the whole document *	1-11,13,14	INV. H01H13/704
A	DE 196 00 768 A1 (IBM [US]) 24 July 1997 (1997-07-24) * the whole document *	1-14	
D,A	US 2003/025617 A1 (KUNIGKEIT ECKHARD [DE] ET AL) 6 February 2003 (2003-02-06) * the whole document *	4,12	
A	US 2006/102458 A1 (KIM BO S [KR] ET AL KIM BO SOON [KR] ET AL) 18 May 2006 (2006-05-18) * paragraph [0080] - paragraph [0081] *	4,12	
			TECHNICAL FIELDS SEARCHED (IPC)
			H01H
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 1 November 2007	Examiner Ruppert, Christopher
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

3
EPO FORM 1503 03.82 (P04C01)

01-11-2007

EPO FORM P0459

12

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 20030025617 A [0004]
- WO 2005086546 A [0005]
- EP 1432031 A [0006]
- US 6438825 B [0006]
- DE 19600768 [0008]

Non-patent literature cited in the description

- *IBM technical disclosure bulletin*, February 1991, vol. 33 (9), 448-449 [0007]