A method of manufacturing a key plate for an electronic keyboard

A method of manufacturing a key plate 1 for an electronic keyboard comprises forming a plurality of key recesses 10 in a plate member, with each recess comprising a base 12 and side walls 14 configured to receive a keyboard key; a plurality of keyboard keys are provided comprising a key cap 36, a key cap support (i.e. scissor or dome mechanism) and a movable actuator for engaging a corresponding node of an electrical input membrane; at least one attachment element for attachment to a keyboard key is formed in the base of each recess, and at least one aperture 26 is formed extending through the base of each recess for receiving at least a portion of a movable actuator of a keyboard key; a keyboard key is located in each recess and said key is secured to the at least one attachment member such that the movable actuator is aligned with and able to move into the aperture in the base. The aperture may be sealed using a flexible membrane. Parallel plate sensors may be placed beneath the apertures.
A Method of Manufacturing a Key Plate for an Electronic Keyboard

The present invention relates to a key plate for an electronic keyboard assembly and in particular to a waterproof laptop keyboard assembly, and a method of manufacturing the same.

Keyboards provide an interface between a computer and a user, with the user providing input commands to the computer via the keyboard. A computer keyboard essentially comprises a series of switches connected to a microprocessor that monitors the state of each switch and initiates a specific response to a change in that state. For desktop computers the keyboard is provided as a stand alone component remote from the computer. In portable laptop and notebook computers the keyboard is an integrated part of the computer unit.

A typical laptop keyboard assembly of the prior art comprises a plurality of keys each supported on a scissor mechanism configured to return the key to a rest position. The scissor mechanisms are connected to a support plate which supports the mechanisms. The support plate comprises a thin open frame work having a plurality of connection tabs for connecting to and anchoring the scissor mechanisms of the keys. Beneath each scissor mechanism is an elastic dome member. A membrane switch assembly is sandwiched between the keys and the support plate, and the membrane assembly may include apertures through which the connection tabs of the support plate extend to connect to the scissor mechanisms.

A keyboard assembly as formed above is an independent self-contained component including both the electrical circuitry and mechanical key mechanisms. The keyboard is installed into the body of a laptop computer such that the keys are accessible through an aperture formed in the upper fascia plate of the laptop body. To secure the keyboard to the laptop body the keyboard assembly may include a rigid base plate located below the thin support plate including a plurality of threaded connection lugs that are screwed into through the lower panel of the laptop panel from beneath to secure the keyboard in position. In another known arrangement the upper fascia panel of the laptop may
include an integral frame work defining a plurality of key apertures that locates over the keyboard to define a cosmetic frame with the keys being received within the key apertures from beneath, and the lattice work of the key plate cover frame running along and covering the spaces between the keys, giving the appearance of a keyboard that is integrally formed as part of the upper surface of the laptop. To secure the keyboard in position multiple screw holes are formed around the periphery of the support plate through which the support plate is screwed to the lower surface of the upper fascia panel.

As the fascia panel is typically formed as thinly as possible, the threaded screw holes in the lower surface may not be very deep, and therefore a large number of screws of very small screws are required to provide a secure attachment. This results in a very cumbersome, delectate and time consuming assembly process to secure the keyboard to the fascia panel. This also makes removal of the keyboard for replacement or repair very difficult. In addition, the keyboard and key plate cover form an assembly comprising multiple parts each requiring independent manufacture prior and subsequent complex assembly. Similar construction issues as described above also apply to free standing keyboards for use with desktop computers, cash telling machines, information kiosks and many other applications.

It is therefore desirable to provide an improved keyboard assembly and method of manufacturing the same, which addresses the above described problems and/or which provides improvements generally.

In accordance with the present invention there is provided a method of manufacturing a key plate for an electronic keyboard, comprising forming a plurality of key recesses in a plate member, each recess comprising a base and side walls formed from the plate material and configured to receive a keyboard key; providing a plurality of keyboard keys comprising a key cap, a key cap support and a movable actuator for engaging a corresponding node of an electrical input membrane; forming in the base of each recess at least one attachment element for attachment to a keyboard key; forming at least one aperture extending through the base of each recess for receiving at least a portion of a movable actuator of a keyboard key; locating a keyboard key in each recess and securing
said key to the at least one attachment member such that the movable actuator is aligned with and able to move into the aperture in the base.

The step of forming a plurality of recesses in a plate member may comprise machining the recesses from a preformed plate, or integrally moulding the recesses into the plate when forming the plate by a moulding operation. Forming a key recess having an integral floor from a single unitary plate member obviates the requirement to form a separate support substrate for supporting the keys and for assembly the support substrate in a complex membrane assembly. Furthermore, forming the key recesses in a single plate member allows a unitary upper fascia panel of a laptop to be provided having the keys integrally located in the upper panel, rather than located beneath the panel in a separate assembly and projecting through an aperture or apertures in the panel. As such, the present invention reduces part numbers, significantly reduces complexity and assembly time, provides a more robust and aesthetically pleasing construction, and significantly reduces the cost of manufacture and assembly.

Each recess may be formed by removing material from the plate member, which is preferably achieved by an automated machining process, preferably controlled by a CAM system. As the plate member is formed from a single piece of material the final structure is significantly more stable and robust. In addition, material waste is significantly reduced by avoiding the need to separately form a plurality of laminar components from separate material parts.

The plurality of key recesses may alternatively be integrally formed in the plate during a moulding or casting operation, with the plate being formed by casting in a mould or die including the recess formations.

The at least one attachment members may formed by a punching operation and a subsequent forming operation. Again the attachment formations or tabs are formed directly from the same single plate member.
The key cap support preferably comprises a scissor frame compressible between an extended and collapsed position, and the movable actuator comprises a compressible elastomeric member.

The at least one attachment member comprises a plurality of attachment members in the form of tabs or clips configured to secure to and retain the scissor frame within the recess. The step of forming the plurality of attachment members may comprise punching a plurality of apertures into the base of the recess shaped to define a plurality of tabs, and in a subsequent step bending of forming said tabs to form a plurality of clips for securing to the scissor frame.

The plate member may be configured to form the surface panel of a laptop thereby providing a unitary upper fascia panel of a laptop to be provided having the keys integrally located in the upper panel.

The base of each recess may include an upper surface located within the recess and a lower surface located on the opposing external side of the base, and the method may further comprise securing a flexible membrane to the base of each of recess to cover and/or seal the aperture, the flexible membrane being deformable by the movable actuator to a position beneath the lower surface of the base. The membrane is preferably resilient. In this way the membrane is able to provide a returning force to the actuator. Preferably the flexible membrane is sealed to the lower surface of the base.

In another aspect of the present invention there is provided a method of manufacturing an electronic keyboard comprising the steps of any preceding claim, and further including providing an electrical input membrane assembly comprising first and second membranes each having an electrical circuit provided on a surface thereof including a plurality of discrete contact nodes corresponding to the plurality of keyboard keys, and means for separating the electrical circuits of the first and second membranes and permitting selective electrical connection between the contact nodes of each membrane; and securing the input membrane to the lower surface of the plate member such that the plurality of contact nodes are aligned with the apertures in the corresponding plurality of key recesses.
The electrical circuits of the membranes are sealed within the input membrane assembly, thereby waterproofing the electrical components of the input assembly. The plate member is preferably a single piece of material.

In another aspect of the invention there is provided a key plate assembly for an electronic keyboard, comprising a plate member comprising a plurality of key recesses formed therein, each recess comprising a base and side walls formed from the plate material and configured to receive a keyboard key; a plurality of keyboard keys located in the plurality of key recess each comprising a key cap, a key cap support and a movable actuator for engaging a corresponding node of an electrical input membrane. The at least one attachment element is formed in each base and attached to a corresponding keyboard key located in the recess, and each base included at least one aperture extending through the base arranged to receive at least a portion of the movable actuator of the corresponding keyboard key.

The key cap support preferably comprises a scissor frame compressible between an extended and collapsed position, and the movable actuator comprises a compressible elastomeric member.

The at least one attachment member preferably comprises a plurality of attachment members formed in the base and configured to secure to and retain the scissor frame within the recess.

The base of each recess preferably includes an upper surface located within the recess and a lower surface located on the opposing external side of the base, the key plate further comprising a flexible membrane secured to the base of each of recess to seal the aperture, the flexible membrane being deformable by the movable actuator to a position beneath the lower surface of the base.

The present invention will now be described by way of example only with reference to the following illustrative figures in which:
Figure 1 shows a portable laptop computer;

Figure 2 is an illustrative view of a keypad panel in various stages of manufacture and assembly according to an embodiment of the invention;

Figure 3 shows a key plate following the machined formation of the key recesses according to an embodiment of the invention;

Figure 4 shows a die according to an embodiment of the invention; and

Figure 5 shows an input membrane assembly according to an embodiment of the invention.

Referring to Figure 1, a laptop 1 includes a body section 2 and a screen section 4 which are hingedly connected. The body section 2 defines a housing for containing the laptop circuitry including the processor and hard drive and includes an upper fascia panel 3 defining the upper surface of the body section and a lower panel 5 defining the base. The body section 2 further contains a keyboard assembly 6. The keyboard assembly 6 provides an interface to permit the input of information to the computer by the user through activation of a plurality of switches located within the keyboard 6.

The present invention minimises the number of component parts and manufacturing steps required to form a keyboard. Figure 2 is a representation of a series of manufacturing steps according to the present invention, shown for illustrative purposes on a common substrate. It will be appreciated that in practice each step will be carried out for all key locations before progressing to the next stage of manufacture.
The manufacturing process commences with a unitary plate of material 1. The material may be metal such as aluminium which is utilised for its light weight properties, or any other suitable material such as a rigid polymer. The plate 1 is a planar member having an upper surface 2, a lower surface 4 and a thickness \( w \) defined between the upper and lower surfaces, which may typically be in the region of 4-5 mm. The outer perimeter of the plate 1 is preferably pre-formed to the required size and shape dependant on the intended final function and location of the plate 1.

A plurality of key locations 8 are defined across the plate 1. The first location \( A \) represents the first stage of manufacture in which a key location is identified and located on the surface of the plate. This information may be provided by a Computer Aided Manufacturing (CAM) system pre-programmed with the locations of the keys. At stage \( A \) the upper surface of the plate 1 has not yet been machined or otherwise worked on.

At stage \( B \) a key recess is formed in the surface of the plate 1. The recess is formed by machining the surface of the plate 1 to remove the plate material. The key recess 10 is configured to receive a keyboard key and each recess 10 is shaped to correspond to the shape of specific corresponding key to be received therein. The recess 10 includes a base 12 and side walls 14 extending upwardly from the base to the upper opening 16 of the recess. The recess 10 is shaped such that the corresponding key is able to move vertically with the recess while minimising the clearance between the key and the side walls 14 to optimise space and provide a desirable aesthetic finish. The recess 10 is formed having a depth \( d \) that is less than the thickness \( w \) of the plate 1 leaving a thickness \( y \) of material defining the base 12. In an alternative embodiment steps A and B may be combined by integrally forming the plate and the recesses in a moulding or casting operation.

Following completion of stage \( B \) the plate 1 comprises a matrix of recesses 10 formed to receive the keys in the desired layout of the keyboard as shown in Figure 3. The recesses 10 are interspaced by network of walls 20 proud standing from the base and defined by the walls 12 having an upper surface comprising the original upper surface 2 of the plate 1.
Returning to Figure 2, following formation of the key recesses 10, at step C a plurality of attachment formations 22 are punched into the base 12 of the recess 10. The attachment formations 22 are substantially u-shaped apertures extending through the base 12 with the remaining material projecting into the aperture defining an attachment tab 24. An operating aperture 26 is also punched through the base 12 and is located centrally within the base 12.

The thickness of the base 12, defined by the width $w$ minus the depth $d$ is typically around 0.4 mm. To prevent deformation of the base 12 during punching a punching die block is provided, as shown in Figure 4. At stage C the plate 1 is located on the punching die block 28 which includes a matrix of raised projections 30 corresponding in shape, size and location to the recesses 10 of the plate 1, and also including a plurality of apertures formed in each projection 30 corresponding to the apertures to be punched in the plate 1. The plate 1 is located on the die block 28 such that the projections 30 are received within the corresponding recesses 10. The punching operation is then performed punching through the material of the plate 1, with the punch extending through a corresponding aperture in the surface of the die beneath to form the apertures 22 and 26.

Following punching, the tabs 24 are then formed in a bending operation to create upstanding connection tabs, as shown at step D of Figure 2. The tabs 24 may be formed in by any suitable forming operation and into any suitable form to hold and retain a corresponding scissors mechanism. With the tabs formed, at step E the scissors mechanism 25 is introduced into the recess 10 secured in the recess by connection to the tabs 24. The scissors mechanism 25 is supported in the recess 10 on the base 12.

In an alternative embodiment where the plate and recesses are formed in a moulding operation, the connections tabs 24 and aperture 26 are formed during the moulding operation, with the tabs being core pulled.

At step F of Figure 2 a domed elastomeric actuating member is located within the recess 10. The domed member 32 includes a domed body having an annular base 34 and an internal actuating spigot or plunger extending downwardly within the dome from the inner surface of the tip of the dome. The base 34 of the domed member 32 may be configured to be
seated and support on the base 12 of the recess surrounding the aperture 26 and arranged such that when the domed member 32 is compressed the actuating spigot extends into the aperture 26. Alternatively the domed member 26 may be mounted within the aperture 26 with the outer side surface of the base section 34 engaging the inner surface of the aperture 26. In yet a further alternative the dome member 32 may be supported within the aperture on a further substrate or membrane located beneath the aperture, as will be discussed in further detail below. The base section 34 may include one or more air channels to permit the escape of air from the dome 32 when the dome 32 is compressed.

In a preferred embodiment the domed member 32 is located within the aperture 26 of the recess 10 using a dedicated vacuum tool. The vacuum tool is similar in configuration to the punching die comprising a plurality of projections configured to be received in the recesses of the plate 1. Each projection includes a vacuum tube arranged to align with the aperture 26 within the recess 10. The plate 1 is placed on the vacuum tool in a face down orientation. The vacuum tubes are sized and arranged to receive and hold the distal end of the domed members 32 such that the base is held within the aperture 26 at least level with the lower surface of the base of the plate 1. The vacuum is activated and a plurality of domed members are loosely distributed into the lower surface of the base of the plate 1, which is upwardly facing during this operation, and the domed members 32 are agitated. The agitated domed members 32 are drawn into the apertures 26 by the vacuum source and held there in position. Following this step, and prior to step G, the domed members may be retained in the apertures 26 while a resilient membrane layer is applied to the base of the plate 1, as discussed in further detail below.

In the final stage G of Figure 2 the key cap 36 is secured in the recess 10 by fixing the key cap 36 to the scissor mechanism 25. The key cap 36 is supported on the scissor mechanism 25 and the domed member 32 beneath. Depression of the key cap 36 by the application of pressure thereto causes the scissor mechanism 25 to collapse and the domed member 32 to compress. The height of the scissor mechanism and/or the depth d of the recess is selected such that the top surface 38 of the key cap 36 is proud of the upper surface 2 of the plate 1 to ensure that it is easily engagable when typing. The lower surface of each key cap 36 includes an engagement lug which projects from the lower surface to engage the domed
member 32 causing it to compress. The length of the engagement lug allows the key cap 36
to depress the domed member 32 with a much shorter travel than the typical rubber dome
keyboard.

When fully assembled at stage G the plate 1 defines a fully assembled key plate that
comprises only mechanical components. The key plate 1 may comprise the upper panel of
a keyboard. Alternatively, in a laptop application the panel 1 may comprise the upper
fascia plate of the laptop, such that the key recesses 10 and floor defining the base 12 for
supporting the keys are an integral part of a unitary upper panel component.

An electrical input assembly 100 is arranged beneath the keypad 1 for converting a
mechanical input applied to the keypad to an electrical input to a printed circuit board
(PCB) to generate a command signal to be passed to the portable computer. As shown in
Figure 5 the input membrane assembly 100 comprises a grid of circuits which are
configured such that the circuits are broken at a plurality of discrete points or nodes. The
nodes are arranged to correspond to the key matrix such that a node is located beneath each
key 36. The input assembly 100 comprises an upper membrane 120, a lower membrane
122, and a spacer membrane 124 arranged between the upper membrane 120 and the lower
membrane 122. The upper membrane 120 is formed from a flexible, non-conductive
material such as polyethylene terephthalate (PET), and preferably a boPET such as Mylar
(RTM). A circuit 126 is provided on the lower surface of the upper membrane 120. The
circuit may be provided on the lower surface 130 by means of printing using an electrically
conductive ink, or any other suitable means. The circuit 126 comprises a plurality of nodes
corresponding to the key matrix of the keypad 1.

The lower membrane 122 is formed from the same material as the upper membrane 120.
The lower membrane 122 includes a circuit 134 on its upper surface 136 formed in the
same manner as the circuit 126 of the upper membrane 120. The circuit 134 includes a
plurality of nodes 135 which positionally correspond to the nodes of the upper membrane
circuit 126. Both the upper membrane circuit 126 and lower membrane circuit 134 also
include output tracks 140 respectively for connection to a PCB or other component of the
laptop computer.
The non-conductive spacer membrane 124 is positioned between the upper membrane 120 and the lower membrane 122, and is formed from the same material as the upper and lower membranes 120 and 122, although this is not essential and other non-conductive materials may be used. The spacer membrane 24 electrically isolates the upper circuit 126 from the lower circuit 134. A plurality of apertures 144 are formed in the spacer membrane 124 at locations corresponding to the nodes 128 and 138 of the upper and lower membrane 120 and 122. The size of the apertures 144 is selected such that the nodes of the upper circuit 126 and lower circuit 134 aligned with the apertures are held spaced apart. Specifically, the diameter of the apertures 144 is selected such that the depth of sag of the upper membrane 120 within the aperture 144 is less than the thickness of the spacer membrane 124. Preferably the thickness of each membrane is 100 micrometers, but the width of the apertures 26 may be varied for varying membranes thicknesses and hence varying sag coefficients.

The upper membrane 120, lower membrane 122 and spacer membrane are secured together to form the input membrane assembly 100. In three-membrane input assembly arrangements of the prior art the membrane assembly is sandwiched within the keypad assembly between the domed layer and the base as discussed above. The three membranes are of equal size and are secured together and sealed around their periphery to form a watertight envelope. However, external component connections such as the connection tabs extend from and are not contained within the input assembly 10 and therefore remain vulnerable to exposure to liquids, as do the points of connection within the laptop. Furthermore, while the circuitry of the membrane assembly itself may be waterproof the internal circuitry of the laptop remains vulnerable to liquid flowing over the membrane assembly and into the laptop body in the event of a spill or otherwise.

The input membrane assembly 100 of the present invention is provided as a discrete and separate element, detached from the keypad 1. The input membrane assembly 100 is sealed to a base member, with the base forming a further layer of the membrane assembly 100. The base member preferably a rigid member and is preferably formed from aluminum and may be the base panel of a laptop or keyboard housing. The upper membrane 120
comprises a peripheral sealing surface on its lower surface which is adhered to the upper surface of the spacer membrane 124. Similarly, the spacer membrane 124 includes a sealing surface on its lower surface which is adhered to the upper surface of the lower membrane 122. In this way a sealed membrane assembly is formed in which the circuits of the upper and lower membranes 120, 122 are sealed within the sealing perimeter defined by the sealing surfaces.

The membrane assembly defined by the upper 120, lower 122 and spacer membrane 124 is adhered to the base member. In one embodiment the membrane assembly 100 is adhered to the base by a sealing surface defined substantially on the lower surface of the lower membrane 122, with the upper membrane 120 and spacer membrane 124 being substantially the same size as the lower membrane 122. The connection track 140 of the lower membrane 122 is located inboard of the periphery of the upper membrane 120 and spacer membrane 122 and extends downwardly towards the base. At this portion of the lower membrane 122 the sealing surfaces of the upper 120 and spacer 124 membranes are located outwardly of the tab 140. The resulting exposed portion of the lower surface of the spacer membrane 124 adhere to the base to complete the sealing surface and to seal and encapsulate the connection tab between the membrane assembly 10 and the base 40.

The input assembly 100 is located beneath the keypad 1 such that the nodes of the input assembly align with the corresponding keys 36 of the keypad 1. Depression of the keys 36 causes the domed member 32 to compress which moves the actuating spigot into the aperture 26. The minimal thickness of the base 12 allows the actuating spigot to extend through the aperture 26 to a depth greater than the lower surface 4 of the key plate 1 to engage and actuate the corresponding node of the input assembly. In a preferred embodiment a resilient membrane is provided on the lower surface of the key plate 1 which covers the apertures 26. The resilient membrane comprises a plurality of preformed apertures corresponding to the plurality of apertures 26. Each of the apertures of the membrane has a diameter that is less than the diameter of the corresponding aperture 26 defining and annular skirt inwardly of the periphery of the aperture 26, and is greater than the diameter of the spigot of the dome member to allow the spigot to extend therethrough.
The resilient membrane may be provided in the form of a plurality of independent membrane elements separately secured over each aperture, or in the form of a continuous single membrane that extends over and seals every aperture 26. Preferably the membrane is a continuous membrane that is pre-punched to include the apertures in the correct locations. The annular skirt defined by the resilient membrane is sufficiently thick to support the annular base of the domed member received in the aperture 26. The resilient property of the membrane is such that when the actuating spigot is in the extended actuating position the resilient membrane imparts a return force to the domed member 32 to return it to its original position. The resilient membrane may be formed to include air channels to permit the evacuation of air from the domes on compression.

In one embodiment the assembly process comprises applying the membrane to the lower surface of the plate 1 with the domed members 32 held in position by the vacuum rig. As discussed above the vacuum rig holds the domed members in the recesses 10 such the base of the domed member 32 is held within the aperture 26. With the domes 32 held in this position, the membrane, having an adhesive applied to its surface, is applied to the lower surface of the plate 1 such that the apertures of the membrane align with the aperture 26. The adhesive in the region of the skirt sections adhere to the base of the domed members 32 such that the domed members are secured to and supported by the membrane. The adhesive is then cured either by heat or UV light. Where heat curing is used the step of applying the scissor mechanisms may be delayed until after heat curing to prevent damaging the mechanisms.

Whilst endeavoring in the foregoing specification to draw attention to those features of the invention believed to be of particular importance it should be understood that the Applicant claims protection in respect of any patentable feature or combination of features hereinbefore referred to and/or shown in the drawings whether or not particular emphasis has been placed thereon.

It will be appreciated that in further embodiments various modifications to the specific arrangements described above and shown in the drawings may be made. For example, while the keypad assembly and method of manufacture thereof of the present invention is
described primarily for use with a laptop, it will be appreciated the keypad assembly may be applied to a keypad for any type of keyboard including mechanical keys. It will also be appreciated that terms such as front, rear, up, down are intended to be relative and non-limiting. Furthermore, while steps A-G are described sequentially, the invention is not limited to these steps being conducted in any predetermined order and the steps may be conducted in an alternative sequence including one or more of the steps being conducted simultaneously.
CLAIMS

1. A method of manufacturing a key plate for an electronic keyboard, comprising:
   forming a plurality of key recesses in a plate member, each recess comprising a
   base and side walls formed from the plate material and configured to receive a keyboard
   key;
   providing a plurality of keyboard keys comprising a key cap, a key cap support and
   a movable actuator for engaging a corresponding node of an electrical input membrane;
   forming in the base of each recess at least one attachment element for attachment to
   a keyboard key;
   forming at least one aperture extending through the base of each recess for
   receiving at least a portion of a movable actuator of a keyboard key;
   locating a keyboard key in each recess and securing said key to the at least one
   attachment member such that the movable actuator is aligned with and able to move into
   the recess in the base.

2. A method according to claim 1 wherein each recess is formed by removing material
   from the plate member.

3. A method according to claim 1 wherein the plurality of recesses are integrally
   formed in the plate during a moulding or casting operation.

4. A method according to any preceding claim wherein the at least one attachment
   members are formed by a punching operation.

5. A method according to any preceding claim wherein the key cap support comprises
   a scissor frame compressible between an extended and collapsed position, and the movable
   actuator comprises a compressible elastomeric member.

6. A method according to claim 5 wherein the at least one attachment member
   comprises a plurality of attachment members configured to secure to and retain the scissor
   frame within the recess.
7. A method according to claim 6 wherein forming the plurality of attachment members comprises punching a plurality of apertures into the base of the recess shaped to define a plurality of tabs, and in a subsequent step bending said tabs to form a plurality of clips for securing to the scissor frame.

8. A method according to any preceding claim wherein the plate member is configured to form the surface panel of a laptop.

9. A method according to any preceding claim wherein each base includes an upper surface located within the recess and a lower surface located on the opposing external side of the base, the method further comprising securing a flexible membrane to the base of each of recess to seal the aperture, the flexible membrane being deformable by the movable actuator to a position beneath the lower surface of the base.

10. A method according to claim 9 wherein the flexible membrane is secured to the lower surface of the base.

11. A method of claim 10 wherein the flexible membrane is resiliently deformable to provide a returning force to the movable actuator.

12. A method according to claim 11 wherein the flexible membrane supports the movable actuator within the at least one aperture and comprises an operating aperture having a smaller diameter than the diameter of the at least one aperture to permit a portion of the movable actuator to extend therethrough.

13. A method of manufacturing an electronic keyboard comprising the steps of any preceding claim, and further including:

   providing an electrical input membrane assembly comprising first and second membranes each having an electrical circuit provided on a surface thereof including a plurality of discrete contact nodes corresponding to the plurality of keyboard keys, and means for separating the electrical circuits of the first and second membranes and
permitting selective electrical connection between the contact nodes of each membrane; and

securing the input membrane to the lower surface of the plate member such that the plurality of contact nodes are aligned with the apertures in the corresponding plurality of key recesses.

14. A method according to claim 13 wherein the electrical circuits of the membranes are sealed within the input membrane assembly.

15. A method according to any preceding claim wherein the plate member is a single piece of material.

16. A key plate assembly for an electronic keyboard, comprising:

a plate member comprising a plurality of key recesses formed therein, each recess comprising a base and side walls formed from the plate material and configured to receive a keyboard key;

a plurality of keyboard keys located in the plurality of key recess each comprising a key cap, a key cap support and a movable actuator for engaging a corresponding node of an electrical input membrane wherein the at least one attachment element is formed in each base and attached to a corresponding keyboard key located in the recess, and each base included at least one aperture extending through the base arranged to receive at least a portion of the movable actuator of the corresponding keyboard key.

17. A method according to any preceding claim wherein the key cap support comprises a scissor frame compressible between an extended and collapsed position, and the movable actuator comprises a compressible elastomeric member.

18. A key plate according to claim 17 wherein the at least one attachment member comprises a plurality of attachment members formed in the base and configured to secure to and retain the scissor frame within the recess.
19. A key plate according to any one of claims 15 to 17 wherein each base includes an upper surface located within the recess and a lower surface located on the opposing external side of the base, the key plate further comprising a flexible membrane secured to the base of each of recess to seal the aperture, the flexible membrane being deformable by the movable actuator to a position beneath the lower surface of the base.

20. A key plate according to claim 19 wherein the flexible membrane is sealed to the lower surface of the base.

21. A key plate according to claims 19 or 20 wherein the movable actuator is supported directly on the flexible membrane.

22. A key plate according to claim 21 wherein the movable actuator is a resilient domed member comprising an internal spigot and wherein the spigot is arranged and configured to extend through the aperture in the base of the recess when the domed member is compressed, and wherein the flexible membrane is configured to permit the spigot to extend past the lower surface of the base.

23. A key plate according to claim 20 wherein the flexible membrane is resiliently deformable to provide a returning force to the movable actuator.

24. An electrical keyboard comprising a key plate according to any one of claims 15 to 22.
Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

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<th>Category</th>
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<td>GB2332648 A LIM BYUNG-GUL - see Figure 7 and related description.</td>
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<td>X</td>
<td>1-24</td>
<td>US5697718 A ERLER et al - see Figure 15 and related description.</td>
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<td>GB2065372 A BURNS et al - see whole document.</td>
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Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC:

Worldwide search of patent documents classified in the following areas of the IPC

G06F

The following online and other databases have been used in the preparation of this search report

WPI, EPODOC

International Classification:

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