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(54) **KEYBOARD MEMBRANE AND KEYBOARD**

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This patent is subject to a terminal disclaimer.

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(51) **Int. Cl.**
G06F 3/02 (2006.01)

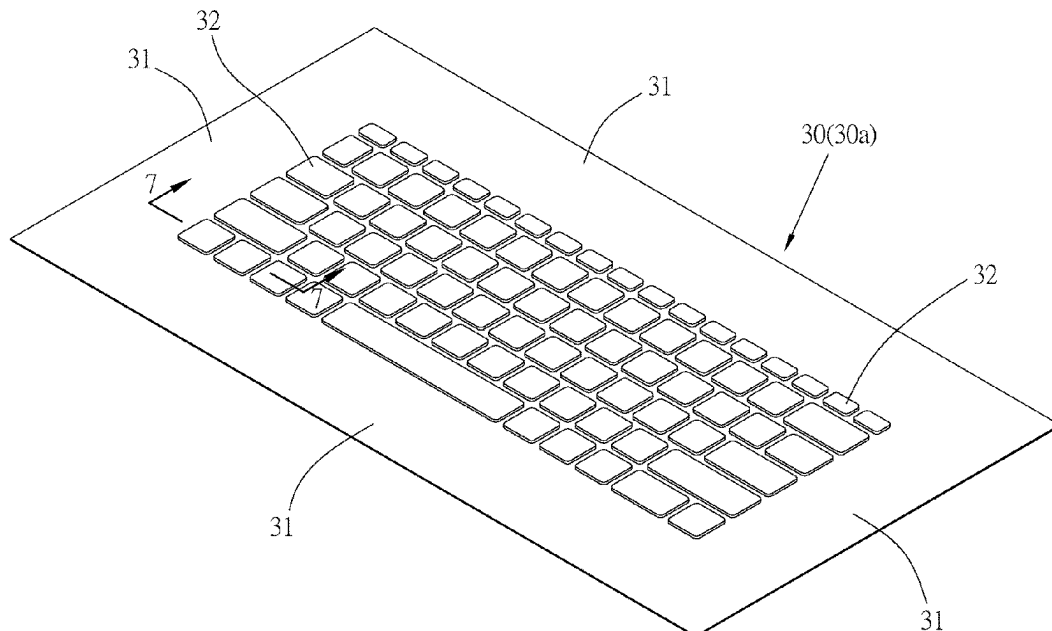
(52) **U.S. Cl.**
CPC **G06F 3/0202** (2013.01)

(58) **Field of Classification Search**
CPC G06F 3/0202
See application file for complete search history.

(57) **ABSTRACT**

A keyboard membrane, which is a thin sheet molded object thermoformed by a thermoplastic wear-resistant molding membrane, comprising a plurality of concave-convex parts, the concave-convex part comprises a plurality of upwardly protruding pressing parts, each of the pressing parts has a top wall and a peripheral wall extending downward from a periphery of the top wall; the keyboard membrane is disposed on a key module with keys; each of the pressing parts is connected with one of the keys of the key module; a periphery of the keyboard membrane has a peripheral edge extending outward from the pressing part, and the peripheral edge wraps the key module to form a waterproof and dustproof keyboard.

19 Claims, 9 Drawing Sheets



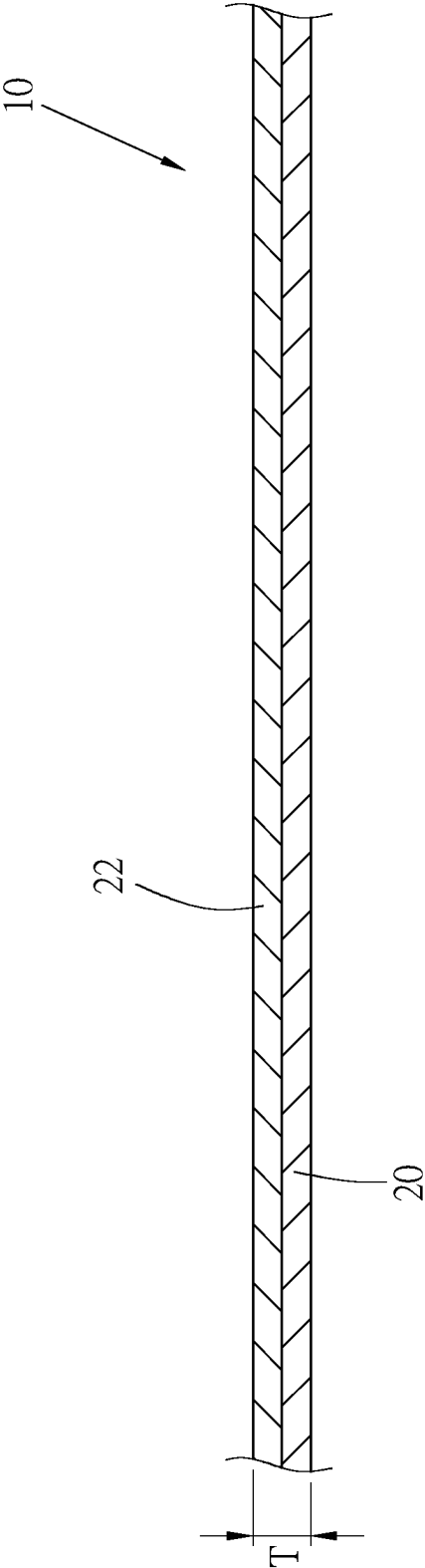


Fig. 1

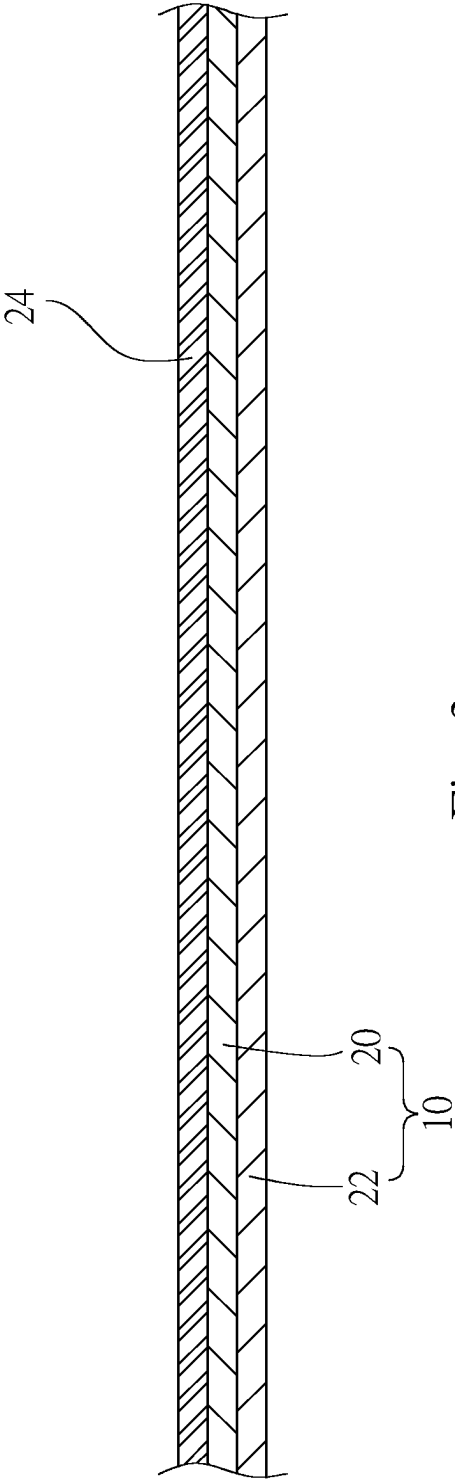


Fig. 2

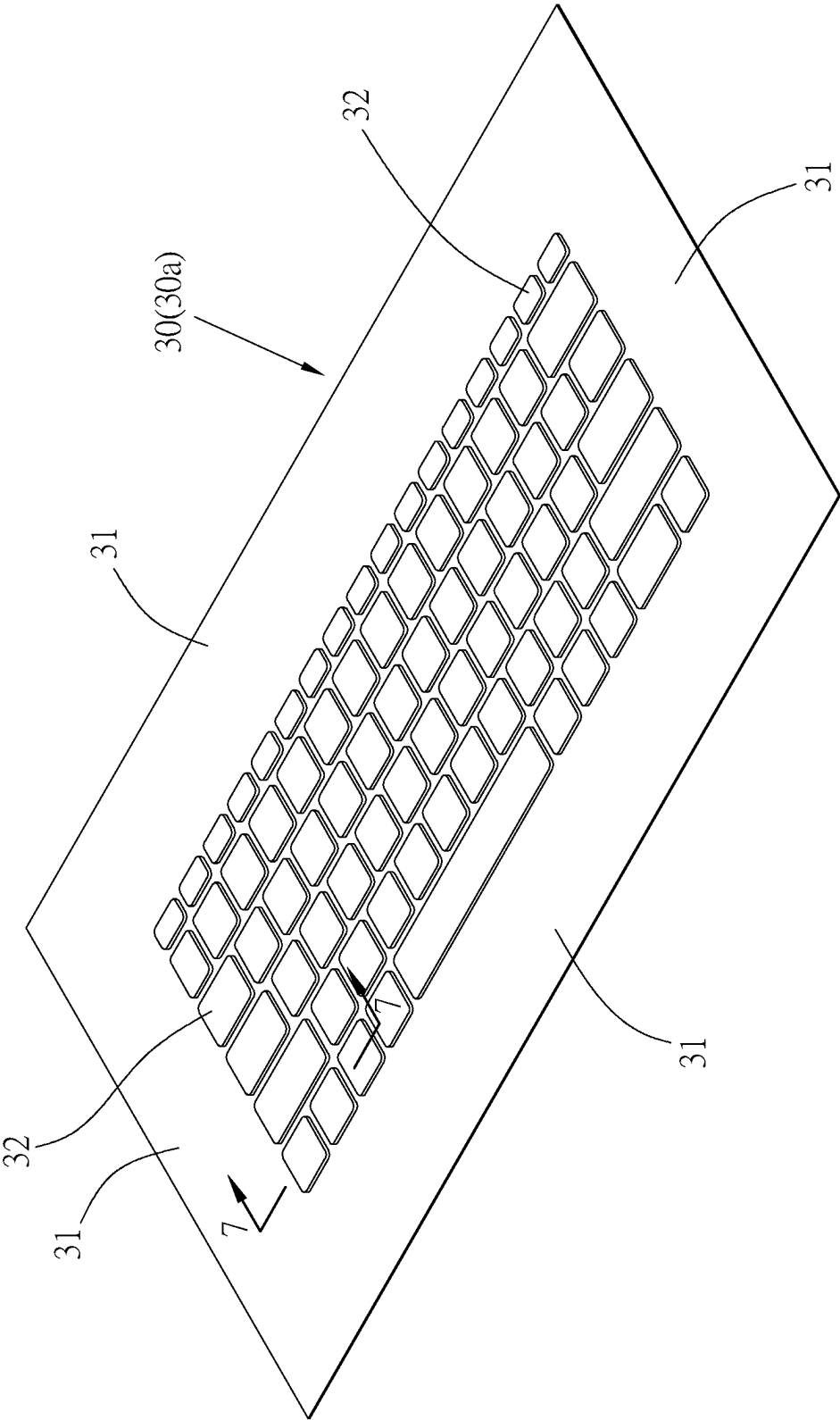


Fig. 3

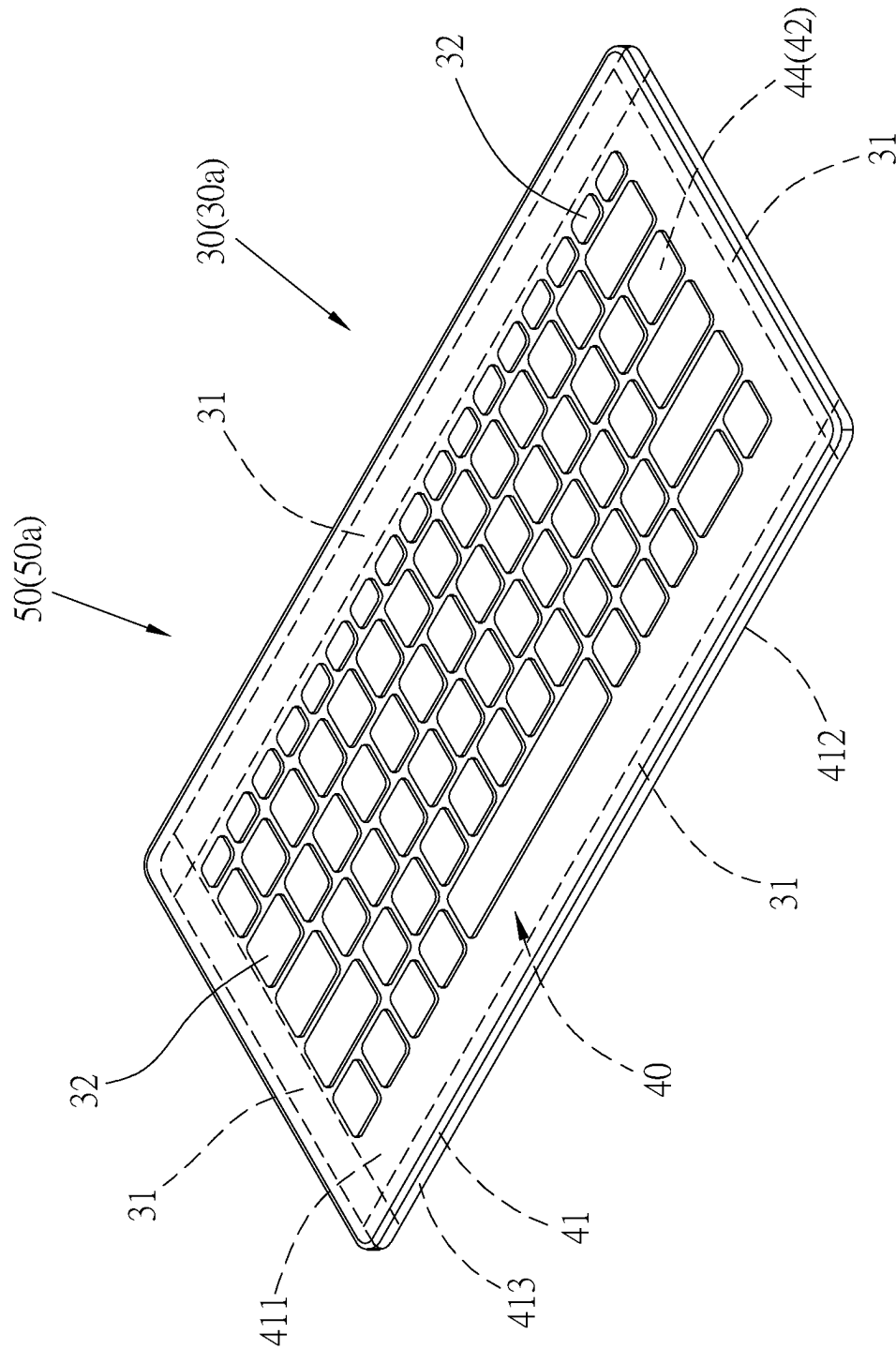


Fig. 3A

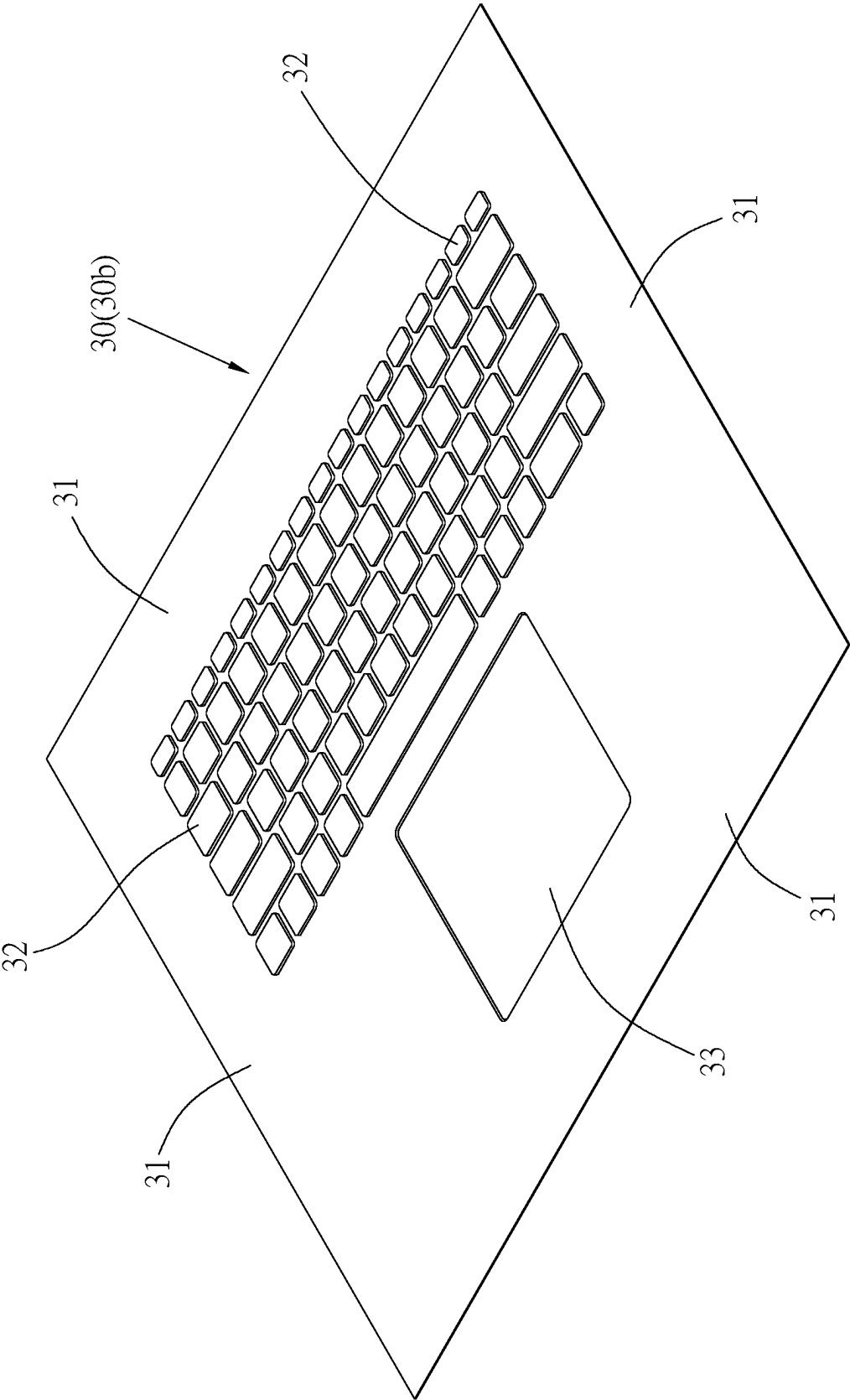


Fig. 4

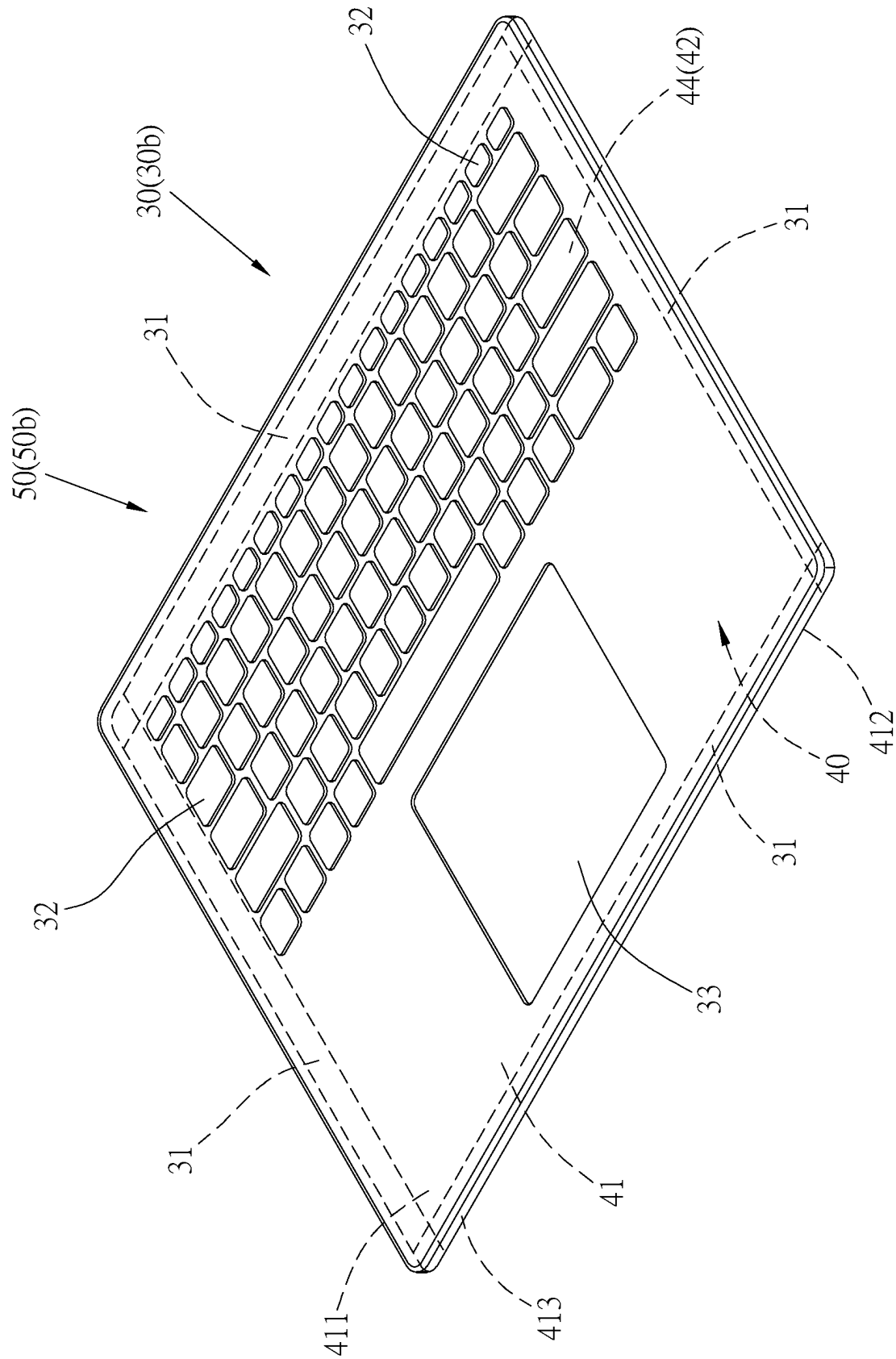


Fig. 4A

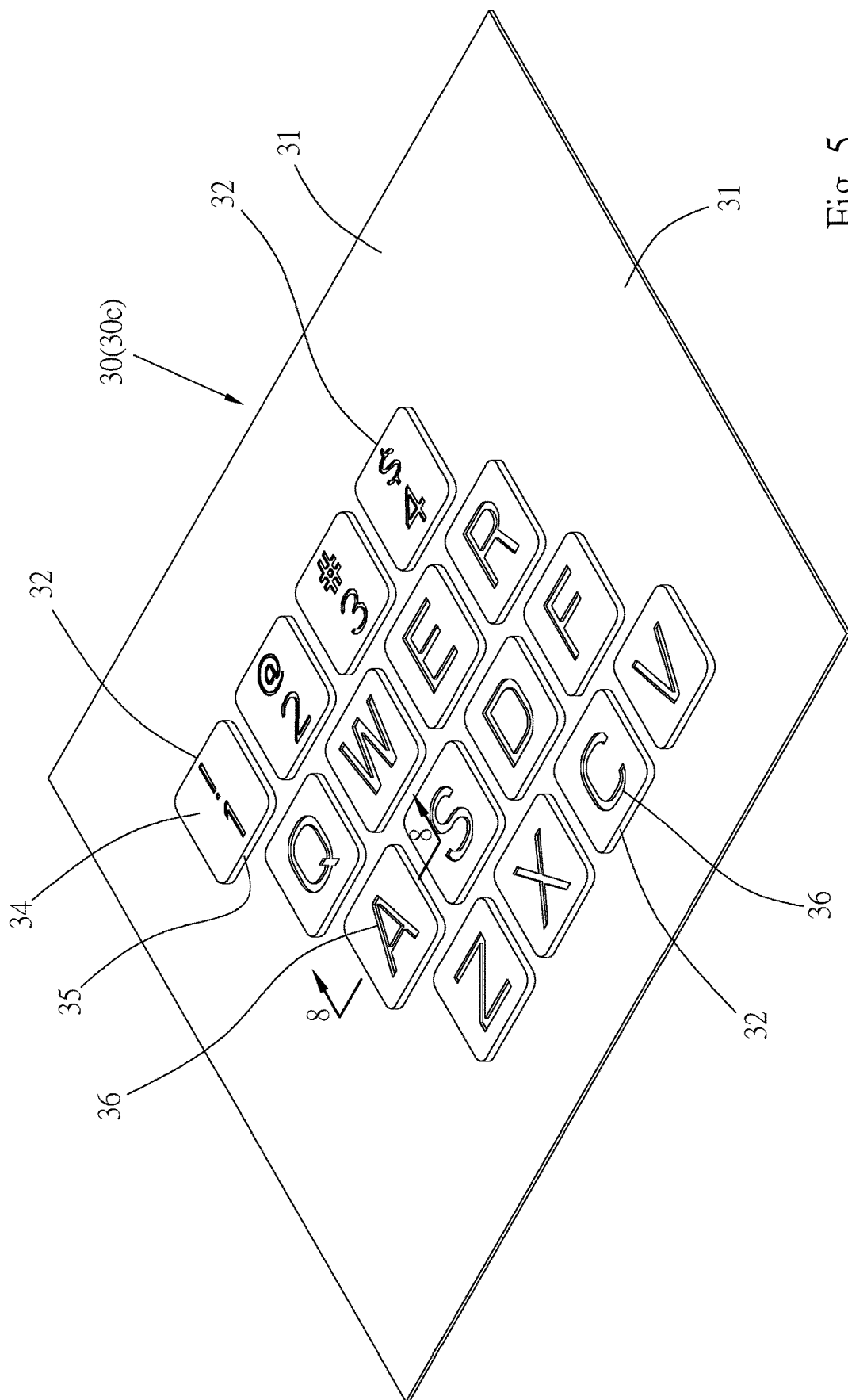


Fig. 5

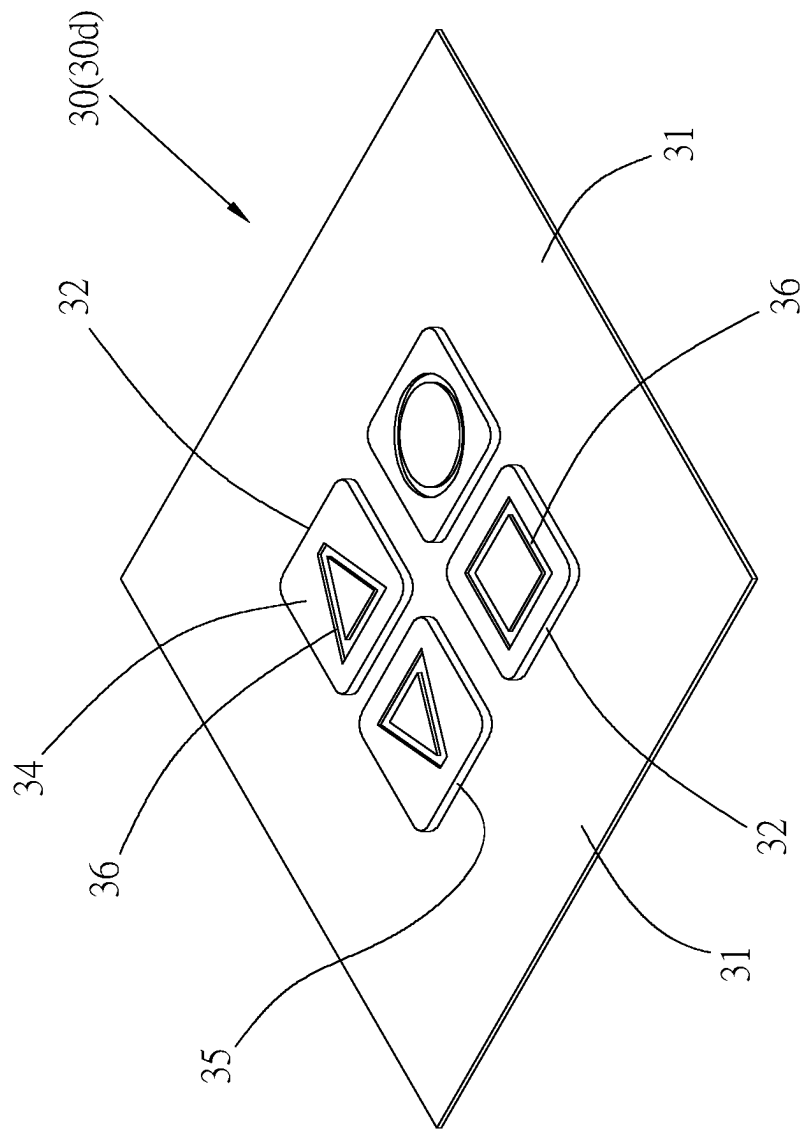


Fig. 6

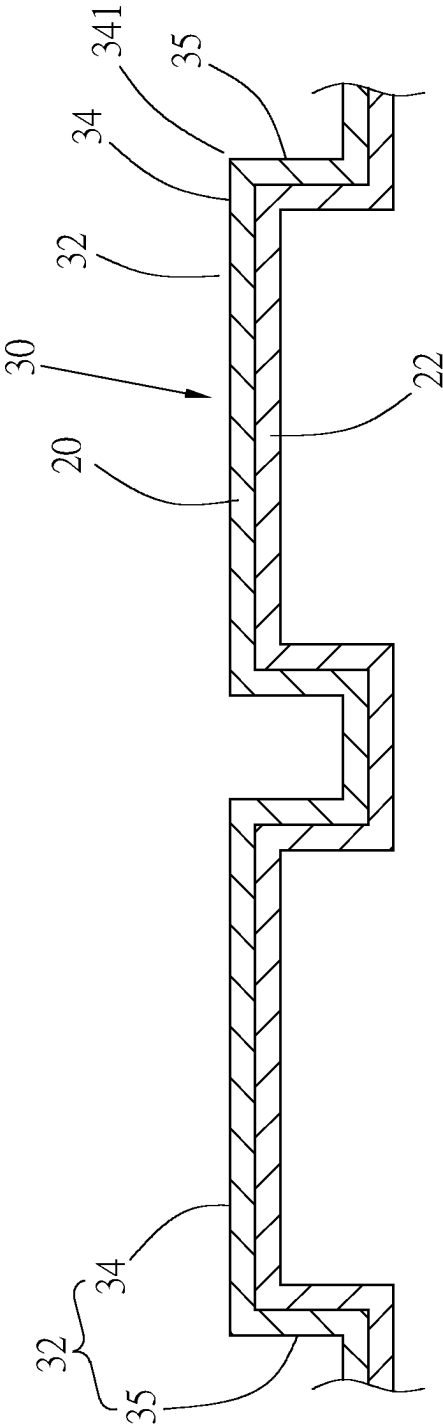


Fig. 7

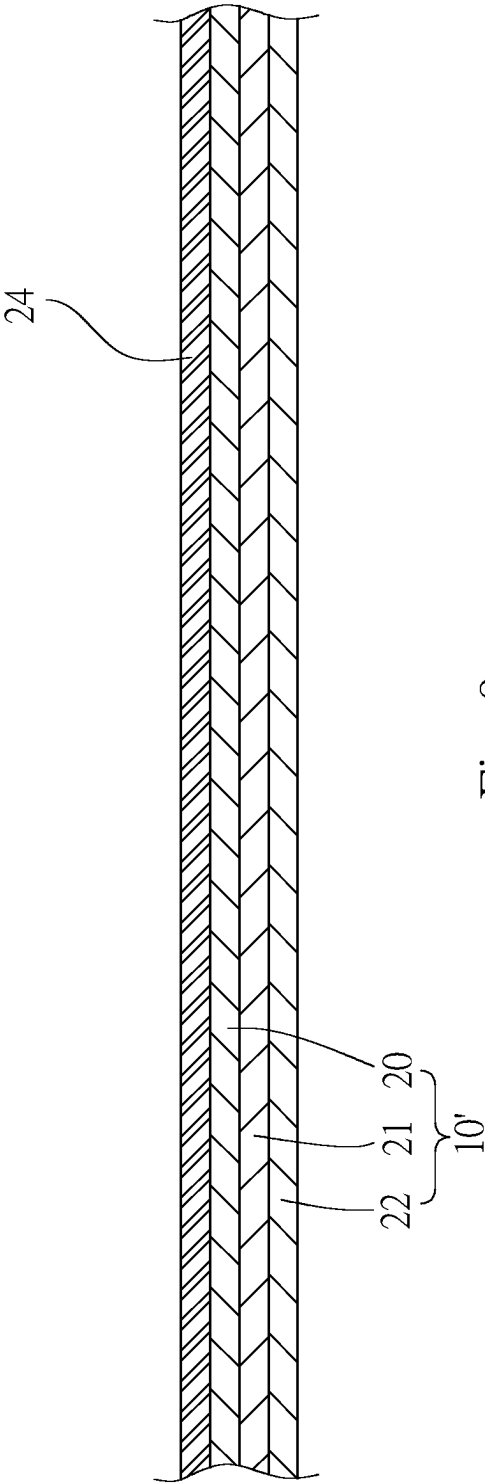


Fig. 9

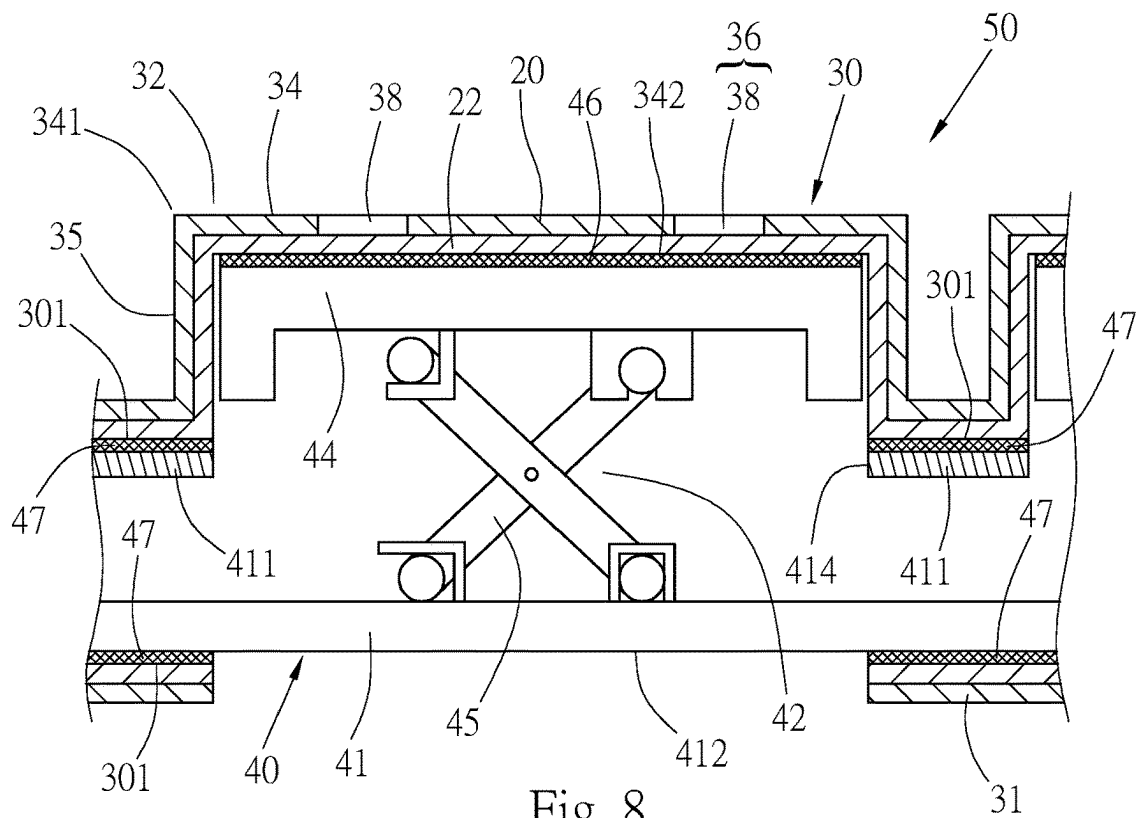


Fig. 8

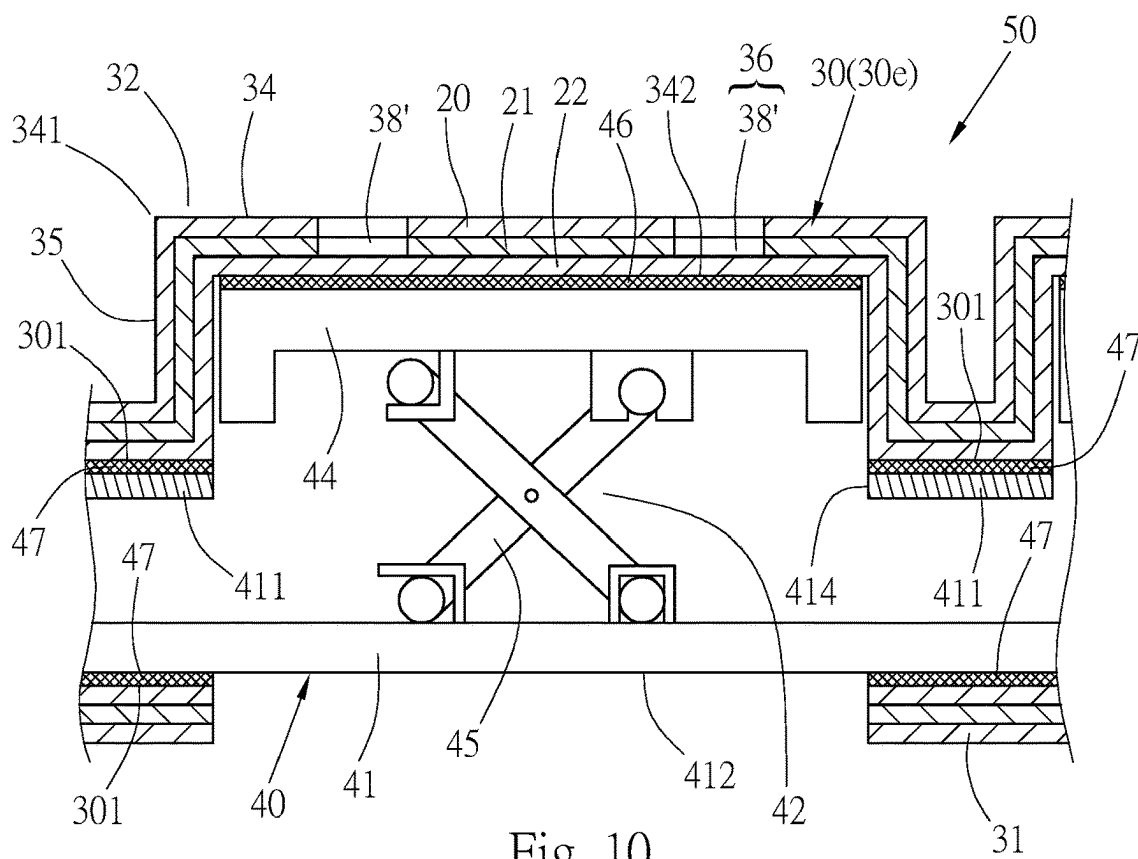


Fig. 10

KEYBOARD MEMBRANE AND KEYBOARD

This application is a Continuation-In-Part currently pending application U.S. Ser. No. 18/329,301, entitled “Keyboard Membrane and Keyboard” and filed on Jun. 5, 2023, and which is incorporated herein by reference in its entirety.

FIELD OF THE INVENTION

The invention relates to a thin sheet molded object, and more particularly to a key membrane, a keyboard membrane, and a keyboard with the key membrane and the keyboard membrane.

DESCRIPTION OF THE RELATED ART

Electronic products or machinery such as various remote controls, keyboards, or mechanical equipment have a large number of buttons or keys for transmitting signals. The buttons of the remote control and mechanical equipment are not waterproof and dustproof, the surfaces of the buttons are not wear-resistant, and the tactile impression is not good.

A flexible protective membrane is disposed on the keyboard of a notebook computer to protect the keys, and the user taps the keys through the protective membrane. The early protective membrane is flat, and the tactile impression of pressing the keys is not good.

It is known that a type of conventional membrane placed on top of a laptop is molded to match the concave-convex structure of the keys, and the feeling of use is better than that of a flat protective membrane. However, this type of membrane is made of materials such as silicone rubber, it is thick, such as at least 0.5 mm or more, the wear resistance is poor, the moldability is not good, it is easy to twist, the surface is easy to wear, get dirty and sticky, and the effect of use is not good. Moreover, characters are printed on the surface of the membrane, which is not environmentally friendly.

The conventional membrane has the following problems:

The conventional protective membrane or membrane only covers the keys, and cannot provide waterproof and dustproof functions for the keyboards of electronic products.

The conventional membrane is thick, the ductility is poor, the molding effect is not good, the intersection angles or bending positions of the concave-convex parts of the membrane cannot be well shaped, and defects such as cracking and poor molding are prone to occur.

Due to the membrane being thick, the adjacent concave-convex parts are pulled against one another, and the user has to tap the keyboard hard, resulting in poor handfeel when tapping the keyboard. Moreover, due to the keyboard membrane being thick, the stroke of keystrokes is not accurate. After the keyboard is used for a period of time, the problem of invalid keystrokes is prone to occur, and the keys cannot be pressed effectively.

The surface layer of the conventional membrane is not wear-resistant, which affects the effect of use, and the surface of the keyboard membrane is unstable, easy for dirt to stick on the surface, or easy to get sticky. For example, the physical properties of the plastic layer will change due to oxidation and degradation, resulting in poor tactile impression of the keyboard membrane.

SUMMARY OF THE INVENTION

An object of the invention is to provide a keyboard membrane and a keyboard, so that the keyboard using the keyboard membrane has effects of waterproof and dustproof.

Another object of the invention is to provide a waterproof keyboard membrane with a concave-convex structure, the keyboard membrane is thin, soft, wear-resistant, excellent in physical properties, has excellent ductility and elasticity, and is conducive to being molded and shaped in a mold.

The keyboard membrane provided by the invention is a thin sheet molded object thermoformed by a thermoplastic molding membrane, comprising a plurality of concave-convex parts;

the concave-convex part comprises a plurality of upwardly protruding pressing parts, each of the pressing parts has a top wall and a peripheral wall extending downward from a periphery of the top wall; the keyboard membrane is used for disposing on a key module with keys; each of the pressing parts is used for connecting with one of the keys of the key module;

a periphery of the keyboard membrane further has a peripheral edge extending outward from the pressing part, and the peripheral edge is used for wrapping the key module;

the keyboard membrane being a membrane material in the form of at least two layers, comprising: a wear-resistant polyurethane (PU) layer and a second polyurethane (PU) layer, the wear-resistant PU layer being polycarbonate polyurethane, or polyurethane added with a crosslinking agent to increase wear resistance, or polyurethane added with a wear-resistant auxiliary agent to reduce friction resistance, the wear-resistant PU layer being a surface layer of the keyboard membrane; the second PU layer being disposed on a surface of the wear-resistant PU layer to form an inner layer of the keyboard membrane.

Preferably, the wear-resistant polyurethane is polyurethane added with a slip agent or a lubricant to reduce the friction resistance of the wear-resistant PU layer and improve the wear-resistant effect of the wear-resistant PU layer.

Preferably, the wear-resistant polyurethane is polyurethane added with a curing agent to increase the curability of the wear-resistant polyurethane.

Preferably, the second PU layer is a thermoplastic polyurethane (PU) layer with ductility and elasticity greater than ductility and elasticity of the wear-resistant PU layer.

The keyboard provided by the invention has a keyboard module and the keyboard membrane, the keyboard module has a casing and a plurality of keys installed in the casing; the keyboard membrane is disposed on a top surface of the keyboard module, each of the pressing parts of the keyboard membrane is connected with a keycap of one of the keys of the key module; and the peripheral edge of the keyboard membrane wraps a periphery of the key module, said the peripheral edge wraps a periphery of the keyboard module, the peripheral edge at least wraps a top surface of the keyboard module.

Thereby, the keyboard membrane is capable of wrapping the key module, the keyboard membrane and the key module form a waterproof and dustproof keyboard as a whole, making a key module of electronic products or mechanical equipment waterproof and dustproof, even if a keyboard or an electronic product is put into water, the keyboard is still waterproof and dustproof, preventing dirt and moisture from entering the keyboard.

In the keyboard, preferably, an inner surface of each of the pressing parts is bonded to the keycap of each of the keys with an adhesive; the peripheral edge of the keyboard membrane wraps a top surface of the keyboard module, or the peripheral edge wraps a top surface and a peripheral

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surface of the keyboard module, or the peripheral edge wraps a top surface, a peripheral surface and a bottom surface of the keyboard module.

Preferably, an inner surface of the keyboard membrane other than the pressing parts is bonded to the surfaces of the key module with an adhesive. The keyboard membrane cannot be separated from the key module.

Top walls of all or part of the pressing parts are provided with at least one character, and the character is formed by removing a material of the wear-resistant PU layer, so that the top wall forms a hollow part.

Preferably, the thermoplastic PU layer is manufactured to have a color, and the thermoplastic PU layer is exposed in the hollow part.

Preferably, an intermediate PU layer can be further provided between the wear-resistant PU layer and the second PU layer (the thermoplastic PU layer); a depth of the hollow part reaches the wear-resistant PU layer or the intermediate PU layer.

Preferably, the intermediate PU layer is transparent, translucent or opaque, and the intermediate PU layer can be polycarbonate polyurethane, or polyurethane added with a crosslinking agent, or polyurethane added with a wear-resistant auxiliary agent or a lubricant, or a thermoplastic PU layer.

Preferably, the intermediate PU layer has transmittancy; the key module has a backlight module, a light of the backlight module is capable of penetrating the intermediate PU layer and passing through the hollow part.

Preferably, the concave-convex part comprises a touch area formed to be used as a touch panel of an electronic device or a mechanical equipment.

Preferably, when the thermoplastic PU layer is stretched no more than 20% of stretching amount, after being stretched repeatedly for 300,000 times, an elastic recovery rate thereof is no less than 98%.

A thickness of the keyboard membrane is less than 0.1 mm, preferably, the thickness is between 0.05 mm and 0.1 mm, or 0.03 mm and 0.1 mm.

Preferably, the keys of the key module are not produced with characters.

BRIEF DESCRIPTION OF DRAWINGS

The objects, features, and achieved efficacies of the invention can be understood from the description and drawings of the following preferred embodiments, in which:

FIG. 1 is a cross-sectional view of a thermoplastic wear-resistant molding membrane used in the invention.

FIG. 2 is a cross-sectional view of a molded structure of the molding membrane of FIG. 1.

FIGS. 3 to 6 are perspective views of four keyboard membranes molded from the molding membrane of FIG. 1, wherein the keyboard membranes of FIGS. 5 and 6 show that characters are made.

FIG. 3A is a perspective view of a peripheral edge of the keyboard membrane of FIG. 3 wrapping a keyboard module to form a keyboard.

FIG. 4A is a perspective view of the peripheral edge of the keyboard membrane of FIG. 4 wrapping the keyboard module to form the keyboard.

FIG. 7 is a cross-sectional view of section line 7-7 in FIG. 3.

FIG. 8 is a partial cross-sectional view of the keyboard of a preferred embodiment of the invention, and this cross-sectional view is at a position of section line 8-8 in FIG. 5.

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FIG. 9 is a cross-sectional view of another thermoplastic wear-resistant molding membrane used in the invention.

FIG. 10 is a partial cross-sectional view of the keyboard of another preferred embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

The invention provides a keyboard membrane 30 and a keyboard 50 with the keyboard membrane 30, so that the keyboard 50 is waterproof. FIG. 3 to FIG. 6 show several preferred embodiments of the keyboard membrane 30 (30a~30d) of the invention, and the keyboard membrane 30 is made with a thermoplastic wear-resistant molding membrane 10 (hereinafter referred to as the molding membrane) of FIG. 1.

The molding membrane 10 comprises: a wear-resistant polyurethane layer (or wear-resistant PU layer) 20 and a thermoplastic polyurethane (polyurethane elastomer) layer (or thermoplastic PU layer) 22, and the two PU layers 20, 22 are combined. The molding membrane 10 can be molded into a thin sheet molded object with a concave-convex structure, which can be used as the keyboard membrane 30 for various products such as calculators, computers, laptops, wired or wireless keyboards, remote controls, and automation equipment or mechanical equipment to become a touch and pressing molded object.

A material of the wear-resistant PU layer 20 can be polycarbonate polyurethane, a thermoplastic polyurethane elastomer formed by polymerization of polycarbonate compounds, such as polycarbonate diols (PCDL), which has excellent physical properties and mechanical properties such as hydrolysis resistance, heat resistance, wear resistance, oxidative degradation resistance and weather resistance to be capable of withstanding a temperature of -40° C.~80° C.

The wear-resistant PU layer can be polyurethane added with a crosslinking agent to increase wear resistance. The crosslinking agent, such as a curing agent, can increase the curability of the wear-resistant PU layer 20 and improve its wear-resistant effect.

The wear-resistant PU layer can be polyurethane added with a wear-resistant auxiliary agent. The wear-resistant auxiliary agent, such as a slip agent or a lubricant, can impart lubricity to the wear-resistant PU layer 20, reduce the surface friction coefficient of the PU layer 20, reduce its wear, and thereby enhance the wear resistance.

The thermoplastic PU layer 22 is a polyester type (Ester), polyether type (Ether) or polycarbonate type thermoplastic polyurethane, which is a polymer elastomer with excellent ductility and elasticity. Preferably, a ductility of the thermoplastic PU layer 22 of this embodiment still has an elastic recovery rate of no less than 98% after being stretched for 300,000 times at a stretching amount of no more than 20%. Preferably, a stretching recovery rate is not less than 99%, and has excellent recovery after stretching. The thermoplastic PU layer 22 is softer, more stretchable and elastic than the wear-resistant PU layer 20, and is suitable for molding and shaping.

Please refer to FIG. 2, the wear-resistant PU layer 20 and the thermoplastic PU layer 22 are coated on a release surface of a release layer 24 with a liquid PU material, and are formed by drying. The release layer 24 can be a release paper or release membrane. The wear-resistant PU layer 20 is disposed on the release surface of the release layer 24, and the thermoplastic PU layer 22 is disposed on a surface of the wear-resistant PU layer 20. Through a coating method of the applicant, problems of producing fish eyes (refer to incom-

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pletely mixed and refined crystals of PU particles in a manufacturing process of extrusion or injection of PU membrane, commonly known as crystal dots) and producing bubbles by the conventional coating method can be avoided in the molding membrane 10 to be capable of producing the thin molding membrane 10 with small tolerance and uniform texture precisely, so that a thickness T is less than 0.1 mm, which is between 0.03 mm and 0.1 mm, preferably, a thickness of the molding membrane 10 is 0.03 mm~0.07 mm, most preferably, the thickness T ranges from 0.05 mm~0.06 mm, and a hardness thereof is below 85D (inclusive) of Rockwell hardness, and has flexibility. The molding membrane 10 is light, thin, soft, easy to shape, and has excellent elasticity, ductility and wear resistance. In this embodiment, a thickness of the wear-resistant PU layer 20 is 0.04 mm or 0.05 mm, and a thickness of the thermoplastic PU layer 22 is 0.02 mm or 0.03 mm. The release surface of the release layer 24 can be patterned or matte treated, so that an outer surface of the wear-resistant PU layer 20 can be patterned or matted.

When the molding membrane 10 is to be thermoplastically molded, the molding membrane 10 can be molded without peeling off the release layer 24 or in a state where the release layer 24 is peeled off. If molding is carried out in a state where the release layer 24 is not peeled off, the release layer 24 is torn off after the molding membrane 10 is finished with molding.

With a moldability of the thermoplastic PU layer 22, the molding membrane 10 can be molded into thin sheet molded objects of various shapes by a mold, to be used as touchable molded objects for users to press and touch, for example, being used as touchable outer layers of various electronic devices, such as but not limited to, keyboard membranes of remote controls, notebook computers, mobile phones, monitors, etc. The four types of keyboard membranes 30 (30a to 30d) shown in FIGS. 3 to 6 can be used in electronic devices or machines with physical keys or buttons, for example, for using in keys or buttons of notebook computers, keyboards, remote controls, and mechanical operation panels.

The molding membrane 10 is thermoplastically molded into the keyboard membranes 30 of various dimensions and sizes in a mold at a temperature of 100~250° C., for example, molding is performed in the mold by suction. Each of the keyboard membranes 30 can be molded with a plurality of concave-convex parts as required, as shown in FIG. 3 to FIG. 8. The concave-convex part comprises a plurality of upwardly protruding pressing parts 32, corresponding to a plurality of keys 42 of a key module 40, and each of the keys 42 has a keycap 44 and a key foot 45. Please refer to FIG. 4, the concave-convex part further comprises a larger concave touch area 33, which corresponds to a touch pad of an electronic device or a notebook computer. The molding membrane 10 is thin enough to enable the keyboard membranes 30 to form the touch area 33. The key module 40 is a general PC keyboard, a notebook computer keyboard, a portable keyboard, or a remote control with keys.

Please refer to FIG. 3 to FIG. 6, front, rear, left and right peripheries of the keyboard membrane 30 of the invention are further provided with a peripheral edge 31 extending outward from the pressing parts 32, and the peripheral edge 31 can be used to wrap other parts other than the keys 42 of the key module 40, as shown in FIGS. 3A and 4A. The peripheral edge 31 of the keyboard membrane 30 wraps a periphery of the key module 40, so that the keys 42 and the parts other than the keys 42 can also be waterproof and dustproof. The key module 40 comprises a casing 41 and the keys 42 are arranged in the casing 41, and keycaps 44 of the

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keys 42 exposed on a top surface 411 of the casing 41 for pressing. Each of the keys 42 is exposed from a key hole 414 of the casing 41, as shown in FIG. 8. The casing 41 has a bottom surface 412 and a peripheral surface 413 located between the top surface 411 and the bottom surface 412. The peripheral edge 31 of the keyboard membrane 30 wraps the top surface 411 of the casing 41 of the key module 40, or the peripheral edge 31 wraps the top surface 411 and the peripheral surface 413 of the key module 40, or the peripheral edge 31 of the keyboard membrane 30 wraps the top surface 411, the peripheral surface 413 and the bottom surface 412 of the casing 41, as shown in FIG. 3A and FIG. 4A. The peripheral edge 31 can wrap all or part of the bottom surface 412 of the casing 41 as required.

In addition, please refer to FIG. 8, an inner surface 301 of the keyboard membrane 30 other than the pressing parts 32 is bonded to the surfaces of the casing 41 of the key module 40 with an adhesive (such as hot melt adhesive) 47. Except for the key holes 414, all the inner surface 301 of the keyboard membrane 30 is bonded to all the surfaces of the casing 41 with the adhesive 47. For example, when the peripheral edge 31 of the keyboard membrane 30 wraps the top surface 411, the peripheral surface 413 and the bottom surface 412 of the casing 41, the inner surface of the entire keyboard membrane 30 (including the peripheral edge 31) is bonded to the top surface 411, the peripheral surface 413 and the bottom surface 412 with the adhesive 47. After the keyboard membrane 30 is adhered to the casing 41, the keyboard membrane 30 and the casing 41 cannot be torn apart, capable of completely blocking foreign objects and preventing foreign objects from entering the keys 42. Therefore, excellent water resistance can be provided.

After the keyboard membrane 30 wraps the key module 40, the waterproof and dustproof keyboard 50 (50a, 50b) is formed as a whole. The wear-resistant PU layer 20 is a surface layer of the keyboard membrane 30, and the thermoplastic PU layer 22 is an inner layer of the keyboard membrane 30. When a user presses the keys 42, the wear-resistant PU layer 20 is contacted.

Each of the pressing parts 32 has a rectangular or other geometrically shaped top wall 34 and a peripheral wall 35 extending downward from a periphery of the top wall 34. As shown in FIG. 5 and FIG. 8, top walls of all or part of the pressing parts are provided with characters. one character 36 or a plurality of characters 36 is/are engraved on the top wall 34 of each of the pressing parts 32 by laser, and the different characters 36 are engraved on the different pressing parts 32. The characters 36 engraved by laser are formed by removing a material of the wear-resistant PU layer 20, and a depth of engraving reaches the thermoplastic PU layer 22, so each of the characters 36 forms a hollow part 38 penetrating the wear-resistant PU layer 20 on the top wall 34, as shown in FIG. 8, and the thermoplastic PU layer 22 is exposed at the hollow part 38.

The wear-resistant PU layer 20 and the thermoplastic PU layer 22 have different colors, for example, the wear-resistant PU layer 20 has a dark color, while the thermoplastic PU layer 22 has a light color, and vice versa. Therefore, a color of the character 36 is a color of the thermoplastic PU layer 22, which can be clearly displayed on the pressing part 32. The thermoplastic PU layer 22 can be a color layer, which can be formed by mixing colorants or pigments to display various colors and become a color of the character 36.

The keyboard membrane 30 after laser engraving, as shown in FIG. 8, is installed on the key module 40 of an electronic device or a mechanical equipment, and the periph-

eral edge 31 of the keyboard membrane 30 wraps the key module 40. Each of the pressing parts 32 corresponds to one of the keys 42, and an inner surface of the pressing part 32 is bonded to the keycap 44 of the key 42 with an adhesive 46, such as hot melt adhesive. For example, the hot melt adhesive is applied to a top surface of the keycap 44 to bond an inner surface 342 of the top wall 34 of the pressing part 32 to the top surface of the keycap 44 with the adhesive 46, and each of the keys 42 can be pressed from each of the pressing parts 32. The wear-resistant PU layer 20 is a surface layer of the keyboard membrane 30, which makes a surface of the keyboard membrane 30 wear-resistant, free from hand marks, difficult for dirt to stick on the keyboard membrane 30, and not sticky. Preferably, the pressing part 32 is bonded to the top surface of the keycap 44 only by the inner surface 342 of the top wall 34, and the peripheral wall 35 of the pressing part 32 is not bonded to the keycap 44, so that physical properties of the peripheral wall 35 will not be affected by the hot melt adhesive. The key module 40 described above is not a main object of the invention, so it will not be described in detail.

The thermoplastic PU layer 22 can not only be made to have different colors, but also can be made transparent or translucent to have transmittancy, so that the key module 40 can use backlight technology to enable LED light to penetrate through the hollow part 38 to make the character 36 glow. Since each of the pressing parts 32 is provided with the character 36, the keys 42 of the key module 40 do not need to be provided with characters.

A thermoplastic wear-resistant molding membrane 10' of FIG. 9 can be thermoplastically made into the keyboard membrane 30 (30e) of FIG. 10 in a mold, the molding membrane 10' has the wear-resistant PU layer 20, the thermoplastic PU layer 22, and further comprises: an intermediate polyurethane layer (or intermediate PU layer) 21. The wear-resistant PU layer 20 and the thermoplastic PU layer 22 are the same as those of the first preferred embodiment, which can be understood from that embodiment. Same components use the same reference numerals.

The intermediate PU layer 21 in this embodiment is also a polycarbonate PU, or the same material as the wear-resistant PU layer 20, but not limited thereto, and other types of thermoplastic PU can be used.

The wear-resistant PU layer 20, the intermediate PU layer 21 and the thermoplastic PU layer 22 are sequentially coated with a liquid PU material on the release layer 24 and formed by drying. The wear-resistant PU layer 20 is disposed on the release surface of the release layer 24, the intermediate PU layer 21 is disposed on a surface of the wear-resistant PU layer 20, and the thermoplastic PU layer 22 is disposed on a surface of the intermediate PU layer 21. The applicant is capable of precisely manufacturing the thin molding membrane 10' with small tolerance and uniformity by a coating method, and there are no fish eyes (crystal dots) and air bubbles inside the molding membrane 10'. The thickness T of the molding membrane 10' ranges from 0.04 mm to 0.1 mm, preferably 0.04 mm to 0.09 mm. The thickness T formed by the three PU layers 20, 21 and 22 of this embodiment is preferably below 0.04 mm~0.08 mm (inclusive), most preferably, the thickness T is between 0.05 mm and 0.07 mm, and a hardness of the molding membrane 10' is below 85D of Rockwell hardness. The molding membrane 10' is light, soft, and has excellent elasticity, ductility and wear resistance. In this embodiment, the wear-resistant PU layer 20 has a thickness of 0.03 mm, the intermediate PU layer 21 has a thickness of 0.02 mm, and the thermoplastic PU layer 22 has a thickness of 0.02 mm. The wear-resistant

PU layer 20 and the thermoplastic PU layer 22 are made to have contrasting colors of dark and light colors; and the intermediate PU layer 21 is transparent or translucent.

When the molding membrane 10' is thermoplastically molded, it can be molded under a state of peeling off or not peeling off the release layer 24 in order to be molded into the keyboard membrane 30 with desired shape and contour. A thickness of the keyboard membrane 30 is T, and a hardness thereof is below 85D of Rockwell hardness.

FIG. 10 shows that the molding membrane 10' of FIG. 9 is thermoplastically molded into the keyboard membrane 30 (30e) in a mold, and combined with the key module 40 to form the waterproof and dustproof keyboard 50, the keyboard membrane 30 has the concave-convex parts, comprising the upwardly protruding pressing parts 32, and an inner surface of each of the pressing parts 32 is bonded with the keycap 44 of the key 42 of the key module 40. The wear-resistant PU layer 20 is a surface layer of the keyboard membrane 30 (30e), the thermoplastic PU layer 22 is an inner layer of the keyboard membrane 30 (30e), and the intermediate PU layer 21 is located between the wear-resistant PU layer 20 and the thermoplastic PU layer 22. The wear-resistant PU layer 20 is touched by the user when operating keys or buttons of an electronic device. The intermediate PU layer 21 is made into a transparent or translucent layer to enable light to penetrate, or the intermediate PU layer 21 can be made into an opaque layer.

Each of the pressing parts 32 has the top wall 34 and the upright peripheral wall 35, the character 36 or the characters 36 is/are engraved on the top wall 34 by laser, so that the top wall 34 forms a hollow part 38' that penetrates the wear-resistant PU layer 20. Laser engraving is used to remove a material of the wear-resistant PU layer 20, a depth of laser engraving (that is, a depth of the hollow part 38') is capable of reaching the wear-resistant PU layer 20 or even reaching the intermediate PU layer 21. The intermediate PU layer 21 is capable of protecting the thermoplastic PU layer 22 during laser engraving. If the intermediate PU layer 21 is transparent or translucent, even if a material of the intermediate PU layer 21 is not removed or only partially removed, a color of the thermoplastic PU layer 22 can still be exposed in the hollow part 38', making the characters 36 of the pressing parts 32 have colors. When a backlight module of the key module 40 emits light, the light is capable of penetrating the intermediate PU layer 21 and passing through the hollow part 38', so that the characters 36 of the pressing parts 32 are capable of emitting light.

The keyboard membrane 30 of the invention has the following efficacies.

The keyboard membrane 30 is molded and shaped in one piece, which is dustproof and waterproof, preventing liquid or dirt from entering the keys 42. In addition to the keyboard membrane 30 wrapping all the keys 42, the keyboard membrane 30 also wraps a periphery of the key module 40 with the peripheral edge 31, including wraps the bottom surface 412 of the key module, so that the keyboard membrane and the key module form the waterproof and dustproof keyboard 50, preventing dirt, liquid, and moisture from entering the keyboard 50. Thus the keyboard of an electronic device or an independent keyboard can be used for military purposes, such as notebook computers and keyboards used by special forces, even if wading into water, the keyboard is still waterproof to maintain usability. Since it is waterproof, the keyboard 50 is easy to clean, and there is no need to worry about water vapor causing a short circuit or any damage to the keyboard 50.

A surface layer of the keyboard membrane **30** is formed by the wear-resistant PU layer **20**, which has a property of wear resistance and can be used for a long period of time without wear. The wear-resistant PU layer **20** is subjected to a wear resistance test with a soft rubber weighing 350 grams, and is capable of withstanding more than 15,000 times of friction without breaking.

Physical and chemical properties of the wear-resistant PU layer **20** are stable, a surface of the keyboard membrane **30** is stable, does not change, is not easy to get dirty, and is not sticky, and a tactile impression of fingers on surface layers of the pressing parts **32** (that is, the wear-resistant PU layer **20**) is fresh and clean and not sticky. Moreover, the wear-resistant PU layer **20** is weather-resistant, and a usability thereof will not be affected in extreme weather environments.

The keyboard membrane **30** is extremely thin (not more than 0.1 mm), soft and has excellent ductility, and can be precisely thermoplastically molded, and an intersection angle **341** or a bending position between a junction of the top wall **34** and the peripheral wall **35** of the pressing part **32** can be precisely, completely and beautifully molded and shaped. A ductility of the thermoplastic PU layer **22** is excellent, and can be stretched to more than twice a length, so the molding membrane **10** is capable of meeting particularly large demands for ductility at angles of the molded object, and the intersection angle **341** or a bending position of the keyboard membrane **30** can be molded and shaped smoothly without breaking.

The keyboard membrane **30** of the invention is formed of at least two PU layers of two different materials, is thin and soft, and the thermoplastic PU layer **22** provides excellent elasticity. The shaped keyboard membrane **30** is also thin and has excellent elasticity. When the pressing part **32** is pressed, the peripheral wall **35** can be easily deformed, flexed and elastically recovered. A keystroke (press-recover) of tapping the pressing part **21** and the key **42** is clear, providing excellent tactile impression and handfeel of tapping. Since the keyboard membrane **30** is thin and soft, the user only needs to press the key **42** effortlessly. The keyboard membrane **30** has an excellent stretching recovery rate, so that the pressing part **32** has an excellent recovery after being tapped. According to the applicant's experiment, the pressing part **32** has an elastic recovery rate of 99% after being tapped tens of thousands of times.

Furthermore, the keyboard membrane **30** is thin, soft and has excellent elasticity, and the adjacent pressing parts **32** will not pull against one another, so the user can easily tap the keyboard **50**.

A keystroke of tapping the pressing part **21** of the keyboard membrane **30** is stable and reliable, even after a long period of use, and invalid keystroke will not occur.

The molding membrane **10** has no fish eyes and air bubbles, and there will be no crystal dots and air holes in the molded keyboard membrane **30**. When a light of a backlight module passes through the characters **36**, the light will not be refracted or scattered, and will not cause consumers to consider the keyboard membrane to be a defective product.

The molding membrane **10** is thin and uniform, and a manufacturing tolerance thereof is small, a tolerance of thickness can be 0.005 mm~0.01 mm, such as 0.025 mm, so that the keyboard membrane **30** of the invention with a thickness of less than 0.1 mm can be precisely engraved by laser.

The keyboard membrane **30** is engraved by laser from the front wear-resistant PU layer **20** toward an inner direction, and laser engraving operation is simple and easy to implement.

The thermoplastic PU layer **22** is used as a color layer, which can be toned into different colors to make the characters **36** have different colors. The thermoplastic PU layer **22** of this embodiment is made white with white pigments, such as titanium white or calcium carbonate, while the wear-resistant PU layer **20** is made black, so the two PU layers **20**, **22** form contrasting colors of light color and dark color, making the characters **36** distinct. In addition, the molding membrane **10** can be added with graphene to make the keyboard membrane **30** conductive electrically.

The molded keyboard membrane and keyboard provided by the present invention are the first articles and structures in this field, which can solve the deficiencies of prior arts and increase the efficiency. The embodiments disclosed in the present invention are merely to illustrate the technical means of the invention and are not intended to limit it. Any equivalent modifications of the invention should be considered as the protection scope of the invention.

What is claimed is:

1. A keyboard membrane, being a thin sheet molded object thermoformed by a thermoplastic molding membrane, comprising a plurality of concave-convex parts;

the concave-convex parts comprising a plurality of upwardly protruding pressing parts, each of the pressing parts having a top wall and a peripheral wall extending downward from a periphery of the top wall; the keyboard membrane being used for disposing on a key module; each of the pressing parts being used for corresponding to a key of the key module;

a periphery of the keyboard membrane further having a peripheral edge extending outward from the pressing part, and the peripheral edge being used for wrapping the key module; and

the keyboard membrane being a membrane material in the form of at least two layers, comprising: a wear-resistant polyurethane (PU) layer and a second polyurethane (PU) layer, the wear-resistant PU layer being polycarbonate polyurethane, or polyurethane added with a crosslinking agent to increase wear resistance, or polyurethane added with a wear-resistant auxiliary agent to reduce friction resistance, the wear-resistant PU layer being a surface layer of the keyboard membrane; the second PU layer being disposed on a surface of the wear-resistant PU layer to form an inner layer of the keyboard membrane;

wherein a thickness of the keyboard membrane is equal to or greater than 0.03 mm and less than 0.1 mm.

2. The keyboard membrane as claimed in claim 1, wherein the wear-resistant polyurethane layer is polyurethane added with a curing agent, or polyurethane added with a slip agent or a lubricant.

3. The keyboard membrane as claimed in claim 1, wherein the second PU layer is a thermoplastic polyurethane (PU) layer with ductility and elasticity greater than ductility and elasticity of the wear-resistant PU layer.

4. The keyboard membrane as claimed in claim 1, wherein top walls of all or part of the pressing parts are respectively provided with at least one character.

5. The keyboard membrane as claimed in claim 4, wherein the character being formed by removing a material of the wear-resistant PU layer, so that the top wall forming a hollow part.

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6. The keyboard membrane as claimed in claim 5, wherein the second PU layer is exposed in the hollow part.

7. The keyboard membrane as claimed in claim 5, further comprising an intermediate PU layer disposed between the wear-resistant PU layer and the second PU layer; a depth of the hollow part reaching the wear-resistant PU layer or the intermediate PU layer.

8. The keyboard membrane as claimed in claim 7, wherein the intermediate PU layer has transmittancy.

9. The keyboard membrane as claimed in claim 7, wherein the intermediate PU layer is polycarbonate polyurethane, or polyurethane added with a crosslinking agent, or polyurethane added with a wear-resistant auxiliary agent or a lubricant, or thermoplastic polyurethane.

10. The keyboard membrane as claimed in claim 3, wherein when the thermoplastic PU layer is stretched no more than 20% of stretching amount, after being stretched repeatedly for 300,000 times, an elastic recovery rate thereof is no less than 98%.

11. A keyboard comprising:

the keyboard membrane as claimed in claim 1; and
a key module having a casing and a plurality of keys, each of the keys having a keycap, the keycap being located on a top surface of the key module;

the keyboard membrane wrapping the top surface of the key module, an inner surface of each of the pressing parts being connected with the keycap of each of the keys;

the peripheral edge of the keyboard membrane at least wrapping the top surface of the key module.

12. The keyboard as claimed in claim 11, wherein the inner surface of each of the pressing parts is bonded to the keycap of each of the keys with an adhesive; the peripheral edge of the keyboard membrane wraps the top surface of the key module, or wraps the top surface and a peripheral

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surface of the key module, or wraps the top surface, the peripheral surface and a bottom surface of the key module.

13. The keyboard as claimed in claim 11, wherein an inner surface of the keyboard membrane other than the pressing parts is bonded to the surfaces of the key module with an adhesive.

14. The keyboard as claimed in claim 12, wherein an inner surface of the keyboard membrane other than the pressing parts is bonded to the surfaces of the key module with an adhesive.

15. The keyboard as claimed in claim 11, wherein the wear-resistant polyurethane layer is polyurethane added with a curing agent, or polyurethane added with a slip agent or a lubricant.

16. The keyboard as claimed in claim 11, further comprising at least one character being provided on a top wall of each of the pressing parts, the character is formed by removing a material of the wear-resistant PU layer, so that the top wall forming a hollow part.

17. The keyboard as claimed in claim 16, further comprising an intermediate PU layer disposed between the wear-resistant PU layer and the second PU layer; a depth of the hollow part reaching the wear-resistant PU layer or the intermediate PU layer.

18. The keyboard as claimed in claim 17, wherein the intermediate PU layer has transmittancy; the key module has a backlight module, a light of the backlight module is capable of penetrating the intermediate PU layer and passing through the hollow part.

19. The keyboard as claimed in claim 11, wherein top walls of all or part of the pressing parts are respectively provided with at least one character; the keys of the key module are not produced with characters.

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