



PROTECTIVE SEALABLE TRANSPARENT FLEXIBLE MEMBRANE FOR ELECTRONIC TOUCH SCREENS

The present invention relates to a protective sealable transparent membrane which
5 covers the touch screen of a personal electronic device encased in a protective enclosure.

Personal electronic devices, such as hand held computers, cell phones, pagers,
personal digital assistants (PDAs), gaming devices, electronic music players, voice
recorders, global positioning systems (GPS) and the like, have become common place in
today's society. These personal electronic devices have found utility in all aspects of life
10 including personal and/or professional activities. A touch screen is commonly used to input
and view data into personal electronic devices. The advantage of a touch screen is that the
operator may simply touch the display object or portion of the screen to highlight or select
or otherwise input information.

In most environments, and in outdoor environments in particular, personal electronic
15 devices are subject to liquids, dust, foods, grease, moisture and other contaminants.
Contamination of the touch screen can adversely affect the operability of the personal
electronic device. Following contamination, these devices need to be cleaned, further
exposing the personal electronic devices to harsh cleaning fluids, liquids and solutions.
Thus, in order to operate properly in harsh environments, an enclosure with a protective
20 transparent membrane having a liquid tight seal is needed to protect sensitive electronic
display elements.

Prior art techniques have attempted to solve this problem in several ways.
Typically, an enclosure with a front cover for a touch screen contains one or more gaskets.
Not only do gaskets leak with time and exposure to environmental contamination and
25 cleaning fluids, but they also require the use of additional assembly steps and addition of the
gasket(s) itself. The gasket must be attached and seated properly in order to function
effectively. The use of gaskets requires multiple operations and parts which makes front
covers using gaskets expensive to manufacture. Gaskets also tend to leak after a relatively
short period of time due to the expansion and contraction of the gasket itself due to
30 temperature changes in the environment.

Other attempts to solve the problem involve an enclosure with an openable/closeable
protective lid. These solutions are less than desirable as they are not sealed to liquids and
must be opened to activate the touch screen, thus providing opportunities for exposing the
touch screen to potential contamination. One such example is taught in US-A-5,990,874 of



a personal electronic device with an attachable openable/closeable lid where there is limited capability to activate the touch screen by depressing the protective lid while closed. Unfortunately, the lid does not provide a seal to liquids and the elements and the only function through the lid is the ability to turn the personal electronic device on or off.

5 Accordingly a need exists for a protective sealable transparent flexible membrane for personal electronic devices having touch screens encased in a protective enclosure, which allows activation of the touch screen through the membrane, provides an effective liquid and dust tight seal and protects the touch screen from the environment and elements. Further, it is desirable that the number of parts, assembly steps and hence the cost can be
10 reduced.

FIG. 1 is a perspective view showing the protective transparent flexible membrane.

FIG. 2 is a perspective view of the protective transparent flexible membrane and underside of the top portion of the protective enclosure for a personal electronic device that the protective transparent flexible membrane fits into.

15 FIG. 3 is an exploded perspective view of the protective transparent flexible membrane, top portion of the protective enclosure, a personal electronic device and the mating bottom portion of the protective enclosure.

It is an objective of the invention to provide a protective sealable transparent flexible membrane that fits into a protective enclosure for a personal electronic device through
20 which the touch screen can be viewed.

It is another objective of the invention to provide a protective sealable transparent flexible membrane that when in place in the protective enclosure provides protection and scratch resistance for the touch screen of the personal electronic device.

It is another objective of the invention to provide a protective sealable transparent
25 flexible membrane that when in place in the protective enclosure provides a liquid, especially water, tight seal.

It is another objective of the invention to provide a protective sealable transparent flexible membrane that when in place in the protective enclosure provides a particulate, especially dust, tight seal.

30 It is yet another objective of the invention to provide a protective sealable transparent flexible membrane that when in place in the protective enclosure allows for activation of the touch screen on the personal electronic device through the membrane.

It is still a further objective of the invention to provide a protective sealable transparent flexible membrane that is easy to replace.

It is still a further objective of the invention to provide a protective sealable transparent flexible membrane that is easy to manufacture.

5 An embodiment of the present invention is a protective sealable transparent flexible membrane comprising a film and a frame, which fits into a protective enclosure and is suspended above a personal electronic device, said protective sealable transparent flexible membrane provides a liquid and particulate tight seal.

10 In a further embodiment of the present invention, the film is a flexible transparent thermoplastic, preferably a transparent thermoplastic polyurethane elastomer.

In a further embodiment of the present invention, the frame is a flexible thermoplastic elastomer, preferably a thermoplastic polyurethane elastomer.

15 In a further embodiment of the present invention, the film and frame are the same or different flexible thermoplastic elastomer, preferably the same or different thermoplastic polyurethane elastomer.

In a further embodiment of the invention the film is a flexible thermoplastic, preferably a thermoplastic urethane elastomer, with a hardness of between Shore 50 A to Shore 65 D.

20 In yet a further embodiment of the present invention, the protective sealable transparent flexible membrane comprises buttons, preferably molded-in buttons.

In yet a further embodiment of the invention, the protective sealable transparent flexible membrane comprises decorative printing.

25 The present invention is a protective sealable transparent flexible membrane. Said protective sealable transparent flexible membrane fits into a protective enclosure which houses a personal electronic device having a display and/or touch screen, such as a hand held computer, cell phone, a pager, a personal digital assistant (PDA), a gaming device, an electronic music player, a voice recorder, a global positioning system (GPS) and the like. The protective sealable transparent flexible membrane 1 shown in FIG. 1 having a top side and an underside and comprising a film 11 and a frame 12. As shown in FIG. 2, the protective sealable transparent flexible membrane 1 fits into the underside of the top portion of a protective enclosure 21 having an under side 22 and a top side 23. The protective sealable transparent flexible membrane 1 can fit into the topside or underside of the top portion of the protective enclosure 21. The frame 12 forms a mechanical seal with a mating

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recess 24 in the top portion of the protective enclosure 21. The top portion of the protective enclosure 21 mates with a bottom portion of the protective enclosure 31 as shown in FIG. 3 to form the protective enclosure for a personal electronic device 43.

5 The film 11 can be made from any translucent or preferably transparent thermoplastic by any known film making process known in the art. Preferably, the film is made from a translucent or transparent polyamide, polyurethane (PU), polycarbonate (PC), polyvinyl chloride (PVC), polyolefin (PO), such as polyethylene (PE) and polypropylene (PP), polyacrylate, polyester, polysiloxane, polystyrene (PS), styrene and acrylonitrile copolymer (SAN) or mixtures thereof. Preferably the film is a thermoplastic polyurethane 10 (TPU). Preferably the film 11 is a thermoplastic elastomer.

The film must allow for activation of the touch screen through it, for example by depressing the film. Preferably the film is an elastomer. Moreover, the film has good flex fatigue resistance so as to recover its original position after being depressed when activating the touch screen, rigid enough to maintain its position above the touch screen so as to 15 minimize unwanted screen activation, good hardness so as to afford scratch resistance, good solvent resistance and good long term creep properties so that it will not sag over time. Preferred hardness is equal to or greater than Shore 50 A and equal to or less than Shore 65 D.

20 Preferably the film 11 has a thickness equal to or greater than 0.001 millimeter (mm), preferably equal to or greater than 0.01 mm, more preferably equal to or greater than 0.02 mm and most preferably equal to or greater than 0.04 mm. Preferably the film 11 has a thickness equal to or less than 0.5 mm, preferably equal to or less than 0.1 mm, more preferably equal to or less than 0.08 mm, even more preferably equal to or less than 0.06 mm and most preferably equal to or less than 0.05 mm.

25 The frame 12 can be made from any thermoplastic elastomer which can (1) be adhered to the film and (2) make a liquid and particulate tight mechanical seal when fitted into the recess 24 in the top portion of the protective enclosure 21. Suitable elastomers are described, for example, in Billmeyer, F., *Textbook of Polymer Science*, Interscience Publishers, New York, N.Y. (1965) and in *Kirk-Othmer Science of Chemical Technology* 4th 30 Ed, John Wiley & Sons, New York N.Y. (1993). Preferably the frame is made from a thermoplastic elastomer such as thermoplastic polyolefin (TPO), polyethylene, such as low density polyethylene (LDPE), ethylene and vinyl acetate copolymer (EVA), ethylene and propylene copolymers (EP), polyvinyl chloride, polyurethane, polyamide, polyester and

mixtures thereof. Preferably the frame is made from a thermoplastic polyurethane, such as PELLETHANE™ 2102-75A available from The Dow Chemical Company.

5 The film 11 and the frame 12 may be made from different thermoplastic elastomers or the same thermoplastic elastomer. Preferably the film 11 and the frame 12 are made from thermoplastic polyurethane.

10 The protective sealable transparent flexible membrane 1 is a single part, but the film 11 and the frame 12 may be one or more distinct parts. If the film 11 and frame 12 are a single part, it must comprise a translucent or transparent thermoplastic elastomer. If the film 11 and frame 12 are two or more parts, the frame can be made by any known plastic processing technique, such as injection molding, thermoforming, extrusion and die cutting, and the like. The film 11 and the frame 12 may be attached to one another by any means known in the art to form the protective sealable transparent flexible membrane, for example by a mechanical bond or physically with adhesives, solvent bonding, heat staking, sonic welding or insert molding. A preferable method of bonding 11 to 12 is insert molding, for example injection molding or thermoforming the frame 12 over the film 11 to form the protective sealable transparent flexible membrane 1.

20 The protective sealable transparent flexible membrane can vary in size, preferably it enables a view of the personal electronic device within the protective enclosure and more preferably a view of the touch screen of the personal electronic device 43 housed within the protective enclosure.

EXAMPLE

The following example serves to demonstrate an embodiment of the invention but is not intended to limit the scope of the invention.

25 A thermoplastic polyurethane flexible film available as PT9200 U type S-2332, natural/clear from Deerfield having a thickness of 0.043 mm and a hardness in the range of Shore 50A to Shore 65 D is used. The frame comprises PELLETHANE 2102-75A from the Dow Chemical company. The protective sealable transparent flexible membrane is formed by insert injection molding the frame onto the film in an injection molding machine having a mold cavity in the shape of the frame. A piece of the PT9200 U type S-2332 film, larger than the frame cavity, is placed between the mold halves, the mold is closed and PELLETHANE 2102-75A is insert molded onto the PT9200 U type S-2332 film. The PELLETHANE 2102-75A is dried at a temperature between 80 to 95°C and the molding conditions are a melt temperature between 200 to 215°C with a mold temperature between

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15 to 60°C. The combined frame and film are removed from the mold and excess film is die cut away to provide a protective sealable transparent flexible membrane of the desired shape.

5 The resulting protective sealable transparent flexible membrane is placed into a top portion of a protective enclosure such that the frame mates with a recess in the top portion of the protective enclosure to form a water and dust tight seal. A personal electronic device is placed in the protective enclosure and the top portion of the protective enclosure is mated with the bottom portion of the protective enclosure. The resulting protective sealable transparent flexible membrane allows for activation of the touch screen as well as good
10 scratch resistance, water and dust resistance.

CLAIMS:

1. A protective enclosure for holding a portable personal electronic device comprising a touch screen, wherein the enclosure comprises:
 - (i) a top body portion having an aperture therein positioned, in use, so as to provide access to the touch screen of the portable personal electronic device;
 - (ii) a bottom body portion adapted to mate with the top body portion to form the protective enclosure; and
 - (iii) a replaceable protective transparent flexible membrane associated with the said aperture, for closing the aperture and forming a liquid and particulate tight seal, while allowing activation of the touch screen through the aperture, the membrane comprising a film and a frame such that the membrane is a single part, wherein the top body portion includes a recess around the periphery of the aperture adapted to receive the frame of the membrane, thereby to form a mechanical seal in a liquid and particulate-tight manner between the frame and the recess.
2. The enclosure of Claim 1 wherein the replaceable protective transparent flexible membrane is injection molded or thermoformed.
3. The enclosure of Claim 1 wherein the replaceable protective sealable transparent membrane is formed by insert injection molding the frame onto the film in an injection molding machine having a mold cavity in the shape of the frame.
4. The enclosure of Claim 1 wherein the film comprises a transparent thermoplastic elastomer.
5. The enclosure of Claim 1 wherein the film comprises a transparent thermoplastic polyurethane.
6. The enclosure of Claim 1 wherein the frame comprises a thermoplastic elastomer.
7. The enclosure of Claim 1 wherein the frame comprises a thermoplastic polyurethane.
8. The enclosure of Claim 1 wherein the film has a hardness between Shore 50 A to Shore 65 D.
9. The enclosure of Claim 1 wherein the replaceable protective transparent flexible membrane further comprises molded-in buttons.

10. The enclosure of Claim 1 wherein the replaceable protective transparent flexible membrane further comprises decorative printing.

11. The enclosure of Claim 1 further comprising a personal electronic device comprising a touch screen, wherein the membrane is suspended above, but does not touch, the touch screen allowing activation of the touch screen through the membrane.