

designed so as to come in contact with the substrate **1840** such that pressing the flexible surface **320** will not actuate the dome switch **1842**.

[0059] As shown in FIG. **18b**, the flexible sliding member **1846** is moved, as described above based on any suitable structure to activate and in this case, raise portions of the flexible skin structure **320**. However, since the material is compressible, when a user presses on a top surface of the flexible skin structure **320**, the pin causes the moving portion **1834** to press down upon the flexible material of the flexible sliding member **1846** and depress the dome switch **1842**. As such, in this embodiment, a user may activate the dome switch only when the flexible skin texture is actuated. It will be recognized that the geometry of the movable section of the hinged element **1834** may also be designed such that the dome switch may be actuated by pressing the flexible skin **320** whether the skin is in either the actuated or unactuated state (FIGS. **18b** and **18a**, respectively). Among other advantages, this embodiment may allow the flexible sliding member **1846** to be stamped rather than, for example, molded and also uses conventional dome switches in combination thereby providing a potentially lower cost structure. The hinged elements **1830** may be made of any suitable material such as nylon, polypropylene sheet or any other suitable material as desired. As also noted above, the flexible sliding member may be configured as a sliding member that slides along rails formed in a housing or other structure or may be configured in any other suitable manner as desired.

[0060] FIGS. **19-20** illustrate another example of a controllable skin texture surface structure that employs an expandable gas actuation structure to raise and lower desired portions of a flexible skin structure to provide a controllable tactile surface of a portable electronic device. As shown in FIG. **18**, a skin texture surface actuation structure includes an expandable gas actuation structure that includes a gas therein **1802** such as air, or a material such as Freon or alcohol that changes from liquid to gas at a specified temperature and pressure, and a flexible skin structure **1804** such as the type described above. The expandable gas actuation structure includes a gas chamber **1800** that is thermally coupled to a heating element **1808** such as an electrical resistor, or any other suitable structure, that may be turned on and off by control logic as desired to heat the gas **1802** within the chamber **1800** and cause the gas to expand. The expansion of the gas **1802** causes the gas to expand and fill the chamber **1800** of the flexible skin structure **1804**. When the heating element **1808** is turned off, the gas cools and the chamber **1800** collapses to put the flexible skin structure in an unactuated state. As such, the flexible skin structure **1804**, as also described above, includes pockets corresponding to desired texture features wherein the pockets or chambers are molded into the reverse surface or an undersurface of the flexible skin structure **1804**. The flexible skin structure **1804** is attached to a substrate **1814** as described above, which may be part of the housing of the device or any other structure. It is bonded so as to provide a sealed environment so that the gas **1802** in the chamber **1800** cannot escape the chamber **1800**. When an electric current is sent through the heating element **1808**, the increased temperature causes the trapped gas in the pockets to expand thereby raising the pocket or outer surface over the chamber **1810**. The flexible skin structure includes expandable portions (e.g., pockets) that define a plurality of gas

chambers. Each of the gas chambers includes a controllable heating element that may be activated together or individually.

[0061] The substrate **1814** includes a heating element(s) **1808** corresponding to each respective texture element. In addition, as noted above, all of the examples described herein may include one or more touch sensors **202** which may be used in any suitable manner. FIG. **19** shows a deactivated state of the flexible skin texture and FIG. **20** shows an activated state of the flexible skin structure **1804**.

[0062] FIGS. **21** and **22** diagrammatically illustrate one example of a controllable skin texture surface **2102** with a particular pattern **2102** that may be activated and nonactivated using one or more of the above described actuation structures based on any suitable condition. In this example, the tactile configuration or pattern **2102** may simply be located on an outer surface of the portable electronic device **2106** and need not be part of a user interface but instead provides a unique visual experience and tactile experience for a user.

[0063] FIGS. **23-25** illustrate yet another example of controlling of a controllable skin texture surface **2300** (here shown as multiple hearts) of the types described above wherein a different portion **2302-2306** is activated at different points in time by control logic to give a visual appearance or tactile feel of a moving object. In this example, a "heart" in the pattern is activated at different times. Also, animation of texture, such as variations in surface texture over time, may be used to animate a character or feature. It will be recognized that the above description and examples are merely for illustrative purposes only and that any suitable configurations, designs or structures may be employed as desired.

[0064] Among other advantages, a portable electronic device includes controllable skin texture surfaces to provide unique user experiences by providing different tactile configurations (and/or visual appearances) by selectively controlling portions of a flexible skin structure using various skin texture surface actuation structures. Also, all of the controllable skin texture surface configurations herein can be employed in the handheld wireless device shown in FIG. **1** or any suitable device. Other advantages will be recognized by those of ordinary skill in the art.

[0065] The above detailed description of the invention, and the examples described therein, has been presented for the purposes of illustration and description. While the principles of the invention have been described above in connection with a specific device, it is to be clearly understood that this description is made only by way of example and not as a limitation on the scope of the invention.

What is claimed is:

1. A portable electronic device comprising:
 - a controllable skin texture surface comprising a skin texture surface actuation structure that is comprised of a hydraulic actuation structure comprising a fluid and a flexible skin structure that moves in response to movement of the fluid to change a tactile configuration of at least a portion of the controllable skin texture surface.
2. The portable electronic device of claim **1** comprising control logic to control a fluid pump to control movement of the fluid.
3. The portable electronic device of claim **2** wherein the control logic is operative to control the controllable skin texture surface to change the tactile configuration of a non-user interface portion of the portable electronic device.