communicate a force applied to the tactile layer **110** at the deformable region **112** into the substrate **120**, as shown in FIG. **25**A. Furthermore, in this variation, the free piston is preferably undersized for the cavity **125** such that the piston can move freely therein, as shown in FIGS. **23**A and **23**B. However, the support member **160** can be of any other form and include any other number of beads, pistons, or other elements.

[0087] In this second variation and as described above, the support member **160** preferably includes substantially the same or similar material as the substrate **120**. This may be particularly beneficial in the variation in which an image is transmitted through the substrate **120** and the tactile layer **110**, since the refractive index of the support member **160** can be matched to the refractive index of the substrate **120**. Furthermore, the fluid preferably fills all volumes within the cavity **125** (e.g., around the beads, piston, or other elements or features of the support member **160**) to substantially optically hide edges and surfaces of the cavity **125** and elements therein in both the retracted and expanded settings. By substantially matching the optical properties (e.g., refractive index, color, clarity, etc.) of the substrate **120**, support member **160**, and/or fluid **170**, surfaces within the cavity **125** may be substantially indistinguishable to the naked eye. This may enable a high level of optical clarity in the user interface **100** that also provides the functionality of a dynamic tactile surface.

[0088] In the variation in which the displacement device **130** interacts with support member **160** to transition the deformable region **112** between settings, the support member **160** can further include a metallic or magnetic material. For example, in the variation in which the support member **160** includes a plurality of beads, the displacement device **130** can induce an electrical field across a portion of the cavity **125** to displace at least a portion of the beads within the cavity **125** and thus modify the position (and setting) of the deformable region **112**, as shown in FIGS. **22**A and **22**B. In another example, in the variation in which the support member **160** includes a free piston, the displacement device **130** can induce a magnetic field across a portion of the cavity **125** to displace the piston into the deformable region **112**, thus transitioning the deformable region **112** from the retracted setting to the expanded setting. Alternatively, the support member **160** can be physically coupled to the displacement device **130**, such as via a connecting rod or other lever, wherein the displacement device **130** modifies the orientation or position of the support member **160** within the cavity **125** to engage and/or disengage the deformable region **112** to transition the deformable region **112** between settings, as shown in FIGS. **23**A and **23**B. However, the support member **160** can be perpetually decoupled from the displacement device **130** or interact with the displacement device **130** to transition the deformable region **112** between settings in any other way.

3E. Displacement Device

[0089] The displacement device **130** of the third preferred embodiment preferably functions to transition the deformable region **112** from the retracted setting to the expanded setting, wherein the expanded setting is tactilely distinguishable from the retracted setting at the tactile surface **115**. As described above and like the displacement device **130** of the second preferred embodiment, the displacement device **130** can be a pump connected to the cavity **125** via a fluid channel **138**, wherein the displacement device **130** modifies the pressure within the fluid channel **138** (and the cavity **125**) to displace fluid into and/or out of the cavity **125**. In this variation, the displacement device **130** can be any of a mechanical pump (shown in FIG. **24**), an electrical pump, or a magnetic pump. In another variation, the displacement device **130** can modify the fluid within the cavity **125** directly, such as by heating the fluid with a heating element to expand the fluid or by generating a magnetic or electric field within the cavity **125**, as described above. Alternatively, in the variation in which the support member **160** includes a plurality of beads, displacement device **130** can interact directly with the beads rather than with the fluid, wherein the displacement device **130** motivates beads through the fluid channel **138** and into the cavity **125**, and vice versa, as shown in FIGS. **26**A and **26**B. Alternatively, the displacement device **130** can be a heater that heats the support member **160** that is a plurality of beads or a free piston, wherein the plurality of beads or a free piston expand under heating to displace fluid and transition the deformable region **112** between settings.

[0090] In yet another variation, the displacement device **130** can be mechanically, electrically, and/or magnetically coupled to the support member **160** to modify the position and/or orientation of the support member **160** within the cavity **125**, wherein the support member **160** engages the deformable region **112** to transition between settings, as shown in FIGS. **23**A and **23**B. In this variation the displacement device **130** can include a linear actuator or solenoid that mechanically operates the support member **160**. The displacement device **130** can also be one or more inductors that generate the magnetic field or a series of electrodes (or conductive pads) that generate the electric field to motivate the free piston within the cavity.

[0091] In a further variation, the displacement device **130** can modify the tactile layer **110** directly, such as by imparting a force across a portion of the tactile layer **110** to wrinkle, scrunch, or stretch the deformable region **112** between the expanded and retracted settings. For example and as shown in FIGS. **25**A and **25**B, the displacement device **130** can shift the position of one or more portions of the attachment face **122** to stretch the deformable region **112** in the retracted setting, then relax the tactile layer **110** to transition the deformable region **112** to the expanded setting. In this example, the tactile layer **110** can include a shape memory material such that the deformable region **112** returns to a raised or indented surface in the relaxed setting. The displacement device **130** can again be an actuator or solenoid. In another example, the displacement device **130** can induce a voltage potential across a portion of the tactile layer **110** to wrinkle or relax the portion thereof. In this example, the tactile layer **110** can include doped latex that changes form, thickness, elasticity, or other mechanical or physical property in the presence of an electric field, and the displacement device **130** can again include a series of electrodes or conductive pads. However, the displacement device **130** can interface with any other element or number of elements and functions in any other way.

[0092] As described above, in the retracted setting, the tactile surface **115** of the deformable region **112** is preferably flush with the tactile surface **115** of the undeformable region **114**. Furthermore, in the retracted setting, the deformable region **112** is preferably in contact with the support member **160** such that the support member **160** supports the deformable region **112** and substantially resists inward deformation of the deformable region **112** given an input (e.g., touch or other force) applied to the tactile surface **115** at the deformable region **112**, as shown in FIG. **6**A. In the expanded setting,