[0047] At block **808**, the magnetic flux creates attractive magnetic force between the electromagnet devices which opposes a biasing force imparted by biasing elements arranged to counter the attractive magnetic force. The attractive magnetic force causes the pole pieces of the electromagnet devices to attract to each other. The process moves to the next block.

[0048] At block **810**, the attractive magnetic force creates a movement between the electromagnet devices. In one embodiment, one pole piece of one electromagnet device is physically moved closer to another pole piece of another electromagnet device.

[0049] At block **812**, the current is removed.

[0050] At block **814**, a biasing element provides a bias force or return force to control the movement between the electromagnet devices within a predefined range. When the power is reduced or turned off in block **812**, the pole pieces of electromagnet devices move back to their original positions.

[0051] With turning on and off the power continuously, a continuous movement between the electromagnet devices is created. Accordingly, the haptic effect is generated in response to the movement between the electromagnet devices. It should be noted that the frequency and amplitude of the movements between the electromagnet devices can be controlled by controlling the input current.

[0052] **FIG. 9** is a block diagram illustrating a system having an actuator in accordance with one embodiment of the present invention. The system includes a computer or central processing unit (CPU) **906** with appropriate interfaces **908** to a memory **910** for storing program steps for controlling the processor **906**, **912** for controlling a display device **914**, **916** for communicating with a touch-sensitive panel **918** and **920** for driving an amplifier circuit (if required) which in turn drives actuator **924**. Actuator **924** is arranged to create relative movement between display device **914** and touch-sensitive panel **918**. The relative movement may be in the plane of the touch-sensitive panel, out of the plane of the touch-sensitive panel, or same combination of the two. When the touch panel **904** is touched or depressed, it sends a contact signal to computer **906** via connection **926**. The contact signal indicates that the touch panel has been selected or touched. Computer **906**, which can be any general purpose computer operating under the control of suitable software and for firmware, is coupled to amplifier **922** via connection **928** and instructs amplifier **922** to provide input current to the actuator **924** over connection **930**. Upon receipt of an instruction from the computer **906**, amplifier **922** provides an input current to the actuator **924** via connection **930**. Actuator **924** provides a haptic sensation or effect to the touch-sensitive panel **918**. The processor **906** (or, potentially, another device (not shown) provides a display image or image to display device **914**.

[0053] In the foregoing specification the invention has been described with reference to specific exemplary embodiments thereof It will, however, be evident that various modifications and changes may be made thereto without departing from the broader scope of the invention. For example, if desired, two or more actuators could be attached together to provide multiple inputs to generate haptic effects and/or to increase the haptic effect and/or a component to be haptically effected could be arranged so that actuators are arranged to be able to pull it in more than one direction. Accordingly, the specification and drawings are to be regarded in an illustrative rather than restrictive sense.

What is claimed is:

1. An actuator, comprising:

a first structural element having mounting structure mountable to a first component;

a second structural element having mounting structure mountable to a second component;

a first biasing element coupling the first structural element to the second structural element;

a first magnetic device carried by the first structural element, the first magnetic device including a first pole piece; and

a second magnetic device carried by the second structural element, the second magnetic device including a second pole piece;

a first coil disposed about at least one of said first pole piece and said second pole piece;

wherein the first biasing element is arranged to provide a biasing force opposing an attractive magnetic force urging the first and second pole pieces together when current is applied to the first coil and electric current applied to the first coil causes a haptic effect to be generated between the first component on the second component.

2. The actuator of claim 1, wherein the second magnetic device includes a second coil disposed about at least one of said first pole piece and said second pole piece.

3. The actuator of claim 1, further comprising a second biasing element, wherein the second biasing element is arranged to provide a biasing force opposing an attractive magnetic force urging the first and second pole pieces together when current is applied to the first coil.

4. The actuator of claim 1, wherein the first biasing element comprises a spring.

5. The actuator of claim 1, wherein the first biasing element comprises an elastomeric element.

6. The actuator of claim 1, wherein the first biasing element comprises a foam material.

7. The actuator of claim 1, wherein the first and second structural element and the first biasing element are all formed from the same material and the first biasing element is formed thinner than the first and second structural elements so that it is free to flex when perturbed.

8. A touch panel assembly, comprising:

a touch-sensitive panel;

a display device; and

an actuator including

a first structural element;

a second structural element;

a first biasing element coupling the first structural element to the second structural element;