because the operating member **12** is essentially in a movable state. In a third embodiment, immobilization means are provided to forcefully place a moving member in an immovable state when a condition such as hard braking, a sharp turn, a crash, or the like requires strong gripping of the steering wheel.

[**0056**] **FIG. 6** shows a plan view of a haptic interface device of the third embodiment, with the top of its housing being removed. **FIG. 7** shows a side elevation view of the haptic interface device shown in **FIG. 6**. The same components as those in the above-described embodiments are labeled with the same reference numerals and their description will not be repeated.

[**0057**] A solenoid **54** is fixed to the case **21** of a driving section **20** in the present embodiment. A solenoid moving part **56** of the solenoid **54** moves away from a frame **30** (toward the top of the drawing) when the power supply is off and approaches the frame **30** (moves toward the bottom of the drawing) when the power supply is on. In the power-on state, the solenoid moving part **56** continues to descend, toward the bottom of the drawing, to fit into a locking hole **58** provided in the top surface of the frame **30**. According to the present embodiment, this structure forms a lock mechanism for physically immobilizing a movable state of the moving member. Locking by this lock mechanism is controlled by a control section **40**.

[**0058**] An example operation of the present embodiment will be described below. A state sensor unit **4** determines whether or not a condition that requires strong hold of the steering wheel for hard braking has occurred. When it is determined that strong gripping may be required, the state sensor unit **4** outputs a signal indicating that immobilization is required. The control section **40** receives this immobilization signal from the state sensor unit **4** and powers the solenoid **54**. This causes the solenoid moving part **56** to move toward the frame **30** to fit into the locking hole **58**. Because the movement of the frame **30** is then physically inhibited by the solenoid moving part **56**, the operating member **12** does not move relative to the steering wheel when gripped.

[**0059**] Thus, according to the present embodiment, the moving members can be forcedly immobilized.

[**0060**] Assuming that the frame **30** is at a neutral position when it is not driven by the control section **40**, the frame **30** in an unlocked state is not always positioned at the neutral position because it is driven by the control section. When the frame **30** is not at the neutral position, a solenoid moving part **56** moving toward the frame **30** cannot lock the frame **30** because the locking hole **58** is not positioned at the corresponding position. Therefore, the control section **40**, which would otherwise control the frame **30** to move back to the neutral position when it receives an immobilization signal from the state sensor unit **4** so that the solenoid moving part **56** locks into the locking hole **58**, controls the solenoid **54** so that the top surface of the frame **30** is pressed against the solenoid moving part **56** if the frame **30** is not returned to the neutral position. If the frame **30** has not returned to the neutral position, the control section **40** inhibits the movement of the frame **30** by a pushing force, rather than moving it back to the neutral position.

[**0061**] While the solenoid **54** is provided to immobilize the frame **30** from above in the present embodiment, a locking hole may be provided in one side or the bottom of the frame **30** to immobilize it from the side or bottom. Furthermore, while the frame **30**, which is a moving member, is immobilized in the present embodiment, immobilization means may be provided that immobilizes the operating member **12**, instead of the frame **30**, provided that the operating member **12** is not moved by a holding force exerted by the driver.

[**0062**] Fourth Embodiment

[**0063**] In the embodiments described above, operating member **12** is moved in two dimensions, two directions within a plane, to provide haptic stimuli to the driver. A fourth embodiment is characterized in that a two-degree-of-freedom haptic interface device is provided to allow three-dimensional haptic stimuli to be provided to the driver.

[**0064**] **FIG. 8** shows a schematic perspective view of a haptic interface device according to the fourth embodiment. **FIG. 9A** is a view showing a physical relationship between a coil and a magnet in the haptic interface device shown in **FIG. 8** viewed from above. **FIG. 9B** is a side elevation view showing a configuration of the haptic interface device shown in **FIG. 8** with a part of its housing removed. The configurations of a state sensor unit and control section are the same as those of the first embodiment and therefore they are omitted from these drawings.

[**0065**] Two stacked housings **60** and **70** are shown in the drawings. A rotary motor **62** is contained in the housing **60** as shown in **FIG. 9B**. The rotating shaft **64** of the rotary motor **62** is coupled to the housing **70**. The housing **70** contains a rail **72** provided at the bottom of the housing, a slider **74** sliding on the rail **72**, and an arm **76** fixed to the slider **74** and extending from an opening in one side of the housing **70**. Magnets **78** and **80** are attached to the internal side of the top plate of the housing **70**. The magnets **78** and **80** are provided in such a manner that their polarities are opposite to each other. A coil **82** is provided on the arm **76** facing the magnets **78** and **80**. The coil **82** is electrically connected to a control circuit (not shown) through a signal line, which is not shown. An operating member **12** is attached to the tip of the arm **76** extending from the housing **70**.

[**0066**] The haptic interface device **102** according to the present embodiment has a combined configuration in which the rotary motor and the linear motor are as described above. The haptic interface device **102** is embedded in a steering wheel in such a manner that only the operating member **12** projects from the steering wheel. To enable movement of the operating member **12** in three-dimensions, a notch is provided in the surface of the steering wheel and a hollow space is provided inside the steering wheel.

[**0067**] The functional block configuration according to the present embodiment is the same as that of the first embodiment shown in **FIG. 5**. **FIGS. 8 and 9** show only the configuration of a haptic presentation unit **52**. An indication control unit **50** generates haptic information based on the status of the vehicle or conditions outside the vehicle sent from a state sensor unit **4** and controls the haptic presentation unit **52**, when required. The same process as in the first embodiment is performed in the state sensor unit **4** and the