

portion 3 is supported by the spherical bearing 1, whereby the lever handle 4 is rockably and rotationally mounted to the supporting member 2. Also, at the lower end portion of the lever handle 4, there is formed a substantially hemispherical external force receiving portion 10, and on a spherical surface 10a, which is a lower end surface of the external force receiving portion 10, there is provided a magnetic plate 11 through a leaf spring 10b.

[0030] The electromagnetic coil 5 and lining material 12 provided on the upper surface thereof cooperate with the magnetic plate 11 provided on the spherical surface 10a to constitute an electromagnetic brake 13 for applying an external force to the lever handle 4.

[0031] As the detection means 6, any well-known position sensor can be used. Since, however, the amount of rocking and rocking direction of the lever handle 4 and the amount of rotation and direction of rotation can be detected without contact, there is less variation with time in characteristics due to contamination and wear, and a mechanism for converting the rocking motion of the lever handle 4 into the rotary motion or linear motion is not required as in the case where an encoder or a variable resistor is used, it is particularly preferable to use a non-contact type optical position sensor which irradiates the surface of the lining material 12 with detection light to detect reflected light from the surface of the lining material 12 for detecting the operating position and the direction of operation of the lever handle 4.

[0032] The control means 7 includes: as shown in FIG. 1, an input unit 71 for inputting an output signal a from the detection means 6; a first storage 72 in which a control signal c of the electromagnetic coil 5 corresponding to the output signal a has been stored in the form of a table; a second storage 73 in which a control signal d of an unit to be operated corresponding to the output signal a has been stored in the form of a table; a CPU 74 for reading out a control signal c of the electromagnetic coil 5 corresponding to the output signal a from the detection means 6 inputted into the input unit 71 and a control signal d of the unit to be operated from the first storage 72 and the second storage 73 respectively for outputting; a first driver circuit 75 for D/A converting the control signal c outputted from the CPU 74 for amplifying to generate a driving signal b of the electromagnetic coil 5; a second driver circuit 76 for D/A converting a control signal d outputted from the CPU 74 for amplifying to generate a driving signal e of the unit to be operated; and an output unit 77 for outputting a driving signal b of the electromagnetic coil 5 and a driving signal e of the unit to be operated.

[0033] The first storage 72 is capable of storing any external force table in accordance with a type of the unit to be operated through the use of the lever handle 4 and a type of a function to be adjusted. FIG. 2A is a view exemplifying an external force to be applied to the lever handle 4 when the lever handle 4 is rock-operated from a center position (position at which the lever handle 4 is in an upright position) to four directions: +X, -X, +Y, and -Y, exemplifying a case where different click feelings are given to the lever handle 4 in accordance with each of the rocking directions. Also, FIG. 2B is a view exemplifying the external force to be applied to the lever handle 4 when the lever handle 4 is rotationally operated around the axis A-A of the lever handle 4, exemplifying a case where a feeling of

resistance that varies in intensity depending upon the amount of rotation is applied to the lever handle 4. The operator perceives this feeling of click or feeling of resistance, whereby the operator can learn by blind touch whether or not the lever handle 4 is being rock-operated in an intended direction, or whether or not the lever handle 4 has been rotationally operated by the intended amount of rotation. Therefore, it is possible to improve the operability of the haptic input apparatus. In this respect, when the lever handle 4 is rock-operated in any oblique direction other than the +X direction, -X direction, +Y direction, and -Y direction, it is possible not to output a driving signal b to the electromagnetic coil 5, not to apply any external force to the lever handle 4, or possible to output a driving signal b to the electromagnetic coil 5 applying an external force to lock the lever handle 4.

[0034] In a haptic input apparatus according to the present embodiment, as an actuator for applying an external force to the lever handle 4, there is provided an electromagnetic brake 13 made up of a magnetic plate 11 provided on the lower end surface of the lever handle 4, a lining material 12 arranged opposite to the magnetic plate 11, and an electromagnetic coil 5 so as to apply an external force to the lever handle 4 through a leaf spring 10b and magnetic material 11. Therefore, it is possible to omit the rotation shaft for converting the rocking motion of the lever handle into the rotary motion and the link and the like for converting the rocking motion of the lever handle into the linear motion, to simplify the structure of the haptic input apparatus with an operating feeling imparting function equipped with the lever handle 4, and to miniaturize this sort of haptic input apparatus at low cost. Also, in the haptic input apparatus according to the present embodiment, since both the amount of rocking and rocking direction of the lever handle 4 for the supporting member 2 and the amount of rotation and direction of rotation of the lever handle 4 for the supporting member 2 are detected by the detection means 6, as well as on the basis of an output signal from the detection means corresponding to the amount of rocking and rocking direction of the lever handle 4 and the amount of rotation and direction of rotation, the driving of the electromagnetic coil 5 is controlled, it is possible, by operating one lever handle 4, to obtain a control signal of an unit to be operated corresponding to the amount of rocking and rocking direction of the lever handle 4 and a control signal of the unit to be operated corresponding to the amount of rotation and direction of rotation of the lever handle 4. Therefore, it is possible to provide multifunction to the haptic input apparatus with an operating feeling imparting function equipped with the lever handle 4.

[0035] Next, with reference to FIG. 3, the description will be made of a haptic input apparatus according to a second embodiment of the present invention. FIG. 3 is a structural view showing a haptic input apparatus according to the second embodiment.

[0036] As shown in FIG. 3, the haptic input apparatus according to the present embodiment is characterized by the fact that the electromagnetic brake 13 is formed of an electromagnetic coil 5, a permanent magnet 13b arranged below the electromagnetic coil 5, and a magnetic plate 11 mounted to the spherical portion 3, and that when the electromagnetic coil is not energized, the magnetic plate 11 is attracted under the action of the permanent magnet 13b