

gel layer is preferably 0.3 to 2.0 millimeters. When the thickness of the conductive gel layer is less than 0.3 millimeters, the wearer experiences extremely severe pain. When the thickness of the conductive gel layer is thicker than 2.0 millimeters, the sensation does not occur. The thickness of the conductive gel layer is preferably 0.5 to 1.0 millimeters. In this range, particularly comfortable electrical stimulation is provided to the wearer.

**[0012]** In a preferred mode, the electro-tactile display includes stimulation determination means that determine whether or not to carry out electrical stimulation based on a threshold value of a stimulation determination function, and threshold value adjustment means that adjusts the threshold value of the stimulation determination means. The means for alleviating a sensation is then configured from the stimulation determination means and the threshold value adjustment means. The threshold value adjustment means changes the threshold value so that the number of times of stimulation occurring in a fixed time period does not exceed a predetermined maximum number of stimuli. It is then possible to provide the target stimulation frequency by controlling the threshold value. It is preferable to ensure that the stimulation frequency is at least 30 Hz or more by suppressing the total number of stimuli occurring in a fixed time period. Further, in a preferred mode, an intermediate gradation representation is implemented by increasing the number of times of stimulation at one point in a fixed time period.

**[0013]** In a preferred mode, an electrical stimulation presentation board of the electro-tactile display is comprised of an electrode substrate provided with a plurality of stimulation electrodes on a surface thereof, a conductive gel layer provided at the surface side of the electrode substrate, and a switching circuit section provided at the reverse side of the electrode substrate. The electrical stimulation presentation board is electrically connected to a control unit of the electro-tactile display (including a stimulation pattern generating section) and a power supply. The conductive gel layer is directly or indirectly (via another member) provided at the surface side of the electrode substrate. The switching circuit section is directly or indirectly (via another member) provided at the rear surface side of the electrode substrate. Here, the rear surface side of the electrode substrate means the opposite side to the side where the electrodes are provided.

**[0014]** In a preferred mode, the electrode substrate is a flexible substrate. At least one cut is preferably formed in the flexible substrate. The electrical stimulation presentation board can be configured to match with the curved surface of a forehead etc. as a result of the flexible substrate preferably being provided with one or more cuts. More specifically, in one aspect, a plurality of regions are defined by forming a plurality of cuts in transverse and vertical directions so as to leave the edges of the flexible substrate.

**[0015]** A predetermined number of electrodes are provided at each region. Still more preferably, a set of a switching circuit and a communication circuit is provided for each region. Communication wiring for each communication circuit is then provided at the edges. More specifically, in a further mode, the flexible substrate includes a plurality of strip-shaped regions extending in a longitudinal direction of the electrical stimulation presentation board, with a predetermined number of electrodes being provided at each strip-shaped region.

**[0016]** In a preferred mode, the electrical stimulation presentation board is provided with one or more elastic layers

positioned at the surface side and/or the rear surface side of the electrode substrate. It is also possible to provide superior adaptability with the curved surface of a person's forehead etc. by providing the elastic layer at the electrical stimulation presentation board. The elastic layer is exemplified by an anisotropically conductive elastic layer provided at the surface of the electrode substrate. In this case, the electrical stimulation presentation board comprises a stimulation electrode substrate, an anisotropically conductive elastic layer provided so as to cover the surface of the stimulation electrode substrate, and a conductive gel layer provided on the anisotropically conductive elastic layer. The stimulation electrodes then supply electrical stimulation to the skin via the anisotropically conductive flexible layer and the conductive gel layer. Alternatively, the electrical stimulation presentation board comprises a stimulation electrode substrate, a conductive gel layer provided so as to cover the surface of the stimulation electrode substrate, and an anisotropically conductive elastic layer provided on the conductive gel layer. The stimulation electrodes then supply electrical stimulation to the skin via the conductive gel layer and the anisotropically conductive elastic layer. The elastic layer provided at the rear side of the electrode substrate does not have to be conductive. When the elastic layer is provided at the rear side of the electrode substrate, the electrode substrate is preferably a flexible substrate.

**[0017]** In one mode, the switching circuit section is provided at the flexible substrate. In a specific example, the electrical stimulation presentation board includes a flexible substrate provided with stimulation electrodes, and an elastic layer provided at the rear surface side of the flexible substrate. A portion of the flexible substrate (the portion with no stimulation electrodes) is folded to extend to the rear surface side of the elastic layer and a switching circuit section is provided at the folded and extended section of the flexible substrate. In a further mode, the electrical stimulation presentation board includes a circuit substrate that is independent of the flexible substrate. The switching circuit section is then provided at the circuit substrate. In a specific example mode, the electrical stimulation presentation board includes a flexible substrate having stimulation electrodes, an elastic layer provided at the rear surface side of the flexible substrate, a circuit substrate independent of the flexible substrate provided at the rear surface side of the elastic layer, and a switching circuit provided at the rear surface side of the circuit substrate.

**[0018]** In a preferred mode, the electro-tactile display includes means for measuring stimulation voltage and means for adjusting power supply voltage. The power supply voltage is set to a voltage a predetermined voltage  $V$  higher than the measured stimulation voltage by the power supply voltage adjusting means.

**[0019]** In a preferred mode, the electro-tactile display is a forehead-mounted electro-tactile display. The display includes means for emphasizing stimulation at time-varying locations. This means cancels changes to images caused by movement of the wearer and emphasize an object moving in an external environment.

**[0020]** In a preferred mode, the electro-tactile display includes means for detecting depth, and presents sensations depending on distance.

#### BRIEF DESCRIPTION OF THE DRAWINGS

**[0021]** FIG. 1 is a view of a forehead-mounted electrical stimulation system;