vertical scan when a camera for this system is used in a visual-tactile conversion system. As a result, 60 fps stimulation is possible using, for example, an approximately 30 fps NTSC camera. Each image obtained in two consecutive vertical scans is then spaced separated by one line portion precisely, the influence on the tactile presentation is minor, and correction is possible.

[B-2] Electrode with a Round Tip

Background and Object

**[0063]** The present invention prepares finger mount of the same rate of curvature as the finger in order to provide stability of finger position. The curved surface finger mount can be adopted in the OPTACON described above. According to the electro-tactile display of the prior art, when a normal finger mount is a flat electrode matrix, the contact portion of each electrode is also flat. However, when the finger mount is used, the angle of contact of the skin of the finger and the electrodes changes depending on the position.

Resolving Means

**[0064]** It is therefore necessary to make the tip of the electrode round as shown in FIG. **12** in order to ensure stable and reliable contact. In FIG. **12**, a plurality of electrodes project from the curved finger mount T**1** of the electro-tactile display **1**. The tip of each electrode is formed in a curved surface (preferably spherical). Ideally, if the electrode tip is completely spherical, then the contact pressure will be stable and the contact surface area will also be constant whichever angle contact is made at. However, even without being exact, it can be understood that contact is made stable by making electrode contact section appropriately round and the resulting tactile sensations are also stable.

[B-3] Mode Switching by Force Sensor

Background and Object

**[0065]** Adjustment of stimulation current is also an extremely important problem in tactile sense presentation by electrical stimulation. With regards to this problem, the inventors of this application proposed measuring pressing force of a finger using information from force sensor so that the current is then a monotonically increasing function with respect to force (laid-open publication no. 2002-328596). In the electrical stimulation of the related art, there is the fear that a user may be subjected to a strong stimulation, for example, at the instant of touching (as a result of current becoming focused on a small contact surface area). However, by having the amount of stimulation correspond to the force, it is possible to actively control the extent of the tactile sensation. The corresponding relationship between the force and the extent of the tactile sensation increases monotonically, i.e. has a relationship where "a strong tactile sensation is returned when strong pressing takes place". This stimulation is the same as mechanical stimulation occurring in daily life and can be handled naturally. In the case of a mobile type, the degree of freedom of operation of the operator is low. It is therefore useful to provide the force sensor with a number of functions.

Resolving Means (Volume Function)

**[0066]** In the method of the related art, the current and force have a 1 to 1 relationship. Namely, current flowing with respect to a certain force is decided uniquely. This is to say that I=f(F), where I is current, F is force, and f is a function correlating current and force. In addition to this, strong pushing exceeding a certain threshold value is detected, and one parameter of the relational expression of current to force will be changed. Namely, when the relational expression of current and force is expressed as I=g(F, k), where k is a parameter in a function, and g is a function for deducing current from force and parameters, the parameter k can be adjusted due to a strong pressing force. In the most simple example, strong pushing exceeding a threshold value is handled as "pushing down of the button" and the amount of current can be changed. For example, the current level is in three levels (weak, medium, strong), and a user may change from "weak"-"medium"-"strong"-"weak"-"medium" . . . .

**[0067]** The important point is the point that this mode changing and control of the amount of current depending on this force of the related art co-exist. Namely, a control method of the related art is utilized with respect to pressing force where the threshold value is not exceeded. The mode changing described is hereinafter referred to as "volume adjustment". With regards to this, with, for example, a stationary electro-tactile display of the related art, volume adjustment is carried out using rotating type or sliding type input device but with a mobile electro-tactile display, it is difficult to use finger grip type input device. This invention can therefore typically be used in an electrical stimulation apparatus and in a preferred embodiment may be used in a mobile electrical stimulation apparatus.

**[0068]** The finger pressing force referred to here relates to finger pressing force of a finger to which tactile sensation is presented in the method of the related art but in the method on this occasion may refer to pressing force of a finger to which tactile sensation is presented to or may refer to other finger pressing force. For example, in the situation given in FIG. **15** and FIG. **16**, the tactile display is provided between a first finger and a forefinger so as to be held by two fingers, with pressing force of the first finger and pressing force of the forefinger being equal.

[Safety Countermeasure 1 (Volume Initialization)]

**[0069]** The volume function described above is initialized when finger pressing force is less than a certain threshold value. According to the example described above, suppose that a volume is "strong" when a hand is withdrawn. When the hand makes contact again, the electrical state of the finger (electrical resistance due to perspiration etc.) is considered to have changed and remaining "strong" is taken to be dangerous. The volume is therefore returned to an initial state of "weak". This is essential with respect to safety of electrical stimulation, and may also be applied to the case of other volume adjustment methods (for example, adjustment by rotating type and slide type input apparatus) that do not use volume adjustment by pressure.

[Safety Countermeasure 2 (Multipoint Stimulation at the Time of Volume Adjustment)]

**[0070]** The pattern presented when the volume is changing is not the pattern presented at that time, but rather a multipoint pattern expanding over the whole of the presentation display is used. For example, all of the points are stimulated, or points every other one or two points are stimulated. This is because when the pattern presented at this time is an extremely small number of points, or when the points are extremely difficult or