

DESCRIPTION

Title of the Invention

BEAUTY DEVICE

Technical Field

5 [0001]

The present invention relates to a beauty device adapted to apply a voltage to skin.

Background Art

[0002]

10 Methods are known for non-invasive permeation of substances such as drugs, cosmetics, and others from a skin surface into skin by application of a voltage to the skin surface. For example, electroporation (a method of electrical perforation), changes cell structure and facilitates
15 incorporation of macromolecules. Application of a weak electric current to an active ingredient in a beauty serum or the like ionizes the active ingredient and facilitates permeation of the active ingredient into skin (generally referred to as "ion introduction").

20 Patent Document 1 describes a method by which a single pulse and a group of pulses are alternately applied to skin to deliver an active ingredient into a dermal layer of the skin.

Citation List

25 Patent Documents

[0003]

Patent Document 1: Japanese Unexamined Patent Application

Publication No. 2013-78514

Summary of the Invention

Problems to be solved by the Invention

5 [0004]

 Depending on a molecular weight and other properties (hydrophilicity, ionization, and the like) of a drug or the like, alternate application of a single pulse and a group of pulses to skin, as in Patent Document 1, may not provide
10 adequate permeation. Further, to achieve electroporation by use of a single ultrashort pulse it is necessary to use a high voltage, which may cause discomfort to a user. Furthermore, if an interval between applications of pulses is set to be long, "holes" in skin cells may close too quickly, resulting
15 in an insufficient effect.

 An object of the present invention is to improve targeted permeation of a drug or the like into skin.

Means for solving the Problems

20 [0005]

 According to one embodiment of this invention a beauty device is provided having: a first electrode and a second electrode that are placed on a same surface, and a third electrode that is not placed on the same surface; a first
25 generating means that generates a DC pulse train; a second generating means that generates an alternating current; and a control means that alternately repeats, at a predetermined

cycle, application of the DC pulse train by using the third electrode and at least one of the first electrode and the second electrode, and application of the alternating current by using the first electrode and the second electrode.

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Advantageous Effect of the Invention

[0006]

According to the present invention, targeted permeation of a drug or the like into skin is enhanced.

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Brief Description of the Drawings

[0007]

FIG. 1 is an external view of a beauty device 10 (front side)

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FIG. 2 is an external view of the beauty device 10 (back side)

FIG. 3 is a schematic diagram of a contact section

FIG. 4 is a functional block diagram of the beauty device

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FIG. 5 is a diagram illustrating a waveform example of an applied voltage.

Mode for carrying out the Invention

25

[0008]

<Embodiment>

FIG. 1 is an external view (front side) of a beauty

device 10, and FIG. 2 is an external view (back side) thereof. The beauty device 10 is a device that at least exerts an action of permeating a substance such as a drug or a lotion from a surface of a user's skin (epidermis) to the inside of the user's skin by application of a voltage to the surface of the user's skin. In addition to the permeating action, a muscle stimulating action or a warming action may be imparted. To use the beauty device 10, the user hand holds a housing 190 and presses a head section of the beauty device 10, which is provided with a first electrode 111 and a second electrode 112, against an area of skin onto which the user has preapplied a substance for permeation of the substance into the skin (e.g., a facial area or any other area of the user's body, such as a foot, with the exception of the hand holding the device).

[0009]

The housing 190 of the beauty device 10 is shaped as a substantially rounded bar, and is provided on its front side surface with the first electrode 111, the second electrode 112, and switches 121 and 122, and is provided on its back side surface with a third electrode 113 and a power supply terminal 130. The switches 121 and 122 are operated by the user to turn power ON/OFF and also to enter instructions such as for setting, executing, and interrupting various operations.

[0010]

The housing 190 includes a part held by the user (a handle). During use, the first electrode 111 and the second electrode 112 are brought into contact with a skin area to

which a voltage is applied (a target skin area for permeation of a substance). The first electrode 111 and the second electrode 112 are arranged substantially on the same plane (such that a height of each of the electrodes from the housing 190 is substantially the same). Thus, when the head part is pressed against a target area, the first electrode 111 and the second electrode 112 together form a contact area that comes into contact with the target area.

[0011]

During use, the third electrode 113 provided on the back side surface of the housing 190 comes into contact with the user's hand. The third electrode 113 is not necessarily be provided on the back side surface, and may be provided at a different position insofar as the third electrode 113 comes into contact with the user's hand. The third electrode 113 is preferably located at a position away from the first electrode 111 and the second electrode 112, and at least is not provided on the same surface as the first electrode 111 and the second electrode 112. In FIG. 2, the third electrode 113 is substantially rectangular; however, each of a shape, size, position, and thickness of the third electrode 113 is optional. In short, any configuration may be adopted for the third electrode 113 as long as it functions as one of the electrodes via which a voltage is applied to the user's skin.

[0012]

The first electrode 111 and the second electrode 112 are each ring-shaped (substantially annular in this example) and

are arranged concentrically, with the second electrode 112 on the outer side.

[0013]

FIG. 3 is an enlarged schematic diagram of the part that comes in contact with the skin. The respective widths of the first electrode 111 and the second electrode 112 are w_1 and w_2 . The first electrode 111 and the second electrode 112 are arranged in concentric circles, and are separated from each other by a distance d_1 in their radial direction. Preferably, d_1 is 1mm (millimeters) to 3 mm, and $w_1=w_2=3\text{mm}$.

[0014]

Included inside the housing 190 is a voltage application assembly, which will be described later with reference to a functional block diagram.

[0015]

FIG. 4 is a functional block diagram of the beauty device 10. Elements that are not directly related to the present invention are not shown.

The beauty device 10 has a power source 160, a first power circuit 161, a second power circuit 162, a third power circuit 163, a DC pulse train generator 152, an AC generator 153, the first electrode 111, the second electrode 112, the third electrode 113, a first switching unit 171, a second switching unit 172, a third switching unit 173, and a fourth switching unit 174.

[0016]

The power source 160 is a battery that stores power for

supply via the power supply terminal 130. Power supplied from the power source 160 is distributed to the first power circuit 161, the second power circuit 162, and the third power circuit 163. The first power circuit 161, the second power circuit 162, and the third power circuit 163 include rectifier circuits and circuits for modulating amplitudes, frequencies, phases, and the like, and convert input electrical signals into electrical signals suited for operating a control unit 151, the DC pulse train generator 152 and the AC generator 153, and output the converted electrical signals.

[0017]

The DC pulse train generator 152 generates a DC (unipolar) pulse train in accordance with S1 supplied from the control unit 151, and supplies the generated DC pulse train to the third electrode 113, the first switching unit 171, and the second switching unit 172.

The AC generator 153 generates an AC voltage in accordance with S2 supplied from the control unit 151, and supplies the generated AC voltage to the third switching unit 173 and the fourth switching unit 174.

[0018]

Each of the first switching unit 171 to the fourth switching unit 174 selectively applies the DC pulse train and the alternating current to the first electrode 111, the second electrode 112, and the third electrode 113 in accordance with control signals supplied from the control unit 151.

More specifically, the first switching unit 171 applies

a voltage supplied from the DC pulse train generator 152 to the first electrode 111 in accordance with S3 supplied from the control unit 151. The second switching unit 172 applies a voltage supplied from the DC pulse train generator 152 to
5 the second electrode 112 in accordance with S4 supplied from the control unit 151. The third switching unit 173 applies a voltage supplied from the AC generator 153 to the first electrode 111 in accordance with S5 supplied from the control unit 151. The fourth switching unit 174 applies a voltage
10 supplied from the AC generator 153 to the second electrode 112 in accordance with S6 supplied from the control unit 151.

[0019]

In other words, the DC pulse train generated by the DC pulse train generator 152 is applied, with the first electrode
15 111 and second electrode 112 acting as a common (equipotential) electrode, and the third electrode 113 acting as the other electrode. The AC voltage generated by the AC generator 153 is applied, with the first electrode 111 as a positive electrode (or negative electrode) and the second electrode 112
20 as a negative electrode (or positive electrode).

The term "DC pulse train" in this specification means not only a waveform having a sharp peak but also a waveform constituted of any regularly repeated unipolar waveform (e.g., a square wave or a triangular wave). Further, the term
25 "alternating current" in this specification is not only a sine wave, and may be any other waveform insofar as the waveform is bipolar.

[0020]

The control unit 151 generates the control signals S1 to S6 and outputs the generated control signals S1 to S6 to the DC pulse train generator 152, the AC generator 153, and the
5 first switching unit 171 to the fourth switching unit 174 such that application of the DC pulse train and application of the alternating current described above are alternately repeated at a predetermined cycle.

More specifically, the control unit 151 sets the control
10 signals S1, S3 and S4 as ON signals and sets S2, S5 and S6 as OFF signals thereby to maintain a first state, during which the DC pulse train is applied, for a first period of time, and then sets the control signals S1, S3 and S4 as OFF signals and sets the control signals S2, S5 and S6 as ON signals thereby
15 to maintain a second state, during which the alternating current is applied, for a second period of time, and thereafter repeats these settings. During the application of the DC pulse train, either the first electrode 111 or the second electrode 112 may function as the positive electrode or the
20 negative electrode, and the other electrode may be isolated.

[0021]

Preferably, the control unit 151, the DC pulse train generator 152, and the AC generator 153 are installed as signal processing processors or modules that function to generate
25 arbitrary differing waveforms. However, the functions of the control unit 151, the DC pulse train generator 152, the AC generator 153, the first switching unit 171, the second

switching unit 172, the third switching unit 173, and the fourth switching unit 174 may be implemented by relays and switching elements for switching a circuit for applying DC pulse trains and a circuit for applying an alternating current, which are independent. Preferably, a non-contact relay comprising a semiconductor such as a MOS FET is used.

[0022]

FIG. 5 is a schematic diagram illustrating a waveform example of an applied voltage. The horizontal axis indicates time and the vertical axis indicates voltage (amplitude). For convenience of explanation, the scales indicated in the vertical and horizontal axes differ from those of actual values. In this example, a rectangular DC pulse train of a voltage V_1 is continuously applied at a repetition frequency F_1 for an application period T_1 , and immediately thereafter, a sine waveform alternating current of an amplitude V_2 and a frequency F_2 is continuously applied for an application period T_2 , and immediately thereafter, another rectangular DC pulse train of the voltage V_1 is continuously applied at the repetition frequency F_1 for the application period T_1 . Thus, the DC pulse train having the predetermined waveform profile and the alternating current having the predetermined waveform profile are repeatedly applied.

[0023]

Here, each of the application periods T_1 and T_2 is, for example, 0.1 seconds to 10 seconds, and preferably 3 seconds to 6 seconds. The application periods T_1 and T_2 are preferably

$0.5 < T1/T2 < 2$, and most preferably $T1 = T2$, in view of effectiveness of targeted absorption of a drug or the like, and a physical sensation experienced by a user, as identified from findings made by the inventors of this invention.

5 [0024]

The (repetition) frequency F is preferably $F1 < F2$, and more preferably, $F1 = 1$ kHz (kilohertz) to 3 kHz (the repetition cycle being 0.3 to 1 ms), and $F2 = 70$ kHz to 300 kHz (the cycle being 3 to 14 μ s). The applied voltages are
10 preferably $V1 < V2$, and more preferably, $V1 = 10$ V (volts) and $V2 = 50$ V to 300 V.

[0025]

The values of the applied voltages (amplitudes), the periods of time of application, and frequencies (repetition
15 frequencies) described above are examples only and can be set taking into account a molecular weight and other properties of a drug or the like for absorption into skin, a resistance value of the user's skin, physical sensation (including discomfort) experienced by the user, and other purposes (to impart a
20 warming effect, and to stimulate muscles), and the like.

[0026]

The inventors of this application found that an electroporation effect produced by applying a DC pulse train, and an ion introduction effect obtained by applying an
25 alternating current can coexist by regularly repeating application of voltages of the DC pulse train and the alternating current, which have different waveforms, as

described in the above embodiment. By applying a pulse train rather than a single pulse for a predetermined period of time, "holes" in skin do not rapidly close but rather remain open for a sufficient period of time, and by applying an AC voltage during this period of time, a drug or the like is efficiently absorbed into the skin. Further, in a preferred mode, a DC pulse train is applied for a period of approximately a few seconds, whereby use of a relatively lower voltage than that used in application of short pulses suffices to obtain the electroporation effect. This reduces discomfort experienced by the user.

[0027]

Further, according to the electrode layout and the voltage application method in the embodiment described above, the electrode to be used is switched among the three electrodes in conjunction with switching of an applied voltage. In other words, the first electrode 111 and the second electrode 112, which are relatively close to each other are used as a pair of electrodes, which is preferable in view of minimizing discomfort experienced by the user when an alternating current is applied, while the first electrode 111 (or the second electrode 112) and the third electrode 113, which are at a distance apart from each other that is appropriate for applying a direct current, are used as the electrode pair when applying a DC pulse train. At this time, the first electrode 111 and the second electrode 112 function as a single electrode thereby increasing the effective area of the electrodes, and

thus enhancing a targeted absorption effect of a drug or the like.

[0028]

5 In addition, by using a non-contact relay such as a semiconductor device to perform switching between a DC pulse train and alternating current, switching can be accomplished more quickly than when using hardware switching element. In a preferred mode, switching is performed at intervals of several seconds. If a switching element is used, the element may be
10 subject to an excessive load. In contrast, use of a non-contact relay to perform switching obviates such a risk, and improves both durability and reliability of the device.

[0029]

<Other examples>

15 The first electrode 111 and the second electrode 112 do not have to be shaped as perfect circles, and may have an elliptical shape, a teardrop shape (raindrop shape), a polygonal shape, a rectangular shape, or any other circular shape. For example, a projection may be formed on an outer
20 peripheral surface or an inner peripheral surface of a ring. In other words, the term "circular shape" includes a form having a hollow portion. However, the distance between the electrodes is preferably kept as constant as possible. Further, another ring-shaped electrode may be provided on the inner
25 side of the first electrode 111 or on the outer side of the second electrode 112. Further, the first electrode 111 may have a non-hollow shape such as a disk. Alternatively, the

first electrode 111 and the second electrode 112 need not each be one ring, but may be formed by, for example, combining two semi-arc rings separated from each other, or by combining four quarter arc rings separated from each other so as to provide
5 a configuration that as a whole is a circular shape.

[0030]

In short, the beauty device according to this invention is simply required to have a first electrode and a second electrode placed on a same surface; a third electrode not on
10 the same surface; a first generating means that generates a first waveform voltage (e.g., a DC pulse train voltage); a second generating means that generates a second waveform voltage (e.g., an AC voltage); and a control means that alternately repeats, at a predetermined cycle, the application
15 of the first waveform voltage using the third electrode and at least one of the first electrode and the second electrode and the application of the AC voltage using the first electrode and the second electrode.

20 Description of Reference Numerals

[0031]

10 ... beauty device; 111 ... first electrode; 112 ... second electrode; 113 ... third electrode; 121 ... switch; 122 ... switch; 190 ... housing; 130 ... power supply terminal; 160 ... power
25 source; 161 ... first power circuit; 162 ... second power circuit; 163 ... third power circuit; 151 ... control unit; 152 ... DC pulse train generator; 153 ... AC generator; 171 first switching unit;

172 ... second switching unit; 173 ... third switching unit; and
174 ... fourth switching unit.

CLAIMS

1. A beauty device comprising:
- a first electrode and a second electrode placed on a same surface, and a third electrode that is not on the same surface;
- a first generating means that generates a DC pulse train;
- a second generating means that generates an alternating current; and
- a control means that alternately repeats, at a predetermined cycle, application of the DC pulse train by using the third electrode and at least one of the first electrode and the second electrode, and application of the alternating current by using the first electrode and the second electrode.
2. The beauty device according to claim 1, having a part that comes in contact with the skin, and a handle part,
- wherein the first electrode and the second electrode are each ring-shaped and concentric in a part that comes into contact with the skin,
- the third electrode is provided in the handle part,
- the alternating current is applied using the first electrode and the second electrode as a positive electrode and a negative electrode, respectively, with the third electrode isolated, and
- the DC pulse train is applied using the third electrode as one electrode, and the first electrode and the second electrode as another electrode.

3. The beauty device according to claim 1 or 2, including a switching means that selectively supplies the DC pulse train and the alternating current to the first electrode, the second
5 electrode, and the third electrode,

wherein the control means supplies a control signal to the first generating means, the second generating means, and the switching means to switch the DC pulse train and the alternating current.

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4. The beauty device according to any one of claims 1 to 3, wherein a repetition frequency of the DC pulse train is 1 kHz to 3 kHz, and

a frequency of the alternating current is 70 kHz to 300
15 kHz.

5. The beauty device according to any one of claims 1 to 4, wherein a length of an application period of time of the DC pulse train and a length of an application period of time
20 of the alternating current are substantially the same.

6. The beauty device according to any one of claims 1 to 5, wherein each of the length of the application period of time of the DC pulse train and the length of the application period
25 of time of the alternating current is 3 seconds to 6 seconds.