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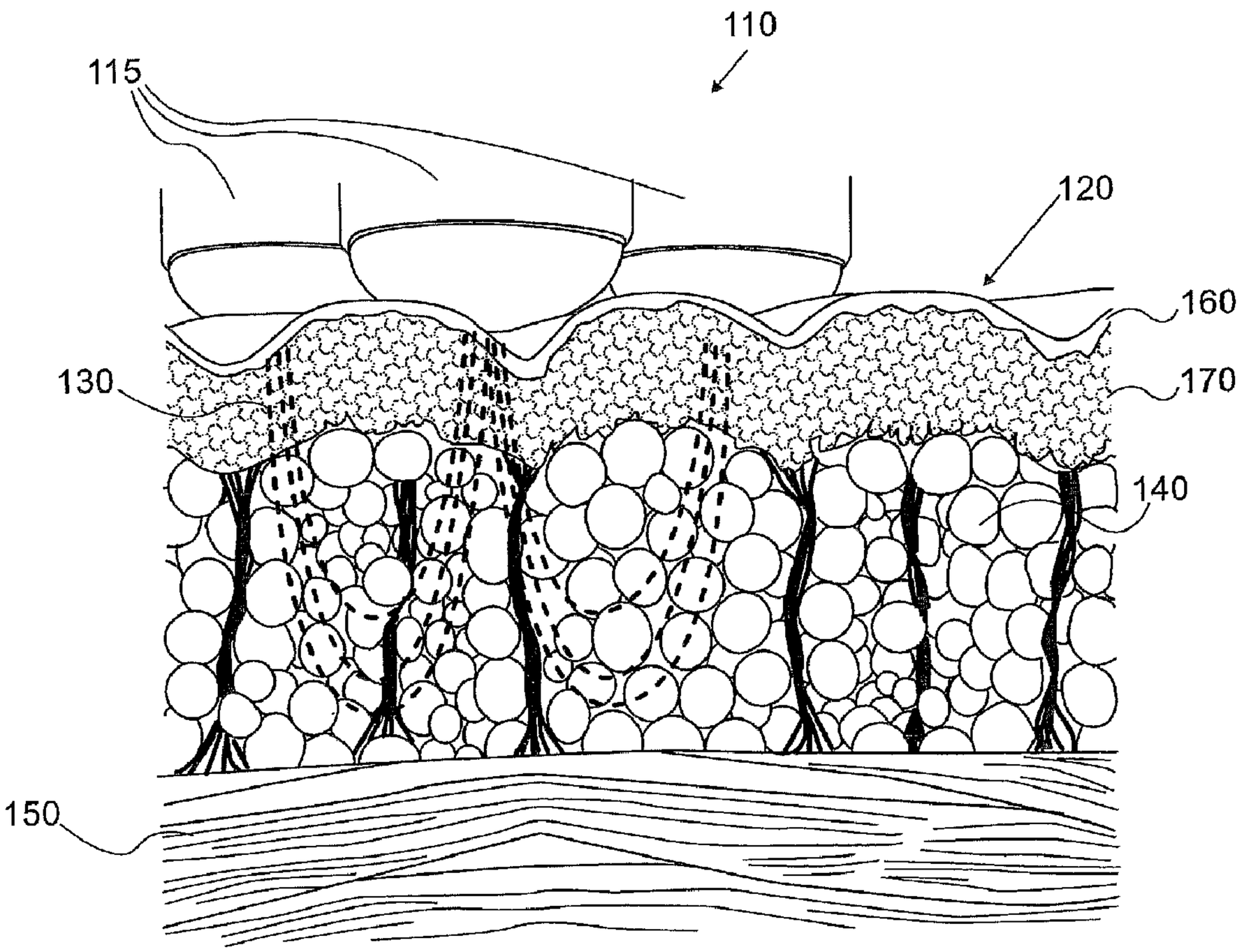

FIG. 1

(57) Abrégé/Abstract:
A device for massaging skin, including, a RF generator adapted to generate a radio frequency AC current to heat fat tissue in the adipose layer of the skin, an electrical pulse generator adapted to generate pulses of DC current to provide electrical muscle

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(57) Abrégé(suite)/Abstract(continued):
stimulation for the muscles below the adipose layer, an applicator including one or more heads adapted to be placed in contact with the user's skin; and wherein the heads serve as massage contacts to massage the outer layer of a user's skin above the adipose layer or as electrodes to deliver the AC current and DC current, or as both.

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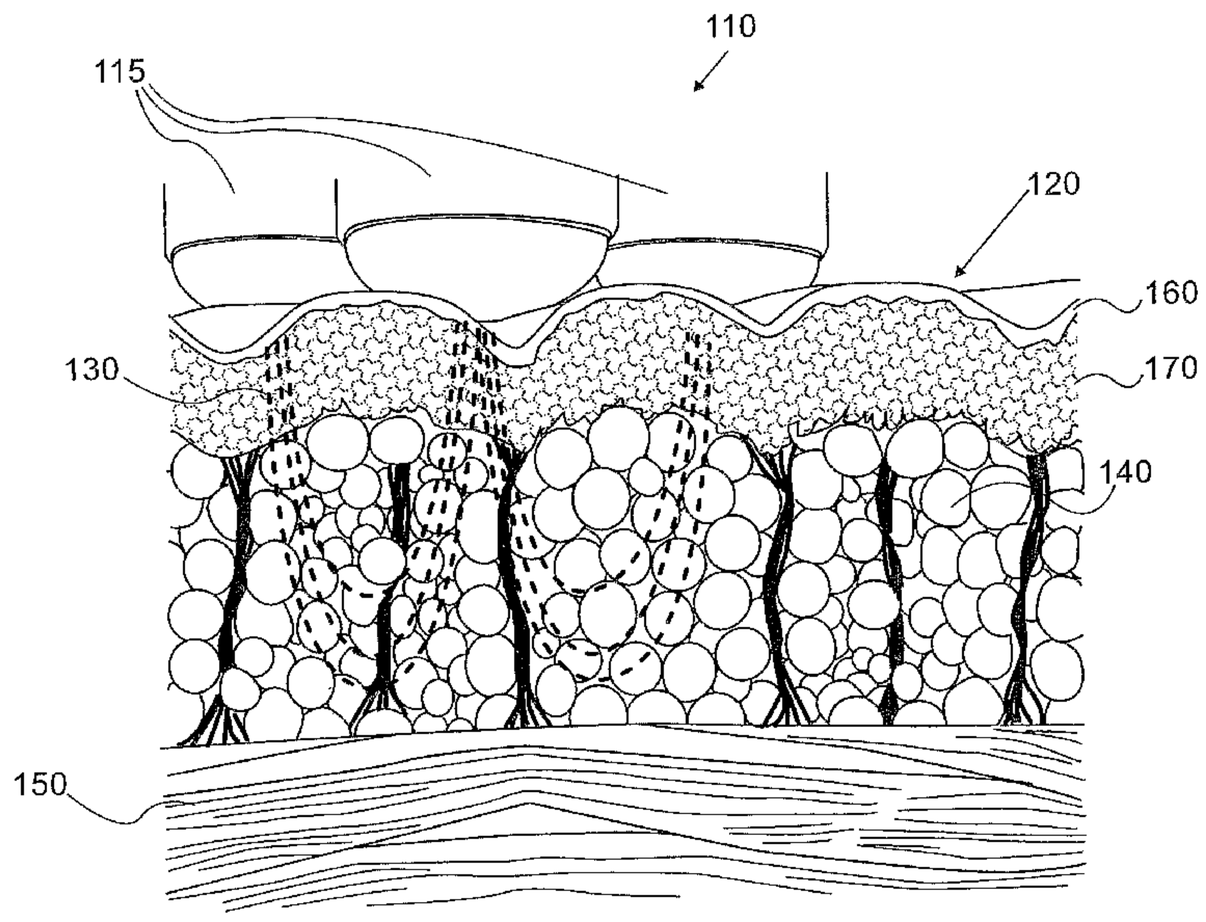

FIG. 1

(57) **Abstract**: A device for massaging skin, including, a RF generator adapted to generate a radio frequency AC current to heat fat tissue in the adipose layer of the skin, an electrical pulse generator adapted to generate pulses of DC current to provide electrical muscle stimulation for the muscles below the adipose layer, an applicator including one or more heads adapted to be placed in contact with the user's skin; and wherein the heads serve as massage contacts to massage the outer layer of a user's skin above the adipose layer or as electrodes to deliver the AC current and DC current, or as both.

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NON-INVASIVE FAT REMOVAL

RELATED APPLICATIONS

This application claims priority from US provisional application No. 61/261,381 filed on November 16, 2009 the disclosure of which is incorporated by reference.

FIELD OF THE INVENTION

The present invention relates generally to a system and method for non-invasive fat removal and more specifically to a system and method that enhances lymphatic fat drainage.

BACKGROUND OF THE INVENTION

Skin tissue comprises an outer epidermal layer overlaying a dermal layer. The dermal layer is in contact with a subcutaneous adipose layer referred to as fatty tissue. Massaging the skin is known to improve blood circulation in the subcutaneous adipose tissue and help release fat from the cells of the fatty tissue into the surrounding cellular matrix. The fat is then removed by the body's lymphatic system.

US patent No. 5,961,475 to Guitay discloses a massaging device in which negative pressure is applied to the user's skin while massaging. The combined treatment increases the blood circulation in the subcutaneous adipose tissue and breaks connections between adipose cells in the tissue.

US patent No. 6,273,884 to Altshuler et al. discloses simultaneous application of optical energy and negative pressure to the user's skin for treating skin defects.

There is however a need for improved methods to enhance the release of fat from adipose tissue to increase lymphatic drainage.

SUMMARY OF THE INVENTION

An aspect of an embodiment of the invention, relates to an apparatus and method for accelerating lymphatic drainage. The method includes applying RF energy to heat the adipose layer. Additionally the method includes massaging the skin above the area that is heated by RF energy. Further additionally the method includes electrical muscle stimulation (EMS) to contract the muscles below the heated area thus providing pressure on the adipose layer from below. The apparatus is designed to apply the above three methods either separately or any combination of them simultaneously: namely, massaging the skin from above, causing electrical muscle stimulation from below, and heating the fatty tissue with RF radiation.

In an exemplary embodiment of the invention, the RF energy is provided by a high frequency AC current, and the EMS energy is provided by a low current DC pulse signal. Optionally, the electrical energies (RF and EMS) are provided by a mono-polar configuration wherein the apparatus applied to the user's skin is provided with a first electrode of one polarity, and a second electrode of the opposite polarity is attached to the user or held by the user to form a closed circuit. Alternatively, the electrical energy may be provided by a bi-polar configuration wherein the apparatus applied to the user's skin includes two electrodes to form a closed circuit without attaching electrodes external to the apparatus to the body of the user. In some embodiments of the invention, the apparatus uses a multi-pole configuration wherein the apparatus includes multiple electrodes of both poles of the circuit.

In some embodiments of the invention, some electrodes provide RF energy and other electrodes provide EMS energy. Alternatively, the same electrodes are designed to synchronize the pulses and deliver any of the two currents by control of the apparatus.

In an exemplary embodiment of the invention, the skin massage may be performed by applying positive pressure, for example in the form of vibrations, pushing, pounding and the like. Alternatively or additionally, the skin massage may be performed by applying negative pressure, for example using a vacuum or suction and the like. Optionally, the element of the apparatus applying the pressure may be heated or cooled while applying the pressure.

In an exemplary embodiment of the invention, when the apparatus is placed in contact with the user's skin an electric circuit is formed and electric current flows automatically from the electrode to the user. Optionally, the RF energy may be coordinated with the EMS energy so that both will be activated simultaneously or separately by control of the apparatus.

In an exemplary embodiment of the invention, the frequency of the RF energy is selected to heat the user's skin mainly at the adipose layer positioned under the apparatus. The EMS flow is designed to contract the muscles below the adipose layer causing pressure on the fatty cells from below.

In some embodiments of the invention, parameters related to the RF energy are user selectable, for example signal intensity, frequency, duration and the like, to optimize usage of the apparatus for different users or different positions on the body of the user. Optionally, the parameters related to the EMS energy can be modified to fit the needs of the user, for example by selecting intensity, frequency, duration and the like.

In some embodiments of the invention, parameters related to massaging the skin are user selectable, for example the vibration rate, duration of vibrations, intensity, temperature of the massaging element and the like. Alternatively, the massaging may be performed by manually pressing the apparatus on the user's skin and moving it over a designated area.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be understood and better appreciated from the following detailed description taken in conjunction with the drawings. Identical structures, elements or parts, which appear in more than one figure, are generally labeled with the same or similar number in all the figures in which they appear, wherein:

Fig. 1 is a schematic illustration of a fat reduction device deployed upon a user's skin, according to an exemplary embodiment of the invention;

Fig. 2 is a schematic illustration of liquefied fat exiting from fat cells into the extra cellular matrix responsive to the use of the fat reduction device, according to an exemplary embodiment of the invention;

Fig. 3 is a schematic illustration of a fat reduction device applying an electrical current to stimulate a user's muscles, according to an exemplary embodiment of the invention;

Fig. 4 is a schematic illustration of a fat reduction device and the user's skin following use of the fat reduction device, according to an exemplary embodiment of the invention;

Fig. 5 is a schematic block diagram of the elements of a fat reduction device, according to an exemplary embodiment of the invention; and

Fig. 6 is a schematic illustration of an RF signal combined with an EMS signal, according to an exemplary embodiment of the invention.

DETAILED DESCRIPTION

Fig. 1 is a schematic illustration of a fat reduction device 110 deployed upon a user's skin 120, according to an exemplary embodiment of the invention. The skin 120 includes an upper epidermal layer 160, a lower dermal layer 170, and an adipose layer 140 (fat tissue layer). Muscles 150 are located below the adipose layer 140.

In an exemplary embodiment of the invention, fat reduction device 110 includes one or more heads 115 that serve as massage contacts and optionally also as electrodes for applying electrical energy. Optionally, fat reduction device 110 is adapted to perform at least three actions:

1. Massaging the outer layer of skin 120;

2. Heating the adipose layer 140 using RF energy 130 (e.g. with a frequency between 0.5MHz to 2MHz);

3. Stimulating the muscles 150 below the adipose layer 140 with an electrical muscle stimulation (EMS) signal (e.g. with pulses of DC current between +/- 500ma).

In an exemplary embodiment of the invention, fat reduction device 110 is deployed upon the user's skin 120 and applies pressure with heads 115 to massage the skin 120. Optionally the pressure may be in the form of vibrations, pushing, pounding, or other tactile forms. Alternatively or additionally, the massaging may be in a negative form, for example by applying a vacuum or suction or similar form. Figure 1 demonstrates how the skin 120 takes an uneven form due to the physical pressure exerted upon it. In some embodiments of the invention, fat reduction device 110 includes an element that applies the pressure, for example a motor a piezoelectric chip or other devices known in the art. Alternatively, the pressure may be exerted by manually pressing heads 115 against the user's skin.

In an exemplary embodiment of the invention, the RF energy 130 is delivered through the skin to the adipose layer 140. The RF energy 130 accelerates natural fat cell metabolism causing the release of liquefied fat from the cells into the extra cellular matrix. Additionally, the RF energy 130 heats collagen fibers and stimulates fibroblast metabolism resulting in tightening of the skin 120 and an increase in new collagen production.

Optionally, the physical pressure loosens the ties between the fat cells and together with the heating from the RF energy 130 accelerates release of liquefied fat

from the fat cells. The heating and massaging also increase blood flow thus providing more nourishment to the area and removing dead cells and other impurities at an increased rate.

Fig. 2 is a schematic illustration of liquefied fat 220 exiting from fat cells 210 into the extra cellular matrix responsive to the use of the fat reduction device 110, according to an exemplary embodiment of the invention. In an exemplary embodiment of the invention, the RF energy is set to heat the fat cells 210 to a level wherein the temperature on the surface of the skin does not exceed 40°C-45°C to prevent skin damage. Optionally, higher temperature ranges may be possible for short durations.

Fig. 3 is a schematic illustration of fat reduction device 110 applying an electrical current 310 to stimulate the user's muscles 150, according to an exemplary embodiment of the invention. In an exemplary embodiment of the invention, electrical current 310 from the electrical muscle stimulation (EMS) pulse causes the muscles 150 to contract below the adipose layer 140, which causes a dual force to be applied to the fat cells 210. From above the adipose layer 140 is pressured physically by fat reduction device 110 and from below the EMS signals cause the muscles 150 to exert pressure on adipose layer 140. In some embodiments of the invention, the RF energy 130 and/or the EMS pulse may be activated by an activation switch on fat reduction device 110. Alternatively, they may be activated upon contact with the user's skin, for example by closing a circuit through the user's skin or by applying pressure on the head of fat reduction device 110.

Fig. 4 is a schematic illustration of fat reduction device 110 and the user's skin 120 following use of fat reduction device 110, according to an exemplary embodiment of the invention. Optionally, after applying fat reduction device 110 the distance between the muscles 150 and the epidermal layer 160 is reduced due to the exit of liquefied fat from the fat cells 210 of the adipose layer 140. Additionally, the epidermal layer 160 becomes smoother due to the tightening resulting from the collagen production as described above.

Fig. 5 is a schematic block diagram of the elements of fat reduction device 110, according to an exemplary embodiment of the invention. In an exemplary embodiment of the invention, fat reduction device 110 includes an RF generator 510 to provide an AC current in the form of a radio frequency (RF) electrical pulse for heating

the user's skin 120. Optionally the AC signal is a low current signal, for example of about 1-10ma, 24VAC with a frequency between 0.5MHz-2MHz to prevent damage to the user's skin 120. In an exemplary embodiment of the invention, fat reduction device 110 also includes an electric pulse (EP) generator 520 that provides low current DC pulse signals, for example between +500ma to -500ma to cause the muscles 150 to expand and contract. In an exemplary embodiment of the invention, fat reduction device 110 includes a control board 530 that determines the actions of the device. Optionally, control board 530 may be a general purpose computer or a dedicated circuit. Control board 530 controls the duration, intensity, frequency and any other parameters of the electric pulses of the electrical current 310 for stimulating the muscles 150, and the RF energy 130 for heating the adipose layer 140. Additionally, the control board 530 determines the timing for applying the EP signal and the RF signal. In some embodiments of the invention, control board 530 includes a CPU, a memory, and input/output devices, for example a keypad and a screen.

In some embodiments of the invention, the control board accepts measurements from various sensors and controls fat reduction device 110 responsive to the measurements, for example temperature readings from a temperature sensor 550, which may include a thermistor or thermocouple monitoring the skin temperature. Optionally, the sensors may be placed in head 115, for example adjacent to the electrodes.

In an exemplary embodiment of the invention, fat reduction device 110 includes an applicator 540 for applying the actions described above. In an exemplary embodiment of the invention, fat reduction device 110 is fed from a power source 590. Optionally, the power source 590 may be an internal power source, for example a battery. Alternatively, power source 590 may be an external power source, for example by connecting a power cable to a standard household power outlet.

In an exemplary embodiment of the invention, applicator 540 includes one or more heads 115 that serve as massage contacts 560, and electrodes 570. In some embodiments of the invention, the applicator may include an activation switch 580 to turn on and off fat reduction device 110. Optionally, activation switch 580 may be independently controlled by the user or may be automatically controlled, for example by placing fat reduction device 110 in contact with the user's body so that an electric circuit

is formed or by pressing the fat reduction device 110 against the user's body causing the activation switch 580 to be depressed.

In some embodiments of the invention, fat reduction device 110 may use a mono-polar configuration wherein one pole of the circuit is represented by one or more electrodes on heads 115 and placed in contact with the user's skin. Optionally, the opposite pole is placed as a patch on the user's body or on a handle for grasping fat reduction device 110, to form a closed circuit. Alternatively, fat reduction device 110 may use a bi-polar configuration wherein both poles are represented by electrodes on the head 115 of the device, and no external electrodes are required. In some embodiments of the invention, a multi-polar configuration is used, with multiple electrodes wherein some of the electrodes on head 115 represent a first pole of the circuit and some represent the opposite pole. Optionally, the polarity of the electrodes may be controlled by control board 530, and their polarity may alternate during use of fat reduction device 110.

In some embodiments of the invention, some of the electrodes deliver RF energy 130 and some deliver electrical current 310. Alternatively, the same electrodes may deliver RF energy 130 and electrical current 310 intermittently. In some embodiments of the invention, electrical current 310 from the electrical muscle stimulation (EMS) signal is applied independent of the RF energy signal 130.

In an exemplary embodiment of the invention, control 530 controls the actions of the massage contacts 560. Optionally, the massage contacts 560 may include a motor, a piezoelectric element, a suction, a vacuum or other devices to massage the user's skin either positively or negatively. In an exemplary embodiment of the invention, the action of massage contacts 560 are synchronized with the electrical muscle stimulation (EMS) so that the adipose layer will be pressurized on both sides simultaneously. Alternatively, each function may act independently. In some embodiments of the invention, the massage is applied manually by pressing massage contacts 560 against the user's skin 120, and optionally moving them back and forth across the user's skin 120. Optionally, massage contacts 560 may be made from a soft material or hard material selected for providing a comfortable feeling to the user while massaging the user's skin 120. In some embodiments of the invention, the massage contacts 560 may include a heater to warm the contacts to enhance comfort and/or effectiveness of the massage.

Fig. 6 is a schematic illustration of an RF energy signal synchronized with an EMS signal, according to an exemplary embodiment of the invention. In an exemplary embodiment of the invention, an electric pulse 610 of for example 100 micro-seconds is provide during an interval of 1 ms after which a RF energy signal 620 is applied, for example for a duration of 9ms. This sequence is applied repetitively while the fat reduction device is activated. Optionally, other duration may be used, for example the duration of electric pulse 610 may be longer than the duration of RF radiation signal 620 or vice versa.

It should be appreciated that the above described methods and apparatus may be varied in many ways, including omitting or adding steps, changing the order of steps and the type of devices used. It should be appreciated that different features may be combined in different ways. In particular, not all the features shown above in a particular embodiment are necessary in every embodiment of the invention. Further combinations of the above features are also considered to be within the scope of some embodiments of the invention.

It will be appreciated by persons skilled in the art that the present invention is not limited to what has been particularly shown and described hereinabove. Rather the scope of the present invention is defined only by the claims, which follow.

CLAIMS

We claim:

1. A device for massaging skin, comprising:

a RF generator adapted to generate a radio frequency AC current to heat fat tissue in the adipose layer of the skin;

an electrical pulse generator adapted to generate pulses of DC current to provide electrical muscle stimulation for the muscles below the adipose layer;

an applicator including one or more heads adapted to be placed in contact with the user's skin; and

wherein the heads serve as massage contacts to massage the outer layer of a user's skin above the adipose layer or as electrodes to deliver the AC current and DC current, or as both.

2. A device according to claim 1, wherein the electrodes are adapted to apply the AC current and the DC current intermittently.

3. A device according to claim 1, wherein the electrodes are adapted to apply the AC current and the DC current simultaneously.

4. A device according to claim 1, wherein said massage contact is adapted to vibrate the outer layer of the skin.

5. A device according to claim 1, wherein said massage contact is adapted to apply negative pressure to the skin.

6. A device according to claim 1, wherein said AC current and DC current are adapted to be activated upon placing the device in contact with the user's skin.

7. A device according to claim 1, wherein said AC current and DC current are adapted to be activated by activating a switch.

8. A device according to claim 1, wherein the electrodes in the applicator of the device represent both poles to form a closed circuit.

9. A device according to claim 1, wherein the electrodes in the applicator of the device represent a first pole and an electrode external to the applicator provides the opposite pole to form a closed circuit.

10. A device according to claim 1, wherein the electrical muscle stimulation is synchronized with the massage contact so that the adipose layer of the skin is pressurized simultaneously from above and below.

11. A device according to claim 1, wherein at least some of the heads only serve as massage contacts and some of the heads only serve as electrodes.

12. A device according to claim 1, wherein some of the electrodes only deliver AC current and some only deliver DC current.

13. A device according to claim 1, further comprising a control board adapted to control operation of the device responsive to temperature measurements from the surface of the skin of the user.

14. A device according to claim 13, further comprising a temperature sensor in said applicator to provide temperature measurements from the surface of the skin.

15. A method of treating skin, comprising:

massaging the outer layer of the skin with a massage element;

heating the adipose layer of the skin below the area being massaged using one or more electrodes providing RF energy;

stimulating the muscle below the adipose layer with an electrical current pulse provided by one or more electrodes; and

wherein the massaging, heating and stimulating are performed by a single device.

16. A method according to claim 15, wherein said heating and said stimulating are adapted to be activated intermittently.

17. A method according to claim 15, wherein said heating and said stimulating are adapted to be activated simultaneously.

18. A method according to claim 15, wherein said massaging includes vibrating the outer layer of the skin.

19. A method according to claim 15, wherein said massaging includes applying negative pressure to the skin.

20. A method according to claim 15, wherein said heating and said stimulating are adapted to be activated when the device is placed in contact with the user's skin.

21. A method according to claim 15, wherein said heating is performed by multiple electrodes.

22. A method according to claim 15, wherein some of the electrodes perform stimulating and heating and some of the electrodes form a closed circuit through the body of the user.

23. A method according to claim 15, wherein all the electrodes are adapted to perform stimulating and heating.

24. A method according to claim 15, wherein said massaging and said stimulating are synchronized so that the adipose layer of the skin is pressurized simultaneously from above and below.

25. A method according to claim 15, further comprising heating collagen fibers to stimulate fibroblast metabolism leading to skin tightening and new collagen production.

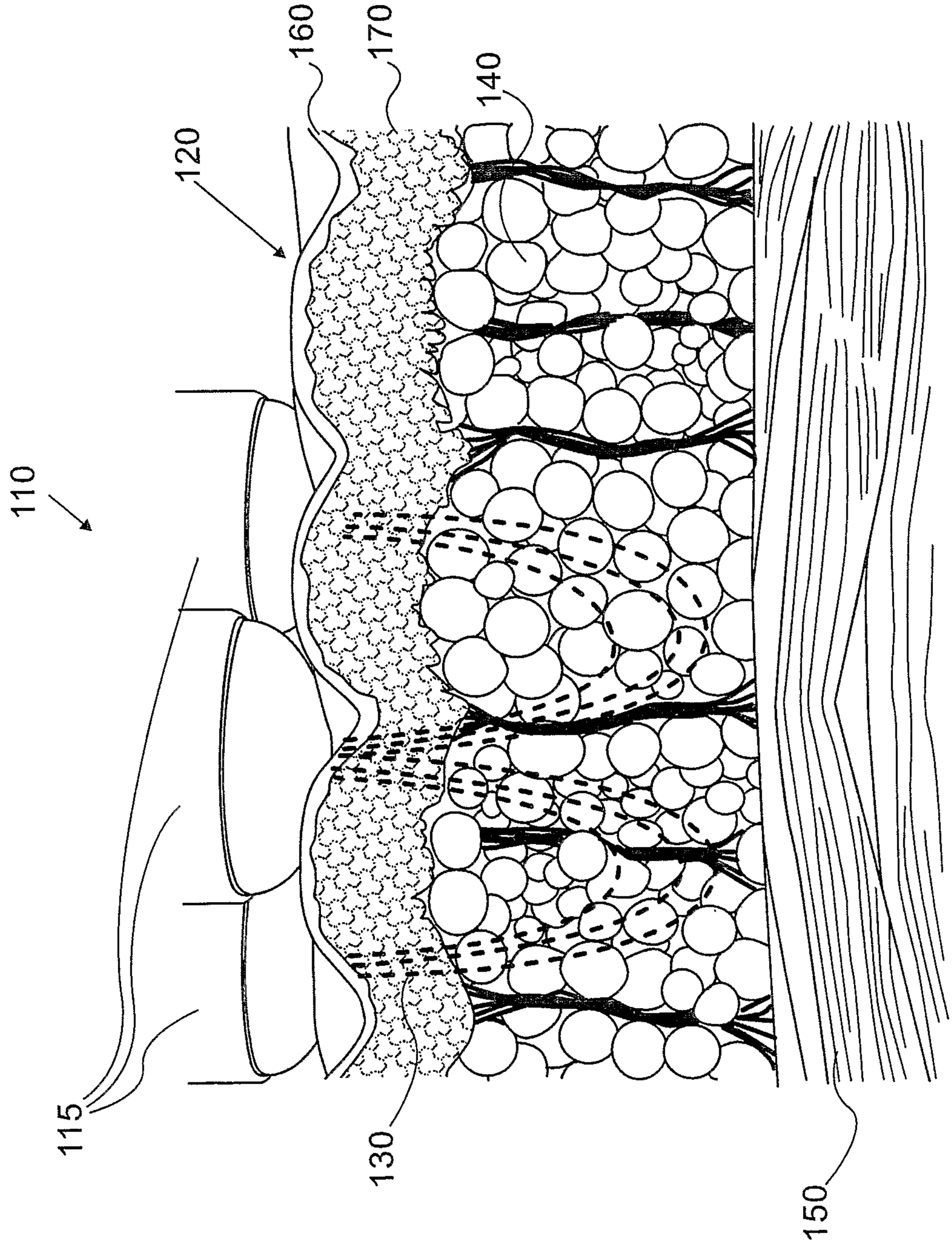
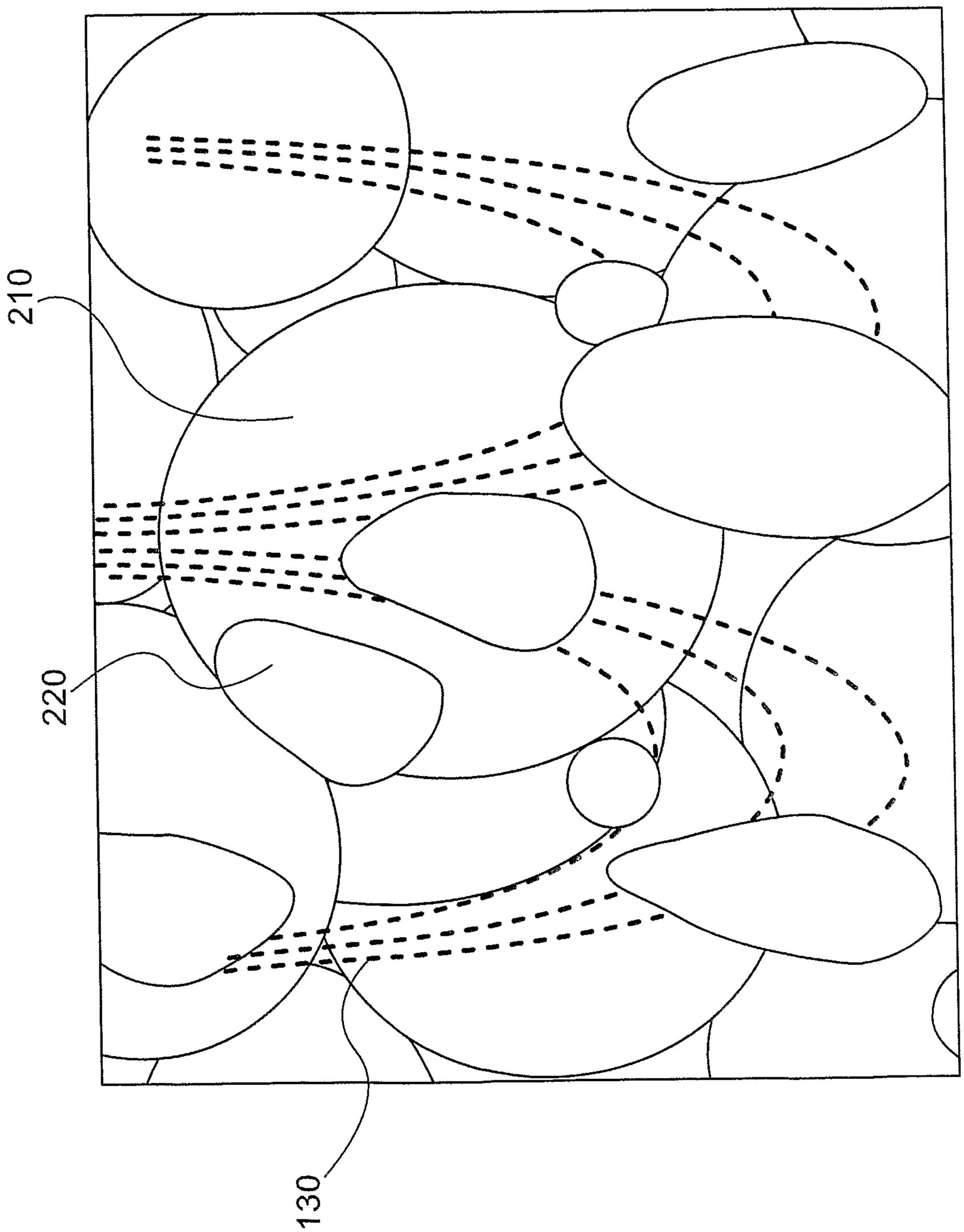


FIG. 1

FIG. 2



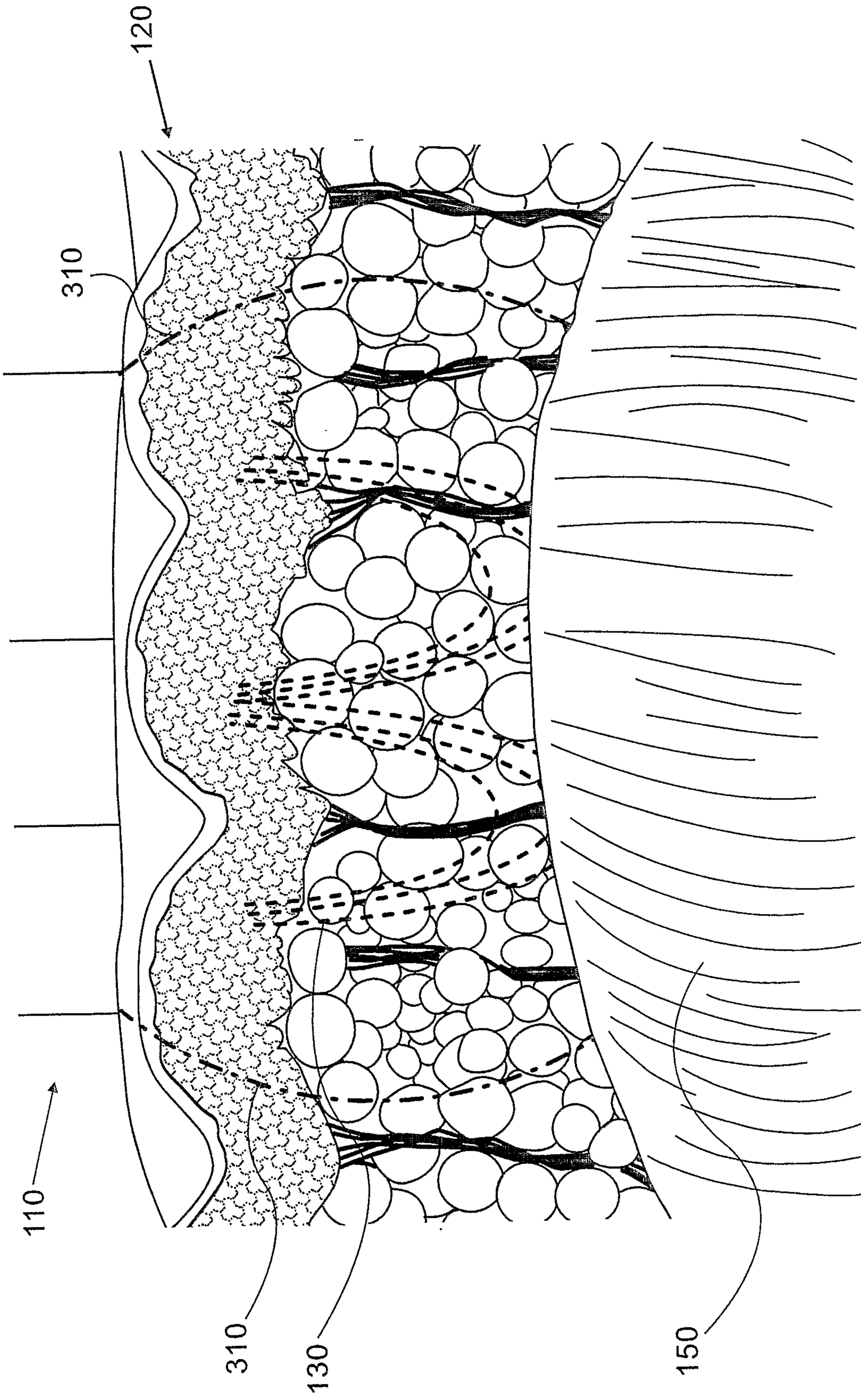


FIG. 3

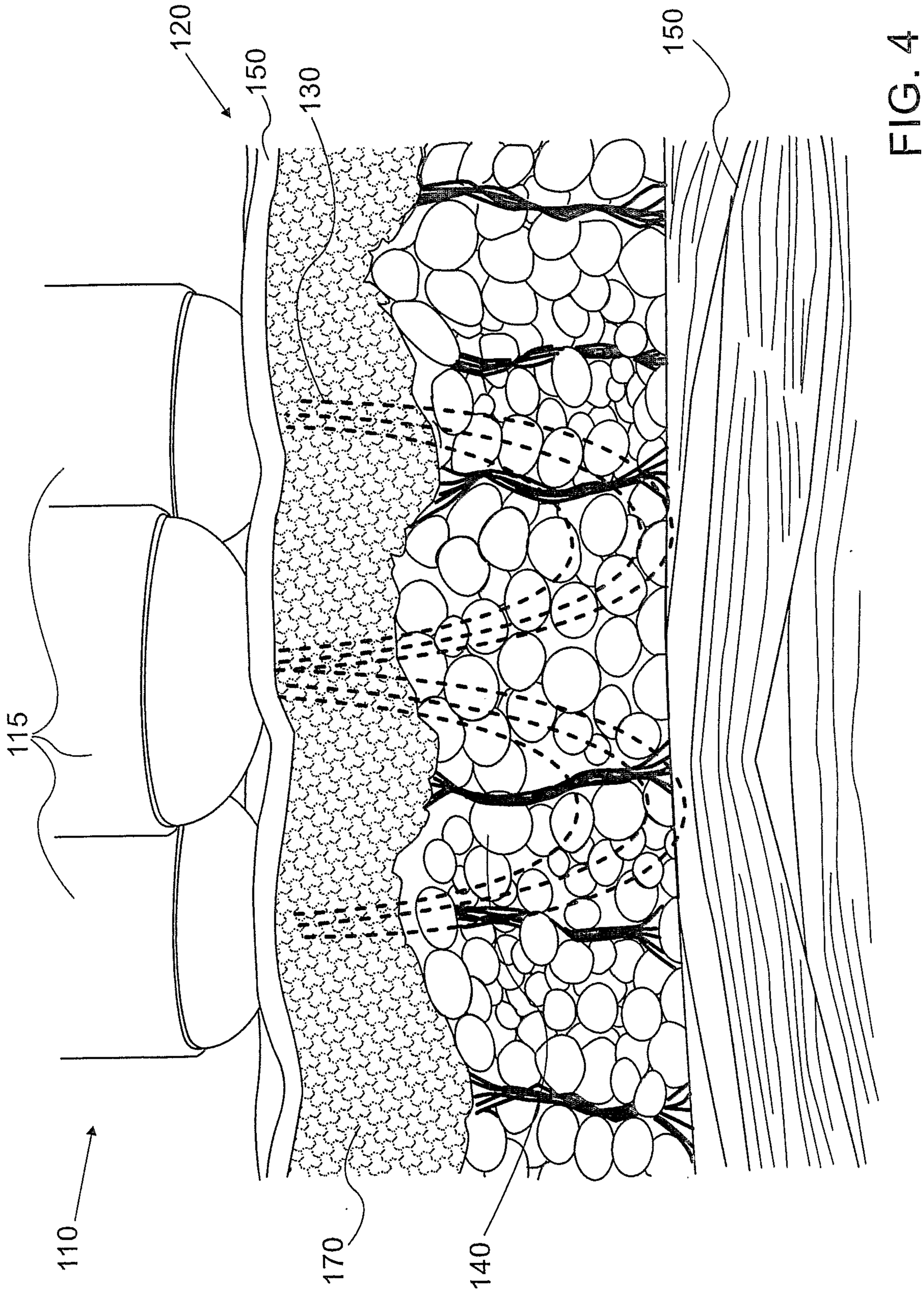
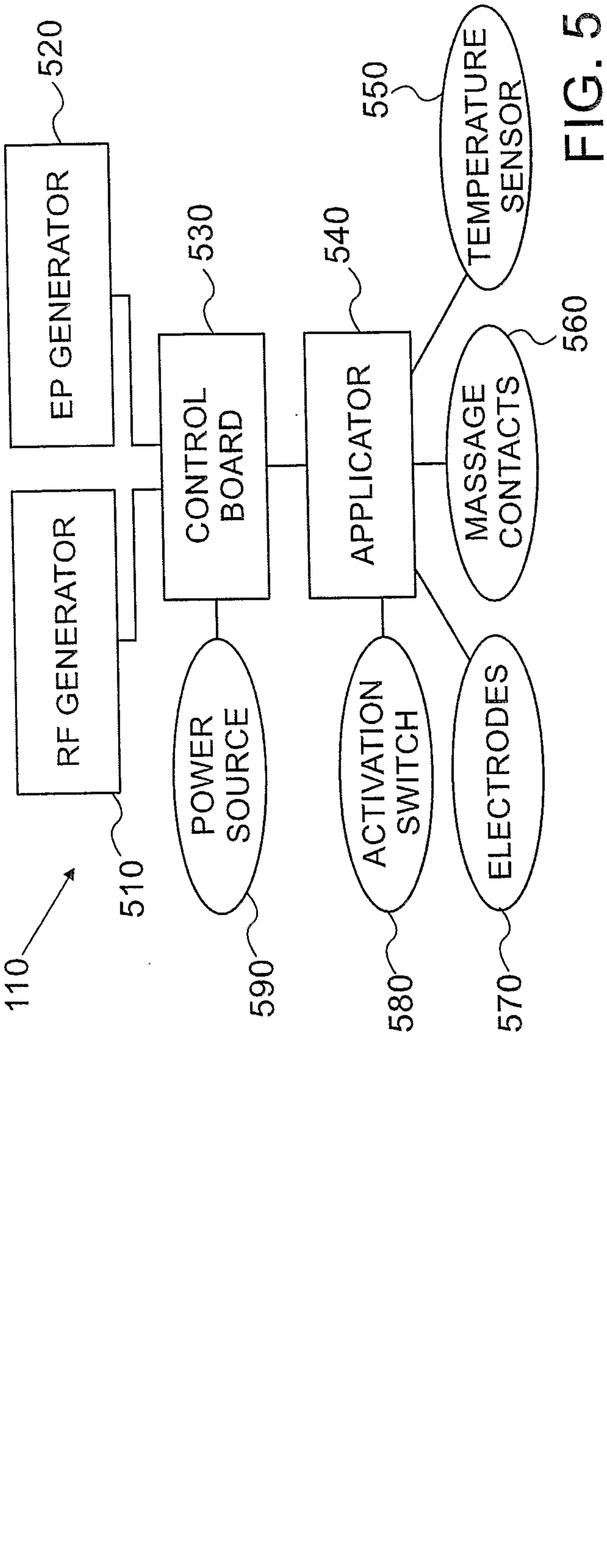


FIG. 4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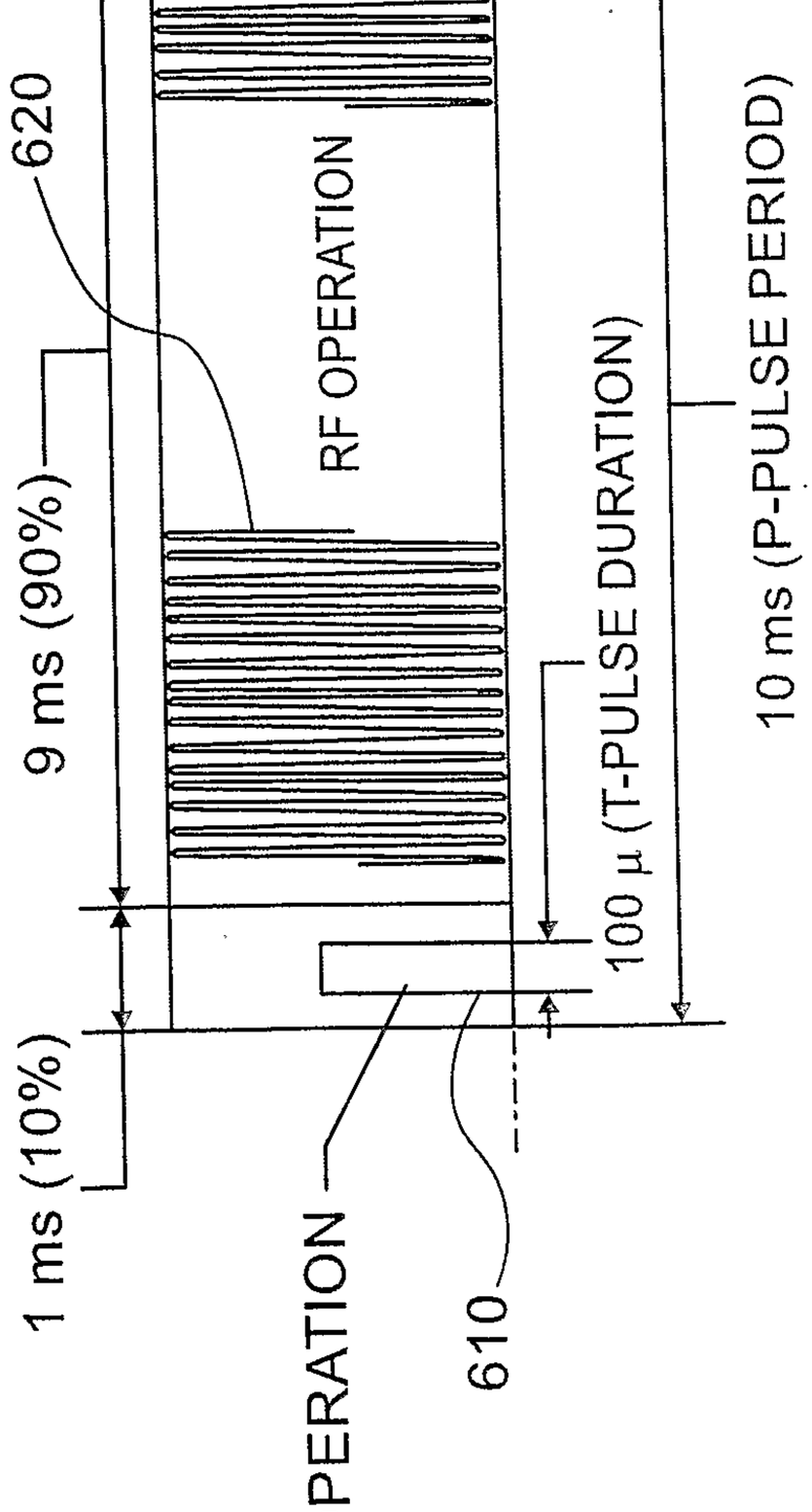
RF GENERATOR
520
EP GENERATOR
530
CONTROL BOARD
540
APPLICATOR
550
TEMPERATURE SENSOR
560
MASSAGE CONTACTS
570
ELECTRODES
580
ACTIVATION SWITCH
590
POWER SOURCE

FIG. 5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EP OPERATION
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10 ms (P-PULSE PERIOD)
610

FIG. 6

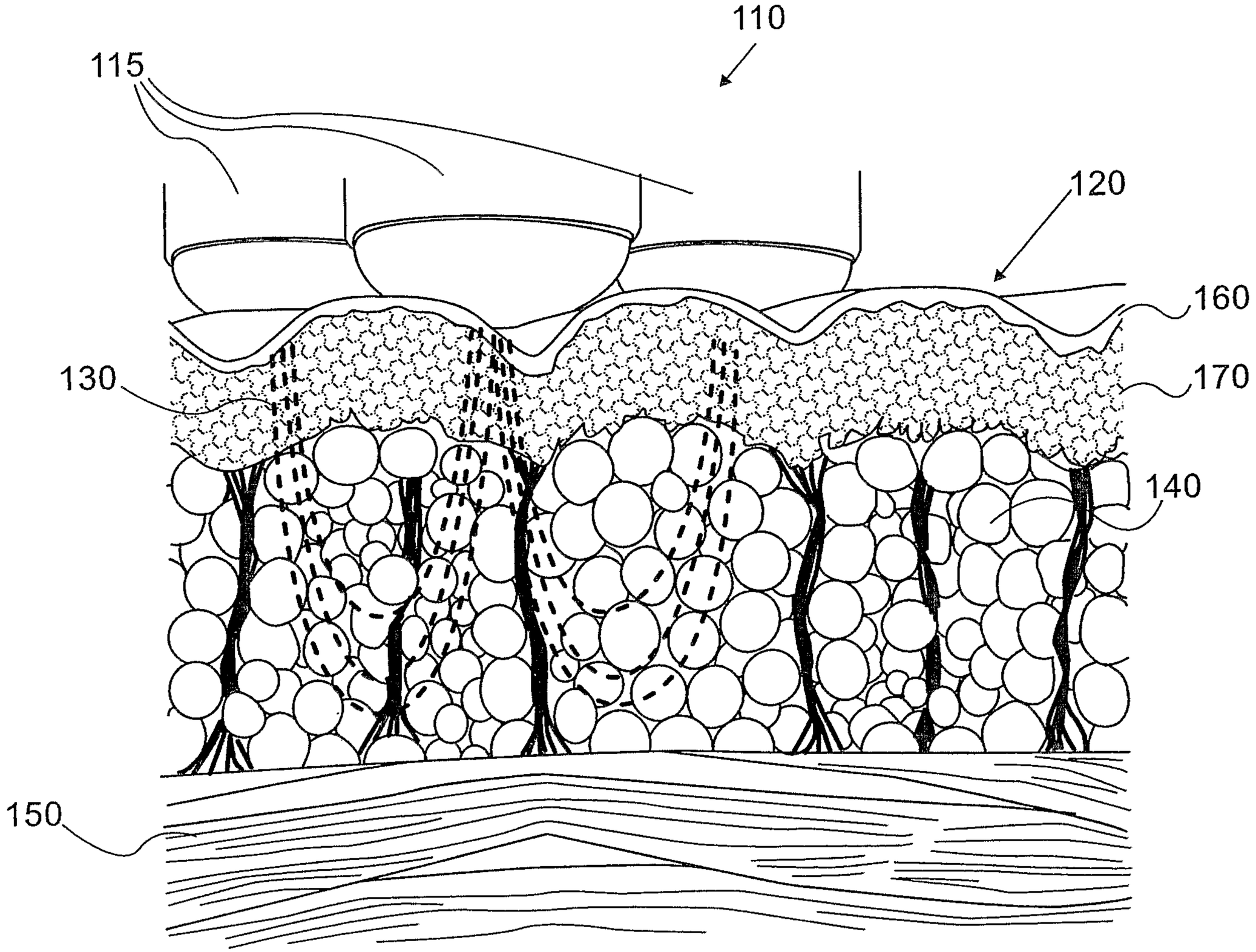

FIG. 1