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Rey

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[54] **DIAGNOSTIC AND THERAPEUTIC APPARATUS FOR COSMETICALLY AND HYGIENICALLY TREATING SKIN**

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[52] **U.S. Cl.** ..... **128/2.1 R**, 128/422
[51] **Int. Cl.** **A61b 5/05**
[58] **Field of Search** ..... 128/2.1 RC, 2.1 Z, 172.1, 128/419 R, 421, 422

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[57] **ABSTRACT**

A method and apparatus are disclosed for aiding in the cosmetic and hygienic treatment of human skin—particularly skin of the face and scalp. The apparatus comprises resistance measuring circuitry for measuring the electrical resistivity of areas of the skin and a micro-massage unit for applying to the skin a low frequency, low voltage electrical massage. The resistance measuring circuitry comprises means for determining the average resistivity of the skin, means for detecting localized departures from this average value, and means for measuring the resistivity in localized areas. The micro-massage unit stimulates the underlying muscular tissues, thereby inducing more rapid penetration of cosmetic or therapeutic preparations into the skin.

4 Claims, 5 Drawing Figures

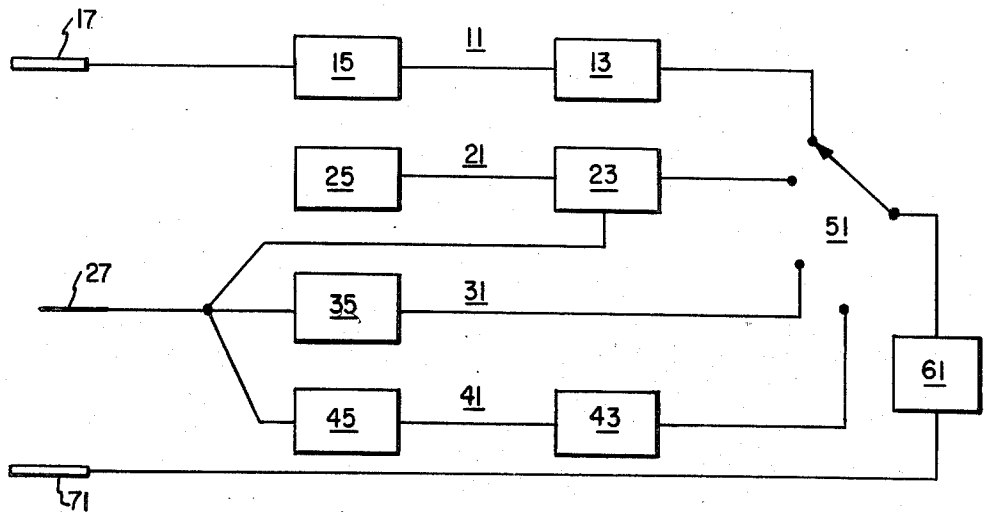
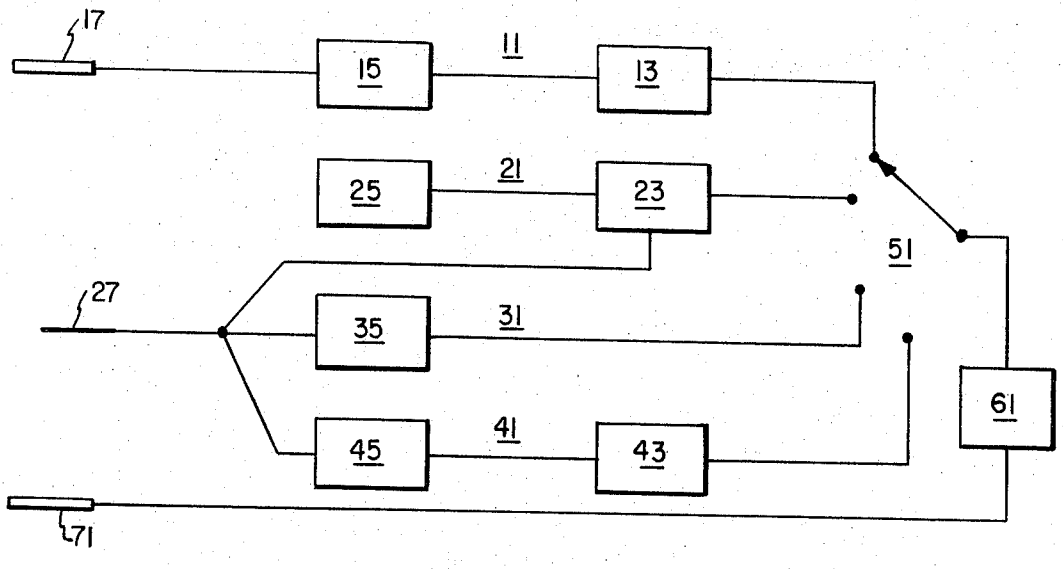


FIG. 1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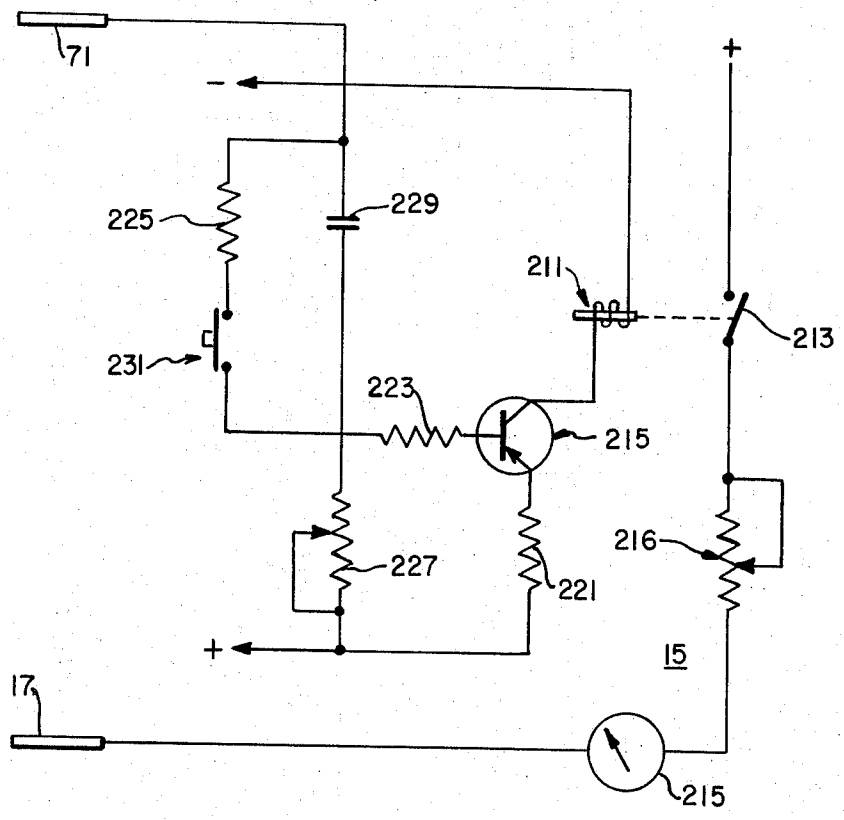
71

FIG. 2


71
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229
211
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FIG. 3

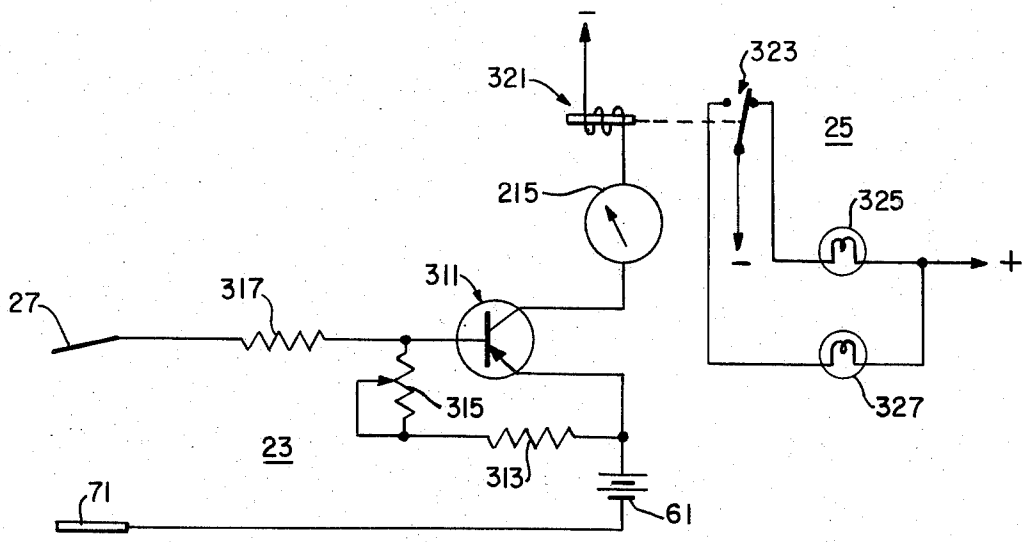


FIG. 4

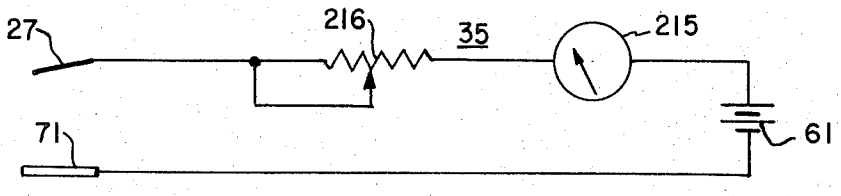
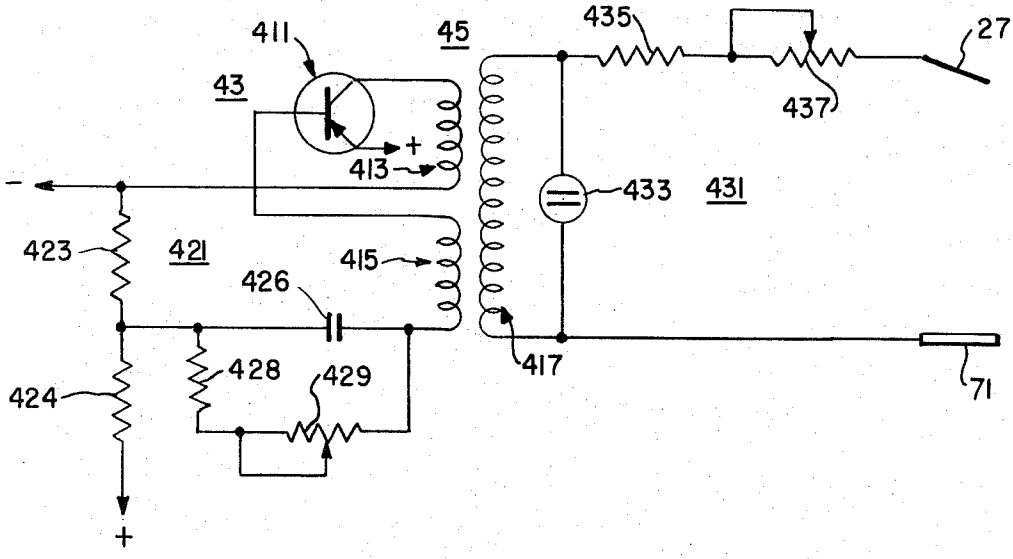


FIG. 5



DIAGNOSTIC AND THERAPEUTIC APPARATUS FOR COSMETICALLY AND HYGIENICALLY TREATING SKIN

BACKGROUND OF THE INVENTION

The present invention relates to a method and apparatus for aiding in the cosmetic and hygienic treatment of human skin.

Cosmetic and therapeutic lotions are customarily applied to the skin by manually dabbing the lotions onto the skin and manually rubbing them in. This technique is relatively satisfactory in instances where the skin problem is evident; however, it is not satisfactory in instances—such as typical scalp problems—where no readily apparent visual indications are present. As a consequence, in such cases, the subject generally applies the cosmetic or therapeutic lotions indiscriminately to healthy and unhealthy regions alike, thus failing to provide the relatively unhealthy regions with the greater stimulation which they require.

SUMMARY OF THE INVENTION

In the present invention, the aforementioned problems are alleviated by providing apparatus for quickly detecting relatively unhealthy areas of the skin to which cosmetic and therapeutic lotions may be selectively applied. In addition, apparatus is provided for applying an electrical massage to the skin. By stimulating the muscles, the penetration of cosmetic and therapeutic lotions into the skin is promoted.

The unhealthy areas of the skin are detected by resistance measuring circuitry. In the preferred embodiment of the invention, this comprises three circuits, the first of which determines the average resistivity of the skin; the second of which finds localized departures from this average resistivity; and the third of which permits accurate measurement of the resistivity in localized areas.

The micro-massage unit comprises an oscillator and a transformer for applying a low-frequency, low-voltage signal directly to the skin.

BRIEF DESCRIPTION OF THE DRAWING

These and other objects, features, and elements of this invention will be more readily apparent from the following detailed description of the drawing in which:

FIG. 1 is a schematic diagram of a preferred embodiment of the invention;

FIG. 2 is a schematic diagram of a first circuit in the preferred embodiment of the invention;

FIG. 3 is a schematic diagram of a second circuit in the preferred embodiment of the invention;

FIG. 4 is a schematic diagram of a third circuit in the preferred embodiment of the invention; and

FIG. 5 is a schematic diagram of a fourth circuit in the preferred embodiment of the invention.

DETAILED DESCRIPTION OF THE DRAWING

As shown in the schematic diagram of FIG. 1, the preferred embodiment of the invention comprises four electrical circuits 11, 21, 31, 41 that may be selectively connected, one at a time, by a switch 51 to a voltage 61 and a return electrode 71. The first three of these circuits are used for performing various skin resistance measurements in order to determine areas of living human skin to which treatment should be applied. The fourth circuit is used for stimulating the skin with a low-frequency, low-voltage electrical massage.

Circuit 11 comprises a timer 13, resistance indicating means 15, and an electrode 17. When it is connected by switch 51 to voltage source 61 and electrode 71, it may be used to measure the average resistivity of a layer of skin.

Circuit 21 comprises an amplifier 23, indicating means 25, and a probe 27. When it is connected by switch 51 to voltage source 61 and electrode 71, it may be used to detect specific areas of the skin whose resistivity departs from the average resistivity of the skin.

Circuit 31 comprises an indicating means 35 and the same probe 27 that is used in circuit 21. When circuit 31 is connected, precise measurement of the resistivity of a small portion of the skin can be made.

Circuit 41 comprises a low frequency relaxation oscillator 43, a transformer 45, and the same probe 27 that is used in circuits 21, 31. When circuit 41 is connected, it may be used to provide a low-frequency, low-voltage electrical massage to a portion of the skin.

The foregoing circuits are mounted in a small console having a display panel for indicating means 15, a knob to control switch 51, and plugs for electrodes 17, 71 and probe 27. In addition, several control knobs are mounted on the console for adjusting variable resistors used in these circuits. Electrodes 17, 71 are identical, cylindrical devices sized to fit in the user's hands. One end of each electrode is a flat surface about two to three centimeters in diameter that is placed in contact with the user's skin. Probe 27 is a pointed rod mounted in a handle. Preferably, the tip of probe 27 is platinum plated to provide an inert surface that is not corroded by the products used in skin treatment. Voltage source 61 illustratively is a nine-volt battery.

Each of the foregoing circuits is used by placing return electrode 71 and either electrode 17 or probe 27 in contact with the skin of the user. This completes an electrical circuit from electrode 17 or probe 27 down through one layer of skin through the tissue underlying the skin and up through the layer of skin to return electrode 71. As is well known, the resistance of the skin itself is relatively high while the resistance in the tissue underneath the skin is quite low. As a result, any measurement of the resistance between return electrode 71 and either electrode 17 or probe 27 is essentially a measure of the resistance in the two layers of skin underlying electrode 71 and either electrode 17 or probe 27. Inasmuch as the thickness of these layers of skin is generally constant and the cross-sectional area of the layer underlying an electrode or probe is determined by the area of the electrode or probe in contact with the skin, it is possible to determine the resistivity of the skin.

Circuit 11 is shown in greater detail in FIG. 2. As indicated in connection with FIG. 1, the circuit comprises two electrodes 17, 71, indicating means 15, and a voltage source 61. Indicating means 15 typically is a micro-ammeter 215. A variable resistor 216 is used to adjust the reading of micro-ammeter 215 to a convenient scale and is permanently set once this calibration is complete. Although the reading of micro-ammeter 215 is in micro-amps, a scale can readily be provided that indicates the resistance between the two electrodes 17, 71. As indicated above, this measure of resistance is also a measure of the resistivity of the layers of skin underneath the electrodes.

The remaining elements in the circuit of FIG. 2 constitute the timing circuit 13 of FIG. 1. This circuit comprises a relay 211 that controls a switch contact 213, a PNP transistor 215, and a resistor-capacitor network for controlling the voltage supplied to the base of transistor 215. This resistor-capacitor network comprises fixed resistors 221, 223, 225, variable resistor 227, capacitor 229, and switch 231 connected as shown.

To use this circuit to measure the average resistivity of living skin, the user places the two electrodes 17, 71 on the surface of the skin to be measured. He then closes switch 231, thereby applying a relatively negative voltage to the base of transistor 215. As a result, this transistor is turned on and current flows from the voltage source through resistor 221, transistor 215, and relay 211. This energizes the relay causing switch contact 213 to close, thereby completing a circuit through voltage source 61, indicating means 15, electrode 17, the skin whose resistivity is being measured, and return electrode 71. Inasmuch as electrode 17 has a broad flat surface about two or three centimeters in diameter, the measurement of skin resistivity by micro-ammeter 215 depends on the condition of the skin throughout the portion of the skin under electrode 17. Thus, the reading on micro-ammeter 215 is an average reading of the condition of the skin.

Once switch contact 213 is closed, switch 231 should be opened. This permits capacitor 229 to charge through variable resistor 227. When the voltage across capacitor 229 becomes high enough, transistor 215 is shut off, thereby de-energizing relay 211 and opening switch contact 213. Variable resistor 229 may be adjusted to vary the time period during which relay 211 is energized. Typically, relay 211 should be energized for no more than one minute in order to keep polarization effects in the skin from affecting the reading on indicating means 15.

The second circuit in the apparatus is used to locate particular areas of the skin whose resistivity departs from the average value. As shown in FIG. 3, the amplifier 23 of this circuit comprises a PNP transistor 311, a resistor 313 and a variable resistor 315 connected in series between the emitter and base of the transistor and a resistor 317 connected between the base of the transistor and the probe 27. The indicating means comprises a relay 321 that is connected to the output of the amplifier, a switch contact 323 controlled by relay 321, and two lamps 325, 327 that are selectively lighted in accordance with the position of switch contact 323. Ammeter 215 may also be connected in series with relay 321 if desired.

The circuit of FIG. 3 is designed so that one of lights 325, 327 is lighted when probe 27 is in contact with skin having normal resistivity while the other light is lighted when the probe is in contact with skin whose resistivity is too low. To detect the particular areas of the skin whose resistivity departs from the average, variable resistor 315 is set so that the amount of amplification by transistor 311 is not enough to cause relay 321 to alter the position of switch contact 323 when probe 27 is placed on skin having average resistivity. Electrode 71 and probe 27 are then placed in contact with the skin and probe 27 is moved about to locate areas of the skin having too low a resistivity. When such an area is located, the voltage applied to the base of transistor 211 decreases. As a result, the emitter-collector current increases by an amplification factor characteristic of the transistor and this amplified current is applied to relay 321. If the decrease in voltage applied to the base of transistor 211 is sufficiently high, a large enough amplified current will be produced to energize relay 321 causing switch contact 323 to move from one position to the other. As a result, one of lamps 325, 327 is extinguished and the other is lit.

If micro-ammeter 215 is connected in series with the amplifier and relay 321, it too can be used to monitor the resistivity of the areas over which probe 27 is moved. In practice, however, it seems preferably simply to observe the condition of lights 325, 327.

Once an area of low resistivity is detected, its condition can be very accurately measured by means of the circuit of FIG. 4. This circuit simply comprises a voltage source 61, micro-ammeter 215, calibrating resistor 216, probe 27, and electrode 71. By connecting electrode 71 to the skin and placing probe 27 on a particular area, the user can measure the resistivity of that particular area of the skin by observing the reading on micro-ammeter 215. This measurement can then be compared with other measurements taken on different subjects or previous measurements the user has taken to indicate the present condition of the skin. In accordance with these determinations, appropriate skin treatments can be applied to those areas and only those areas of the skin that need such treatment.

It is also possible to stimulate the skin by means of the circuit shown in FIG. 5. As indicated, this circuit comprises a voltage source 61, a relaxation oscillator 43, a transformer 45, probe 27, and electrode 71. Oscillator 43 is a blocking oscillator comprising a PNP transistor 411, transformer windings 413, 415, and a resistor-capacitor network 421. Resistor-capacitor network 421 comprises two voltage dividing resistors 423, 424; capacitor 426 connected to the node between resistors 423, 424; and a fixed resistor 428 and a variable resistor 429 that shunt capacitor 426. This is a conventional blocking oscillator such as is shown in FIG. 16–14(*b*) of Millman and Taub's *Pulse, Digital and Switching Waveforms*. Transformer 45 comprises windings 413, 415, secondary winding 417, and voltage regulating apparatus 431. Voltage regulating apparatus 431 comprises a peak limiter 433 which illustratively is a neon tube that shunts secondary winding 417 and a fixed resistor 435 and a variable resistor 437 connected in series between secondary winding 417 and probe 27 to adjust the voltage available at the probe.

When operation of the unit is switched to the circuit shown in FIG. 5, the blocking oscillator operates in known fashion to produce a low frequency signal. The operating frequency of oscillator 43 may be adjusted by variable resistor 429. In the preferred embodiment of the invention, the operating frequency may be varied between one and 25 Hertz. The optimum frequency for most users will be found to be about 3 Hertz.

The windings of the transformer are selected to step up the voltage from voltage source 61. In the preferred embodiment of the invention, the maximum voltage is limited by peak limiter 433 to the order of 60 volts.

From the foregoing description of the operation of the circuits of this invention, one skilled in the art will be able to select appropriate values for the various resistors and capacitors shown. In these circuits, the following components have been used. The transistors have been AC 132 transistors, capacitors 229 and 426 have had a capacitance of 47 microfarads, and variable

resistor **216** has been a 100,000 ohm resistor. Resistors **223, 317,** and **435** were 1,000 ohm resistors, resistors **225** and **425** were 18 ohm resistors, variable resistors **227, 315,** and **437** had a maximum resistance of 10,000 ohms, resistor **423** had a resistance of 470 ohms, and variable resistor **429** had a maximum resistance of 5,000 ohms. Typical values of the normal resistance measured between a pair of electrodes or an electrode and probe range from 20,000 to 50,000 ohms. If the resistance is in the range between 12,000 and 15,000 ohms, the skin resistance is low enough that treatment with cosmetic or therpeutic lotions is likely to be beneficial.

As will be evident, different timing circuits, amplifying circuits, and oscillator circuits may readily be substituted for the specific embodiments set forth in the foregoing description. Other indicating means may also be used. While it is advantageous to use the electrical massage to promote the penetration of lotions applied to areas of the skin that are determined to have less than average resistance, the electrical massage can also be used separate from the skin resistance measuring equipment to massage muscle tissue as desired.

What is claimed is:

1. A therapeutic apparatus for cosmetically and hygienically treating the skin, comprising:

a. a first electrode having a relatively large area;

b. a second electrode having a relatively large area;

c. a voltage source coupled to said first electrode;

d. a third electrode having a pointed tip;

e. selector switch means coupled to said voltage source having a plurality of positions and a plurality of output terminals;

f. first circuit means for measuring the average resistivity of the skin between said first and second electrodes, said first circuit means comprising:

i. an indicator coupled to said second electrode means; and

ii. means for applying power from a first output terminal on said selector switch means to said indicator;

g. second circuit means for detecting localized deviations in the average resistance measured between said first and third electrodes, comprising:

i. an indicator; and

ii. amplifier means coupled to a second output terminal on said selector switch means and coupled to said third electrode responsive to the resistance measured between said first and third electrodes for actuating said indicator; and

h. third circuit means for obtaining a quantitative indication of the resistance between said first and third electrodes, comprising an indicator coupled to a third output terminal on said selector switch means and said third electrode.

2. Apparatus as in claim **1,** wherein said means for applying power from said first output terminal to said indicator is a timing circuit.

3. Apparatus as in claim **2,** further comprising:

a. an oscillator coupled to a fourth output terminal on said selector switch means; and

b. a transformer coupled to the output of said oscillator and applying the output of said oscillator to said third electrode.

4. Apparatus as in claim **1,** wherein said amplifier means includes resistance means for varying the level of resistivity of the skin, in contact with said third electrode means, needed to actuate said indicator.

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