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(54) Title: ELECTRO-STIMULATION DEVICE AND METHOD OF SYSTEMATICALLY COMPOUNDED MODULATION OF CURRENT INTENSITY WITH OTHER OUTPUT PARAMETERS FOR AFFECTING BIOLOGICAL TISSUES

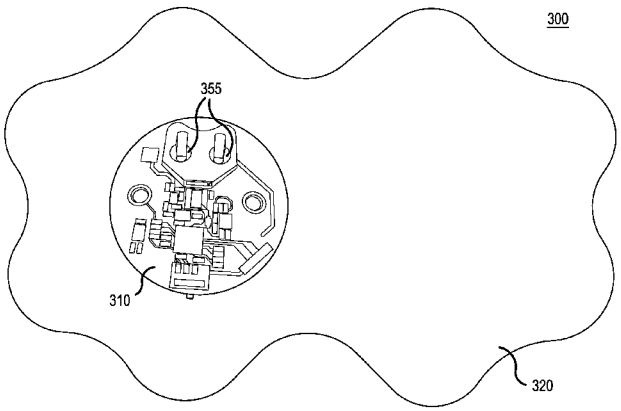

FIG.3

(57) Abstract: A non-user controllable electro-therapy device has a housing for a microprocessor, power source, status indicator, activation switch, and one or more channels for electrode contact. Only the activation switch is user-accessible. The microprocessor generates a non-user controllable frequency dependent mixed electrical signal through the electrodes, wherein the mixed electrical signal is a combination of at least two different frequencies, a first frequency having a first minimum and maximum microamp range and a second frequency having a different second minimum and maximum microamp range. The higher of the two frequencies is superimposed on the lower frequency, creating a current intensity window as an envelope along a profile of the lower frequency. The mixed electrical signal is automatically applied for a pre-determined period of time, and amplitude and/or duration and/or frequencies is varied according to a pre-set schedule programmed into a controller coupled to the one or more electrodes.

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Electro-stimulation Device and Method of Systematically Compounded Modulation of Current Intensity With Other Output Parameters for Affecting Biological Tissues

CROSS-REFERENCE TO RELATED APPLICATION(S)

[0001] This application claims the benefit of U.S. Provisional Patent Application No. 61/787,900, filed March 15, 2013, the contents of which are hereby incorporated by reference in its entirety

Field

[0002] This invention relates to electro-stimulation schemes for treatment of biological tissue. More particularly, it relates to low to no supervision designs for specially modulated electro-stimulation of tissue.

Background

[0003] Clinical electrotherapy devices have been used for over a century to treat many types of medical problems. During the past several decades, Transcutaneous Electrical Nerve Stimulation (TENS) has been used successfully as an alternative or adjunct to drugs for the symptomatic relief and management of pain syndromes. Typically, TENS devices temporarily block pain sensations by providing a milliampere level electrical signal that interferes with the ability of the affected nerves to transmit the pain signals to the brain. A problem with this electrical stimulation is the process known as habituation, accommodation or tachyphylaxis. Essentially, with increasing duration of TENS pain treatment approaches, the stimulated nerves become habituated to the electrical current, diminishing treatment efficacy. While TENS is known to block pain, it is not known to promote tissue healing.

[0004] With respect to the latter, Microcurrent Electrical Nerve Stimulation (MENS) therapy, which is at lower microampere levels, has shown tissue healing effects. However, the suite of MENS devices on the market have very specific restrictions on their abilities. For example, limited number of frequencies, a limited range of current intensities, some with timers, waveform/polarity limitations, and so forth. All of these prior art systems involve detailed setup and require active "during-treatment" control and adjustment. Consequently, the prior art devices having many user controlled functions and adjustments that are difficult to manage, are not adaptable for treating "mobile" tissue, such as animals. Therefore, the prior art's long term treatment sessions invariably require constant monitoring by the treating specialist, resulting in poor effectiveness.

[0005] Accordingly, there has been a long-standing need in the electro-treatment industry for devices and/or methods that allow minimal to unattended supervision of the treatment, while

providing effective treatment. Solutions to these and other shortcomings in the prior art are addressed in the below detailed description.

SUMMARY

[0006] The following presents a simplified summary in order to provide a basic understanding of some aspects of the claimed subject matter. This summary is not an extensive overview, and is not intended to identify key/critical elements or to delineate the scope of the claimed subject matter. Its purpose is to present some concepts in a simplified form as a prelude to the more detailed description that is presented later.

[0007] In one aspect of the disclosed embodiments, a method to therapeutically aid tissue or biological material via direct application of a mixed electrical signal is provided, comprising: placing at least one or more electrodes in contact with a subject tissue or material; initiating a triggering of the mixed electrical signal; automatically applying, via processor control, a non-user controllable frequency dependent mixed electrical signal through the one or more electrodes, wherein the mixed electrical signal is a combination of at least two different frequency signals, a first frequency signal having a first minimum and maximum microamp range and a second frequency signal having a different second minimum and maximum microamp range, wherein a higher of the two frequency signals is superimposed on the lower of the two different frequency signals, whereby a current intensity window is sustained as an envelope along a profile of the lower of the two different frequency signals; and maintaining the application of the mixed electrical signal for a pre-determined period of time and varying the mixed electrical signal's amplitude and/or duration and/or frequencies according to a pre-set schedule programmed into a controller coupled to the one or more electrodes.

[0008] In another aspect of the disclosed embodiments, the above method is provided, further comprising, energizing a status indicator when the method is in operation and de-energizing the status indicator or altering a state of the status indicator when the method is completed; and/or wherein the controller is mechanically attached to a contact pad via a snap-in mechanism, the contact pad containing the at least one or more electrodes; and/or further comprising adding a fixed or varying DC offset to the mixed electrical signal; and/or wherein the varying of the mixed electrical signal and DC offset is random, or according to a look-up table, or according to a sine, square, or triangle wave function; and/or wherein a maximum current is below 800 microamp and the first and second frequencies are below 1000 Hz; and/or wherein the maximum current is momentarily raised above 1 milliamp and then dropped below 800 microamp; and/or wherein the method is used to promote healing or reduce pain, with minimal to no treatment plateaus, accommodation, habituation or tachyphylaxis; and/or wherein the method is used to treat one or more of perfusion, Nitric Oxide amounts, decrease inflammatory cytokines, local scalp hair

follicle cell induction, follicular stem cell induction, or increased migration of stem cells; and/or wherein the method is used to treat incontinence of urine or stool; and/or wherein the method is used to treat one or more symptoms of nephritis, glomerulonephritis, pyelonephritis, hepatitis, hepatomegaly, gall bladder pain or inflammation; and/or wherein the method is used to treat one or more symptoms of acute and/or chronic cystitis, interstitial cystitis or chronic non-infection related urethritis, bladder distension, bladder dysfunction, hemorrhoids or rectal/anal fissures; and/or wherein the method is used to treat swelling and promote healing in acute trauma conditions, Compartment Syndrome in a limb, thyroiditis, laryngitis, macular degeneration and retinitis, diabetic opthalmoplegia or diabetic retinopathy; and/or wherein the method is used for cellular electroporation growth, cellular telomeric attrition and telomerase expression in vivo and in vitro, cell culture health, or cell culture growth; and/or wherein the method is used to decrease symptoms of pelvic cervical dysplasia, tonsillitis or other tissue inflammation associated with HPV infection; and/or wherein the method is used to decrease healing time of dermal, neural or mucosal irritations, lesions or wounds that are caused by various herpetic viruses; and/or wherein the method is used to improve healing for mesenchymal tissues such as, but not limited to myalgia, myositis, fasciitis, tendonitis, bursitis and tenosynovitis, arthritis (rheumatoid and osteo-arthritis) and injuries such as strains, sprains, repair of microtraumas in fascia, periostitis and other tissues of orthopedic concern; and/or wherein the method is used to decreases symptoms of sinusitis and facial pain, or stimulate healing of post-surgical dental, orthopedic, cosmetic or other surgical procedures; and/or wherein the method is used to decrease pain, physical discomfort and psychological symptoms of substance abuse withdrawal with transcerebral or other body location stimulation when the electrodes are placed on a subject's ear lobes, head, neck and/or abdomen, or to treat depression, anxiety and/or insomnia; and/or wherein the method is used to affect the growth of algaes in aquariums, ponds, aquaculture, or plants in a hydroponic system; and/or wherein the method is used to to improve a cosmetic appearance of skin, by decreasing skin roughness, or decreasing depth and breadth of wrinkles in the skin, or to treat psoriasis, dermatitis, eczema, or acne; and/or wherein the method is used to positively influence an activity of microbes of a fermentation system; and/or further comprising applying a topical ingredient such as an analgesic, anti-inflammatory, anti-viral, cosmetic, or nutraceutical compounds of benefit between the at least one or more electrodes in contact with the subject tissue or material.

[0009] In another aspect of the disclosed embodiments, a non-user controllable electro-therapy device is provided, comprising: a housing for a microprocessor, power source, status indicator, activation switch, and one or more channels for electrode contact, wherein only the activation switch is user-accessible, wherein the microprocessor controls a generation of a non-user controllable, frequency dependent mixed electrical signal through the one or more channels, the mixed electrical signal being a combination of at least two different frequencies, a first frequency having a first minimum and maximum microamp range and a second frequency having a different

second minimum and maximum microamp range, wherein a higher of the two frequencies is superimposed on the lower of the two different frequencies, whereby a current intensity window is sustained as an envelope along a profile of the lower of the two different frequencies; and control instructions encoded in the microprocessor or a memory accessed by the microprocessor, setting an application of the mixed electrical signal for a pre-determined period of time and varying the mixed electrical signal's amplitude and/or duration and/or frequencies according to a pre-set schedule programmed into the microprocessor.

[0010] In another aspect of the disclosed embodiments, the above device is provided, further comprising the microprocessor enabling a fixed or varying DC offset to be added to the mixed electrical signal; and/or wherein the varying of the mixed electrical signal and DC offset is random, or according to a look-up table, or according to a sine, square, or triangle wave function; and/or wherein a maximum current is 800 microamp and the first and second frequencies are below 1000 Hz; and/or wherein the maximum current is momentarily raised above 1 milliamp and then dropped below 800 microamp; and/or further comprising a contact pad distributing the mixed electrical signal to a subject tissue or material, wherein the housing is mechanically attached to the contact pad via a snap-in mechanism; and/or wherein the pad has a Shuriken shape.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] FIG. 1 is an illustration of a self-enclosed embodiment on the back of a horse.

[0012] FIG. 2 is an illustration of an exposed controller comprising circuit board.

[0013] FIG. 3 is an illustration of an exposed controller attached to an electrode pad, with batteries installed.

[0014] FIG. 4 is a block diagram of a device embodiment.

[0015] FIG. 5 are illustrations of various electrode pad configurations with attached controller.

[0016] FIGS. 6A and 6B are illustrations of alternate self-contained controller shapes with external electrode connectors

[0017] FIG. 7 is an illustration of an embodiment applied to a flask of cultures.

[0018] FIG. 8 is a plot of one embodiment of a representative signal waveform.

[0019] FIG. 9 contains graphical representations of various modulated signals, bounded by varying microamperage values.

DETAILED DESCRIPTION

[0020] Electrotherapy devices of the related art are limited to blocking pain, promoting healing of dermal wounds, non-healing bone fractures, disease of the macula, and exercising and/or massaging muscles or dispersing lymphedema.

[0021] For example, Cheng et al., Arch. Dermatol., Vol. 129, pp. 264-271 (1993), reported an experiment involving the conducting of electrical currents through rat skin submerged in a buffer to study the effect of electric current on glycine incorporation into proteins and on the alpha-aminoisobutyric acid uptake by skin cells. Constant currents from 100 to 600 microamperes were used during incubation of the rat skin in solution for a period of up to four hours at 37 degrees Centigrade. It was reported that, at this low current, the synthesis of ATP was increased. However, at currents over 800 microamperes, that effect was lost.

[0022] Wood et al., Arch. Dermatol., 129, pp. 999-1008 (1993), reported the treatment of decubitus ulcers using pulsed, low-intensity direct current ("PLIDC"). A PLIDC instrument (MEMS CS 600, Harbor Medical Inc., Minneapolis, Minn.), an investigational exempt device, was used with a 12 volt battery to provide current breakthrough across the ulcer of 300 microamperes followed by treatment at 600 microamperes. The current was pulsed starting negative with a frequency of about 0.8 Hz.

[0023] A variety of U.S. Patents (e.g. Nos. 2,622,601, 2,771,554) involve TENS devices that vary the rate, amplitude or pulse width of the generated electrical pulse in a singular way. Typically, accommodation would still occur unless an individual manually adjusted the controls extensively during the treatment. The process was mentally and physically demanding and no one can accurately and quickly adjust manual controls in a manner that taps the potential maximum pain relief provided by non-user controlled means. For example, U.S. Pat. No. 4,019,519 (Geerling) discloses a unit having only its amplitude adjustable. U.S. Pat. No. 4,084,595 (Miller), and U.S. Pat. No. 4,759,368 (Spanton) disclose TENS devices in which the stimulus signal has a manually and independently varied rate, amplitude and pulse width. To provide improved output pulse compensation, one TENS device (U.S. Pat. No. 5,184,617 to Harris et al.) provided manual adjustment of pulse width control linked to a predetermined change in range of intensity of the pulses. Although various types of programmed and manual variation enabled one to deal with accommodation, pain relief in milliamperage TENS devices is a function of the relationship between the strength of the current intensity and the duration of that impulse. The relationship when plotted graphically is known as a strength-duration curve. U.S. Pat. No. 2,808,826 (Reiner), disclosed a unit that permitted instantaneous changes in pulse width and amplitude to two pre-set points along the strength-duration curve. U.S. Pat. Nos. 4,340,063, 4,431,002 and 4,442,839 (Maurer), disclose units with modulation of amplitude, pulse width, and repetition rates, but the problem of accommodation still existed.

[0024] MENS therapy has recently been shown to have other beneficial effects that go beyond TENS pain blocking theories. MENS has been shown to have significant effects on diminishing inflammation and edema as well as positive effects on collagen and cellular ATP promotion. However, these benefits are limited by the therapeutic concepts utilized by those doing the programming of the electrical output capabilities of the devices available today, the amount of

time that a practitioner can monitor the application of therapy as well as the number of times this limited therapy can be repeated. For instance, the process of repairing microtraumas in the periosteum and bone of equine bucked shins cannot only be attributed to the anti-inflammatory effect reported in the literature with certain forms of microcurrent, for if that was the case treatment with strong veterinary anti-inflammatory medications would be adequate primary therapy. Anti-inflammatory therapies are used adjunctively in bucked shins, but are not known to heal the damaged tissues.

[0025] Despite the above breath of knowledge in this field, none of the above contemplate an embodiment for a therapeutic technique of modulating the current intensity function as a waveform being driven between two systematically changing maximum and minimum microamperage values while simultaneously carrying a systematically changing DC or AC frequency among other modulatable output parameters in a single or multi-channel system. The application of this method has been demonstrated by the inventor as not only providing pain relief, but also in healing of human and animal tissues; and reveals an electrotherapeutic technique of compounding the biophysical effects of combined waveforms.

[0026] A further complication in the prior art is that the administration and monitoring of electro-therapy is an issue when treating an injured or sore horse or dog with prior art devices. While treating equine or canine conditions with prior art devices, therapy can only be administered as long as the practitioner is willing to monitor the animal, manipulate the device, confirm positive electrode contacts and keep the animal from biting or stepping on the wire leads connecting the device to the electrodes. This limits the practitioner's ability to adjust electro-therapeutic outputs, restricts unattended treatment time as well as the total time per session that therapy can be administered, as well as the cumulative time across treatment sessions. These multiple monitoring requirements decrease the horse or dog owner's and trainer's interest and motivation in applying therapy in an attempt to benefit the horse or dog. Since prior art devices are typically human-based systems crudely adapted for animal use, they have not been effectively used in therapy for unattended animals, such as horses or dogs.

[0027] Another difficulty is the fact that the intensity control functions of prior art electro-stimulation devices are user controlled, with a manually adjusted interface, which can be complicated and challenging when the user tries to decide how to control and adjust the settings for current intensity of each channel, frequency, duty cycle, pulse duration, waveform, waveslope, etc. Often, the user may have little or no rationale for adjusting the device a particular way. Connecting wires and other user controls are difficult to manage even by those well trained in the art. The rationale for user controlled intensity function is based in the belief that higher current intensities are a requisite to block pain perception.

[0028] The dosage and modulation of electro-therapy in prior art devices is determined by the practitioner's level of motivation to adjust the device during the entire treatment process. Clearly,

low practitioner interest or training in how to use the device results in a minimally changing (which can be less effective) treatment program. While, high practitioner interest results in poorly standardized, multiple dosages of different intensities, non-repeatable adjustments based on the subjective observation of the human, horse or dog's behavior and response to treatment, and indiscernible intuition. It is indisputable that devices with multiple user controls breed treatment sessions that cannot be standardized or reproduced. As with any type of medical intervention, unstandardized treatment or medication dosage tends to decrease effectiveness.

[0029] Prior art devices are configured with a manually controlled, minimally changing current intensity control function to prevent nerve habituation, accommodation or tachyphylaxis to an unchanging electrical stimulus by increasing the intensity of the electrostimulation as the nerves gradually accommodate to the previous set point.

[0030] In view of the limitations in the prior art, both in current waveform type and application methodology, a non-user controlled, specially modulated low current intensity, microcurrent electrical therapy design is described. For example, one embodiment has a programmable device with precise non-user accessible controls (over current intensity and frequency) producing a standardized therapeutic sequence and dosage of electrotherapy with resultant increase in reliability of results. Further, various new embodiments for non-wire lead based electro-therapy are described. For example, another embodiment has a miniaturized device mounted directly to an electrode (of a multitude of designs) without wires thereby facilitating usability in both human and animal applications.

[0031] The mechanism of action produced by the therapeutic techniques disclosed herein is hypothesized to be due to one or more of the following: increased perfusion and/or vasodilation secondary to nitric oxide induction; enhancement of stem cell attraction, and/or migration, and/or implantation, and/or stem cell induction, etc.; anti-inflammatory effect due to modulation of cytokines, neuropeptides and other pro-inflammatory substances; anti-edema effect due to regulation of intracellular water and ion balance vs. extracellular water and ionic balance; regulation of cellular physiologic balance (e.g. between osteoclasts and osteoblasts in bone formation), systemic and local hormone and peptide release as well as cell-to-cell messenger signaling systems and activation of cell membrane proteins by electrical means, hence the potential to influence gene activation through this cell membrane receptor mediated method.

[0032] Accordingly, the intensity modulation capability of one or more of these embodiments is believed to significantly improve electro-therapy treatment responses in conditions such as: Pain, Inflammation, Shingles pain (Varicella zoster), Macular Degeneration, Psychological Mood, skin Cosmetic concerns and wrinkles, nausea, PMS, injury or trauma, wound healing, etc. The ability to improve or potentiate Iontophoresis treatment responses and/or depth of penetration of the involved compounds and/or medications(s), is also believed to be enhanced. Electro-therapy treatment, previously known in the prior art to be unresponsive or inefficacious for Hepatitis,

Nephritis, Interstitial Cystitis, high blood pressure, Benign Prostatic Hypertrophy (BPH), Prostatitis, etc., can be effectively treated by various embodiments described herein. Various embodiments are understood by the inventor to positively affect cellular physiologic and/or nuclear (e.g., genetic, etc.) structure and/or functioning in tissues not only in vivo, but also in vitro, as well as improving or potentiating cellular electroporation methods known in the art.

[0033] Various embodiments are understood to have the ability to influence biological systems at a cellular level, organ level and organism level, including rate of cellular proliferation growth rates (both enhancing and inhibiting) as well as differentiation into the various specialized cellular sub-types as well as de-differentiation, cellular telomeric attrition, cellular membrane phospholipid dynamics, cellular membrane protein activation and/or deactivation; hormonal, immunologic, peptide, protein and other cellular signaling systems; up regulation and down regulation of various genes of interest, etc.

[0034] Details of these and other embodiments with their capabilities and therapeutic techniques are further described below.

[0035] FIG. 1 is an illustration 100 of a self-enclosed embodiment on the back of a horse 110. A protective housing 130 contains the (not shown) power supply, a microchip or microprocessor, associated frequency/current controller, active state indicator and one or more channels for applying microamperes of electrical current to the skin of the horse 110. The channels are coupled to embedded electrodes and/or current paths in the pad 120 to contact desired treatment areas. The controller device is not user accessible, being encased in the protective housing 130, and provides a programmatically controlled, systematically changing amount of current in each channel from about 0 microamperes to about 600 microamperes. The frequency function is programmatically controlled, by the microprocessor, and systematically changing from direct current to about 1,000 Hertz or more. The other parameters of electrical output such as duty cycle, waveform, polarity, etc. are also programmatically controlled and systematically changing.

[0036] The above embodiment is representative of one of many possible configurations, but exemplifies a commercial embodiment, with the specified current and frequency values, that has been used for treating animals. Of course, other configurations, modifications, applications are possible and, being within the purview of one of ordinary skill in art, are within the scope and spirit of this disclosure.

[0037] FIG. 2 is an illustration 200 of an exposed controller comprising circuit board 210, microprocessor 220, battery chamber 230, two channels 240 for electrode contact having outer "snap-in" collars for attachment, and input/output pin 250. DC/DC step up converter 260, on/off switch 270, status light 280, frequency crystal 290, with discrete circuit elements are disposed about circuit board 210. Battery chamber 230 houses the battery (one or more may be used to obtain the desired voltage/current). Microprocessor 220 (or associated memory) contains the program for controlling the output such as duty cycle, waveform, polarity, etc.

[0038] In some embodiments, channel 240 may be connected to only one electrode, according to design preference. An instance where this could occur would be if the subject had a natural polarity opposite to the single channel 240. Or, a buildup of charge is intended by the therapy.

[0039] FIG. 3 is an illustration of an exposed controller 310 attached to an electrode pad 320, with batteries 335 installed. The overall shape of this electrode pad 320 is designed to be symmetric to allow the entire pad to rest in a balanced manner over the horse's back (or other subject feature). Symmetry keeps the electrode pad 320 balanced so as to minimize slipping during slight movements by the horse (human, plant and/or microbial tissue) and also with its extended surface area and adhesive properties of an electroconductive hydrocolloid gel provides sufficient downward force to ensure that the underside electrodes physically contact and adhere to the tissue as well as conduct the current through the hairy coat of an animal.

[0040] As to the specific shape and size of the electrode pad 320, it can be sized to provide a range of "current densities" as it disperses the current from the controller's channel(s) to the anode and cathode. In a commercial embodiment, the electrode pad 320 uses a 64 square centimeter dispersion surface area for the anode and another 64 square centimeter dispersion surface for the cathode. A "Shuriken" (hexagonal shape with extended edges) shape creates a dispersion surface that increases the perimeter length of the pad's electrode relative to the central energized area of the pad's electrode, encouraging a dispersion gradient from the central area of the pad's electrode to the perimeter that changes/pulses partly as a function of the distance from the central discharge area and partly as a function of the waveforms changing with the controller's current management program.

[0041] The extension "nubs" (or undulating edge) of the electrode pad 320 also serve to improve the ability of the electrode pad 320 to form to curved surfaces of the subject's body, therefore improving treatment effectiveness by improving body surface contact / tissue electrodispersion. These extension "nubs" also improves usability, in contrast to a typical medical device (electrode) that traditionally utilizes square, circular and rectangular designs that are built for ease of manufacture, but not for facilitation of electrotherapy to a body composed of very few flat surfaces.

[0042] In a commercial embodiment, the electrode pad 320 is configured to have mating snap connectors to allow the controller 310 to "snap" into the electrode pad 320, to form the electrical connection and also be secured to the electrode pad 320. The makeup of the electrode pads 320, depending on application, can be composed of a material that has been tested for biocompatibility, allergenicity, cytotoxicity, and engineering verification and validation. Depending on implementation, the electrode pad 320 may need to be FDA compliant, or compliant with any other medical device/treatment approving body.

[0043] FIG. 4 is a block diagram 400 of a device embodiment. Power source 410 is coupled to an on/off switch 420 which is connected to a boosting converter 430, which boosts the power

source 410's voltage to a higher level (if power source 410 is of sufficient voltage/current, then boosting converter 430 may be bypassed or deleted from the design). The boosted voltage is channeled via power rail 435 to status indicator electronics 470 which feeds status indicator 480. The status indicator 480 will typically be an LED, but may be another light emitting device, and/or be proxied by a sound emitter. Status indicator electronics 470 can generate a blinking/varying signal to status indicator 480, or may be a steady state signal. Of course, other types of signals and/or indicators 480 may be used without departing from the spirit and scope of this disclosure. Moreover, more than one status indicator 480 may be utilized, according to design preference.

[0044] Power rail 435 (or by separate connection from power source 410 – not shown) carries power to microprocessor 440, which contains the program/instructions for controlling the output such as duty cycle, waveform, polarity, etc. The program may be activated by initiation of the on/off or momentary switch 420 or upon some other trigger. Microprocessor 440 has output channels 450, 460 which are the channel electrodes forwarding the current signals to the subject. Various resistors/switches/controls 445 may be switched on/off via signals from microprocessor 440, to modulate/alter the output current to output channels 450, 460.

[0045] This embodiment contemplates the frequency control to be part of the microprocessor 440. That is, frequency control actions are facilitated by software instructions. However, the actual frequency "source" may be a clock signal external to the microprocessor 440 or internal to the microprocessor 440. Understanding that some clock sources can generate multiple frequencies, more than one clock source may not be necessary. Therefore, microprocessor 440 may rely on internal frequency changing/amplitude changing capabilities or rely on other chips (not shown) that may be more effective in providing the desired control. Therefore, multiple chips may be used according to design preference. Aspects of microprocessor and/or chip level control/manipulation of signal frequency and amplitude are well known and, therefore, the details thereof are within the purview of one of ordinary skill in the art.

[0046] FIG. 5 are illustrations of various electrode pad configurations with attached controller. The lower illustration shows an embodiment 500A with electrode pad 520A and controller 530A attached thereto. Pad 520A is shaped as a horse-shoe so as to rest over or fold over a neck, back, or shoulder, etc. The middle illustration shows an embodiment 500B with electrode pad 520B and controller 530B attached thereto. Electrode pad 500B is shaped as a long "double shuriken" to cover larger areas for treatment (e.g., horse's hind quarters). The upper illustration shows an embodiment 500C with electrode pad 520C and controller 530C attached thereto. Electrode pad 500C is shaped as a small double shuriken for smaller treatment areas. It is noted that these embodiments show symmetrically shaped electrode pads 520A, 520B, 530B. Of course, it may be desirable in some embodiments to have non-symmetric electrode pads or of differently shaped electrode pads. Therefore, these considerations of shape and symmetry are dependent on the

application and accordingly may be modified, altered without departing from the spirit and scope of this disclosure.

[0047] For a non-limiting example, an electrode pad can have several sections, e.g., a two piece electrode pad with the controller device snapping onto one side and each electrode pad piece shaped with the "Shuriken" design with an electroconductive wire between the two electrode pad pieces.

[0048] Some variations of these embodiments can be:

[0049] A disposable system, where the controller is attached to the electrode pad which has a limited service life and the electrode pad alone is thrown away after its service life has expired;

[0050] The controller is "integrated" into the electrode pad, being built and fabricated as a non-detachable single piece unit. Such a system could also have a limited service life, wherein the entire system is disposed of; and

[0051] The controller could have a wireless chip, communicating information, status, etc. wirelessly to a remote device, such as, for example, a smart phone. This would be beneficial for situations where the user could choose different treatment options (e.g., low back, knee, elbow, etc.), query to determine the "stage" of treatment, percent of current flow being transferred through the tissue to the reference electrode, health of controller battery, etc.

[0052] Therefore, it should be apparent that various modifications and changes may be made without departing from the spirit and scope of this disclosure.

[0053] FIGS. 6A and 6B are illustrations of alternate self-contained controller shapes with external electrode connectors. FIG. 6A is an illustration of a "cylindrical" controller housing 610 with indicator "light" 620 and reset/power button 625 on its surface. Ends of the housing 610 contain external electrode connectors 630 which can be plugged into to whatever connector arrangement is found on the pad (not shown) or contacting element. In one embodiment, the external electrode connectors 630 can be rigid male pins, to mate female connectors on/in the pad/contacting element. Of course, other types of connectors may be devised, according to design preference.

[0054] FIG. 6B is an illustration of another "cylindrical" controller housing 650, with indicator "light" 660 and reset/power button 665 on its surface. Ends of the housing 650 contain flexible lines terminated with electrode connectors 675 which can be connected to whatever connector arrangement found on the pad (not shown) or contacting element.

[0055] FIG. 6C is an illustration of an electrode connector extension 680, having a male style connector 685 on one side and a female style connector 685 on the other side. This extension embodiment contemplates having the controller connected in a non-rigid fashion to a pad (not shown) or contacting element.

[0056] It should be appreciated that while the above embodiments are described in the context of an enclosed controller administering electro-therapy via contact through a pad (or electrode

extension) to the subject, via electrical waveforms shaped as further detailed below, the actual shape/design of the controller and/or pad and/or extension may be altered, modified according to design preference. So, if design preference is to apply the above embodiments, for example, to a laboratory situation or medical environment, the above designs may be easily modified to provide the desired effect. For example, if the subject is laboratory-housed tissue or culture of cells, etc., the contacts of the controller can be redesigned to allow the appropriate signals to be fed to the tissue or culture of cells, to the appropriate subject contacts. Accordingly, in these and other instances, different designs/implementations of the controller and its contacts/electrodes, etc., with consideration of the nature/type of electrical signals being generated to achieve the respective effect on the subject material, may be contemplated without departing from the spirit and scope of this disclosure.

[0057] FIG. 7 is an illustration 700 of an embodiment rudimentally applied to a flask of cultures. Exposed controller device 710 has its electrode channels connected by simple alligator clips 720, 725 to rod electrodes 730, 735. The rod electrodes 730, 735 are submerged into culture solution 740 that is housed by flask 750. This embodiment illustrates the application of an embodiment without a corresponding electrode pad and is demonstrative of the multiple "subject" applications possible.

[0058] FIG. 8 is a plot 800 of one embodiment of a representative signal waveform. The time-harmonic or frequency based waveform is composed of high frequency f_1 signal 810 being amplitude modulated according to a lower frequency f_2 signal to form a fixed separation (or current intensity window - CIW) having a minimum 820 and maximum 830 envelope. It is evident that this signal waveform is wavelike in form and has a positive DC offset of approximately 20 uA, with a cyclical amplitude modulation range of 20 uA. The combination of the two frequencies (f_1, f_2) and offset generates a current signal that has a 50 uA peak and a 10 uA floor, but fluctuates between the peak and floor values. In this example, the lower frequency (carrier) f_2 is one-tenth the frequency of the higher frequency f_1 signal. A corresponding set of frequencies would be 3 Hz and 30 Hz, or 10 Hz and 100 Hz, and so forth. Of course, other frequency ratios may be used, according to design preference, as well as DC offsets.

[0059] The intertwining of the high frequency f_1 signal 810 within the CIW envelope creates a current "density" within the CIW, that more slowly fluctuates in overall amplitude with the lower frequency modulating signal 830. This provides a unique electro-therapy signal profile, one that fluctuates very rapidly within a small time frame (aka – high frequency signal f_1), while in the aggregate (CIW) fluctuates very slowly (aka – low frequency signal f_2). Further, with the DC offset, a total of three effects are being applied simultaneously.

[0060] The embodiment of FIG. 8 shows one configuration where the core amplitudes of the low and high frequency signals are fixed (f_1 relative displacement is 20 uA, and f_2 relative displacement is 20 uA, where the composite signal is different). If either f_1 or f_2 are not

amplitude fixed (held constant), then the composite signal will have a different profile (the CIW envelope will change), but still provide multiple frequency dependent signal effects that are beneficial.

[0061] FIG. 9 contains graphical representations of various amplitude modulated signals, bounded by two varying microamperage values. Referring to example A, higher frequency signal 910 is amplitude modulated with a lower frequency signal 920, to form a CIW envelope that is symmetric across the 50 uA midline (a DC offset of 50 uA is implicit). This example contemplates a larger high frequency "swing" from peak-to-trough, the high frequency swing becoming smaller for a period and then larger and then repeating, as a function of the lower frequency signal 920, as seen in the humps of example A. This particular embodiment shows a max current applied as 100 uA, and a min current applied as 0 uA, with a CIW that varies in aggregate current "density" in accordance to the lower frequency signal 920 component. This can be further extrapolated to form a "pulsing" wave or other variations.

[0062] Referring to example B, high frequency signal 950 is amplitude controlled by the low frequency signal having its peak 960 and trough 970. Here, the amplitude of the low frequency signal is held constant while the high frequency signal 950 is "rippled" over the low frequency signal. In this example, the high frequency signal is at 30 Hz, while the low frequency signal is at 2 Hz. Evident in this example is the fact that the CIW (excursion of one cycle of high frequency signal 950) envelope is very small in comparison to the overall low frequency range (excursion of one cycle of low frequency signal).

[0063] These embodiments demonstrate a non-user controlled electrotherapeutic technique of systematically modulating the device's output parameters by superimposing multiple waves upon each other allows the application of low microamperage current intensity for longer treatment durations on humans and animals with decreased time to effectiveness, improved treatment efficacy and expanded treatment capabilities over prior art devices. Other embodiments are anticipated and this disclosure only serves as an introduction to the fundamentals of the concept.

[0064] Modifications and variations to the above current/signal profiles are contemplated in the context of therapeutic or biological treatments. One example of a variation is by changing the intensity of the output current in a predetermined sequence (increasing and decreasing the microamperage intensity "quickly or gradually" over time between a maximum and minimum value in a stepwise fashion) while keeping the AC frequency and/or DC current and other output parameters that are superimposed on the changing current intensity constant over a period of output time. One non-limiting example would be, 15uA at 40 Hz for 2 seconds followed by 20uA at 40 Hz for 2 seconds followed by 25uA at 40 Hz for 2 seconds followed by 30uA at 40 Hz for 2 seconds, followed by 25uA at 40 Hz for 2 seconds followed by 20 uA at 40 Hz for 2 seconds followed by 15uA at 40 Hz for 2 seconds, etc. Of course, the time periods, frequency, and amplitude may be of different values, according to design preference.

[0065] Another example of a variation is by changing the intensity of the output current in a predetermined sequence (increasing and decreasing the intensity "randomly" over time) while keeping the AC frequency and/or DC current and other output parameters that are superimposed on the changing current intensity constant while changing the duty cycle (amount of ON time vs. OFF time within a waveform) of the output in a predetermined systematic way.

[0066] Another example of a variation is by changing the intensity of the output current in a predetermined sequence (increasing and decreasing the Intensity randomly over time) while keeping the AC frequency and/or DC current superimposed on the changing current intensity constant while changing the duty cycle (amount of ON time vs. OFF time within a waveform) of the frequency output in a pulsed manner that can be measured in pulses per second or Hertz.

[0067] Another example of a variation is by changing the intensity of the output current in a predetermined sequence (increasing and decreasing the microamperage current intensity randomly over time and randomly as a discrete output packet of time duration) while keeping the AC frequency and/or DC current constant and superimposed on the changing current intensity while changing the duty cycle (amount of ON time vs. OFF time within a waveform) of the output in a random pulsed manner that can be measured in pulses per second or Hertz.

[0068] Another example of a variation is by changing the intensity of the output current in a predetermined sequence (increasing and decreasing the microamperage current intensity quickly or gradually over time, e.g. systematically as in a step-wise increase and/or decrease of the microamperage level of current intensity output) while changing the AC frequency and/or DC current specifically, systematically and/or randomly and superimposed on the changing current intensity level.

[0069] Another example of a variation is by changing the intensity of the output current in a predetermined sequence [increasing and decreasing the intensity in a waveform manner, (e.g. sine wave, square wave, triangle wave, etc.) and quickly or gradually over time and quantified in Hertz or cycles per second, (e.g., a 3 Hz sine wave for 1 minute moving between a lower and a higher microamperage "window of intensity" that said window can vary systematically and/or randomly and sequentially, etc.)] while keeping the AC frequency and/or DC current specific and/or systematically and/or randomly changing and superimposed on the modulating current intensity "waveform."

[0070] Another example of a variation is by changing the intensity of the output current in a predetermined sequence [increasing and decreasing the intensity in a waveform manner, (e.g. sine wave, square wave, triangle wave, etc.) and quickly or gradually over time and quantified in Hertz or cycles per second, (e.g., 3 Hz sine wave 1 minute, 40 Hz square wave 3 minutes, etc.)] while changing the AC frequency (including or excluding DC current) systematically (for example with a predetermined sequence, an algorithm, a randomizer and a look-up table, a random value generator, etc.) and superimposed on the modulating current intensity "waveform."

[0071] Another example of a variation is by changing the intensity of the output current in a predetermined sequence [increasing and decreasing the intensity in a waveform manner, (e.g. sine wave, square wave, triangle wave, etc.) and quickly or gradually over time between a higher and lower level of microamperes (which acme and nadir can vary at different times) and quantified in Hertz or cycles per second] while changing the AC frequency (including or excluding DC current) in a specified manner (e.g., according to a look-up table) and/or randomly and/or according to an algorithm. For example, a current intensity modulated as a 3 Hz sine wave between a CIW of 10 and 30 microamperes with an AC frequency of 970 Hz square wave superimposed on this 3 Hz current intensity "wave" for 60 seconds followed by a current intensity modulated as a 40 Hz triangle wave between a CIW of 15 and 25 microamperes with an AC frequency of 116 Hz sine wave superimposed on this current intensity wave for 30 seconds, etc.

[0072] Another example of a variation is by lowering the intensity of the output current to a range that changed according to the variability scheme of the programming to be below 1 milliamp and increasing the duration of the use of the device to a longer total treatment time. Such a configured device can be worn continuously over many hours with a current intensity setting that is below the point of concern for the user or below the point that significant sensation can be felt or muscular stimulation could occur. By increasing treatment time while decreasing, but varying the intensity of the output current in a waveform-like fashion simultaneously with other output characteristics such as AC frequency, etc., beneficial treatment results were able to be obtained more quickly than with traditional devices.

[0073] Various embodiments described have been experimentally shown to minimize treatment plateaus, accommodation, habituation or tachyphylaxis.

[0074] Another example of a variation is by using a multi-channel device whereby the intensity of the output current is modulated in a waveform-like fashion and can be synchronized or desynchronized between the various channels while keeping the AC frequency and/or DC current treatment packets constant (e.g. 3 Hertz on channel A and 3 Hertz on channel B) or systematically varying (e.g. 3 Hertz on channel A and 116 Hertz on channel B) and/or by varying systematically or randomizing the synchronization or desynchronization or both over a period of output time.

[0075] Another example of a variation is to systematically and/or randomly or both, continuously change all the parameters of output. An software-encoded algorithm is anticipated to direct the output in this manner.

[0076] Another example of a variation is being able to sweep through various intensity output current conditions either in an increasing sweep or decreasing sweep (e.g. sweeping from 0 - 100 uA, then 90 - 60 uA, then 25 - 75uA, then 30 – 15 uA, etc. over a period of time) while the AC/DC frequency function is sweeping through various frequencies (e.g. 1 - 1,000 Hz, then 1 - 3 Hz, then 40 - 100 Hz, etc.) over the same or different period of time.

[0077] Another example of a variation is to have the "Duty cycle" pulsed.

[0078] As apparent from the above embodiments, it is believed the non-user controlled modulation of electrical current intensity, and/or systematically varying (waveform-like modulatation), and/or with DC positive and/or negative current level, and/or in combination with other electrical output parameters such as AC frequency modulation are new to at least the field of TENS devices. Further, experiments with the above embodiments have shown increased efficacy on the healing of equine, canine and human tissues and physiologic functions beyond the pain blocking effects produced by prior art TENS devices.

[0079] Accordingly, the use of this new electrotherapeutic technique is foreseen to have beneficial effects on human, veterinary, plant and other biological tissues and physiologic functions in vivo and in vitro that are not able to be attained by modulation of the other output parameters alone, such as found in the prior art methods of manually adjusting and modulating intensity, frequency, frequency sequences, frequency combinations in dual channel devices, polarity, duty cycle, waveform, single or multiple channel devices, interferential devices, etc.

[0080] Various embodiments in consideration of the new signal manipulation scheme is contemplated for use in traditional TENS/MENS applications. For example, one embodiment demonstrates an On/Off switch user activated miniaturized human and veterinary TENS/MENS/Iontophoresis device, with non-user controlled microcurrent output that delivers a preprogrammed waveform modulated intensity function with other output parameters superimposed on the modulated intensity. Another embodiment discloses the manipulation and modulation of the electrical current intensity both singly and in combination with systematic and/or random modulation of the other output parameters, such as frequency, frequency sequences, duty cycle, waveform, sweeps, polarity, single or multiple channel outputs, interferential, etc. for human and veterinary electro-therapy systems such as TENS/MENS/Iontophoresis, as well as in vitro plant and/or animal cellular culture systems and cellular electroporation.

[0081] One embodiment allows a user to place a self-powered electrode(s) on the skin like a large band-aid, and connect a single channel device wirelessly to the self-powered electrode. The user can turn it on and let the program run until the user turns the device off.

[0082] With the non-supervisory, self-contained system, therapy can be implemented while conducting activities, for example, household chores, or while sleeping, thus saving a great deal of time going to doctors to receive therapy. This also allows for longer electro-therapy treatment durations with improved effectiveness.

[0083] By reducing the various aspects of several different embodiments to practice and conducting animal experiments on horses, dogs, as well as humans, it appears reasonably foreseeable that the ability to affect various tissues or organ function as well as various physiologic functions, such as tissue repair, perfusion, nitric oxide induction, hormone modulation, anti-inflammation secondary to various sources (e.g., cytokines, trauma,

neuropeptides, etc.), blood pressure, vascular condition, pain of many origins and sources, nausea, emesis, wounds, orthopedic, nerve function, mood or psychological condition, or other organ or tissue function such as: connective tissue matrix, heart function, penile or clitoral perfusion, kidney, liver, pancreas, bladder, prostate or any other viscera or gland, ocular, dental health, etc. over a number of days, weeks, months, years or decades.

[0084] Accordingly, one embodiment enables a user to treat an area of the skin and lower blood pressure and/or inflammatory markers with or without other medication over a period of time sufficient that treatment could influence the development of other cardio-vascular conditions. Another embodiment enables a user to electrically stimulate cell culture systems in vitro and obtain enhanced effects over the prior art methods. Another embodiment enables a user to electroporate compounds of interest into a group of cells in vitro and obtain enhanced effects over the prior art methods. Another embodiment enables a user to electrically extract botanical compounds of interest without damaging heat sensitive constituents of the plant base material.

[0085] TENS/MENS/Iontophoresis output controller (and anticipates a multi-channel device) that is activated by the only user control, an ON/OFF switch, that activates firmware (hardware components, microchip and software programming) and has its intensity output current controlled by this firmware and has its output frequencies very accurately controlled by the firmware and a quartz timer and current controlled by the firmware with or without a voltage regulator and is powered by a 3 volt coin battery.

[0086] This is not a complete list of embodiments and other variations are contemplated. One embodiment increases perfusion and/or nitric oxide in the skin among other physiological processes, therefore when used over larger areas of the skin, the skin can produce decreases in Blood Pressure, enough that over increased duration of usage one's risk of Heart Disease and other vascular conditions can be diminished. One embodiment increases perfusion and/or Nitric Oxide and/or decreases inflammatory cytokines and/or local scalp hair follicle cell induction and/or follicular stem cell induction and/or increased migration of stem cells among other physiological processes in the scalp can be utilized to stop or slow scalp hair loss and/or increase hair regrowth processes. One embodiment improves incontinence of urine and stool. One embodiment can decrease symptoms of nephritis, glomerulonephritis, pyleonephritis, etc. and slow progression. One embodiment can decrease symptoms of hepatitis, hepatomegaly, gall bladder pain and inflammation.

[0087] One embodiment can decrease symptoms of acute and/or chronic cystitis, interstitial cystitis or chronic non-infection related urethritis with a probe that is inserted vaginally. One embodiment improves healing of bladder distension after being overstretched from an obstruction or other bladder inflammation or dysfunction when used with a rectal probe connecting an electrode placed over the skin above the pubic bone. One embodiment improves hemorrhoids and rectal and anal fissures when used with a rectal probe connecting an electrode placed over the skin

above the pubic bone. One embodiment can be used to minimize swelling and promote healing in acute trauma conditions, such as injuries and including head and spinal cord injuries. One embodiment can be used as an adjunct to treat acute, subacute or chronic Compartment Syndrome in a limb. One embodiment can decrease symptoms of thyroiditis, both local and systemic, both hyper and hypo-functioning types. One embodiment can decrease symptoms of laryngitis, particularly in over-use syndromes as with singers and orators. One embodiment can be used to improve treatment outcomes of ocular conditions such as, but not limited to macular degeneration and retinitis, diabetic opthalmoplegia and diabetic retinopathy. One embodiment can be used to affect and/or improve known effects of electrical stimulation applied to biological tissue being studied in vitro. It is anticipated that one embodiment can be applied to cell culture systems of any methodology and any cell type such as plant, human or veterinary tissue or any combination of these. One embodiment increases perfusion and/or nitric oxide in the pelvis among other physiological processes, therefore when used near the genitalia can increase sexual responsiveness in both men and women. One embodiment can decrease symptoms of ovarian cyst and/or folliculitis with electrodes placed on the abdomen or with a probe that is inserted vaginally. One embodiment is anticipated to decrease symptoms of pelvic cervical dysplasia, tonsillitis or other tissue inflammation associated with HPV infection. One embodiment is anticipated to decrease healing time of dermal, neural or mucosal irritations, lesions or wounds that are caused by various herpetic viruses. One embodiment, when combined with cellular electroporation techniques to drive compounds or other ingredients of interest across cell membranes and into cells is anticipated to improve methodology, enhance technique, and/or improve yields, and/or decrease cellular membrane damage and improve the results obtained with the methods taught in the prior art. One embodiment can decrease pain, physical discomfort and psychological symptoms of substance abuse withdrawal with transcerebral stimulation with the electrodes placed on the ear lobes, head, neck and/or abdomen. One embodiment can be used to beneficially affect the growth of algaes in aquariums, ponds and aquaculture. Another embodiment can be used to detrimentally affect the growth of algaes in aquariums, ponds and aquaculture or by altering the frequency, waveform positively affect the growth of fish in aquariums, ponds and aquaculture. One embodiment can be used to affect the growth of plants in hydroponic systems. One embodiment can be used to affect cellular telomeric attrition and telomerase expression in vivo and in vitro thereby affecting longevity of biological systems, tissues, humans and animals.

[0088] "Smart electrodes" are envisioned to be used with the device such that some of the components of the device are split between the electrode and the driver device. The electrode and device will act as a "Lock and Key" system such that the device will not operate unless it recognizes specific components, some could be "dummy," some could be "nonsense," some could be active, some could be coded or encrypted in such a way that the electrodes engineered without

these components will not work. These smart electrodes could have a microchip and/or other components attached to a PCB board or flex circuit built into the electrode in such as way as the device will not operate unless it recognizes these components and various codes on the smart electrode. The operating system could also be split between two "Lock and Key" microchips, one portion on the device and another on the electrode, thereby increasing the security that a compatibly engineered electrode was used with the device and impairing the ability of poorly engineered products to be substituted for use with the device.

[0089] Another embodiment of a Smart Electrode Lock and Key design is with an RFID built into the electrode with a coded signature that can communicate with the device and determines its authenticity thereby impairing the ability of poorly engineered products to be substituted for use with the device.

[0090] Other Smart Electrode embodiments are envisioned such as the "Smart PEMF" electrodes that has components such as microchips, mini-inductors, capacitors, magnetic chips, or a PEMF loop built into the electrode that, in combination with the device driver can sequentially fire discrete micro electromagnetic pulses that are geometrically shaped to produce a virtual "electron massage" effect.

[0091] Other Smart Electrode embodiments are envisioned such as one that has components built into the electrode that is programmed to be a sensor, reporting back to the driver device and providing a form of feedback loop to adjust the output according to the information collected. The program could sense when the electrode is worn out and send a signal to an indicator so that therapy is not attempted with an electrode that is no longer usable.

[0092] Another smart electrode embodiment is envisioned with specific design patterns layered into the electroconductive portion of the electrode as a technique to influence the spatial shaping of the electrical current flow as well as the mixing of currents in multi-channel systems.

[0093] Another electrode embodiment is envisioned with different materials for inclusion in the electroconductive hydrogel component of the electrode. For instance, by adding colloidal silver at about 25ppm or more the hydrogel material will be rendered bacteriostatic, thereby decreasing the likelihood that the patient would get a dermal infection or cross-contaminate someone else handling the product. This is important for wound care, skin care and other infection treatment products such as shingles treatment electrodes. A good example of a beneficial application of this technology to equine electrodes would be ringworm. One horse with Ringworm can spread the infection throughout the entire barn. If you use the same electrode on different horses, you could cross-contaminate, so a colloidal silver impregnated gel electrode could have some protective benefits especially in the dirty barn setting. Plus the silver would likely facilitate conduction through the hydrogel improving electrode performance. Studies have shown an average of 13% of equine veterinary personnel are colonized with primarily the equine related genotype of Methacillin Resistant Staphylococcus Aureus (MRSA). So anything that can prevent zoonotic

transmission of germs to veterinary personnel or to other horses from handling electrodes would be a helpful improvement. At this level of concentration colloidal silver is typically hypoallergenic and much less toxic and caustic than other types of antimicrobial compounds.

[0094] Another electrode embodiment is envisioned with the layer above the hydrogel being composed of an photo-emitting electrosensitive material so that when the current was flowing the gel would glow thereby creating an indicator light. This gel could be inlaid in the outer edge so that the edge of the electrode glowed or backed on the whole electrode surface or discrete sections so that they glowed and with the electrode foam backing cut away in the design of company branding,

[0095] The below matrix in Table 1 describes one possible "control" program for treatment. This is programmed as a sequence of discrete output events at a specific current intensity for a specific time duration, upon initiation. For this example, the program generates a CIW 15 uA – 30 uA window and runs for 4 hours. 1,443 coded lines are called out, each line code segment calls for a 10 second output duration event, encapsulated in the 223 steps below. At the end of the 4 hour program the device cycles back to line 1 to repeat the program.

[0096]

Frequency (Hz)	microAmps	Duration	Cum. Time
1. DC+	15	1 min.	1 min
2. DC-	25	1	2
3. DC+	20	1	3
4. DC-	30	1	4
5. DC+	25	1	5
6. DC-	20	1	6
7. DC+	30	1	7
8. DC-	15	1	8
9. 3	15	1	9
10. 3	20	1	10
11. 3	25	1	11
12. 3	30	1	12
13. 970	15	1	13
14. 970	20	1	14
15. 970	25	1	15
16. 970	30	1	16
17. 40	15	2	18
18. 40	20	2	20
19. 40	25	2	22
20. 40	30	2	24
21. 9	15	1	25
22. 9	20	1	26
23. 9	25	1	27
24. 9	30	1	28
25. 284	15	1	29
26. 284	20	1	30
27. 284	25	1	31
28. 284	30	1	32
29. DC-	15	1	33
30. DC-	20	1	34

31. DC-	25	1	35
32. DC-	30	2	37
33. DC-	25	1	38
34. DC-	20	1	39
35. DC-	15	1	40
36. 100	15	1	41
37. 100	20	1	42
38. 100	25	1	43
39. 100	30	1	44
40. 13	15	1	45
41. 13	20	1	46
42. 13	25	1	47
43. 13	30	1	48
44. 396	15	1	49
45. 396	20	1	50
46. 396	25	1	51
47. 396	30	1	52
48. 49	15	1	53
49. 49	20	1	54
50. 49	25	1	55
51. 49	30	1	56
52. 562	15	1	57
53. 562	20	1	58
54. 562	25	1	59
55. 562	30	1	60
56. 0	0	1	61
57. 142	15	1	62
58. 142	20	1	63
59. 142	25	1	64
60. 142	30	1	65
61. 321	15	1	66
62. 321	20	1	67
63. 321	25	1	68
64. 321	30	1	69
65. 3	15	1	70
66. 3	20	1	71
67. 3	25	1	72
68. 3	30	1	73
69. 81	15	1	74
70. 81	20	1	75
71. 81	25	1	76
72. 81	30	1	77
73. 189	15	1	78
74. 189	20	1	79
75. 189	25	1	80
76. 189	30	1	81
77. 29	15	1	82
78. 29	20	1	83
79. 29	25	1	84
80. 29	30	1	85
81. 389	15	1	86
82. 389	20	1	87
83. 389	25	1	88
84. 389	30	1	89
85. 40	15	2	91

86. 40	20	2	93
87. 40	25	2	95
88. 40	30	2	97
89. DC-	15	1	98
90. DC-	20	1	99
91. DC-	25	1	100
92. DC-	30	2	102
93. DC-	25	1	103
94. DC-	20	1	104
95. DC-	15	1	105
96. 111	15	1	106
97. 111	20	1	107
98. 111	25	1	108
99. 111	30	1	109
100. 294	15	1	110
101. 294	20	1	111
102. 294	25	1	112
103. 294	30	1	113
104. 51	15	1	114
105. 51	20	1	115
106. 51	25	1	116
107. 51	30	1	117
108. 20	15	1	118
109. 20	20	1	119
110. 20	25	1	120
111. 20	30	1	121
112. OFF	0	1	122
113. 3	15	1	123
114. 3	20	1	124
114. 3	25	1	125
116. 3	30	2	127
117. 3	25	1	128
118. 3	20	1	129
119. 3	15	1	130
120. 321	15	1	131
121. 321	20	1	132
122. 321	25	1	133
123. 321	30	1	134
124. 94	15	1	135
125. 94	20	1	136
126. 94	25	1	137
127. 94	30	1	138
128. 355	15	1	139
129. 355	20	1	140
130. 355	25	1	141
131. 355	30	1	142
132. 124	15	1	143
133. 124	20	1	144
134. 124	25	1	145
135. 124	30	1	146
136. 50	15	1	147
137. 50	20	1	148
138. 50	25	1	149
139. 50	30	1	150
140. DC-	15	1	151

141. DC-	20	1	152
142. DC-	25	1	153
143. DC-	30	2	155
144. DC-	25	1	156
145. DC-	20	1	157
146. DC-	15	1	158
147. 40	15	2	160
148. 40	20	2	162
149. 40	25	2	163
150. 40	30	2	165
151. 415	15	1	166
152. 415	20	1	167
153. 415	25	1	168
154. 415	30	1	169
155. 77	15	1	170
156. 77	20	1	171
157. 77	25	1	172
158. 77	30	1	173
159. 18	15	1	174
160. 18	20	1	175
161. 18	25	1	176
162. 18	30	1	177
163. 245	15	1	178
164. 245	20	1	179
165. 245	25	1	180
166. 245	30	1	181
167. OFF	0	1	182
168. 9	15	1	183
169. 9	20	1	184
170. 9	25	1	185
171. 9	30	2	187
172. 9	25	1	188
173. 9	20	1	189
174. 9	15	1	190
175. 91	15	1	191
176. 91	20	1	192
177. 91	25	1	193
178. 91	30	1	194
179. 157	15	1	195
180. 157	20	1	196
181. 157	25	1	197
182. 157	30	1	198
183. 30	15	1	199
184. 30	20	1	200
185. 30	25	1	201
186. 30	30	1	201
187. 116	15	1	202
188. 116	20	1	203
189. 116	25	1	204
190. 116	30	1	205
191. 50	15	1	206
192. 50	20	1	207
193. 50	25	1	208
194. 50	30	1	209
195. DC-	15	1	210

196. DC-	20	1	211
197. DC-	25	1	212
198. DC-	30	2	214
199. DC-	25	1	215
200. DC-	20	1	216
201. DC-	15	1	217
202. 40	15	2	219
203. 40	20	2	221
204. 40	25	2	223
205. 40	30	2	225
206. 783	15	1	226
207. 783	20	1	227
208. 783	25	1	228
209. 783	30	1	229
210. 89	15	1	230
211. 89	20	1	231
212. 89	25	1	232
213. 89	30	1	233
214. 147	15	1	234
215. 147	20	1	235
216. 147	25	1	236
217. 147	30	1	237
218. 62	15	1	238
219. 62	20	1	239
220. 62	25	1	240
221. 62	30	1	241
222. OFF	0	1	242

223. Return to Line 1 to repeat program.

Table 1

[0097] Using a current profile scheme as shown above or a modification therefore, an embodiment increases perfusion and/or Nitric Oxide and/or decreases inflammatory cytokines and/or local scalp hair follicle cell induction and/or follicular stem cell induction and/or increased migration of stem cells among other physiological processes in the scalp can be utilized to stop or slow scalp hair loss and/or increase hair regrowth processes.

[0098] Testing was conducted on the inventor's receding hairline and examined by a cosmetic surgeon at monthly intervals for 3 months. One electrode 1.5" x 5" was placed on the forehead, another identical electrode was placed on the nape of the neck, the device was connected between these two electrodes. The device was worn for 1-2 hours 3-4 times each week. The hair diameter and hair density at the temples bilaterally was found to improve during the 3 month period.

[0099] An average of 50% of hairs transplanted during hair transplant surgery do not survive the transplant and fall out within the first several days after the procedure. One embodiment decreases hair loss after hair replacement surgery by increasing perfusion and/or Nitric Oxide and/or decreasing pro-inflammatory cytokines and/or increasing ATP and/or collagen formation among other physiological processes in the scalp such as stimulating migration and/or differentiation induction and/or implantation of stem cells.

[00100] Testing was conducted on one hair transplant volunteer conducted by a cosmetic surgeon. One electrode 1.5" x 5" was placed on the forehead, another identical electrode was placed on the nape of the neck, the device was connected between these two electrodes. The device was worn for 1-2 hours a day, 3-4 times each week for one month after the surgery. Upon follow-up the cosmetic surgeon noted that the scalp recovered after surgery in an accelerated fashion and hair transplant loss was much less than the normal amount.

[00101] One embodiment decreases swollen prostates in Benign Prostatic Hypertrophy (BPH) and decreases pain in Prostatitis when used with a rectal probe connected to a reference electrode placed over the skin above the pubic bone. This drives the current through the pelvic region through the prostate and bladder tissues.

[00102] Testing was conducted on one volunteer with BPH and Prostatitis. The prostate was examined by ultrasound over a follow-up period of 6 months. The prostatic volume decreased slightly and the subjective prostatic pain report decreased significantly.

[00103] One embodiment decreases skin roughness and improves cosmetic appearance of skin, and decreases the depth and breadth of wrinkles in the skin, improving cosmetic appearance of the skin.

[00104] Example: 58 year old male volunteer used the device one time for two hours on the right lateral orbital region and nothing on the left side of the face as a control. His face was examined by a cosmetic surgeon and the skin roughness, hydration, softness and general cosmetic appearance was estimated to be 50% improved when compared to the other side. Similarly, the device was used one time for two hours on the right lateral orbital rhytides or crow's feet wrinkles and nothing on the left side of the face as a control. His face was examined by a cosmetic surgeon and the depth and breadth of the wrinkles on the treated side of the face was estimated to be 50% improved when compared to the other side.

[00105] Another embodiment improves skin disease conditions such as psoriasis, dermatitis, eczema, acne, etc. as well as anticipates many others.

[00106] Example: 27 year old female volunteer with psoriasis of the elbows was treated once for 4 hours on one elbow. Skin roughness was significantly diminished compared to the other side. Subjective evaluation of the individual suggested the itching sensations were significantly diminished when compared with the other elbow.

[00107] One embodiment decreases dermal wound healing times by increasing perfusion and/or Nitric Oxide and/or decreasing pro-inflammatory cytokines and/or increasing granulation tissue formation, stimulating migration and/or differentiation induction and/or implantation of stem cells, ATP and collagen formation among other physiological processes of concern in wound healing.

[00108] Example: 65 year old quadriplegic volunteer with pressure sores was treated with the device for 4 hours daily for one week. The pressure sores resolved in a progressive and uncomplicated fashion.

[00109] One embodiment decreases pain and swelling by increasing perfusion and/or nitric oxide and/or decreasing pro-inflammatory cytokines and/or nerve secreted substances such as Substance P or Neuropeptide Y and by increasing ATP and collagen formation among other physiological processes in tissues of orthopedic and/or neurological concern.

[00110] Example: 75 year old female volunteer diagnosed with lumbar spinal stenosis and experiencing peri-lumbar swelling and pain used the device for 6 hours during the day. The swelling and discomfort diminished significantly every time the device was used over the area of concern.

[00111] One embodiment improves healing times as well as improved healing quality in various types of orthopedic pain conditions in mesenchymal tissues such as, but not limited to myalgia, myositis, fasciitis, tendonitis, bursitis and tenosynovitis, arthritis (rheumatoid and osteo-arthritis) and injuries such as strains, sprains, repair of microtraumas in fascia, periostitis and other tissues of orthopedic concern.

[00112] Example: 18 year old female volunteer who was 4 years status post broken lumbar spine. She was spending most of her day trying to find her way out of pain. She had failed numerous types of orthopedic pain injection treatments and physical therapy. She began using the device for several hours each day. Within two months she was pain free for the first time in 4 years.

[00113] One embodiment diminishes peripheral neuropathy regardless of cause such as diabetic, viral disease related (HIV, Hepatitis C, etc.), hypoperfusion, etc.

[00114] Example: 62 year old male volunteer positive for Hepatitis B and C for an estimated 40 years with mild peripheral neuropathy of both feet used the device on one foot for 4 hours daily for 3 days and reported moderately increased sensation in the treated foot while the untreated foot remained unchanged.

[00115] One embodiment improves canine veterinary orthopedic conditions such as injuries or hip dysplasia.

[00116] Example: 14 year old Terrier with low back arthritis and hip dysplasia had his coat trimmed from the dorsal lumbo-sacral area to facilitate contact of the electrodes to the skin of the region. The device was left adhered to the skin for 3 days and activated and deactivated at random intervals throughout the day and left on overnight. Significant improvement in the dog's personality and vitality were reported by the owner as well as improved ability to climb stairs and take walks.

[00117] One embodiment decreases symptoms of sinusitis and facial pain when used on the face.

[00118] Example: 62 year old male volunteer with chronic right sided maxillary sinusitis used the device over this area of his face for 3 hours three days in a row. He reported significant decrease in the pain symptoms with use of the device.

[00119] One embodiment can decrease pain and stimulate healing of post-surgical dental, orthopedic, cosmetic or other surgical procedures.

[00120] Example: 53 year old male volunteer post triple hernia surgery placed a device on his abdomen for 8 hours daily for the first 3 weeks after the surgery. His recovery was extremely hastened by use of the device as he was able to move comfortably 5 weeks ahead of schedule.

[00121] One embodiment can stimulate healing of orthopedic fractures and non-healing unions in bone fractures.

[00122] Example: 60 year old female volunteer broke her large toe and was in acute pain. The device was applied to her toe and foot and resolved the pain while the device was active. The bone was able to knit and heal 2 weeks sooner than expected with regular use of the device.

[00123] One embodiment can be used to decrease symptoms and stimulate healing of hand tendon syndromes such as DeQuervain's and Dupuytrens's as well as Carpal Tunnel Syndrome.

[00124] Example: 48 year old female volunteer diagnosed with DeQuervain's tenosynovitis was the only person in her family that had not had surgery for the condition yet. She used the device for 3-4 hours daily for one month and has not needed surgery since.

[00125] One embodiment can be used to improve Iontophoresis results when combined with other topically applied ingredients such as analgesics, anti-inflammatories, anti-virals, as well as cosmetic and/or nutraceutical compounds of benefit. The iontophoresis embodiment increases depth of penetration of the therapeutic substances over the prior art.

[00126] Example: 1 mL of Dexamethasone sodium phosphate (4mg/ml) was placed under one side of the electrode, while 1 mL Sarapin was placed on the other side. The device was activated and treatment of chondromalasia of the fetlock joint in a 2 year old Thoroughbred racehorse in training was initiated. Severe swelling of the ankle and lameness was resolved in one treatment.

[00127] One embodiment can be used as an adjuvant to fermentation systems to influence the activity of the microbes of the ferment, such as a stalled ferment and/or influence the production of fermentation by-products of interest. One embodiment has been used with kefir, beer, wine, and mead ferments and was found to be satisfactory for this purpose.

[00128] Example: Extensive experimentation was conducted with non-dairy kefir culture grains over a period of a year that determined that biomass yields could be increased by 5-20% over controls when specific types of electrostimulation were utilized.

[00129] One embodiment can improve treatment outcomes over the prior art and decrease symptoms of Premenstrual Syndrome (PMS) with electrodes placed on the abdomen and/or lower back or with a probe that is inserted vaginally or rectally and the reference electrode placed on the abdomen.

[00130] Example: 35 year old female volunteer with chronic PMS placed the device over her abdomen when she began experiencing her PMS symptoms. She used the device once daily for 4 hours and was able to control her pain, cramping and dysphoria typical during her period.

[00131] One embodiment can decrease psychological symptoms of dysregulated mood such as depression, anxiety and/or insomnia with transcerebral stimulation with the electrodes placed on the ear lobes, head, neck and/or abdomen.

[00132] Example: A device was programmed with low frequencies and placed on the abdomen of a 58 year old male volunteer insomniac. He was able to get to sleep and stay asleep with the device running while attached to his abdomen.

[00133] One embodiment can be used to augment ionic aqueous and/or solvent (e.g. ethanol, hexane, etc.) extraction systems for plant materials and other phytochemicals, nucleic and ribonucleic acids, etc. without having to expose the botanical material to the potentially damaging effects of heat from hot water extraction. By increasing the current intensity to include either or both the microamperage (1-1,000uA) and millamperage range (1-1,000mA) One embodiment has been reduced to practice for commercial “cold” green tea extraction and was found to be more than satisfactory for this purpose.

[00134] Example: Extensive experimentation was conducted with pilot scale cold temperature green tea extraction. The process worked quite well and extracted the green tea constituents adequately when compared to hot water extraction methods without damaging the heat sensitive polyphenols or aromatic compounds.

[00135] One embodiment can be used to treat acute, subacute or chronic plantar fasciitis.

[00136] Example: 60 year old female volunteer with chronic plantar fasciitis, unable to run, her primary form of exercise. Using the device 4 hours daily for three weeks allowed her to return to running without pain.

[00137] Accordingly, as will be appreciated by one skilled in the art, the present disclosure and of the microcontroller/microprocessor described herein may be embodied as an apparatus that incorporates some software components. Accordingly, some embodiments of the present disclosure, or portions thereof, may combine one or more hardware components such as microprocessors, microcontrollers, or digital sequential logic, etc., such as processor with one or more software components (e.g., program code, firmware, resident software, micro-code, etc.) stored as non-transitory signals or instructions in a computer-readable memory device such as a computer readable memory device or computer media, that in combination form a specifically configured apparatus that performs the functions as described herein. These combinations that form specially-programmed devices may be generally referred to herein "modules". The software component portions of the modules may be written in any computer language and may be a portion of a monolithic code base, or may be developed in more discrete code portions such as is typical in object-oriented computer languages. In addition, the modules may be distributed across

a plurality of computer platforms, servers, terminals, and the like. A given module may even be implemented such that the described functions are performed by separate processors and/or computing hardware platforms.

[00138] Note that the functional blocks, methods, devices and systems described in the present disclosure may be integrated or divided into different combinations of systems, devices, and functional blocks, as would be known to those skilled in the art.

[00139] In general, it should be understood that the circuits described herein may be implemented in hardware using integrated circuit development technologies, or via some other methods, or the combination of hardware and software objects could be ordered, parameterized, and connected in a software environment to implement different functions described herein. For example, the present application may be implemented using a general purpose or dedicated processor running a software application with non-transitory signals through volatile or non-volatile memory. Also, the hardware objects could communicate using electrical signals, with states of the signals representing different data.

[00140] It should be further understood that this and other arrangements described herein are for purposes of example only. As such, those skilled in the art will appreciate that other arrangements and other elements (e.g. machines, interfaces, functions, orders, and groupings of functions, etc.) can be used instead, and some elements may be omitted altogether according to the desired results. Further, many of the elements that are described are functional entities that may be implemented as discrete or distributed components or in conjunction with other components, in any suitable combination and location.

[00141] Further, although process steps, algorithms or the like may be described in a sequential order, such processes may be configured to work in different orders. In other words, any sequence or order of steps that may be explicitly described does not necessarily indicate a requirement that the steps be performed in that order. The steps of processes described herein may be performed in any order practical. Further, some steps may be performed simultaneously despite being described or implied as occurring non-simultaneously (e.g., because one step is described after the other step). Moreover, the illustration of a process by its depiction in a drawing does not imply that the illustrated process is exclusive of other variations and modifications thereto, does not imply that the illustrated process or any of its steps are necessary to the invention, and does not imply that the illustrated process is preferred.

[00142] The present disclosure is not to be limited in terms of the particular embodiments described in this application, which are intended as illustrations of various aspects. Many modifications and variations can be made without departing from its scope, as will be apparent to those skilled in the art. Functionally equivalent methods and apparatuses within the scope of the disclosure, in addition to those enumerated herein, will be apparent to those skilled in the art from the foregoing descriptions. Such modifications and variations are intended to fall within the

scope of the appended claims. The present disclosure is to be limited only by the terms of the appended claims, along with the full scope of equivalents to which such claims are entitled. It is to be understood that this disclosure is not limited to particular methods, implementations, and realizations, which can, of course, vary. It is also to be understood that the terminology used herein is for the purpose of describing particular embodiments only, and is not intended to be limiting.

[00143] With respect to the use of substantially any plural and/or singular terms herein, those having skill in the art can translate from the plural to the singular and/or from the singular to the plural as is appropriate to the context and/or application. The various singular/plural permutations may be expressly set forth herein for sake of clarity.

[00144] While various aspects and embodiments have been disclosed herein, other aspects and embodiments will be apparent to those skilled in the art. The various aspects and embodiments disclosed herein are for purposes of illustration and are not intended to be limiting, with the true scope being indicated by the following claims.

CLAIMS

What is claimed is:

1. A method to therapeutically aid tissue or biological material via direct application of a mixed electrical signal, comprising:

placing at least one or more electrodes in contact with a subject tissue or material;

initiating a triggering of the mixed electrical signal;

automatically applying, via processor control, a non-user controllable frequency dependent mixed electrical signal through the one or more electrodes, wherein the mixed electrical signal is a combination of at least two different frequency signals, a first frequency signal having a first minimum and maximum microamp range and a second frequency signal having a different second minimum and maximum microamp range, wherein a higher of the two frequency signals is superimposed on the lower of the two different frequency signals, whereby a current intensity window is sustained as an envelope along a profile of the lower of the two different frequency signals; and

maintaining the application of the mixed electrical signal for a pre-determined period of time and varying the mixed electrical signal's amplitude and/or duration and/or frequencies according to a pre-set schedule programmed into a controller coupled to the one or more electrodes.

2. The method according to claim 1, further comprising, energizing a status indicator when the method is in operation and de-energizing the status indicator or altering a state of the status indicator when the method is completed.

3. The method according to claims 1 or 2, wherein the controller is mechanically attached to a contact pad via a snap-in mechanism, the contact pad containing the at least one or more electrodes.

4. The method according to claim 3, further comprising adding a fixed or varying DC offset to the mixed electrical signal.

5. The method according to claim 4, wherein the varying of the mixed electrical signal and DC offset is random, or according to a look-up table, or according to a sine, square, or triangle wave function.

6. The method according to claim 5, wherein a maximum current is below 800 microamp and the first and second frequencies are below 1000 Hz.

7. The method according to claim 5, wherein the maximum current is momentarily raised above 1 milliamp and then dropped below 800 microamp.

8. The method according to any one of claims 4 -7, wherein the method is used to promote healing or reduce pain, with minimal to no treatment plateaus, accommodation, habituation or tachyphylaxis.

9. The method according to claim 8, wherein the method is used to treat one or more of perfusion, Nitric Oxide amounts, decrease inflammatory cytokines, local scalp hair follicle cell induction, follicular stem cell induction, or increased migration of stem cells.

10. The method according to claim 8, wherein the method is used to treat incontinence of urine or stool.

11. The method according to claim 8, wherein the method is used to treat one or more symptoms of nephritis, glomerulonephritis, pyelonephritis, hepatitis, hepatomegaly, gall bladder pain or inflammation.

12. The method according to claim 8, wherein the method is used to treat one or more symptoms of acute and/or chronic cystitis, interstitial cystitis or chronic non-infection related urethritis, bladder distension, bladder dysfunction, hemorrhoids or rectal/anal fissures.

13. The method according to claim 8, wherein the method is used to treat swelling and promote healing in acute trauma conditions, Compartment Syndrome in a limb, thyroiditis, laryngitis, macular degeneration and retinitis, diabetic opthalmoplegia or diabetic retinopathy.

14. The method according to any one of claims 4 – 7, wherein the method is used for cellular electroporation growth, cellular telomeric attrition and telomerase expression in vivo and in vitro, cell culture health, or cell culture growth.

15. The method according to any one of claims 4 – 7, wherein the method is used to decrease symptoms of pelvic cervical dysplasia, tonsillitis or other tissue inflammation associated with HPV infection.

16. The method according to claim 8, wherein the method is used to decrease healing time of dermal, neural or mucosal irritations, lesions or wounds that are caused by various herpetic viruses.

17. The method according to claim 8, wherein the method is used to improve healing for mesenchymal tissues such as, but not limited to myalgia, myositis, fasciitis, tendonitis, bursitis and tenosynovitis, arthritis (rheumatoid and osteo-arthritis) and injuries such as strains, sprains, repair of microtraumas in fascia, periostitis and other tissues of orthopedic concern.

18. The method according to claim 8, wherein the method is used to decreases symptoms of sinusitis and facial pain, or stimulate healing of post-surgical dental, orthopedic, cosmetic or other surgical procedures.

19. The method according to claim 8, wherein the method is used to decrease pain, physical discomfort and psychological symptoms of substance abuse withdrawal with transcerebral or other body location stimulation when the electrodes are placed on a subject's ear lobes, head, neck and/or abdomen, or to treat depression, anxiety and/or insomnia.

20. The method according to any one of claims 4 – 7, wherein the method is used to affect the growth of algaes in aquariums, ponds, aquaculture, or plants in a hydroponic system.

21. The method according claim 8, wherein the method is used to to improve a cosmetic appearance of skin, by decreasing skin roughness, or decreasing depth and breadth of wrinkles in the skin, or to treat psoriasis, dermatitis, eczema, or acne.

22. The method according to any one of claims 4-7, wherein the method is used to positively influence an activity of microbes of a fermentation system.

23. The method according to claim 8, further comprising applying a topical ingredient such as an analgesic, anti-inflammatory, anti-viral, cosmetic, or nutraceutical compounds of benefit between the at least one or more electrodes in contact with the subject tissue or material.

24. A non-user controllable electro-therapy device, comprising:

a housing for a microprocessor, power source, status indicator, activation switch, and one or more channels for electrode contact, wherein only the activation switch is user-accessible, wherein the microprocessor controls a generation of a non-user controllable, frequency dependent mixed electrical signal through the one or more channels, the mixed electrical signal being a combination of at least two different frequency signals, a first frequency signal having a first minimum and maximum microamp range and a second frequency signal having a different second minimum and maximum microamp range, wherein a higher of the two frequency signals is superimposed on the lower of the two different frequency signal, whereby a current intensity window is sustained as an envelope along a profile of the lower of the two different frequency signals; and

control instructions encoded in the microprocessor or a memory accessed by the microprocessor, setting an application of the mixed electrical signal for a pre-determined period of time and varying the mixed electrical signal's amplitude and/or duration and/or frequencies according to a pre-set schedule programmed into the microprocessor.

25. The device according to claim 24, further comprising the microprocessor enabling a fixed or varying DC offset to be added to the mixed electrical signal.

26. The device according to claim 25, wherein the varying of the mixed electrical signal and DC offset is random, or according to a look-up table, or according to a sine, square, or triangle wave function.

27. The device according to claim 26, wherein a maximum current is 800 microamp and the first and second frequencies are below 1000 Hz.

28. The device according to claim 26, wherein the maximum current is momentarily raised above 1 milliamp and then dropped below 800 microamp.

29. The device according to claims 27 or 28, further comprising a contact pad distributing the mixed electrical signal to a subject tissue or material, wherein the housing is mechanically attached to the contact pad via a snap-in mechanism.

30. The device according to claim 29, wherein the pad has a Shuriken shape.

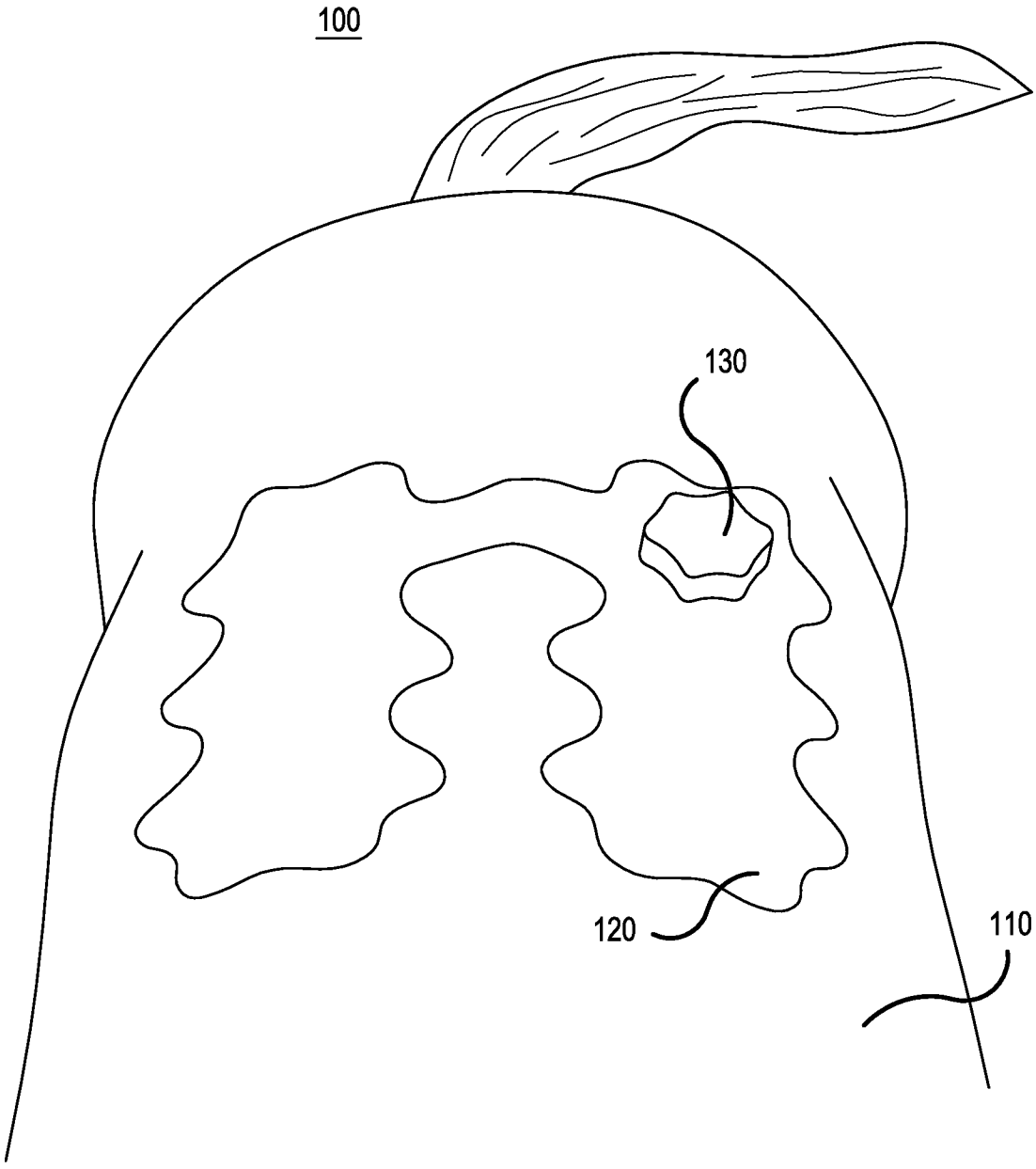
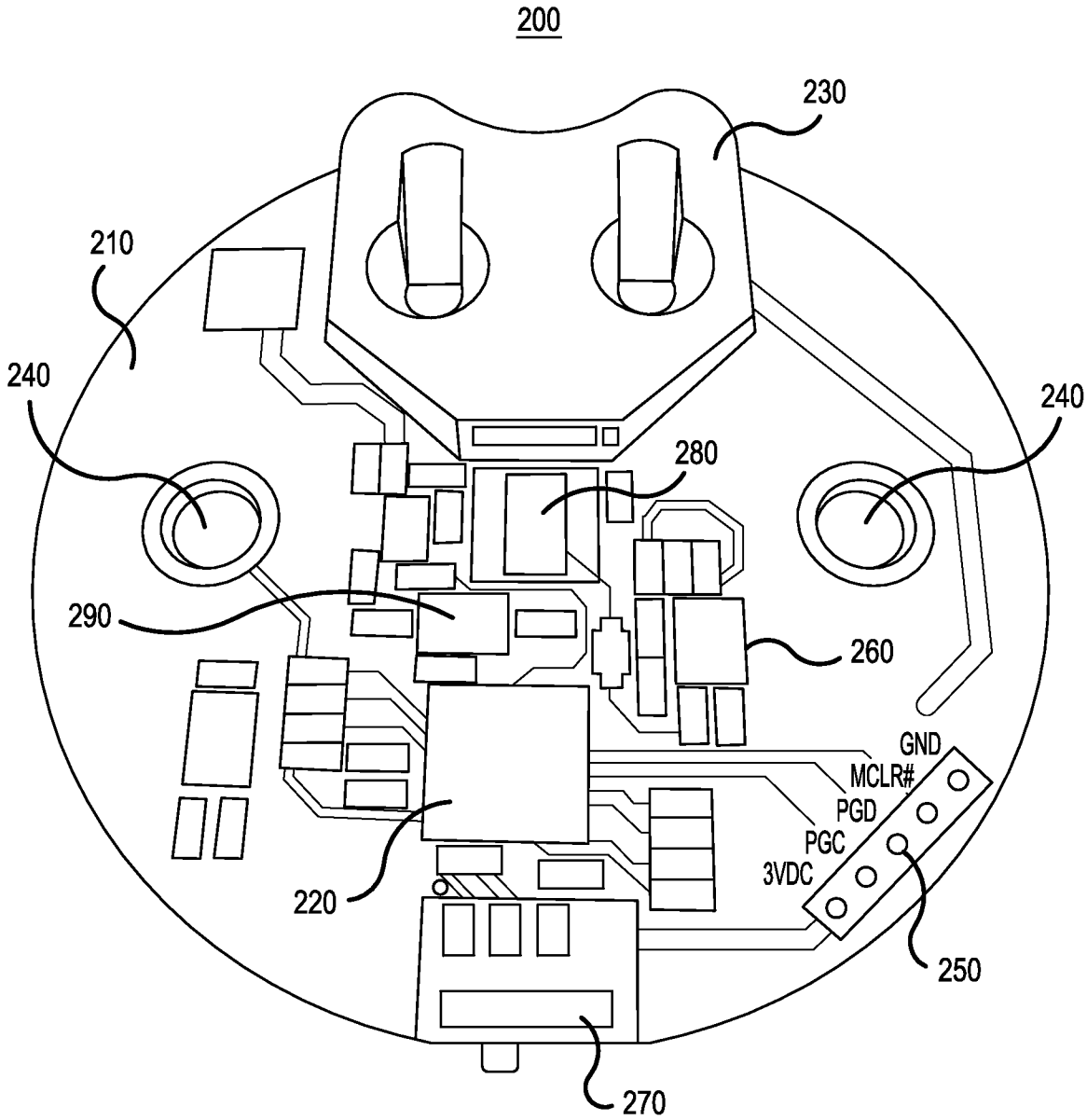


FIG.1


200
230
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290
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GND
MCLR#
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220
250
270

FIG.2

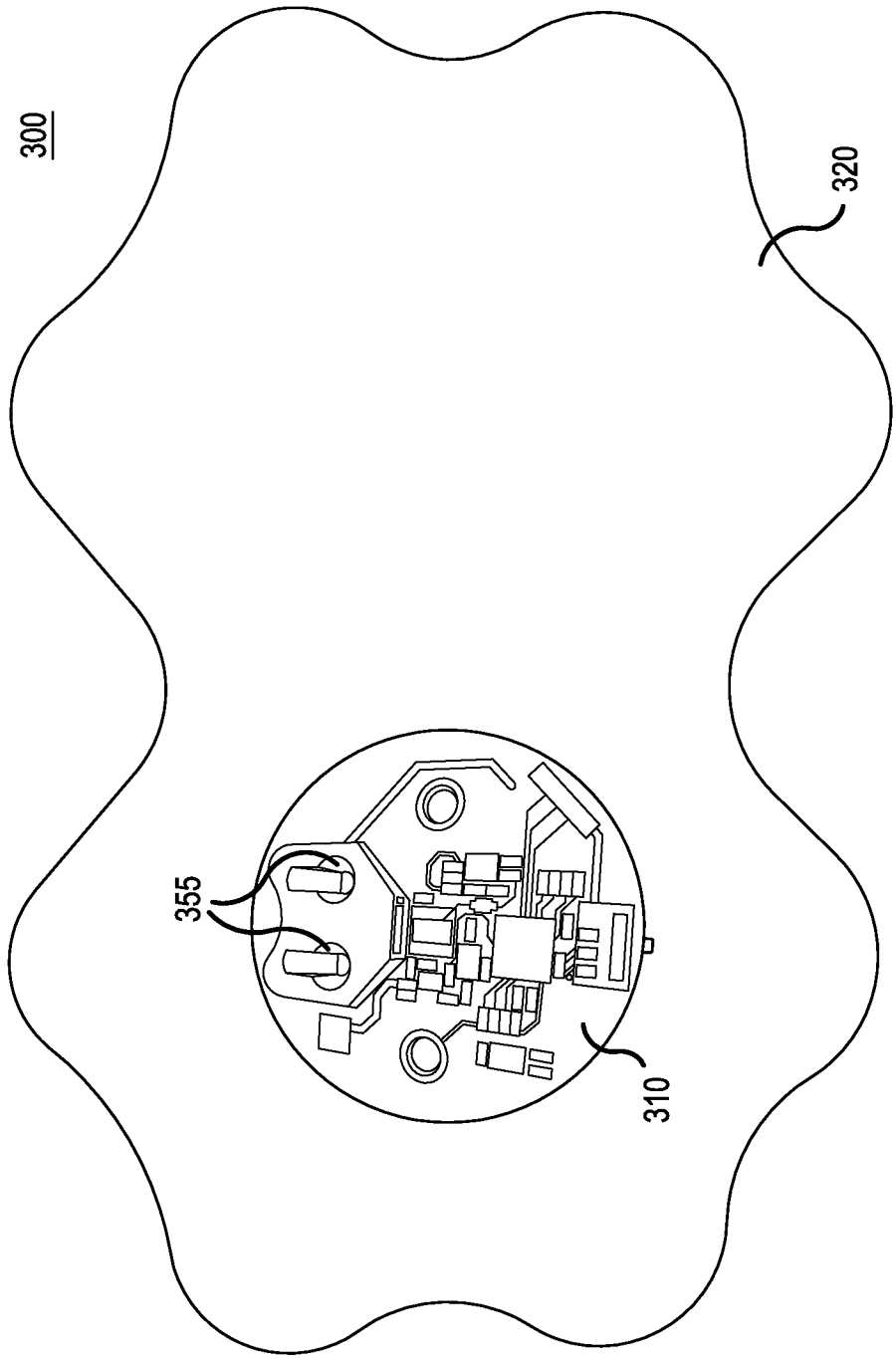
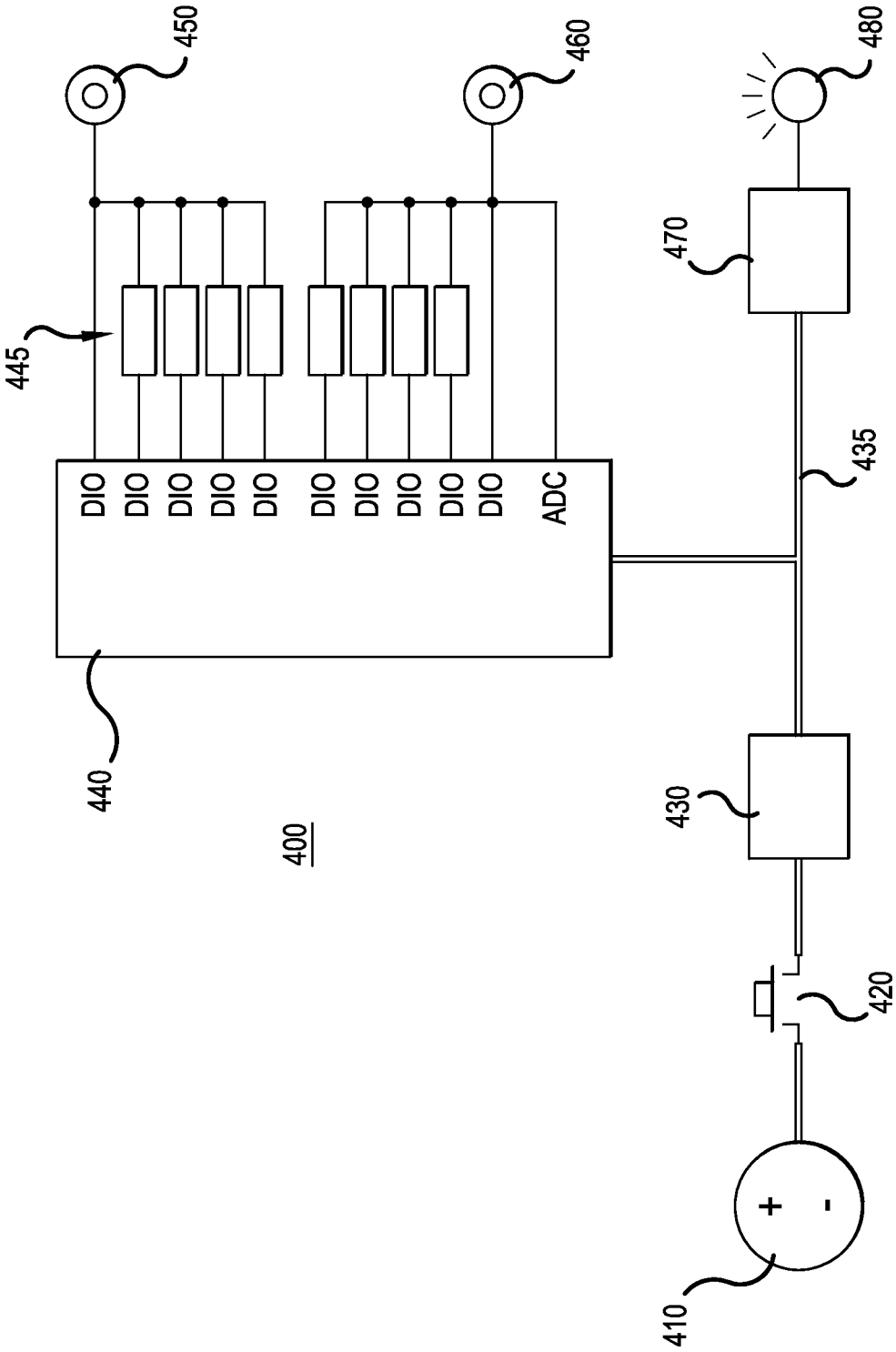


FIG.3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460
480
445
470
DIO
DIO
DIO
DIO
DIO
DIO
DIO
DIO
DIO
DIO
ADC
435
440
400
430
420
410
+
-

FIG.4

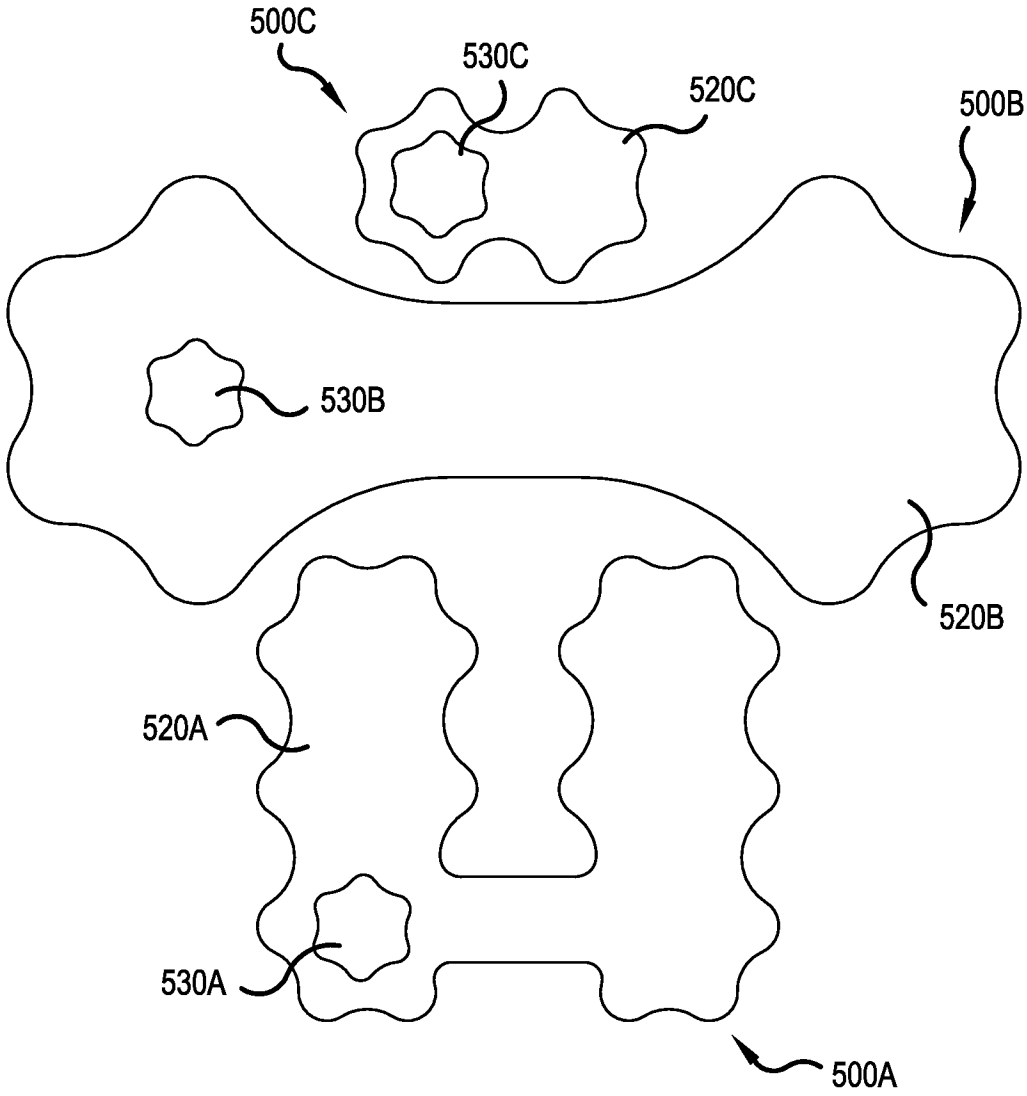

FIG.5

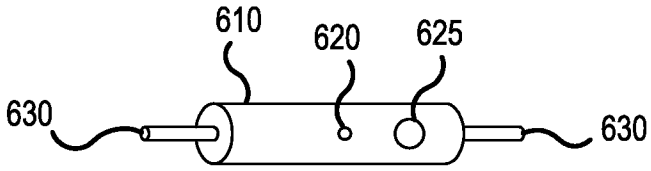

FIG.6A

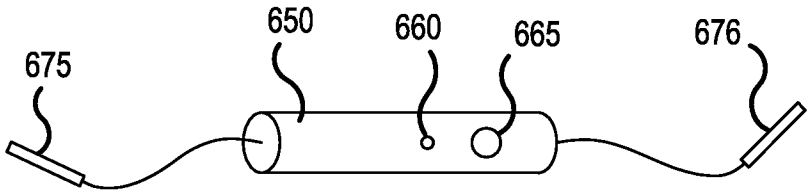

FIG.6B

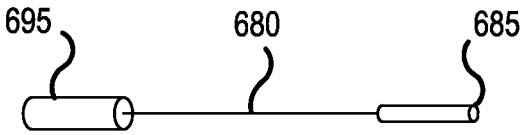

FIG.6C

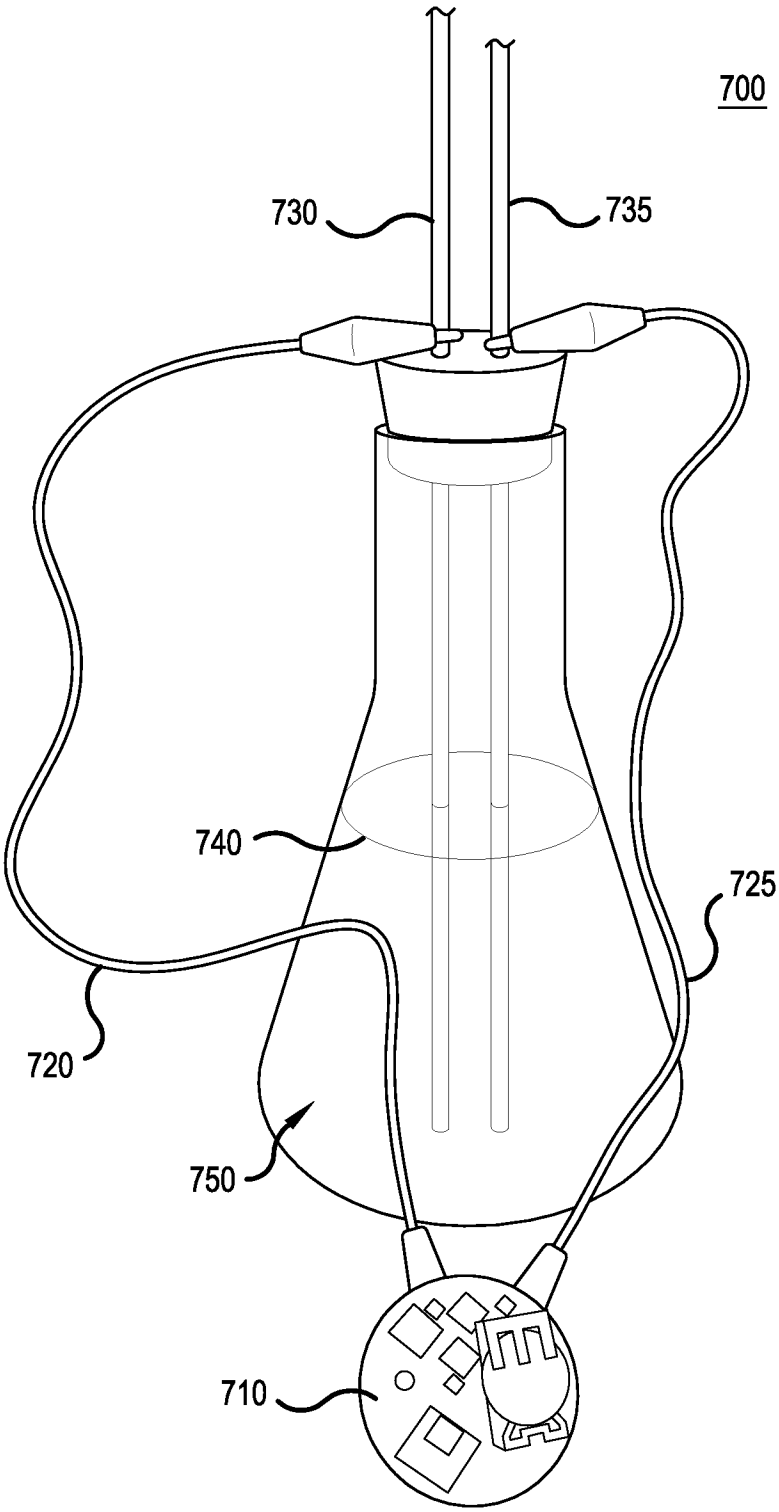

FIG.7

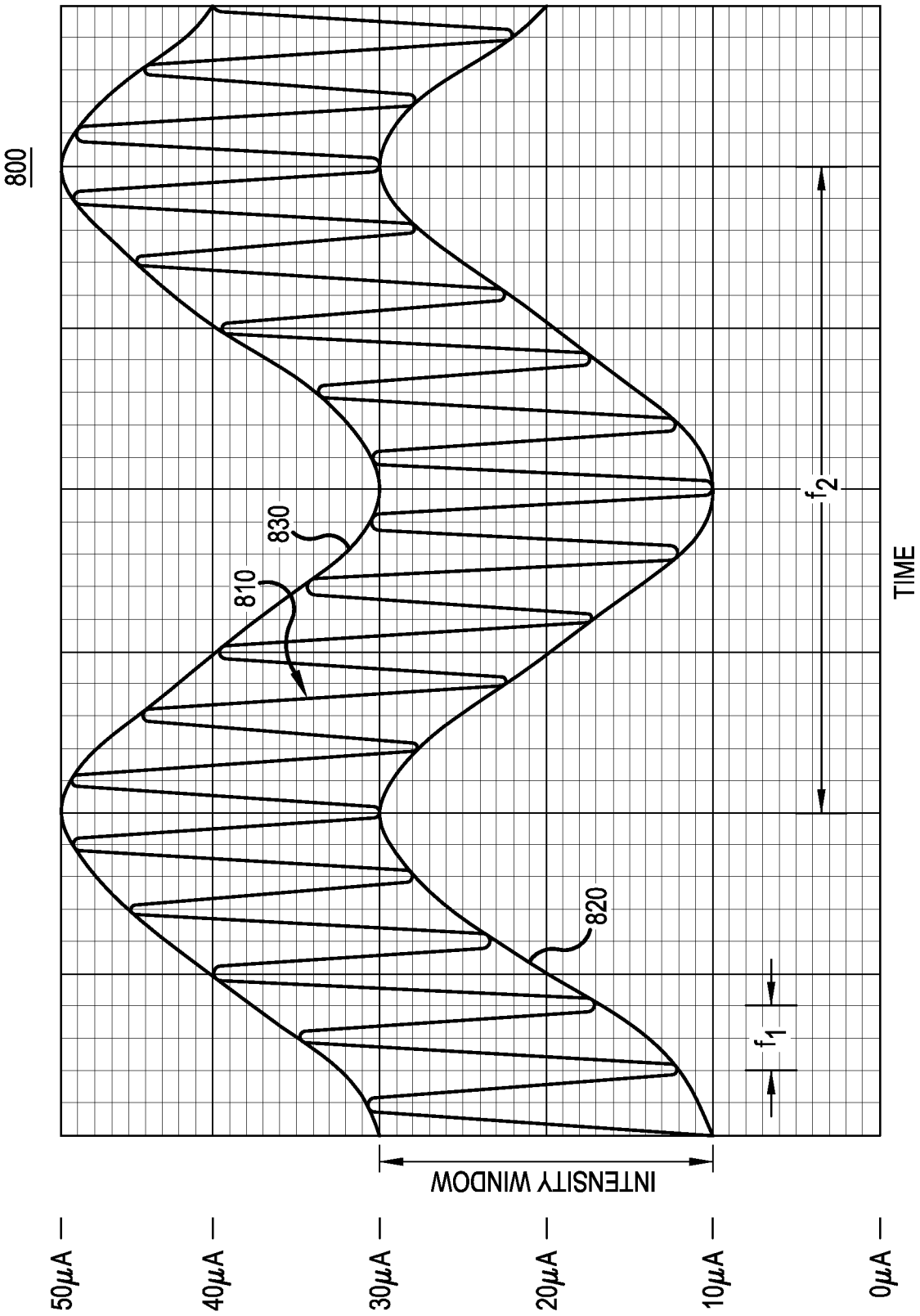
800
50μA
40μA
30μA
20μA
10μA
0μA
INTENSITY WINDOW
TIME
810
820
830
f1
f2

FIG.8

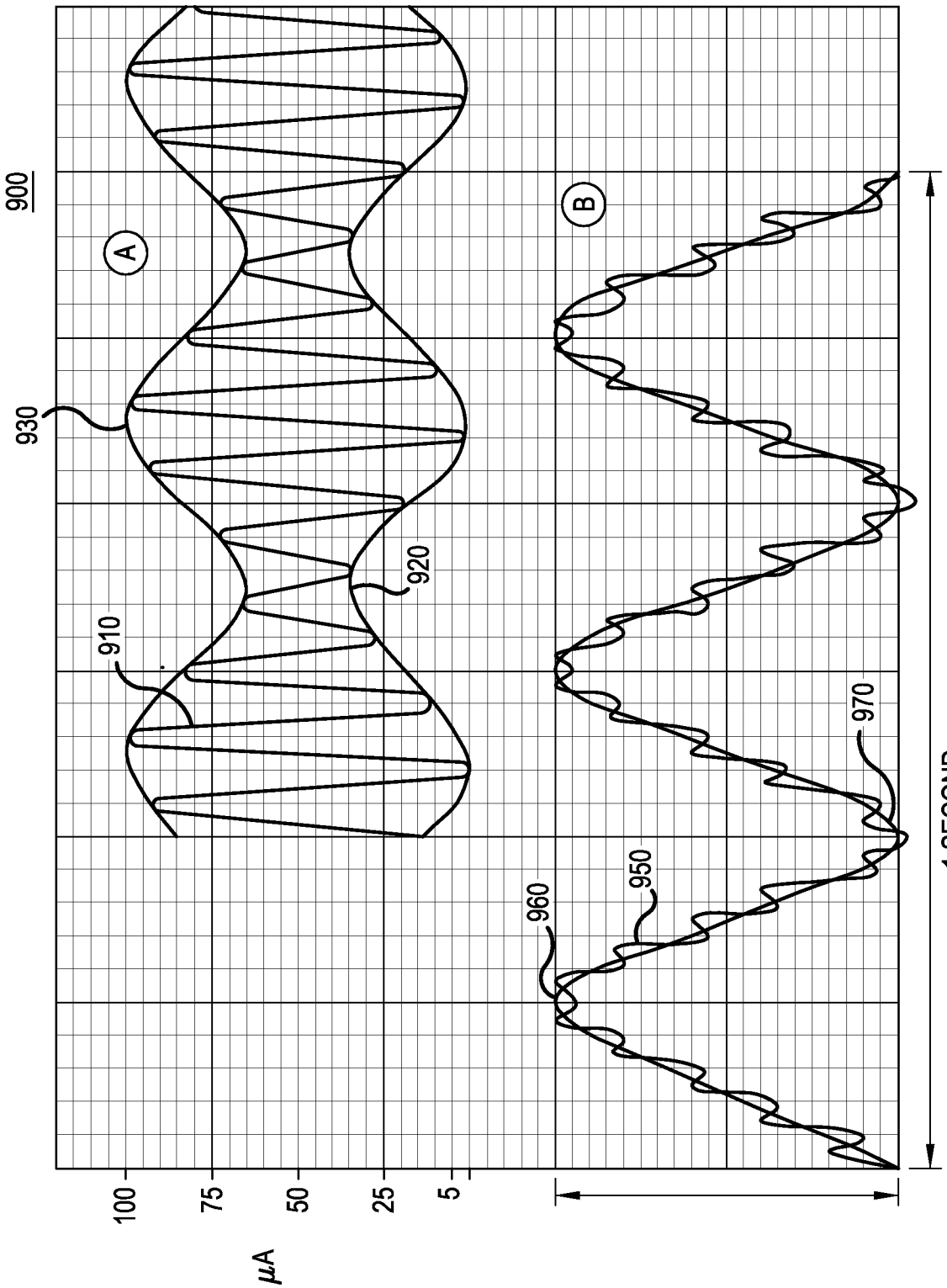

FIG.9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/029963

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - A61N 1/18 (2014.01)
USPC - 607/40
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) - A61B 5/04; A61N 1/00, 1/18 (2014.01)
USPC - 600/546; 607/40, 41, 45, 46, 48

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
CPC - A61B 5/04; A61N 1/00, 1/18 (2014.07)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Orbit, Google Patent, Google Scholar

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 7,239,918 B2 (STROTHER et al) 03 July 2007 (03.07.2007) entire document	1-7, 24-30
A	US 7,283,867 B2 (STROTHER et al) 16 October 2007 (16.10.2007) entire document	1-7, 24-30
A	US 6,564,103 B2 (FISCHER et al) 13 May 2003 (13.05.2003) entire document	1-7, 24-30

☐ Further documents are listed in the continuation of Box C. ☐

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 July 2014	19 AUG 2014
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/029963

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☒ Claims Nos.: 8-23
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.