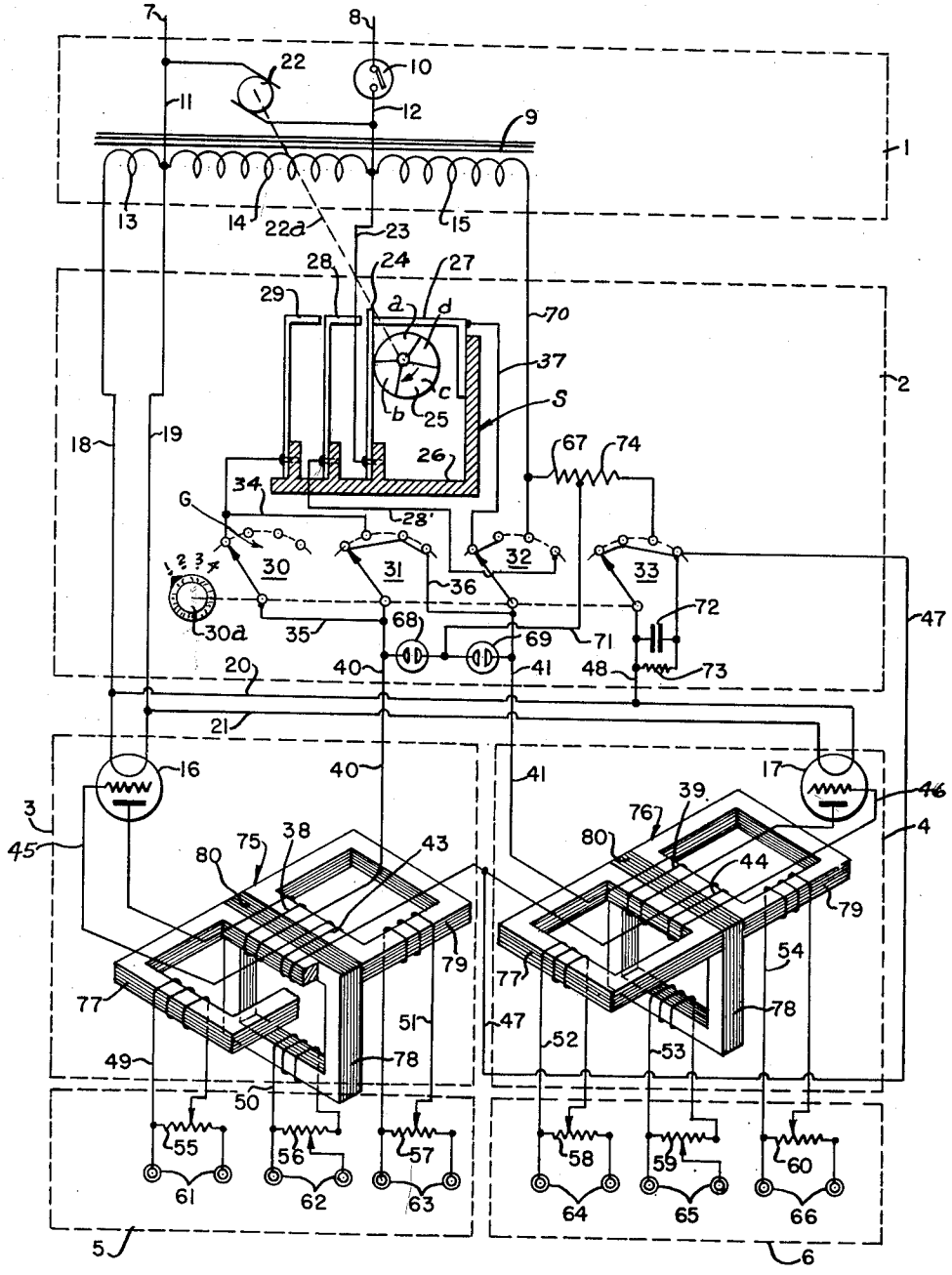
Feb. 9, 1954 W. J. BROWNER 2,668,540

MEANS FOR ELECTRICAL THERAPY

Filed Sept. 19, 1949



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Patented Feb. 9, 1954

2,668,540

UNITED STATES PATENT OFFICE

2,668,540

MEANS FOR ELECTRICAL THERAPY

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Application September 19, 1949, Serial No. 116,552

13 Claims. (Cl. 128—423)

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My invention relates to electrical therapy for stimulation of the tissues of the human body and for producing muscular response and contraction for the purpose of improving the tone and general health of bodily parts. The invention relates in particular to a means and method for producing an electrical current very similar in wave form to bodily nerve currents.

It is an object of the invention to produce a therapeutic current of great effectiveness. This current is characterized by ability to give exceptionally good muscular response or contraction from an extremely low current value, and without burning or stinging sensations where the electrodes engage surfaces of the body.

It is an object of the invention to provide a device of extremely simple form and ruggedness which has therein a novel cooperation of parts resulting in the production of an improvement in the therapeutic and contractile current. In this device, I am able to use the simplest of electronic tubes and a minimum of parts which will cooperate with the tubes to produce oscillator circuits, which circuits are characterized by their ability to produce the effective wave form referred to herein.

It is an object of the invention to produce a therapeutic device having simple means for controlling the rates of impulse delivery or the so-called off and on periods, during which the therapeutic current is applied. For example, the simple means shown herein provides a knob which may in one position of adjustment cause the device to intermittently deliver the therapeutic current at a rate of 40 cycles per minute, and by another position of adjustment cause the device to deliver the therapeutic current intermittently at a rate of 20 cycles per minute.

A further object of the invention is to provide a device which will not only deliver a contractile current, but also a characteristic vibratory current.

Further objects of the invention include the provision of a device having current delivering means for energizing output circuits in alternate or flexion-extension relation for improved therapeutic effect. It is possible by the use of my device to energize opposing tissues or muscles in alternate relation, thereby producing results which cannot be obtained without this sequential application of therapeutic effect. In my present device, one circuit energizes a selected portion of the body while another circuit is inactive. This order is then reversed so that the first named portion of the body is deenergized, or permitted

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to relax, while a second circuit is employed on an adjacent or related portion of the body. By the arrangement described in the foregoing, movement of bodily parts back and forth can be obtained in a manner to assist in recovery of the use of bodily parts rendered inactive by afflictions. Also, by the use of the device postural corrections and compensations are relatively rapidly and effectively made, and muscular tone is improved so that there is a correction of sagginess and flabbiness of bodily parts.

It is a further object of the invention to provide a multiple outlet therapeutic device of the character described, wherein a plurality of output circuits are supplied by a single oscillator and wherein each of the output circuits may be individually adjusted as to current strength without changing the current strength or potential in the remaining output circuits. This feature of the invention is of material importance since, in the use of my device, it is possible to turn down, or off, one of the output circuits without a rise in voltage in the remaining circuits which would produce discomfort of the patient.

Further objects and advantages of the invention will be brought out in the following part of the specification wherein I have described only a preferred embodiment of my invention for the purpose of making a complete disclosure without limiting the scope of the invention as defined in the accompanying claims, with the understanding that various changes or modifications may be made within the scope of the claims hereto attached without departing from the substance of the invention.

Referring to the drawing which schematically shows a preferred embodiment of the invention, I have for easy understanding of the invention divided it into six units identified in six dotted-line rectangles, these units or parts being power input circuit 1, control circuit 2, left and right oscillator circuits 3 and 4, and left and right output circuits 5 and 6. The power circuit 1 is energized from conductors 7 and 8 adapted to be connected to a commercial power system. The power lines 7 and 8 are connected to an auto-transformer 9 through conductors 11 and 12 under control of a switch 10. The auto-transformer 9 has series connected windings or winding sections 13, 14 and 15, the conductors 11 and 12 being connected to the ends of the winding or coil 14 which then constitutes the primary of the auto-transformer 9.

The oscillators 3 and 4 include simple triode tubes 16 and 17, which may be of the inexpensive

and rugged type 45. The filaments of these triodes 16 and 17 are energized from the coil section 13 of the auto-transformer 9, at a potential of 2½ volts, through conductors 18, 19, 20 and 21. A motor 22 is conducted across the conductors 11 and 12 so as to be energized when the switch 10 is turned on. This motor 22 is preferably of the brushless fractional horsepower synchronous type, and through a shaft means 22a is adapted to revolve a cam or eccentric associated with the control circuit 2 of the device. In the embodiment of the invention shown, the cam 25, which is insulated, is revolved at 20 R. P. M., it being understood that other speeds may be employed as desired. The cam 25 is adapted to close and open the contacts of a switch device S.

The switch device S has, as schematically indicated, a base or support 26 carrying a spring contact 24 arranged to be directly moved by the cam 25, and contacts 27, 28 and 29. Tension in the spring portion of the contact 24 tends to move it into engagement with the contact 27. The cam 25 is shown divided into sections *a*, *b*, *c*, and *d*, the section *a* of the cam 25 being closest to the center of rotation of the cam and permitting the contact 24 to rest in engagement with the contact 27. Assuming that the cam 25 is rotating in clockwise direction, from the position in which it is shown in the drawing, engagement of section *b* with the contact 24 will move the same leftwardly out of engagement with contact 27. When substantially the center of the section *b* engages the contact 24, the contact 24 will have been moved into engagement with contact 28. As clockwise rotation of the cam 25 is continued the cam will move contact 24 further in leftward direction, contact 24 then transmitting leftward movement to contact 28. By the time the front end *c* of section 25 is brought into engagement with contact 24, contact 28 will engage contact 29 and this engagement between contacts 28 and 29 will be maintained until the end of section *c* moves out of engagement with contact 24. Then, as section *d* moves across the face of contact 24, this contact 24 will move out of engagement with contact 28 and when the end of section *d* moves from engagement with contact 24, this contact 24 will engage contact 27, and this engagement of contact 24 with contact 27 will be maintained while section *a* of the cam 25 is moving across the face of contact 24. The contacts 24, 27, 28 and 29 are so placed with relation to each other and to the cam 25 that contact 24 will engage contact 27 through a period of time corresponding to ⅓ of the revolution of the cam 25, contact 24 will be in engagement with contact 28 for a period of time corresponding to substantially ½ the revolution of cam 25, and contact 28 will be in engagement with contact 29 through a period of time corresponding to about ⅓ the revolution of the cam 25. The arcs presented by the sections *b* and *d*, representing the periods of time between disengagement of contact 24 from contact 27 and engagement of contact 28 with contact 29, each corresponds to ⅙ of the time of revolution of the cam 25. In association with the switch S there is a manually operated gang switch G having switch sections 30, 31, 32 and 33, each comprising four stationary contacts and a travelling contact, the travelling contacts being simultaneously moved by a knob 30a.

The rightward terminal of coil 14 of auto-transformer 9 is connected by conductor 23 to moving contact 24 of the switch S, and the opposite terminal of the coil 14 is connected through conductors 19 and 21 with the filaments of the triodes 16 and 17. The first, third and fourth contacts of switch section 31 are connected, the first and second switch contacts of switch section 32 are connected together, and contacts 1, 2 and 4 of switch section 33 are connected together. Through conductor means 34, contact 29 of switch S is connected to the first and second contacts respectively of switch sections 30 and 31. Conductor means 28' connects contact 28 of the switch S with the fourth contact of switch section 32, and conductor means 37 connects contact 27 of switch S with the first and second contacts of switch section 32. The third contact of switch section 32 is connected by conductor means 70 with the outer or rightward terminal of winding 15 of the autotransformer 9. The moving contacts of the switch sections 30 and 31 are connected through conductor means 35 with a conductor 40 which leads into the left oscillator section 3 of the device. The moving contact of switch section 32 and stationary contacts 1, 3 and 4 of switch section 31 are connected through conductor means 36 with a conductor 41 leading into the oscillator section 4 of the device. Glow lamps 68 and 69 are provided for showing when the conductors 40 and 41 are energized. One terminal of each of these glow lamps 68 and 69 is connected to a conductor 40 and 41 respectively, and the remaining terminals thereof are connected through a conductor 71 and a resistor 67 which connects with conductor 70 leading to the outer terminal of the transformer coil 15.

I am able to produce the wave form which is a valuable characteristic of my device by the manner of connecting and relating the plate and grid circuits of the triodes 16 and 17. The plate circuit of triode 16 has a primary winding 38 which is connected to the conductor 40, and the plate circuit of triode 17 has a primary winding 39 which is connected to the conductor 41. The grid circuits 45 and 46, respectively, of the triodes 16 and 17 have therein windings 43 and 44 which are connected through a conductor 47 with the first, second and fourth stationary contacts of the switch section 33 so that when the moving contact of switch section 33, when in first, second and fourth positions will connect the grid circuits with the leftward end of section 14 of the transformer 9 through a conductor 48, a portion of conductor 20, conductor 21 and conductor 19. The windings 38—43 and the windings 39—44 are inductively coupled through use of the magnetic field elements of transformers 75 and 76 which, in addition to serving as means for magnetically coupling the windings of the plate and grid circuits, serve as means for energizing output circuits 49, 50 and 51 in output section 5 of the device and output circuits 52, 53, and 54 in the output section 6 of the device. These transformers 75 and 76 each have three magnetic paths or field pieces 77, 78 and 79 which come together so as to have primary portions of common extension 80. It is on these primary portions of common extension 80 that the windings 38—43 and 39—44 associated respectively with the tubes 16 and 17 are wound, as schematically shown in the drawing. The secondary coils of the output circuits 49, 50 and 51 are respectively wound on the secondary portions of separate field parts or cores 77, 78 and 79 of the transformer 75, and the secondary coils of the output circuits 52, 53 and 54 are separately wound on the secondary portions of the field parts or cores 77, 78 and 79 of

the transformer 76. The respective output circuits supply electrical energy to their respective potentiometers 55, 56, 57, 58, 59 and 60, good results being obtained where these potentiometers have a resistance of about 2,000 ohms. By the manner of applying primary and secondary windings to the separate cores 77, 78 and 79, I am able to avoid change in current strength in one of the output circuits when a potentiometer of another of the output circuits is adjusted to a different value. The respective output circuits 49 to 54 inclusive are connected with pairs of outlet receptacles for sockets 61 to 66 inclusive, for connection into the respective output circuits of body electrodes, by use of flexible insulated conductors. When the switch means, shown in section 2 of the device, connects the wires 40 and 41 with the conductor 23, current will flow in the plate circuit coils 38 and 39 of the multiple magnetic circuit transformers 75 and 76, inducing a voltage into the grid circuit coils 43 and 44, building up a bias in the grids of the tubes 16 and 17 and producing a feedback which causes the circuits to oscillate and produce a current wave form which is capable of tissue stimulation and muscle contraction in a manner very similar to that accomplished by motor nerve impulses. By a proper balancing of the impedances of the plate and grid circuits, I am enabled to obtain a frequency of oscillation in the output currents at what I have determined to be essentially or very close to the physiological rate of nerve impulse.

The gang switch G shown diagrammatically, operates in conjunction with the switch S to give four arrangements of circuits for four types of stimuli comprising fast intermittent, alternate energization, vibratory and slow intermittent. When the knob 30*a* is in its first position, as shown in the drawing, the moving contacts of the switch sections 30 to 33 inclusive will all engage the first stationary contacts. Then, at this time, contacts 27 and 29 will both be connected to the conductors 40 and 41. As the cam 25 rotates contact 24 will deliver current to contact 27 and then when the cam 25 moves contact 24 leftwardly, current will be delivered from contact 24 to contact 28 to contact 29, intermittently energizing the contacts 27 and 29 which are both connected to the conductors 41 and 40. This will produce in the oscillators of sections 3 and 4 forty surges per minute. When the knob 30*a* is moved to position 2, the moving contacts of the switch sections 30 to 33 inclusive will be brought into engagement with the second stationary contacts thereof. At this time, contact 29 will be connected only to conductor 40 and contact 27 will be connected only to conductor 41. Therefore, as the rotation of the cam 25 swings the contact 24 back and forth, the contacts 27 and 29 will be alternately connected to the conductor 23 and the plate circuits of the tubes 16 and 17 will be alternately connected to the conductor 23 and the three output circuits 49, 50 and 51 will be energized as a group, this being followed by energization of the output circuits 52, 53 and 54. This is referred to as the flexion-extension relation between any one or more of the output circuits 49, 50 and 51 with relation to any one or more of the output circuits 52, 53 and 54. One of the output circuits derived from the transformer 75 may be connected to a flexor muscle or muscles and one of the output circuits derived from the transformer 76 may be connected to an extensor muscle or muscles, with the result that back and forth movement of a bodily part is accomplished. When knob 30*a* is turned to position 3 thereof, the moving contacts of the switch sections 30 to 33 inclusive will engage the third stationary contacts thereof and conductors 40 and 41 will be connected by the switch sections 31 and 32 with conductor 70. Also, switch section 33 will connect the filaments of the tubes 16 and 17 with the conductor 70 through a resistor 74 and conductor 48. The plate circuit voltage will now be derived from coils 14 and 15 of the transformer 9, and a condenser 72 with bleed 73 are connected between conductor 48 and the conductor 47 leading to the grid circuit windings 43 and 44. Current increasing in plate coils 38 and 39 induces a voltage in the grid coils 43 and 44 respectively and a charging of the condenser 72 occurs. With each swing of oscillation in the oscillators, the condenser 72 charges up to a greater value so that the grid bias voltage furnished by the condenser reaches a value to cut off the tubes and stop oscillation. Then condenser 72 discharges through resistance 73, since the grid coil is no longer generating a charging voltage because of the blocking off of the plate current. As soon as the grid bias lowers sufficiently, a plate current again starts to build up, but oscillation lasts for only a few swings, as induced voltage in the grid circuit charges up condenser to block the tubes again. The result of the foregoing is to provide electrical impulses of a characteristic wave form and frequency, evidenced by a feeling of vibration when this current is applied to bodily parts. During the supply of this vibratory current the neon lamps glow continuously, but in the other settings of the knob 30*a* the neon indicator lamps glow only when there is current flow in the conductors 40 and 41.

When knob 30*a* is turned to position 4, the moving contacts of the switch sections 30 to 33 inclusive engage the fourth stationary contacts thereof, and switch sections 31 and 32 now act to connect both conductors 40 and 41 to switch contact 28, and the supply of plate current is now controlled entirely by contacts 24 and 28. If the cam 25 rotates at a rate of 20 R. P. M., causing contact 24 to engage contact 28 at this same frequency, periods of rest between the periods of energization will be substantially equal in time value. This is the slow surge or impulse rate embraced in the present embodiment of the invention.

I claim:

1. In a device for electrical treatment, utilizing electrical energy from a source of electrical potential: a timing switch comprising a cam and motor means to rotate the same, movable contact means adapted to be connected to said source of electrical potential and arranged to be moved back and forth as the result of rotation of said cam, a first contact arranged to be connected to said contact means when said contact means is moved back, and second and third contacts arranged to be sequentially connected to said moving contact means when said moving contact means is moved forth; a pair of tubes each having a plate, a cathode and a grid; transformer means associated with each of said tubes, each of said transformer means comprising a plurality of cores having portions of common extension, a grid circuit having a winding on said portions of common extension, a plate circuit having a winding on said portions of common extension, and separate output windings on said cores; and adjustable switch means operative to connect said first contact with the plate circuit of one of said tubes and the third contact with the plate cir-

cuit of the other of said tubes, operative to connect said first and third contacts with both of said plate circuits, operative to connect only said second contact to both of said plate circuits, and operative to connect both of said plate circuits directly to a source of electrical potential and connect a condenser in series with said grid circuit.

2. In a device for electrical treatment, utilizing electrical energy from a source of electrical potential; a timing switch comprising a cam and motor means to rotate the same, movable contact means adapted to be connected to said source of electrical potential and arranged to be moved back and forth as the result of rotation of said cam, a first contact arranged to be connected to said contact means when said contact means is moved back, and second and third contacts arranged to be sequentially connected to said moving contact means when said moving contact means is moved forth; a pair of tubes each having a plate, a cathode and a grid; transformer means associated with each of said tubes, each of said transformer means comprising a plurality of cores having portions of common extension, a grid circuit having a winding on said portions of common extension, a plate circuit having a winding on said portions of common extension, and separate output windings on said cores; and adjustable switch means operative to connect said first contact with the plate circuit of one of said tubes and the third contact with the plate circuit of the other of said tubes, operative to connect said first and third contacts with both of said plate circuits, and operative to connect only said second contact to both of said plate circuits.

3. In a device for electrical treatment, utilizing electrical energy from a source of electrical potential: a pair of tubes each having a plate, a cathode and a grid; transformer means connected with each of said tubes, each of said transformer means comprising a plurality of cores having primary portions of common extension and separate secondary portions, a grid circuit having a winding on said portions of common extension, a plate circuit having a winding on said portions of common extension, and separate output windings on said secondary portions of said cores; a power driven member and switch means operative by said power driven member and being adapted to intermittently connect said plate circuits simultaneously to said source of electrical potential, and to connect said plate circuits intermittently and alternately to said source of electrical potential.

4. In a device for electrical treatment, utilizing electrical energy from a source of electrical potential: a pair of tubes each having a plate, a cathode and a grid; transformer means connected with each of said tubes, each of said transformer means comprising a plurality of cores having primary portions of common extension and separate secondary portions, a grid circuit having a winding on said portions of common extension, a plate circuit having a winding on said portions of common extension, and separate output windings on said secondary portions of said cores; a power driven member; and switch means operative by said power driven member and being adapted to connect said plate circuits intermittently and alternately to said source of electrical potential.

5. In a device for electrical treatment, utilizing electrical energy from a source of electrical potential: a timing switch comprising a cam and motor means to rotate the same, movable contact means adapted to be connected to said source of electrical potential and arranged to be moved back and forth as the result of rotation of said cam, a first contact arranged to be connected to said contact means when said contact means is moved back, and second and third contacts arranged to be sequentially connected to said moving contact means when said moving contact means is moved forth; a pair of oscillator means each comprising a tube having a plate, a cathode and a grid, a plate circuit and a grid circuit; output circuits coupled to said oscillator means; and adjustable switch means operative to connect said first contact with the plate circuit of one of said tubes and the third contact with the plate circuit of the other of said tubes, operative to connect said first and third contacts with both of said plate circuits, operative to connect only said second contact to both of said plate circuits, and operative to connect both of said plate circuits directly to a source of electrical potential and connect a condenser in series with said grid circuit.

6. In a device for electrical treatment, utilizing electrical energy from a source of electrical potential: a timing switch comprising a cam and motor means to rotate the same, movable contact means adapted to be connected to said source of electrical potential and arranged to be moved back and forth as the result of rotation of said cam, a first contact arranged to be connected to said contact means when said contact means is moved back, and second and third contact arranged to be sequentially connected to said moving contact means when said moving contact means is moved forth; a pair of oscillator means each comprising a tube having a plate, a cathode and a grid, a plate circuit and a grid circuit; output circuits coupled to said oscillator means; and adjustable switch means operative to connect said first contact with the plate circuit of one of said tubes and the third contact with the plate circuit of the other of said tubes, operative to connect said first and third contacts with both of said plate circuits, and operative to connect only said second contact to both of said plate circuits.

7. In a device for electrical treatment, utilizing electrical energy from a source of electrical potential: a pair of oscillator means each comprising a tube having a plate, a cathode and a grid, a plate circuit and a grid circuit; output circuits coupled to said oscillator means a power driven member; and switch means operative by said power driven member and being adapted to intermittently connect said plate circuits simultaneously to said source of electrical potential, and to intermittently connect said plate circuits alternately to said source of electrical potential.

8. In a device for electrical treatment, utilizing electrical energy from a source of electrical potential: a pair of oscillator means each comprising a tube having a plate, a cathode and a grid, a plate circuit and a grid circuit; output circuits coupled to said oscillator means; a power driven member; and switch means operative by said power driven member and being adapted to connect said plate circuits intermittently and alternately to said source of electrical potential.

9. In a device for electrical treatment, utilizing electrical energy from a source of electrical potential: an electronic tube having a plate, a cathode and a grid; a plurality of transformer cores arranged so that they will have portions of

common extension; a plate circuit for said tube connecting the plate and cathode of said tube and having a winding on said portions of common extension of said cores; a grid circuit for said tube connecting the cathode and grid of said tube and having a winding on said portions of common extension; separate output circuits having windings on separate of said cores; and switch and conductor means adapted to energize said plate circuit from said source of electrical potential.

10. In a device for electrical treatment, utilizing electrical energy from a source of electrical potential: an electronic tube having a plate, a cathode and a grid; a plurality of transformer cores each comprising a primary portion and a secondary portion; plate and grid circuits for said tube both having windings on said primary portions of said cores whereby magnetic flux will be produced in all of said cores; separate output circuits having windings on separate secondary portions of said cores; and switch and conductor means adapted to energize said plate circuit from said source of electrical potential.

11. In a device for electrical treatment, utilizing electrical energy from a source of electrical potential: an electronic tube having a plate, a cathode and a grid; a plurality of transformer cores each having a primary portion and a secondary portion; a grid circuit for said tube having a conductor wound about the primary portion of each of said cores; a plate circuit for said tube having a conductor wound about the primary portion of each of said cores; separate output circuits having windings on the secondary portions on each of said cores; and switch and conductor means adapted to energize said plate circuit from said source of electrical potential.

12. In an electrical device for exercising human musculature in flexion-extension relation: a pair of output circuits having outlet means for connecting one of said circuits in series with a flexor muscle and the other of said circuits in series with an extensor muscle opposite said flexor muscle, oscillator means for generating, when energized,

musculature contracting currents in said output circuits, means adapted to connect said oscillator means to a source of electrical potential, switch means connected to said oscillator means and being operative to effect delivery of musculature contracting currents from said oscillator means alternately to said output circuits and power driven means connected to said switch means for continuously operating said switch means whereby said flexor muscle and said extensor muscle are alternately contracted by said contracting currents to exercise the musculature.

13. In an electrical device for treating human tissues in flexion-extension relation, from a source of electrical potential: a pair of output circuits having electrode means for connecting said circuits in series with selected portions of the body; and means for alternately flowing contractile current through said circuits comprising oscillator means comprising an electronic tube means having a plate, grid and cathode, a transformer core means, plate and grid circuits for said tube means, each having a winding on said transformer core means and an output winding on said transformer core means connected to said output circuits, said oscillator means being adapted when energized to deliver contractile current to said ouput circuits, means adapted to connect said oscillator means to said source of electrical potential, and alternating switch means connected to said oscillator means and being operative to effect delivery of contractile current from said oscillator means alternately to said output circuits.

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