

Sept. 25, 1962

W. J. BROWNER

3,055,372

DEVICE FOR ELECTRICAL TREATMENT OF BODILY TISSUES

Filed Feb. 11, 1960

4 Sheets-Sheet 1

Fig. 1.

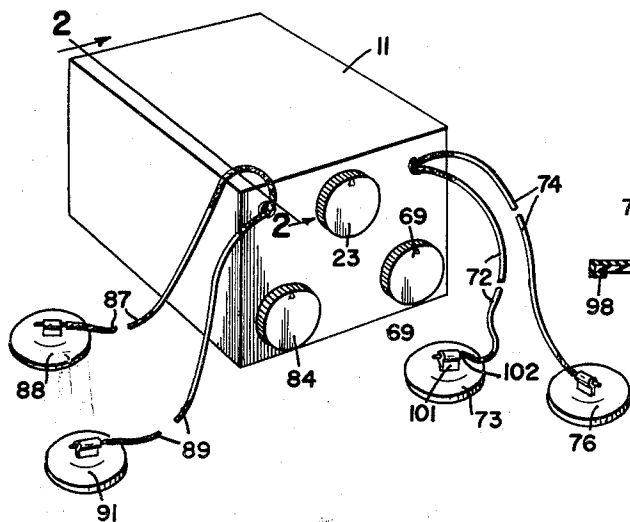


Fig. 6.

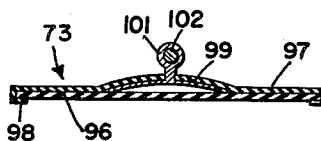


Fig. 2.

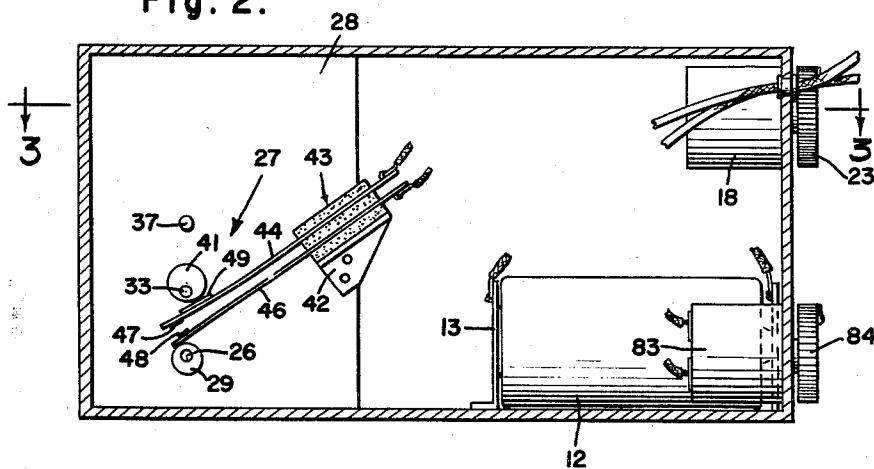
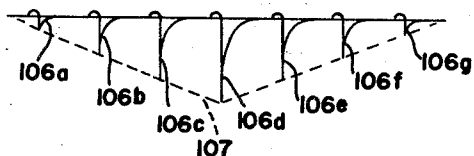


Fig. 5.



INVENTOR.

William J. Browner

BY

Townsend, Townsend and Caplan
attorneys

Sept. 25, 1962

W. J. BROWNER

3,055,372

DEVICE FOR ELECTRICAL TREATMENT OF BODILY TISSUES

Filed Feb. 11, 1960

4 Sheets-Sheet 2

Fig. 3.

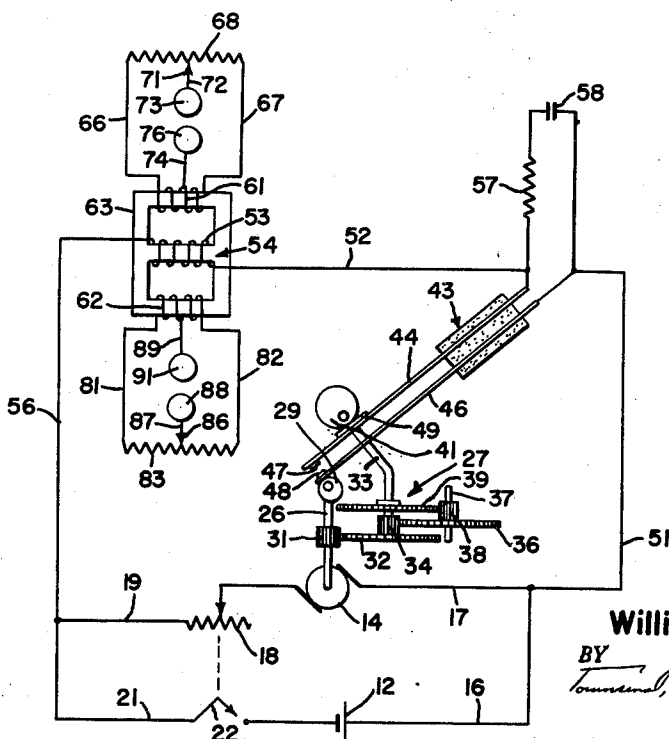
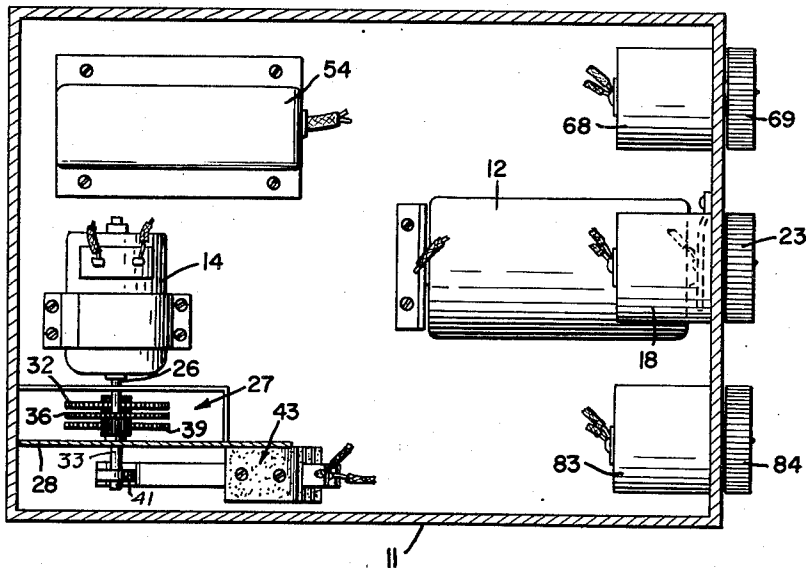


Fig. 4.

INVENTOR.
William J. Browner
BY
Townsend, Townsend and Caplan
attorneys

Sept. 25, 1962

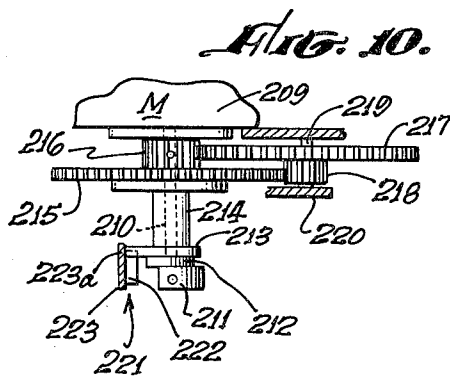
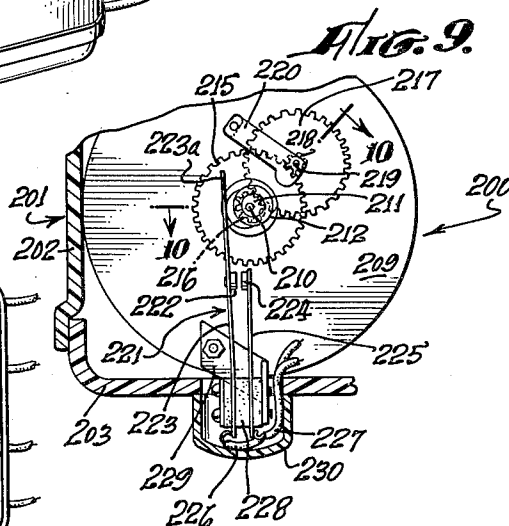
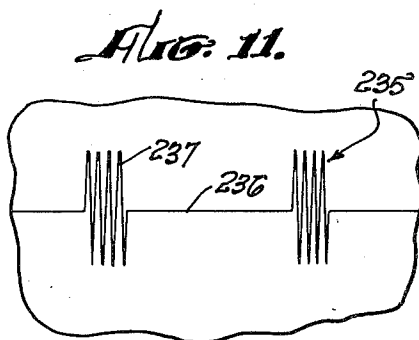
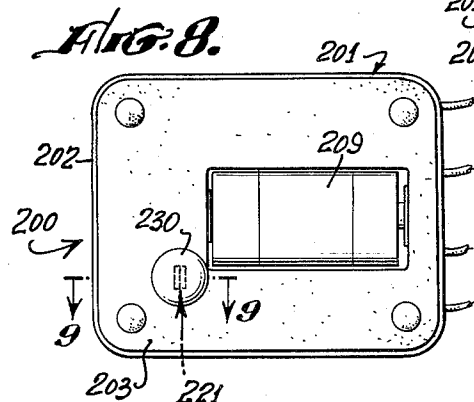
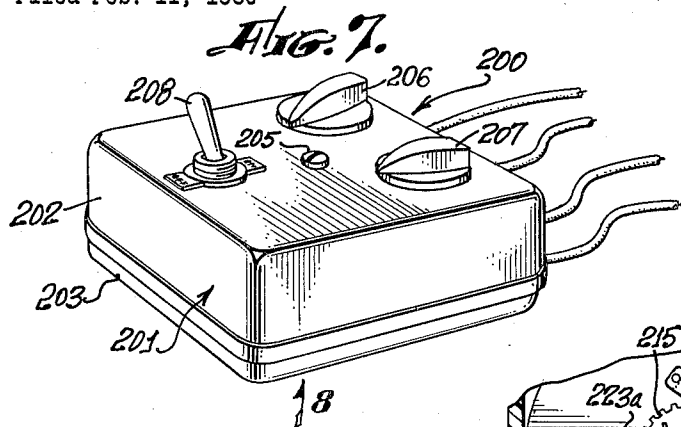
W. J. BROWNER

3,055,372

DEVICE FOR ELECTRICAL TREATMENT OF BODILY TISSUES

Filed Feb. 11, 1960

4 Sheets-Sheet 3



WILLIAM J. BROWNER,
INVENTOR.

BY *Spensley and Hahn*

ATTORNEYS.

Sept. 25, 1962

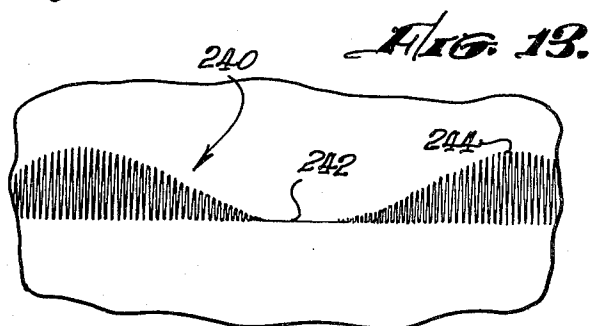
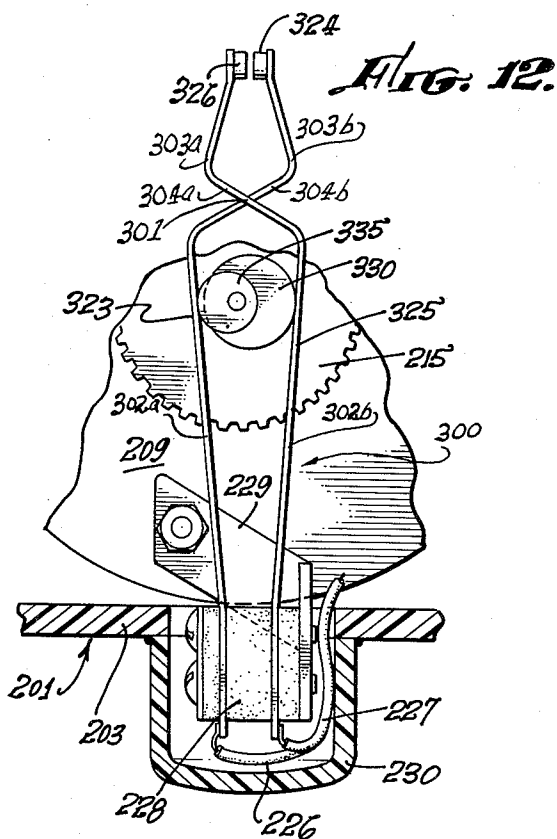
W. J. BROWNER

3,055,372

DEVICE FOR ELECTRICAL TREATMENT OF BODILY TISSUES

Filed Feb. 11, 1960

4 Sheets-Sheet 4



WILLIAM J. BROWNER,
INVENTOR.

BY *Spensley and Hahn*

ATTORNEYS.

1

3,055,372

DEVICE FOR ELECTRICAL TREATMENT OF BODILY TISSUES

William J. Browner, San Mateo, Calif., assignor to Relaxacizor, Inc., Los Angeles, Calif., a corporation of California

Filed Feb. 11, 1960, Ser. No. 10,532
3 Claims. (Cl. 128—421)

This invention relates to a new and improved device for electrical treatment of bodily tissues wherein a pulsating electrical current is passed through bodily tissues and wherein the wave form of the current is controlled by mechanical means preferably driven by an electric motor.

This application is a continuation in part of co-pending (now abandoned) U.S. patent application Serial No. 765,348, filed October 6, 1958, entitled "Device for Electrical Treatment of Bodily Tissues."

The invention relates generally to electrical therapy for stimulation of the tissues of the human body and for producing muscular response and contractions for the purpose of improving the tone and general health of bodily parts. An oscillatory electrical current, very similar to the wave form of bodily nerve currents, is generated in the present invention by a novel means.

A general object of this invention is to produce a therapeutic current of greater effectiveness. Such current is characterized by ability to give exceptionally good response or contraction with extremely low current values, and without any burning or stinging sensation where the electrodes contact surfaces of the body.

A further object of the invention is to provide a device of simple form and ruggedness to produce the desired current wave slopes hereinafter to be described in greater detail. Control of the current is accomplished primarily by means of a motor rotating a pair of cams at different speeds, the cams controlling vibration of a switch including resilient cooperating arms so as to produce the required wave shape.

The oscillatory current which is desired for therapeutic treatment with which this invention is concerned is a particular type hereinafter illustrated and described. The wave shape or form is preferably made up of a series of pulsations. Each individual pulsation is substantially unidirectional and of a controlled duration and controlled frequency. Major groupings of individual pulsations are generated. In accordance with the presently preferred embodiment of this invention, each major group consists of a plurality of pulsations which gradually increase in amplitude to a peak and then gradually decrease from this peak. Thus, the envelope of each major pulsation shows a generally sloping curve which rises to a peak and then diminishes at about the same slope as the rise. This generally corresponds to the nerve currents of the human body. The major pulsations are also spaced apart in time at a frequency which is desirable for therapeutic treatment.

The present invention provides means for controlling the currents so that the major pulsations are spaced apart in predetermined time intervals, and such time intervals may be controlled by the user of the device. Additionally, the frequency of the individual pulsations is effectively controlled and the gradual increase and decrease of the amplitude of the pulsations are also controlled.

A further feature of the invention is the compact, inexpensive, and rugged construction.

Another feature of the present invention is the fact that the current requirements for its operation are small, so that a conventional flashlight battery may be used as the sole source of current.

2

A still further feature of the invention is its ready portability and the absence of the requirement of an electrical outlet as a source of current.

A further feature of the invention is the use of a potentiometer connected to one of the electrodes which are connected to the human body in a circuit so that the direction of the current through the pad may be reversed and the amplitude thereof may be varied. This control is desirable in therapeutic treatments since reversal of the direction of the current is important in treatment of certain portions of the body.

The novel features which are believed to be characteristic of the invention, together with further objects and advantages thereof, will be better understood from the following description considered in connection with the accompanying drawings in which a presently preferred embodiment of the invention is illustrated by way of example. It is to be expressly understood, however, that the drawings are for the purpose of illustration and description only, and are not intended as a definition of the limits of the invention.

In the drawings:

FIGURE 1 is a perspective view of a device constructed in accordance with this invention;

FIGURE 2 is a sectional view taken along line 2—2 of FIGURE 1;

FIGURE 3 is a sectional view taken along line 3—3 of FIGURE 2;

FIGURE 4 is a wiring diagram of the device of FIGURES 1, 2 and 3;

FIGURE 5 is a schematic view of the wave form generated by the device of FIGURES 1—4;

FIGURE 6 is an enlarged fragmentary sectional view through one of the pads applied to the body;

FIGURE 7 is a perspective view of an alternative embodiment of the present invention device;

FIGURE 8 is a view looking in the direction of the arrow 8 in FIGURE 7;

FIGURE 9 is a view taken along line 9—9 of FIGURE 8;

FIGURE 10 is a view taken along line 10—10 of FIGURE 9;

FIGURE 11 is a schematic view of the wave form generated by the device of FIGURES 7—10;

FIGURE 12 is a schematic view similar to that of FIGURE 9 of a second alternative embodiment of the present invention; and

FIGURE 13 is a schematic view of the wave form generated by the wave device of FIGURE 12.

Referring now to the drawings and more particularly to FIGURE 1, there is shown, in perspective, an exemplary device in accordance with the present invention. The device is contained in a small portable casing 11 which contains all of the elements hereinafter to be described. Positioned within the casing 11 is a flashlight battery 12 which is held in place by bracket 13, as may best be seen in FIGURE 2. Battery 12 is preferably of the type rated at 1½ volts. In actual practice the voltage of such a battery generally decreases with use. The present invention device is designed to operate at voltages lower than the 1½ volts at which the battery is rated. Thus, a voltage as low as 0.6 volt can be employed. The battery 12 operates a motor 14 and additionally provides the power source of the therapeutic current. Motor 14 is connected in series with battery 12 through leads 16 and 17, rheostat 18, lead wire 19, and on-off switch 22. This may best be seen in FIGURE 4. By adjustment of externally positioned knob 23 which controls rheostat 18, the speed of motor 14 may be varied to control the desired frequencies of the major groupings of pulsations and also to provide adjustment as the strength of the battery 12 diminishes with use.

The motor 14 drives a shaft 26 which is connected into gear box 27. The shaft 26 extends through the side 28 of the box 27 and rotates an eccentric cam 29 which is coupled at the end of the shaft. Shaft 26 also drives a pinion gear 31 which meshes with a gear 32 at a 4:1 ratio. Gear 32 is rotatably mounted upon a counter shaft 33. Gear 32 is fixed for rotation with pinion gear 34 which is likewise mounted on but rotatable relative to counter shaft 33. Pinion gear 34 meshes with a gear 36 mounted on a secondary counter shaft 37 at a 4:1 ratio. A pinion gear 38 rotates with gear 36 and meshes with a gear 39 fixed for rotation with the counter shaft 33. The pinion gear 38 meshes with the gear 39 at a 4:1 ratio. Accordingly, shaft 26 rotates at a speed 64 times as great as the speed of rotation of the shaft 33, the overall gear ratio of the gear box 27 being 64:1. The shaft 33 which has the gear 32 mounted upon one end has the other end thereof projecting through the side 28 and rotatably carried on this end is a second cam 41.

For purposes of clarity of explanation, the two cams 29 and 41 are shown in FIGURE 4 rotated through an angle of 90° with respect to the shafts which drive them. The correct position of these cams relative to the leaf spring switch hereinafter to be described is correctly shown in FIGURE 2.

In FIGURE 2 there is shown mounted on side 28 by means of a bracket 42 a switch generally designated by reference numeral 43. Switch 43 has a pair of downwardly slanting flexible leaves 44 and 46 carrying adjacent their outer ends contacts 47 and 48 respectively. Leaf 46 is caused to vibrate by cam 29 which, as it revolves, raises and lowers the contact point 48 relative to contact 47. Cam 41 controls vibration of leaf 44 in a similar manner. An insulator 49 is disposed on the leaf 44 to insulate the same from the cam 41. The leaves 44 and 46 are biased toward each other by the cams 29 and 41 which, upon rotation thereof, move the outer ends of the leaves 44 and 46 further toward and away from each other. The relative speeds of rotation of cams 29 and 41 control the wave form of the current as will hereinafter be explained.

Again, referring to FIGURE 4, leaf 46 is shown to be connected to the positive terminal of battery 12 by means of lead wires 51 and 16. Leaf 44 of switch 43 is connected by lead wire 52 to primary winding 53 of a transformer 54 which includes two secondary windings 61 and 62. The opposite end of winding 53 is connected by means of lead wires 56 and 21 through switch 22 to the negative terminal of battery 12. A spark suppressor consisting of resistance means 57 and capacitance means 58 which are connected in series is placed across the terminals of leaves 44 and 46 in order to minimize contact wear on contacts 47 and 48 of switch 43.

The transformer 54 is preferably of the type having two secondary windings, as shown schematically in FIGURE 4. This is accomplished by the peculiar shape of lamination 63. The secondary winding 61 is connected by electrical leads 66 and 67 to a potentiometer 68 which is controlled by external knob 69 (see FIG. 3). The potentiometer 68 has a movable tap 71 which is connected by a lead wire 72 of extended length to a first body contact pad 73. A lead wire 74 is tapped into the middle of the secondary winding 61 and leads to the second body contact pad 76. The movable contact arm 71 of potentiometer 68 is shown in the midposition in FIGURE 4. Thus, the resultant flow of current through the pads 73 and 76 will be zero. By moving the tap 71 to the left or the right by rotation of knob 69 the direction of resultant current flow is controlled, as is the amplitude thereof through the pads 73 and 76.

The other secondary winding 62 is similarly connected by leads 81 and 82 to a second potentiometer 83 which is controlled by an external knob 84 (see FIG. 1). The knob 84 controls a movable tap 86 of potentiometer 83, which movable tap is connected by a lead wire 87 of ex-

tended length to a third body contact pad 88. A center tap of secondary coil 62 is connected by a lead wire 89, also of extended length, to a fourth body contact pad 91. The pairs of pads 73—76 and 88—91 may be used when it is desired to simultaneously treat both the contractor and extensor of a set of muscles. It will be appreciated that any reasonable number of pad sets exceeding the two shown may be used by providing additional secondary windings and associated elements.

An exemplary pad such as 73 is shown in detail in FIGURE 6. It will, of course, be understood that other pads capable of conducting current to muscles of the body by providing a large area, low-resistance contact may be used. Pad 73 employs a section of electro-conductive rubber 96 which is in surface contact with the skin of the user. A flexible nonconductive plastic casing 97 covers the back of section 96 and has a turned-in peripheral edge 98 which holds the conductive rubber section 96 in place. A bowed clip 99 is positioned between casing 97 and section 96 and is in electrical contact with section 96. The clip 99 projects out through casing 97 and is provided with a terminal 101 which receives pin 102 fastened to the end of wire 72.

The output wave generated at each of the pads is shown schematically in FIGURE 5. The wave form is made up of a plurality of pulsations 106a through 106g which are shown as a major pulse grouping, the envelope of which is indicated by the dotted line 107 in FIGURE 5. Taking as representative the individual pulsation 106d, of maximum amplitude, it will be seen that this pulsation is of a generally sawtooth shape which is slightly oscillatory in configuration and which is primarily unidirectional. Under load, the shape approaches that of a sine wave. The amplitude of pulsations 106a through 106d gradually increases as is shown by the dotted line 107, looking from left to right, and then the amplitude of the pulsations 106d to 106g decreases.

Upon completion of a major pulse grouping, another succeeding pulse group is generated after a discrete time interval. The time interval between the beginning of each of the major pulse groupings 107 is controlled by the cam 41 and is, for the gear box 27 herein illustrated and described, equal to 64 times the time interval between the pulsations 106a and 106b. When desired, the ratio of the time interval between the beginning of major pulse groupings and the time interval between individual pulses in a group can be altered by changing the overall gear ratio of the gear box 27. Further, the time interval between the beginning of major pulse groupings can be adjusted by regulation of the speed of motor 14 by adjustment of rheostat 18 or by equivalent means.

The time interval between each individual pulsation such as the pulsations 106a and 106b is determined by the speed of rotation of cam 26. Hence cam 41 causes leaf 44 to vibrate at one frequency and cam 49 causes the other leaf 46 to vibrate at a different frequency. The shape of the dotted line 107 is caused by the rotation of cam 41 resulting in a gradual movement of the outer end of the leaf 44 toward and away from the leaf 46. The movement of the leaf 44 away from the leaf 46 proceeds to a point beyond which the vibration introduced by cam 41 no longer will result in any pulsations at all, i.e., the contacts 47 and 48 are periodically closed for progressively shorter periods of time until they no longer close at all. Similarly, as the rotation of the cam 41 urges the outer end of the leaf 44 closer to the vibrating leaf 46 the contacts 47 and 48 will eventually momentarily close and then subsequently close for successively longer periods of time. The longer the switch contacts 47 and 48 are closed, the greater the build-up of current in the primary winding 53 of the transformer 54 and the larger the magnitude of the voltage pulse induced in the secondary winding upon opening of the contacts. This condition is illustrated by the pulses 106a through 106d

of FIGURE 5. The frequency, of course, is determined by the other faster rotating cam. That is, pulsations are produced by the vibration introduced by the cam 29 and the amplitude thereof is controlled by the shape of cam 41.

In a preferred embodiment of the invention herein illustrated the voltage of the battery 12 can vary between a maximum of 1.5 volts and a minimum of 0.6 volt. The speed of motor 14 accordingly varies between 4000 r.p.m. (67 c.p.s.) and 1000 r.p.m. (17 c.p.s.). Inasmuch as it has been found that a preferred frequency vibration of individual pulsations 106a to 106g is 30 c.p.s., the range available from the common flashlight battery will be seen to cover the ideal frequency. Assuming the same voltage range, the corresponding speed of shaft 33 then becomes a maximum of 62 r.p.m. and a minimum of 15 r.p.m. and this results in a range of from 62 to 15 contractions of the muscle being treated per minute. The individual pulsations 106 have a peak wavelength of about 0.15 millisecond. This equals the equivalent of .066 millisecond, square wave.

For the sake of clarity of understanding in the wiring diagram of FIGURE 4, certain values of the electric components are indicated. It will be understood that these values are subject to considerable variation. Thus, battery 12 may be rated at 1.5 volts. Rheostat 18 is preferably 2 or 3 ohms. Motor 14 is preferably rated at 3,800 r.p.m. and is of the type commonly used on battery operated toys. Resistor 57 is rated at 33 ohms for one-half volt. Capacitance 58 is rated at 0.01 microfarad at 200 volts. Transformer 54 has a primary of 125 turns and each of the secondaries has 500 turns. The potentiometers 68 and 83 are each rated at 10 ohms.

Thus, in use, either or both groups of pads 73—76 or 88—91 may be used depending upon the portion of the body being treated. The pads are brought in contact with the prescribed portions of the surface of the body. Switch 22 is turned on and rheostat 18 adjusted by means of external knob 23. The speed of motor 14 produces the desired time interval between the beginning of the major pulse groupings. The adjustment of rheostat 18 may be used to compensate for decrease in the strength of battery 12. The knobs 69 and/or 84 are adjusted so that the direction of current flow through the pads is as desired and the maximum amplitude of the individual pulsation is as desired. Motor 14 causes the cams 29 and 41 to revolve and this produces the individual pulsations 106a—106g and also the spacing between the major pulse groupings by controlling the times during which electrical energy is fed to the primary winding 53 of the transformer 54, in the manner heretofore explained. Treatment is continued as long as desired.

The foregoing description and accompanying illustrations show that a very light weight, portable device may be driven by a single flashlight battery 12 which produces the desired therapeutic effect wherein sets of muscles may be conditioned by application of currents simulating human motor nerve currents and wherein the adjustments of such currents are controlled as hereinbefore indicated. For treatment of small bodily muscles, a major pulse grouping duration (the time interval between pulses 106a and 106g) of the range of 60 microseconds may be achieved; for larger muscles, a duration of .4 to .5 millisecond.

Although the embodiment of FIGURE 4 illustrates transformer coupling for energization of the body contact pads, other suitable means of output coupling will be apparent to those skilled in the art. For example, the body pads may be resistively coupled to the circuit of FIGURE 4 merely by connecting a potentiometer across the switch leaves 44 and 46 with one pad connected to the movable arm of the potentiometer and the other pad connected to the leaf 44. When utilizing resistive coupling, the transformer 54 functions merely as a choke coil, and hence an iron core choke may be connected to

the electrical leads 52 and 56 instead of the transformer primary 53. In such cases, variations in current through the choke coil cause correspondingly similar variations in the voltage drop across the potentiometer connected in series with the choke coil. Hence, the body pads are again energized in accordance with variations in the flow of current through an induction coil.

In FIGURE 7 there is shown a perspective view of an alternate compact unit 200 in accordance with the present invention and containing circuitry in accordance with the schematic diagram of FIGURE 4. The unit 200 is contained within a substantially square shaped relatively thin plastic box 201 including two matable portions. The upper portion is designated by the numeral 202 and the lower portion by the numeral 203. The upper and lower portions are fastened together by a screw 205. Two knobs 206 and 207 are shown in FIGURE 7 and function as the knobs 69 and 84 of the FIGURES 1—4 unit hereinabove described. Switch 208 is an on-off switch functioning as switch 22 in FIGURE 4, and serves to open and close the circuit including the battery 204 which is shown in FIGURE 8.

A motor 209 drives a gear train through shaft 210. Two eccentric cams 211 and 213 are concentrically mounted upon two concentric shafts 210 and 214. The shaft 214 is rotatably disposed upon the shaft 210. A large gear 215 is fastened to shaft 214, this gear being rotatable on shaft 210. The first cam 211 is directly driven by the shaft 210. The second cam 213 is driven at a different speed by shaft 214 which is mounted on gear 215. The speed of rotation of the two cams is determined by the gear train consisting of pinion gear 216 which is fastened to the shaft 210, large gear 217 which is driven by gear 216 and pinion gear 218 which is mounted on shaft 219, which is the same shaft upon which gear 217 is fastened. A support bracket 220 for the gear train is shown in FIGURE 10. The contact assembly, which produces the pulses for the bodily current, is indicated as 221 in FIGURES 8, 9 and 10. The contact assembly consists of two leaf springs or arms designated by the numerals 223 and 225. It will be noted in FIGURE 9 that arm 223 extends further from the insulated block 228 which supports both arms than does arm 225. A contact is provided on each of the arms 223 and 225, these contacts being designated as 222 and 224. These two contacts 222 and 224 are both mounted on the inner face of their respective contact arms 223 and 225. Both cams 211 and 213 are disposed to bear against arm 223, the extension of arm 223 being designated as 223a.

Cam 213 is somewhat larger in diameter than cam 211 as may best be seen in FIGURE 10. A shoulder 212 is provided between the two cams 211 and 213 in order to separate them. In this specific embodiment the larger cam 213 rotates at a speed at approximately 40 r.p.m. while the smaller cam rotates at a speed of approximately 2000 r.p.m. (the speed of the motor 209). The larger cam 213 results in a sufficient separation between the contacts 222 and 224 once during every revolution thereof so as to preclude the passage of current between the two contacts. The smaller cam 211, during the time that the contacts are close enough to permit current to flow therebetween, results in a rapid opening and closing of the circuit to produce a plurality of pulses of substantially constant amplitude at the output leads 226 and 227 shown in FIGURE 9. Thus, the overall wave shape produced by the action of both cams 211 and 213 in cooperation with the contact extension 223a appears as shown in FIGURE 11. Therein, each of the pulses 237 represents each rotation of the smaller and faster rotating cam 211 while the line 236 indicates zero output during the time when the larger and slower cam 213 is in the extreme position as shown in FIGURE 10 resulting in an open circuit condition. That is, while the cam 213 is in the extreme position of FIGURE 10, regardless of the lateral

movement in extension 223a no contacting will occur between the contacts 222 and 224 as the maximum diameter of the cam 211 is smaller than the maximum diameter of the cam 213. However, since the maximum diameter of the cam 211 is greater than the minimum diameter of the cam 213, during that portion of the rotation of cam 213 wherein it does not bear against the arm extension 223a, the contacts will be opened and closed a plurality of times by rotation of the cam 211 which can then contact the arm extension 223a during portions of its rotation. The series of pulses 235 which are the second series of pulses looking from left to right will, of course, be of the same number and amplitude as the first series. The distance between the series of pulses 235 is dependent upon the shape of cam 213, its size and its speed of rotation, all of which may be appropriately varied in accordance with the output desired. In this embodiment the envelope of the pulses assumes a generally rectangular shape. The time represented by the zero line 236 represents the relaxed period between the surges or pulses. The overall output from this type of arrangement is known as spasm and relax (rather than surge and relax as shown in FIGURE 5) wherein the envelope of the pulses builds up and decreases gradually rather than abruptly assuming a generally triangular shape.

In the bottom view of the unit, FIGURE 8, there is shown a housing bubble 230 which may be made of plastic in order to accommodate the extending insulator block 228 which supports the two leaves 223 and 225 forming part of the contact assembly 221. There is thus shown in FIGURES 7-10 a simplified unit which will produce spasm and relax pulses by two cams operating on a single extension of a two-leaf contact switch.

Referring now to FIGURE 12, there is shown an enlarged view of a second alternate switch and cam arrangement which may be used in accordance with the present invention to perform the function of the switch 43 and the motor driven gear and the cam arrangement in the schematic diagram of FIGURE 4. This particular arrangement results in a surge and relax rather than a spasm and relax type wave shape, and is shown in FIGURE 13. This wave shape is quite similar to that produced by the device of FIGURES 1-4 which is shown in FIGURE 5 except that the polarity of the pulses is reversed. The output wave shape produced by the FIGURE 12 embodiment is shown in FIGURE 13. During the interval when the larger cam separates the contacts 324 and 326 no output occurs regardless of the vibration produced by the smaller and faster revolving cam. The zero output during this period is designated as 242. The individual pulses which are produced are designated by the number 244. These pulses build up from a very low value to a peak value and then they decrease in amplitude. The frequency, however, remains substantially constant. This is due to the fact that during rotation of the large eccentric cam the time that the contacts 324 and 326 are closed gradually diminishes from a relatively long time to a relatively short time and thereafter increases again as the cam continues to rotate urging the contact 326 from an extreme left hand to an extreme right hand position when viewing FIGURE 12. The envelopes of the individual pulses 244 are designated by the numeral 240. The polarity of the output signals is, of course, optional, it depending upon the manner in which the electrodes are wired to the battery. In this embodiment an improved contact assembly is employed; it is generally designated by the numeral 300. The assembly 300 includes two generally flat opposing contact leaves 323 and 325. These leaves are arranged to provide a "clothes pin" type action. That is, they are crossed over with respect to each other at point 301. The leaf 323 includes a substantially vertical elongated extension 302a, an oblique section 304b, and an end section 303b carrying the contact 324. The leaf 325 includes a substantially vertical

elongate extension 302b, an oblique section 304a, and an end section 303a carrying the contact 326. In the vicinity of the crossover point 301 the oblique sections 304a and 304b are further bent in a plane at an angle with the viewing surface so that the contacts 324 and 326 affixed to the end sections 303a and 303b will be in the same plane. Thus the contacts 324 and 326 will be brought together upon separation of the end sections 302a and 302b, with the distance between the contacts being proportional to the separation. In the FIGURE 12 embodiment, two cams, 330 and 335 are employed in a manner quite similar to that hereinabove described with reference to FIGURE 9. That is, both cams are driven by two concentric shafts through a gear train similar to that shown in FIGURES 9 and 10. Here again the smaller cam 335 will be driven at a considerably faster speed of rotation than will the larger cam 330. In this particular embodiment, however, the cams urge the two leaves 323 and 325 apart in the vicinity of the elongate extensions 302a and 302b in order to produce the make and break between the contacts 324 and 326. This particular arrangement results in a more uniform pulse, reduces wear on the contacts and contact arms and is generally easier to manufacture and adjust. In all other respects, the cam and contact assembly of FIGURE 12 is similar to that hereinabove described.

It should further be noted in this embodiment that cam 335 is in the same plane as is leaf 323 while cam 330 is in a plane therebehind with the other leaf 325. Thus each cam serves to vibrate but one leaf and at different amplitudes and different frequencies. Of course, the amplitude and frequency of these vibrations may be selectively chosen by the shape of the cams, their size and their speed of rotation, the latter of which is dependent upon the speed of the motor and the gear train mechanism. In this particular embodiment it was found most convenient and advantageous to choose the shape of both cams as round, the vibrations resulting from the eccentric mounting of the cams. By this design, uniformity from device to device in production is obviously easier to achieve than the circumstance where either one or both of the cams are irregularly shaped. It will, of course, be understood that irregularly shaped cams may be employed in this or the other embodiments of the present invention device.

There has thus been described a new and improved readily portable device for electrical treatment of bodily tissues which is compact, and includes novel design features which render it extremely reliable, and relatively simple to manufacture.

What is claimed as new is:

1. In a device for electrical contraction of muscular tissues: a source of direct current potential; a motor driven by said potential source; a control switch and an induction coil electrically connected in series across said potential source, said control switch having a pair of extended contact leaves arranged to make and break current flow therethrough by relative vibration of said leaves; a first cam driven by said motor at a first speed, said first cam being positioned and so constructed and arranged as to produce during a portion of its cycle a relative vibration between said two leaves at a first predetermined frequency and amplitude; a second cam driven by said motor at a second speed substantially different from said first speed, said second cam being positioned and so constructed and arranged as to produce during a portion of its cycle a relative vibration between said two leaves at a second predetermined frequency and amplitude, said contact leaves being successively opened and closed at predetermined time intervals by the resultant vibrations between said two leaves caused by rotation of said first and second cams to thereby apply successive controlled pulses of electrical current to said induction coil; and means coupling said induction coil to body tissues for the application to said body tissues of voltage

pulses varying in accordance with variations in the flow of current through said induction coil.

2. In a device for electrical contraction of muscular tissues in which the tissues are contracted by pulses of electrical current through low resistance pads in contact with said tissues, the improvement comprising means for generating said pulses, said means including: a source of direct current potential; a direct current motor driven by said potential source; a spring biased switch and an induction coil electrically connected in series across said potential source, said switch having a pair of extending oppositely disposed contact leaves arranged to make and break the current flow through said induction coil by relative vibration of said leaves; a first cam driven by said motor at a first speed, said first cam being positioned and so constructed and arranged as to produce during a portion of its cycle a relative vibration between the said two leaves at a first predetermined frequency and amplitude; a second cam driven by said motor at a second speed different from said first speed, said second cam being positioned and so constructed and arranged as to produce during a portion of its cycle a relative vibration between said two leaves at a second predetermined frequency and amplitude, said contact leaves being successively opened and closed at predetermined time intervals by the resultant vibrations between said two leaves caused by rotation of said first and second cams to thereby apply successive controlled pulses of electrical current to said induction coil; and means for electrically coupling said induction coil to said low resistance pads to apply to said body tissues voltage pulses which vary in accordance with variations in the flow of current through said induction coil.

3. In a device for electrical contraction of muscular tissues: a source of direct current potential; a motor driven by said potential source; a control switch and a trans-

former primary winding electrically connected in series across said potential source, said control switch having a pair of extended oppositely disposed flexible contact leaves arranged to make and break current flow through said primary winding by relative vibration of said leaves; a first cam driven by said motor at a first speed and positioned during a portion of its cycle to produce a relative vibration between said two leaves at a first predetermined frequency and amplitude; a second cam driven by said motor at a second speed materially different from said first speed and positioned during a portion of its cycle to produce a relative vibration between said two leaves at a second predetermined frequency and amplitude, said contact leaves being successively opened and closed at predetermined time intervals by the resultant vibrations between said two leaves caused by rotation of said first and said second cams to thereby apply successive controlled pulses of electrical current to said transformer primary winding; at least one transformer secondary winding inductably energized by said primary winding; and a pair of body contact pads connected to said secondary winding and adapted when in contact with the human body to complete a circuit through said secondary winding.

References Cited in the file of this patent

UNITED STATES PATENTS

1,820,242	Niemann et al.	Aug. 25, 1931
1,908,688	Call	May 16, 1933
2,004,751	Fischer et al.	June 11, 1935
2,182,223	Dobert	Dec. 5, 1939
2,838,672	Paust	June 10, 1958
2,842,135	Browner	July 8, 1958

FOREIGN PATENTS

523,882	Canada	Apr. 17, 1956
---------	--------------	---------------