July 10, 1945. M. CROSSE ET AL 2,379,884

ELECTRO-THERAPEUTIC DEVICE

Filed Dec. 9, 1941 2 Sheets-Sheet 1

Fig. 1.

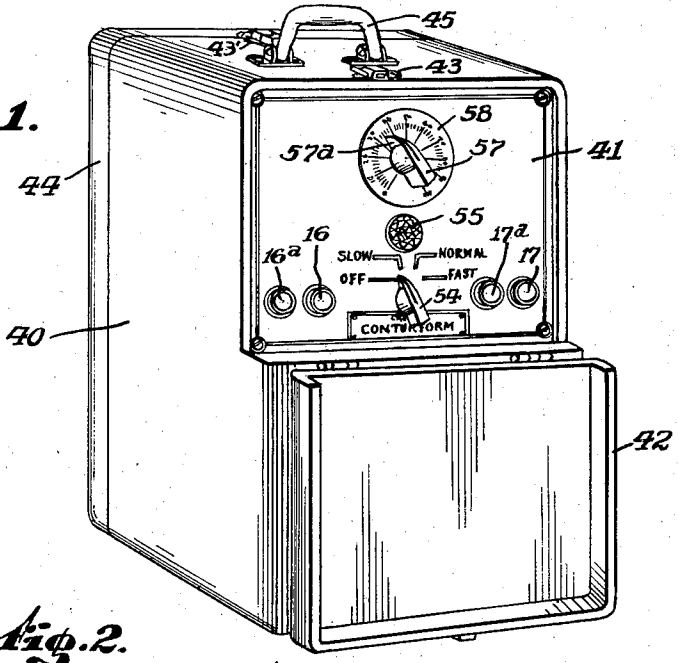

Fig. 2.

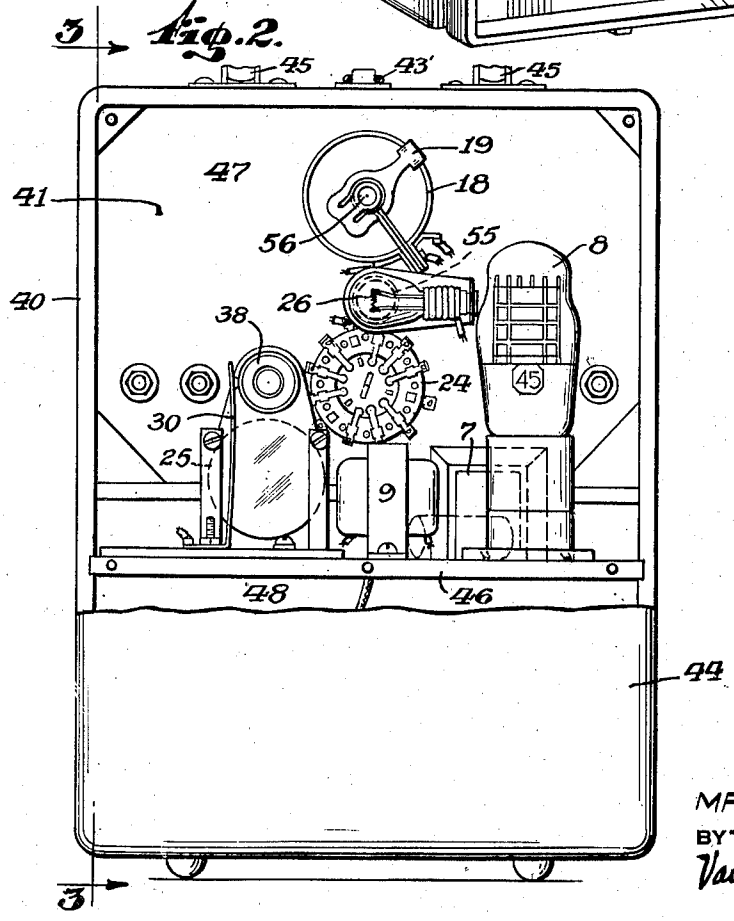

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Fig. 3.

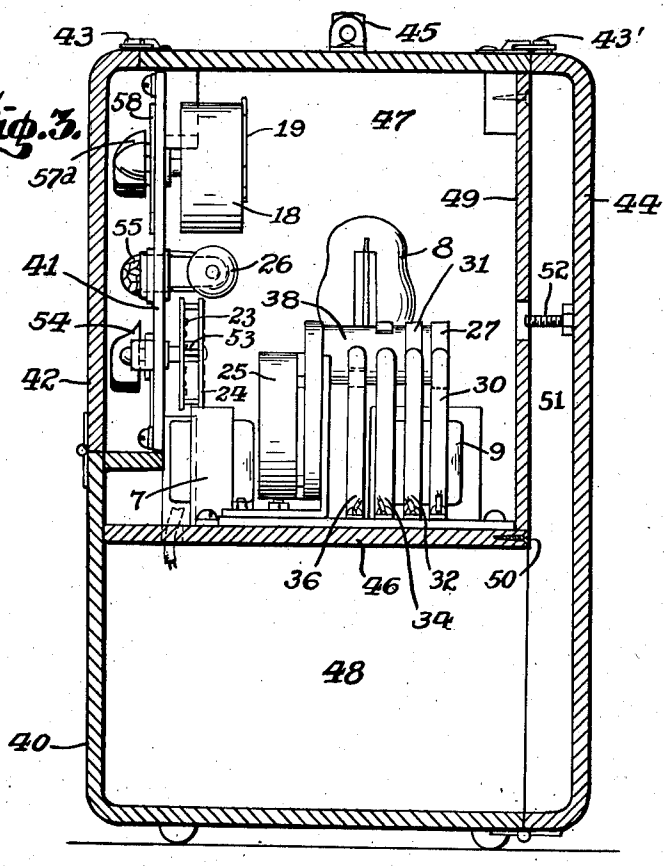
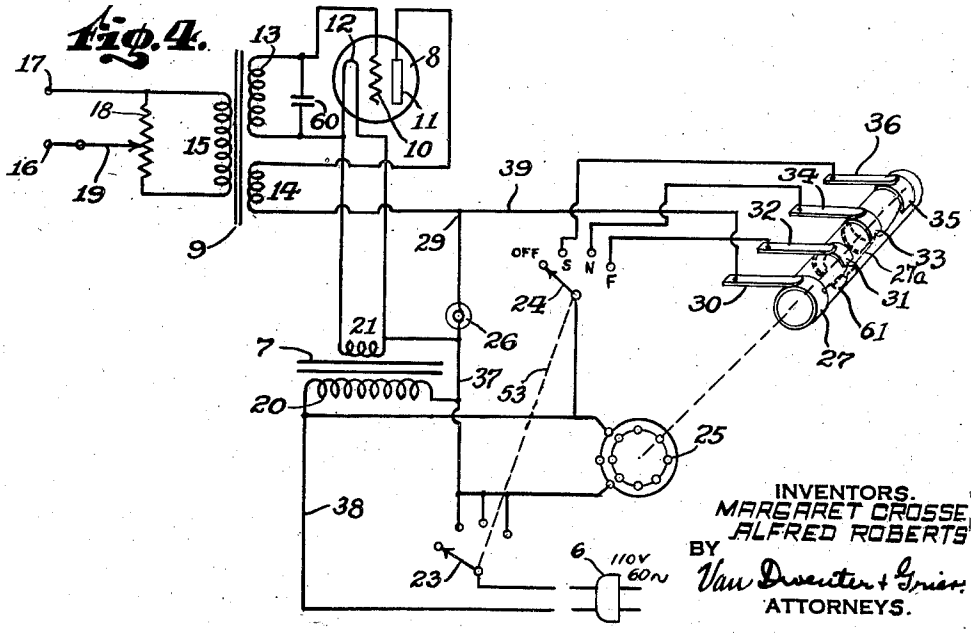


Fig. 4.



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ELECTROTHERAPEUTIC DEVICE

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3 Claims. (Cl. 250—36)

This invention relates to improvements in electro-therapeutic devices and has for an object the provision in such devices of transformers in which the timing of the energization of the primary windings is controlled by an oscillating thermionic tube.

Another object of the invention is the provision in an electro-therapeutic device, of a special iron core induction transformer having thereon two windings, one of which is connected to the plate of a thermionic tube and the other of which is connected to the control grid of said tube, thereby inductively coupling said elements. Suitable constants included in the circuits limit the oscillations to a fairly low rate. The transformer also carries a secondary winding to which the output terminals are connected, one output terminal being connected directly to the winding and the other terminal being connected to the moving arm of a potentiometer bridging said winding.

A further object of the invention is the provision, in an electro-therapeutic device, of a motor driven commutator carrying a plurality of series of segments all connected to a collector ring thereon, brushes being provided for contacting said collector ring and for each of said series, and switching means associated with said brushes and a source of current whereby an operator may selectively control the periodicity of the intervals during which energy is supplied to said device.

Other objects of the invention will in part be obvious to those skilled in the art and in part be pointed out hereinafter.

In the accompanying drawings which are given by way of example, Figure 1 is a perspective view of one form of our electro-therapeutic device with control panel exposed to view. Figure 2 is a rear elevation of the device shown in Figure 1. Figure 3 is a side view taken along the line 3—3 of Figure 2. Figure 4 is a circuit diagram of the device.

Referring first to Figure 4, an induction transformer 9 carries a primary winding 14, a grid winding 13, and a secondary or output winding 15. A thermionic tube 8 has its cathode 12 connected to the secondary 21 of a transformer 7 and thereby energy is furnished for heating said cathode. The transformer 7 has one side of its primary 20 connected to one prong of an attachment plug 6 via a wire 38 and its other end connected to a feeder wire 37. The other prong of the attachment plug 6 is connected to a switch arm 23. The switch arm 23 is preferably connected in tandem with a switch arm 24, the purpose of which will presently be described.

An electric motor is bridged across the wires 37 and 38 and is mechanically connected through suitable reduction gearing (not shown) to a cylinder 61. The cylinder 61 is formed of insulating material and has mounted thereon a collector ring 27. Spaced apart from the collector ring 27 is a set of three metallic segments 31 equally spaced about the surface of the cylinder. Axially spaced apart from the segments 31 is a second set of segments 33 consisting of two segments of predetermined lengths circumferentially spaced 180° apart.

A third set consisting of a single segment 35 is axially spaced apart from said second set. Each and every one of the segments referred to above is electrically connected by means of a conductor 27a to the collector ring 27.

A brush 36 bears on the cylinder 61 in the path of the segment 35 so that it is contacted by said segment each time the cylinder rotates. The brush 36 is connected to the switch point "S." A brush 34 bears on the cylinder 61 in the path traversed by the segments 33 and is successively contacted by these segments during each revolution of the cylinder. This brush is connected to the switch point "N." A brush 32 bears on the cylinder in the path traversed by the three segments 31 and is successively contacted by these segments as the cylinder rotates. This brush is connected to the switch point "F."

A brush 30 bears on the collector ring 27 and is connected via a wire 39 to one terminal of the primary winding 14. The other terminal of the primary winding 14 is connected to the plate 11 of the tube 8. The wire 37 connects to the wire 39 at the point 29, a lamp 26 being connected therebetween.

The grid winding 13 has one terminal connected to the cathode 12 of the tube 8, and the other terminal is connected to the grid 10.

The secondary of the transformer 9 has one end thereof connected to a terminal 17. The winding 18 of a potentiometer is bridged across the ends of the winding 15, and the moving arm 19 is connected to the terminal 16. The terminals 16 and 17 are preferably sockets which accommodate plugs carried on the wires connected to the attachments for use with this device.

The elements just described are mounted in a cabinet such as that shown in Figures 1, 2 and 3. The cabinet, generally designated by the numeral 40, has a control panel 41 which is normally covered and protected by a hinged cover 42. This cover is shown in the open position in Figure 1, and when closed by swinging the cover upwardly

on its hinges its cover may be locked into position by a catch 43. A door 44 is hingedly connected to the cabinet 40 and secured by a catch 43¹. Secured to the top of the cabinet is a carrying handle 45. The door 44 gives access to the interior of the cabinet, which interior is divided by means of a partition 46 into an upper chamber 47 and a lower chamber 48. The mechanism is positioned in the upper chamber 47 and is protected by a plate 49 which is secured therein in any suitable manner, for example, by means of screws 50. The lower chamber 48 and the space 51 between the door 44 are provided for containing the attachments or applicators and the attachment cords, a stud 52 being provided to loop the cords over.

The control panel carries the sockets 16 and 17 into which the attachment and/or applicator cords may be plugged. For convenience duplicate sockets 16*a* and 17*a* are provided, 16*a* being connected internally to the socket 16, and 17*a* being connected to the socket 17. A shaft 53 connecting the switch arms 23 and 24 has secured thereto a knob 54, which in Figure 1 is shown in the "off" position. The panel carries a scale the points of which are marked "Slow," "Normal," and "Fast," these corresponding to the "S," "N" and "F" in connection with Figure 4. The terms "low rate," "low period," "slow rate," etc., used in this specification may be taken to mean that the oscillator has a periodicity of from 250 to 300 cycles per second.

We are of the opinion that the above low periodicity causes muscular contractions at a rate approximately as follows:

When the knob 54 is in the position marked "Slow," there are approximately twelve contractions of the muscles per second, twenty-four when the knob is in the "Normal" position, and thirty-six when the knob is in the "Fast" position.

The control panel also carries a jewel 55 which is in alignment with the lamp 26, so that when the latter is lighted the jewel is illuminated.

The potentiometer 18 has its moving arm 19 mounted on a shaft 56 which projects through the panel 41 and carries on its outer end a control knob 57, the pointer 57*a* of which traverses a scale 58. The electrodes may consist of flexible metallic plates where the areas of the patient's body to be treated are large, or the electrodes may consist of small rigid plates, where small areas of the body are to be treated. These plates are electrically connected to the terminals 16 and 17 or 16*a* and 17*a*.

Operation

To operate the device the plug 6 is inserted in a convenient outlet and the switch knob 54 is turned to the right, as viewed in Figure 1, to either one of the three positions indicated on the panel. For example, if it is turned to "Slow" the switch arm 23 connects one side of the line to one terminal of the motor 25 and connects one side of the primary 20 to the line. The wire 39 is also connected to the line with the lamp 26 in series. This causes the secondary 21 of the transformer 7 to supply heating energy to the cathode 12. At the same time the motor 25 starts rotating and causes the cylinder 38 (constituting a commutator) to rotate. Once during each revolution of the commutator the segment 35 picks up energy from the brush 36 (the switch arm 24 having been moved to the position "S" by movement of the knob 54 above described). From the segment 35 current is led to the collector ring 27 and this is picked up by the brush 30 and delivered over the wire 39 through the plate winding 14, thence to the plate 11 of the tube.

Due to the coupling between the windings 13 and 14 the tube 8 oscillates and thereby controls the generation of current in the secondary 15. It is preferable that the tube 8 oscillate at a comparatively low period, and therefore suitable constants are included in the circuits to give this effect.

Bridging the grid winding 13 is a condenser 60. Although this is shown as a single condenser it is obvious that for low capacities we may use two or more condensers in series.

With the applicators in position and their cords plugged into the sockets 16 and 17 the knob 57 may be adjusted by turning the same to the right, as viewed in Figure 1, to increase the current supplied to the applicators, or turned to the left to decrease the current supplied to the applicators. This current will, due to the commutator action, be delivered to the applicators internally and at a comparatively slow rate. To increase this rate the knob 54 may be turned to the position indicated on the panel as "Normal," whereupon the impulses will be doubled. For a further increase in the rate the knob may be turned to the "Fast," whereupon the impulses will be delivered at three times the rate described in the first instance.

In practice we have found that for general all around use it is preferable to set the knob 54 to the position marked "Normal," and to use the "Slow" and "Fast" position under other conditions or for other phases of treatment.

Although we show in the example herein given the use of a thermionic tube in which the filament is used as the cathode it is obvious that other types of tubes may be used regardless of whether the filament or heater is the cathode or whether the tube has an internally heated cathode therein.

It is also obvious that many other changes may be made in the arrangements herein shown and described without departing from the spirit of the invention as set forth in the annexed claims.

What is claimed is:

1. In an electro-therapeutic device, an iron core induction transformer having a secondary winding to which applicators are to be connected, a primary or anode winding and a grid winding, all three of which are inductively coupled by said iron core; a thermionic tube including an anode, a cathode, and a control grid, means for heating said cathode; a gird circuit circuit extending from said grid and including said grid winding and a connection to said cathode; a commutator carrying a plurality of sets of contact segments, the segments of each set being of a different length from that of the others, a collector ring electrically connected to the segments in all said sets, a brush connected to said primary or anode winding and bearing on said collector ring, an individual brush for each of said sets, each bearing on said commutator in the path traversed by the segments in its set, means for rotating said commutator at a constant rate of speed, a series of contact points connected to said individual brushes, and switching means cooperating with said contact points and connected to said source of current for completing the circuit from the anode to said source, whereby an

operator may selectively set said switch to select any of said sets of segments for controlling the timing of the energization of said anode circuit.

2. In an electro-therapeutic device, an iron core induction transformer having a secondary winding to which applicators are to be connected, a grid winding inductively coupled to said secondary by said core, an anode winding inductively coupled by said core to both said grid winding and said secondary; a thermionic tube including a grid, an anode, and a cathode; a circuit including said cathode, said grid winding and said grid; a second circuit including said anode, said anode winding, and a source of current; means for heating said cathode, said tube being adapted to oscillate at a low rate and thereby institute varying magnetomotive forces in the core of said transformer, a constant speed motor-driven commutator including a plurality of sets of contact segments, the segments in each set being of lengths different from the lengths of the others, said commutator being connected to said second circuit, and means for selectively placing any of said sets in series in said second circuit for timing the periods in which said magnetomotive forces are instituted in said second circuit.

3. In an electro-therapeutic device, an iron core induction transformer having a secondary winding to which applicators are to be connected, a grid winding inductively coupled via said iron core to said secondary, and an anode winding inductively coupled via said iron core to said grid winding; a thermionic tube including an anode, a cathode, and a control grid; means for supplying energy to said cathode, connections between said cathode and said grid winding and continuing to said grid, a connection from said anode to one end of said anode winding, other connections between the other end of said anode winding and a source of current, said connections including parameters whereby said tube will oscillate at a predetermined low periodicity and cause varying magnetomotive forces in the core of said transformer, a commutator carrying a plurality of sets of contact segments, a collector ring on said commutator electrically connected to the segments in all said sets, a brush bearing on said collector ring and forming part of said connections, individual brushes for said sets each bearing on said commutator in the path traversed by the segments in its set, means for driving said commutator, and switching means connected between said brushes and said source of current for completing the anode circuit, whereby an operator may selectively set said switching means in accordance with a desired timing of the flow of said varying magnetomotive forces in said transformer core.

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