May 6, 1930. R. W. CHAPMAN 1,757,110

ELECTRICAL THERAPEUTIC APPARATUS

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Fig. 1.

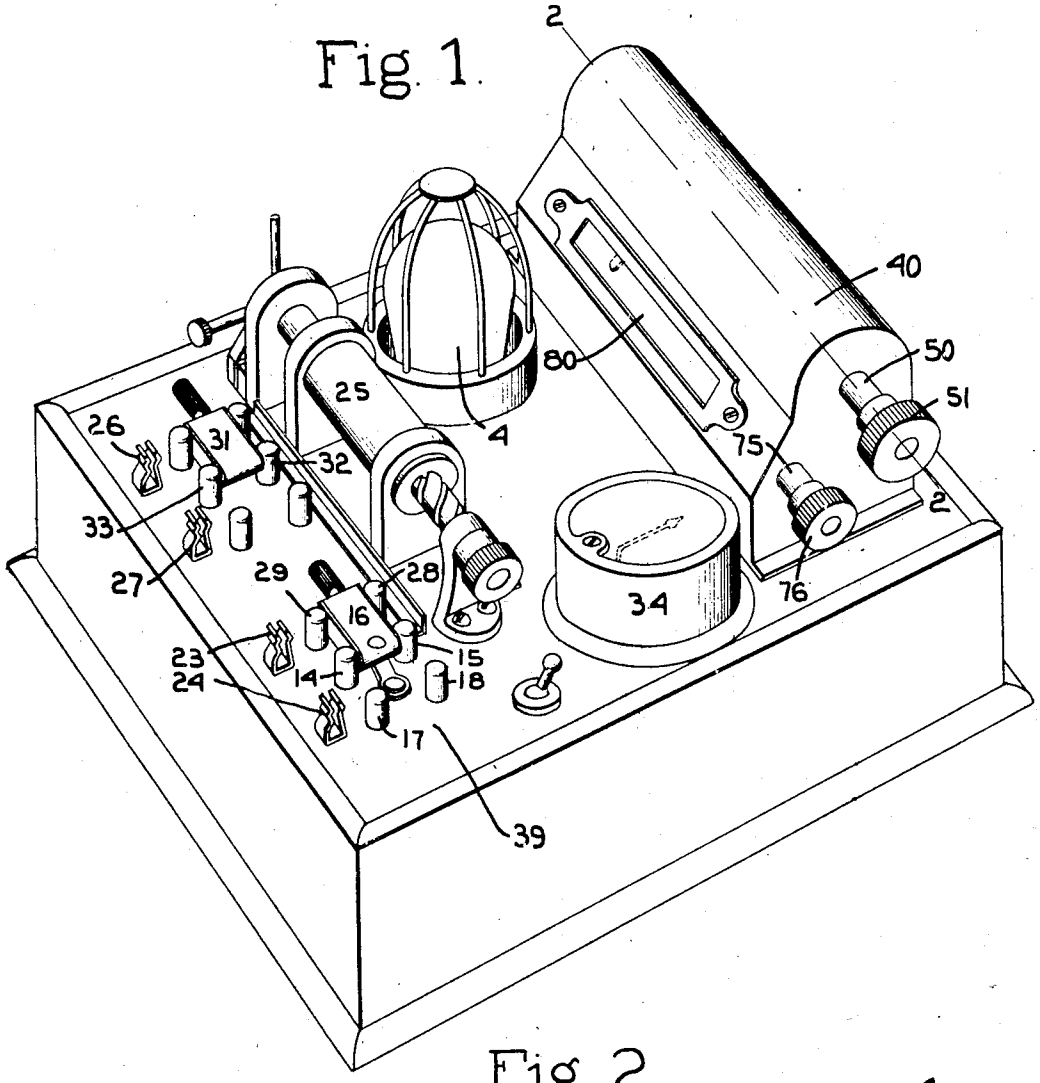
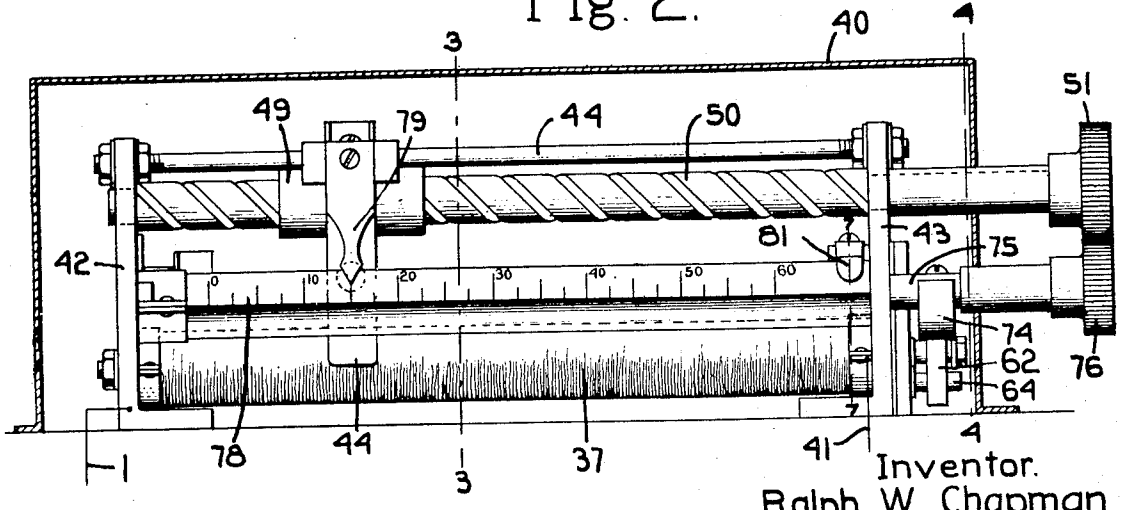


Fig. 2.



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Fig. 3.

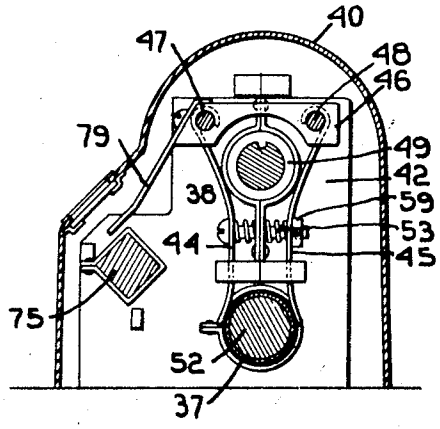


Fig. 4.

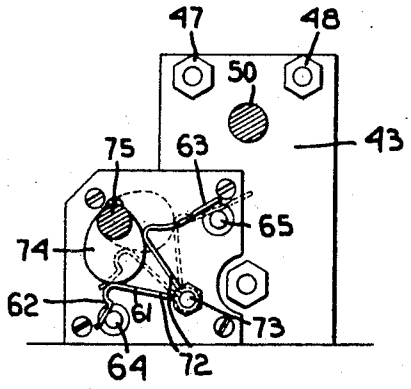


Fig. 5.

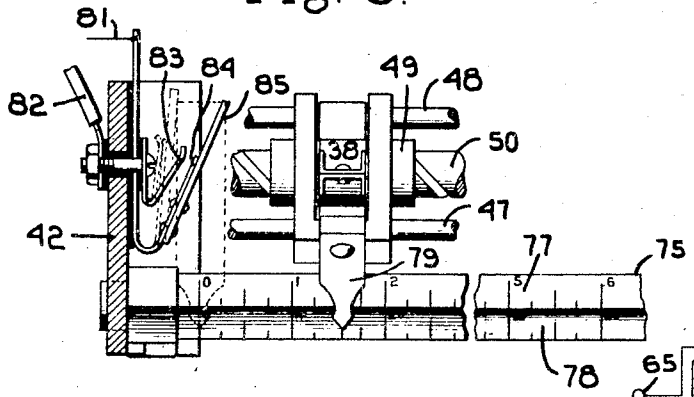


Fig. 7.

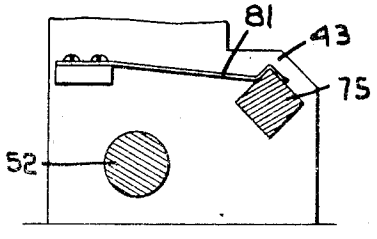
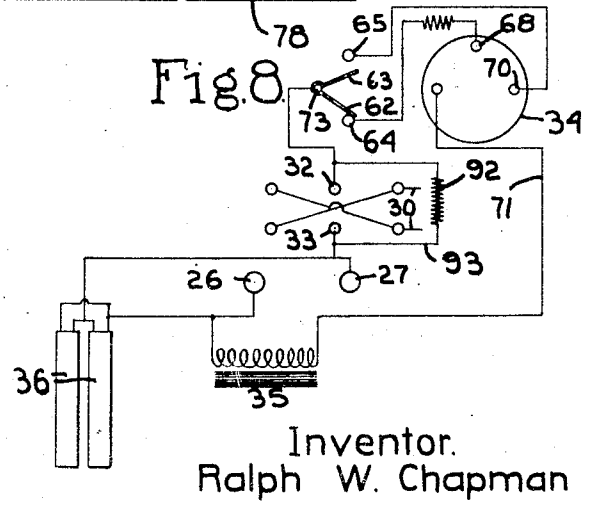


Fig. 8.



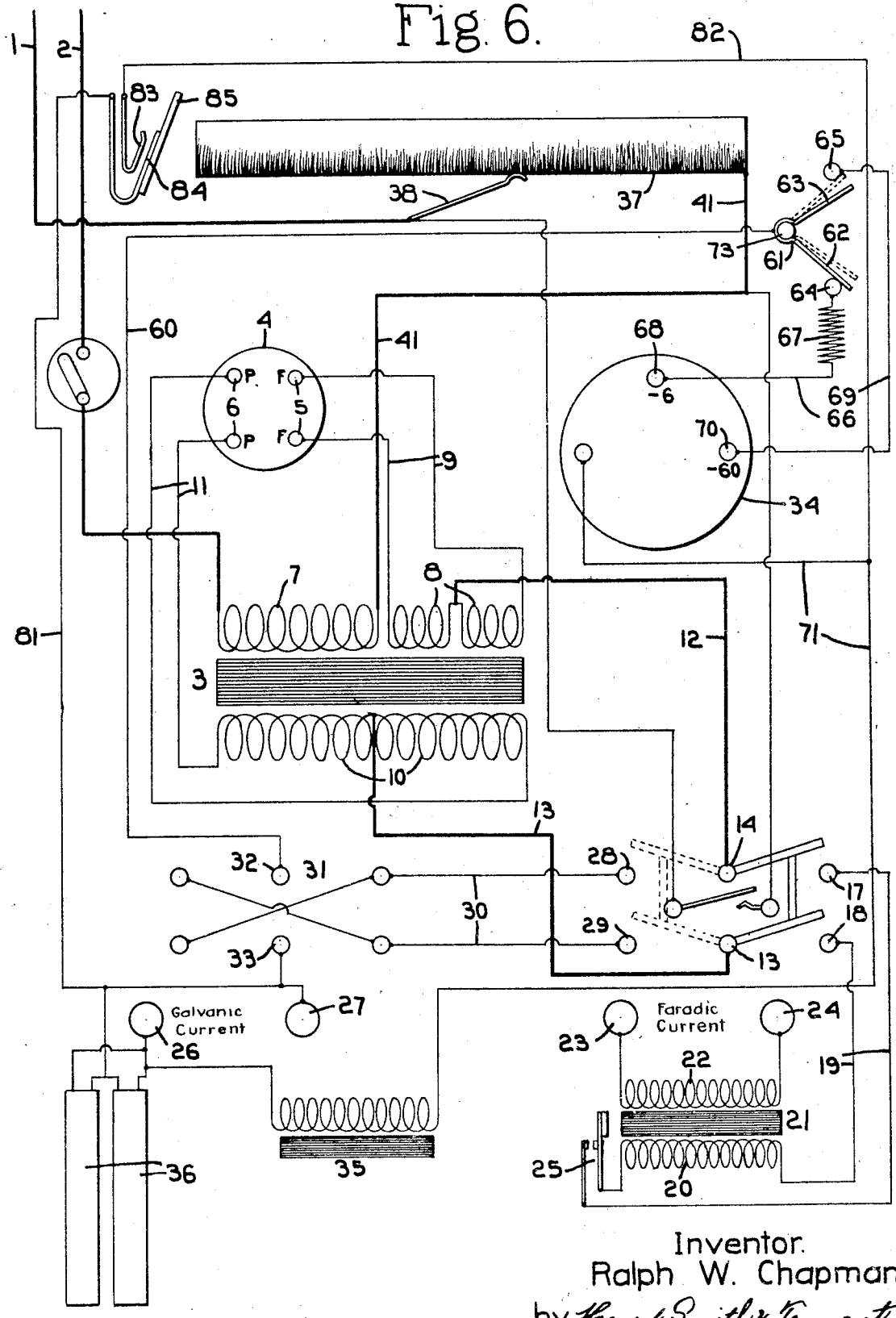
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Fig. 6.



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UNITED STATES PATENT OFFICE

RALPH W. CHAPMAN, OF OLDTOWN, MAINE, ASSIGNOR TO T. M. CHAPMAN'S SONS CO., OF OLDTOWN, MAINE, A CORPORATION OF MAINE

ELECTRICAL THERAPEUTIC APPARATUS

Application filed October 3, 1927, Serial No. 223,579. Renewed September 23, 1929.

This invention relates to electrical therapeutic apparatus, and has for one of its objects to provide a novel apparatus of this type by which commercial alternating current such as is commonly used for lighting purposes may be converted into direct current suitable for therapeutic use.

It is desirable that an electrical therapeutic apparatus should be so constructed as to deliver voltages varying from zero to, perhaps, 200, and another object of my invention is to provide a novel apparatus of this class by which the ordinary alternating current of 110 volts may be converted into the desirable direct current of any desired voltage within the above limits, and which will accomplish this end in a manner that is perfectly safe for the patient.

My invention contemplates an apparatus adapted to deliver either a continuous direct current (which is sometimes referred to as "galvanic" current), or an interrupted direct current (which is sometimes referred to as a "faradic" current).

In rectifying the alternating current to produce the direct current, I preferably employ a rectifying tube, which is constructed to rectify both semi-cycles of the alternating current, the rectified current being smoothed out by means of choke coils and condensers.

For ordinary practice the output current of a machine of this type is relatively small, usually less than six milliamperes, although it is desirable to construct the apparatus to yield a much larger output.

Another of the objects of my invention is to provide a novel construction by which when the apparatus is adjusted for an output current of relatively small amperage, it will be impossible for the patient to receive an injurious current in case the condenser should accidently break down.

Other objects of the invention are to improve generally electrical therapeutic apparatus in the various particulars hereinafter set forth.

In order to give an understanding of my invention I have illustrated in the drawings a selected embodiment thereof which will now be described, after which the novel features will be pointed out in the appended claims.

In the drawings Fig. 1 is a perspective view of the apparatus embodying my invention;

Fig. 2 is an enlarged section on the line 2—2, Fig. 1;

Fig. 3 is a section on substantially the line 3—3, Fig. 2;

Fig. 4 is a section on the line 4—4, Fig. 2;

Fig. 5 is a fragmentary detail showing the switch for discharging the condenser;

Fig. 6 is a diagrammatic view showing the wiring of the apparatus; Fig. 7 is a section on the line 7—7, Fig. 2;

Fig. 8 is a diagrammatic view showing a different modification of the invention.

In rectifying the alternating current I employ a transformer of suitable design, the primary of which has the alternating current impressed thereon, and I also employ a rectifying tube which is connected in the secondary circuit of the transformer.

The tube I prefer to use is of that type adapted to rectify both cycles of the alternating current.

Referring first to Fig. 6, 1 and 2 designate the leads coming from the source of alternating current supply, 3 indicates generally the transformer, and 4 the rectifying tube, the latter being provided with two filament terminals 5 and with the two plate terminals 6. The primary 7 of the transformer 3 is connected to the leads 1 and 2 and thus has the alternating current impressed thereon. The secondary of the transformer 3 is of the proper construction to co-operate with the rectifying tube shown, said secondary comprising the double coil 8 which is connected to the filament terminals by wire connections 9 and also the double coil 10 which is connected to the plate terminals by the wire connections 11. The coils 8 and 10 have the output circuit wires 12 and 13 connected thereto, which lead to the terminals 14, 15 of a double pole switch 16 which may be adjusted to cause the apparatus to deliver either the galvanic current or the faradic current. The transformer 3 and rectifying tube 4 will function in a well-known way to deliver continuous current through the output circuit

12, 13. This double pole switch 16 is provided with two terminals 17, 18 which are connected by circuit wires 19 to the interrupter, the latter comprising the transformer 21 the secondary of which is connected to the two terminals 23, 24. The circuit 19 has a make and break therein indicated generally at 25 and which causes an interrupted direct current to be delivered from the terminals 23, 24. As stated above, this interrupted direct current is sometimes referred to as a "faradic" current.

When therefore, the double pole switch 16 is adjusted so as to connect the terminals 14, 15 with the contacts or terminals 17, 18, the output current will be delivered from the apparatus as an interrupted direct current.

The terminals from which the continuous direct or "galvanic" current is delivered are indicated at 26, 27, and these terminals are connected to the output circuit 12, 13 through the terminals 28, 29 of the double pole switch 16. The switch terminals 28, 29 are shown as connected by circuit wires 30 to a reversing switch 31, the contacts 32, 33 of which are connected to the galvanic current contacts 26, 27 through a circuit which preferably includes an ammeter 34 for indicating the amperage of the current, and a choke coil 35 and condensers 36 which function to smooth out the current in a well-known way.

The input circuit 1, 2 which includes the primary coil 7 of the transformer 3, has therein a variable resistance by which the output current may be varied as desired. This variable resistance is herein shown as a resistance coil 37 wound on a suitable core 52 of insulating material, said resistance coil forming part of the input circuit. The adjustment of the resistance is secured by a sliding contact member 38 adapted to be moved over the turns of the coil 37 and connected with the leading-in wire 1.

These various parts of the apparatus, which are shown diagrammatically in Fig. 6, are mounted on a suitable base 39 which is best seen in Fig. 1.

The variable resistance is illustrated in Figs. 1 and 2 as being enclosed in a hood or casing 40. The cylinder on which the coils 37 are wound is supported by and insulated from two standards 42, 43, the said coil having a circuit wire 41 connected to one end thereof which leads to the primary 7 of the transformer 3. The sliding contact member 38 of the variable resistance is herein shown as in the form of two resilient fingers 44, 45 which are carried by a carrier 46 that is slidably mounted on two rods 47, 48 that connect the two standards 42, 43 and, consequently, form part of the input circuit. This carrier is also provided with a nut 49 which has screw-threaded engagement with an adjusting screw 50 that is journaled in the standards 42, 43 said screw having a thumb-piece 51 at its end by which it may be turned. This nut 49 is prevented from turning, and, therefore, as the screw 50 is rotated the carriage 46 and the contact members 44, 45 will be moved longitudinally of the resistance coil 37 thereby varying the amount of resistance in the primary circuit of the transformer 3. The resilient fingers 44, 45 are held in yielding contact with the resistance coil 37 by means of a tie bolt 53 which extends through both fingers. This tie bolt has a nut 59 screw-threaded thereto so that by adjusting the nut the resilient pressure or contact of the fingers 44, 45 with the resistance coil 37 may be adjusted.

It will be noted that the resistance coil is relatively long, an advantage of which is that the change in the resistance will be relatively slow as the knob 51 is turned, thus avoiding the subjecting of the patient to any sudden changes of current.

In a large proportion of the treatments the patient will be subjected to a current of relatively small amperage, probably not over six milliamperes, although it is sometimes necessary to subject the patient to a larger current.

I have provided herein a construction whereby the aparatus may be adjusted so that it will take the full range of the variable resistance to bring the output current from zero to a predetermined low amperage, such, for instance, as six milliamperes, which will be sufficient for the great majority of treatments, or may be adjusted so that as the variable resistance is moved throughout its entire range, the output current may be varied from zero to a much higher amperage, such, for instance, as sixty milliamperes. This is accomplished by employing two shunt sections in the output circuit leading to the galvanic current terminals 26, 27, either of which shunt sections may be connected into the output circuit, and one of which has a resistance therein sufficient to limit the output circuit to the low voltage.

Referring to Fig. 6, the output circuit leading to the galvanic current terminals 26, 27 comprises the wire connection 60 extending from the terminal 32 and leading to a switch 61 which is provided with two switch arms 62, 63 that are adapted to contact with terminals 64, 65, respectively. The two shunt sections of this output circuit lead from these two terminals 64, 65 one section being indicated at 66 and having a resistance 67 therein. This secton leads to a terminal 68 of the ammeter 34. The other shunt section of the circuit is indicated at 69 and it leads from the switch section leads to a terminal 68 of the ammeter 34, these terminals 68, 70 being parallel. The ammeter is connected by a wire connection 71 to the choke coil 35 above referred to. When the switch 61 is turned into the position shown in Fig. 6 with its arm 62 engaging the contact

64, the shunt section 66 will be in the output circuit and the shunt section 69 will be disconnected from the circuit. On the other hand, when the switch is thrown into the dotted line position Fig. 6 thereby bringing the switch arm 63 against the terminal 65 and separating the arm 62 from the terminal 64, the shunt section 66 will be cut out of the circuit and the shunt section 69 will be cut into the circuit. When the shunt section 66 is in the circuit, the resistance 67 will prevent the output current from having an amperage greater than the predetermined low value, which, for the sake of illustration, has been taken as six milliamperes. Hence, when the shunt section 66 is in operation, the shifting of the contact member 38 of the variable resistance from one end to the other of the resistance coil will result in giving an output current varying from zero to six milliamperes.

On the other hand, if the switch 61 is adjusted into the dotted line position Fig. 6 then the adjustment of the contact member 38 from one end to the other of the resistance wire 37 will result in producing a current varying from zero to sixty milliamperes.

The mechanical construction of the switch 61 is best seen in the Fig. 4. The two switch arms 62, 63 are at the ends of the legs of a V shaped member 72 which is pivotedly mounted on a stud 73. The switch is actuated by a cam member 74 which is received between the legs 72 and is mounted on a shaft 75 the latter being journaled in the standards 42, 43. This cam is preferably of insulating material, so as not to short-circuit the output current. The shaft 75 is provided with a thumb-piece 76 by which it may be turned, the turning of the shaft so as to shift the cam into the dotted line position Fig. 4 results in moving the contact finger 63 into engagement into the contact 65 and separating the contact 62 from the contact 64 thereby opening the shunt section 66 and closing the shunt section 69.

The apparatus is provided with a visible indicator by which the operator may observe the position of the contact member 38 of the variable resistance. This indicator may conveniently be graduated in terms of amperage, in which case the reading on the indicator for any adjustment of the variable resistance should correspond to the reading of the ammeter 34.

The portion of the shaft 75 between the standards 42, 43, is shown as being square in cross section. The face 77 of this square portion is provided with graduations running from "0" to "6" and an adjacent side 78 is provided with graduations running from "0" to "60". The carriage 46 is provided with an indicator finger 79 which partially overlies one or the other of the graduated faces 77, 78 dependent on the position of the shaft 75. The arrangement is such that when the shaft 75 and cam 76 are in the position shown in Fig. 4, the face 77 will be presented underneath the indicating finger 79 while when the shaft is turned into the dotted line position Fig. 4 the face 78 will be so presented.

The hood or casing 40 is provided with a sight opening 80 through which the indicator finger 79 and the graduated scale may be observed.

The shaft 75 is yieldingly held in either adjusted position by a resilient retaining arm 81.

When, therefore, the shaft 75 is turned to cut the shunt section 66 into the output circuit, the indicator scale which is visible through the sight opening 80 will indicate the maximum amount of current which can be delivered. Similarly, when the shaft 75 is turned to cut the shunt section 66 out of the circuit and to cut the shunt section 69 into the circuit, the indicator scale, which is then visible, will also indicate the maximum amount of current which can be delivered from the apparatus.

This arrangement has a two-fold advantage. In the first place, when the apparatus is adjusted for delivering a maximum amperage of six milliamperes for instance, it will not be possible for a current of a greater amperage to be delivered even though the condenser should break down. Suppose, for instance, that the patient is being treated with a current of two milliamperes and the condenser 36 should break down, the largest current which the patient could receive would be six milliamperes, and the change from two milliamperes to six milliamperes would hardly be noticeable by the patient. Whereas, if the patient should receive the maximum current of sixty milliamperes upon the breaking down of the condenser, the result would be extremely unpleasant and possibly serious.

In the second place, the full range of the variable resistance is available for either shunt section, that is, whether the apparatus is adjusted to deliver a maximum of six milliameperes or sixty milliamperes, and by using a variable resistance of the type shown, the change in the resistance is very gradual and smooth, thus obviating any unpleasant effects on the patient, such as would result from sudden changes in the current.

In using apparatus of this type, it is customary to so adjust the variable resistance before the treatment of a patient begins, that the maximum resistance will be in the circuit thereby cutting the current to the minimum. In the present instance this maximum resistance would be introduced when the contact member 38 is at its extreme position to the left in Figs. 2 and 6, which is the starting position.

I have provided herein novel means whereby when the variable resistance is so adjusted the condenser will be automatically dis-

charged so that any treatment will start with a discharged condenser. The importance of this is that it obviates the possibility that when the apparatus is started the patient may receives a shock from the charged condenser. For this purpose I have provided a circuit connection 81, 82 through which the condenser may be short-circuited and thus discharged. This circuit connection has a normally open switch therein which is shown as comprising two switch contacts 83, 84 that are normally separated from each other. The contact 84 carries a plate 85 of insulating material. This switch is so situated that when the nut 49 has been screwed to the left hand limit of its movement, in which position the entire resistance of the resistance coil 37 is in the circuit, the said nut will engage the plate 85 on the switch contact 84 and thus close the latter contact against the contact 83. This will short-circuit the condenser and discharge it. Hence, each treatment will be begun with a discharged condenser thus eliminating any possibility that the patient may receive an unexpected shock from a charged condenser.

Instead of using the switch contacts 83, 84 for discharging the condenser I may employ the construction shown in Fig. 7 in which a slow leakage path is established across the condenser. This may be accomplished by a circuit connection 93 connecting the terminals 32, 33 and having therein a resistance 92. This resistance is of sufficient amount so that while it will not appreciably affect the normal operation of the machine yet it will allow for the gradual discharge of the condenser when the current is shut off from the input circuit and the machine is not in operation. With this arrangement, therefore, the condenser will become discharged within a short time after the current has been shut off from the input circuit so that when the machine is put in use again the condenser will be in a discharged state.

The advantage of this construction is that when the machine is idle the discharge of the condenser will gradually take place regardless of the position of the contact 38.

I claim:

1. In an electrical therapeutic apparatus, the combination with means to rectify alternating current, said means having an input circuit and an output circuit, of a condenser and choke coil in the output circuit, a variable resistance in the input circuit, and means to discharge the condenser when the variable resistance is in starting position.

2. In an electrical therapeutic apparatus, the combination with means to rectify alternating current, said means having an input circuit and an output circuit, of a variable resistance in the input circuit, said variable resistance having a movable element by which the resistance is varied, a condenser connected to the output circuit, and means actuated by said movable element when it is in starting position to discharge the condenser.

3. In an electrical therapeutic apparatus, the combination with means to rectify alternating current, said means having an input circuit and an output circuit, of a variable resistance in the input circuit, a condenser connected to the output circuit, a normally-open circuit by which the condenser may be short-circuited, and means to close said circuit when the variable resistance is in starting position.

4. In an electrical therapeutic apparatus, the combination with means to rectify alternating current, said means having an input circuit and an output circuit, of a variable resistance in the input circuit, said resistance comprising a resistance coil and a contact movable longitudinally of the coil, a condenser connected to the output circuit, and means for discharging the condenser when the movable contact is at the starting end of the coil.

5. In an electrical therapeutic apparatus, the combination with means to rectify alternating current, said means having an input circuit and an output circuit, of a variable resistance in the input circuit, said variable resistance comprising a resistance coil and a contact movable longitudinally of the coil, an adjusting screw by which the contact is given its longitudinal movement, a condenser and choke coil connected to the output circuit, and means to discharge the condenser when the movable contact is in starting position.

6. In an electrical therapeutic apparatus, the combination with a transformer, of a variable resistance in the primary circuit thereof, means to rectify the current induced in the secondary, an output circuit for the rectified current, said output circuit having two shunt sections, a resistance in one section thereby to make it a low amperage circuit, means for connecting either shunt section into the output circuit, an indicating pointer for indicating the position of the movable element of the variable condenser, two graduated scales co-operating with the pointer to indicate the value of the current in different adjusted positions of the variable resistance, and means to bring one scale into operative position when one of the shunt sections is connected into the circuit and the other scale into operative position when the other shunt section is so connected.

7. In an electrical therapeutic apparatus, the combination with means to rectify an alternating current, said means having an input circuit and an output circuit, of a condenser and choke coil in the output circuit, a variable resistance in the input circuit, and means to provide for the discharge of the condenser when the current has been cut off from the input circuit.

8. In an electrical therapeutic apparatus,

the combination with means to rectify an alternating current, said means having an input circuit and an output circuit, of a condenser and choke coil in the output circuit, a variable resistance in the input circuit, and a slow leakage path across the terminals of the condenser, whereby when the current is cut off from the input circuit the condenser will be gradually discharged.

In testimony whereof, I have signed my name to this specification.

RALPH W. CHAPMAN.