June 10, 1958 L. R. PAUST 2,838,672

ELECTRO-THERAPY GENERATOR

Filed June 29, 1954 2 Sheets-Sheet 1

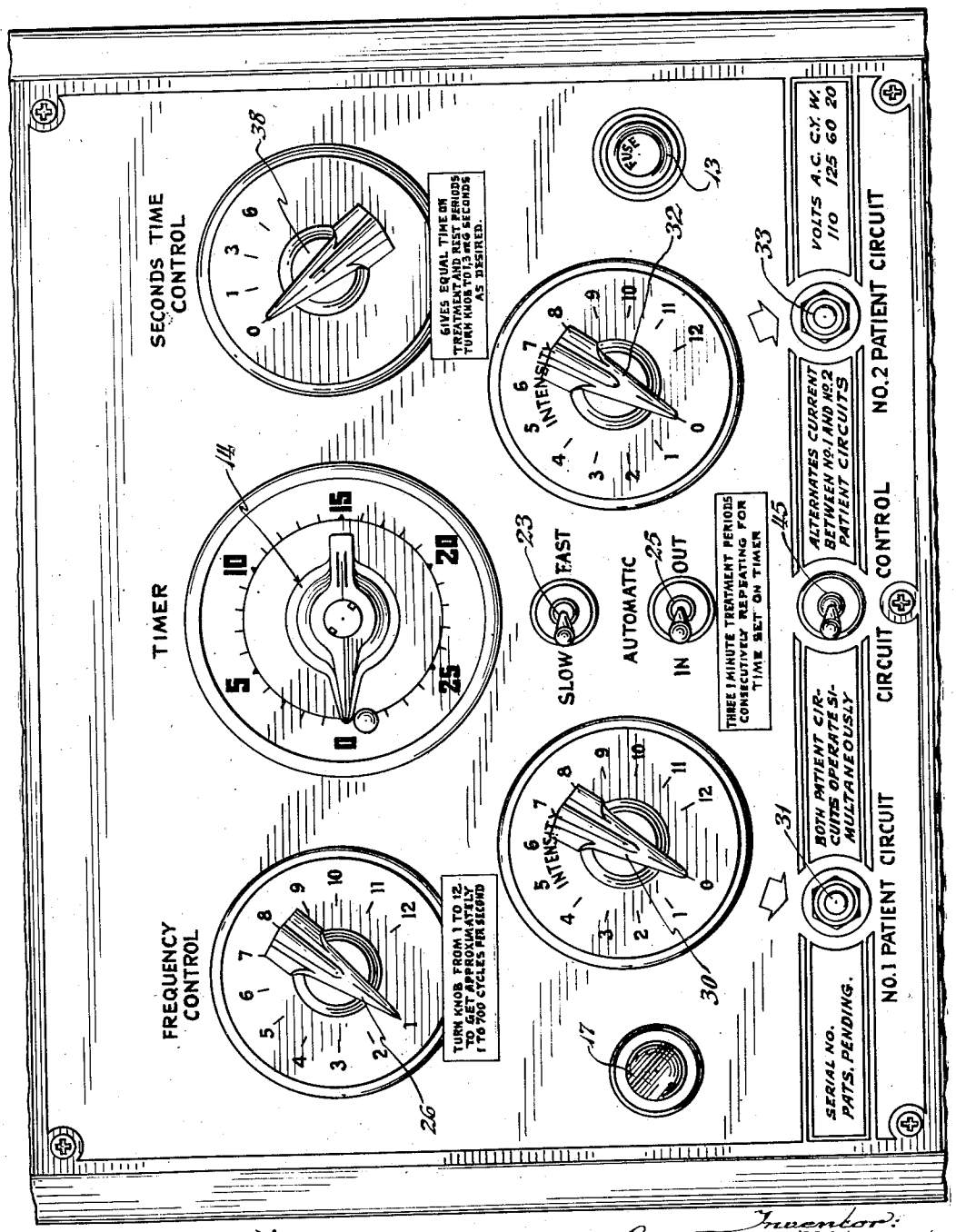


Fig. 1.

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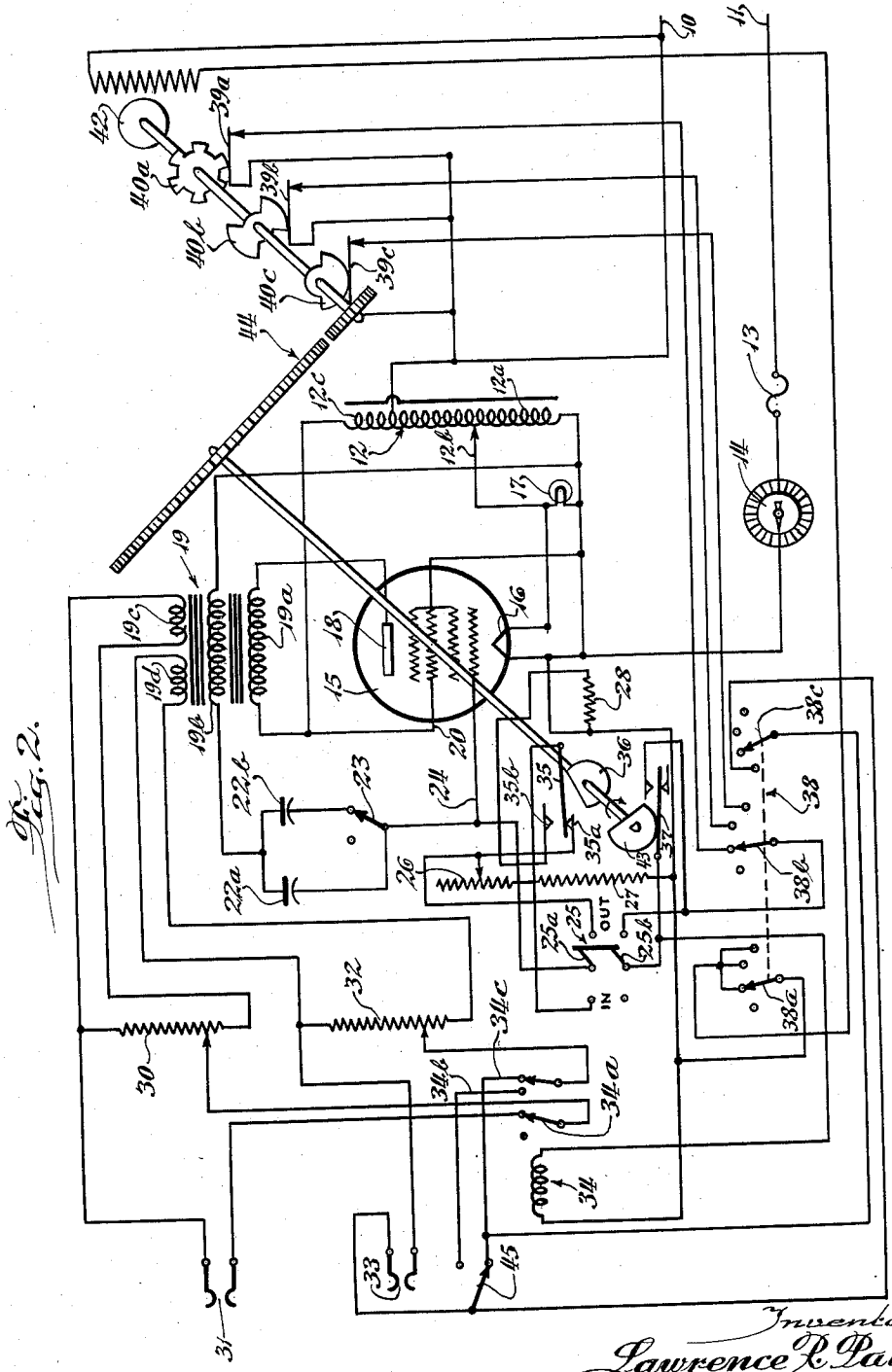


Fig. 2.

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United States Patent Office 2,838,672 Patented June 10, 1958



2,838,672

# ELECTRO-THERAPY GENERATOR

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Application June 29, 1954, Serial No. 440,049

4 Claims. (Cl. 250—36)

This invention is concerned with an electro-therapy generator and more particularly with an electro-therapy generator which automatically provides an output comprising a sequence of signals of different character.

The electrical treatment or stimulation of muscles is a rapidly growing field and new types of treatment and new applications are constantly being found. Generally speaking, an electro-therapy generator includes a source of relatively low frequency alternating current preferably having a pulsed rather than a sine wave form. Direct current also has some specific applications but is not as widely used as pulsed alternating current. Electro-therapy treatments are primarily designed to permit the exercise of muscles which for one reason or another could not otherwise be sufficiently exercised as to prevent atrophy in the case of paralysis or other temporary immobilization and in the treatment of strains, sprains and dislocations to speed the reduction of the attendant swelling. It has been found that certain combinations or sequences of treatments are sometimes much more effective than continuous treatment of a single type.

I have devised and disclose and claim herein a novel electro-therapy generator which provides a variety of types of signals and automatically changes the type of signal available at regular intervals.

One feature of the invention is the provision of an electro-therapy generator comprising means for producing a plurality of types of electro-therapy signals, means for utilizing the signals and control means for automatically changing the type of signal available at the utilizing means.

Another feature is that the electro-therapy generator comprises an oscillator, means connectable to the oscillator for causing a plurality of types of operation thereof, output circuit means connected to the oscillator and control means for connecting both of the means to the oscillator for providing a sequence of signals of predetermined character at the output means.

Another feature is that the generator includes an electron tube having a control element, a first circuit connectable to the control element for causing operation at a fixed frequency, a second circuit connectable to the control element for causing operation at a variable frequency, a double-throw switch for effecting alternate connection of one or the other of the circuits to the control element of the tube, motor-driven cam means for controlling the operation of the switch at regular intervals and means for utilizing the oscillations produced in the electron tube.

Still another feature is that means are provided for equalizing the intensity of the signal available in the utilizing means throughout the sequence of the operation of the generator.

Further features and advantages will readily be apparent from the following specification and from the drawings, in which:

Figure 1 is an elevation view of the control panel of an electro-therapy generator embodying the invention; and

Figure 2 is a schematic drawing of the circuit of the electro-therapy generator.



The electro-therapy generator described herein is basically similar to that disclosed and claimed specifically in copending Paust and De Groff application, Serial No. 283,082, filed April 18, 1952, now Patent No. 2,764,683, issued September 25, 1956. As in the generator shown in that application, three different types of outputs, pulse, surge and tetanizing, are provided. The three different types of signals are made available at a pair of output jacks to which suitable pads may be connected for applying the signals to the patient. Means are provided, however, which make these various output signals available sequentially and automatically at a desired predetermined repetition rate. This permits treatments to be given continuously with a single type of signal and also permits treatments to be given with different types of signals occurring in an automatic sequence.

Referring now to the drawings, the particular embodiment of the electro-therapy generator shown herein will be described. The values of the various circuit elements and the type of circuit shown, illustrate merely one embodiment of the invention and many modifications will readily be apparent to those skilled in the art.

The electro-therapy generator may be energized by connecting leads **10** and **11** to a suitable source of power such as 110 volts A. C. The primary winding **12***a* of a power supply auto transformer **12** is connected across the line through fuse **13** and timer switch **14**, the timer switch **14** permitting treatments to be given for a predetermined period of time and then automatically turning off the generator.

A power oscillator **15** is provided in the generator and may be a type 1619 pentode. The filament **16** of the tube is connected to a tap **12***b* on the power transformer and an indicator light **17** is connected across the filament to indicate to the operator when the generator is energized. The anode **18** of the oscillator is connected through primary winding **19***a* of combined feedback and output transformer **19** to the secondary winding **12***c* of power transformer **12**; and screen grid **20** of the tube is connected directly to secondary winding **12***c*.

A feedback winding **19***b* is provided on transformer **19** and has one terminal connected to the common line **11**, to which the power transformer and one side of the filament **16** are returned. The other terminal of winding **19***b* is connected through feedback capacitors **22***a* and **22***b* to the control grid **24** of tube **15**. Switch **23** is provided to determine whether one or both of the capacitors **22** are connected in the feedback circuit, providing a rough frequency control.

Control grid **24** is returned to the common side of the filament, line **11**, through element **25***a* of double-throw switch **25**, which serves to determine whether the generator operates automatically or not, and one or the other of two operation controlling circuit means, the first comprising variable resistor **26**, 1.25 megohms, and resistor **27**, 10,000 ohms, in series, and the second comprising resistor **28**, 5,000 ohms. When the first control circuit, resistors **26** and **27**, is connected to the control grid **24** of oscillator **15** the frequency of oscillation may be manually adjusted as desired; while when the second circuit, resistor **28**, is used fixed frequency oscillations are provided.

Two output circuits are provided so that treatments may be applied to two different points on the patient at the same time. The first includes winding **19***c* on transformer **19**, amplitude control resistor **30**, 3,000 ohms, and output jack **31**. The second circuit is substantially

identical, comprising winding **19***d*, amplitude control resistor **32**, 3,000 ohms, and output jack **33**. Both of the output circuits are completed through contacts associated with relay **34**, the operation of which will be described later.

Assuming that switch **25** is thrown to the "in" position (the position for automatic sequential output operation), the feedback circuit of the oscillator will be completed through double-throw cam-operated switch **35**. When the switch **35** is in the lower position closing contact **35***a* as shown, the first circuit, comprising resistors **26** and **27**, will be connected in the circuit while when cam **36** moves switch **35** to the upper position closing contact **35***b*, the second circuit, resistor **28**, will be connected to control grid **24**. At the same time the output control relay **34** is connected from line **11** through cam-operated switch **37**, section **38***b* of time control switch **38** and one or the other of cam-operated timing switches **39***a*, **39***b* and **39***c* to line **10**. Switches **39***a*, **39***b* and **39***c* are operated respectively by cams **40***a*, **40***b* and **40***c* all of which are driven concurrently by motor **42**.

The motor **42** is energized through a section **38***a* of switch **38** and runs at any time the switch is in other than the zero position. Cams **36** and **43**, which operate switches **35** and **37** respectively, are also driven by motor **42** through a reduction gearing arrangement **44**.

Assuming that switch **25** is in the "in" position and that timing switch **38** is set to either 1, 3 or 6, the output appearing at terminals **31** and **33** will include the three different types of operation of the device, surge, pulse and tetanizing currents, in a repeating sequence for so long as timer **14** permits the generator to continue in operation.

As shown in the drawings, cam switch **35** is in the lower position so that contact **35***a* is closed connecting variable frequency controlling resistors **26** and **27** to grid **24** of the oscillator. This circuit provides a pulsed output at a frequency of from 1 to 400 cycles per second with switch **23** connected in the position shown or if switch **23** is opened, up to 700 cycles per second with only capacitor **22***a* connected in the circuit. The actual number of pulses produced during any given period is, however, considerably less than the nominal frequency of the oscillator due to the inherent rectifying action obtained by using the straight transformer power supply.

As cams **36** and **43** are driven in a clockwise direction by motor **42**, switch **37** will close, contact **35***a* of switch **35** will open and contact **35***b* thereof will close at approximately the same time. Switch **35** acts to change the operation controlling portion of the feedback circuit of the oscillator, substituting fixed resistor **28** for resistors **26** and **27**, the oscillator providing oscillations at a fixed frequency.

In addition, the energizing circuit of relay **34** will alternately be made and broken through the action of cam-operated switch **39***a* (if switch **38** is in the "1" position). Contact **34***a* of relay **34** alternately makes and breaks the circuit of output **31** while contacts **34***b* and **34***c* are similarly connected in the circuit of output **33**. If switch **45** is in the position shown in the drawing, outputs **31** and **33** are energized simultaneously, while if it is moved to the other position, connecting contact **34***b* of the relay in the circuit, the outputs are switched alternately.

Each of the cams **40***a*, **40***b* and **40***c* are designed to provide a different time period for the operation of relay **34**, as for example one second intervals, three second intervals and six second intervals indicated on the drawings. Other periods may be provided if so desired.

After a period of surge type treatment, cam switch **37** is again opened and a continuous output at a fixed frequency, as determined by the position of switch **23** and the size of resistor **28**, appears at the output terminals. If switch **45** is in the alternate position as shown, the constant frequency will appear only at outlet **31**, while if switch **45** is in the opposite position the oscillations will appear continuously at both outlets **31** and **33**.



Cams **36** and **43** and step-down gearing **44** are so arranged that a cycle of three one minute treatments are provided. That is, there will first be an output of pulse type treatment at a frequency determined by the setting of variable resistor **26**, then a period of surge type treatment at a rate determined by the setting of switch **38** and then a period of one minute of tentanizing treatment. In order to accomplish this in the embodiment of the invention illustrated, cam **36** has a portion corresponding to 120° cut away so that switch **35***a* is closed for 120° of the rotation thereof, a period of one minute, while switch **35***b* is closed for 240° of the rotation thereof, a period of two minutes. Cam **43** similarly has a portion corresponding to 120° cut away and permits the closing of switch **37** for a period of one minute during each cycle. The relative positions of cams **36** and **43** are adjusted so that switch **37** is closed during the first minute of the two minute period during which switch **35***b* is closed.

When switch **25** is thrown to the "out" position, the variable frequency control, resistors **26** and **27** are connected in the circuit through section **25***a* thereof while section **25***b* shorts across switch **37** connecting relay **34** to section **38***b* of switch **38** at all times.

Section **38***c* of switch **38** serves to complete the circuit to outlet **33** should switch **45** be left in the alternate position when switch **38** is turned to zero.

The value of resistor **28**, 5,000 ohms, is so correlated with resistors **26** and **27**, 1.25 megohms and 10,000 ohms respectively, that the relative intensities of the outputs occurring during different portions of the cycle of operation are approximately the same so that the muscle stimulation provided may be of the maximum permissible amplitude at all times.

While I have shown and described certain embodiments of my invention, it is to be understood that it is capable of many modifications. Changes therefore, in the construction and arrangement may be made without departing from the spirit and scope of the invention as disclosed in the appended claims.

I claim:

1. An electro-therapy generator of the character described, comprising: an electron tube having a control element; a first circuit connectable to said control element for causing operation of said oscillator at a fixed freqency; a second circuit connectable to said control element for causing pulsed operation of said electron tube at a different frequency; a double-throw switch for effecting alternate connection of one and then the other of said circuits to the control element of said electron tube; motor-driven cam means for controlling the operation of said switch at regular intervals; and means including a contact device connected to said tube for applying the oscillations to a patient.

2. An electro-therapy generator of the character described, comprising: an electron tube having a control element; a first circuit, including a first resistance, connectable to said control element for causing operation of said oscillator at a fixed frequency; a second circuit, including a second resistance larger than said first resistance, connectable to said control element for causing pulsed operation of said electron tube at a different frequency; circuit means including a contact device connectable to said tube for applying the oscillations to a patient; double-throw first switch means for effecting alternate connection of said first and second circuits to the control electrode of said tube; second switch means for effecting connection of said contact device to said electron tube; a motor; a first cam driven by said motor for effecting operation of said first switch means to connect said first and second circuits alternately to said control electrode of said tube; and a second cam driven by said motor and associated

with said second switch means to control the connection of said contact device to said electron tube.

3. An electro-therapy generator of the character described in claim 2, wherein said first circuit is connected to said control element for a period longer than the second circuit is connected thereto, and the connection of the contact device to the electron tube is periodically interrupted during a portion of the time said first circuit is connected to the control element.

4. An electro-therapy generator of the character described, comprising: an electron tube having a control element; means connectable to the control element of said tube for causing oscillation at a fixed frequency; means connectable to the control element of said tube for causing pulsed oscillation at a different frequency; means, including a contact device connectable to said tube for applying said oscillations to a patient; control means for automatically connecting one and then the other of the first two of said means alternately to the control element of said electron tube at predetermined intervals, one of said means being connected to said control element for a longer period than the other; means for periodically interrupting the connection of said contact device to said electron tube during at least a portion of said longer period; and a second output circuit including a contact device connected to said tube for applying said oscillations to a patient, first switch means for periodically interrupting the connection of said output circuits to said oscillator, and second switch means in said output circuits and movable between a first position in which the connection of said output circuits is interrupted simultaneously and a second position in which the connection of said output circuits is interrupted alternately.




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