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[54] **ELECTRO PULSE ARTHRITIC PHYSIOTHERAPY SYSTEM**

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[51] **Int. Cl.** **A61n 1/36**

[58] **Field of Search** ..... 128/419 R, 419 P, 421, 128/422, 423, 404, 405, 411

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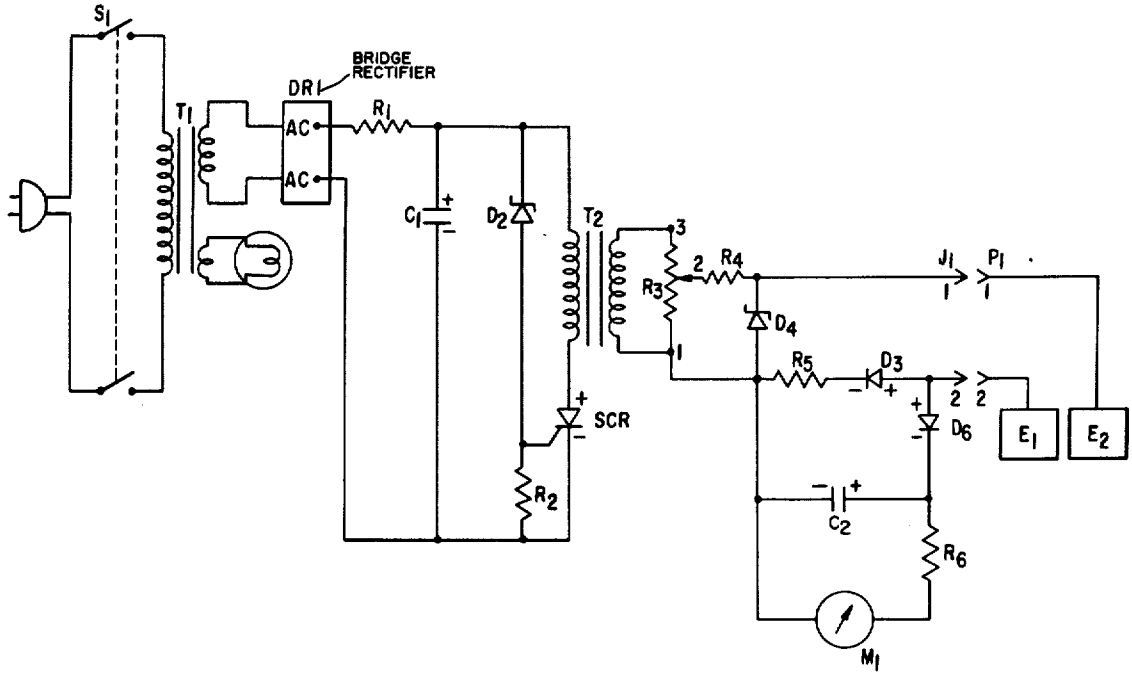
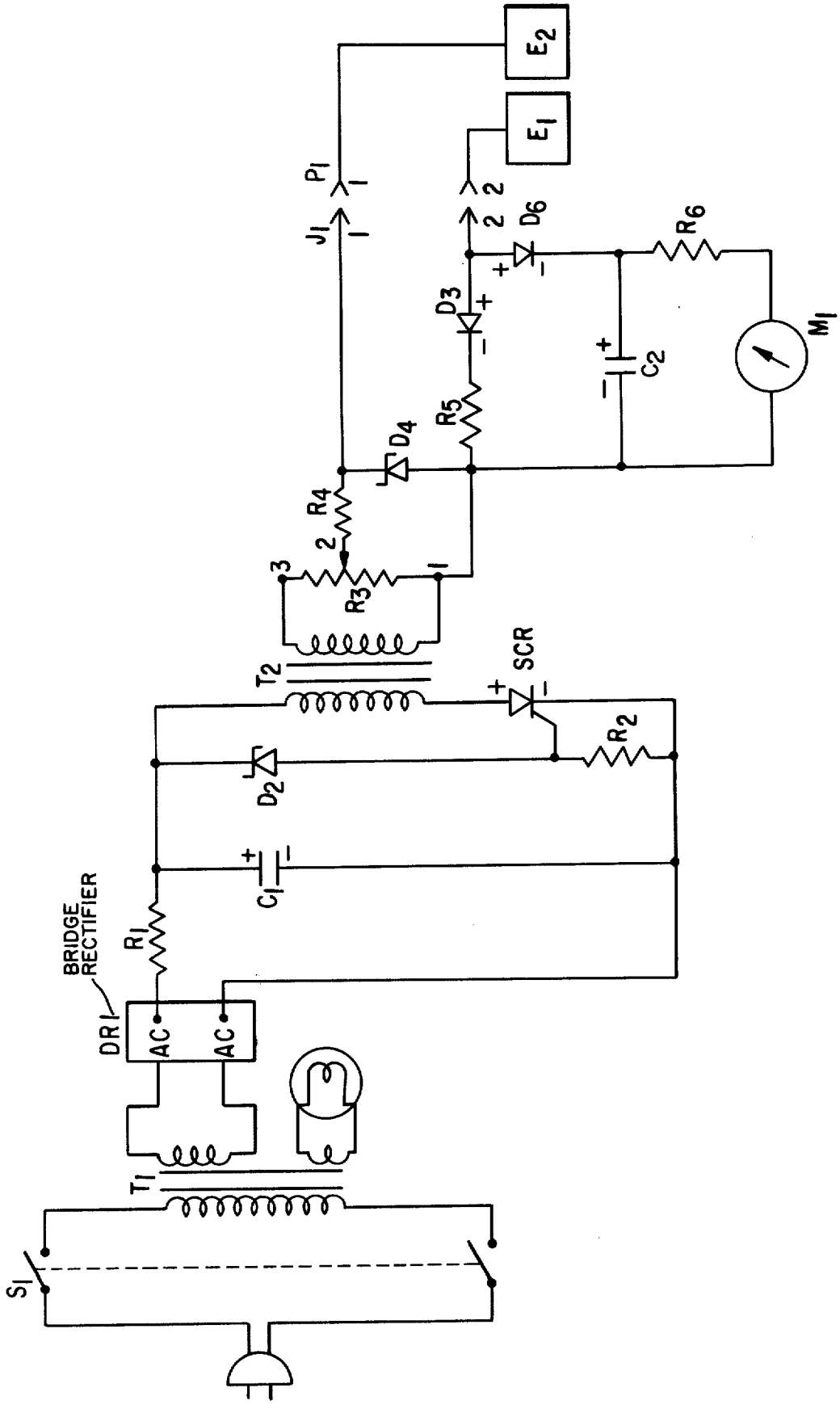
[57] **ABSTRACT**

An electro-pulse system for providing temporary pain relief to arthritic patients through therapeutic use of a circuit with a two wire alternating current plug connected between a switch and a transformer which in turn is connected to a bridge rectifier, and in turn to a pulse generating portion of said circuit, said pulse generating portion of the circuit consisting of a silicon controlled rectifier and associated control components, said generator portion having an output transformer coupled to a variable amplitude, current limiting, metering, and maximum amplitude limiting circuit with connections to electrodes designed for attachment to the mammalian subject.

8 Claims, 1 Drawing Figure




E2
E1
P1
J1
D6
R6
D3
M1
C2
R5
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T2
SCR
R2
D2
C1
BRIDGE RECTIFIER
R1
DR1
AC
AC
T1
S1

ELECTRO PULSE ARTHRITIC PHYSIOTHERAPY SYSTEM

BACKGROUND OF THE INVENTION

This invention is concerned with medical-electronic pulse stimulators by means of an electronic circuit involving a self-repetitive capacitive discharge technique. The prior methods of treatment for arthritis now in use involve aspirin, endicine, benazoladin alka, cortisone, ATCH, cortisone administered by Ion trophoresis and ultrasonic treatment. All of these medications lose their effectiveness as the arthritis progresses, with the exception of ultrasonic treatment which has not been in use long enough to determine its capability of sustained effectiveness. Also, with ultrasonic treatment, there is a danger of damage to the bone structure with improper use, since this treatment vibrates the bone structure (by acoustical means) at an ultrasonic rate. The power level of this ultrasonic treatment has to be carefully controlled to achieve the desired effect of breaking up the calcium deposits in the joints without damage to the bones of the affected joint or the bone marrow of the joint. Even at the proper level of treatment for effectiveness, if used over an extended period of time, it could very possibly inhibit the bone marrow capability from producing the needed components of the blood to sustain a healthy body. This would be a more predominant side effect if the area of exposure to treatment over the body's bone structure becomes large with respect to the total area.

All of the medications listed above, possibly with the exception of aspirin, in addition to losing their effectiveness and allowing the progression of arthritis to continue, also have bad side effects on the person's general health. They initiate a slow progressive deterioration and shorten an otherwise normal potential life span.

SUMMARY OF THE INVENTION

Briefly described, the apparatus of this invention comprises an electronic circut designed to provide a medical-electrical stimulant to a specific area of the mammalian body.

In the use of this system, a large sponge (about 3 inches wide and 4 inches long), and a small sponge (about 1 ¼ inches square) are soaked in a strong solution of sodium chloride and water. As soon as the sponges become flooded, they are squeezed to a damp, dry condition. The large sponge is placed in a location above the joint to be treated and a large electrode (E2) is placed in contact with the upper surface of the sponge and fixed in place by a wrap-around strap. The electrode (E2) remains in this location throughout the treatment of this particular joint. The small sponge is placed at the first location of treatment on the affected joint and is fixed in place with the electrode placed on the upper surface of the sponge and secured as explained for the large electrode (E2). The small sponge and the other electrode (E1) are moved at various times during treatment, to other locations of the affected joint until the whole desired area of the affected joint has been treated. Each time electrode (E1) is moved, it is re-secured in the same manner as described above.

The level of current used in the treatment is the maximum level the patient can comfortably endure. The output of this circuit is designed in such a fashion that

the maximum output level allowed by Zener diode (D4) is within the limits of safe use. From time to time during the treatment of each location, the output current may be increased slowly without additional discomfort to the patient since he gradually builds up a higher tolerance during treatment. The patient will be able to comfortably endure more current in some locations than others, even so the impedance load to the system appears constant, regardless of the location on the joint. This difference in tolerance at various locations of treatment is apparently associated with the nerve stimulant effect of the system.

The effectiveness of this treatment, at levels of current that are completely comfortable to the patient, is attributable to the low duty cycle of the output pulses. Due to the low duty cycle of the output pulses a larger magnitude of peak current can be passed through the affected joint without discomfort to the patient.

BRIEF DESCRIPTION OF THE DRAWING

The single FIGURE in the drawing shows an embodiment of the apparatus of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the drawing there is shown an electro-pulse stimulant device having a circutit with two wire AC plug connected with one wire to the wiper arm of switch (S1) and the other wire is connected to the remaining wiper arm of the switch (S1). A wire is connected between one normally open contact of the switch (S1) and one side of a transformer (T1) primary. A wire is connected between the remaining normally open contact of the switch (S1) and the remaining side of the transformer (T1) primary The secondary of the transformer (T1) is connected to the AC input of the bridge rectifier (DR1). A pilot light is provided at the transformer (T1). The positive output of the bridge rectifier (DR1) is connected to one side of a resistor (R1). The other side of the resistor (R1) is connected to the positive lead of a capacitor (C1), the cathode lead of a Zener diode (D2) and one side of the primary of an output transformer (T2). The other side of the primary of outer transformer (T2) is connected to the anode lead of a silicon controlled rectifier (SCR). The anode lead of the Zener diode (D2) is connected to the gate lead of the silicon controlled rectifier (SCR) and one side of the resistor (R2).

The cathode lead of the silicon controlled rectifier (SCR) is connected to the remaining side of the resistor (R2), the negative side of the capacitor (C1) and the negative output of the bridge rectifier (DR1). This completes the pulse generating portion of the circuit.

The output circuit of the system is connected as follows:

The secondary lead of the output transformer (T2), that is in phase with the primary lead of the transformer (T2) connected to the cathode end of the Zener diode, is connected to the pin (3) of the variable resistor (R3). The remaining lead of the secondary of the output transformer (T2) is connected to a pin (1) of the variable resistor (R3), then to one end of the resistor (R5), the negative side of the capacitor (C2) and the negative side of the voltmeter (M1). The positive end of the voltmeter (M1) is connected to one end of the resistor (R6), the other end the resistor (R6) is connected to the positive end of the capacitor (C2) and the cathode

side of the diode (D6). The anode side of the diode (D6) is connected to the anode of the diode (D3). The cathode of the diode (D3) is connected to the remaining end of the resistor (R5). The cathode of the Zener diode (D4) is connected to the resistor (R4) and anode of the Zener diode (D4) is connected to pin (1) of the resistor (R3). Pin (2) of the resistor (R3) is connected to one side of the resistor (R4), the other side of which is connected to the cathode side of the Zener diode (D4) and pin (1) of the output of connector terminal (J1). Pin (1) of the ristor (R3) is connected in series with resistor (R5), diode(D3) and pin (2) of connector terminal (J1). Pin (1) of the resistor (R3) is connected in series with resistor (R5), diode (D3) and pin (2) of connector terminal (J1). resistor to charge (C1). (C1) is charged to the voltage value of zener diode (D2). When the (SCR) fires current flow is through the primary of (T2). This current is supplied mainly by the existing charge on (C1) and some small amount of current from (DR1) which is limited by the value of (R1). The duration of this discharge current from (C1) is determined by the capacitance value of (C1) and the inductance value of the primary of (T2). (R1) limits the current delivered from (DR1) to a value that will not sustain current flow through the (SCR). Therefore, when (C1) discharges to a level insufficient to sustain current flow through the (C1) discharges to a level insufficient to sustain current flow through the (SCR), the (SCR) turns off and allows (C1) to begin a new charge cycle. The interval between pulses is determined by all of the following values in combination (each of the values below will have an effect on the pulse interval rate). The value of (R1), the output voltage of (DR1), the value of (C1), and the voltage breakdown value of the zener diode(D2).

The output circuit operates as follows:

The pulse generated as explained above is coupled to the secondary of the output transformer (T2) and then it is applied across the output voltage control (R3). The resistor (R4) limits the maximum current available to the electrodes (E1) and (E2). The Zener diode (D4) limits the maximum voltage available across the electrodes (E1) and (E2). When the output voltage control (R3) is increased to a point that delivers a voltage across the Zener diode (D4) that is higher than its voltage breakdown rating, the Zener diode (D4) breaks down in the reverse direction and provides the Zener effect clamping the peak voltage output to a certain maximum as selected by the voltage breakdown value of the Zener diode (D4). The above explanation of the operation of the Zener diode (D4) is for the purpose of illustrating its action when the output voltage reaches its breakdown value. Normally the voltage value selection of the Zener diode (D4) is selected to be just above the normal full loaded output voltage as controlled by the resistor (R4). The Zener diode (D4) is in the circuit acting as a safety device to clamp the output to a selected maximum. The diode (D3) serves a double purpose in that it eliminates the voltage overshoot, making the output monopolar and it provides a linear function to the charging of the capacitor (C2) so that no offset error or non-linear readout is seen on the voltmeter (M1).

The output pulse appears across the electodes (E1 and E2), which are connected as follows: the large electrode (E2) is connected at a location above the arthritic joint and the small electrode (E1) is placed at various locations around the area of the affected joint during treatment.

The current meter circuit operates as follows: the capacitor (C2) charges to the value of the voltage drop across the resistor (R5) and the voltmeter (M1) circuit measures this voltage which is directly interpolated into the current value by the calibration of the meter scale. The diode (D6) is in the circuit to prevent the discharge of the capacitor (C2) back through the resistor (R5).

The advantages of this treatment for arthritis is in its ability to give pain relief from arthritis without the use of drugs that are detrimental to the body, also its potential ability to control the arthritis without allowing it to progress to later stages, and hopefully, its potential curative effect over a sustained period of treatment. The system is also small and portable.

The equipment disclosed for use in this treatment has a controlled amplitude of very low duty cycle positive going direct current pulses. The pulse used is between 175 microseconds wide and 5 milliseconds wide with an interval of time between pulses of 40 milliseconds to 2 seconds. The equipment has a fixed pulse width, interval ratio.

While I have illustrated and described a presently preferred picture of my invention in the foregoing specification, it will be understood that this invention may be otherwise embodied within the scope of the following claims.

I claim:

1. An electro-pulse arthritic physiotherapy system for providing an output electronic stimulative impulse to a mammalian subject comprising an alternating current source; a switch means connected to said source; a first transformer having a primary and a secondary; said switch and primary being connected in series with said source; a bridge rectifier; said rectifier being connected to said secondary of said first transformer; said rectifier having first and second outputs; a first resistance; a second transformer having a primary and secondary; said first resistance being connected to said first output; a circuit including a first capacitor connected between said first resistance and the second output; a first Zener diode; a second resistance; said Zener diode and said second resistance being connected in a series circuit between said first resistance and second output of said bridge rectifier; a silicon controlled rectifier having a gate lead; the primary of said second transformer and said silicon controlled rectifier being connected in a circuit in series between said first resistance and second output; and said first capacitance circuit, said Zener diode circuit and said second transfomer primary circuit all being arranged in parallel; said gate lead of the silicon controlled rectifier being connected in to said Zener diode circuit between the Zener diode and second resistance; first and second pins forming output connections for the secondary of said second transformer; a variable resistance connected between said first and second pins in parallel with said secondary of said second transformer; a first electrode for attachment to a mammalian subject; a third resistance; means to connect said third resistance in series with said electrode and a portion of said variable resistance; a second electrode for attachment to a mammalian subject; a first diode; a fourth resistance; a second Zener diode; said second electrode, said first diode and said fourth resistance being connected in series with said second

pin; said second Zener diode being connected between said third and fourth resistance elements, and also in parallel with the secondary of said second transformer; a second capacitor connected in parallel with said first diode and said fourth resistance; a second diode connected between said first diode and said second capacitor; a voltmeter connected in parallel with said second capacitor; and a fifth resistance connected between said second capacitor and said voltmeter.

2. The system of claim **1**, having direct current pulses between 175 microseconds and 5 milliseconds.

3. The system of claim **2**, having an interval of time between pulses from about 40 milliseconds to about 2 seconds.

4. The system of claim **3**, wherein said Zener diodes control the output voltage within a selected maximum range.

5. The system of claim **2**, wherein said Zener diodes control the output voltage within a selected maximum range.

6. The system of claim **1**, having an interval of time between pulses from about 40 milliseconds to about 2 seconds.

7. The system of claim **6**, wherein said Zener diodes control the output voltage within a selected maximum range.

8. The system of claim **1**, wherein said Zener diodes control the output voltage within a selected maximum range.

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