

- [54] APPARATUS FOR TEMPORARILY ARRESTING ARTHRITIC PAIN
- [76] Inventors: Saul Liss, 555 E. 27th St., Paterson, N.J. 07514; George Feldstein, 407 Concord St., Cresskill, N.J. 07626
- [22] Filed: Sept. 13, 1974
- [21] Appl. No.: 505,864
- [52] U.S. Cl. 128/422
- [51] Int. Cl.² A61N 1/36
- [58] Field of Search..... 128/419 R, 421, 422, 423, 128/2.1 R, 1 C, 172.1

[56] References Cited

UNITED STATES PATENTS

2,823,678	2/1958	Luftman et al.	128/422
3,195,540	7/1965	Waller	128/422
3,255,753	6/1966	Wing	128/421
3,516,413	6/1970	McDonald et al.	128/422
3,648,708	3/1972	Haeri	128/422
3,791,373	2/1974	Winkler et al.	128/422
3,817,254	6/1974	Maurer	128/421

FOREIGN PATENTS OR APPLICATIONS

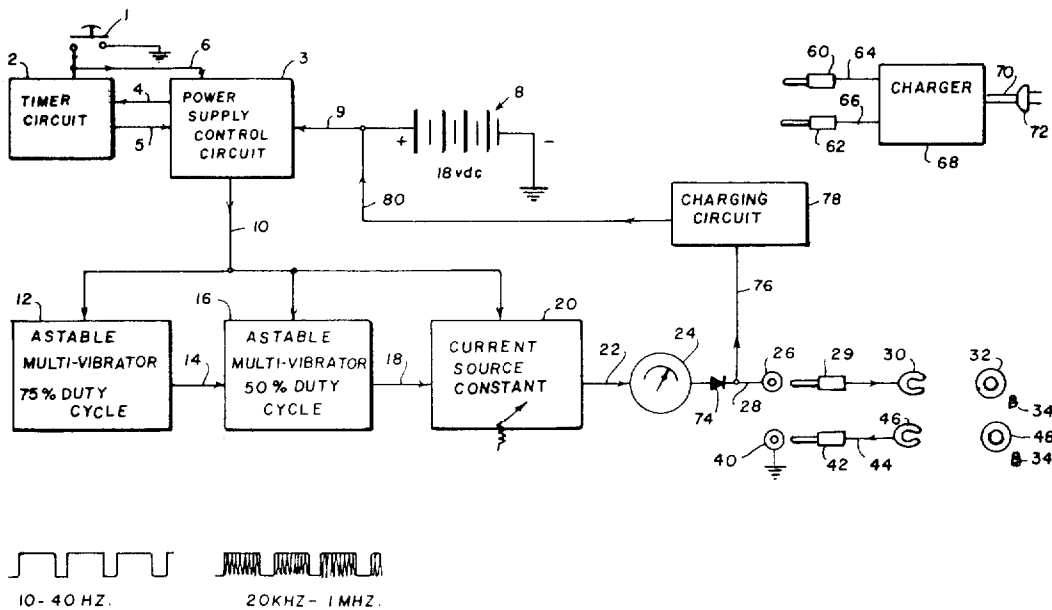
706,466	3/1954	United Kingdom	128/423
---------	--------	----------------	---------

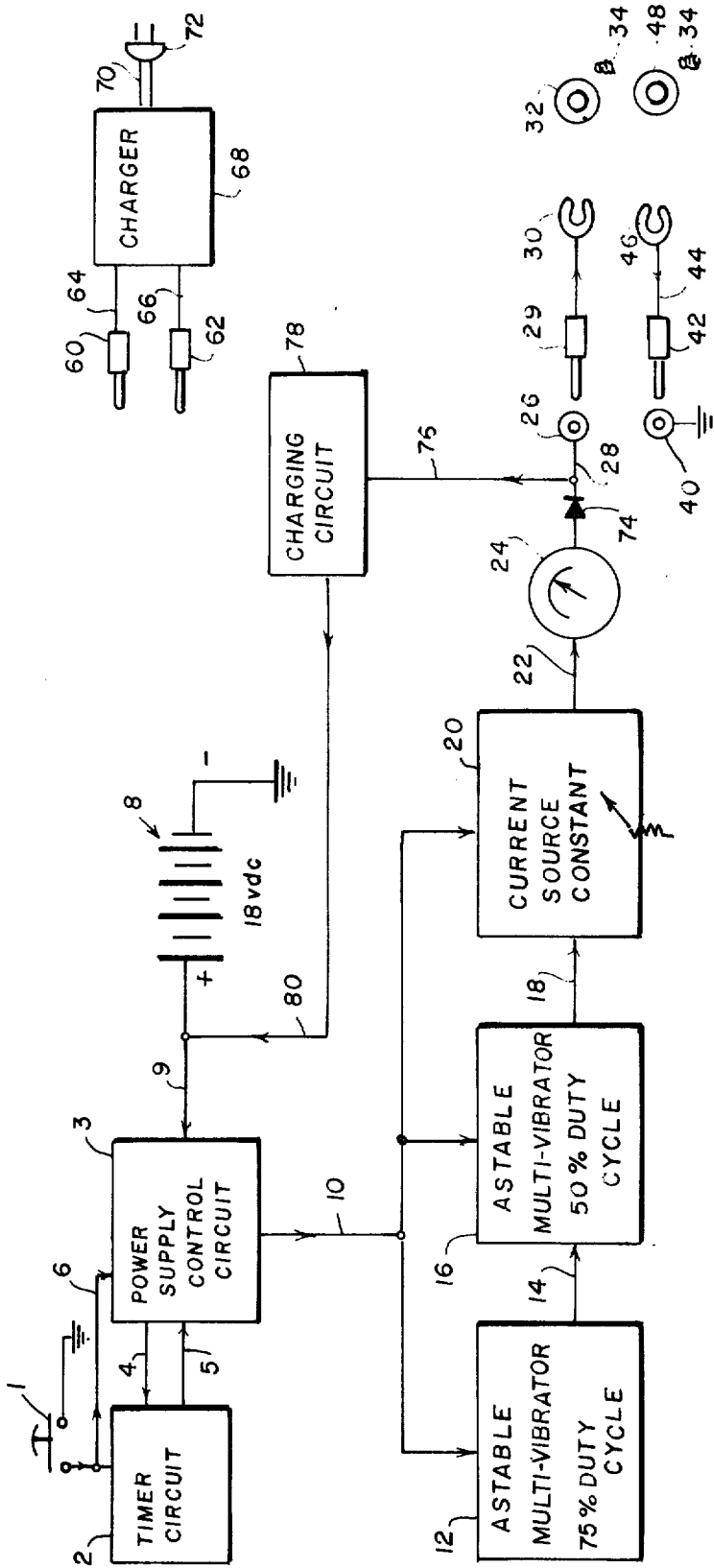
Primary Examiner—William E. Kamm
 Attorney, Agent, or Firm—Ralph R. Roberts

[57] ABSTRACT

The present invention pertains to portable electronic apparatus which is locally applied to relieve an arthritic condition and as a treatment relieves the pain for a time period of 1 hour to 8 hours. No curative effects are claimed or anticipated by this apparatus, however, the temporary relief appears to equal or surpass local cortisone shots in joints, inflamed muscles or other arthritic afflicted areas and without the side effects of cortisone. The present apparatus preferably as a small electronic device employs a current source provided by a battery having nominally eighteen volts d.c. This current is comprised of two major frequency components and is applied to local areas and controlled so that a current of 0.8 milliamperes or less is the peak current applied and is indicated on a meter scale measuring the flow through the contacts applied at the affected part. This current flow is in one direction and is limited to 10 to 40 cycles at a 75 percent duty cycle imposed upon a current flow of between 20 kilocycles and one megacycle.

10 Claims, 1 Drawing Figure





APPARATUS FOR TEMPORARILY ARRESTING ARTHRITIC PAIN

Background of the Invention

2. Field of the Invention

With reference to the classification of art as established by the United States Patent Office the present invention discloses and claims apparatus and method as found in the general Class entitled, "Surgery" (Class 128) and in particular in the subclass entitled, "electrical systems" (subclass 419R) and the subclass thereunder of "oscillation circuits" (subclass 422).

2. Description of the Prior Art

Electrical pulses in both low and high voltages and current flow have been used to treat human aches and pains. Aches and pains is the misery of arthritis and many attempts to temporarily relieve the discomfort of arthritic pain have been made and many are exemplified in patents specifically or peripherally describing and/or claiming arthritis relief or cure. The study of physiotherapy and the use of electrically produced waves are reviewed in U.S. Pat. No. 3,056,409 to EDWARDS as issued on Oct. 2nd, 1962. In this patent audio frequency current in square wave form at a frequency of 9 to 26 c.p.s. is applied locally to the afflicted areas. From the lack of acceptance of this device since its public disclosure in 1962 it is evident that arthritic pain is not alleviated by its square wave producing circuit. These waves are disposed above and below a theoretical horizontal datum line and in a symmetrical pattern. Although the therapy from this device may be beneficial to muscle stimulation the use of wave patterns similar to brain waves does not alleviate the pain from arthritis.

A very recent dual oscillator, variable pulse duration electrotherapeutic device as seen in U.S. Pat. No. 3,794,022 as issued to NAWRACAJ on Feb. 26th, 1974 uses square waves in a cycle pattern where the pulse pattern provides separate voltage currents of separate frequencies by a series of pulses of a varying duration during a predetermined period.

U.S. Pat. No. 3,513,851 as issued to SMITH et al. on May 26th, 1970 uses a balanced signal from a datum line wherein the signal, when the pulse is actuated, tapers to a peak intensity then diminishes to the datum line.

In most of the electrotherapeutic devices, muscle stimulation seems to be achieved and proof of the effectiveness of such devices for muscular stimulation is found in the locker rooms of athletic teams, health spas, etc. In many instances, the electrical source is A.C. current from a wall plug. The voltages may be from 2 to 5 and in some instances up to 250 volts is approved by the American Medical Association for physiotherapy treatment.

The present invention is unique in that the desired arthritic suppression is achieved by providing a very small current flow at a low voltage (18 v.d.c.). This current flow is applied to give a pumping action to the nerve train between the applied contact points. The impedance of the patient is compensated for by the constant current circuit which is automatically readjusted to the needs of the patient. The pumping action current flow is achieved by applying at a cycle rate between 10 and 40 hz., a 75 percent on and 25 percent off a high carrier frequency from 20 khz. to one megacycle. This high frequency is produced by a 50 percent duty cycle

multivibrator so that all cycles are above the datum line. The modulation low frequency vibrator provides a square wave output.

The selection of the modulation frequency to fall within 10 to 40 cycles per second avoids causing any fugitive signal transmission to the brain whose cycle frequency is eight or less and the heart which is fifty or more. The control of the voltage to 18 volt. d.c. at a current flow of eight-tenths of a milliamperes insures that repeated usage beyond the normal three to four minute application is perfectly safe under any and all circumstances. As reduced to practice, the apparatus including power supply is of a very small size. The application may be personally applied by the one for whom the treatment is required. Many patients are, or are anticipated to be, senior citizens and for this reason the use of the apparatus must be absolutely foolproof as to possible misapplication, shorts in the apparatus and even to the extent of immersion in water or a similar medium. The low voltage supply and the use of solid state electronics insures that the apparatus of this invention is absolutely safe in all circumstances.

SUMMARY OF THE INVENTION

This invention may be summarized at least in part with reference to its objects.

It is an object of this invention to provide, and it does provide, a small electronic device from which is controllably discharged a one-way electrical current flow.

This current is controllably applied to a localized source of affliction for a determined time period as for example three and one-half minutes. This current flow is applied in the nature of a pumping action which appears to assist the synaptic chain flow in the nerves to cause the nerves to be relieved of their tension. The current as applied has a base vibration of 20 kilocycles to 1 magacycle, which current is modulated by an astable multivibrator with a 75 percent duty cycle to present a current flow of 75 percent on and 25 percent off at a cycle of frequency 10 to 40 hz. with a current flow automatically controlled not to exceed eight-tenths of a milliamperes.

It is a further object of this invention to provide, and it does provide, both an apparatus and method wherein a very low voltage such as 18 volts d.c. is fed to a power supply control circuit and from thence to a gated multivibrator circuit containing one astable multivibrator having a 50 percent duty cycle. This high frequency current of 20 kilohertz to 1 megahertz is gated by a second astable vibrator with a 75 percent duty cycle in which the cycle is between 10 to 40 hz. with the resulting local current flow automatically restricted to eight-tenths of a milliamperes when applied to the afflicted area to provide arthritic pain suppression. Tests have established that the pain suppression is effective for periods of 1 to 7 hours.

It has been found that since this controlled flow is in the nature of a one-way current flow which is asymmetrical, the placing of the contacts on the patient with or without the use of a conductive jelly is extremely important in that the current flow must be through the nerves associated with the local pain area.

As reduced to practice, and under the controlled evaluation by doctors it has been found that a very small current flow such as eight-tenths of a milliamperes or less of the dual frequency current when applied to a local area for approximately three and one-half min-

utes has reduced arthritic pains to substantially painless levels. Since the arthritic pain can occur at any time the apparatus has been made portable and in a package approximately the size of two packs of cigarettes. Much of this size is to accommodate in this apparatus two

nine volt d.c. batteries. In the circuit, to be hereinafter more fully described, these batteries are of the rechargeable variety and provision for recharging is shown in this circuit diagram.

The treating current produced by this circuit through two multivibrators operating as a combination provides a pulsing action of current to the afflicted area. The forward going current is "on" 75 percent and "off" 25 percent and is a square wave derived by a 75 percent duty astable multivibrator. This square wave further controls a 50 percent duty cycle astable multivibrator. The resulting applied current is at 20 kilocycles to one megacycle at a modulated frequency of ten to 40 hz. A current control limits the current flow to a maximum of eight-tenths of a milliampere with a maximum applied voltage nominally of 18 volts, but independent of the actual voltage across the contacts. This current output is carried to two contacts, one identified as a positive and one as a negative or common electrode.

In addition to the above summary the following disclosure is detailed to insure adequacy and aid in understanding of the invention. This disclosure, however, is not intended to prejudice that purpose of a patent which is to cover the inventive concept therein no matter how it may later be disguised by variations in form or additions of further improvements. For this reason there has been chosen a specific embodiment of the apparatus for temporarily arresting arthritic pain as adopted for use by arthritic sufferers. This specific embodiment has been chosen for the purposes of illustration and description as shown in the accompanying circuit diagram wherein:

BRIEF DESCRIPTION OF THE CIRCUIT DIAGRAM

The circuit diagram is in the form of a block diagram in which is represented the various functions of the components forming the circuit and providing the special current flow output of the arthritic pain suppression device. In this circuit diagram and in the description hereinafter the same identifying numbers are applied to like components for the sake of convenience and not necessarily in a limiting sense.

DESCRIPTION OF THE PREFERRED CIRCUIT

Referring now to the electronic arthritic pain suppression apparatus as shown in the accompanying and above-identified circuit diagram the desired current flow is initiated by an on-off switch 1 which is preferably spring biased to the normally "off" condition. When the switch is actuated it causes the circuit to be turned on with the rest of the functions being performed in an automatic nature. With the actuating of the switch a timer circuit 2 is turned on. This timer circuit when initiated has a predetermined set timing cycle and, as reduced to practice, through monitored tests is preferably three to four minutes in duration. At the same time that the timer circuit is turned on the power supply control circuit 3 is also turned on. This power supply control circuit 3 is interconnected to timer circuit 2 by means of conductors 4 and 5 and its actuation results from the closing of switch 1 with this signal carried through conductor 6. Power for this ap-

paratus is fed to the power supply control circuit by and from an eighteen volt d.c. source 8 which is contemplated to be two nine volt rechargeable batteries. This voltage source identified as 8 is connected by conductor 9 to the positive side of the battery 8 and to the power control circuit 3. From this power control supply circuit 3 the current is fed through conductor 10 simultaneously to three interconnected and related components. An astable multivibrator 12 which produces square waves is quite familiar to those skilled in the art. This astable multivibrator has a 75 percent duty cycle and is adjusted to produce a cycle of 10 to 40 hz. and is connected by means of conductor 14 to another astable multivibrator 16 which has a 50 percent duty cycle and functions anywhere from 20 kilo hz. to 1 mega hz.

The resulting vibrating current from astable multivibrator 16 is connected by conductor 18 to a current control apparatus 20 which in the present device is anticipated to allow adjusting the current flow to a maximum of eight-tenths of a milliampere. The amount of current also is indicated to the user or supervisor of the apparatus by connecting the output of the current control through conductor 22 to and through a microampere meter 24 which is connected to a positive outlet female receptor 26 by means of a conductor 28. This receptor 26 is a female receptor sized to receive a male jack 29 which is inserted into the female jack receptor to make an electrical connection. This, of course, is merely a convenience and the use of a jack connection as far as the circuit is concerned may be eliminated by connecting the output of the microampere meter 24 directly to the conductor 28 and thence to a contact member 30. This contact retaining member 30 preferably is a spring clip such as is used with the flexible conductors normally used in apparatus for taking ekg's. In this member 30 is mounted a contact 32 having an adhesive outer retaining means. These contacts are replaceably mounted in the member connector 30. To improve the conductivity between the conducting portion of the contact 32 and the skin of the patient a jelly 34 is indicated as being applied to the contact before and at the time of the mounting of the contact on the skin of the patient. The negative or ground side of battery 8 is connected preferably to a female receptor 40 which is connected by means of a male jack 42 and a conductor 44 to a spring clip retaining member 46. A discardable adhesive contact 48 is removably retained by this retaining member 46 and the conductivity from and to the skin is enhanced by using a dab of jelly 34. This commercially available jelly 34 is applied to the contact as is customary in the taking of an ekg.

In order to insure versatility of the equipment and eliminating the replacement of the battery power source a recharging means is contemplated. A charger circuit is therefore incorporated into the present apparatus. This charger is contemplated as only being employed when contacts 30 and 46 are disconnected with the withdrawal of jacks 29 and 42. Charging orientation is insured by making jacks 29 and 42 different in size. Correspondingly sized jacks 60 and 62 are adapted for insertion into the female receptacles 26 and 40 in the manner of the jacks 29 and 42. Jacks 60 and 62 by means of conductors 64 and 66 are connected to a charger 68 of conventional known design. These chargers convert 120 volts A.C. current to the required d.c. voltage and charge conventionally rechargeable batteries. The charger 68 is connected by

means of conductors 70 to outlet plug 72 connectable to available A.C. house current. To prevent damage to the current source control 20 and the multivibrators 12 and 16 a diode 74 is inserted into the conductor 28. The positive current flow is then carried by conductor 76 from the female receptor 26 to a charging circuit 78 and thence by means of a conductor 80 to the positive side of the battery 8 for recharging the battery at the needed intervals.

Use and Operation of the Apparatus

The "on" switch 1 is depressed to start the timing circuit 2 and activate the power supply control circuit 3 to the several components forming the vibrating pulse which is applied locally for a determined time period to stimulate the nerves in the afflicted area in a desired orientation. The timer circuit 2 limits the flow of current from power supply 3 to a determined time interval such as three and one-half minutes after the power from the battery 8 is turned off. The eighteen volt d.c. battery supply 8 supplies the electromotive force for all of the circuitry and from the power supply control circuit 3 there is a distribution of function of this power force not only to the timer circuit and back to the power supply control circuit but also to the various other items such as the multivibrators and the current controlling circuit.

The astable multivibrator 12 is special insofar as it has a 75 percent duty cycle which means it has a 25 percent "off" time and a 75 percent "on" time. For the purpose of safety and use by the patient this particular multivibrator has a cycle time of from 10 to 40 hz. This cycle is set at the factory and usually is about 25 hz. The multivibrator 12 is connected by means of a conductor 14 to the astable multivibrator 16 and is a modulator for this high frequency vibrator 16 which functions at anywhere from 20 kilo hz. to 1 mega hz. The signal from vibrator 12 is gated at its input side to multivibrator 16. The vibrations of the second astable multivibrator 16 is pulsed by the output or flow control of multivibrator 12 which literally turns the second of high frequency multivibrator 16 "on" and "off" as the case may be depending upon the function of the astable multivibrator 12. The combined output of the astable multivibrators 12 and 16 is then presented to the current source control 20 through conductor 18 as a square wave function. All of the wave vibrations are above a minimum or medium line and occur as a 75 percent "on" and a 25 percent "off" flow. As a square wave signal this current is fed to and through the current control source 20 so that a maximum current flow of eight-tenths of a milliampere is maintained and this is read by the indicator signal of the micro ampere meter 24. This flow is fed to the output receptor 26 and eventually to the contact member 30 and the contact pad 32 and then to the skin of the patient. Although the source has been established to a maximum limit of eight-tenths of a milliampere the particular ampere flow level generally through the afflicted area of a patient is from three-to six-tenths of a milliampere. Provision may be made to permit the doctor or the user of the device to adjust the current source control by a variable control. This adjustment is generally set at the factory but may be adjusted to a particular patient and if necessary for a particular afflicted portion.

During the time the apparatus is not in use the battery may be charged. Jacks 29 and 42 are removed

from receptors 26 and 40 and jacks 60 and 62 mounted therein. Charger 68 is then connected to A.C. power through plug 72 and the charging circuit 78 feeds the required charging power to battery 8. Diode 74 is a one-way gate preventing current from charger 68 from flowing to the vibrating and current flow limiting components.

The above-described apparatus has recited specific limitations which are deemed significant. First, the astable multivibrator limits the forward going pulses to a 10 to 40 cycle range. This limitation is deliberate. The 10 cycle low limit prevents any stray pulse signals in the nerves to affect the human brain function which is at 8 or less cycles. The high limit of 40 cycles is established to prevent any stray pulse signals from affecting heart signals of 60 or more. The square wave signal insures that the "pulses" when "on" are alike and regular. The 50 percent duty cycle insures that all pulses are forward going and no alternating or reversing tetanizing current flows to the afflicted nerve area.

The current source control 20 automatically compensates for the impedance in the skin of the patient at the particular time of use. It was recognized that there are many variables in the effecting of a localized electrical contact with the skin. The impedance in the skin appears to vary from day-to-day and even from hour-to-hour. It is impractical, if not impossible, to apply the contacts to the exact same skin locations time after time. In addition the contact pressure varies from time to time and particularly with and during the patient's movement. Hence, to apply a precise forward going vibrating current of a very low controlled amount to the afflicted area an automatic impedance control is needed and is provided. The apparatus can only be connected to a potentially dangerous power source during the battery recharging period. As arranged, contacts 30 and 46 with jacks 29 and 42 must be removed before jacks 60 and 62 are inserted to carry converted current from the charger 68 to battery 8.

The above-described apparatus provides a nerve stimulator which although battery powered employs such a small current that it often requires a viewing of the meter 24 to be sure that treatment is in process. This is in sharp contrast to apparatus such as that employing 25 milliampere at 120 volts. This type of apparatus requires a manual control by which the patient can reduce the input to his own tolerant levels until repeated use builds up a conditioning acceptance. Most of the prior art apparatus known to the Applicant's permit the applying of the contacting electrodes to the patient's skin without a definitive arrangement of the positive and negative contacts. This is not true of the present apparatus, as above noted, the orientation of the contacting electrodes on the patient is extremely important. The orientation is aligned to augment the nerve flow and is achieved with the positive electrode nearer the heart so that the applied pulse is only forward going and when "on" the frequencies are only on one side of a datum line.

It is also to be noted that although the astable multivibrator is shown as a 75 percent duty cycle, other ratios provide to varying degrees success in the arresting of pain as long as the pulse vibrations are forward going. Ratios of two to one, four to one and even five to one have produced temporary pain relief. The most effective ratio with the several patients treated under a doc-

tor's evaluation and supervision has been the three to one ratio produced by multivibrator 12.

Terms such as "in," "out" and the like are applicable to the components described in conjunction with the circuit diagram. These terms are merely for the purposes of description and do not necessarily restrict the components and their manipulation.

While a particular circuit diagram has been shown and described it is to be understood the invention is not limited thereto and modifications may be made within the scope of the accompanying claims and protection is sought to the broadest extent the prior art allows.

What is claimed is:

1. An electronic apparatus for temporarily arresting at local areas a patient's arthritic pain and the like, said apparatus having conducting leads for carrying the output of the apparatus to contact ends to conductively apply to the skin of the patient and at a localized area a forward going pulse which is automatically continued for a short period such as 3 to 4 minutes, said apparatus including: (a) a power source providing a d.c. voltage to the apparatus; (b) switch means which when closed at least momentarily initiates a flow of d.c. voltage from the power source to a pulse forming apparatus; (c) means for limiting the time duration of the d.c. current flow to the pulse forming apparatus; (d) a first astable square wave multivibrator having a asymmetrical duty cycle which may be as little as two-thirds of the cycle and as great as five-sixths of the cycle and operating at a selected rate of not less than ten and not more than 40 hz., said vibrator connected to and providing a gate control for; (e) a second astable square wave multivibrator having a duty cycle of 50 percent and operating at a selected rate of not less than 20 khz. and not more than 1 mhz., the combined forward going pulsed wave being fed to; (f) an automatic current control by which the output level of the pulsed wave is maintained at a selectively set level not exceeding eight-tenths of a milliampere, and (g) means for conducting said output to two contact members in local contact on the skin of the patient, the automatic current control maintaining the selected set level no matter what changes in impedance occur in the transmission of said current locally through the skin of the patient.

2. An electronic apparatus as in claim 1 in which the switch means is a spring-biased switch which is urged to its "off" condition and when closed causes a timer circuit to be initiated and with a power supply control

circuit feeds the d.c. voltage to the first and second multivibrator and the automatic gate control.

3. An electronic apparatus as in claim 2 in which a microampere-meter is connected to the output conductor leading from the automatic current control to the skin contact member, said micro-ampere-meter arranged so as to provide a visual indication of the output level flowing through the local skin area.

4. An electronic apparatus as in claim 1 in which the voltage source is about eighteen volts d.c.

5. An electronic apparatus as in claim 1 in which the voltage source is a rechargeable d.c. battery system and the apparatus circuit includes a charging circuit disposed to feed rectified current as received from an A.C. current supplied charger to the rechargeable battery.

6. An electronic apparatus as in claim 5 in which the electronic circuit includes a diode so connected in the circuit that the charging current sent to the d.c. battery source from the charger is prevented from flowing in a reverse direction to the automatic current control and first and second multivibrator.

7. An electronic apparatus as in claim 6 in which the apparatus and power source is encased in a small housing to make the apparatus portable and in which the means for conducting the output current are conductive leads to the patient and include disconnecting means provided at one of the walls of the housing by which the conductive leads may be disconnected and connected as desired.

8. An electronic apparatus as in claim 7 in which the disconnecting means includes jacks of two different configurations and mating receptacles so that reconnection can be achieved only in one arrangement, and in which the charger is provided with two conductors, one terminating at a jack adapted for connection with one receptacle and the other conductor terminating at a jack adapted for connection to the other receptacle, said charger thus being able to be connected to the apparatus only when the conductors for the skin contactors are disconnected.

9. An electronic apparatus as in claim 1 in which the first multivibrator has a duty cycle of three-fourths "on" and one-fourth "off."

10. An electronic apparatus as in claim 1 in which the means for limiting the time is a timer circuit which is preset to provide between 3 and 4 minutes.

* * * * *

50

55

60

65