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H. B. FARENSBACH

3,521,641

ELECTRONIC APPARATUS FOR INDUCING SLEEP

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2 Sheets-Sheet 1

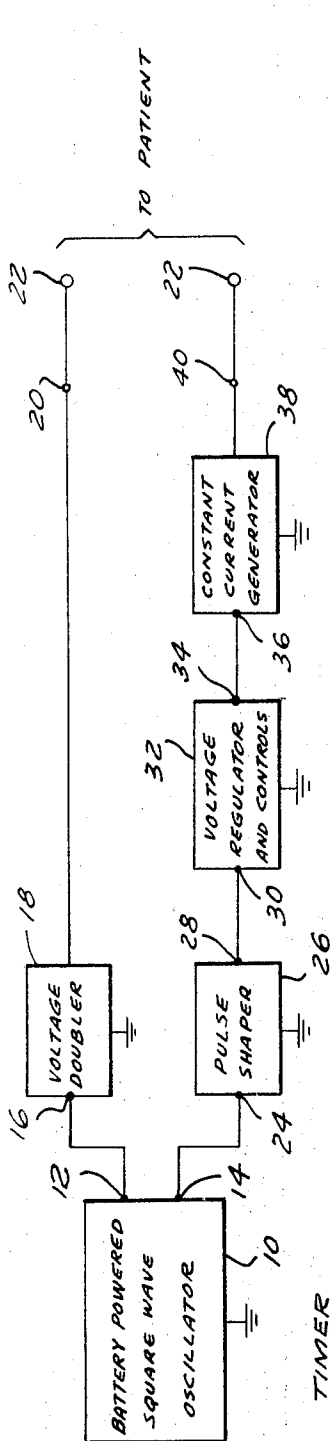


FIG. 1

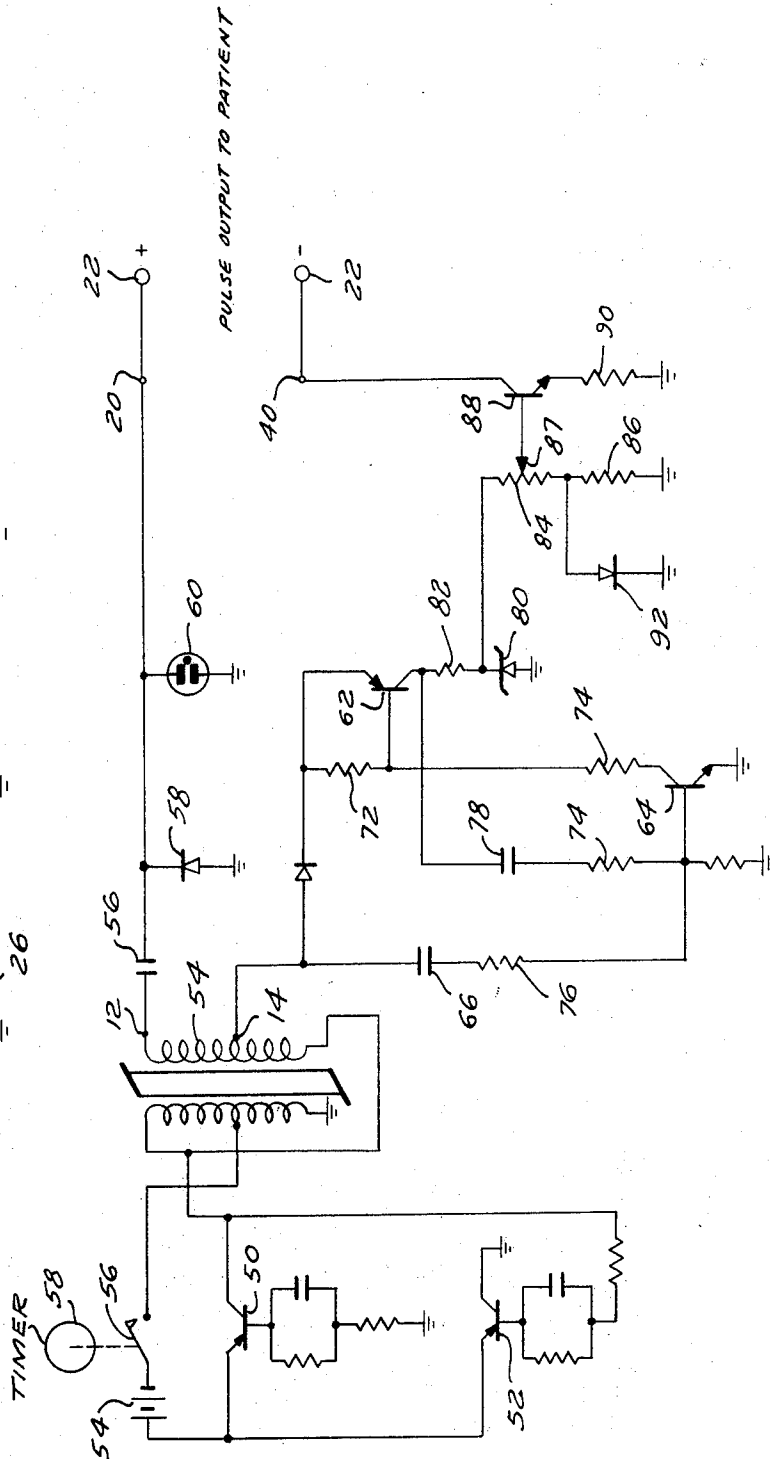


FIG. 2

INVENTOR
H. B. FARENSBACH
BY *Thodore J. J.*
ATTORNEY

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FIG. 3

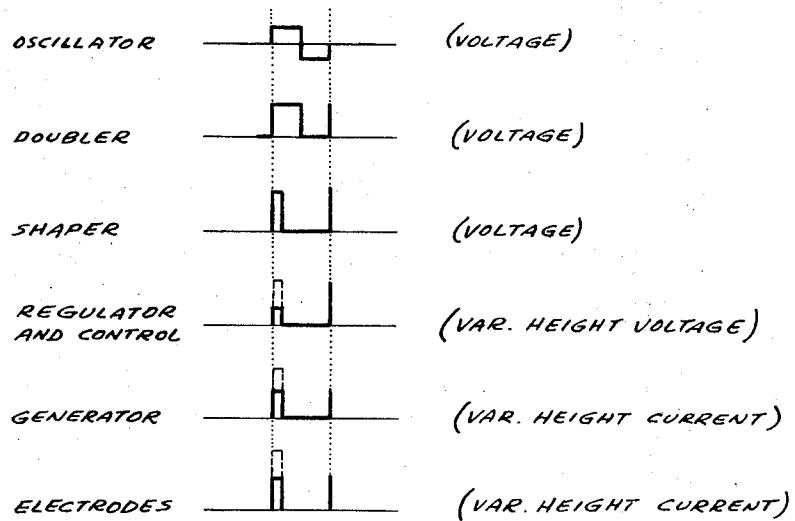
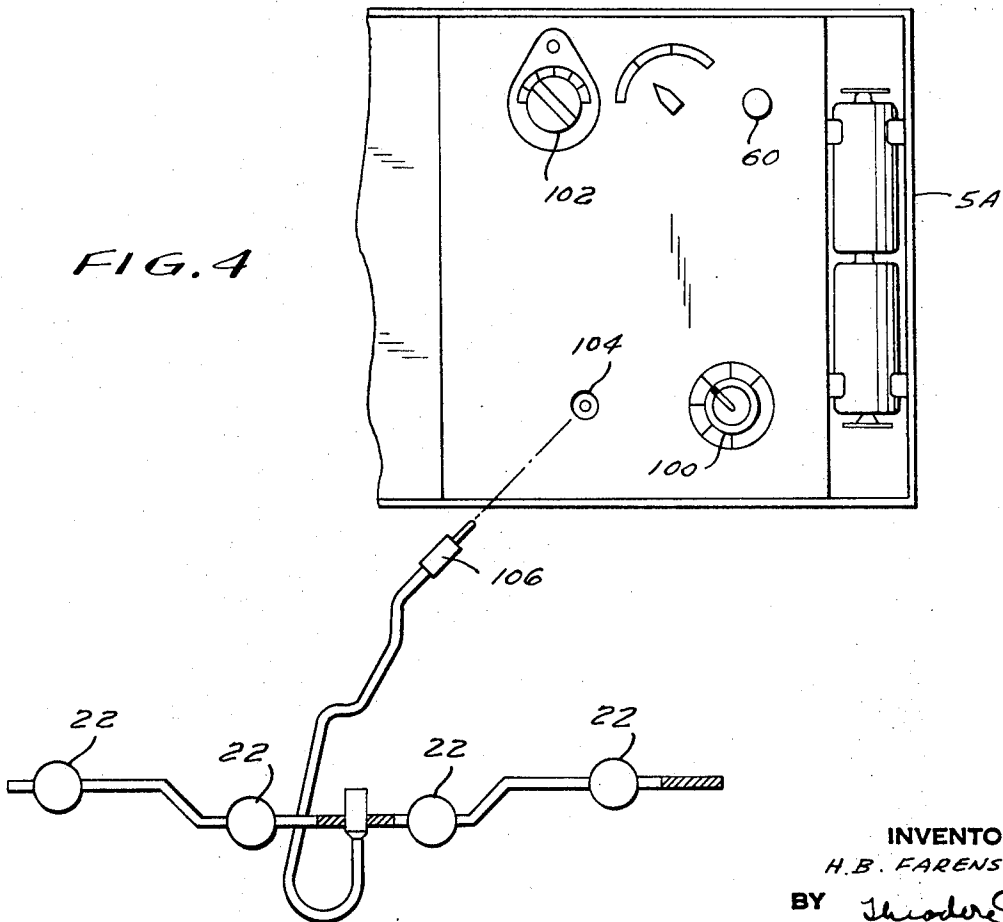


FIG. 4



INVENTOR
H. B. FARENSBACH
BY *Theodore J. J. J.*
ATTORNEY

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3,521,641 ELECTRONIC APPARATUS FOR INDUCING SLEEP

Harry B. Farensbach, 420 Riverside Drive,

New York, N.Y. 10025

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4 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for generating an electrical pulse train of selected characteristics and for subsequently applying this train between the eyes and neck of a human subject to ease nerve tensions, reduce insomnia and even induce sleep.

THE PRIOR ART

In 1947, Russian experimenters discovered that a low level pulsating current could induce sleep in a human subject when this current was applied between the eyes and neck for a relatively short period. In order to continue research in this field, special machines were constructed for hospital use under medical supervision. These machines operated from electrical mains, and constant adjustment and maintenance was required to avoid malfunctions which could feel mains current to the subject and cause serious injury.

Additional research conducted in the United States with the Russian machines has established that the electrical treatment was extremely effective, providing that the pulse train contained current pulses of uniform height and width which were supplied at a constant recurrence frequency. Typically, the frequency should be about one hundred cycles per second, the pulse width should be about one millisecond, and the pulse amplitude should be variable (depending upon the patient) over a range from slightly more than zero to a few milliamperes.

SUMMARY OF THE INVENTION

My apparatus is designed not only to satisfy the requirements indicated above but to do so in such manner that a subject can avail himself of the advantages of the electrical pulse technique by operating the apparatus by himself in his own sleeping facilities without supervision of any kind, without special training and with complete safety.

To this end, my apparatus utilizes a battery powered square wave oscillator which generates a square wave at very low power and at the desired recurrence frequency.

One output terminal is connected to the input of a voltage doubler circuit, the output of which is connected to one of the eye and neck electrodes. Another output of the oscillator is coupled to the input of a pulse shaper. The shaper responds to the square wave to derive therefrom a pulse train of unidirectional pulses of desired recurrence frequency.

These pulses are supplied to a reference voltage and control network, and the output of this network is connected to the input of a constant current generator. The output of the generator is connected to the other of the eye and neck electrodes and supplies the desired pulse train thereto.

The network controls permit the manual adjustment of the amplitude of the output pulses to be set between the limits required. The generator is so designed that this set amplitude is maintained regardless of the variations in the electrical impedance of the user.

The duration of each treatment (which can be repeated periodically) is short but can be preset by the subject

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whereby the apparatus can turn itself off should the subject fall asleep during the treatment. To this end, my apparatus includes a timer which will disable the oscillator by opening a switch (connecting the batteries to the remainder of the oscillator) when the period ends.

The network also can be adapted to provide a regulating function to insure supply of constant operating potential to the generator during each period, thus preventing any change in pulse amplitude, despite changes in battery voltage that could occur in normal use.

The batteries employed can be, for example, two conventional flashlight cells whereby no electrical hazard can possibly develop; the instantaneous power level of these cells is too small to cause injury.

The electrodes can be made of carbon impregnated rubber which avoids any special cleaning and care required for metallic electrodes. (Metallic electrodes can contribute metallic ions to the saline solution; these ions can cause eye irritations and in some cases can even injure the eyes.)

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a block diagram of my invention;

FIG. 2 is a circuit diagram thereof;

FIG. 3 illustrates certain wave forms associated with the circuit of FIG. 2; and

FIG. 4 is a view of the control panel and electrodes employed in my apparatus.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

Referring now to FIG. 1, a battery powered square wave oscillator 10 produces a square wave oscillatory signal which appears at a first voltage level at terminal 12 and is connected to the input terminal 16 of voltage doubler 18. The output terminal 20 of doubler 18 is connected to one of the neck and eye electrodes 22. Terminal 14 is connected to the input terminal 24 of pulse shaper 26. The output terminal 28 of shaper 26 is connected to the input terminal 30 of the reference and control network 32. The output terminal 34 of network 32 is connected to the input terminal 36 of a constant current generator 38. The output terminal 40 of this generator is connected to the other of electrodes 22. (Each of these electrodes actually comprises two electrodes in parallel as shown in FIG. 4 described below.)

As can be seen from the wave forms of FIG. 3, the apparatus yields a pulse train of unidirectional current pulses having a selected constant amplitude falling within the range zero to about five milliamperes at a recurrence frequency of about one hundred cycles per second, with a selected uniform pulse which falls within the range one tenth to two milliseconds (and is typically about one millisecond).

Referring now to FIG. 2, the oscillator is a saturable transformer core inverter utilizing transistors 50 and 52 operated typically by two one and one-half volt flashlight cells 54. The oscillator is only operative when switch 56 (mechanically opened and closed by a resetable timer 58) is closed and is disabled when switch is open to prevent the cells from discharging.

Transistors 50 and 52 are alternatively conductive to produce the desired square wave output. The secondary winding 54 of the saturable core transformer acts as an autotransformer whereby the output at terminal 12 swings, for example, plus and minus thirty volts and the output at terminal 14 swings between plus and minus twelve volts.

The voltage doubler includes capacitor 56 and rectifier 58 connected in series between terminal 12 and ground. (Rectifier 58 is shunted by indicator bulb 60.)

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Since the output capacitor normally used in a conventional doubler circuit in shunt with a rectifier is absent, the output of my doubler appearing at terminal 20 is pulsating and swings between about one volt to sixty volts. This modification sharply reduces power requirements below that required by a conventional doubler (which would maintain a sixty volt output). The sixty volt level is only required when output pulses are present, and the apparatus is so designed that coincidence of the sixty volt level as present on one of the electrodes 22 with the output pulses as present on the other of electrodes 22 always occurs as shown in FIG. 3.

The pulse shaper is a complementary Schmitt trigger, employing transistors 62 and 64. When a positive going portion of the square wave signal appears at terminal 14, capacitor 66 passes a pulse spike to the base of transistor 64 through resistor 76 and through resistor 74 and capacitor 78 to the collector of transistor 62. The emitter of transistor 62 is connected through resistor 72 to the base of transistor 62 and through series connected resistors 72 and 74 to the collector of transistor 64. Initially transistor 62 saturates; capacitor 78 rapidly charges up; at this point, the transistor 62 is swung out of saturation to cut off. Thus the square wave is converted to a pulse train of positive going pulses as shown. The pulse width is determined by the value of capacitor 78 and can be changed by varying this value.

The reference and control network includes a Zener diode 80 connected in series with resistor 82 between the collector of transistor 62 and ground. The diode 80 is shunted by a potentiometer 84 in series with a resistor 86 to ground. Diode 92 shunts resistor 86. The purpose of this circuit is to maintain a constant voltage across potentiometer 84 during any period in which the timer switch remains closed. As a result, the voltage at arm 86 remains constant during this period once the arm is set to a desired position.

The arm 86 is connected to the base of transistor 88. The collector of this transistor is connected to the other electrode 22; its emitter is grounded through resistor 90.

Transistor 88 functions as a constant current generator and the amplitude of the pulses is controlled in the manner described.

FIG. 4 shows the control panel including the current control knob 100 (which turns the arm of potentiometer 84), the timing control 102 for operating the timer, the indicator light 60 and an output jack 104. The electrodes 22 are secured to a headband and electrically to a plug 106 to be inserted in the jack.

The electrodes can be formed of rubber with finely dispersed carbon disposed therein. This structure provides the necessary electrode action but at the same time is chemically inert when in contact with the saline solution as described above.

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While I have described my invention with particular reference to the drawings, my protection should be limited only by the terms of the claims which follow.

I claim:

1. Apparatus for inducing sleep and having first and second electrodes, said apparatus comprising:

- (a) a battery powered oscillator for producing a square wave oscillatory signal;
- (b) a voltage doubler responsive to said signal and connected to said first electrode to supply a doubled potential thereto;
- (c) a pulse shaper responsive to said signal to derive therefrom a pulse train of uniformly spaced unidirectional voltage pulses of uniform height and width;
- (d) a constant current generator for producing constant amplitude output current pulses at a fixed recurrence frequency and uniform width and supplying said pulses to said second electrode, the amplitude being independent of any variations in body impedance when the electrodes are connected to a human subject; and
- (e) means including a control for varying the pulse amplitude coupled between said shaper and said generator for supplying the shaped pulses thereto and setting the amplitude of the output pulses.

2. Apparatus as set forth in claim 1 wherein said voltage doubler produces an output voltage which is unidirectional and which has periodic equidistantly spaced periods of peak voltage, each output pulse being in time coincidence with a corresponding portion of a corresponding period of peak voltage.

3. Apparatus as set forth in claim 2 wherein said periodic periods of peak voltage are represented essentially flat topped voltage pulses having leading and trailing edges each output pulse being coincident with the leading edge of the corresponding flat topped pulse.

4. Apparatus as set forth in claim 3 wherein the recurrence frequency of the output pulses is identical with the frequency of oscillation.

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WILLIAM L. KAMM, Primary Examiner