March 13, 1951 F. J. HART 2,545,087

ELECTRICAL THERAPEUTIC DEVICE

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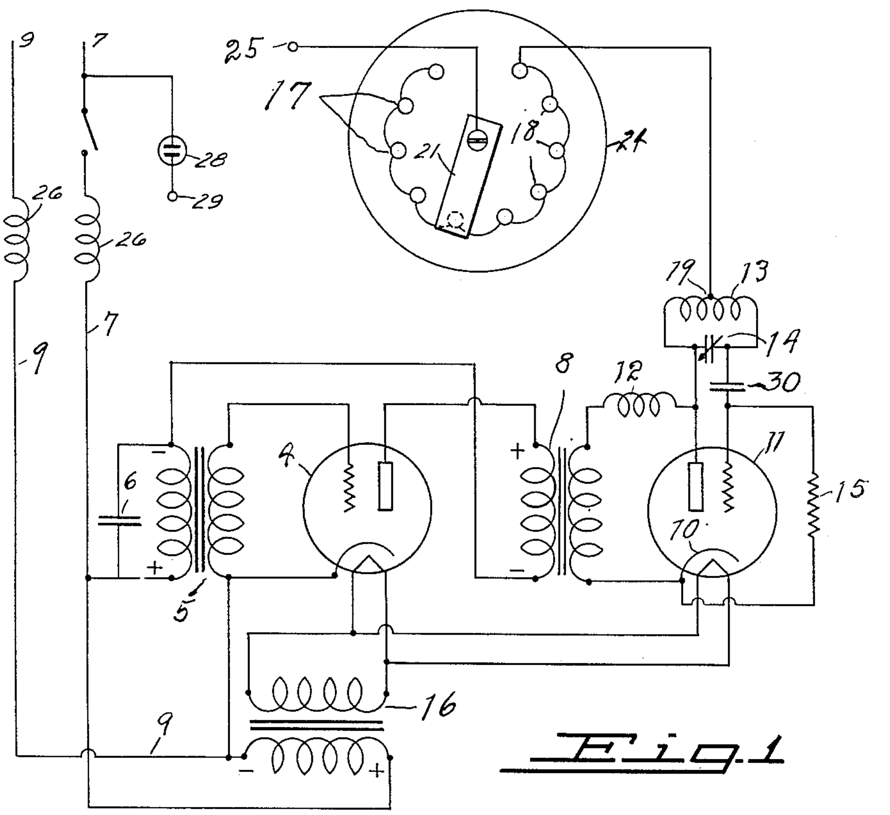

Fig. 1

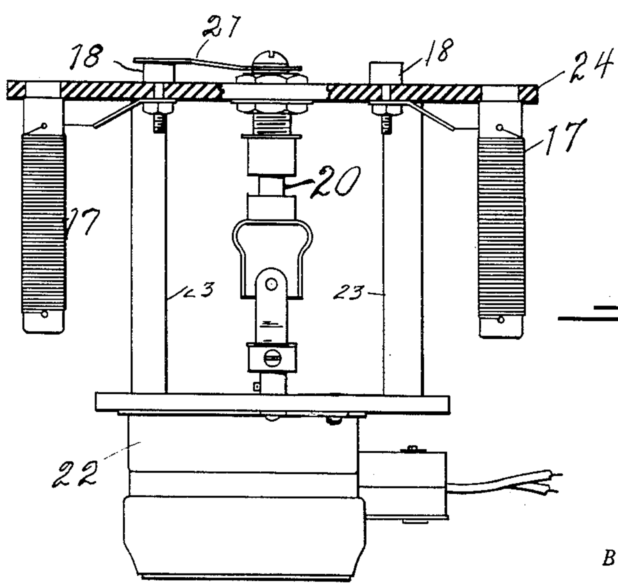

Fig. 2

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ELECTRICAL THERAPEUTIC DEVICE

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1 Claim. (Cl. 128—422)

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My invention relates more particularly to high frequency low power oscillators for therapeutic use.

One object is the provision of simple and efficient means for accomplishing this end.

Another object is the provision of an electromagnetic oscillator adapted for therapeutic use and provided with means for automatically changing its frequency output over a certain band.

Other objects will be apparent from the following description and accompanying drawing in which:

Fig. 1 is a diagrammatic view of the electrical circuits of my device, and

Fig. 2 is an enlarged section on line 2—2 in Fig. 1.

Referring more particularly to the drawing, the form of oscillator indicated has three main parts. The first part has an oscillating tube 4 of the cathode type with the heater connected to the primary coil of transformer 5 and the latter is connected to the grid of tube 4. The secondary coil of transformer 5 is connected to a condenser 6 to provide a tank circuit. One side of the tank circuit is connected with one of the supply wires 7 and the other side of the tank circuit is connected to the primary coil of transformer 8. The other terminal of the primary coil of the transformer 8 is connected to the plate of tube 4. The primary coil of transformer 5 is also connected to the other of the supply wires 9. One terminal of the secondary of transformer 8 is connected to the cathode 10 of tube 11 and the other terminal of this secondary coil is connected through a radio choke 12 to the plate of tube 11. The plate of tube 11 is connected to a high frequency tank circuit consisting of an inductance coil 13 and an adjustable condenser 14. This latter tank circuit is also connected with the grid circuit of tube 11. A resistor 15 is connected between the cathode and grid of tube 11 to obtain grid current for this tube.

A transformer 16 takes its current from the supply wires 7 and 9 and supplies proper voltages for the filaments of both tubes 4 and 11. Choke coils 26, are connected in wires 7 and 9 to help keep the high frequencies from the supply circuit. A neon tube 28 and metal button 29 are used to show whether wire 7 or 9 is on the grounded side of the light wire supply.

The arrangement is such that the first tube 4 with its circuits oscillates around 90 times per minute although any desired number of oscillations may be used. At each oscillation of tube 4 and its circuits an impulse voltage is impressed on tube 11 and its circuits. The frequency of the output depends largely on the natural frequency of the tank circuits 13—14. I preferably arrange this tank circuit for a frequency of 43 megacycles, but any other frequency may be used. The condenser 14 is locked against further adjustment when a desired frequency is reached.

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Ten inductance coils 17 are disposed with their axes parallel and all connected in a series except the first and last. A switch point 18 is connected to the junction of each adjacent pair of coils. Any desired number of coils and switch points may be used. The first coil 17 is connected to a point 19 on coil 13 to obtain maximum output. The switch points 18 are disposed in a circle. A shaft 20 extends through the center of the switch point circle and carries a spring switch blade 21 so that as the shaft rotates, the switch arm will touch the switch points consecutively. An electric motor 22 is connected to the shaft 20 for operation of the latter. The motor 22 is preferably mounted on supports 23 which extend between the coils and secured in a frame 24 which supports the coils 17 and switch points 18 and maintains the motor 22 beyond the coils 17 to prevent interference between the motor and coils.

The spring switch blade 24 is electrically connected to a patient's electrode 25. The arrangement is such that the switch blade 21 engages the switch points 18; first one coil is used; then, when the switch blade engages the next switch point, two coils will be used, and so on as the shaft 20 revolves.

Tube 4, transformer 5, condenser 6, the primary coil of transformer 8 and their connecting wires are fed current from supply wires 7 and 9. A small amount of current is drawn to the parts just mentioned all the time. When the tube 4 and its connecting circuit oscillates a sharp rise in the current occurs.

At present, I use a conventional tube 27 as tube 4. The value of the condenser 6 is four microfarads, electrolytic. The transformer 8 is a conventional 3:1 audio transformer. Transformer 5 is very critical. I use No. T57A37 Thordarson to make these parts oscillate at about 90 times per minute.

The tube 11, condenser 14, coil 13, and the rest of this oscillating circuit are of standard parts arranged in the Hartley type of circuit. A resistor 15 provides the usual grid bias and condenser 30 blocks the plate current from the grid.

As already stated, the condenser 14 is locked after the circuit is tuned to an output frequency of 43 megacycles. The coils 17 are added progressively to the lead from the point 19 to the electrode 25. The coils 17 are loaded into the output instead of further adjusting condenser 14 because doctors had difficulties in making the very small adjustments necessary to obtain desired tunings. Adding the coils 17, one at a time, by rotating the arm 21 over switch points 18, enables doctors to automatically obtain the desired frequencies with no effort on their parts.

The 60 cycle current fed to the device provides waves at a frequency of 60 times per second at the electrode 25. Between the oscillations of tube 4, each wave starts from zero going to 5 volts above, drops to 3.75 below and then returns to zero. During the oscillations of tube 4 the voltages are higher. Each wave starts at zero, going to 10 volts above, drops to 1.1 volts below, raises again to 1.5 volts above, then down to 4.95 volts below and finally returning to zero.

As an example, with the oscillator set to oscillate at 43 megacycles and the coils 17 all of a certain size the following frequency changes occur:

1 coil gives 43.245 megacycles
2 coils give 43.296 megacycles
3 coils give 43.322 megacycles
4 coils give 43.338 megacycles
5 coils give 43.346 megacycles
6 coils give 43.350 megacycles
7 coils give 43.352 megacycles
8 coils give 43.354 megacycles
9 coils give 43.356 megacycles
10 coils give 43.357 megacycles

As switch blade 21 rotates clockwise, all of the above frequencies will be delivered to the patient in contact with electrode 25. Heretofore, one, two or three of these frequencies were used in one application and sometimes other frequencies than those used might have been more suited to the patient. The arrangement of my invention is such that as the coils 17 are added, one at a time, as the shaft 20 makes a rotation, the lead from the oscillator to the patient is loaded out in steps and the frequency changes at each switch point give the frequencies mentioned above.

I claim:

An electrical therapeutic device comprising a high frequency oscillator including an electron tube having cathode, grid and anode electrodes, an input circuit including said grid and cathode electrode, an output circuit including said anode and cathode electrode, transformers each having primary and secondary windings, the primary winding of one of said transformers being connected in series in said input circuit and the primary winding of said other of said transformers being connected in series with said output circuit through the secondary winding of said first mentioned transformer, a high frequency electrode, a step-by-step variable frequency adjustable inductance system comprising a frame, a plurality of switch points mounted on said frame, a plurality of inductance coils having their ends connected through said switch points in a series relation, with an open circuit between the first and last coils of the series, a shaft arrangement rotatably mounted in said frame and disposed equidistant from all of said coils, a switch arm carried by said shaft and having one end engaging one of said switch points and being selectively movable to successively engage each of the other switch points, a motor device mounted on said frame in insulated spaced relation to said coils and connected with said shaft, said arm being electrically connected in series with said high frequency electrode, a coupling circuit comprising an electron tube having cathode, grid and anode electrodes, a circuit between said anode and cathode electrodes through the secondary winding of said second mentioned transformer, a circuit comprising a high resistance path extending between said last mentioned cathode and grid electrode, a tank circuit including an inductance and an adjustable condenser, a connection between one end of said tank circuit and said last mentioned anode electrode, a connection between the other end of said tank circuit and said last mentioned grid electrode through a capacity element, a center tap connection from the inductance in said tank circuit with said series connected inductance coils whereby said switch arm operates to selectively adjust said inductance system for transferring high frequency oscillations generated in the circuits of said first mentioned electron tube through the circuits of said last mentioned electron tube to said high frequency electrode, condenser means for fixing the frequency of said output circuit of said first mentioned electron tube and transformer means connected with said electron tubes for supplying power to the cathodes and the circuits of said electron tubes.

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