

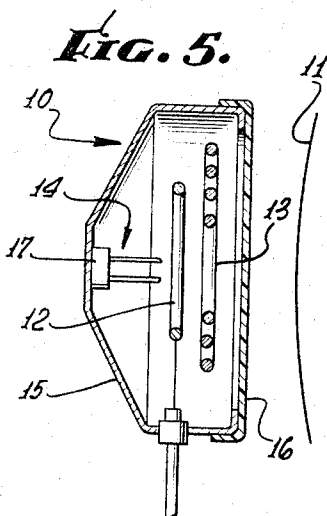
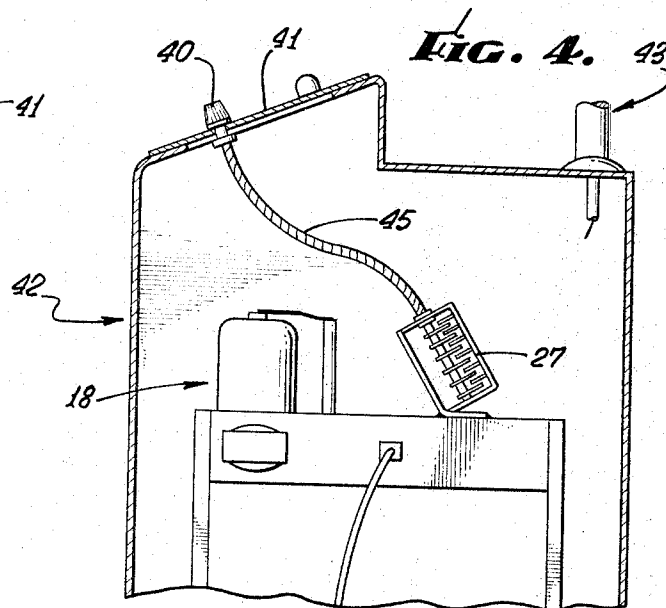
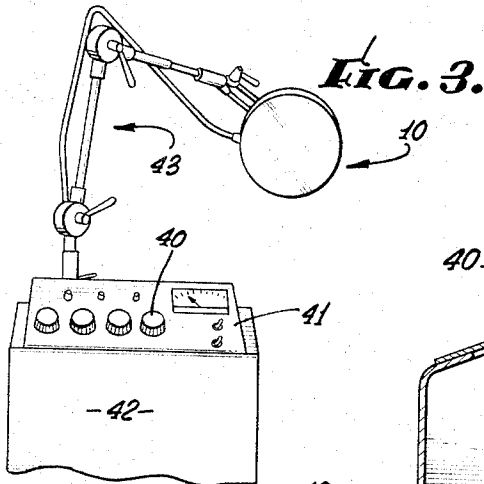
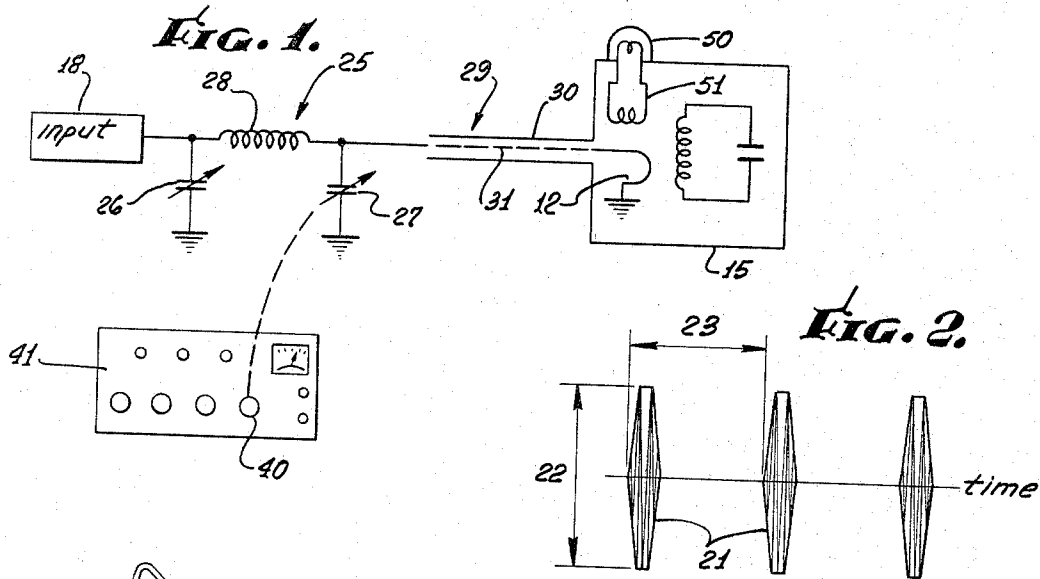
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3,329,148

CONTROL OF ELECTROTHERAPEUTIC APPARATUS

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1

3,329,148

CONTROL OF ELECTROTHERAPEUTIC APPARATUS

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This invention relates generally to electrotherapeutic apparatus, and more particularly concerns improvements in circuitry for transmitting high power pulsed radiation and the control thereof.

Major objects of the invention include provision for improved control of pulsed radiation transmission to enable the operator of the equipment to obtain higher power output and better matching of the equipment to the load represented by the patient, and simplification of the circuitry and controls. In this regard, it has been thought necessary in the past to provide a variable capacitor in a secondary coil tank circuit at the treatment head, with a manual control at the head; however, such an arrangement has disadvantages which are overcome by the present invention.

The above objects may be realized in accordance with the invention through the provision in electrotherapeutic apparatus of a power radiating head including first means operable to effect transmission of pulsed high frequency radiation for treatment of a patient, said means including inductively coupled primary and secondary coils and a condenser electrically connected with the secondary coil to form a tank circuit, input means to supply pulsed high frequency energy, a network coupled to the output of the input means, a coaxial cable having a center conductor coupling the output of the network to the primary coil, and the network having a capacitor that is controllable to adjustably match the output impedance characteristic of the input means to the input impedance characteristic of the coaxial cable when a patient is undergoing treatment, thereby to optimize the electromagnetic energy output of the head. Typically, the network comprises a pi-network or low pass filter, a console contains the input means and network and the console has a control panel, and a manual control at the control panel has operative connection to the controllable capacitor. Also, the head typically may include a housing carrying an indicator inductively coupled to at least one of the coils to indicate visually to an observer the strength of the field associated with the inductive coupling, and the condenser in the housing has fixed capacitance.

These and other objects and advantages of the invention, as well as the details of illustrative embodiments, will be more fully understood from the following detailed description of the drawings, in which:

FIG. 1 is a schematic showing of the inventive combination;

FIG. 2 shows the wave form transmitted to the power head;

FIG. 3 is an external elevation showing the console, control panel and the arm supported head;

FIG. 4 is a section taken through the control panel and console; and

FIG. 5 is a section taken through the power radiating head.

In the drawings, a power radiating head is indicated generally at 10, and it includes first means operable to effect transmission of pulsed high frequency radiation for treatment of a patient's anatomy 11 placed directly in front of the head. Such a means includes inductively coupled primary and secondary coils 12 and 13, the secondary coil typically having three or four turns and

2

the primary coil a single turn, and a condenser 14 electrically connected with the secondary coil to form a tank circuit. The coils and condenser are shown as located within a drum-shaped metallic head shell 15 having an insulative cover plate 16, and the condenser has an insulative mount at 17.

Indicated at 18 in FIG. 1 is an input means to supply pulsed high frequency energy. As an illustration of this, reference is made to FIG. 2 showing the sequence of like pulses 21, each of which is made up of a high frequency signal burst having a selected amplitude 22, and having intervals 23 therebetween, these having predetermined relationship. Typically, the signal frequency will be 27.12 megacycles, or some other fixed value, and the interval 23 will be variable, as for example in stepwise relation. Also the amplitude equal to one-half the dimension 22 will be variable in stepwise relation. The time interval 23 may typically be varied so as to provide between about 160 and 5,200 pulses per second in order to increase or decrease the intensity of treatment given to the patient. Apparatus described in U.S. Patent 3,127,895 is usable to provide waveform seen in FIG. 2.

A network is coupled to the output of the input means, one such network being indicated generally at 25 in FIG. 1 and comprising an unsymmetrical pi-network or low pass filter having variable capacitors 26 and 27 and an inductance 28 connected as shown. There is also a coaxial cable 29 having a grounded sheath 30 and a center conductor 31, the latter being connected to one terminal of the primary coil 12. The opposite terminal of the coil 12 is grounded as by connected to the sheath 30 or metallic shell 15. In this regard, no controls are needed at the head for adjusting any electrical impedance elements contained within the shell 15.

Capacitor 27 of the network 25 is controllable as by a manual control 40 on a control panel 41 that is part of the console 42. The latter carries an articulated arm 43 supplied with adjustable joints and swivels to permit universal movement of the head 10. FIG. 4 shows the manual control knob 40 having shaft or link connection at 45 to the rotary plates of capacitor 27 located within the console cabinet.

Capacitor 27 is controllable to adjustably match the output impedance that is characteristic of the input means 18 to the input impedance that is characteristic of the coaxial cable 29 when a patient is undergoing treatment, thereby to optimize energy output of the head 10 for transmission to the patient. In this regard, the input impedance characteristic of the coaxial cable is that which is seen by the network 25 "looking into" the cable, keeping in mind that the cable, head elements 12, 13 and 14 and the patient 11 present a load having an impedance that is seen by the network 25 "looking into" the cable. The impedance of that load varies somewhat with the patient's anatomy presented to the head, and the user of the equipment may easily and to best advantage match the impedance of the load to the impedance of the input means 18 by adjusting the knob 40 at the control panel 41, for optimum energy transfer. This result is different from an adjustment of the capacitor 14 in the head, since the latter adjustment tends to vary the resonant frequency of the tank circuit to offset it from 27.12 megacycles. The present circuit keeps the tank circuit resonant at 27.12 megacycles and at the same time enables optimum energy transfer, for therapeutic benefit.

An indicator glow lamp 50 is mounted on the head, and has a coil 51 inductively coupled to at least one of the coils 12 and 13 so as to indicate visually to an observer the increase or decrease in strength of the field associated with the inductive coupling of coils 12 and 13, which reflects the increase or decrease in energy

3

transfer to the head as controlled by adjusting knob 40 on the control panel.

I claim:

1. In electrotherapeutic apparatus, a power radiating head including first means operable to effect transmission of pulsed high frequency radiation for treatment of a patient, said means including inductively coupled primary and secondary coils and a non-adjustable capacitance condenser electrically connected with the secondary coil to form a tank circuit, input means to supply pulsed high frequency energy in the megacycle range, a network coupled to the output of said input means, a coaxial cable having a center conductor coupling the output of the network to the primary coil, said network having a variable capacitor that is controllable to adjustably match the output impedance that is characteristic of said input means to the input impedance that is characteristic of said coaxial cable when a patient is undergoing treatment, thereby to optimize the electromagnetic energy output of said head, a console remote from said head and containing said input means and network and having a control panel, and a manual control at said panel and having operative connection to said controllable capacitor.

2. The combination of claim 1 in which said network

4

comprises a pi-network, an articulated arm interconnecting the console and head, said cable extending to said head outside but adjacent said arm, said cable center conductor electrically connecting said controllable capacitor with said primary coil.

3. The combination of claim 2 in which said head includes a housing, and including an indicator on the housing and having a coil in the housing and inductively coupled to at least one of said primary and secondary coils to indicate visually to an observer the strength of the field associated with said inductive coupling.

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