Diathermic apparatus.

PATENT SPECIFICATION

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COMPLETE SPECIFICATION.

Diathermic Apparatus.

I, JÖRGEN GUNNER FRIIS KIILERICH, of 4, Rygaards Allé, Hellerup, Denmark, of Danish Nationality, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

The present invention relates to a diathermic apparatus adapted to generate continuous high-frequency currents through the parts of the human body to be subjected to treatment. The use of continuous high-frequency currents for diathermic treatment is previously known, the said currents having heretofore been produced by the use of apparatus with a Poulsen-Arc, but the latter have gradually been replaced everywhere by simpler and more economical apparatus which by the use of fast-extinguishing spark gaps produce discontinuous high-frequency currents.

In comparison with discontinuous currents, however, continuous current possesses many advantages, for instance

—continuous high-frequency currents do not act at all on the nerves of the patient, whereas discontinuous currents do so act,

—when continuous currents are used the work can be done with far lower supply voltage than is needed for plants adapted to supply discontinuous currents, where relatively high voltages are required for producing sparks; furthermore the continuous action produced by the continuous current renders possible the attainment of the same generation of heat at a lower maximum voltage in the high-frequency circuit, so that dangerous effects will be precluded,

—the apparatus can be connected directly to direct-current lighting networks or some corresponding source of power, without the use of special converters or the like.

It has therefore also been attempted to produce diathermic apparatus for the generation of continuous high-frequency oscillations, which apparatus in order to avoid the complicated and costly Poulsen-Arc use in lieu thereof electron valves, but the experiments heretofore have not been entirely successful, one of the reasons being the difficulties in tuning and the requirements with respect to simple and economical operation that have to be fulfilled by apparatus for the purpose here concerned.

These drawbacks, however, are avoided by the diathermic apparatus according to the present invention, as by the use of a generator arrangement known per se but heretofore not used in this connection —viz. two electron valves in "push pull" position—it has become possible to produce in simple manner easily tuned and stable continuous high-frequency currents fully satisfying the requirements of diathermic treatment.

The invention comprises also as described below various arrangements in the apparatus according to the invention, which arrangements have for their object to cause the apparatus to be entirely useful in practice, allowing partly the same apparatus to be useful for various medical as well as surgical purposes in the medical and dental art, and partly simplifying the treatment and operation of the apparatus and enabling the surgeon at any time to control and accurately regulate the intensity of current, without having to interrupt the treatment of the patient.

In the accompanying drawing

Fig. 1 shows in outline a wiring diagram for an apparatus according to the invention,

Fig. 2 an electrode-holder containing a thermo-couple and a switch, shown diagrammatically in section,

Fig. 3 a modified construction of the arrangement of the thermo-couple in connection with an electrode-holder, similarly in section.

Referring to the drawing, 1 and 2 are two electron valves connected in push-pull position and adapted in known manner to produce continuous high-frequency oscillations in an oscillation circuit 3, 4, 5. 3 is a tunable condenser, 5 a self-induction coil to the centre of which the anode voltage is applied in known manner. An aperiodic therapeutic circuit comprising two electrodes 12 and

13 and the parts 14 of the patient's body that are to be treated, can be coupled to the oscillation circuit 3, 4, 5 in various ways by means of a switch 7, 8, 9. In the position of the switch shown by 7, 7, the therapeutic circuit is coupled to the circuit 3, 4, 5 by means of a special smaller self-induction coil 6. This adjustment is used in medical diathermic treatment, where the resistance 14 is relatively low. In the positions 8, 8 and 9, 9 of the switch the therapeutic circuit is coupled directly to the oscillation circuit 3, 4, 5, the self-induction coil 5 being used as an auto-transformer. The position 9, 9, is used when surgical incisions are to be made by means of the electrode 12 modified for such purpose as shown in Fig. 2. In making the electrode 12 rather small in comparison with the electrode 13, for instance by forming it as a needle or knife, the intensity of current and thereby the concentration of heat is very great, so that the body tissue immediately round the needle, knife or the like is destroyed. The position 8, 8 is used where coagulations are to be effected. When the switch is adjusted to the position 8, 8 or 9, 9 a condenser 10 and 11, respectively, is inserted automatically in each of the supply wires leading to the electrodes 12 and 13 of the therapeutic circuit. These condensers serve to cut off the plate voltage of the electron valves, so that any accident due to any possible connection between the patient and the negative terminal of the source of power will be precluded.

As it is necessary for the surgeon at any time to know with what intensity of current he is working, there must be provided a measuring instrument showing this. Such an instrument, when inserted in the therapeutic circuit close to the switch 7, 8, 9, will not show exactly the current passing through 14, but also the part of the current due to radiation losses in the supply wires to the electrodes, which losses for the continuous high-frequency currents used here may be quite considerable. It has therefore been usual to encase the supply wires to the electrodes, in order thereby to attain constant radiation losses, or the measuring instrument has been disposed close to one of the electrodes, but both arrangements are complicated and unpractical.

According to the present invention the difficulties are overcome by the provision, in one of the electrode holders 15, besides the electrode 12 and if desired a cut-off switch 23, 24 of some known construction, of a thermo-couple 16 which suitably may be built into a small glass vessel 25, Fig. 2. From the thermo-couple run the wires leading the thermal current to a galvanometer 17, which thus shows accurately the current passing through the parts 14. The galvanometer may be disposed on the front side of the box of the apparatus or at any other point convenient to the surgeon.

The distinguishing feature of the arrangement will not be altered by disposing the thermo-couple 16, as shown in Fig. 3, instead of in the holder 15, in a plug box 26, which is disposed at the end of the supply lead 22 and into which various holders with electrodes of special shape may be inserted in known manner. Fig. 3 shows thus a plate electrode, which is used for thorough heating for longer periods and therefore is not fitted with any cut-off switch in the holder, as would be the case for electrodes that during the treatment may have to be displaced or moved.

Another characteristic arrangement of the invention has for its object to allow a variation of the current within the limits of energy determined by the various positions of the switch 7, 8, 9, and consists of a potentiometer 18, which is inserted over the points of supply 21 of the source of power, and from which the plate voltage thus continuously variable can be tapped. As frequently it is most suitable to regulate the current during the treatment itself, and thus for instance first to apply the electrodes and then to close the circuit by depression of the cut-off switch 23 provided in the holder 15, while the plate tension is maintained at a certain low value, and only gradually to allow the current to rise to the permissible maximum, it will be of importance that such a regulation should be able to be effected, without the surgeon having to leave his position alongside the patient. As further the surgeon frequently requires the use of both hands for holding the electrode 12 in position etc., the potentiometer 18 in the arrangement according to the invention is built into a separate box, which is connected by means of wires to the apparatus, the said potentiometer being operated by means of a pedal projecting from the box and disposed in known manner. During the use of this apparatus the potentiometer box is placed in such a position that the surgeon conveniently can have his foot on the pedal and thus, while keeping an eye on the conveniently disposed galvanometer, can secure the proper intensity of current at any time.

As by the diathermic apparatus according to the invention, when connection to the source of current is effected by means of a plug box, it cannot at once be ascer-

tained whether the plug has been turned correctly, there is inserted in the apparatus according to the invention, between the wires leading from the source of power, a neon-lamp 20, which for instance can be seen through a window in the front panel of the apparatus, and which is fitted with two electrodes of unequal size and of special shape, in such a manner that there will be seen for instance a luminuous red letter if the connection is right, but only a line if the contact plug has been inserted the wrong way.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is :—

1. Diathermic apparatus characterized by two electron valves 1 and 2 connected in push-pull position and producing continuous high-frequency oscillations in an oscillation circuit 3, 4, 5, which is coupled inductively to the aperiodic therapeutic circuit proper.

2. An arrangement in diathermic apparatus according to claim 1, characterized by a switch 7, 8, 9, which either can couple the therapeutic circuit to the oscillation circuit 3, 4, 5 by way of a special self-induction coil 6 inserted in the therapeutic circuit, or couple the two circuits directly by using the self-induction coil 5 in the oscillation circuit 3, 4, 5 as an auto-transformer, the switch 7, 8, 9 being adapted to be adjusted to different tappings, all depending on the use to be made of the apparatus.

3. An arrangement in diathermic apparatus according to claim 2, characterized by two condensers 10 and 11, respectively, inserted automatically each in one of the supply wires to two electrodes 12 and 13 in the therapeutic circuit, when the switch 7, 8, 9 is adjusted into one of the positions where the self-induction coil 5 is used as an auto-transformer.

4. An arrangement in diathermic apparatus according to claims 1 to 3, characterized by the feature than an electrode holder 15 for one electrode 12 of the therapeutic circuit contains, in addition to the electrode and if desired a cut-off switch 23, 24 also a thermo-couple 16, which is inserted in the supply wire for the electrode 12, and from which the thermo-current is directed to a galvanometer 17 disposed at some suitable point.

5. A modified construction of the arrangement according to claim 4, characterized in that the thermo-couple 16 is disposed, not in the electrode holder 15 but, instead thereof, in a plug box 26 provided at the end of the supply wire, the said box being adapted, in known manner, to receive holders with electrodes of various shapes.

6. An arrangement in diathermic apparatus according to claims 1 to 3, characterized by the insertion, in the anode circuit common to the electron valves 1 and 2, of a potentiometer 18, for the purpose of regulating continuously the energy of the apparatus.

7. An embodiment of the arrangement according to claim 6, characterized in that the potentiometer 18 is disposed in a separate box, which is connected by wires to the apparatus, and is regulated by means of a pedal operated by the foot.

8. An arrangement in diathermic apparatus according to claims 1 to 3, characterized by a neon-lamp 20 having electrodes of unequal size and being inserted between the branches of the supply main and indicating whether the connection, by plug contact, to the lighting network or other source of power is correct, which lamp in such case for instance shows a letter but, if the plug is turned the wrong way, shows only a line.

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Fig.1.

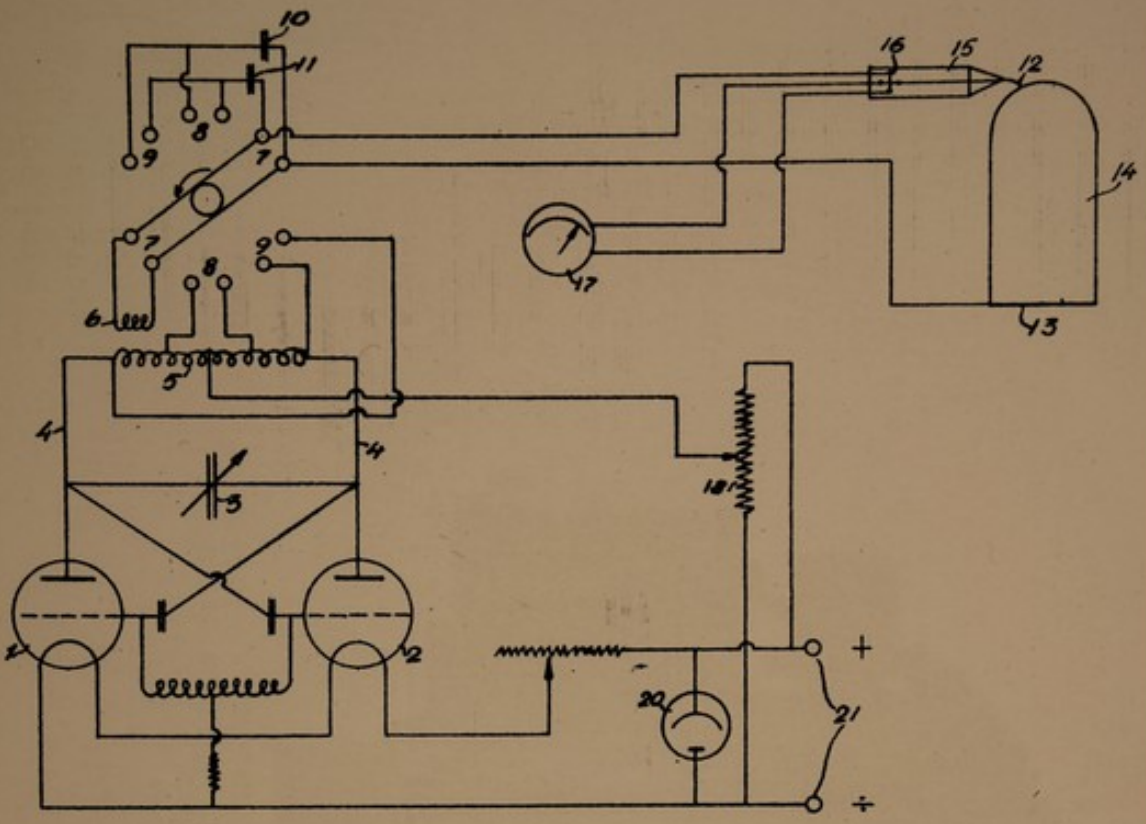


Fig.2.

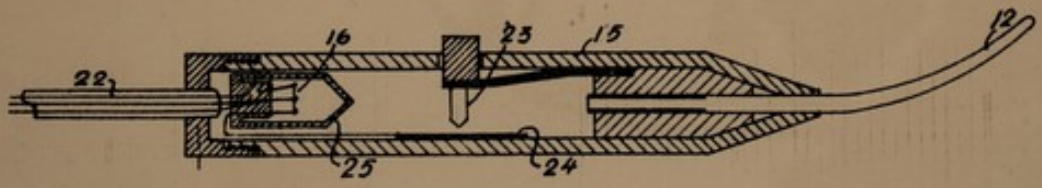
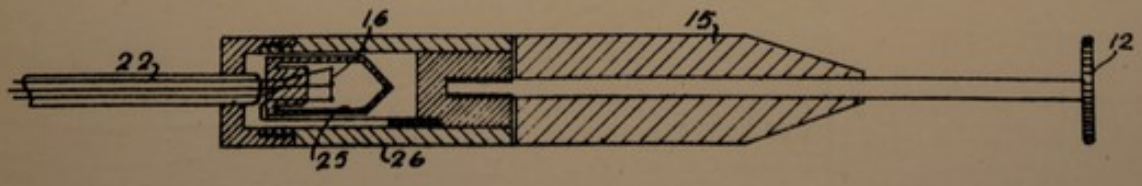


Fig.3.



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