

April 15, 1941.

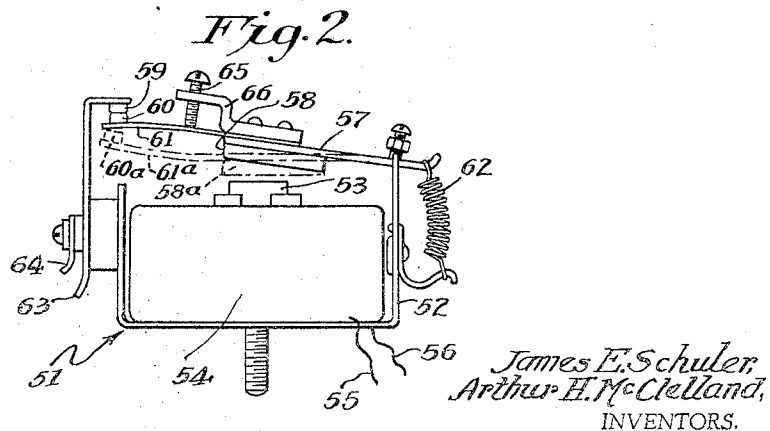
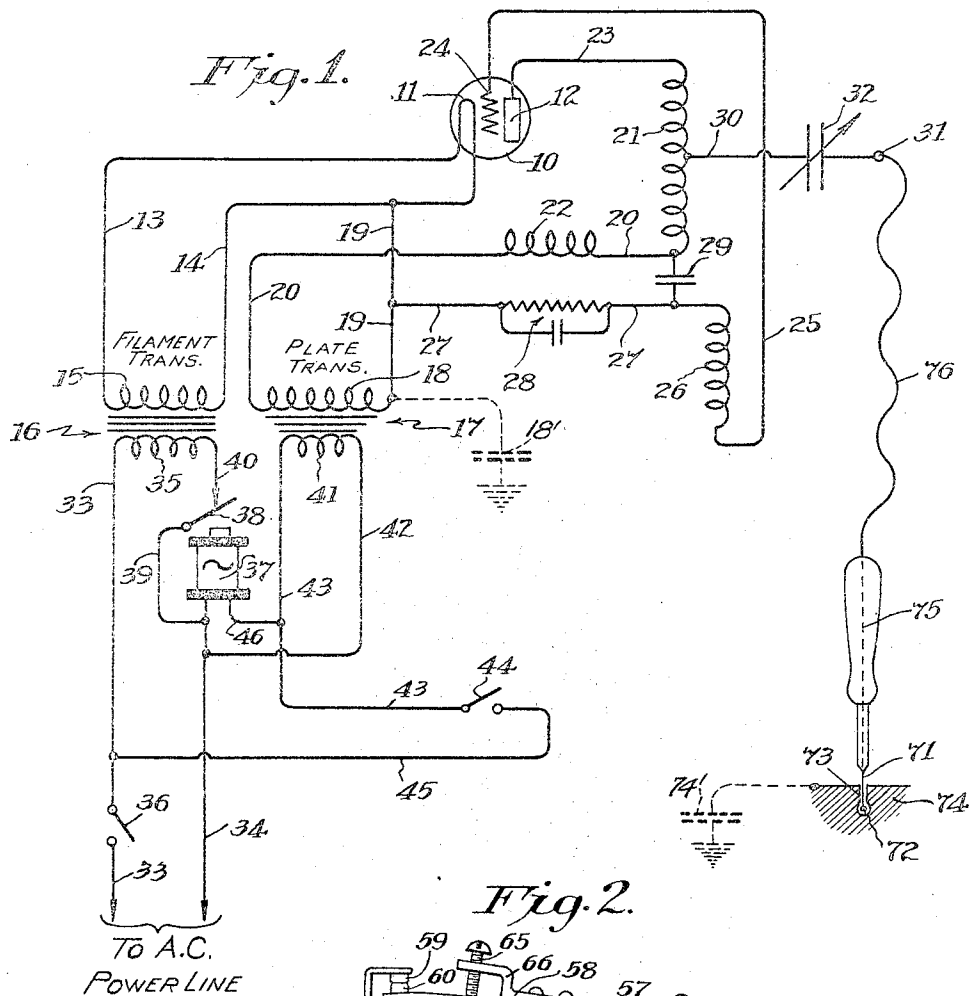
J. E. SCHULER ET AL

2,238,344

HIGH-FREQUENCY EPILATION APPARATUS

Filed Nov. 8, 1939

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig. 3.

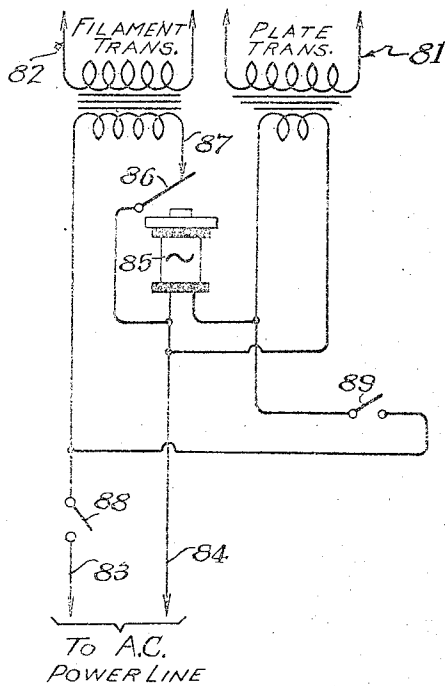
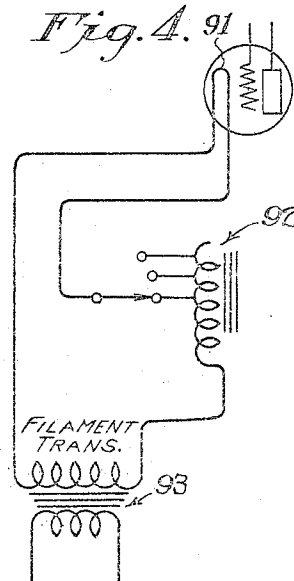


Fig. 4.



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HIGH-FREQUENCY EPILATION APPARATUS

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7 Claims. (Cl. 128—422)

This invention relates to an apparatus for epilation (the removal of hair), and pertains more particularly to a high-frequency electrical epilation apparatus.

The removal of superfluous hair by high-frequency coagulation of the root bulb is well-known in the art. Prior suggested forms of "short-wave" epilatory devices have been such, however, as to impose a tremendous burden upon the operator to do effective work without undue discomfort or actual injury to the patient from whom the hair is being removed. The coagulation procedure is essentially that of inserting a bulb-pointed needle into the follicle containing the unwanted hair and crowding the needle-bulb into position adjacent the hair-bulb; the needle is then energized by high-frequency current of such intensity and for such a period of time (as controlled by the operator) as to "coagulate" the hair-bulb and thus "kill" the hair-root, and the dead hair may then painlessly be plucked from the follicle. The needle is removed either before or after abstraction of the hair, and a new hair operated upon by a repetition of the process at a new follicle.

Effective "killing" of a hair-root requires definite coagulation of the root-bulb, necessitating the use of currents of the type and order of magnitude of those used in electro-surgical cutting apparatus. It is therefore apparent that injudicious control of the energization time of the needle on the part of the operator will result in inadequate coagulation of the hair-bulb on the one hand, or burning or cutting of the patient on the other hand. For this reason, the skill and concentration which the operator must necessarily exert places an important limitation on the number of hairs which may be removed in a given time, and many instances of serious burns and actual disfigurement have resulted to patients, even with highly skilled operators.

According to the present invention, a type of epilation apparatus is provided which removes from the scope of the operator's requirements all exercise of judgment as to the length of time the coagulation current is maintained, wherefore the operator has merely to place the epilation needle in position in the follicle, institute the supply of current to the needle, and remove the needle and dead hair from the follicle. This change has resulted, by actual test, in doubling and even trebling the number of hairs which a skilled operator may remove in a given time. Furthermore, the device of the present invention operates to supply current sufficient for epilation during a limited interval of time. Thus, each time the operating switch is depressed by the operator to cause the current-supply to supply current to the needle, current sufficient for epilation will flow through the needle for a limited

interval of time, after which time the current will fall to zero or to some value insufficient to secure epilation or cause burning of the patient. This limited interval of time is relatively short, being in the neighborhood of one second or less, so that there is little opportunity for the operator to inadvertently move the needle while the current is flowing and cause burns to the patient. At the same time, the dangers resulting from an overdosage of current are greatly minimized if not wholly eliminated. The time interval during which a "coagulating" current is supplied to the needle is caused to be independent of the length of time during which the operator holds the operating switch depressed; hence, it relieves the operator of the burden of holding the operating switch down for a definite interval of time. These safety features and operating advantages make it possible for the operator to remove hair more rapidly and to work for longer periods of time without fatigue, and with minimized danger to the patient.

It is, therefore, a particular object of our invention to provide a high-frequency epilation apparatus which may be operated with a minimum danger of burning the patient.

Another object of the invention is to provide an apparatus with which epilation may be carried out with great rapidity.

Another object of the invention is to provide an apparatus for supplying current to an epilation needle which supplies an epilating current to the needle for only a limited interval of time which is not subject to control by the operator, and is independent of the length of time during which the operator maintains the operating switch in closed condition.

Further objects and advantages of our invention will either be brought out specifically in the ensuing description or will be apparent therefrom.

The above and other objects of our invention are accomplished by providing an apparatus for supplying high-frequency current to the epilation needle, which includes an electron discharge device having a plate and a cathode. The cathode is adapted to supply electrons to the plate when a potential difference exists between the cathode and the plate. This flow of electrons causes the apparatus to supply current to the needle. Operating switch means are provided for applying a potential difference between the plate and cathode to cause current to be supplied to the needle with a magnitude sufficient for epilation. Means are provided, in association with the operating switch means, to decrease the number of electrons supplied by the cathode to the plate to bring the current supplied to the needle to a value below that required for epilation in a limited interval of time after

the current sufficient for epilation has started to flow.

Our invention will be better understood as described in conjunction with the accompanying drawings, in which:

Fig. 1 is a diagrammatic illustration of an embodiment of our invention which is preferred because of its simplicity from the standpoint of manufacture;

Fig. 2 is a side elevation of a form of relay which may be advantageously employed in the circuit illustrated in Fig. 1;

Fig. 3 is a diagrammatic illustration of an alternative power supply which may be substituted for the power supply portion of the diagram shown in Fig. 1, and illustrates the use of a form of retarded relay different than that shown in Fig. 2; and

Fig. 4 is a diagrammatic illustration of another alternative power supply arrangement which may be substituted for the comparable portion of Fig. 1, and illustrates the use of a reactance for defining an operating interval.

Referring now to Fig. 1, an example of our apparatus for supplying high-frequency current to an epilation needle is shown as comprising an electron discharge device 10 provided with a cathode, which may comprise a filament 11, and a plate 12. Conductors 13 and 14 lead from the opposite sides of the filament 11 to secondary 15 of a filament transformer 16, which is adapted to supply electric current to the filament, i. e., a cathode heating-current adapted to place the cathode in electron-emitting condition. Means for applying a potential difference between the cathode 11 and the plate 12 is shown as comprising a plate transformer 17 having a secondary winding 18 which has one lead 19 connected to filament lead 14 to provide a plate return and another lead 20 connected to one side of a plate tank coil 21. A suitable radio frequency choke 22 is shown inserted in the lead 20. The remaining side of the tank coil 21 is connected through a lead 23 to the plate 12. The discharge device 10 is also provided with a grid element 24 which is connected through a lead 25 to one side of a grid coil 26. The remaining side of the grid coil 26 is connected through a conductor 27 to plate return lead 19 which is connected to filament lead 14. A grid leak and condenser assembly 28 is shown inserted in the lead 27 to provide for the bias. A coupling condenser 29 is shown connected between the leads 27 and 20 to provide for the feed-back between the plate and grid circuit. No condenser is shown connected across the plate tank coil 21, since the inter-turn capacity of the coil is usually relied upon to provide the necessary capacity for resonance with the high frequency employed.

The oscillator circuit just described is conventional and is used to show the common manner in which an electron discharge device is utilized in an apparatus for supplying high-frequency current to an epilation needle. It will be obvious after reading the ensuing description that this invention is applicable to any type of high-frequency power supply which utilizes an electron discharge device as a member whose current conducting ability is required to supply current to the needle, whether it functions as an oscillator or an amplifier. Furthermore, while a conventional "A.-C." circuit is shown, it will be appreciated that an equivalent "D.-C." circuit could be substituted if desired.

It should now be obvious that upon energization

of the filament transformer 16 and the plate transformer 17 electrons will flow between the filament 11 and the plate 12 as soon as the filament reaches a high enough temperature, and oscillations will be produced which will produce high-frequency current in the plate tank coil 21. A lead 30 is shown extending from an intermediate point on the tank coil 21 to an output terminal 31 which is adapted for connection to an epilation needle. An adjustable coupling condenser 32 is provided in the lead 30 to provide an adjustment on the amount of current fed through the terminal 31 and to isolate the patient's circuit from the high-voltage power supply circuit.

With the apparatus illustrated in Fig. 1, the objects of this invention are attained particularly by the circuit arrangement for energizing the filament and plate through their respective supply transformers 16 and 17. Leads 33 and 34 are adapted for connection to a suitable alternating current power source, and lead 33 is shown connected to one side of primary 35 of filament transformer 16. A line switch 36 is shown inserted in the lead 33. The lead 34 is connected directly to one side of the operating coil of a relay 37. Moving contact or armature 38 of the relay 37 is connected by a suitable conductor 39 to the lead 34, and fixed contact 40 of this relay is connected to the remaining side of the primary 35 of filament transformer 16. The relay 37 is shown in its normal or unenergized position, so that contacts 38 and 40 are connected, in which case closure of the line switch 36 completes the circuit through the primary of the filament transformer 16 and causes a flow of current through the filament 11. It can now be seen that as soon as the line switch 36 is closed, the filament will be heated and the discharge device 10 will be in condition to produce oscillation as soon as a potential difference is supplied between the plate and filament, that is, as soon as the plate supply transformer is energized.

Primary 41 of the plate supply transformer 17 has one side connected through a conductor 42 to the lead 34. The other side of this primary winding is connected through a conductor 43 to one side of a normally open operating switch 44, and the other side of this switch is connected through a lead 45 to the remaining line lead 33. With the portion of the circuit thus far described, the closure of the switch 44 will energize the plate supply transformer, and since the filament is already heated by the filament supply transformer which is always connected as long as the line switch 36 is closed, oscillations are set up and current may be obtained from the terminal 31.

The closing of switch 44 also operates relay 37, since a connection 46 is provided between the remaining side of the operating coil of this relay and the lead 43. Thus, closure of the switch 44 establishes a connection from line terminal 33 through leads 45, 43, and 46 to one side of the relay coil and directly to line terminal 34 from the other side of the coil. Energization of the relay 37 moves the armature 38 away from the contact 40 and breaks the primary circuit of the filament transformer 16. The coil of relay 37 remains energized and the armature contact 38 remains open until operating switch 44 is opened. The supply of current to the terminal 31 is not interrupted immediately upon the closing of the switch 44, but current is available at the terminal 31 practically coincidentally with the closing of the switch 44.

The interval between the time when current

is available at the terminal 31, i. e., the time the switch 44 is closed, and the time when current is no longer available at the terminal 31 after the switch 44 has been closed depends, among other things, upon the speed of operation of the relay 37, the resistance and reactance of the filament circuit, and the heat-storing ability of the filament. The ability of a filament or cathode to emit electrons depends upon its temperature, and the discharge device will continue to operate after the filament is deenergized until the filament cools to a temperature where insufficient electrons are emitted to sustain the discharge and cause the circuit to continue in oscillation. Thus, even if the contacts 38 and 40 opened simultaneously with the closing of the switch 44 and the filament circuit had no reactance, the filament 11 may have, or may be designed to have, sufficient heat-storing capacity to cause operation of the power supply for a sufficient length of time to produce epilation. It is generally preferable, however, to provide for a greater interval of operation than is provided by the heat-storing capacity of commercially available filament-type electron discharge devices. For that reason we prefer to make the relay 37 so that it holds the contacts 38 and 40 closed for a short interval after its coil is energized by the closing of the switch 44.

Referring to Fig. 2, we have illustrated a suitable relay which may be substituted for the relay 37 illustrated in Fig. 1. In Fig. 2, a relay 51 is shown as comprising a U-shaped iron frame member 52 to which is attached an iron pole member 53 about which is wound a relay energizing coil 54. The coil 54 is provided with suitable leads 55 and 56. An armature 57 is shown pivotally mounted on the U-shaped frame 52 and is shown carrying a heavy iron pole piece 58 which is adapted to be attracted to the pole member 53 when a source of current is connected to the leads 55 and 56. Mounted on the frame member 52 and insulated therefrom is a fixed upper contact 59 which is adapted for connection with a lower moving contact 60 when the relay is in unenergized position, as shown. The contact 60 is carried by a flexible spring arm 61 which is attached to the armature 57 and is movable therewith. The armature 57 and the spring arm 61 are biased upwardly by spring 62. This spring is preferably sufficiently strong to bow the spring arm 61 upwardly, as shown in full lines in Fig. 2, so that the contacts 59 and 60 are not broken until after the armature 57 and the plate 58 have moved downwardly for some distance after the coil 54 is energized. In order to take full advantage of the flexure of the spring 61 in causing a delay in the opening of the contacts 59 and 60, the spring 61 preferably has a normal upward bow, as shown in the dot-dash lines at 61a. The position of the armature plate 58 and of the spring 61 at rest when the coil 54 is energized is shown in dot-dash lines at 58a and 61a respectively. From an inspection of Fig. 2, it may be seen that the moving contact 60 in moving from its full-line position to its dot-dash position 60a moves a much shorter angular distance along a greater radius than the armature 58 in moving to its dot-dash position 58a. Thus, the contacts 59 and 60 do not break until the armature 58 is nearly at the end of its travel. This delays the opening of the filament circuit until some time after the coil 54 has been energized.

The fixed contact 59 is connected to a suitable lug 63, which may be connected in the place of

the element 40 shown in Fig. 1. The moving contact 60 is connected by suitable means to another lug 64 which may be connected in the place of the moving contact 38 shown in Fig. 1. Coil leads 55 and 56 may be connected to conductors 34 and 46 to take the place of the coil 37 illustrated in Fig. 1.

The type of relay illustrated in Fig. 2 may be adjusted to give a greater or lesser delay by limiting the amount of flexure allowed the spring 61 when the contact 60 is in connection with the contact 59. This adjustment in flexure may be provided by adjusting a set-screw 65 which is threadedly secured to a bracket 66 carried by the armature 57. It should be obvious that as the screw 65 is turned to increase the pressure on the spring 61 the amount of flexure allowed this spring is decreased and the time interval is accordingly decreased, and vice versa.

The particular type of relay used to obtain any desired time delay is purely a matter of discretion and there are numerous relays which are available commercially for this purpose. Hence, the relay illustrated in Fig. 2 is to be taken only as a non-limitative example of a relay which is suited for our purposes.

Referring again to Fig. 1, the operation of the power supply in connection with the process of epilation will be described briefly. A needle as used for epilation is shown at 71 and is provided with a bulbous end 72. A preferred form of needle is provided with an insulating coating which extends down to the bulb 72, so that the bulb affords the only direct contact with the flesh. The needle is shown inserted within a hair follicle 73 to a depth sufficient to bring the bulbous end 72 adjacent the hair bulb, which is not shown. The needle and the follicle are shown somewhat enlarged and somewhat ideally, for the sake of clarity. The follicle may be assumed to be located in an anatomical member 74. The needle is mounted in a suitable handle member 75 and is connected through flexible and insulated conductor means 76 to the terminal 31.

With the needle connected to the terminal 31 and the line switch 36 closed, the operator will locate the unwanted hair and will insert the needle 71 into the follicle 73. When the needle has been inserted to the desired depth, the operating switch 44, which is preferably operated by foot pressure, is closed. This energizes the plate of the discharge device 10 and starts the flow of current sufficient for epilation through the needle 71. There is usually sufficient capacity from the body member 74 back to the oscillating circuit to give a return current path (such capacity coupling being indicated in dotted lines in Fig. 1 of the drawings, at 18' and 74', i. e., a coupling from the plate transformer to the ground to the body member) E, so that no more than one metallic connection is required between the patient and the oscillating circuit. After this current has flowed for a short time, the filament is rendered inoperative through the operation of the relay 37 and the current through the needle is either brought to zero or to a value which is too small for epilation. The needle may then be moved with impunity and will cause no damage to the patient from the standpoint of burning. No further energy will be applied to the needle as long as the foot switch 44 is down, nor will there be any flow of current through the needle 71 when the foot switch 44 is opened. No further current will flow in the needle circuit until the foot switch 44 is again depressed, and the current

will flow for only a short time each time this switch is depressed.

Since it is not entirely necessary to provide a time delay relay, the relay 37 in Fig. 1 has been shown as a conventional relay. In Fig. 3, the power supply circuit has been shown with a conventionally illustrated time delay relay. In this figure the electron discharge device and its associated oscillator circuit have been omitted. Plate and filament transformers 81 and 82 are shown connected so that they may be energized from line leads 83 and 84 in exactly the same manner as transformers 17 and 18 respectively in Fig. 1.

Normally unenergized retarded relay 85 is shown with its moving contact 86 connected to its fixed upper contact 87 so that it is normally adapted to energize the filament transformer 82 when line switch 88 is closed. An operating switch is shown at 89 and is adapted when closed to energize the plate transformer 81 and relay 85 which in turn breaks the connection between the contacts 86 and 87. The relay 85 may be suitably retarded as by the provision of the well known copper retarding ring or by other suitable means.

In Fig. 4 an arrangement is illustrated for varying the time required for the filament current to decrease to zero when the filament circuit is deenergized. Only the filament circuit is illustrated since the remainder of the power supply circuit may be the same as illustrated in Fig. 1. It is well known that the time required for the current in a circuit comprising series resistance and reactance to fall to zero is dependent upon the relative values of the resistance and reactance. The filament of the electron discharge device is shown at 91 and is placed in series with the secondary of filament transformer 93 and adjustable reactance 92. By varying the value of the reactance 92 the time required for the current in the filament circuit to fall below a value sufficient to keep the filament at an electron-emitting temperature when the filament transformer is deenergized may be varied within certain limits. Obviously, the reactance 92 introduces a considerable voltage drop in the filament circuit. Thus the filament transformer would have to be designed to accommodate this drop.

The above-described embodiments are directed to the use of a conventional "filament type" thermionic (electron discharge) device, in which the mass of the cathode is relatively small wherefore the "cooling-down" time during which flow of electrons may occur from cathode to plate is quite short. Where a filament of heavy mass is employed, or where a "heater" type of tube is employed, in which the "cooling-down" time is of relatively greater length, the above-described procedure of establishing the plate supply in advance of the disconnection of the cathode heating current may be eliminated, and substantially simultaneous disconnection of the cathode heating current supply and connection of the plate supply, or even a disconnection of the cathode heating current supply in advance of the connection of the plate supply, may be established, as will be apparent to those skilled in the art. Furthermore, it will be appreciated that it is not essential that the plate circuit be wholly interrupted during the period prior to the establishment of a plate-cathode potential which is adequate for epilation, inasmuch as the existence of any potential low enough to insure

a negligible current supply to the needle would be unobjectionable. The essential criterion is that of limiting the period of supply of "coagulation" current to that which is adequate for epilation, through mechanical or electrical means which are independent of control by the operator, wherefore the exercise of any judgment on the part of the operator in this connection is eliminated from the epilation procedure. The operator's manual control of the setting of the condenser 32, for example, provides control of the intensity of the coagulation current, and such control enables the operator to establish the current flow which secures adequate "killing" of the hair-roots of a specific patient (as may readily be determined by the ease with which a coagulated hair may be withdrawn from the follicle). It will be appreciated therefore that we do not choose to consider this invention to be restricted to the specific embodiments herein delineated and described, but rather to the scope of the subjoined claims.

We claim:

1. An apparatus for supplying high-frequency current to an epilation needle, which comprises: an oscillator circuit adapted to supply high-frequency current to said needle, said oscillator circuit including a thermionic discharge device having a plate and a filament; filament current supply means normally connected to supply current to said filament; plate supply means for supplying current to said plate; operating switch means movable between a first position connecting said plate supply means to said plate and a second position disconnecting said plate supply from said plate; and filament switch means movable to a first position interrupting said connection between said filament current supply means and said filament in response to movement of said operating switch means to its first position and movable to a second position restoring said connection between said filament current supply means and said filament in response to movement of said operating switch means to its second position.

2. An apparatus for supplying high-frequency current to an epilation needle, which comprises: an oscillator circuit adapted to supply high-frequency current to said needle, said circuit including a thermionic discharge device having a plate and a thermionic discharge member, said discharge member when heated above a certain temperature being adapted to sustain an adequate discharge between the plate and the discharge member when a given difference in potential is applied between the plate and the discharge member and cause said oscillator circuit to supply current to said needle at a level adequate for epilation; operating switch means associated with said discharge device and movable between a first position causing application of said potential difference between said plate and said discharge member and a second position removing said potential difference between said plate and said discharge member; and switch means associated with said discharge device and said operating switch means and movable between a first position in which it is operable to bring the temperature of said discharge member below said temperature in response to movement of said operating switch means to its first position, and a second position in which it is operable to return the temperature of said discharge member to a temperature above said certain temperature in response to movement of

said operating switch means to its second position.

3. An apparatus for supplying high-frequency current to an epilation needle, which comprises: a power supply circuit including a thermionic discharge device having a plate and a filament, said circuit being adapted to supply current to said needle upon application of a potential difference between said plate and said filament; filament supply means normally connected to supply current to said filament; operating switch means operable when in one position to apply said potential difference to cause said circuit to supply current to said needle with a magnitude sufficient for epilation; and switch means controlled by said operating switch means and operative to interrupt the flow of current through said filament when said operating switch means is in said one position, whereby said filament cools and said current supplied to said needle is caused to decrease, said switch means being connected to maintain the interruption of said current flow until said operating switch means is in another position.

4. An apparatus for supplying high-frequency current to an epilation needle, comprising: circuit means defining a high-frequency oscillator electrically associated with an epilation needle and including an electron-discharge device provided with an electron-emitting cathode and a plate, heating current supply means for said cathode for placing said cathode in electron-emitting condition, plate current supply means, and switch means normally positioned to connect said heating current supply means to said cathode to maintain the same in electron-emitting condition while preventing supply of current to said plate from said plate current supply means and thus preventing supply of high-frequency current to said needle, said switch means being movable to another position to establish supply of current to said plate from said plate current supply means to supply high-frequency current to said needle and decrease the supply of heating current to said cathode from said heating current supply means to decrease the emission of electrons therefrom to such value as to reduce the supply of high-frequency current to said needle to a negligible value in a short period of time, said switch means being operable to maintain the decreased supply of heating current to said cathode after such decreased supply has been established until said switch means is moved from said other position to its first-mentioned normal position.

5. An apparatus for supplying high-frequency current to an epilation needle, which comprises: an oscillator circuit adapted to supply high-frequency current to said needle, said circuit including a vacuum tube having a filament and a plate; a relay having an operating coil and cooperating movable and fixed contacts, said contacts normally engaging one another when said coil is deenergized, said coil when energized operating to hold said contacts out of engagement; a filament supply circuit for supplying current to said filament, said circuit including said contacts and being operable to supply current only when said contacts are closed; a plate supply circuit operable to supply a potential difference between said plate and cathode when energized; connec-

tions between said plate supply circuit and said operating coil, whereby said operating coil is at all times energized when said plate supply is energized; and operating switch means operable to cause energization of said plate supply.

6. An apparatus for supplying high-frequency current to an epilation needle, which comprises: an oscillator circuit adapted to supply high-frequency current to said needle, said circuit including a vacuum tube having a filament and a plate; a relay having an operating coil and cooperating movable and fixed contacts, said contacts normally engaging one another when said coil is deenergized, said coil when energized operating to hold said contacts out of engagement; a filament transformer having a primary and a secondary, said secondary being connected in series with said filament; a series electric circuit adapted for connection to an alternating current power supply and including said primary and said contacts, said contacts operating to close said circuit when in engagement and to open said circuit when out of engagement; a plate transformer having a secondary connected to supply a potential difference between said plate and filament, and a primary; an operating switch; another series electric circuit adapted for connection to an alternating current power supply and including said plate transformer primary and said operating switch as elements thereof, said operating switch acting when closed to permit energization of said last-named circuit; and conductors connecting said operating coil in parallel with said plate transformer primary whereby said operating coil is energized at all times that said plate transformer primary is energized.

7. An apparatus for supplying high-frequency current to an epilation needle, which comprises: an oscillator circuit adapted to supply high-frequency current to said needle, said circuit including a vacuum tube having a filament and a plate; a retarded relay having an operating coil and cooperating movable and fixed contacts, said contacts normally engaging one another when said coil is deenergized, said coil when energized operating to hold said contacts out of engagement; a filament transformer having a primary and a secondary, said secondary being connected in series with said filament; a series electric circuit adapted for connection to an alternating current power supply and including said primary and said contacts, said contacts operating to close said circuit when in engagement and to open said circuit when out of engagement; a plate transformer having a secondary connected to supply a potential difference between said plate and filament, and a primary; an operating switch; another series electric circuit adapted for connection to an alternating current power supply and including said plate transformer primary and said operating switch as elements thereof, said operating switch acting when closed to permit energization of said last-named circuit; and conductors connecting said operating coil in parallel with said plate transformer primary whereby said operating coil is energized at all times that said plate transformer primary is energized.

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