

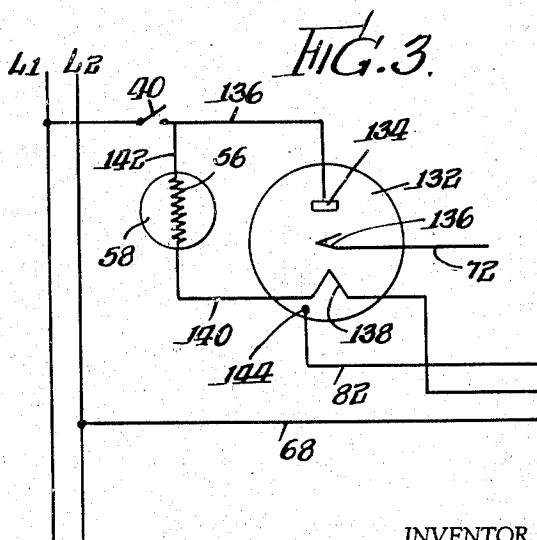
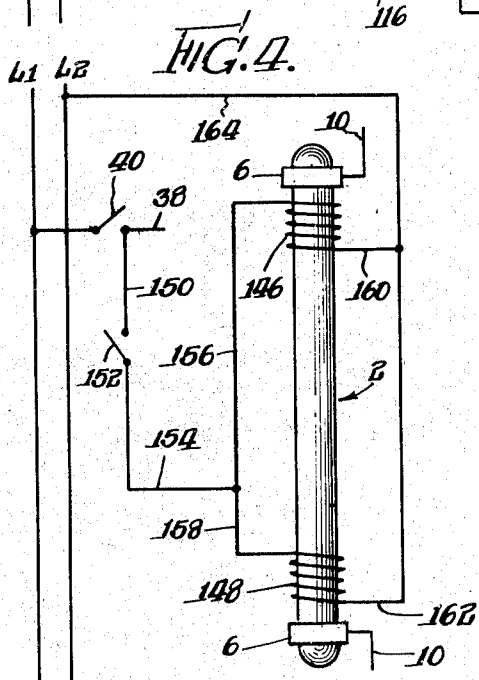
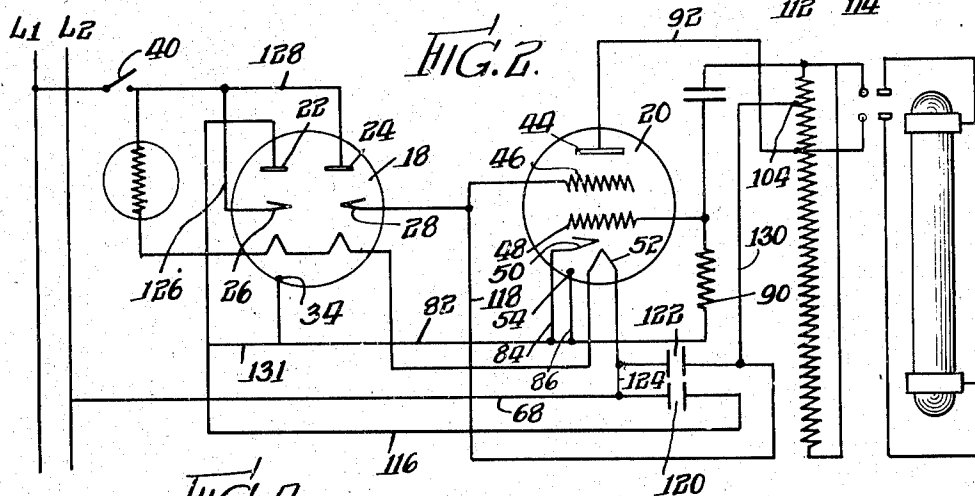
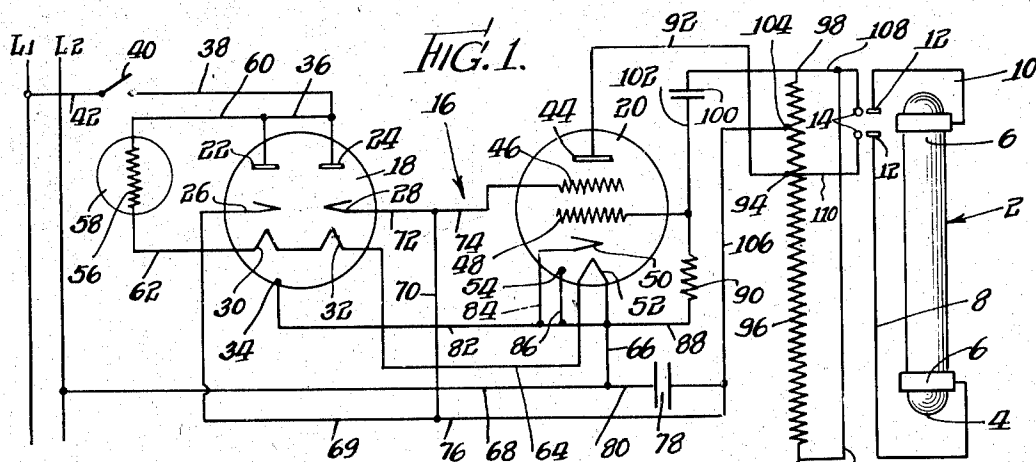
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F. FUREDY

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LAMP CIRCUIT

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LAMP CIRCUIT

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16 Claims. (Cl. 176—124)

This invention relates to a circuit for energizing a gaseous discharge lamp, particularly an ultra-violet lamp.

It is an object of this invention to provide an electronic tube oscillator circuit of such simplicity and compactness that it may be mounted in a space of restricted area, as, for example, the base of an ultra-violet lamp fixture, stand or in a portable unit.

It is a further object of the invention to provide a high frequency oscillating circuit capable of energization from the ordinary house circuit without use of a power transformer and which shall be capable of energizing an electrodeless gaseous discharge tube such, for example, as a fluorescent lamp or an ultra-violet ray lamp for therapeutic treatments or other analogous use.

A further object of the invention is to provide an electrodeless gaseous discharge tube and circuit therefor whereby the tube may be operated selectively as desired either as a cold quartz ultra-violet lamp or as a hot quartz ultra-violet lamp.

Applicant's invention contemplates the provision of a high frequency power supply circuit which is of such simplicity in its number of parts that it may be mounted within an area of small volume, as, for example, a space of cubic area of the order of five inches by three inches by five inches, and at the same time supply sufficient power for the high frequency energization of an electrodeless gaseous discharge tube.

Another object of the invention is to provide a simple high or radio frequency oscillating supply circuit for activating an ultra-violet ray gaseous discharge tube and simultaneously producing ozone.

Other and further objects and advantages of the invention will be apparent from the following description when taken in connection with the accompanying drawing, wherein:

Figure 1 is a schematic drawing of a circuit in accordance with the invention for energization by alternating or direct current;

Figure 2 is a schematic drawing of a circuit in accordance with the invention for energization by alternating current only;

Figure 3 is a schematic drawing of a modification of the circuit of Figure 1; and

Figure 4 is a schematic drawing showing how the circuit of Figures 1 to 3 may be added to for selectively operating a quartz ultra-violet lamp as a hot quartz lamp or a cold quartz lamp.

As shown in Figure 1, the lamp 2, which may be a quartz ultra-violet ray lamp or a fluorescent lamp, comprises an electrodeless gaseous dis-

charge tube exhausted to a high vacuum, filled with mercury vapor, argon, neon, helium, and krypton or other suitable rare gases and with a globule 4 of mercury, after which the lamp is sealed off. High frequency voltage for the excitation of the lamp is supplied thereto by external clips, terminals or electrodes 6 which mount the lamp in a reflector as described in my copending application Serial No. 347,258 filed July 24, 1940.

A voltage is applied to the terminals 6 through the long leads 8 and 10 which in the lamp shown in said copending application are of the order of thirty inches in length and are connected at their outer ends to the plug terminals 12 fitting into the socket terminals 14 in the output of the high frequency generating or oscillating circuit 16. The circuit 16 comprises a rectifying duo-diode thermionic vacuum tube 18 coupled to a power amplifier thermionic vacuum tube 20. The duo-diode tube 18 comprises a pair of plates 22 and 24, cathodes 26 and 28, heater filaments 30 and 32 and a shield of which the prong 34 is the terminal connection.

The plates 22 and 24 are connected in parallel by the wire 36 and by a wire 38 to the timing switch 40 of a conventional timing mechanism, preferably a clock mechanism embodying the switch 40. The other terminal of the timing switch 40 is connected to one of the supply lines as the line L—1 by the wire 42.

The tube 20 comprises a plate or anode 44, a screen grid 46, a control grid 48, a cathode 50, a heater filament 52, and a shield of which the prong 54 is the terminal connection.

The heater filaments 30 and 32 of the tube 18 and the filament 52 of the tube 20 are connected in series with each other and with the ballast resistor 56 of a ballast tube 58. The circuit to the heater filaments extends from the line L—1 through the wire 42, the timing switch 40, the wire 38, the wire 36, the wire 60, the ballast resistor 56, the wire 62, the heater filaments 30 and 32, the wire 64, the heater filament 52, the wire 66 and the wire 68 to the supply line L—2. The lines L—1 and L—2 represent the standard house circuit of 110 volts. The tubes 18 and 20 are of types which require a heater voltage of 25 volts and the ballast resistor 56 is accordingly designed to cause a voltage drop of sixty volts at the rated current value of the heater currents for the tubes 18 and 20.

The cathodes 26 and 28 of the tube 18 are connected together by the wires 68, 70 and 72 and to the screen grid 46 of the tube 20 by the

wire 74. The cathodes 26 and 28 are also connected by the wire 76 to one side of a condenser 78, the other side of which is connected by the wire 80 to the return wire 68. The shield prong 34 of the tube 18 is connected by the wire 82 to the heater filament 52 of the tube 20 and the lead 66 from the return wire 68.

The cathode 50 of the tube 20 is connected by the wire 84 and the wire 82 to the heater filament 52 and the lead 66 to the return wire 68. The shield prong 54 is similarly connected by the wire 86 leading to the wire 82.

The control grid 48 is coupled to the cathode 50 by a wire 88 in which is interposed a grid resistor 90, the wire 88 being connected to the wire 66 and by the wires 82 and 84 to the cathode 50. The plate or anode 44 of the tube 20 is connected by a wire 92 to an intermediate tap 94 of an air core induction coil or inductance 96. The control grid 48 is coupled to the end 98 of the induction coil 96 through a condenser 100 interposed in a wire 102 connected at one end to the control grid and at the other end to the end 98 of the induction coil.

A tap 104 of the induction coil intermediate the end 98 and the tap 94 is connected by the wire 106 to the common wire 76 for the cathodes 26 and 28 of the tube 18 and to the condenser 78. The terminals of the output socket 14 are connected by the wires 108 and 110 to the end 98 and the tap 94 respectively of the induction coil 96.

The end 112 of the induction coil 96 is coupled to the end 98 of the induction coil by the wire 114 and the wire 108.

In a preferred construction the tube 18 is a 25Z6G high vacuum rectifier tube and the tube 20 a 25L6G power amplifier tube. In this preferred construction, the circuit constants have the following value:

1. The ballast resistor 56—200 ohms;
2. The grid resistor, 90—10,000 ohms;
3. The grid condenser, 100—.00025 microfarads;
4. The condenser 78 is an electrolytic 450 volt condenser with a value of four microfarads;
5. The induction coil 96 is of number 23 cotton and enamel magnet wire of 72 turns wound on a $\frac{7}{8}$ inch tube; and the tap 104 is located at three turns from the end 98 of the induction coil and the tap 94 located at three turns from the tap 104.

In operation, the duo-diode thermionic tube operates as a half wave rectifier, passing current when the line L—1 is positive from the wires 38 and 36 through the plates 22 and 24, the cathodes 26 and 28, the wires 69, 70 and 72, the wire 76, the wire 106, the tap 104, three turns of the induction coil 96, the tap 94, and the wire 92, to the plate or anode 44 of the tube 20. The current passes from the plate or anode 44 through the cathode 50 and by the wires 84, 82, 66 and 68 to the negative lead L—2.

As the charges build up on the condenser 100 and then leak away, a high frequency current is produced in the induction coil 96 at a frequency with the given constants of approximately 550 kilocycles, sufficient to excite the lamp 2 to luminescence, but the visible rays within the lamp tube do not extend completely from end to end of the tube and a slight flickering is observed. The portion of the induction coil 96 between the tap 94 and the end 112 when connected as shown reinforces the current from the portion of the coil between the taps 98, 104 and 94, and causes the rays to extend completely from end to end of the lamp tube 2 and with a steady glow.

The circuit shown in Figure 1 operates either on alternating current or direct current. In the case of direct current the wire 42 must of course be connected to the positive supply line. In Figure 2 there is shown a full wave rectifier and voltage doubling circuit in which the plate 22 and the cathode 28 are connected by wires 116 and 118 to the series condensers 120 and 122 to the common tap 124 of which the return line 68 to the line L—2 is connected. The cathode 26 is connected in parallel to the plate 24 which is connected by the wire 128 and through the timing switch 40 to the supply line L—1.

The tap 104 of the induction coil is connected by the wire 130 to the wire 118 extending between the condenser 122 and the cathode 28 of the duo-diode tube 18. It should be observed that in the circuit of Figure 2, the cathode 50 and shield prong 54 of the tube 20 are not connected to the heater filament 52 of this tube, but that the wire 82 connecting the shield prong 34 of the tube 18 to the cathode 50 and shield prong 54 of the tube 20 is connected by the wire 131 to the wire 116 extending between the condenser 120 and the plate or anode 22 of the tube 18.

Where desired, the tube 2 may be mounted in close proximity to the coil 96 and be energized thereby without electrical connection to the coil. The circuit of Figure 2 is otherwise the same as the circuit of Figure 1. The circuit shown in Figure 2 has the advantage over the circuit shown in Figure 1 of greater power, but the disadvantage that it can only be used with alternating current.

In the circuit shown in Figure 3, the duo-diode tube 18 is replaced by the single diode thermionic vacuum tube 132, the plate 134 of which is connected by the wire 136 and through the timing switch 40 to the line L—1. The cathode 138 is connected to the wire 72 of the circuit shown in Figure 1. The heater 138 is connected by the wire 140 to one side of the resistor 56 of the ballast tube 58, the other side of the resistor being connected by the wire 142 to the plate lead 136. The shield prong 144 is connected to the wire 92 of the circuit shown in Figure 1 and the power line L—2 is connected to the return line 68 of the circuit of Figure 1.

In the circuit shown in Fig. 4, the lamp tube 2 is heated by coils 146 and 148 of number 28 nichrome wire snugly embracing the quartz envelope of the lamp tube. Current is supplied to these heating coils 146 and 148 through the timing switch 40 from the line L—1 through the wire 150, a manually operable switch 152, a wire 154, the wires 156 and 158 in parallel, the heater coils 146 and 148 in parallel, the wires 160 and 162 and the wire 164 to the supply line L—2. Upon closing of the switch 152 the circuit to the heating coils 146 and 148 is completed and the lamp operates as a hot quartz lamp supplying rays of radiant energy of the order of 2800 Angstrom units, but with the switch 152 in open circuit position, the lamp operates as a cold quartz lamp supplying rays of radiant energy of pure ultra violet or the order of 2537 Angstrom units.

It is obvious that various changes may be made in the specific embodiments of the invention set forth for purposes of illustration without departing from the spirit of the invention. Accordingly the invention is not to be limited to the specific embodiments shown and described but only as indicated in the following claims.

The invention is hereby claimed as follows:

1. A circuit for energizing a gaseous discharge tube, comprising a thermionic tube having plate, cathode and grid electrodes, means for applying a rectified voltage across said plate and cathode, an induction coil adapted to energize said gaseous discharge tube and having an intermediate portion in the direct current plate circuit of said tube, a direct conductive connection between the opposite ends of said induction coil, and connections including capacity and resistance between the grid and cathode electrodes of said thermionic tube and said connected ends of said induction coil.
2. A circuit for energizing gaseous discharge tubes, comprising a thermionic tube having plate, cathode and grid electrodes, means for applying a rectified voltage across said plate and cathode, an induction coil having an intermediate portion in the plate circuit of said tube, a direct conductive connection between the opposite ends of said induction coil, connections including capacity and resistance between the grid and cathode electrodes of said thermionic tube and said connected ends of said induction coil, a connection between the plate circuit of said thermionic tube and said gaseous discharge tube, and a connection between the connected ends of said induction coil and said gaseous discharge tube.
3. A circuit for energizing a gaseous discharge lamp comprising a source of alternating current, a duo-diode thermionic vacuum tube, a full wave rectifying voltage doubling circuit including a pair of condensers having a common connection to said source and each connected in series with one of the diodes of said duo-diode tube, a thermionic vacuum tube having grid, plate and cathode electrodes and a heater filament for said cathode electrode, a common mid-tap connection between said condensers and said heater filament, an induction coil for supplying energy to said lamp and having a portion thereof connected to the positive potential side of one of said condensers and to the plate electrode of said thermionic tube, a connection including capacity from another portion of said induction coil to the grid electrode, a connection including a leak impedance between the grid electrode and the cathode, and a direct conductive connection between the opposite ends of said induction coil.
4. A circuit for energizing a gaseous discharge tube comprising a thermionic tube having plate, cathode and grid electrodes, means for applying a direct current voltage across said plate and cathode, an induction coil, a circuit connecting one end of said coil to said grid electrode, means for connecting the plate and cathode to intermediate taps on said induction coil, a capacity in the circuit between the coil and the grid, resistance connected between the grid and cathode electrodes, a direct conductive connection between the opposite ends of said induction coil, and a circuit connecting one of said coil taps and one end of said coil to said gaseous discharge tube.
5. A circuit for energizing a gaseous discharge lamp from a standard low voltage power supply source, comprising input leads adapted to be connected to said source, a rectifier having a pair of rectifying electrodes, an inductance for supplying energy to said discharge lamp, an electronic tube having plate, cathode and grid electrodes, said pair of rectifying electrodes, said inductance, and said plate and cathode electrodes being connected in series to said input leads, and connections including a capacity and resistance from said grid to said plate and cathode electrodes.
6. A circuit for energizing a gaseous discharge lamp comprising a rectifier having a pair of rectifying electrodes, an induction coil for supplying energy to said gaseous discharge lamp, an electronic tube having plate, cathode and grid electrodes, a direct current plate circuit for said tube including in series said plate and cathode electrodes, said rectifying electrodes and a portion of said induction coil, a condenser connected to another portion of said induction coil and to the grid electrode of said tube, and a leak impedance connecting the grid and cathode electrodes.
7. A lamp circuit comprising a cold quartz ultra-violet ray gaseous discharge lamp having spaced current electrodes, a power supply source, a high frequency oscillating circuit connected to said source and said electrodes for supplying space current to said electrodes, and a heater independent of the space current in said lamp, said heater being connected to said source and positioned to heat the quartz envelope of said lamp, thereby causing the lamp to emit rays characteristic of a hot quartz ultra-violet ray lamp.
8. A lamp circuit comprising a "cold quartz" ultra-violet ray gaseous discharge lamp having spaced current electrodes and emitting rays of one wave length band, a power supply source, a high frequency oscillating circuit connected to said source and to said electrodes for supplying space current to said electrodes, a heater independent of the space current in said lamp, said heater being connected to said source in parallel to said oscillating circuit and positioned to heat the quartz envelope of said lamp for changing the band width of the rays transmitted through the quartz envelope of the tube, thereby causing the lamp to operate with the characteristic of a "hot quartz" ultra-violet ray lamp, a control switch in the parallel circuit of said heater, and a time-controlled switch connected in common to said oscillating circuit and the circuit of said heater for simultaneously controlling the deenergization of both of said circuits.
9. A circuit for energizing a gaseous discharge lamp from a standard low voltage power supply source, comprising input leads adapted to be connected to said source, a rectifier having a pair of rectifying electrodes, an inductance for supplying energy to said discharge lamp, an electronic tube having plate, cathode and grid electrodes, a circuit in which said pair of rectifying electrodes, said inductance, and said plate and cathode electrodes are connected in series to said input leads, connections including a capacity and resistance from said grid to one of said plate and cathode electrodes and to said circuit, and a condenser connected in shunt to that portion of said circuit which consists of the plate and cathode electrodes in series with said inductance.
10. A circuit for energizing a gaseous discharge lamp, a standard low voltage power supply source, comprising input leads adapted to be connected to said source, a rectifier having a pair of rectifying electrodes, an electronic tube having plate, cathode and grid electrodes, an inductance for supplying energy to said gaseous discharge lamp, a first circuit including in series said pair of rectifying electrodes, said inductance and said plate and cathode electrodes and connected to said input leads, a condenser connected in shunt to that portion of said circuit which consists of the plate and cathode electrodes in series with said inductance, a second circuit including in

series a resistance, a second condenser, and a second inductance, said second circuit being connected between said second condenser and resistance to said grid and at one end to said cathode electrode and at the other end to said first inductance, said second inductance being coupled to said first inductance.

11. A circuit for energizing a gaseous discharge lamp, a standard low voltage power supply source, comprising input leads adapted to be connected to said source, a rectifier having a pair of rectifying electrodes, an electronic tube having plate, cathode, and grid electrodes, an inductance for supplying energy to said gaseous discharge lamp, a first circuit including in series said pair of rectifying electrodes, their inductance and said plate and cathode electrodes and connected to said input leads, a condenser connected in shunt to that portion of said circuit which consists of the plate and cathode electrodes in series with said inductance, a second circuit including in series a resistance, a second condenser, and a second inductance, said second circuit being connected between said second condenser and resistance to said grid and at one end to said cathode electrode and at the other end to one end of said first inductance, said second inductance being coupled to said first inductance, and a third inductance connected at one end to said second circuit between said second condenser and said second inductance and at the other end to the other end of said first inductance.

12. A circuit for energizing a gaseous discharge lamp comprising a thermionic tube having plate, cathode and grid electrodes, means for applying a direct current voltage across the plate and cathode, an induction coil for supplying energy to said lamp, means for connecting the plate and cathode to intermediate taps on said induction coil, a circuit including a capacity and a resistance in series, said circuit being connected between said capacity and resistance to said grid and at one end to the cathode and at the other end of one end of the induction coil, and a direct conductive connection between opposite ends of said coil.

13. A circuit for energizing a gaseous discharge lamp comprising a thermionic tube having plate, cathode, and grid electrodes, a series of direct current voltage, an induction coil having a pair of intermediate taps and for supplying energy to said gaseous discharge lamp, a circuit including in series said source, the portion of said induction coil between said intermediate taps and said plate and cathode electrodes, a condenser connected across said source in parallel to that portion of said circuit which consists of plate and cathode electrodes in series with the portion of the induction coil between said intermediate taps, a second circuit including a second condenser and a resistance in series, said second circuit being connected between the condenser and the resistance to said grid electrode and at one end to said cathode electrode and at the op-

posite end to one end of said induction coil, and a direct conductive connection between one end of said induction coil and the opposite end of said induction coil.

14. A circuit for energizing a gaseous discharge lamp from a standard low voltage source of power, said circuit comprising electronic means having a plate electrode, screen grid electrode, control grid electrode, and a cathode, rectifying electrodes comprising second and third plate electrodes and second and third cathodes, heaters for said three cathodes, input leads adapted to be connected to said source, the second and third plate electrodes being connected in parallel to one of said leads, the first cathode electrode being connected to the other lead, said heaters being connected in series across said leads, said cathodes having a common connection to said screen grid, an induction coil having a pair of intermediate taps, a common connection from said second and third cathodes to one of said taps, a connection from the other of said taps to the first plate electrode, a high voltage condenser connected on one side to the first cathode and on the other side connected in common to said second and third cathodes, a condenser connected between one end of said induction coil and said grid, and a resistance connected between the grid and the first cathode, and a direct conductive connection between the other end of said induction coil and said one end of said coil.

15. A circuit for energizing a gaseous discharge vapor tube, comprising a thermionic tube having plate, cathode, and grid electrodes, means for applying a direct current voltage across said plate and cathode, an induction coil for energizing said vapor tube and having an intermediate portion in the plate circuit of said tube, a direct conductive connection between the opposite ends of said induction coil, connections including capacity and resistance between the grid and cathode electrodes of said thermionic tube and said connected ends of said induction coil, a connection from said connected ends of said coil to said vapor tube, and a connection from said intermediate portion of the coil to said vapor tube.

16. A circuit for energizing a gaseous discharge vapor lamp comprising a thermionic tube having plate, cathode, and grid electrodes, means for applying a direct current voltage across the plate and cathode, an induction coil for supplying energy to said lamp, means for connecting the plate and cathode to intermediate taps on said induction coil, a circuit including a capacity and a resistance in series, said circuit being connected between the capacity and resistance to said grid and at one end to the cathode and at the other end to one end of the induction coil, a direct, conductive connection to opposite ends of said coil, and a circuit connecting one of said taps and said connected ends of said coil to said vapor lamp.

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