

1,452,339

ELECTRICAL DISCHARGE DEVICE

Filed May 28, 1918

Fig. 1.

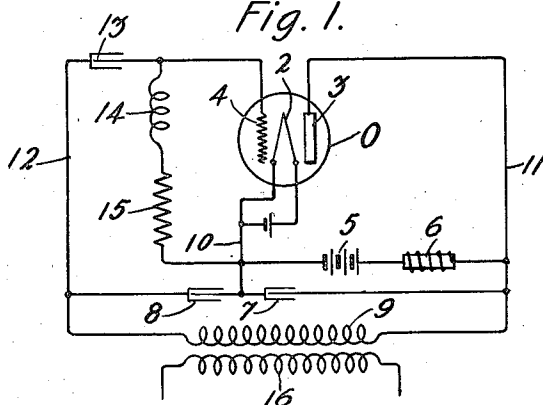


Fig. 2.

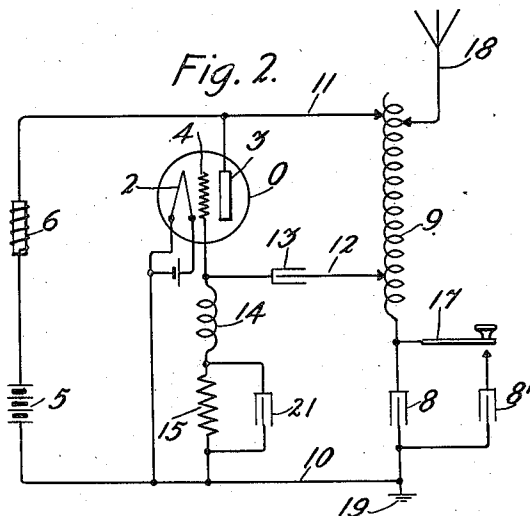
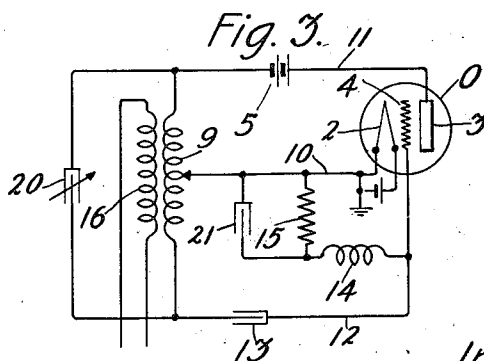


Fig. 3. //



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UNITED STATES PATENT OFFICE.

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ELECTRICAL DISCHARGE DEVICE.

Application filed May 28, 1918. Serial No. 237,110.

To all whom it may concern:

Be it known that I, RAYMOND A. HEISING, a citizen of the United States, residing at East Orange, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Electrical Discharge Devices, of which the following is a full, clear, concise, and exact description.

This invention relates to electric discharge devices and more particularly to arrangements for using such devices to generate, repeat or amplify electric currents.

Heretofore use has been made of a high resistance leak path to discharge undesired electrical charges which accumulate upon the grid or impedance-varying element of highly evacuated electronic discharge devices. It has been found that high frequency energy is dissipated because of this resistance, thereby lowering the efficiency of such devices; and a primary object of my invention is to prevent this dissipation of energy. This result is accomplished by the means herein described without causing the leak path resistance to act less efficiently in controlling the potentials upon the grid. This saving of energy may be accomplished by allowing less high frequency current to flow in the leak path, by causing the current which does flow to be substantially wattless, or by a combination of both these effects.

It has been proposed to place the high resistance leak path between the grid and cathode, but it may be located between any two points which will cause the desired leak. The use of an inductive leak path in connection with electric discharge devices may in certain cases possess incidental beneficial advantages not enumerated herein.

The invention is described herein in connection with highly evacuated tubes of the audion type which function as generators, but may obviously be of utility in connection with similar or equivalent discharge devices functioning as detectors, amplifiers, modulators or for other purposes. The invention is of especial utility in connection with high frequency telephone and telegraph systems of various types.

The invention may be carried out by various combinations of means and devices, some of which are hereinafter described in detail

and illustrated in the accompanying drawings, wherein Fig. 1 shows an oscillation generator; Fig. 2 a modification thereof suitable for radio signaling; and Fig. 3 is a different form of oscillation generator.

In the drawings the vacuum tube 0, containing the filamentary cathode 2, anode 3, and impedance-varying element or grid 4, functions as an oscillation generator. The space current for the tube is supplied by the source 5 through the high inductance coil 6. The period of the oscillations is controlled by the tuned circuit containing capacities 7 and 8 and the inductance coil 9 in series. The cathode is connected to the tuned circuit between the capacities 7 and 8 by the lead 10; the anode is connected to the tuned circuit at a terminal of the coil 9 by the lead 11; and the grid is connected to the tuned circuit at the opposite terminal of the coil 9 by the lead 12. The lead 12 contains a stopping condenser 13. When the oscillator is in operation the grid receives increments of negative electricity from the cathode 2 and thus becomes negatively charged. Heretofore, there has been used a high resistance 15 between the grid and cathode, the magnitude of this resistance largely determining the normal working charge upon the grid. However, as the cathode and grid are alternately at different relative potentials, a certain amount of high frequency energy tends to become dissipated in the resistance 15. The source of high frequency voltage in the input or grid-filament circuit is the condenser 8 through which the high frequency oscillating current set up in the circuit 7, 8, 9 flows. Since coil 14 is not only required to act as a choke coil for high frequency current, but must be designed so as not to dissipate high frequency energy, a non-magnetic and non-conductive core is desirable in order to prevent hysteresis and eddy current losses. The necessary value of inductance of coil 14 will depend upon the nature of the tube, its electrical constants, the constants of the associated elements, and the frequency of the oscillations desired to be generated. A suitable coil 16 may be coupled to coil 9 for conducting high frequency energy from the generating system.

In Fig. 2 there is illustrated a form of the invention modified for use as a simple

form of radio signaling system. This arrangement is generally similar to that of Fig. 1 and parts having corresponding numerals applied thereto will be understood by reference to the description of Fig. 1. In this arrangement the tuned circuit consists of the capacity 8, coil 9 and the capacity between the aerial 18 of an antenna system and the ground 19. Leads 11 and 18 may be connected to the same point in the inductance 9, but in most cases it will be desirable to have them independently variable. The capacity between aerial 18 and ground 19 corresponds to the capacity 7 of Fig. 1. A small condenser 8' is shunted around the condenser 8 and when the key 17 is closed the oscillation frequency will be changed. By opening and closing the key signals may be transmitted. A small condenser 21 is shunted around the resistance 15 and aids in rendering wattless any high frequency current which passes through the leak path. The elements 14, 15 and 21 are so proportioned that the impedance of the whole combination to the generated frequency is highly inductive. This arrangement has the important advantage that the impedance to the direct current (leak current) may be established independently of the impedance to the high frequency current, and that while the whole combination offers a high impedance to the high frequency current, there is substantially no high frequency energy dissipated in the resistance 15, even though some high frequency current passes through the leak path as a whole.

Fig. 3 illustrates a somewhat different form of the invention in which the oscillatory circuit contains a single capacity 20 and an inductance 9. The leak path consists of the resistance 15 shunted around which is the capacity 21; and in series with this arrangement is the inductance coil 14. The other elements of this figure correspond to those of Fig. 1 and will be understood by reference to the description thereof. As shown, the cathode may be grounded, if desired.

The leak path of the arrangement shown in Fig. 1 and that of the arrangement shown in Fig. 2 are interchangeable, that is, the condenser 21 may or may not be used, although its use often produces much better results. Other equivalent arrangements of impedance elements may be used, hence the invention is not limited to those shown. The word "number" as used in the appended claims is intended to include the number "one" as well as all greater numbers. Where any portion of the leak path consists of an inductance and a resistance in series as in Fig. 1, a single inductively wound resistance coil may be conveniently used.

Having described a few only of many possible forms of this invention, the salient

novel features thereof will be defined both broadly and specifically in the appended claims.

What is claimed is:

1. In combination, an electron discharge device having a cathode and an impedance varying element, means for impressing an alternating voltage thereacross, and a leak path between said cathode and said element, said leak path having a highly inductive reactance to alternating current of the frequency produced by said voltage.

2. A generator comprising a space discharge device and suitable circuit connections therefor whereby radio frequency oscillations are generated, a control electrode in said device, a leak path for said electrode, and an element in said path of high inductance for the frequency of oscillations being generated, said path being substantially non-dissipative at the frequency being generated.

3. In combination a discharge device having an impedance varying element, a leak path connected to said element, means for impressing fluctuating voltage across the leak path, and means for impressing direct voltage across said leak path, said leak path comprising means whereby the effect of dissipating energy from said direct voltage means is greater than from said fluctuating voltage means.

4. In an electronic discharge device, an impedance-varying element and means for controlling the normal static charge upon said element during operation, said means including an inductance in series with a parallel arrangement of capacity and resistance.

5. In an electronic discharge device, an electrode, means for regulating the normal operative static charge upon said electrode, and means for reducing the dissipation of high frequency energy by said first mentioned means without materially affecting the efficiency of its regulating action, said second-mentioned means including energy storing devices in series with said first-mentioned means.

6. In combination, an electron discharge device and circuit arrangements including a leak path associated therewith, said leak path comprising impedance elements so proportioned, designed and related that high frequency currents therethrough will have a low power factor.

7. In combination, an electric discharge repeating device adapted to repeat in its output circuit electrical variations applied to its input circuit, a resistive path including an inductance element having a non-magnetic and a non-conductive flux path connecting two of the electrodes thereof which have no other conductive connection for direct current, and an alternating current bypass around the resistive part of said path.

8. In combination, an electron discharge repeater including input electrodes, two paths connecting said input electrodes, one of said paths being substantially opaque to direct current, and the other said path being highly resistive, inductive, and substantially non-dissipative of high frequency energy.

9. In an electric discharge oscillation generating system, an impedance-varying element, and a leak path for discharging undesired charges from said element, said leak path being highly inductive at the operating frequency.

10. In an electric discharge oscillation generating system, a cathode and an impedance-varying element, and a leak path therebetween including a coil having a non-magnetic flux path and a resistance.

11. In an electric discharge oscillation generating system, an impedance-varying element and an associated electrode, and a leak path connecting said electrode and impedance-varying element, said leak path including an inductance in series with a resistance, said resistance being shunted by a condenser.

12. In an electronic high frequency oscillation generating system, a cathode and an electrode, a leak path between said cathode and electrode, and means connected to said leak path to diminish the high frequency energy loss due to said leak path, the impedance across said leak path to current of the frequency or frequencies generated by said system being higher than the impedance due to said resistance.

13. Means for generating oscillations comprising an oscillatory circuit, a discharge device having a cathode, an anode and an impedance-varying element, leads from each of said anode and said impedance-varying element to points in said oscillatory circuit, the difference of potential between said points being alternately large and small, a lead from said cathode to a point in said oscillatory circuit having a potential which is at all times between the potentials of said first mentioned points, and a leak path between said impedance-varying element and said cathode, said leak path containing inductance and resistance.

14. In combination, an oscillation generating system including an electronic discharge device for generating oscillations, an element for varying the impedance of a space in said device, and a resistive and inductive leak path from said element to ground.

15. In a device for maintaining oscillations in an energy dissipating oscillation circuit, a cathode, an anode and an element for varying the space impedance therebetween, said cathode and a point of said circuit being grounded, and an inductive and resistive path from said element to ground.

16. In combination, an electronic repeater device, means including circuit arrangements therefor whereby said device acts as an oscillation generator, an electrode and an impedance controlling member included in said device, and a plurality of paths connecting said electrode and impedance controlling member, all but one of said paths containing a means to prevent the flow of direct current therethrough, said one path being highly inductive.

17. In combination, an electric circuit arrangement including an inductance, having a point thereon adapted for connection to an aerial, a capacity connected to a remote point of said inductance, an anode, a cathode and an impedance-varying element, a connection from said anode to a point in said inductance, a connection from said impedance-varying element to a point on said inductance between said first mentioned point and said capacity, a connection from said cathode to the terminal of said capacity remote from said inductance, and a highly resistive and inductive path from said impedance-varying element to said cathode.

18. In combination, a thermionic discharge device having an anode and a cathode, circuits therefor whereby said device functions as an oscillation generator, said circuits including a resistive and inductive leak path, and a signaling device coupled to a path between the anode and the cathode of said device for varying the oscillations.

19. A signaling system comprising a discharge device, a circuit arrangement including an inductive leak path therefor, means for impressing an electromotive force of desired frequency upon said leak path, and a signaling device included in a circuit shunted around said leak path for varying a characteristic of the applied electromotive force.

20. In combination, a discharge device having an impedance varying element, a leak path connected to said element, said path comprising impedance elements so related and designed that a given direct voltage applied thereto produces a greater dissipation of energy therein than that produced by an alternating voltage of equal effective value.

In witness whereof, I hereunto subscribe my name this 22nd day of May A. D., 1918.

RAYMOND A. HEISING.