

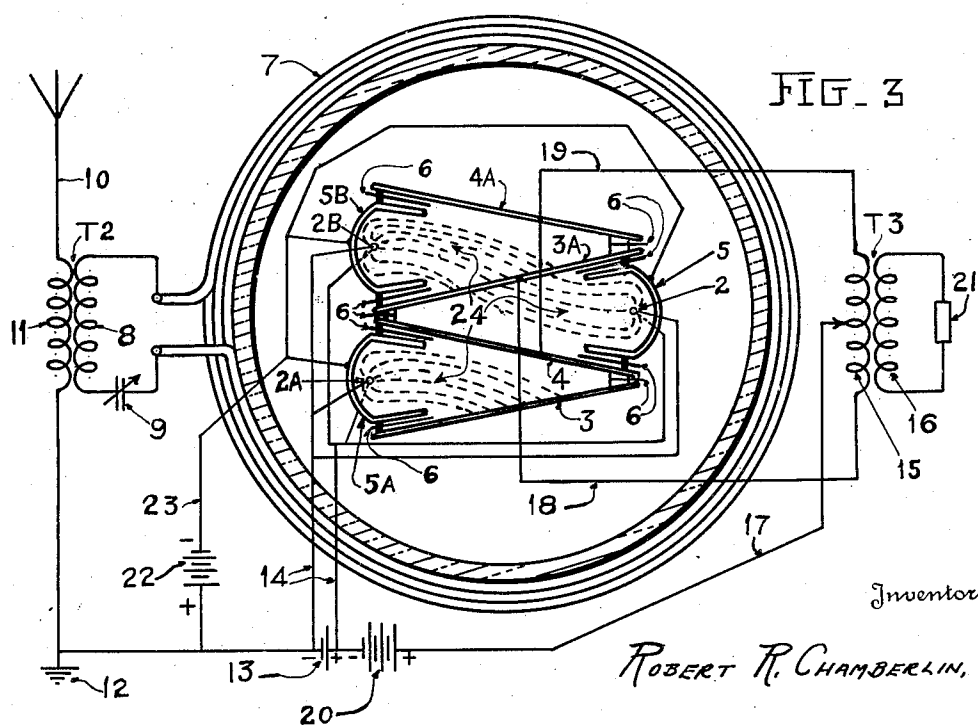
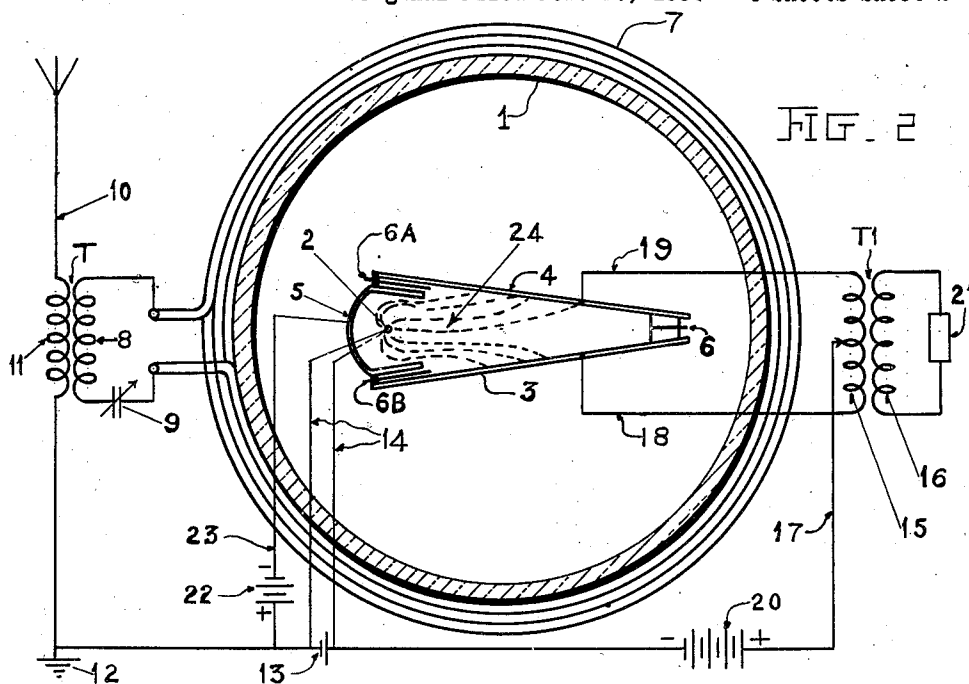
May 24, 1938.

R. R. CHAMBERLIN

2,118,162

ELECTRICAL DISCHARGE APPARATUS

Original Filed Feb. 13, 1934 4 Sheets-Sheet 2



Inventor

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May 24, 1938.

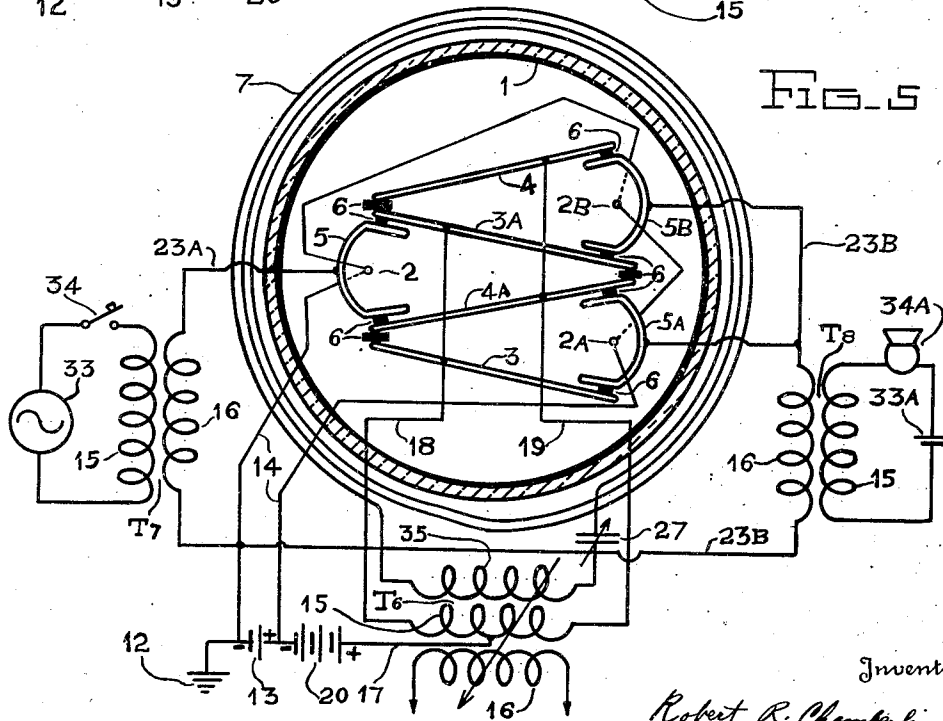
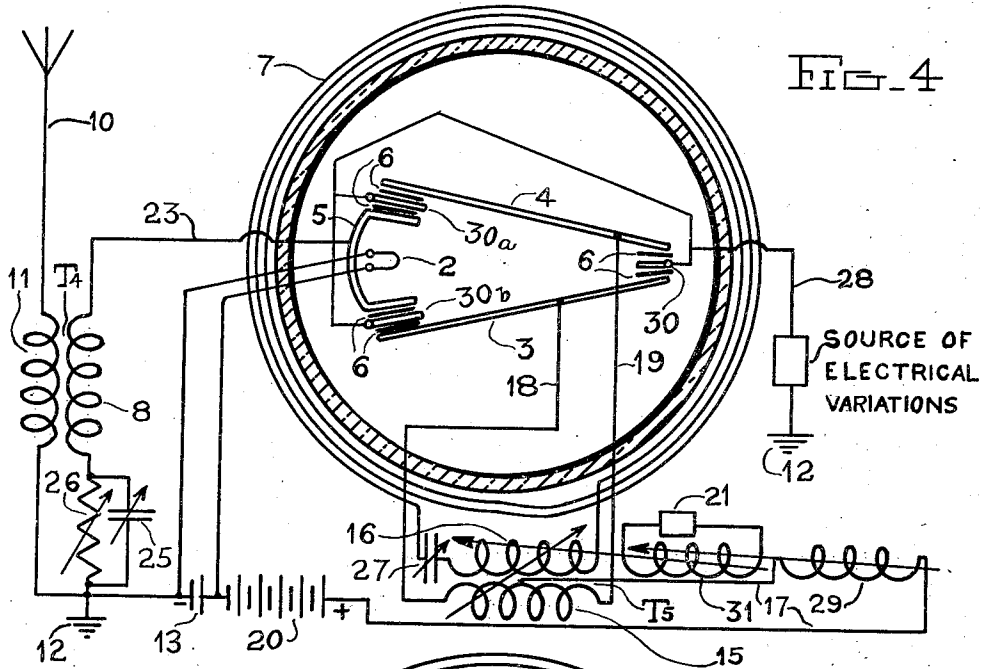
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ELECTRICAL DISCHARGE APPARATUS

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4 Sheets-Sheet 3



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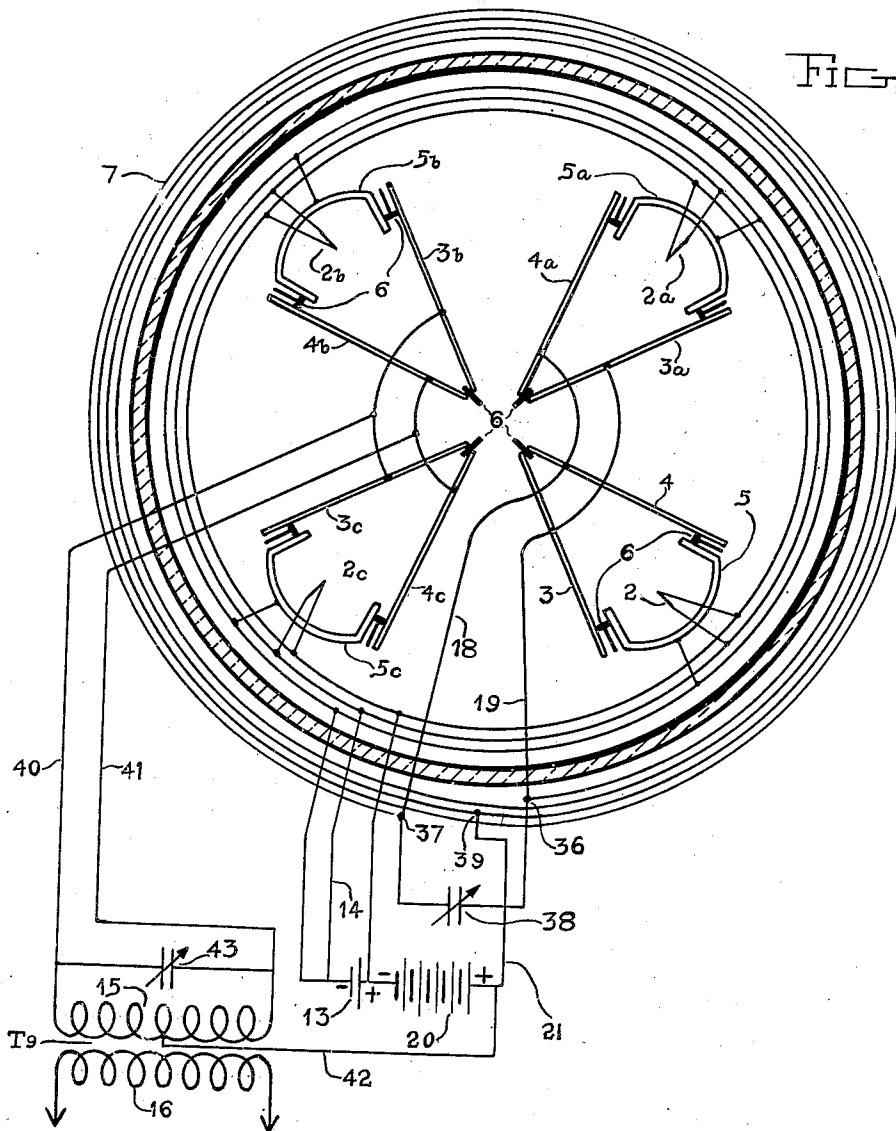
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4 Sheets-Sheet 4

FIG. 6



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DEC - 2 1941

UNITED STATES PATENT OFFICE

2,118,162

ELECTRICAL DISCHARGE APPARATUS

Robert R. Chamberlin, Washington, D. C.

Application February 13, 1934, Serial No. 711,075

Renewed September 25, 1936

37 Claims. (Cl. 250-27)

My present invention relates to improvements in the construction and operation of discharge apparatus and more particularly to devices in which the direction and flow of electrons are controlled by combined magnetic and electrostatic fields.

In carrying out the invention use is made of the principle of deflection by a magnetic field of an electron or ionized stream which may be produced in any of a number of ways. The current variations, to be reproduced or reinforced, may be impressed on a coil so situated that its magnetic field is impressed at right angles to the path of the electron stream.

The use of magnetic and electrostatic fields to control an electron discharge is known to the prior art; but by those means the control is limited and various other restrictions prevail. By my invention the arrangement and combination of elements and the method of their application, means are provided by which the limitations referred to are eliminated and an electron stream response is obtained that is sensitive to a magnetic field of low intensity.

The general object of my invention is to provide an improved apparatus of this type which is sensitive, reliable, and rapidly responsive to electric variations.

Another object of my invention is to provide an improved apparatus for securing amplified reproduction of variations of current energy.

Still another object of my invention is to produce apparatus for amplifying and detecting electric signal variations or impulses of radio telegraphy, radio telephony, or telegraphy and telephony over wires and cables.

Still another object of this invention is to provide apparatus for producing continuous oscillations.

Still another object of my invention is to provide apparatus for transmitting electric variations by radio.

A further object of my invention is to provide apparatus for impressing a plurality of different frequencies, all modulated differently, upon a single frequency.

A further object of this invention is to provide apparatus for limiting the intensity of electric variations, such as static in radio reception.

A still further object of my invention is to provide apparatus for separating each oscillation into two halves differing in phase by 180 degrees.

Other objects will be apparent, from the following description, when considered in connection with the accompanying drawings in which

Figure 1 is an elevation of a simplified form of my invention having a single element.

Figure 1a is a cross-sectional view of Figure 1 taken along the line *m-n*.

Figure 2 is a cross-sectional view of Figure 1 and a diagram of one circuit in which the invention is used.

Figure 3 is a form similar to that shown in Figure 2, but differing in the number of elements.

Figure 4 shows a form similar to Figures 1, 1a, and 2 but differing in the arrangement of the external circuit.

Figure 5 shows a form of similar tube construction to Figure 3 but having means attached thereto for impressing a plurality of different frequencies upon a single frequency.

Figure 6 shows a system for producing continuous oscillations.

Referring to the drawings generally, but more particularly to Figure 1, reference numeral 1 indicates an exhausted container consisting of glass or other convenient material and containing a filamentary cathode 2, which preferably should have considerable length, and is supported in the usual manner by the supports 2a and 2b.

3 and 4 are anodes consisting of conductive material, conveniently molybdenum or graphite, held in position by the supports 3a and 4a, and disposed at a small angle with respect to each other so as to provide a narrow angular opening for the electronic current emanating from the cathode 2. 5 is a deflector of electrons so designed as to enclose the filament on three sides, the opening thereof facing the angular opening formed by the two anodes. The preferred arrangement of the cathode 2, with respect to the deflector 5 and the anodes 3 and 4, is shown in Figure 1a. The filament 2 lies parallel to the anodes 3 and 4 and at or adjacent the angular opening formed by the said anodes.

The anodes and deflectors are insulated from each other by the insulating sheets 6, 6a, and 6b, consisting of any suitable insulating material, such as mica or glass.

In Figure 2 a cross-sectional view similar to Figure 1a is shown surrounded by the winding 7, the terminals of said winding being joined in series with the secondary winding 8, of the transformer T and the variable condenser 9. The antenna 10 is joined, thru the primary winding 11, to a ground 12 as in the usual receiving circuit. The filamentary cathode 2 is heated in the usual manner by the battery 13 to which it is connected by the parallel leads 14, the negative terminal of the said battery being connected to

the ground 12. The anodes 3 and 4 are joined to the terminals of the primary winding 15 of the transformer T1 by the parallel leads 18 and 19 respectively. The neutral point of the winding 15 of the transformer T1 is joined to the positive terminal of the battery 20 thru the lead 17. A detector or indicator of electric variations, 21, is connected in series with the secondary winding 16 of the transformer T1. A battery 22 has its positive terminal joined to the ground 12 and to the battery 13, the negative terminal of said battery 22 being connected to the deflector 5 thru the lead 23. The broken lines 24 indicate the distribution of the electronic current when no current is flowing in coil 7.

In Figure 3 is shown a modification comprising a plurality of elements, for increasing the efficiency of the apparatus, instead of a single element as shown in Figures 1, 1a, and 2. Three filamentary cathodes 2, 2a, and 2b, and four anodes, 3, 3a, 4 and 4a are shown but a greater or less number may be used. Each cathode is partially enclosed by a deflector as 5, 5a, and 5b. The cathodes may be heated in any desired manner. As shown they are joined in parallel to the battery 13 by the leads 14. The anodes 3 and 3a are joined together and to one end of the primary winding 15 of the transformer T3 by the lead 18 and the anodes 4 and 4a are likewise joined together and to the other end of said winding by the lead 19.

The deflectors 5, 5a, and 5b are joined in parallel and to the negative terminal of the battery 22. The anodes are insulated from each other and from the deflectors by the insulating sheets 6.

The three filamentary cathodes 2, 2a, and 2b lie parallel to the anodes 3, 3a, 4, 4a, and each cathode is positioned at or adjacent the opening between and at one side of a pair of anodes.

In all other respects Figure 3 is similar to Figure 2.

Figure 4 shows a modification in which one end of the secondary winding 8 of the transformer T4 is joined to the deflector 5 and the other end to the variable resistance 26 in parallel with the variable condenser 25, both of which are joined to the ground 12 and the negative terminal of the battery 13. The antenna 10 and the primary winding 11 being connected as in Figure 2. The connections of the primary winding 15 of the transformer T5 are likewise similar to the connections of the transformer T1 in Figure 2.

A further modification is shown in the connections of coil 7, said coil being connected in series with the variable condenser 27 and the winding 16 in inductive relation with the primary winding 15 of the transformer T5.

A further modification is the disposition of the conducting electrodes 30, 30a, and 30b between the insulating layers 6 and connected to the ground 12 by the lead 28c and a source of electrical variations.

The winding 31 connected in parallel with the detector 21, is in inductive relation with the winding 16 and the winding 29 connected in series with the lead 17 joining the winding 15 to the positive terminal of the battery 20.

At least one of the conducting sheets 30, 30a, and 30b may be connected directly to ground to stabilize stray capacities or through means interposed for impressing electric variations. Fig. 4 illustrates one possible arrangement wherein the

said conducting sheets are connected to a source of electric variations through the lead 28.

In Figure 5 is shown a modification consisting of three elements wherein the filamentary cathodes 2, 2a, and 2b are joined in series and to the battery 13 by the leads 14. The anodes 3 and 3a are joined in parallel and to one end of the primary winding 15 of the transformer T6 by the lead 18. The anodes 4 and 4a are likewise joined in parallel and to the other end of the said winding by the lead 19. The coil 7 is joined in series with the variable condenser 27 and the winding 35 in inductive relation with the winding 15 of the transformer T6. The terminals of the secondary winding 16 of the transformer T6 may be utilized for transferring electrical energy to other apparatus.

The deflector 5 is connected to one end of the secondary winding 16 of the transformer T7 by the lead 23A, the other end of the said winding being joined to the negative terminal of the battery 13 and the ground 12. In series with the primary winding 15, of the transformer T7, are interposed means 33 for generating alternating currents of any desired frequency and also means, such as a telegraph key 34, for varying the amplitude of the oscillations.

The deflectors 5a and 5b are connected in parallel and joined to one end of the secondary winding 16 of the transformer T8 by the lead 23B, the other end of said winding being joined to the negative terminal of the battery 13 and the ground 12. In series with the primary winding 15 of said transformer T8 are interposed means 33A for producing direct current and also means, such as a microphone 34A, for varying the amplitude of the said current.

While three elements are shown and two generators of alternating currents and means for modulating said oscillations in series therewith, a greater or less number of elements and generators with modulating means may be employed.

Another modification is illustrated in Figure 6, in which the elements are disposed in circular form. Each element is substantially arranged as shown in Figures 1, 1a and 2. The filamentary cathodes 2, 2a, 2b, and 2c may be heated in any desired manner. As shown they are joined in parallel to the battery 13 by the parallel leads 14. The anodes 3 and 3a are connected in parallel and to one end of the coil 7 by the lead 19. Likewise the anodes 4 and 4a are connected to the other end of the coil 7 by the lead 18. The numeral 38 indicates a variable condenser joined in parallel with the anodes and coil 7. The neutral point 39 of the coil 7 is joined to the positive terminal of the battery 20 by the lead 21.

The anodes 3b and 3c are joined in parallel and to one end of the primary winding 15 of the transformer T9 by the lead 40. The anodes 4b and 4c are likewise joined in parallel to one end of said winding by the lead 41. The neutral point of the said winding is joined to the positive terminal of the battery 20 by the lead 42. A variable condenser 43 is connected in parallel with primary winding 15. The secondary winding 16 of the transformer T9 may be joined to any apparatus to which it is desired to transfer energy.

While two groups of elements are shown with their anodes connected in parallel respectively and joined to the primary windings of two different transformers a greater or lesser number of groups may be used.

The term "element" as employed in my description and claims is intended to include a filamentary cathode, the two adjacent collector plates and the deflector associated therewith.

When assembled in a completed apparatus the deflector and the collector plates form closed channels, that is, channels closed except at the ends where the cathode filaments enter or leave the channels. With this construction there are no gaps where electrons can escape except at the ends.

The term "source of electrical variations" as employed in my description and claims is intended to include various sources of potential and/or electric pulsations varying in their time of duration and wave form.

The term "deflector" as employed in my description and claims is intended to include a conducting element, partially surrounding the filament, the potential of which, with respect to the filament, can be so varied that electrons impinge upon it or are deflected therefrom. If a magnetic material is used for said deflector the lines of force, comprising the magnetic field in the space immediately surrounding the cathode, will enter said deflector and thereby substantially eliminate the magnetic field in said space.

The operation of the apparatus is as follows, referring more particularly to Figures 1, 1a, and 2: when there is no current flowing in the coil 7, the electronic current from the filamentary cathode 2 is distributed as indicated by the dash lines 24. The potential of the deflector 5 being negative with respect to the cathode, due to the battery 22 interposed in the lead 23, the electrons projected from the cathode towards the said deflector are deflected from their course so that they enter the narrow converging channel formed by the anodes 3 and 4 in a narrow stream. The anodes and cathode being symmetrically disposed and the space occupied by the electrons being closed on all sides the said electrons are divided equally between the two anodes.

Since the deflection of the electronic current varies in accordance with the magnetic field and the velocity of the electrons emitted from the cathode for a particular field strength those having the slowest velocities will impinge upon an anode near the deflector, those having a greater velocity will impinge upon the anode at a correspondingly greater distance from the deflector, while some of the electrons having the highest velocities will impinge upon the anode near the end of the channel opposite the cathode.

If the magnetic field is too weak to deflect the electrons having high velocities, from one anode to the other during the reversal of the field a variable current may still be obtained due to the slow moving electrons reaching the narrow end of the channel where a small deflection will reverse their flow from one anode to the other. The sensitivity of the apparatus is therefore greatly increased by disposing the narrowest part of the channel at the greatest distance from the cathode. This particular feature of the operation of the apparatus results in advantages over apparatus previously used.

Since the number of electrons in the enclosed space is limited the strength of the output signals is limited to that obtained when all the electrons are reversed from one anode to the other during the reversal of the magnetic field. Therefore, if an undesired electric disturbance, such as a strong discharge of static electricity is received by the antenna 10 and a correspondingly

strong magnetic field is produced within the coil 7 the disturbance in the output circuit produced thereby cannot exceed that which is produced by a desired signal of sufficient intensity to reverse the flow of all electrons.

If it is desired to eliminate one half of an oscillation in the output circuit of the tube 1 the variable contact of the wire 17, Figs. 2 and 3, may be moved toward either the lead 18 or 19 of the transformer primary 15.

The operation of the structure shown in Figure 3 is similar to that shown in Figure 2. When the current in the coil 7 is in a clockwise direction the electronic currents from the cathodes 2 and 2B are deflected towards the anode 3A and the current from the cathode 2A is deflected toward the anode 3, as indicated by the broken lines 24, thereby, increasing the current in the lead 18 and decreasing the current in the lead 19 correspondingly.

When the current in coil 7 is in the counter-clockwise direction the electronic currents from the cathode 2 and 2A are deflected toward the anode 4 and the current from the cathode 2B is deflected toward the anode 4A thereby increasing the current in the lead 19 and decreasing it correspondingly in the lead 18. The variations in the current in the coil 7 will therefore, produce corresponding variations in, but amplified, in the primary winding 15 of the transformer T3 and are made manifest by means connected in series with the secondary winding 16 in the usual manner.

The lead 17 shown in Figs. 2 and 3 connected to the inductance 15 is variable and may of course be moved toward either end of this inductance until in or substantially in contact with either lead 18 or lead 19 to produce rectification by eliminating or reducing alternate half cycles of the alternating current.

In the structure shown in Figure 4 oscillations induced in the secondary winding 8 of the transformer T4, in the usual manner, are impressed upon the electronic current from the cathode 2 thru the medium of the deflector 5 by varying the potential thereof so that electrons are attracted towards it or deflected therefrom in accordance with the impressed electric variations. Said variations passing thru the leads 18 and 19, the primary winding 15 of the transformer T5, the lead 17, and the winding 29, coupled inductively to the winding 31, are thereby induced in the said winding. The secondary winding 16 of the transformer T5 in series with the coil 7 and the variable condenser 27, is likewise in inductive relation with the winding 15 and the winding 31. If the coil 7 is wound in a suitable direction energy will be transferred from the winding 15 to the winding 16 and alternating current will be produced in the oscillating circuit 7, 16, 27. When the frequency of the oscillatory circuit is so adjusted as to differ by a small amount from the frequency of the incoming electromagnetic wave a beat note will be produced in the winding 31 and can be made manifest by inserting a suitable detector in parallel therewith.

The lead 28 connecting the conducting sheets 30, 30a, and 30b in parallel may be connected directly to the ground for stabilizing stray capacities or through means interposed for impressing electric variations upon the said conducting sheets.

In Figure 5 the winding 35 in series with the coil 7 and variable condensers 27, is placed in

inductive relation with the primary winding 15 of the transformer T6. If the coil 7 is wound in a suitable direction an alternating current is produced, its frequency being determined by the natural period of the oscillatory circuit 7, 27, 35. By means of the secondary winding 16 of the transformer T6 the oscillations produced therein may be transferred to other apparatus.

Signals, such as are used in radio telegraphy or modulations of the voice, may be impressed upon said oscillations through the medium of the oscillations generated by 33 and 33A and modulated by 34 and 34A, respectively. For example, the oscillations generated by 33 are impressed upon the deflector 5 through the medium of the transformer T7 producing thereby corresponding variations in the potential difference between the said deflector and filamentary cathode 2 resulting in corresponding variations in the electronic current from the cathode 2.

Since the amplitude of the oscillations in the circuit 7, 27, 35 are proportional to the electronic current from the cathodes variations in the electronic current from one or more cathodes will produce corresponding variations in the oscillations transferred to the secondary winding 16 of the transformer T6. Simultaneously there may be impressed other modulations such as voice modulations by varying the amplitude of the direct current produced by the generator 33A by means of the microphone 34A connected in series therewith, said modulated oscillations being then impressed upon the electronic current from the cathodes 2A and 2B thru the medium of the transformer T8, the lead 23B and the deflectors 5A and 5B.

While only three discharge elements are shown and means for impressing one frequency modulated with telegraph signals, and another frequency modulated by speech or music, simultaneously or alternately on the frequency of the oscillating circuit 7, 27, 35, it is understood that a greater or smaller number of discharge elements and means for impressing a greater or smaller number of modulated frequencies upon the said carrier frequency may be used.

In the structure shown in Figure 6, the electronic current from each cathode is equally divided between the two anodes associated therewith when there is no current flowing in the coil 7, or when the electronic current from the anodes 3 and 3a flowing in a counter-clockwise direction, thru the winding 36-39 which comprises one-half of the coil 7, is equal to the electronic current from the anodes 4 and 4a and flowing in a clockwise direction thru the winding 37-39 which comprises the other half of the coil 7. If due to some irregularity, the current in one-half becomes greater or less than the current in the other half and the coil 7 is wound in a suitable manner continuous oscillations are produced. Their frequency being determined by the coil 7, the condenser 38 and other capacities in parallel therewith.

The magnetic field due to said oscillations will likewise deflect the electronic current from the cathode 2b and 2c toward one or the other of their respective anodes, thereby producing oscillations of like frequency in the circuit attached thereto, consisting of the leads 40 and 41, the variable condenser 43 and the winding 15 in parallel therewith. The oscillations produced therein may be transferred to other apparatus thru the medium of the transformer T9.

While this invention is disclosed in several dif-

ferent embodiments which are deemed desirable, it is to be understood that it is capable of embodiment in other modified forms and in different organizations without departing from the spirit of the invention and the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States, is,

1. Electron discharge device apparatus comprising an evacuated vessel, containing a cathode having a linear extension, a pair of positively charged anode plates disposed so as to form a narrow tapering channel for the stream of electrons emanating from the said cathode, a coil surrounding said anode plates, a deflector of electrons partially surrounding said cathode and closing the opening between said plates at the wider end of said channel and said plates being substantially in contact at the narrower end of the channel, and insulating means between the adjacent surfaces of the deflector and the plates at said wider end of the channel, and the surfaces of the plates at the narrower end.

2. Electron discharge device apparatus comprising an evacuated vessel, a plurality of cathodes in said vessel, a coil surrounding said cathodes, a plurality of deflectors, each partially surrounding one of said cathodes, a plurality of positively charged anode plates, said plates forming in conjunction with said deflectors a plurality of closed narrow tapering channels, each of said channels having a cathode passing therethru.

3. Apparatus as in claim 2 wherein the outer ones of said plurality of plates each form a wall of one channel and the intermediate plates each form a wall of two adjacent channels.

4. Apparatus as in claim 2 with conductors connecting the alternate positively charged plates in parallel forming two sets of connected plates, means for balancing the current from the two sets of plates and means for connecting the two sets of plates to said balancing means.

5. Apparatus as in claim 2 wherein the deflectors are joined together and to the cathodes with means interposed for varying the potential difference between said deflectors and their respective cathodes, and means for connecting said cathodes to a source of electrical energy.

6. Apparatus as in claim 2 with conductors connecting the alternate positively charged plates in parallel forming two sets of connected plates, means for balancing the current from the two sets of plates, means for connecting the two sets of plates to said balancing means, connecting means joining the deflectors together and also to said cathodes, means for varying the potential difference between said deflectors and their respective cathodes and means for connecting said cathodes to a source of electrical energy.

7. Electron discharge device apparatus comprising an evacuated vessel, containing a cathode having a linear extension, a pair of positively charged anode plates disposed so as to form a narrow tapering channel for the stream of electrons emanating from said cathode, a coil surrounding said anode plates, a deflector of electrons partially surrounding said cathode and closing the opening between said plates at the wider end of said channel, conducting electrodes interposed between the deflector and the adjacent ends of the anode plates and insulated therefrom, a conducting electrode between the anode plates at the narrow end of the channel and insulated therefrom, and means connecting said conducting electrodes.

8. Apparatus as in claim 7 wherein means are interposed in the conductor connecting the deflector to ground and said cathode for impressing electrical variations upon the electronic current and varying the potential difference between said deflector and cathode.

9. Apparatus as in claim 7 with an electrical conductor joining said conducting plates thru the walls of said vessel to external means for regulating the potential of said conducting plates.

10. Apparatus as in claim 7 wherein means are provided for connecting the two electrically separated anode plates thru the walls of said vessel to a source of electrical potential for producing positive charges on said anode plates and windings in series therewith for transferring electrical energy to adjacent windings by induction.

11. Apparatus as in claim 7 including an oscillatory circuit coupled to said coil and an auxiliary circuit coupled to said oscillatory circuit for producing sustained oscillations in the oscillatory circuit.

12. Apparatus as in claim 2 including an oscillatory circuit coupled to said coil, an auxiliary circuit coupled to said oscillatory circuit for producing sustained oscillations in the oscillatory circuit and means for transferring said oscillations to other apparatus.

13. Apparatus as in claim 2 including electrical conductors and means, in series therewith connecting said deflectors to their respective cathodes, for impressing modulated high frequencies upon the electronic current emanating from said cathodes.

14. Electron discharge device apparatus comprising an evacuated vessel, a plurality of cathodes in said vessel, a coil surrounding said cathodes, a plurality of deflectors, each partially surrounding one of said cathodes, a plurality of electrically separated positively charged anode plates, said deflectors forming in conjunction with said anode plates a plurality of closed narrow tapering channels each of said channels having a cathode passing therethru, and means insulating said adjacent channels from each other.

15. Apparatus as in claim 14 including an oscillatory circuit and means in inductive relation therewith for receiving electrical variations, a coil of said oscillatory circuit including a coil so arranged as to impose the magnetic field due to electrical variations therein, at right angles to the electronic currents from the plurality of cathodes.

16. Apparatus as in claim 14 including a plurality of pairs of electrical conductors a pair of said conductors joining each of the pairs of anode plates associated with a cathode, said conductors passing thru a wall of said vessel, an oscillatory circuit connected to each of said pairs of conductors and means in inductive relation with each of the oscillatory circuits for transferring energy to other apparatus.

17. In an alternating current generator, having in combination an evacuated vessel, a plurality of cathodes in said vessel, circularly arranged about the axis of said vessel, a coil surrounding said cathodes, a plurality of deflectors connected together, each partially surrounding one of said cathodes, a plurality of positively charged anode plates, said anode plates forming in conjunction with said deflectors a plurality of closed narrow tapering channels, each of said channels having a cathode passing therethru, the adjacent channels being insulated from each other by sheets of insulating material.

18. An apparatus as in claim 17 including, an oscillatory circuit comprising a variable condenser, a coil so disposed as to impose a magnetic field upon the electronic currents emanating from said cathodes means joining said oscillatory circuit to a plurality of anode plates and a source of electrical energy joined to said coil whereby sustained electrical oscillations are produced in said oscillatory circuit.

19. An apparatus as in claim 17 including an oscillatory circuit, comprising a variable condenser, a coil arranged to impose a magnetic field upon the electronic currents emanating from said cathodes, means joining said oscillatory circuit to a plurality of alternate anode plates, a source of electrical energy joined to said coil whereby sustained electrical oscillations are produced in said oscillatory circuit, conductors connecting the remaining anode plates in parallel, said conductors passing thru a wall of said vessel and means outside of said vessel for transferring energy said means being connected to said conductors.

20. An electron discharge device including a pair of elongated anode plates, an insulation member disposed between a pair of adjacent longitudinal edges of said plates for substantially insulating said plates from each other and for substantially closing the opening between said plates along said edges, a cathode positioned between said anode plates adjacent to the other longitudinal edges thereof and a coil of wire wound around said plates for setting up a magnetic field for controlling the movement of electrons emitted from said cathode between said anode plates.

21. An electron discharge device including a pair of anode plates disposed in spaced relation with respect to each other to form the major portions of two sides of a substantially triangular prism, a shield member having a slight curvature, said member forming the other side of said prism, insulating means positioned between adjacent edges of said shield member and said anode plates, a cathode positioned between said anode plates adjacent to said shield member, and a coil of wire encircling said anode plates for controlling the flow of electrons from said cathode between said anode plates.

22. An electron discharge device including a pair of elongated anode plates positioned adjacent to each other and forming an elongated channel therebetween, a shield electrode positioned parallel to said anode plates in spaced relation thereto, insulating means positioned between a pair of adjacent edges of said anode plates for spacing said plates, a cathode extending parallel to said shield electrode and positioned to emit electrons into the space between said anode plates, means for maintaining said shield at a negative potential with respect to said cathode and a coil of wire encircling said anode plates for setting up a magnetic field for controlling the direction of flow of electrons emitted from said cathode.

23. An electron discharge device including a pair of elongated anode plates positioned side by side, and gradually converging toward each other, insulating spacing means positioned between adjacent edges of said anode plates, a cathode positioned between said plates adjacent to the mouth of said converging plates and a coil of wire encircling said plates.

24. An electron discharge device including a pair of elongated anode plates positioned adjacent to each other and forming an elongated

channel therebetween, a shield electrode positioned parallel to said anode plates in spaced relation thereto, insulating means positioned between a pair of adjacent edges of said anodes
 5 for spacing said anodes, a cathode extending parallel to and within said shield electrode and positioned to emit electrons into the space between said anode plates, means for maintaining said shield at a negative potential with respect to said
 10 cathode and a coil of wire encircling said anode plates for controlling the direction of flow of electrons emitted from said cathode.

25. In electron discharge device circuit arrangements the combination of an evacuated vessel having a plurality of electrodes including a cathode, a shield electrode positioned adjacent to said cathode, a pair of anodes, means for impressing signaling energy upon the said shield electrode and said cathode, a coil positioned
 20 around said evacuated vessel for controlling the flow of electrons between said cathode and said anodes, impedance means for coupling said anodes together, means for coupling said impedance means to said coil, means for energizing said
 25 anodes through the circuit of said impedance means and for coupling said impedance means to the circuit of said cathode, said coupling between said coil and said impedance means being adjusted to impress signal impulses upon the
 30 circuit of said coil.

26. In electron discharge device circuit arrangements the combination of an evacuated vessel having a plurality of electrodes including a cathode, a shield electrode positioned adjacent to
 35 said cathode, a pair of anodes, means for coupling said anodes, a source of current supply connected between said anode coupling means and said cathode, means for impressing signaling energy upon the circuit of said cathode and
 40 said shield electrode for varying the electron stream between said cathode and said anodes in accordance with said signal, a coil surrounding said electrodes, means for adjusting the frequency characteristics of said coil and means for coupling
 45 the circuit of said coil to said anode coupling means.

27. In electron discharge device circuit arrangements the combination of an evacuated vessel having a plurality of electrodes including a cathode, a shield electrode and a pair of anodes,
 50 a coil surrounding said electrodes, a transformer having a plurality of windings coupled together, one of said windings being connected to said coil, another of said windings being connected to said anodes, a source of current supply connected to said last mentioned winding and to said cathode and means for impressing signaling energy upon said cathode and said shield electrode.

28. Electron discharge device apparatus including an electron discharge device having a pair of elongated anode plates, an insulation member disposed between a pair of adjacent longitudinal edges of said plates for substantially insulating said plates from each other and for
 60 substantially closing the opening between said plates along said edges, a cathode positioned between said anode plates adjacent to the other longitudinal edges thereof and a coil of wire wound around said plates for setting up a magnetic field for controlling the movement of electrons emitted from said cathode between said
 70 anode plates, an antenna circuit connected to said coil of wire, means for connecting said antenna circuit to said cathode, means for coupling said anodes to said cathode, indicating means

and means for connecting said indicating means to at least one of said anodes.

29. Electron discharge device apparatus including an electron discharge device having a pair of anode plates disposed in spaced relation with
 5 respect to each other to form the major portions of two sides of a substantially triangular prism, a shield member having a slight curvature, said member forming the other side of said prism, insulating means positioned between adjacent edges
 10 of said shield member and said anode plates, a cathode positioned between said anode plates adjacent to said shield member, and a coil of wire encircling said anode plates for controlling the flow of electrons from said cathode between said
 15 anode plates, an antenna circuit connected to said coil of wire, means for connecting said antenna circuit to said cathode, means for coupling said anodes to said cathode, indicating means and means for connecting said indicating means
 20 to at least one of said anodes.

30. Electron discharge device apparatus including an electron discharge device having a pair of elongated anode plates positioned adjacent to each other and forming an elongated channel
 25 therebetween, a shield electrode positioned parallel to said anode plates in spaced relation thereto, insulating means positioned between a pair of adjacent edges of said anode plates for spacing said plates, a cathode extending parallel to said
 30 shield electrode and positioned to emit electrons into the space between said anode plates, means for maintaining said shield at a negative potential with respect to said cathode and a coil of wire encircling said anode plates for setting up a
 35 magnetic field for controlling the direction of flow of electrons emitted from said cathode, an antenna circuit connected to said coil of wire, means for connecting said antenna circuit to said cathode, means for coupling said anodes to said
 40 cathode, indicating means and means for connecting said indicating means to at least one of said anodes.

31. Electron discharge device apparatus including an electron discharge device having a pair of elongated anodes positioned side by side and gradually converging toward each other, insulating
 45 spacing means positioned between adjacent edges of said anodes, a cathode positioned between said anodes adjacent to the mouth thereof, a coil of wire encircling said anodes, an antenna circuit connected to said coil of wire, means for connecting said antenna circuit to said cathode, means for coupling said anodes to said cathode, indicating means and means for connecting said indicating means to at least one of said anodes.

32. Electron discharge device apparatus including an electron discharge device having a pair of elongated anode plates positioned adjacent to each other and forming an elongated channel
 60 therebetween, a shield electrode positioned parallel to said anode plates in spaced relation thereto, insulating means positioned between a pair of adjacent edges of said anodes for spacing said anodes, a cathode extending parallel to and within
 65 in said shield electrode and positioned to emit electrons into the space between said anode plates, means for maintaining said shield at a negative potential with respect to said cathode and a coil of wire encircling said anode plates for
 70 controlling the direction of flow of electrons emitted from said cathode, an antenna circuit connected to said coil of wire, means for connecting said antenna circuit to said cathode, means for coupling said anodes to said cathode, indicating means

indicating means and means for connecting said indicating means to at least one of said anodes.

33. An electron discharge device including a pair of elongated anode plates positioned side by side, and gradually converging toward each other, insulating spacing means positioned between adjacent edges of said anode plates, a cathode positioned between said plates adjacent to the mouth of said converging plates, a coil of wire encircling said plates, and means for impressing signal energy on said coil of wire for directing the electrons emitted by said cathode to one or both of said anodes in accordance with the magnetic field set up by the signal currents, the said anodes, cathode, and coil of wire being arranged to limit the effective intensity of undesired electrical disturbances not to exceed that of the desired signal.

34. An electron discharge device according to claim 33 including electrodes between said anode

plates and said cathode and a source of electrical energy connected between said last mentioned electrodes and said cathode.

35. An electron discharge device according to claim 23 including electrodes between said anodes and said cathode and a source of electrical energy connected between these electrodes and said cathode.

36. An electron discharge device according to claim 24 including electrodes between said anodes and said cathode and a source of electrical energy connected between these electrodes and said cathode.

37. An electron discharge device according to claim 20 including electrodes between said anodes and said cathode and a source of electrical energy connected between these electrodes and said cathode.

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