Nov. 2, 1926. 1,604,986

W. E. GARITY

ALTERNATING CURRENT GENERATOR

Filed Oct. 7, 1921 2 Sheets-Sheet 1

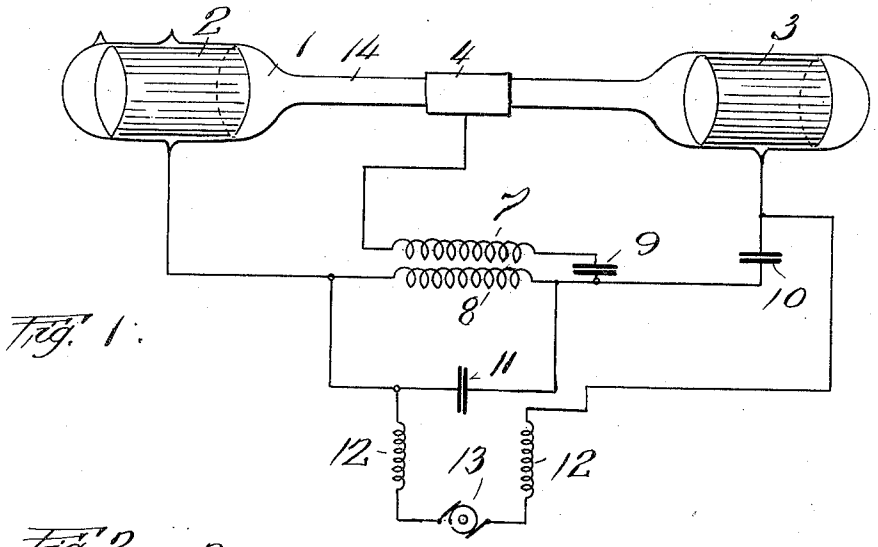


Fig. 1.

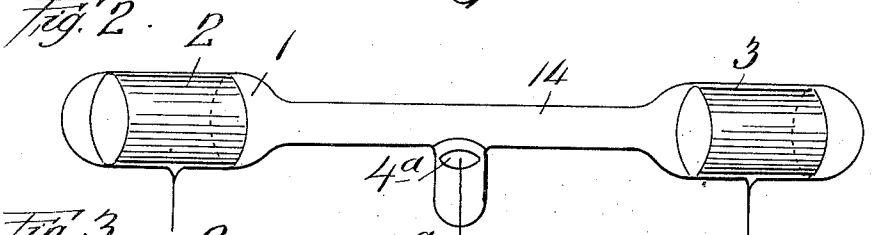


Fig. 2.

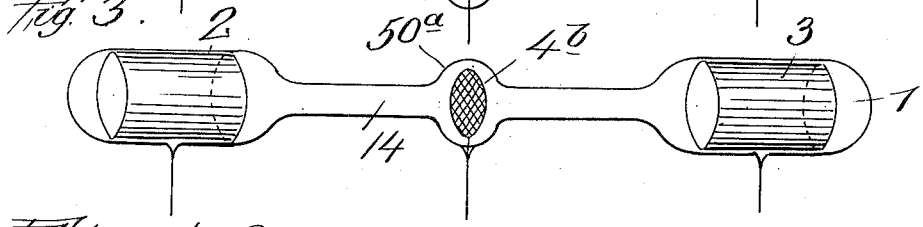


Fig. 3.

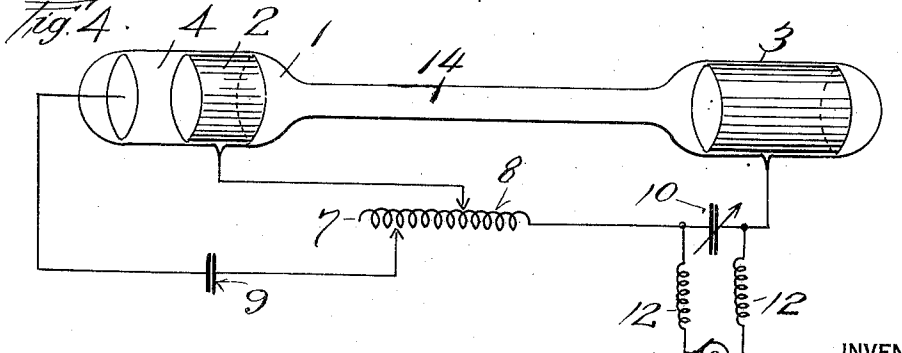


Fig. 4.

INVENTOR

William E. Garity

BY his ATTORNEYS Darby & Darby

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Fig. 5.

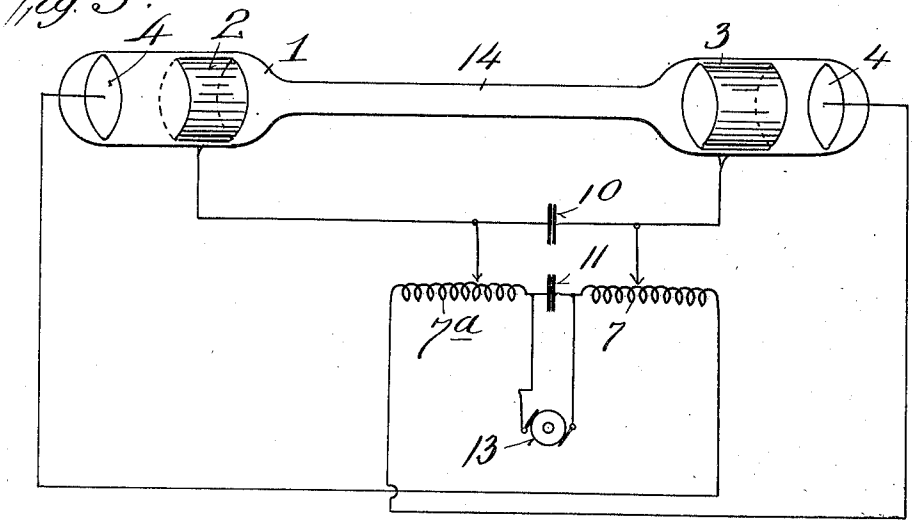
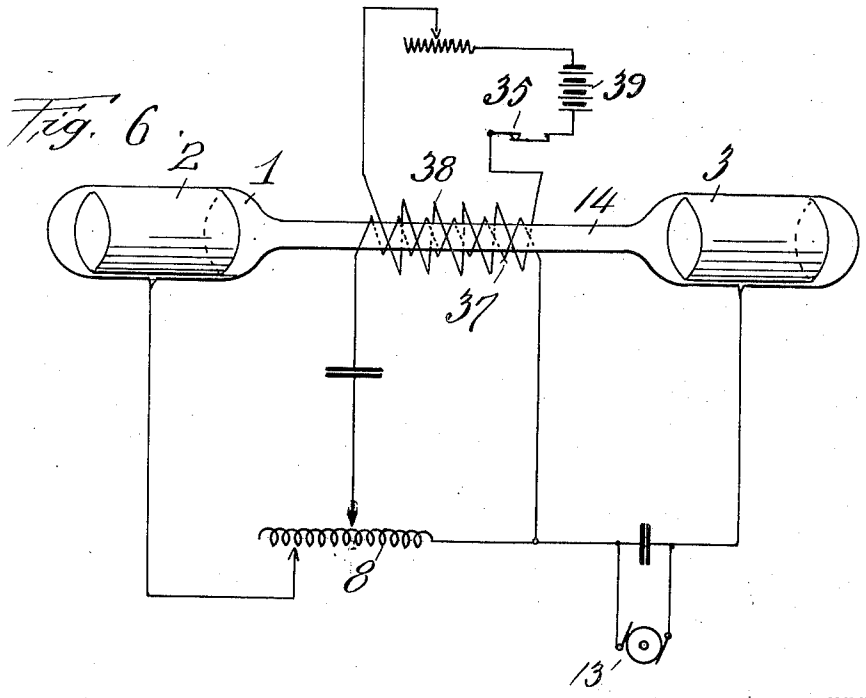


Fig. 6.



INVENTOR

William E. Garity

BY his ATTORNEYS Darby & Darby

Patented Nov. 2, 1926. 1,604,986

UNITED STATES PATENT OFFICE.

WILLIAM E. GARITY, OF NEW YORK, N. Y., ASSIGNOR TO DE FOREST RADIO TELEPHONE AND TELEGRAPH COMPANY, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE.

ALTERNATING-CURRENT GENERATOR.

Application filed October 7, 1921. Serial No. 505,969.

This invention relates to means for generating alternating currents, and more particularly to sustain high frequency oscillating currents.

The object of the invention is to provide means which are simple in structure, highly efficient in operation, and economical of manufacture, for generating alternating currents, by means of the so-called photion or spaced electrode light series tube.

Further objects of the invention will appear more fully hereinafter.

The invention consists substantially in the construction, combination, location, and relative arrangement of parts, all as will be more fully hereinafter set forth as shown by the accompanying drawings, and finally pointed out in the appended claims.

Referring to the drawings,—

Fig. 1 is a diagrammatic view of an alternating current generator system embodying my invention.

Figs. 2 and 3 are views in elevation of a modified structure of evacuated vessel employed in connection therewith.

Fig. 4 is a diagrammatic view illustrating a still further modified arrangement employed in accordance with my invention.

Figs. 5 and 6 show still further modified arrangements.

The same part is designated by the same reference numeral wherever it occurs throughout the several views.

In the so-called photion tube, especially where the central portion is constricted, exists a conducting column of gas which carries a considerable current between the cold electrodes at from five hundred to one thousand volts, provided the gas pressure is such as to give the maximum conductivity, preferably from 0.2 to 5.0 millimeters of mercury pressure. This column of conducting gas is extremely sensitive to electrostatic or electromagnetic influences when applied to the control electrodes positioned either on the outside or the inside of the tube, and at various points thereon, particularly at its narrow or constricted portion, or at either end away from the two main electrodes which are conducting the current through the tube. Referring to the drawings, reference numeral 1 designates the glass tube containing therein attenuated gas, for example, hydrogen, ordinary air, or the like. 2 and 3 represent the main or current supply electrodes, preferably located near either end of the tube, and preferably, but not necessarily, in the form of open ended cylinders of suitable metal, such as nickel, molybdenum, tungsten, etc., and freed of gas, and thoroughly clean. The respective electrodes 2 and 3 are enclosed within the enlarged portions of the tube which are connected together by the neck portion 14, which preferably, but not necessarily, is of constricted cross section. Reference numeral 4 designates the control electrode, which may be, as in Fig. 1, a simple cylinder on the outside of the middle portion of the tube, or in the form of a disk, or the like, 4^a, located in a pocket 50 blown in the tube, as in Fig. 2, or as in Fig. 3, this electrode may be in the form of a grid or mesh 4^b, positioned transverse to the axis of the tube, and preferably in a slightly enlarged portion 50^a thereof at its center, or the control electrode 4 may be located at either or both ends of the tube beyond the main electrode or electrodes as shown in Fig. 5.

The constricted portion 14 of the tube acts to concentrate the discharge path or beam between the electrodes 2 and 3, thus increasing the internal resistance of the tube, but aiding (by means of an effect analogous to the so-called "pinch" effect) in the tendency of the gas discharge to be interrupted or reduced at desired intervals.

If now such a discharge tube as herein shown be connected across a suitable source of high tension either direct current or alternating current, but preferably direct current such as illustrated at 13, Fig. 1, then a steady passage of current therethrough is produced. If a circuit containing suitable inductance and capacity be connected to the main electrodes, oscillations or periodic fluctuations in the discharge through the gas column may be set up (as is well known, for example in connection with Geissler tubes). The period of such oscillations or pulsations depends in large measure on the amount of inductance and capacity in the said attached circuit, but also to a certain degree on the length, diameter, pressure, and nature of the gas column. Such electric oscillations or pulsations, old in the art,

are, however, exceedingly feeble and unreliable in nature, particularly if their frequency be made high. I have found however that if a third or control electrode be provided as herein shown, which control electrode is suitably connected to a proper point in the oscillation circuit, then if at certain instances in the oscillation cycle a sufficiently high transient E. M. F. is applied to said control electrode, the tendency of the direct current in the gas to more or less interrupt itself is very greatly aided, with the result that the fluctuating or pulsating tendency is aided. Thus in Fig. 1 an oscillation circuit consisting of the inductance 8 and the capacity 11 is connected across the two main electrodes 2 and 3 of the discharge tube. In this circuit I prefer to employ a stopping condenser 10, preferably of relatively large capacity, and to connect in the leads of the current source 13 choking or inertia coils 12. The control electrode 4 in this case is connected to one end of a "voltage multiplier" coil 7, which may be advantageously inductively associated with the coil 8. The other end of the coil 7 is preferably connected to one terminal or point on the coil 8, either directly or through a condenser 9.

In Figs. 2 and 3, the control electrode 4 located on the inside of the tube acts in the same way to cut off more or less completely at proper points in the cycle, the flow of current through the gas column. In Fig. 4 the control electrode 4 is placed at one end of the tube outside of the path of discharge between the two main electrodes 2 and 3, and is connected to one or the other of the terminals of the oscillating circuit, either directly or through the voltage multiplier coil 7, which is preferably a continuation of the main oscillating coil 8. In this case a stopping condenser 9 is inserted in the lead to the electrode 4 to insure against the main discharge from passing directly between the control electrode 4 and the main electrode 2 nearest thereto. This is important where the control electrode, as will ordinarily be the case, is connected externally to the more remote of the two main electrodes. In Fig. 5 I employ two control electrodes 4, and each of these is connected through a voltage multiplier or "phase retardation" coil to that one of the main electrodes lying furthest therefrom. In Fig. 4 the oscillation circuit comprises the inductance 7, 8, the condenser 10, and the gas discharge path through the tube, all in series with each other.

I find that with the arrangements of rarified gas discharge path, oscillating circuits and control electrodes above described, continuous oscillations of constant amplitude of high frequencies suitable for use in radio telegraph and telephone transmitters, and capable of generating or converting relatively large amounts of direct electrical energy into alternating electrical energy is afforded. Such arrangements have a very great advantage over all thermionic tube devices in that no energy is wasted in heating the filament or cathode and the life of the tube is indefinite as against a very limited length of life of such filament tube. Where large power is thus converted the tube become excessively hot especially in its constricted portion, and I prefer therefore to make the same, or at least the central or constricted portion thereof, of quartz-glass, or silica, which can withstand a very high temperature without softening or becoming semi-conducting, and furthermore, if desired, any suitable means for cooling the tube or its central portion well known in the art such as immersion in water, oil, or by air blast, may be utilized.

In Fig. 6 I have shown a method of control of the gas conducting column by electromagnetic as distinguished from electrostatic means. Here I surround the central portion 14 of the tube, or a portion thereof, with a coil of wire 37, which is in circuit, either directly or by association, with the oscillating discharge circuit. A current through coil 37 will greatly concentrate or discharge the normal distribution of the ionized current conducting gas in the tube, and if such current be applied at the proper part of the oscillation cycle, the resistance of the gas path to the current flowing therethrough will be greatly increased. In addition to this coil 37 carrying an oscillating or periodic current there may be employed an additional coil 38. Also surrounding the tube and through which passes a direct current from any suitable source, as for example, from a battery 39 or other low frequency source, which current is so regulated that the conducting gas column in the tube is brought to a more critical or less stable condition, whereby it is much more readily interrupted or controlled by the pulsating currents passing through the coil 37 or by the pulsating E. M. F's. applied to the control electrode, as for example, in Fig. 1. I may then place my key, switch, or other suitable signal control device, diagrammatically illustrated in Fig. 5, in this auxiliary circuit. Otherwise I prefer to control the signal generation by placing my key, microphone, or other signaling device in the circuit to the control electrode or associate it with such circuit in a manner similar to that now well known in the oscillating or oscillion art.

Many modifications and changes in details will readily occur to those skilled in the art without departing from the spirit and scope of my invention as defined in the claims, but having now set forth the objects and nature of my invention, and having shown and described various structures embodying the

principles thereof, what I claim as new and useful and of my own invention and desire to secure by Letters Patent is,—

1. Means for generating sustained alternating currents comprising a vessel containing therein two separated cold electrodes, a current source for continuously causing a flow of current between said cold electrodes, and means for causing variations in the flow of current between said cold electrodes, and an oscillating circuit connected between said cold electrodes, said oscillating circuit being independent of said current source so that the varying current generated does not pass through said source.

2. Means for generating sustained alternating currents comprising a vessel containing therein two separated cold electrodes, with a gaseous conducting space therebetween, a current source for causing a continuous flow of current between said electrodes, and means for causing variations in the flow of current between said electrodes, and an oscillating circuit connected between said electrodes, said oscillating circuit, being independent of said current source.

3. Means for generating sustained alternating currents comprising a vessel containing therein two separated cold electrodes, with a sectionally restricted conducting space therebetween, means for causing a continuous flow of current between said electrodes, and means for causing variations in the flow of current between said electrodes, and an oscillating circuit connected between said electrodes.

4. Means for generating sustained alternating currents comprising a vessel containing therein two separated cold electrodes, a current source for continuously causing a flow of current between said cold electrodes, and means including a control electrode for causing variations in the flow of current between said electrodes, and an oscillating circuit connected to all of said electrodes, said oscillating circuit being independent of said current source so that the varying current generated does not pass through said source.

5. Means for generating sustained alternating currents comprising a vessel containing therein two separated cold electrodes, with a gaseous conducting space therebetween, a current source for causing a continuous flow of current between said electrodes, and means including a control electrode for causing variations in the flow of current between said electrodes, and an oscillating circuit connected to all of said electrodes, said oscillating circuit being independent of said current source so that the varying current generated does not pass through said source.

6. Means for generating sustained alternating currents comprising a vessel containing therein two separated cold electrodes, with a sectionally restricted conducting space therebetween, means for causing a continuous flow of current between said electrodes, and means including a control electrode for periodically disturbing the flow of current between said electrodes, and an oscillating circuit connected to all of said electrodes.

7. Means for generating sustained alternating currents comprising a vessel containing therein two separated cold electrodes, with a sectionally restricted conducting space therebetween, means for causing a continuous flow of current between said electrodes, and means including a control electrode positioned adjacent the sectionally restricted portion of the said conducting space between the electrodes for periodically disturbing the flow of current between said electrodes, and an oscillating circuit connected to all of said electrodes.

8. Means for generating sustained alternating currents comprising a vessel containing therein two separated cold electrodes with a sectionally restricted conducting space therebetween, means for causing a continuous flow of current between said electrodes, and means including a control electrode positioned adjacent the restricted portion of the said conducting space and within the vessel for periodically disturbing the flow of current between said electrodes, and an oscillating circuit connected to all of said electrodes.

9. Means for generating sustained alternating currents comprising a vessel containing therein two separated cold electrodes with a gaseous conducting space therebetween, a current source for causing a continuous flow of current between said electrodes, and means including a control electrode enclosed within said vessel for periodically disturbing the flow of current between said electrodes, and an oscillating circuit connected to all of said electrodes, said oscillating circuit being independent of said current source so that the varying current generated does not pass through said source.

In testimony whereof I have hereunto set my hand on this 30th day of September, A. D. 1921.

WM. E. GARITY.