May 12, 1931. T. C. RIVES 1,805,187

APPARATUS FOR AND METHOD OF EXCITING ELECTRICAL OSCILLATIONS

Filed June 20, 1927

Fig. 1.

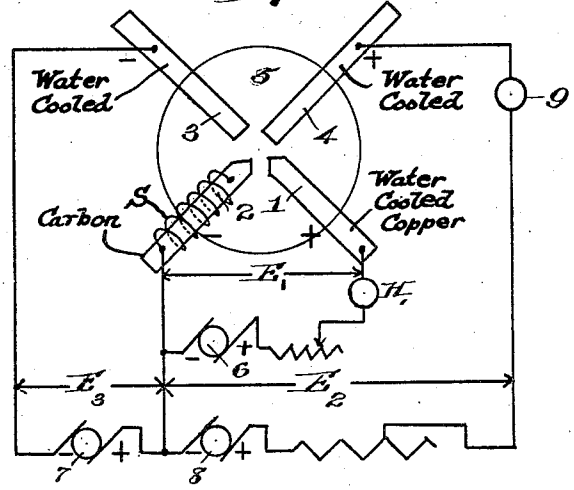
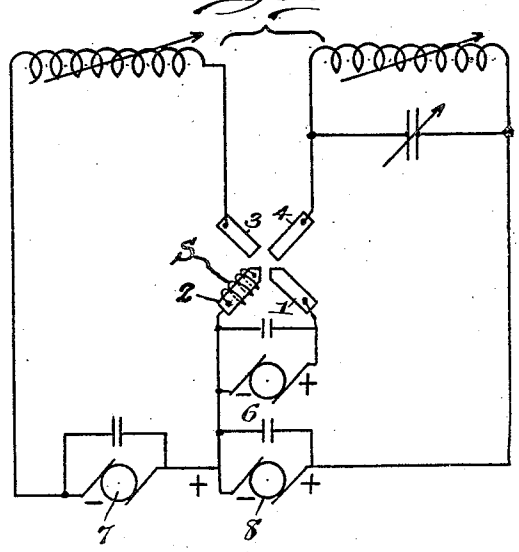


Fig. 2.



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APPARATUS FOR AND METHOD OF EXCITING ELECTRICAL OSCILLATIONS

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This invention relates in general to radio telegraphy and telephony, and more particularly to an apparatus for and a method of exciting high frequency electrical oscillations.

An object of my invention is to replace the conventional three-electrode vacuum tube particularly in transmitting circuits with a four electrode arc in order to provide in a high degree of perfection uniform oscillations by means of a simple, economical, and continuously reliable apparatus of long life and applicable to various uses.

With the foregoing and other objects in view the invention consists in the combination of parts and in the details of construction hereinafter set forth, certain embodiments thereof being shown in the accompanying drawings, in which:

Fig. 1 is a diagrammatical showing of the four-electrode arc with an accompanying circuit.

Fig. 2 is a diagrammatical showing of my device as applied to a transmitting circuit.

Referring more particularly to the drawings, there is provided an arc chamber 5 for containing the four electrodes 1, 2, 3, and 4. Electrodes 1 and 2 are the electrodes of the arc itself and should be of suitable materials, such as carbon for 2 and water cooled copper for 1. Electrodes 3 and 4 are the control electrodes and should be made of any suitable material, preferably water cooled to enable them to withstand the heat of the arc between electrodes 1 and 2 and also to assist in the operation of the device by preventing either of them reaching such a temperature as will allow of its giving off electrons and thus possibly becoming the cathode of an arc. Generators 6, 7 and 8, although not a part of the device are shown to assist in explaining its operation. They supply the electric energy to the device and it is assumed that their voltage may be varied at will.

Now if an arc is struck between electrodes 1 and 2, it will be maintained by a generator 6 which is generating a suitable potential E_1. Let electrode 1 be at a positive potential with respect to electrode 2. Let the voltage E_3 of generator 7 and the voltage E_2 of generator 8 be zero at the start. Now let the voltage E_2 of generator 8 be increased making electrode 4 positive with respect to electrode 2. When a suitable value is reached, a part of the electrons composing the current stream in the arc between electrodes 1 and 2 will be attracted to electrode 4 by reason of the electro-static strain set up between electrodes 2 and 4. An appreciable amount of current can be caused to flow to electrode 4 and through ammeter 9, generator 8 and through electrode 2 and back to 4 before the arc is actually broken between electrodes 1 and 2 and set up between electrodes 2 and 4. When the potential of generator 8 has been adjusted to such a value that a suitable stable current is flowing to electrode 4 and thus through its attendant circuit, the potential of generator 7 may be adjusted making electrode 3 negative with respect to electrode 2, thus setting up an electro-static strain, that, due to the geometry of the device and the polarity and strength of the respective potentials on electrodes 3 and 4, tends to neutralize the electro-static strain caused by the positive potential on electrode 4. This tends to reduce the electron flow of electrode 4 and thru its attendant circuit. If electrode 4 is maintained at a constant positive potential and the negative potential of electrode 3 varied thru certain limits, there will be a corresponding variation of current thru electrode 4 and its attendant circuit. The potential of electrode 3 can be made so highly negative that no current will flow thru electrode 4 and if still further increased, the arc between electrodes 1 and 2 may be blown out. This current flow to electrode 4 and thru its circuit is and will always remain unilateral, since if electrode 4 becomes negative its consequent electro-static field will tend to repel the negative electrons and there will be no current flow until electrode 4 again becomes positive with respect to electrode 2.

If electrodes 1 and 4 are located approximately the same distance from electrode 2 and both are at approximately the same potential with respect to electrode 2, the arc will tend to divide between electrodes 1 and 4 and an equal amount of current flow thru

each. There is no tendency for the arc to break between electrodes 1 and 2 and start between electrodes 1 and 3 due to the fact that it is nearly impossible to transfer an arc from one negative electrode to another, while it is relatively easy to transfer an arc from one positive electrode to another. For like reasons there will never be an arc between electrode 3 and any of the other electrodes since it is negative with respect to all of them. Particularly will this be true if electrodes 1, 3, and 4, are kept at a low temperature by some cooling system since the negative electrode must be at a high enough temperature to give off electrons before it will support the arc.

To secure stable operation of this device, it may be necessary to install some form of magnetic field that will tend to keep the arc playing between or on electrodes 1 and 4. A solenoid wound around electrode 2 as a center would tend to have this effect. Such a winding is shown at S, Fig. 1 and Fig. 2, connected in series with the arc and its generator.

From the foregoing it will be seen that there has been provided a device very similar in action to the three electrode tube. The arc between electrodes 1 and 2 is the electron supplying device just as the filament of the tube, electrode 3 plays a part similar to the grid of the tube and electrode 4 acts in a manner similiar to the plate of the tube.

It is anticipated that the materials of which the electrodes are made and the atmosphere of the arc chamber will both play a large part in the successful operation of this device, but the present invention is not limited to any specific materials.

The action of this device clearly demonstrates that it may be used in transmitting circuits similar to those now used with the three electrode vacuum tube. Such a circuit arrangement is shown in Figure 2. By means of my device, radio frequency currents can be set up and maintained in such a circuit. The device is of great value as it offers a cheap substitute for the large and expensive vacuum tubes used in transmitting circuits at the present. The life of the large tubes is to a large extent dependent upon the life of the filament and in this device the filament has been replaced by an arc between electrodes which may be replaced at will from inexpensive materials.

I claim:

1. An apparatus for producing electrical oscillations comprising in circuit an arc chamber inclosing a pair of arcing electrodes, variable voltage supply means therefor, a pair of control electrodes arranged in said chamber in spaced and opposed relation to said arcing electrodes each of said opposed electrodes being of opposite polarity and having variable voltage supply means therefor, whereby said control electrodes are adapted to attract, repel, and thus regulate the electron flow caused by the arcing of said arc electrodes in accordance with the variance of voltages applied to the various electrodes, and means for automatically discontinuing current flow in the control electrodes upon the blowing out of said arc electrodes.

2. A means for generating controlled electrical oscillations including a pair of arcing electrodes, a positively charged electrode positioned opposite the negative electrode of said arcing electrodes, the charge in said positive electrode being sufficient to cause a strong electronic flow thereto, and a variably negatively charged electrode positioned opposite the positive electrode of said arcing electrodes said negatively charged electrode regulating the electronic flow between the aforementioned negative arcing electrode and said positive electrode by increasing the electronic attraction of said positive arcing electrode.

3. The method of generating controlled electrical oscillations consisting in creating an electrical arc, applying a positive charge to the cathode of the arc causing an electronic flow, applying a variable negative charge to the anode of the arc causing an increase in the electronic flow between the cathode and anode of the arc and a consequent diminishing of the electronic flow created by the positive charge applied to the cathode of the arc all depending on the strength of the said variable negative charge, and applying the electronic flow created by the positive charge to a circuit capable of supporting an oscillating current.

In testimony whereof I affix my signature.

TOM C. RIVES.