

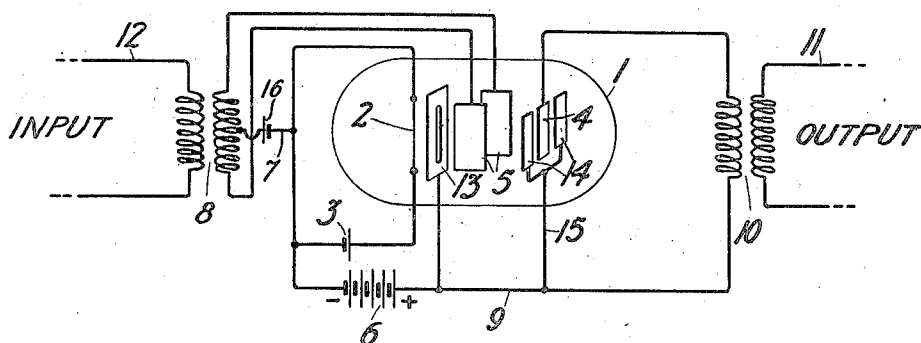
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SPACE DISCHARGE SYSTEM

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UNITED STATES PATENT OFFICE.

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SPACE DISCHARGE SYSTEM.

Application filed September 30, 1918. Serial No. 256,238.

This invention relates to space discharge devices responsive to alternating currents and is an improvement upon the means shown in the applicant's U. S. Patent No. 1,180,043, granted March 2, 1915.

An object of this invention is to provide means for reducing difficulties of operation of the device by limiting or concentrating into a small area the ionic or electronic stream which is produced between a cathode and an anode.

A further object is to provide means for eliminating troubles due to stray electrons.

More general objects are the provision of novel means of general application in electron discharge devices whereby novel methods of utilizing such devices may be practiced.

The invention will be fully understood by reference to the following specification and the accompanying drawing wherein a thermionic device and a system of circuits therefor, which embody the invention, are diagrammatically shown.

In an evacuated vessel 1 is placed an electron producing cathode 2 of any suitable form, but herein illustrated as a filament heated by a battery 3. Also included in the evacuated vessel is the anode 4 and the deflecting electrodes 5.

Connected between the cathode 2 and anode 4 is a source 6 which may be any suitable device such as a battery which will furnish a suitable negative potential to the cathode 2 with respect to the anode 4. A conductor 7 passes from the cathode to the midpoint of a coil 8, whose terminals are respectively connected to the deflecting electrodes 5 which constitute control elements or means. A conductor 9 extends from the anode 4 to the positive terminal of the source 6 and contains a coil 10. Coupled to the coil 10 is an output line 11, and, to the coil 8, an input line 12. So far as has been described the apparatus is similar to that in the patent referred to above. It will be seen that alternating voltages supplied through the input line will produce alternations of double frequency in the output line.

It has been found, however, that ions or electrons passing from the cathode 2 to the electrode 4 tend to be too much dispersed. To overcome this difficulty it is proposed to employ a screening or directing or focusing

element to limit the cross-sectional area of the stream of electrons.

In the form herein shown this function is performed by the electrode 13, which consists of a plate containing an elongated opening through which electrons may pass. This opening is directly aligned with the cathode 2 and the anode 4 so that the electrons passing to the anode 4 will be in a comparatively narrow band or stream. It will be seen that after the electrons pass through the opening in the plate 13, they are subject to substantially no electric field except the alternating field caused by the deflecting plates 5, 5 which may therefore exert their effect more efficiently than if the electrons were subject to another field which was increasing their velocity while they were being deflected, that is, the component of the velocity of the electrons in the direction from the plate 13 to plate 4 will remain constant from the time they leave plate 13 until they reach plates 4 and 14 if the effect of the plates 5 upon them is disregarded.

However, if the plates 5 are both normally negative with respect to the plate 13 so that a field will exist between the plates 5 and 13 in the direction from plate 13 to plate 4, the velocity of the electrons will be decreased until they have passed the central part of the plates 5, owing to the fact that they are in a retarding field. After passing plates 5 the electrons will be accelerated because they are then passing from a point of lower to a point of higher potential, or in other words, they are passing through an accelerating field.

The apparatus may therefore be adjusted so that the electrons may be deflected in that part of their path wherein they move most slowly and hence, since they will remain within the range of action of the plates 5 for a correspondingly longer time, a weaker deflecting field may serve to sufficiently deflect them.

However, if the plates 5 are both normally strongly negative with respect to plate 13, the electrons may be not only deflected but actually attracted to one or the other of plates 5. It may therefore be desirable to locate a source of electromotive force in the lead 7, with its positive terminal towards the plates 5. Source 16 is preferably of a voltage somewhat less than source 6, but may be of a higher voltage; also it

may be desirable with certain relations of the other elements to reverse the source 16 so as to make plates 5 even more negative than cathode 2. This will depend upon the potential of source 6, the size of the various elements within the tube and their relative spacial relation. The plates 5 are therefore means for controlling the velocity of the electrons as well as deflecting means.

It has also been found that when an electron stream is passing to the anode 4 if there is only one anode the electrons will be attracted by it whether they are deflected from their original path by plates 5 or not, so that some of the deflected electrons will always reach the anode. This reduces the efficiency of the device. Furthermore, those electrons which, in virtue of the deflection caused by plates 5, pass by the anode, go to charge up the wall of the vessel 1. When the wall has been sufficiently charged by these electrons, other electrons that pass by the anode are deflected by the charge on the wall and so are returned to the anode. This further reduces the efficiency of the device.

To obviate this there is placed adjacent to the anode 4 a means herein represented as auxiliary anodes or plates 14 which will receive the electrons not reaching the plate 4. Conductor 15 will conduct the resulting charges from the plates 14 to the conductor 9 and hence back to the cathode. The auxiliary electrodes 14 may be of any suitable size, shape or number desirable or necessary to receive electrons which do not impinge upon the anode 4. These features will be determined by the nature and shape of the cathode, the anode, and other elements of the device. The control circuit including coil 8 and plates 5 will therefore act upon the controlled circuit which includes the elements 4, 10, 9, 6 and 2 and the electron stream.

As the stream is deflected in opposite directions alternately by the plates 5, it will swing back and forth across the anode 4 and produce a cycle of changes in the coil 10 of a frequency double that existing in the control circuit. The resulting double frequency current may be led off by the output circuit 11 and used for any desired purpose.

This device may be used as a detector or modulator of electro magnetic waves. An antenna or signaling conductor could for this purpose be coupled to the input circuit and a telephone receiver or equivalent to the output circuit.

Having described one form of the invention in detail, the novel features of the invention will be defined both broadly and specifically in the appended claims.

What is claimed is:

1. A frequency doubling device comprising in cooperative combination, a cathode,

an anode, a directive electrode, a pair of deflecting elements and means to fix the normal potential of said elements relatively to said cathode.

2. Electrical means consisting of an evacuated vessel containing a cathode, an anode, means for establishing an electron stream between said cathode and anode, a pair of deflecting electrodes for removing said stream from said anode at times, a normal potential fixing means connected to said electrodes to determine the potential thereof relatively to the cathode and a directive means operatively associated with said vessel.

3. In combination, in a device for doubling frequency, a cathode, an anode, means for establishing an electron stream therebetween, a directive means, a plurality of deflecting elements for deflecting said stream from said anode at times and means to fix the normal potential of said elements relatively to the cathode.

4. In a device for doubling frequency, a cathode and an anode, means for establishing an ionic stream therebetween, a conductive member having an opening for limiting the cross-sectional area of said stream, a pair of deflecting electrodes in the region of said stream for deflecting said stream from said anode in opposite directions alternately, and a normal potential fixing means for said electrodes adapted to fix the potential thereof relatively to the cathode.

5. In a device for doubling frequency, a cathode and an anode, means for establishing an ionic stream therebetween, means for reducing the cross-sectional area of said stream, means for bodily deflecting said stream alternately in opposite directions to such an extent that it misses said anode, and means to fix the normal potential of said deflecting means relatively to the cathode.

6. In combination, a cathode, a plurality of anodes, means for producing an ionic stream between said cathode and said anodes, means for limiting the cross-sectional area of said stream, a plurality of deflecting electrodes, means for keeping said limiting means and said anodes at the same potential, means for alternately applying positive and negative potentials to the said deflecting electrodes, and means to fix the normal potential of said electrodes relatively to said cathode.

7. In an electronic discharge device, a cathode constituting a source of electrons, a plurality of deflectors, a focusing electrode means between said deflectors and said cathode, means to fix the normal potential of the deflecting means relatively to said cathode, an anode, and an auxiliary anode means adjacent thereto to receive electrons not impinging upon said anode.

8. The combination of a circuit to be controlled including a cathode and a stream of ions moving therefrom in space, a controlling circuit including a source of alternating current, a pair of plates oppositely connected to said source and located in the region of said stream, means adjacent said cathode for limiting the cross-sectional area of said stream, an anode for receiving said stream, connections from said anode to said cathode including a device adapted to be coupled with an output line, auxiliary anodes, connections from said auxiliary anodes and said limiting means to said cathode, all said aforementioned connections including a source of electromotive force to maintain said cathode at a lower potential than said anodes, and a neutral connection from said cathode to said source of alternating current.

9. In an electron discharge device, a cathode, an anode, means for causing an electron stream to flow therebetween, means adjacent to but not directly in the path of said electron stream for bodily deflecting said stream, and means for maintaining said means at a normal potential different from that of said cathode.

10. In combination, in an electron discharge device, an anode, a cathode, means for causing an electron stream to flow therebetween, a pair of conducting bodies oppositely placed with respect to said stream, means to cause said bodies to have a definite normal potential with respect to said cathode, and means to cause an alternating static field between said bodies.

11. In a receiver for wireless signals,

the combination of a thermionic valve having in it a cathode, two anodes and a pair of plate electrodes arranged one on each side of the path between the cathode and the anodes so as to deflect the electrons emitted from the cathode on to the two anodes alternately, a receiving circuit connected to the electrodes, and a detector connected between the anodes.

12. In a receiver for wireless signals, the combination of a thermionic valve having in it a cathode, two anodes and a pair of electrodes arranged one on each side of the path between the cathode and anodes so as to deflect the electrons emitted from the cathode on to the two anodes alternately; a receiving coil connected to one of the electrodes and to the cathode; a second coil connected to the other electrode and to the cathode, and an output detector circuit connected between the anodes.

13. The combination of a vacuous vessel and an electron emitting filament therein, a battery having its poles connected to the two ends of the filament, a pair of electron collecting plates in the vessel, a pair of potential plates within the vessel on opposite sides of the path between the filament and said collecting plates, means for applying a variable potential to said potential plates, a circuit connected between said collecting plates and one end of the filament, and a current responsive device cooperating with said circuit.

In witness whereof, I hereunto subscribe my name this 25th day of September A. D., 1918.

HENDRIK J. VAN DER BIJL.