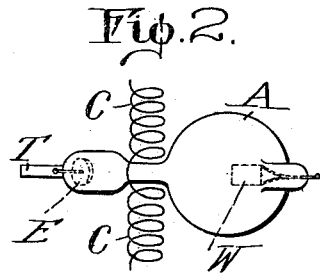
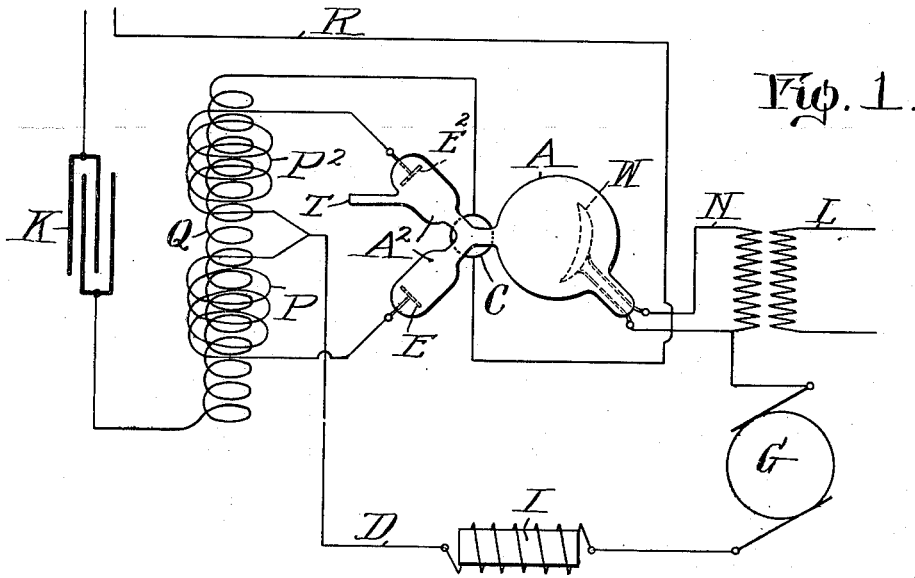


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 METHOD OF AND APPARATUS FOR PRODUCING ELECTRICAL IMPULSES OR OSCILLATIONS.
 APPLICATION FILED AUG. 1, 1912.

1,159,209.

Patented Nov. 2, 1915.



Witnesses:
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UNITED STATES PATENT OFFICE.

ROBERT H. GODDARD, OF WORCESTER, MASSACHUSETTS.

METHOD OF AND APPARATUS FOR PRODUCING ELECTRICAL IMPULSES OR OSCILLATIONS.

1,159,209.

Specification of Letters Patent.

Patented Nov. 2, 1915.

Application filed August 1, 1912. Serial No. 712,793.

To all whom it may concern:

Be it known that I, ROBERT H. GODDARD, a citizen of the United States, residing at Worcester, in the county of Worcester and State of Massachusetts, have invented a new and useful Method of and Apparatus for Producing Electrical Impulses or Oscillations, of which the following is a specification.

This invention relates to the production of electrical oscillations or impulses by means of the motion of a beam or beams of charged particles, ions or electrons emanating from an electrode in an inclosed space under low pressure, and to the use of such a beam or beams for other purposes, as for example for the conduction of high frequency currents.

I have found that it is possible to influence magnetically or electrostatically beams of charged particles, ions or electrons emanating from a Wehnelt cathode or the like, in a vacuum tube so as to obtain from a direct or alternating current, either with or without the use of antennæ, a series of oscillations or impulses; and that by directing the beams through a plurality of narrow paths a very small vacuum tube can be used to produce the same with a relatively high power.

Further objects and advantages of the invention will appear hereinafter.

Reference is to be had to the accompanying drawings in which,

Figure 1 is a section of an apparatus for carrying out this invention showing the electrical connections; and Fig. 2 is a sectional view of the vacuum tube and certain associated parts taken transversely to Fig. 1.

It will be seen that a vacuum tube A is shown having sealed into one side thereof the terminals of a Wehnelt cathode W. This cathode, as is well understood, consists of a platinum strip coated with calcium oxid and adapted to be heated to redness. It is shown as being heated by the secondary coil N of a transformer, the primary coil L also being shown, but an alternating current is not necessary. The cathode W and anodes E and E² are connected with a circuit D in which is a direct current generator G. This produces a beam of negatively charged particles constituting a negative current.

The beam is deflected from side to side by means of two coils C—C for producing

a magnetic field. Preferably they are connected with a high frequency oscillating circuit R to be described hereinafter. The result of this is to cause the beam to be interrupted, and specifically, to strike alternately upon the two metal plates or anodes E and E² located in prolongations A² of the vacuum tube. By directing the beam from the cathode along two narrow paths I find that a very much smaller vacuum tube is required than would be the case otherwise. The beam from the cathode may be concentrated by the form of the cathode, as shown, and can be influenced by a magnetic or electro-static field to pass lengthwise of the prolongations after passing from the main bulb, which of course is well understood and need not be described in detail. The plates E and E² are connected with a pair of coils P and P² respectively. These coils are arranged in parallel and are connected in series with the circuit D. An inductance I is shown in this circuit to prevent the oscillations surging back into the generator. A prolongation T of the tube is provided for exhaustion by a pump. An electro-static field can be used in place of the magnetic field, as will be shown hereinafter.

It will be seen that the negative current carried by the deflected beam of negatively charged particles from the cathode W passes alternately through the coils P and P² and constantly back to the generator. The two coils P and P² are provided with a single secondary Q which is connected up with a circuit R and in which is a condenser K. Thus, during each half oscillation there is induced in the coil Q an electro-motive force so that continuous undamped oscillations in the coil Q of high frequency are set up in the circuit R. The power that can be delivered to the circuit R depends upon the voltage produced by the generator G and therefore is limited only by the strength of the apparatus to withstand high voltages. The oscillating circuit KQR re-acts upon the coils P—P² in such a manner as to influence the operation of the device A, if A was a mercury or other vapor tube, but not if A is a Wehnelt cathode, as herein described. When large amounts of power are being delivered to the circuit RQR, the coil Q will re-act upon P and P², producing a high E. M. F. at E and E². When a Wehnelt cathode is used, each branch A² of the

tube becomes a non-conductor as the beam leaves it, owing to the fact that with a Wehnelt cathode and a high vacuum, all the current is carried by the negative particles shot from the cathode. But because of this high back E. M. F. at E and E², the dynamo G must produce a high potential between W and, alternately, E and E², in order to force current into P or P². This would produce serious heating in the tube A, especially at the narrow part, near C, if a vapor tube were used, owing to impacts of rapidly moving negative particles against particles of the gas present. These impacts need not take place with a Wehnelt cathode, as the vacuum can be high, with the important result that C may be small, and hence, by a well known formula the frequency of KQR may be high. It will be understood, of course, that the coils C—C can be excited in any desired way, but they are shown in Fig. 1 as connected up in series with the circuit R so that the system is self-exciting. To excite separately, the coil C can be replaced by a wire and the coil may be part of the circuit in which the oscillations are taking place. It will be apparent, therefore, that the beam made to impinge alternately upon the two metal plates E and E² results in the conversion of the direct current from the generator G into an oscillating or impulse current in the circuit R, an alternating current being required merely in the transformer N—L. A direct current can be used to heat the Wehnelt cathode if desired.

It will be understood that an alternating current can be used in the circuit D because the Wehnelt cathode gives off negatively charged particles or electrons only. This however, requires the use of one or more cathodes, each sending beams to the plates E and E².

In the form which I have described, if the exciting means as C, consists of part of the inductance in the circuit to be excited, a spark in the high frequency circuit itself, or in some other neighboring circuit, is necessary in order to start the oscillations.

Although I have illustrated and described only one embodiment of the invention, both as to the process and apparatus, I am aware of the fact that modifications can be made

in both without departing from the scope of the invention as expressed in the claims. Therefore, I do not wish to be limited to all the details of construction and procedure herein shown and described, but

What I do claim is:—

1. A method of producing electrical impulses or oscillations which consists in applying a current of electricity to a Wehnelt cathode in a highly rarefied atmosphere, and heating the cathode to produce a beam of particles, ions, or electrons in said rarefied atmosphere, directing said beam into a plurality of narrow paths in succession, and inducing from the currents in each of said paths a succession of currents of short duration, but in the same direction and in another circuit.

2. A method of producing electrical impulses or oscillations from a current in a circuit, which consists in applying the current of electricity to a Wehnelt cathode in a highly rarefied atmosphere and heating the cathode, to produce a beam of particles, ions, or electrons, in said rarefied atmosphere, deflecting said beam alternately on a plurality of anodes through a plurality of narrow paths, said cathode and anodes being connected with said circuit, and inducing from said current a succession of electrical impulses or oscillations in another circuit.

3. In an apparatus of the class described, the combination of a vacuum tube having a main body and two portions isolated from each other and connected to the main body by a narrow passage, an electrode in each of said portions, a cathode in said main body, means for generating a beam of negatively charged particles from said cathode, means for rapidly reflecting them first to one of said electrodes and then to the other, a circuit connecting the cathode with each of said electrodes, another circuit, and means for inducing a current in said other circuit from the first named circuit.

In testimony whereof I have hereunto set my hand, in the presence of two subscribing witnesses.

ROBERT H. GODDARD.

Witnesses:

ALBERT E. FAY,
C. FORREST WESSON.