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ELECTRON DISCHARGE DEVICE AND CIRCUIT

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Fig. 1

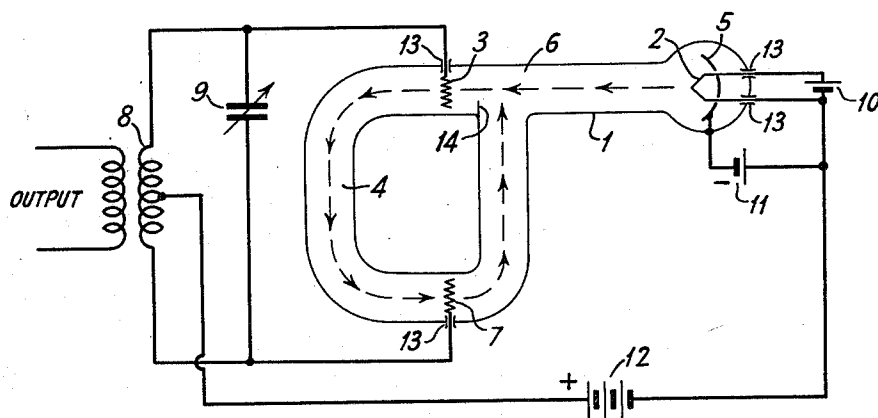
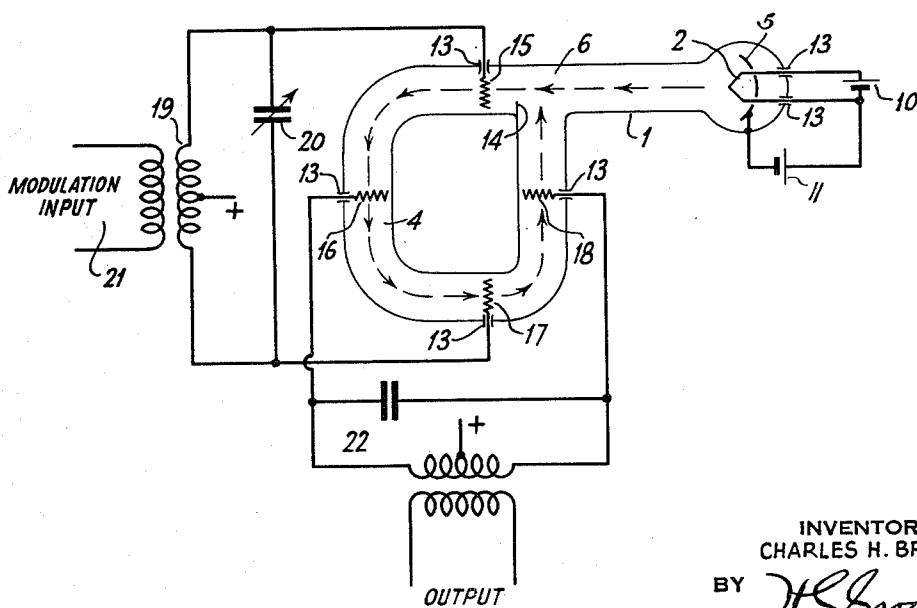


Fig. 2



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ELECTRON DISCHARGE DEVICE AND
CIRCUITCharles H. Brown, Brooklyn, N. Y., assignor to
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10 Claims. (Cl. 179—171)

This invention relates to high frequency electron discharge device oscillators, and modulation circuits for same.

It is known to produce oscillations by employing a stream of electrons which are caused to travel in a curved path so as to cross itself whereby there is obtained a periodically interrupted stream of electrons. This mode of operation is quite similar to the functioning of the air stream in an air whistle and has been called "the electron whistle principle". For a more detailed description thereof, reference is made to United States Patent No. 2,001,133, granted to Clarence W. Hansell May 14, 1935.

The present invention provides an improved electron discharge device circuit arrangement employing the electron whistle phenomenon, and is further explained in connection with the accompanying drawing wherein Figs. 1 and 2 show two different embodiments of the invention.

In Fig. 1, there is shown, partly in section and partly schematic, an oscillation generator system in accordance with one embodiment of the invention, comprising an evacuated metallic device 1 having a tube 6, at one end of which is a cathode 2 energized by a source of heating current 10. A metallic shield 5 is maintained, together with the envelope of device 1, at a suitable negative potential by means of source 11 which serves to concentrate the flow of electrons emanating from the cathode toward the opposite end of tube 6. At the other end of tube 6 there is positioned a grid or mesh affair 3 located at the opening of a flared, tubular, circular portion 4 which, in turn, causes the electrons passing through the grid 3 to travel in a curved path so as to cross itself and thus interrupt the stream entering the flared shell. A second grid 7 is positioned within the shell 4 at a point somewhat removed from the entrance to the shell, and both grids are coupled to opposite terminals of a suitably tuned resonant circuit comprising an inductance coil 8 and a condenser 9, to the coil of which is coupled a source of potential 12 for maintaining the two grids at a high positive potential relative to the cathode. Suitable insulating bushings or mountings 13 serve to insulate the cathode and grids from the metallic sides of the device.

Although portion 4 is made of metal and maintained at a negative potential determined by source 11, it will be understood that it may consist of insulation, such as glass, in which case various portions of the inside of the shell will automatically assume the correct potentials for suitable operation of the device. It should also

be understood that tuned circuit 8, 9 is merely illustrative of any resonant circuit and that, if desired, a resonant line might be employed instead, or the condenser 9 may be omitted and the distributed capacitance of the coil 8 relied upon to complete the tuned circuit.

The operation of the device is as follows:

Electrons emanating from the cathode 2 are negatively charged and are attracted towards the circular shell 4 by the positively charged grid 3. These electrons travel in a substantially straight line along portion 6 of the device and follow, in general, the path of the dotted lines. The envelope of the electron discharge device 1 repels the electron stream and confines same to the interior of the tubular passageways. Most of the electrons attracted by the positive-charged grid 3 pass through the apertures thereof with high velocity and follow the inner periphery of the shell 4 and are further propelled on their way by the positive charge on grid 7, after which, due to their momentum, they cross the path of the electron stream entering the shell 4, and in this way the stream entering the shell is interrupted due to the mutual repulsion between electrons. In order to enable the returning electrons to cross the oncoming stream exactly at right angles, and produce a clean interruption, there is preferably employed a slight extension 14 which protrudes within the interior of the device, in the manner shown in the drawing.

This mode of operation is quite analogous to that of an ordinary air or steam whistle, and a comparison between the two is herein made merely to aid in a better understanding of the invention.

The frequency of interruption of the electron stream and the frequency of oscillations produced in the tuned circuit 8, 9 are dependent on such factors as the grid voltages and the dimensions of the tube. The resonance frequency of the tuned circuit will, of course, suitably conform with the transit time of the electrons between the two grids 3 and 7. By means of such an arrangement it is possible to produce extremely high frequencies in the output circuit which may comprise a transmission line or any suitable utilization device.

Fig. 2 discloses a modification of the circuit of Fig. 1 and shows one method of modulating the high frequency oscillations produced in accordance with the invention. In this embodiment, four positive grids are employed within the interior of shell 4, adjacent grids being connected to different tuned resonant circuits. A

suitable speech or other input circuit is shown electromagnetically coupled to the coil 19 of a resonant circuit 19, 20 to whose terminals are coupled the diametrically oppositely located grids 15, 17. The output circuit in this case is coupled to the tuned circuit 22 which is connected to the other two grids 16, 18.

Obviously more elaborate arrangements may be employed for concentrating the electron stream within tube 6 and/or circular shell 4, and such arrangements may consist of suitably charged tubular or disc electrodes having apertures, or plates, on opposite sides of the electron stream in the manner employed in cathode ray devices.

15 What is claimed is:

1. In a high frequency system, an electron discharge device comprising a cathode for emitting a stream of electrons, an element for attracting said electrons and enabling same to pass by said element with high velocity, means for subsequently causing said stream of electrons to travel in a curved path so as to cross itself, a grid in said curved path, and a resonant circuit coupled between said element and grid.

25 2. In high frequency apparatus comprising an electron emitting element and a pair of spaced cold electrodes, the method of producing high frequency oscillations which comprises unidirectionally propelling a stream of electrons in the form of a beam from said element past said pair of cold electrodes, whereby there is produced a difference in potential between said pair, deflecting said stream of electrons in a curved path so that the stream crosses itself at an angle, thereby interrupting the oncoming stream, and repeating said cycle of operations to produce oscillations of the desired frequency.

3. In high frequency apparatus, an electron discharge device comprising a cathode for emitting a stream of electrons, and means for making said stream of electrons cross upon its own path at an angle periodically, thereby interrupting said stream, including a pair of spaced grids in the path of travel of said stream, a tuned resonant circuit coupled to said grids and a translating circuit coupled to said tuned circuit.

4. A system in accordance with claim 3, characterized in this that said translating circuit is a utilization circuit.

5. A system in accordance with claim 3, characterized in this that said translating circuit is a speech input circuit.

6. In combination, a device for producing high frequency oscillations comprising a cathode for emitting a stream of electrons, a first pair of spaced grids in the path of travel of said stream for controlling the flow of said electrons, a source of potential for maintaining said grids always at a positive potential relative to said cathode, and means for causing the stream of electrons to travel in a curved path so as to cross itself, said means including a curved shell which has a potential at least as negative as said cathode, a second pair of spaced grids at least one of which is located intermediate the grids of said first pair, means for maintaining said second pair of grids always at a positive potential relative to said cathode, a tuned circuit connected to each pair of grids, an input circuit connected to one of said tuned circuits and an output circuit connected to the other tuned circuit.

7. A system in accordance with claim 1, including means for concentrating into a stream the electrons emanating from said cathode.

8. In an electron discharge device, means for causing a stream of electrons to take a substantially circular path, two spaced grids in said circular path, a source of potential for maintaining both of said grids always at a positive potential relative to said stream, and a tuned circuit coupled between said grids.

9. In an electron discharge device, means for unidirectionally propelling a stream of electrons in a circular path, including two spaced grids in said circular path, a source of potential for maintaining both of said grids always at a positive potential relative to said stream, and a tuned circuit coupled between said grids.

10. In an electron discharge device, means for unidirectionally propelling a stream of electrons in a circular path, including four substantially equally spaced grids in said circular path, means for maintaining all of said grids always at a positive potential relative to said stream, a tuned circuit coupled to one pair of oppositely located grids, and another tuned circuit coupled to the other pair of grids.

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