Nov. 10, 1936. H. N. KOZANOWSKI 2,060,508

SHORT WAVE OSCILLATOR

Original Filed Oct. 3, 1931

Fig. 1.

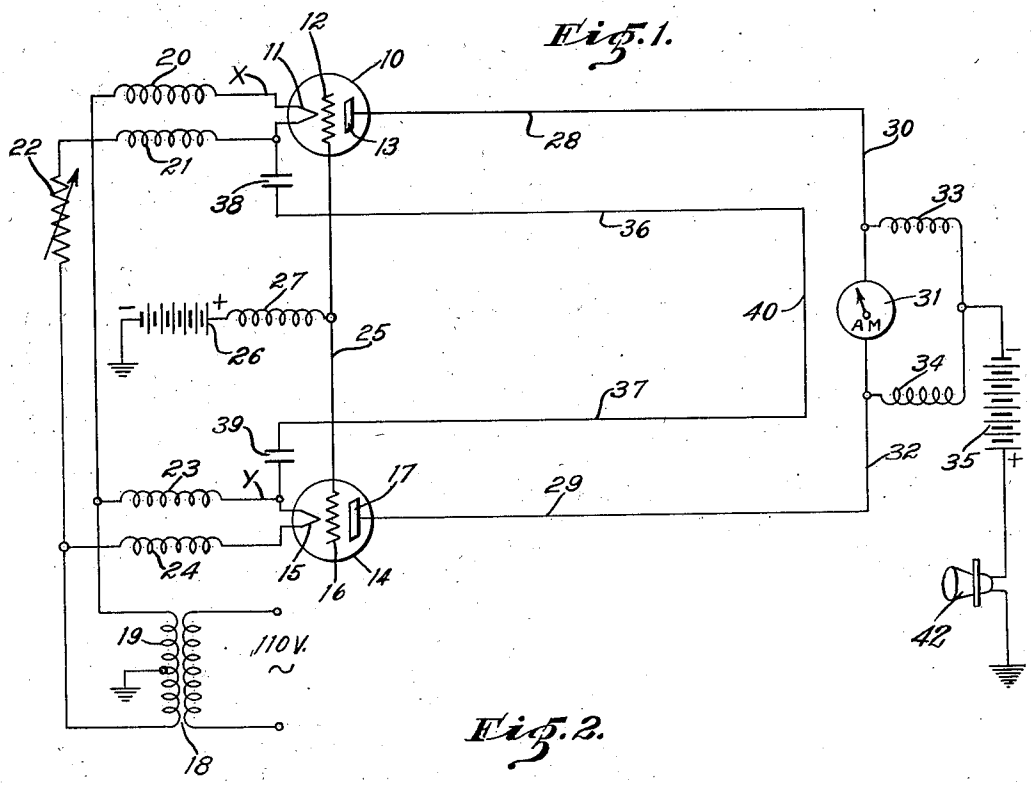


Fig. 2.

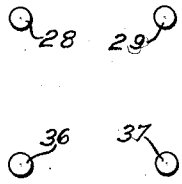
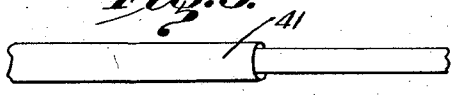


Fig. 3.



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SHORT WAVE OSCILLATOR

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10 Claims. (Cl. 250—36)

My invention relates to high frequency oscillators of the Barkhausen type for producing exceedingly high frequency oscillations.

In the Barkhausen oscillator, the control grid of a three-element tube is maintained at a positive potential, while the plate is maintained at either a low positive potential or at a negative potential. It is believed that this type of oscillator functions in the following manner:

The positive grid attracts the electrons and accelerates them to a speed sufficient to make them pass through the mesh of the grid into the negative field between the grid and the plate. The negative field slows up the electrons and causes them to move back in the opposite direction, so that they again pass through the mesh of the grid. In this way, the electrons oscillate about the grid, the grid remaining at a substantially constant potential.

While it has been possible to generate currents of a very high frequency (having wave lengths of the order of 90 cms.) by means of this type of oscillator, it has been very difficult to obtain a satisfactory power output. Also it has been difficult to make an oscillator function at wave lengths much lower than 90 cms.

One object of my invention is to provide an oscillator of the above-mentioned type which will give a large power output.

Another object of my invention is to provide an oscillator that will oscillate at lower wave lengths than previously known oscillators of the above-mentioned type.

Still another object of my invention is to provide an oscillator of the above-mentioned type in which the frequency is substantially independent of variations in the voltage applied to the tube.

In practicing my invention, I employ two vacuum tubes which have their grids connected together and connected to a source of positive potential. The plates of the tubes are connected to a pair of Lecher wires, while the filaments are connected to a second pair of Lecher wires which are positioned parallel to the first pair. Formerly, the grids instead of the filaments were connected to the second pair of Lecher wires.

Other features and advantages of my invention will appear from the following description taken in connection with the accompanying drawing, in which

Figure 1 is a circuit diagram of an oscillator constructed in accordance with my invention.

Fig. 2 is a view showing the physical arrangement of the Lecher wires.

Fig. 3 is a view illustrating the manner in which the Lecher may be made adjustable.

Referring to the drawing, the oscillator comprises a vacuum tube 10 having a cathode 11, a grid 12 and a plate 13 and a vacuum tube 14 having a cathode 15, a grid 16 and a plate 17. The filaments are heated from a 110 volt line by means of a step-down transformer 18 which has the mid-point of its secondary winding 19 grounded. The filament 11 of the tube 10 is connected to the secondary winding 19 through radio frequency choke coils 20 and 21 and through a variable resistor 22. The filament 15 of the tube 14 is connected to the secondary winding 19 at substantially zero radio frequency potential.

The grids 12 and 16 are connected together by means of a conductor 25 and connected to the positive terminal of a source of potential 26 through a radio frequency choke coil 27. The negative terminal of the source of potential is grounded. With the oscillator adjusted to oscillate at 60 cms. a grid potential of 500 volts has been found preferable. If desired, the choke coil 27 may be omitted, since the grids 12 and 16 are at substantially zero radio frequency potential.

The plates 13 and 17 are connected to the conductors 28 and 29, respectively, of the first pair of Lecher wires. The ends of these wires remote from the tubes are electrically connected through a conductor 30, a low resistance meter 31 and a conductor 32.

The conductors 28 and 29 are connected through the chokes 33 and 34, respectively, to the negative terminal of a source of potential 35. The positive terminal of the source is connected to ground. With the above-mentioned adjustment for operation at 60 cms., a negative potential of 110 volts on the plate was found desirable. One of the choke coils 33 and 34 may be omitted, but it is preferred to employ both of them in order to make the circuit symmetrical.

The filaments 11 and 15 are connected to the conductors 36 and 37, respectively, of the second pair of Lecher wires through coupling condensers 38 and 39. The ends of the conductors remote from the tubes are electrically connected through a conductor 40.

The condensers 38 and 39 may be omitted and the Lecher wires 36 and 37 connected directly to the filaments 11 and 15, providing they are connected to points on the filaments that are at the same potential. For example, the condensers 38 and 39 could be omitted and the Lecher wire 36 connected to the point X on the filament 11 and the Lecher wire 37 connected

to the point Y on the filament 15. It will be noted that points X and Y are connected to the same terminal of the secondary 19.

The use of the filament resistor 22 is important, because it is difficult to obtain two tubes having filaments which have the same electron emitting characteristics. This is especially true of vacuum tubes which have thoriated tungsten filaments. In the Barkhausen oscillator, the grids are maintained at such a high positive potential that the tubes operate at almost their saturation current value. Since, in this case, a grid will remove practically all of the electrons from the filament that the filament is capable of emitting, the tube having the best electron emitting filament will become overheated, while the other tube will remain cool. In my circuit, I place the resistor 22 in series with the filament having the best electron emitting characteristics, so that the filament may be operated at a lower temperature to reduce its electron emissivity. In one embodiment of my invention the tubes employed were UX 852 tubes.

The relative location of the Lecher wires is illustrated in Fig. 2. It will be noted that one pair of Lecher wires is placed directly above the other pair whereby both pairs of wires are electrically coupled to each other. These wires or conductors are preferably of copper tube 41 having telescoping joints so that the length of the conductors may be adjusted. Each conductor is adjusted so that it is about one wavelength long.

It has been found that, by employing two vacuum tubes of a given size in the manner described above, the output of the oscillator is much more than double the output of any known oscillator of this type employing a single tube of the same size.

It may be noted that the output of my oscillator may be modulated by varying the plate voltage as shown diagrammatically by the element 42.

The frequency at which the oscillator operates is determined by the length of the plate Lecher wires, while the length of the filament Lecher wires controls the amplitude of the oscillations. The grid and plate voltages may be varied within wide limits and the frequency remains at the value determined by the plate Lecher wires. This is in marked contrast to the behavior of other Barkhausen oscillators.

Various modifications may be made in my invention without departing from the spirit and scope thereof, and I desire, therefore, that only such limitations shall be placed thereon as are imposed by the prior art and are set forth in the appended claims.

I claim as my invention:

1. An oscillator comprising two vacuum tubes, each tube having a cathode, an anode, and a grid, means for connecting said grids together electrically, means for maintaining said grids at a positive potential with respect to said cathodes, a pair of Lecher wires and means for connecting them to said cathodes, a second pair of Lecher wires positioned substantially parallel to said first pair and connected to said anodes said pairs of Lecher wires being coupled, and means for applying a potential to said anodes lower than that applied to said grids whereby short waves may be produced.

2. An oscillator comprising two vacuum tubes, each having a cathode, a grid, and an anode, two pairs of Lecher wires electrically coupled to each other, said cathodes being connected to one of said pairs of Lecher wires, said anodes being connected to the other of said pairs of Lecher wires, means for applying potentials to said cathodes and anodes, means for electrically connecting said grids and means for maintaining them at a higher potential with respect to said cathodes than said anodes.

3. An oscillator of the Barkhausen type comprising a pair of vacuum tubes, each having a cathode, a grid and an anode, means for maintaining said grids at a positive potential with respect to said cathodes, means for maintaining said anodes at a negative potential with respect to said cathodes, a pair of oscillatory circuits, means for coupling said anodes to one of said circuits, means for coupling said cathodes to the other of said circuits, said pairs of oscillating circuits being electrically coupled to each other.

4. An oscillator of the Barkhausen type comprising a pair of vacuum tubes, each having a cathode, a grid, and an anode, means for maintaining said grids at a positive potential with respect to either of said cathodes, means for maintaining said anodes at a negative potential with respect to said cathode, a pair of Lecher wires connected to said cathodes and a second pair of Lecher wires connected to said anodes, said pairs of Lecher wires being electrically coupled.

5. An oscillator of the Barkhausen type comprising two vacuum tubes, each having a cathode, a grid, and an anode, means for maintaining said grids at a positive potential with respect to either of said cathodes, means for maintaining said anodes at a negative potential with respect to said cathodes, a pair of Lecher wires coupled to said anodes, a pair of Lecher wires coupled to said cathodes, said first pair being electrically coupled to said second pair, and means for separately controlling the amount each cathode is heated.

6. An oscillator comprising two electric discharge tubes spaced apart from each other, each having a cathode, a grid and an anode, a pair of coupled conductors extending each from one of said anodes in a substantially parallel relationship and having distributed capacity, a similar pair of conductors connected to said cathodes, means for maintaining a potential difference between the cathode and anode of each of said electric discharge tubes, a further conductor materially shorter in length than either of said two conductors interconnecting the grid electrodes of said tubes and means for maintaining a higher potential difference than that above-mentioned, between the grid electrode and the cathode of each said electric discharge tubes.

7. An oscillator comprising two electric discharge tubes spaced apart from each other, each having a cathode, a grid and an anode, two conductors, each of which is substantially longer than the distance separating said vacuum tubes, one of said conductors effectively interconnecting said anodes and constituting a Lecher system, the other of said conductors effectively interconnecting said cathodes and constituting a Lecher system, means for adjusting the effective length of at least one of said conductors, and a third conductor of shorter length than either of said two conductors interconnecting the grid electrodes of said tubes, and a potential supply source for said grid electrodes.

8. An oscillator comprising two electric discharge tubes spaced apart from one another, each having a cathode, a grid and an anode, a pair of wires connected to said anodes and coupled to

each other both magnetically and electrostatically to constitute a Lecher system, electrical connections between said grids, a pair of wires similarly coupled and connected to said cathodes to constitute a second Lecher system, means for electrically connecting said pair of anode Lecher wires, said pair of cathode Lecher wires and said grid interconnection to each other to complete circuits between said electron discharge tubes, and means for impressing a positive potential on said grid electrodes relative to both said cathodes and anodes.

9. An oscillator comprising two electric discharge tubes spaced apart from each other, each having a cathode, a grid and an anode, three connections each joining an electrode of one tube with the corresponding electrode of the other tube, at least one of said connections comprising substantially parallel coupled conductors having distributed capacity and constituting in itself a Lecher system, the connection joining said cathodes being parallel along its length to said Lecher system, and means for placing the grid electrodes at a positive potential relative to said anodes and cathodes.

10. An oscillator comprising two electric discharge tubes spaced apart from each other, each having a cathode, a grid and an anode, three connections each joining an electrode of one tube with the corresponding electrode of the other tube, the connection joining the cathodes with each other comprising substantially parallel coupled conductors having distributed capacity and constituting a Lecher system and the connection joining the anodes with each other also constituting a similar Lecher system, and means for placing the grid electrodes at a positive potential relative to said anodes and cathodes.

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