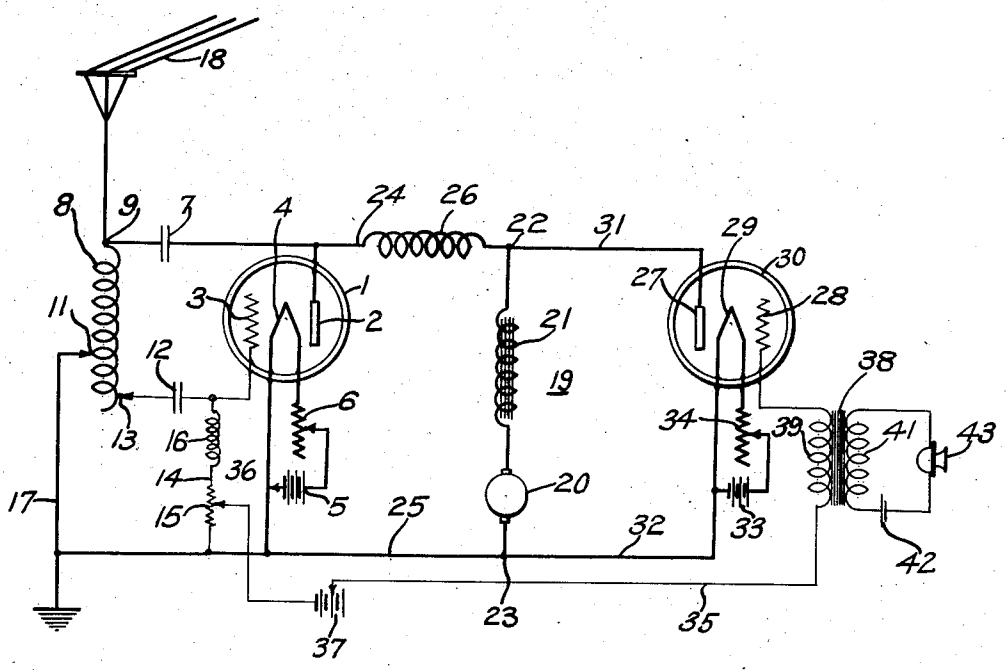
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VACUUM TUBE GRID BIASING MEANS

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UNITED STATES PATENT OFFICE.

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VACUUM-TUBE GRID BIASING MEANS.

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To all whom it may concern:

Be it known that I, DONALD G. LITTLE, a citizen of the United States, and a resident of Edgewood, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Vacuum-Tube Grid Biasing Means, of which the following is a specification.

My invention relates to wireless telegraphy and particularly to wireless transmission systems employing vacuum tubes as oscillation generators or as modulators.

One object of my invention is to provide simple, efficient and readily adjustable means, whereby the control electrode of a vacuum tube may be caused to assume desired negative potentials with respect to its cathode.

Another object of my invention is to provide a wireless transmission system wherein feed-back action may be obtained between an oscillator tube and a modulator tube, tending to increase the effect of the latter.

I have found that, in an electrical system employing vacuum tubes as oscillators or as amplifiers, wherein grid-leak circuits are employed, the control element of one tube may be given a desired negative potential by properly connecting it to the grid-leak circuit of another tube.

I have further found that, if a vacuum-tube oscillation generator employing a grid-leak circuit and a modulator tube having a control electrode, which is operatively associated with a source of modulating currents, are parallelly associated with a constant source of direct-current energy, feed-back action tending to increase the effects of the original modulating currents may be obtained by coupling the control element of the modulator tube and the grid-leak circuit of the generator tube, all as will be explained more fully hereinafter.

With these and other objects in view, my invention further consists in the combination and in the details of structure and circuit arrangement hereinafter described and claimed and illustrated in the accompanying drawing, wherein:

The single figure is a diagrammatic view of a wireless transmission system embodying my invention.

In the drawing, I have shown one particular arrangement of circuits and apparatus to which my invention is applicable, though I do not wish to be limited to the particular system shown.

An oscillator tube 1 comprising a plate 2, a controlling grid 3 and a hot cathode 4 is shown associated with plate-filament and grid-filament circuits of such design as to admit of generator action. The hot cathode 4 may be energized from a source of direct-current energy 5 through a resistor 6.

The plate-filament circuit for the tube 1 comprises a condenser 7 having a low impedance to currents of radio frequency and a portion of a tuning coil 8 between tap points 9 and 11. The grid-filament circuit for the tube 1 includes a biasing condenser 12 and a portion of the tuning coil 8 between tap points 11 and 13. A high-impedance leakage path 14, which serves as a grid leak, is shown as connecting the grid 3 to the hot cathode 4 through a resistor 15 and a radio-frequency choke coil 16.

A portion of the coupling coil 8 between tap points 9 and 11 may be serially included in an antenna circuit comprising, in addition, a ground lead 17 and an antenna 18.

A constant source of direct-current energy 19 comprising a direct-current generator 20 and a series-connected reactor 21 has its opposite terminals 22 and 23 connected, by conductors 24 and 25, to the anode 2 and to the hot cathode 4 of the oscillator tube 1, respectively. A radio-frequency choke coil 26 may be included in the conductor 24.

A modulator tube 30, comprising an anode 27, a controlling grid 28 and a hot cathode 29, has its anode and hot cathode connected, by conductors 31 and 32, to the opposite terminals 22 and 23 of the source of energy 19. The hot cathode 29 may be energized from a source of direct-current energy 33 through a resistor 34.

A conductor 35 serves to connect the controlling grid 28 of the modulator tube to an adjustable tap point 36 on the grid-leak resistor 15, thereby admitting of the grid 28 assuming a negative potential with respect to its cathode element 29. A source of direct-current energy 37 may be included in series with the conductor 35 to vary the amount of modulation-frequency energy fed back to the modulator tube, as hereinafter described. Modulation potentials of signal frequency may be impressed upon the grid 28 through a transformer 38, a secondary winding 39 of which is serially included in

the conductor 35, and a primary winding 41 of which is included in a circuit containing, in addition, a source of direct-current energy 42 and a current modulating means such as a microphone transmitter 43. It will be understood, however, that while I have shown a microphone modulator, a telegraph key or any other modulating apparatus suitable for transmitting signals may be employed.

In operation, when energy is supplied to the oscillator tube 1, high frequency oscillations are generated in accordance with well-known principles. With the building up of the oscillations in the system, the negative charge on the biasing condenser 12 increases to a valve determined by the resistance of the grid-leak resistor 15. When the tube is oscillating steadily, therefore, a constant current is caused to traverse the grid-leak circuit 14. By connecting the controlling element 28 of the modulator tube to a point in the grid-leak circuit, as 36, it is seen that negative potentials may be impressed upon the controlling element 28.

When the controlling element 28 of the modulator tube 30 is caused to assume a lower negative potential, for example, by the presence of a signal impulse, the power drawn by the modulator tube decreases, whereas that supplied to the oscillator tube 1 increases, inasmuch as a constant amount of energy is being supplied at all times to the system. The effect of the increase in the power supplied to the oscillator tube is to increase the amplitude of the oscillations and hence the current traversing the grid-leak circuit 14. However, an increase in the intensity of the current traversing the grid-leak circuit 14 causes an increase in the negative potential impressed upon the controlling grid element 28 and hence increases the original effect upon the controlling grid 28, tending to lower its potential still further. In like manner, the effect of a decrease in the negative potential of the grid 28 is correspondingly amplified by a decrease in the grid-leak potential applied thereto.

In view of the foregoing, it can readily be seen that energy may be fed back from the oscillator system to the modulator system, tending to increase the original effect of the modulating currents. The amount of feedback action, however, is dependent upon the potential of the grid 28, as determined by the direct-current source of energy 37 included in the conductor 35.

One advantage of my invention is that it admits of decreases in the number of amplifier tubes associating a source of modulating currents with its modulator tube. Other advantages and applications of my invention will readily suggest themselves to those skilled in the art.

While I have shown only one application of my invention, for the purpose of describing the same and illustrating its principles of operation, it is capable of various changes and modifications without departing from the spirit thereof. I desire, therefore, that only such limitations shall be imposed thereon as are indicated in the prior art or specifically indicated in the appended claims.

I claim as my invention:

1. In an electrical apparatus, a vacuum-tube generator, including a grid-filament circuit and a plate-filament circuit, said circuits including elements coupling them to provide regeneration, a resistor in shunt to said coupling element in the grid-filament circuit, a second vacuum tube having a grid and a filament and means deriving potentials from said resistor and impressing the same between the grid and filament of said second vacuum tube.

2. In an electrical system, a plurality of vacuum tubes, each having a filament, a grid and a plate, a circuit connecting the grid and filament of one of said tubes, a resistor shunting substantially all of said circuit external to said tube and means connecting an adjustable point in said resistor to the grid of another of said tubes.

3. In an electrical system, a source of current, a work circuit and a modulating circuit, a common connection supplying said circuits in parallel from said source, said common connection including means for preventing fluctuations in the current delivered by said source, means in addition to said prallel relation for increasing the effect upon the energy in one of said circuits of a change in the amount of energy in the other circuit.

4. In an electrical system, an oscillator generator adapted to generate oscillatory currents, means for affecting the action of said generator to modulate said currents and means dependent upon the action of said generator for effecting a transfer of energy from said generator to said modulating means, whereby the effect of the latter is increased.

5. In an electrical system, an oscillator generator having plate-filament and grid-filament circuits admitting of the generation of oscillatory currents, a high-resistance grid leak path, means for affecting the action of said generator to modulate said currents in accordance with a signal and means associating said leakage path and said modulating means, whereby the effect of the latter is increased.

6. In an electrical system, an oscillation-generator, a source of energy therefor, a modulating tube, a source of modulating currents associated with said tube, means associating said tube and said source of energy in such manner that energy supplied to said generator may be modulated in accordance with modulating currents, and

feed-back connections associating said generator and said modulator tube in such manner that the effect of said modulating currents may be amplified.

7. In an electrical system, an oscillator tube, plate-filament and grid-filament circuits therefor, grid-biasing means associated with said grid-filament circuit, a grid leak therefor, a source of energy associated with said plate-filament circuit, means for maintaining constant the energy supplied from said source, a modulator tube connected in shunt to said source of energy, a controlling element for said modulator tube, signal-controlled means for affecting the potential of said controlling element, and feed-back connections associating said grid leak and said controlling element for amplifying the effect of the latter.

8. In a wireless transmission system, an oscillator tube, plate-filament and grid-filament circuits therefor, grid-biasing means associated with said grid-filament circuit, a high-resistance leakage path in shunt relation to grid-biasing means, a constant source of direct-current energy associated with said plate-filament circuit, means for maintaining constant the energy supplied from said source, a modulator tube connected in shunt relation to said source of energy, a controlling element for said modulator tube, signal-controlled means for affecting the potential of said controlling element, and a conductor for connecting points in said leakage path to said controlling element.

9. In an electrical system, a constant source of direct-current energy comprising a series-connected reactor and generator, an oscillator tube, plate-filament and grid-filament circuits therefor, connections associating said source of energy and said plate-filament circuit, means for maintaining constant the energy supplied from said source, grid biasing means associated with said grid-filament circuit, a high-resistance element shunted around said grid-biasing means, a modulation tube having anode, grid and filament elements, conductors connecting said anode and said filament to opposite terminals of said source of energy, signal-controlled means for affecting the potential of said grid element, a conductor connecting said grid and a point in said high-resistance element and a source of modulatory currents associated with said latter conductor.

10. An oscillatory-current signalling system including an oscillation-generator tube having a grid condenser and a grid leak in shunt thereto, a modulator tube having a controlling grid, a source of modulated electromotive forces for said controlling grid, biasing means for said controlling grid comprising connections utilizing a potential drop in said grid leak and a radio-frequency choke in said shunt.

11. In an oscillatory-current signaling system, the combination with an oscillator-tube generator system including a grid-leak, of a modulating system including a modulator tube having a controlling grid, means for operatively associating said modulating system with said oscillation generator system in such manner that the amplitude of the oscillations are caused to decrease when the potential upon said controlling grid becomes less negative, and vice versa.

12. In an oscillatory-current signaling system, the combination with an oscillator-tube generator system including a grid-leak, of a modulating system including a modulator tube having a controlling grid, and means for operatively associating said modulating system with said oscillation generator system in such manner that the amplitude of the oscillations are caused to decrease when the potential upon said controlling grid becomes less negative, and, vice versa, said means comprising biasing means for said controlling grid comprising connections utilizing a potential drop in said grid-leak, and a radio-frequency selective impedance device in circuit with said grid leak.

13. A modulation system comprising a vacuum-tube generator, having a grid, a vacuum-tube modulating device controlling the supply of energy to said generator and so affecting the potential of said grid, a grid leak carrying a current dependent upon the potential of said grid and means for regulating the effect of the modulating device in accordance with the current in said grid leak.

14. In a vacuum-tube system, a pair of vacuum tubes, a controlling element in one of said tubes, a source of energy, means for causing the energy from said source to be apportioned between said tubes in accordance with the potential of the said control element, and means for effecting changes in the potential of said control element by the energy changes in the other tube, whereby the amplitude of said changes is increased.

15. In an electrical system, a source of current, a work circuit and a modulating circuit, a common connection supplying said circuits in parallel from said source, said common connection including means for preventing fluctuations in the current delivered by said source and means in addition to said parallel relation controlled by changes in the energy in the work circuit for affecting the impedance of the modulating circuit.

In testimony whereof, I have hereunto subscribed my name this 25th day of February 1922.

DONALD G. LITTLE.