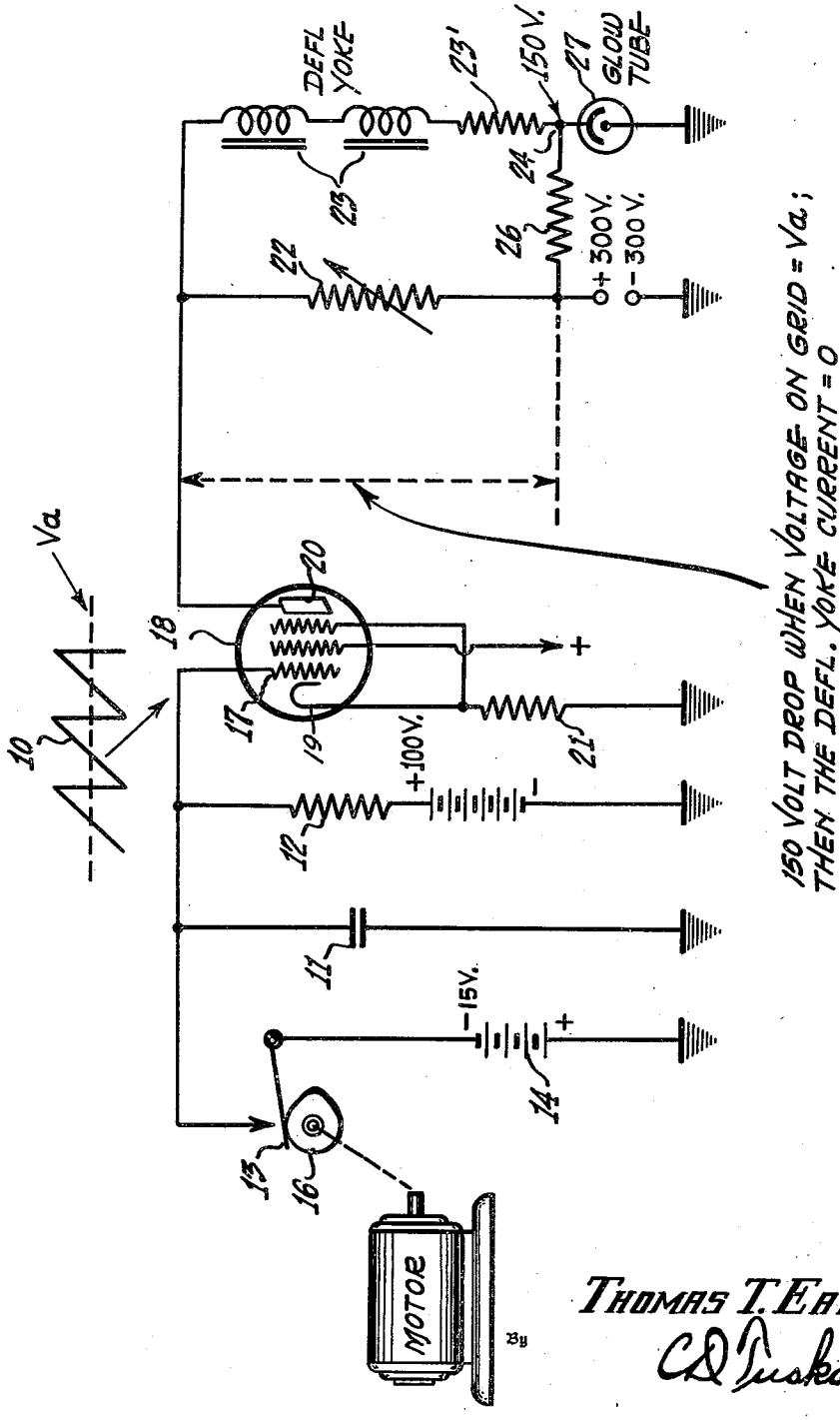
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LOW FREQUENCY DEFLECTING CIRCUIT

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LOW-FREQUENCY DEFLECTING CIRCUIT

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My invention relates to electromagnetic deflecting circuits and particularly to circuits for deflecting a cathode ray or the like at a very low repetition rate.

In apparatus where it is desired to deflect a cathode ray at a very slow rate, such as a rate of one deflection per second, for example, it is common practice to obtain the deflecting voltage or current by mechanical means such as a potentiometer comprising a current carrying resistor and a rotating potentiometer arm that makes a sliding contact with the resistor. This method of obtaining a sawtooth wave or the like for cathode ray deflection has obvious disadvantages.

An object of the present invention is to provide an improved method of and means for producing a low frequency deflecting current for electromagnetic deflection.

A further object of the invention is to provide an improved method of and means for producing a low frequency deflecting current of sawtooth or triangular wave shape.

In one preferred embodiment of the invention, a sawtooth voltage wave is generated which recurs at the desired repetition rate and this voltage wave is applied to the control grid of a vacuum tube, such as a pentode, having high impedance between anode and ground. The anode circuit of the tube includes an anode resistor and a pair of deflecting coils which have one terminal direct-current connected to the anode. The other terminal of the deflecting coils is direct-current connected to a point that is at a steady potential which is lower than the anode supply potential. If, with a fixed voltage (such as the average sawtooth voltage) on the control grid of the tube, the resistance of the anode resistor is adjusted until the anode potential equals said lower potential, the current flow through the coils will then be zero. Any increase or decrease in the control grid voltage will cause a corresponding current flow in the deflecting coils in one direction or the other to produce the desired electromagnetic deflection.

The invention will be better understood from the following description taken in connection with the accompanying drawing in which the single figure is a circuit diagram of one embodiment of the invention.

Referring to the drawing, a sawtooth voltage wave 10 is generated by charging a capacitor 11 slowly through a high impedance resistor 12 and then discharging the capacitor 11 rapidly through a switch 13 and a biasing battery 14. The switch

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13 is closed periodically for a short interval by a motor driven cam 16.

The saw tooth voltage 10 is applied through a direct-current connection to the control grid 17 of a high impedance vacuum tube such as a pentode 18. The cathode 19 of the pentode may be connected to ground through a cathode resistor 21 which introduces some degeneration for straightening the sawtooth current wave. The value of the biasing voltage supplied by the battery 14 preferably is about equal to the cut-off voltage of the tube 18, the capacitor 11 discharging substantially to this voltage while the switch 13 is closed.

A suitable anode voltage is applied to the anode 20 of tube 18 through a variable anode resistor 22. One terminal of a pair of deflecting coils 23 is direct-current connected through a conductor 25 to the anode 20. The other terminal of the coils 20 is direct-current connected to the junction point 24 of a resistor 26 and a glow tube 27 that are serially connected across the anode voltage supply. The point 24 is held at a constant potential by the glow tube 27. For the purpose of illustration it is assumed that the anode voltage is 300 volts and that the constant potential at point 24 is 150 volts.

The circuits may be adjusted for operation by applying to the control grid 17 the average voltage V_a of the sawtooth wave 10 and by adjusting the resistor 22 until the voltage drop thereacross equals the constant potential at the junction point 24, or, in the example assumed, until the voltage drop across resistor 22 is 150 volts. There will now be no current flow through the deflecting coils 23.

When the voltage wave 10 is applied to the grid 17, with the circuit adjusted as described above, a sawtooth current will flow through the coils 23; the current flowing in one direction when the sawtooth voltage is below the average value, and in the opposite direction when the sawtooth voltage is above the average value.

Centering may be accomplished by changing the adjustment of the resistor 22. If the resistor 22 has a much larger resistance than the resistance of the deflecting coils 23, (the resistance of the coils 23 being indicated at 23') the size or amplitude of the sawtooth deflecting current will remain substantially unchanged with changes in the centering adjustment. In order to avoid wave shape distortion, the reactance of the deflecting coils 23 should be small compared with the resistance of the anode resistor 22. In the drawing, voltage values have been indicated merely by way of example.

I claim as my invention:

1. A low frequency deflecting circuit comprising a vacuum tube having an anode, a cathode and a control grid, a direct-current voltage supply having a comparatively high potential point and an intermediate potential point, means for holding the voltage of said intermediate potential point constant regardless of the flow of deflecting current, said high potential point being connected to said anode through an anode resistor, a deflecting coil that is connected between said anode and said intermediate potential point by direct-current connections only, means for producing a periodic voltage wave having a repetition rate equal to that of the desired low frequency deflection, and means for applying said voltage wave to said control grid to produce a periodic flow of anode current, said anode resistor having a resistance such that the anode voltage equals the voltage of said intermediate potential point when the voltage on the control grid is at some intermediate value of said periodic voltage whereby deflecting current flows through said deflecting coil in one direction when the control grid voltage is less than said intermediate value and flows through said coil in the opposite direction when the grid voltage is greater than said intermediate value.

2. A low frequency deflecting circuit comprising a vacuum tube having an anode, a cathode and a control grid and having high cathode-anode impedance, a direct-current voltage supply having a comparatively high potential point and an intermediate potential point, means for holding the voltage of said intermediate potential point constant regardless of the flow of deflecting current, said high potential point being connected to said anode through a variable anode resistor, a deflecting coil that is connected between said anode and said intermediate potential point by direct-current connections only, means for producing a periodic voltage wave having a repetition rate equal to that of the desired low frequency deflection, and means for applying said voltage wave to said control grid to produce a periodic flow of anode current, said anode resistor having a resistance such that the anode voltage equals the voltage of said intermediate potential point when the voltage on the control grid is at some intermediate value of said periodic voltage whereby deflecting current flows through said deflecting coil in one direction when the control grid voltage is less than said intermediate value and flows through said coil in the opposite direction when the grid voltage is greater than said intermediate value.

3. A low frequency deflecting circuit comprising a vacuum tube having an anode, a cathode and a control grid and having high cathode-anode impedance, a direct-current voltage supply having a comparatively high potential point and an intermediate potential point, means for holding the voltage of said intermediate potential point constant regardless of the flow of deflecting current, said high potential point being connected to said anode through an anode resistor, a deflecting coil that is connected between said anode and said intermediate potential point by direct-current connections only, means for producing a periodic voltage having a linear wave form and having a repetition rate equal to that of the desired low frequency deflection, and means for applying said voltage wave to said control grid to produce a periodic flow of anode current, said anode resistor having a resistance

such that the anode voltage equals the voltage of said intermediate potential point when the voltage on the control grid is at some intermediate value of said periodic voltage whereby deflecting current of linear wave form flows through said deflecting coil in one direction when the control grid voltage is less than said intermediate value and flows through said coil in the opposite direction when the grid voltage is greater than said intermediate value.

4. A low frequency deflecting circuit comprising a vacuum tube having an anode, a cathode and a control grid and having high cathode-anode impedance, a direct-current voltage supply having a comparatively high potential point and an intermediate potential point, means for holding the voltage of said intermediate potential point constant regardless of the flow of deflecting current, said high potential point being connected to said anode through a variable anode resistor, a deflecting coil that is connected between said anode and said intermediate potential point by direct-current connections only, means for producing a periodic voltage wave having a repetition rate equal to that of the desired low frequency deflection, and means for applying said voltage wave to said control grid through a direct-current connection to produce a periodic flow of anode current, said anode resistor having a resistance such that the anode voltage equals the voltage of said intermediate potential point when the voltage on the control grid is at some intermediate value of said periodic voltage whereby deflecting current flows through said deflecting coil in one direction when the control grid voltage is less than said intermediate value and flows through said coil in the opposite direction when the grid voltage is greater than said intermediate value.

5. A low frequency deflecting circuit comprising a deflecting coil, a vacuum tube having an anode, a cathode and a control grid and having high cathode-anode impedance compared with the impedance of said coil, a direct-current voltage supply which has a voltage divider connected thereacross, said voltage divider comprising a resistor and a constant voltage device connected in series with each other with the constant voltage device at the low potential end, said constant voltage device having the characteristic that the voltage thereacross is substantially independent of the current flow therethrough within the operating range of the device, said anode being connected to the positive terminal of said voltage supply through an anode resistor, said deflecting coil being connected between said anode and the junction point of said constant voltage device and said voltage divider resistor by direct-current connections only, means for producing a periodic voltage wave having a repetition rate equal to that of the desired low frequency deflection, and means for applying said voltage wave to said control grid to produce a periodic flow of anode current, said anode resistor having a resistance such that the anode voltage equals the voltage at said junction point when the voltage on the control grid is at some intermediate value of said periodic voltage whereby deflecting current flows through said deflecting coil in one direction when the control grid voltage is less than said intermediate value and flows through said coil in the opposite direction when the grid voltage is greater than said intermediate value.

6. A low frequency deflecting circuit comprising a deflecting coil, a vacuum tube having

an anode, a cathode and a control grid and having high cathode-anode impedance compared with the impedance of said coil, a direct-current voltage supply which has a voltage divider connected thereacross, said voltage divider comprising a resistor and a glow tube connected in series with each other with the glow tube at the low potential end, said anode being connected to the positive terminal of said voltage supply through a variable anode resistor, said deflecting coil being connected between said anode and the junction point of said glow tube and said voltage divider resistor by direct-current connections only, means for producing a periodic sawtooth voltage wave having a repetition rate

equal to that of the desired low frequency deflection, and means for applying said voltage wave to said control grid through a direct-current connection to produce a periodic flow of anode current, said anode resistor having a resistance such that the anode voltage equals the voltage at said junction point when the voltage on the control grid is at some intermediate value of said periodic voltage whereby deflecting current flows through said deflecting coil in one direction when the control grid voltage is less than said intermediate value and flows through said coil in the opposite direction when the grid voltage is greater than said intermediate value.

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