

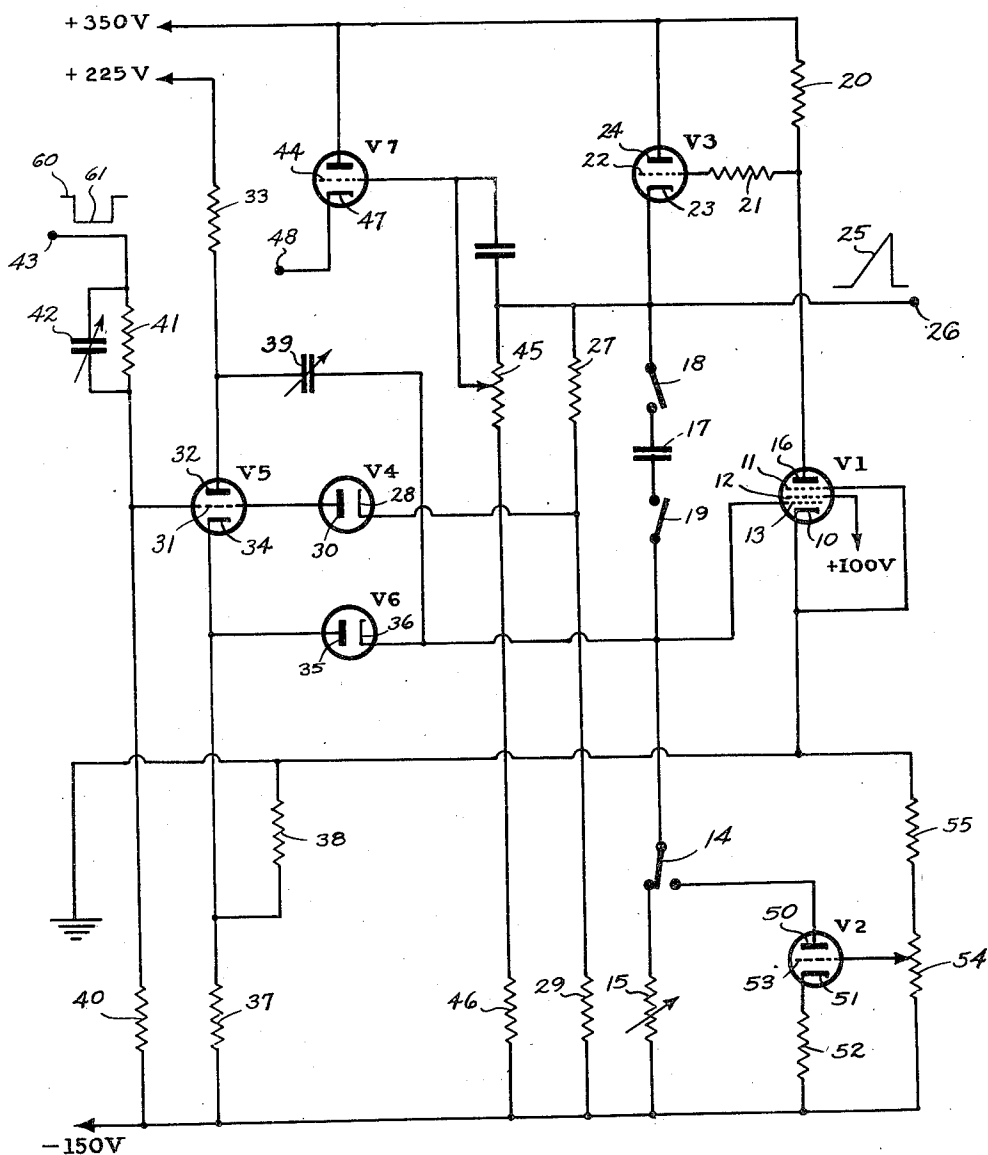
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GATED SWEEP GENERATOR

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GATED SWEEP GENERATOR

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This invention pertains to sweep circuits, and relates particularly to a gated sweep generator for producing a sawtooth waveform of sharply defined and precisely reproducible configuration.

It is a principal object of the present invention to provide a sweep generator which produces a sawtooth waveform which is devoid of the usual step formed at the beginning of the sweep in sweep generators of conventional construction.

Another important object of the present invention is the provision of a sweep generator in which the starting potential of the sweep is maintained constant and sharply defined.

A further object of the present invention is the provision of a sweep generator in which the termination potential of the sweep is maintained constant and sharply defined.

A still further important object of this invention is to provide a sawtooth sweep generator for producing a positive sweep that is variable in slope over a wider range than provided heretofore.

The foregoing and other objects and advantages of the present invention will appear from the following detailed description taken in connection with the accompanying drawing which illustrates, by schematic diagram, the electrical circuitry of a sweep generator embodying the features of the present invention.

The pentode tube V1 is a Miller tube time base generator. The cathode 10 and the suppressor grid 11 are grounded, and the screen grid 12 is connected to a positive potential, for example 100 volts. The control grid 13 is connected through switch 14 alternatively to variable resistance 15 or constant current tube V2 to a negative potential of, for example, -150 volts.

The plate 16 of tube V1 is connected to grid 13 through the timing capacitor 17 by means of switches 18, 19 and preferably through the cathode follower V3. The plate 16 is also connected through resistance 20 to a positive potential of, for example, 350 volts.

The plate 16 of tube V1 is connected preferably through parasitic suppressor resistance 21 to the grid 22 of V3 and the cathode 23 is connected to switch 18. The plate 24 of tube V3 is connected to the positive potential of 350 volts.

In the illustrated provision of cathode follower V3 the output waveform, i. e. the sawtooth sweep 25, is taken from the cathode 23. This output waveform may be utilized for any purpose, and terminal 26 is provided for that purpose. It will be understood that if cathode follower V3 is omitted, the output waveform is derived at the plate 16.

The cathode 23 of the cathode follower V3 is connected through resistance 27 to the cathode 28 of diode V4. The cathode is connected through resistance 29 to the negative potential indicated. The plate 30 of diode V4 is connected to the grid 31 of the cathode follower V5. The plate 32 of the cathode follower V5 is

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connected through resistance 33 to a positive potential of, for example, 225 volts.

The cathode 34 of the cathode follower V5 is connected to the plate 35 of diode V6, and the cathode 36 of said diode is connected to the control grid 13 of the sweep generator tube V1.

The cathode 34 and plate 35 of the respective tubes V5 and V6 are connected through resistance 37 to the negative potential indicated and through resistance 38 to ground. A capacitor 39 is connected between the plate 32 of tube V5 and the cathode 36 of the diode V6 for purposes of neutralizing the capacity of said diode. The diode V6 and the aforementioned resistances 33, 37 and 38 and the neutralizing capacitor 39 may be omitted under certain conditions of operation. For example, capacitor 39 and resistance 33 may be omitted when the capacitance 17 is large compared with the feed-through capacity of diode V6. These elements may also be omitted if it is desired to provide a step at the start of the sweep. The magnitude of the step may be regulated by clipping resistances 37, 38. When the charging current set by resistance 15 or by the constant current tube V2 is large compared with the cut-off leakage current of cathode follower V5, the diode V6, resistances 33, 37 and 38 and capacitor 39 may be omitted.

The grid 31 of cathode follower V5 is connected through resistance 40 to the negative potential, as indicated, and also through the parallel combination of resistance 41 and capacitor 42 to terminal 43. This terminal may represent, for example, a connection to the output side of a triggering multivibrator, the output waveform of which functions to gate the operation of the sweep generator.

There is also preferably provided the cathode follower V7 whose grid 44 is connected through potentiometer 45 to the cathode 23 of cathode follower V3. The grid 44 is also connected through potentiometer 45 and resistance 46 to the negative potential indicated. The cathode 47 of the cathode follower V7 is connected to terminal 48 which represents, for example, the connection to the normally non-conducting side of a multivibrator for purposes of reverting the latter, as explained in detail hereinafter.

In the alternate arrangement in which the constant current tube V2 is substituted for the variable resistance 15, switch 14 interconnects the grid 13 of the sweep generator tube V1 and the plate 50 of tube V2. The cathode 51 of tube V2 is connected through resistance 52 to the negative potential indicated. The grid 53 is connected through potentiometer 54 to the negative potential and also through potentiometer 54 and resistance 55 to ground.

It will be seen that there is a D. C. divider from the sweep output cathode follower V3, one section of which goes through diode V4 to clamp the grid of the gating cathode follower V5. Since the cathode 34 of V5 is connected through diode V6 to the grid 13 of the sweep generator tube V1, there is a complete degenerative D. C. feed-back path which is provided under conditions in which both of the diodes V4 and V6 are conducting. This condition occurs during the quiescent period of the sweep with the normally conducting side of a multivibrator (not shown) conducting and cathode follower tube V5 conducting. In the circuitry illustrated, the grid 13 is thus held at about -3 volts during the quiescent period of the sweep and the plate 16 is held at about +50 volts. This is well within the class A operating region of tube V1, wherein the plate voltage is directly proportional to the grid voltage, and therefore the relationship of plate-to-grid voltage is determined by the grid-to-plate relationship of the tube itself.

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The actual grid voltage set by the voltage divider cathode follower arrangement with tube V5 through the disconnecting diode V6 and the constant current tube V2 determines the actual starting voltage of the sawtooth sweep 25. In the embodiment illustrated, the sawtooth sweep runs from 50 volts to 200 volts. However, the length of the sweep may be adjusted as desired by proper adjustment of the potentiometer 45. This potentiometer controls the reverting of the multivibrator connected at 48 when the sweep 25 reaches a predetermined voltage level.

The operation of the sweep generator circuit illustrated in the drawing and described in detail hereinbefore is as follows: During the quiescent period of the multivibrator (not shown), as indicated by the voltage level 60 of the gate waveform 61, the grid 31 of cathode follower V5 is held in a positive direction and the grid 13 of the sweep generator tube V1 is held at -3 volts with the plate 16 at +50 volts. With the production of the negative step 61, by flop over of the multivibrator, the resulting lowering of the voltage on the grid of cathode follower V5 cuts off the diodes V4 and V6 simultaneously. That is to say, upon conduction of the normally non-conducting side of the multivibrator, the plate voltage thereof functions to cut off diode V4, while the following cathode 34 cuts off diode V6.

The negative step 61 disconnects the grid 13 of the sweep generator tube V1 from the D. C. feed-back loop described hereinbefore, and thus the grid 31 immediately begins to drop in voltage and the plate 16 begins to rise. Since the plate is coupled back to the grid 13 through timing capacitor 17, said plate rises in voltage in accordance with the linear charge rate of the capacitor 17 and the amount of constant current provided, for example, by tube V2. When diode V6 disconnects the grid 13 from the D. C. feed-back loop, tube V2 sustains the current at a constant value, thereby pulling the grid 13 downward. During the run-up period in the development of the sawtooth waveform 25 the timing capacitor charging current is thus kept essentially constant by the action of tube V2.

When the plate 16 of the sweep generator tube V1 has risen to the vicinity of 200 volts, the grid 44 of the cathode follower V7 has risen to about 100 volts. At this point current begins to flow in this tube and current is diverted from the conducting side of the multivibrator (not shown), whereupon the latter reverts to its initial stage with the normally conducting side conducting. Upon reversion of the multivibrator in this manner, the grid 31 of cathode follower V5 is caused to rise, whereupon diode V6 conducts and the grid 13 of the sweep generator tube V1 rises to its initial potential of -3 volts and the plate 16 drops to its initial starting level.

Upon reversion of the multivibrator, with conduction of cathode follower V5, the grid 13 of the sweep generator tube V1 is pulled abruptly upward to a slightly positive bias, thereby suddenly increasing the plate current of said tube. Accordingly, plate 16 instantly drops in voltage, but there is a disconnect action in the sweep output cathode follower V3 because it has a capacity load and therefore cannot fall until the capacitor 17 discharges. The discharge path of this capacitor is through diode V6 and cathode follower V5, and during discharge of the capacitor diode V4 is still cut off because its cathode was at a level of about 100 volts at the termination of the sweep and therefore it will not begin to conduct until its cathode voltage is lowered. Thus, the D. C. feed-back loop is inoperative until the sweep 25 recovers its quiescent level at 50 volts. At that time diode V4 will conduct to lower the voltage on the grid 31 of cathode follower V5 and thereby bring the start of the sweep to 50 volts.

It is to be noted that during the run-up producing the sawtooth waveform 25, by the linear rise in potential of plate 16, the capacitor 17 is caused to charge. Grid 13 is maintained at an essentially constant value by the A. C. feed-back loop from plate 16 through capacitor 17. Thus,

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since the grid is the voltage point determining the amount of current flowing through the resistance 15, for example, the current is maintained substantially constant. Thus, it will be seen that the constant current tube V2 need not be employed under many conditions, but that the linearity of the sweep may be improved still further if desired by switching in the constant current tube V2.

From the foregoing description, it is believed to be apparent that the present invention provides a sweep generator which offers advantages heretofore unavailable. The starting level of the sawtooth waveform is very sharply defined and the usual step at the beginning of the sweep, and characterizing the sweep generator provided heretofore, is completely eliminated. In addition, the termination level of the sawtooth waveform is also very sharply defined by virtue of the feed-back, preferably through cathode follower V7, to the gating multivibrator in such manner that the sweep functions to terminate itself.

It will be apparent to those skilled in the art that various changes and modifications in details of the arrangement described and illustrated herein may be made without departing from the scope and spirit of the present invention. For example, the production of a negative going sweep may be readily provided by utilizing a positive gating waveform in place of the negative gate 61, by returning grid 13 of tube V1 to a positive potential instead of the negative potential indicated and by reversing the diodes V4 and V6. This form of run down circuitry is advantageous at very low sweep rate, but does not provide the precision of operation at high sweep rate afforded by the run up circuitry described hereinbefore. This and other changes may be made, as will be apparent to those skilled in the art. Accordingly, it is to be understood that the foregoing description is merely illustrative and is not to be considered as limiting the scope thereof.

Having now described my invention and the manner in which the same may be used, what I claim as new and desire to secure by Letters Patent is:

1. A sweep generator adapted to be actuated by a gate source and comprising an electron discharge device having a grid and a plate, a capacitor connected between said grid and plate, resistance means connecting the grid to a source of potential, degenerative direct current feed back means connected between the grid and plate and including a pair of series-connected diodes, and means for connecting a gate source between said diodes.

2. A sweep generator adapted to be actuated by a gate source and comprising an electron discharge device having a grid and a plate, a capacitor connected between said grid and plate, resistance means connecting the grid to a source of potential, degenerative direct current feed back means connected between the grid and plate and including the series combination of a first diode, the grid-cathode path of a cathode follower having a grid and a second diode, and means for connecting a gate source to the grid of the cathode follower.

3. A sweep generator adapted to be actuated by a gate source and comprising an electron discharge device having a grid and a plate, a capacitor connected between said grid and plate, resistance means including a constant current electron discharge device connecting the grid to a negative potential, degenerative direct current feed back means connected between the grid and plate and including a pair of series-connected diodes, and means for connecting a gate source between said diodes.

4. A sweep generator adapted to be actuated by a gate source and comprising an electron discharge device having a grid and a plate, a capacitor, cathode follower means connecting said capacitor between said grid and plate, resistance means connecting the grid to a negative potential, degenerative direct current feed back means connected between the grid and plate and including a pair of series-connected diodes, and means for connecting a gate source between said diodes.

5. A sweep generator adapted to be actuated by a

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gate source and comprising an electron discharge device having a grid and a plate, a capacitor, cathode follower means connecting said capacitor between said grid and plate, resistance means connecting the grid to a negative potential, degenerative direct current feed back means connected between the grid and plate and including the series combination of a first diode, the grid-cathode path of a cathode follower having a grid and a second diode, and means for connecting a gate source to the grid of the last named cathode follower.

6. A sweep generator adapted to be actuated by a gate source and comprising an electron discharge device having a grid and a plate, a capacitor, cathode follower means connecting said capacitor between said grid and plate, resistance means including a constant current electron discharge device connecting the grid to a negative potential, degenerative direct current feed back means connected between the grid and plate and including a pair of series-connected diodes, and means for connecting a gate source between said diodes.

7. A sweep generator adapted to be actuated by a gate source and comprising an electron discharge device having a grid and a plate, a capacitor connected between said grid and plate, resistance means connecting the grid to a negative potential, degenerative direct current feed back means connected between the grid and plate and including a pair of series-connected diodes, means for connecting a gate source between said diodes, and means connecting the plate to the gate source, whereby to utilize the generated sweep to terminate the gate and the sweep.

8. A sweep generator adapted to be actuated by a gate source and comprising an electron discharge device having a grid and a plate, a capacitor connected between said grid and plate, resistance means connecting the grid to a negative potential, degenerative direct current feed back means connected between the grid and plate and including a pair of series-connected diodes, means for connecting a gate source between said diodes, and cathode follower means connecting the plate to the gate source, whereby to utilize the generated sweep to terminate the gate and the sweep.

9. A sweep generator adapted to be actuated by a gate source and comprising an electron discharge device having a grid and a plate, a capacitor connected between said grid and plate, resistance means connecting the grid to a negative potential, degenerative direct current feed back means connected between the grid and plate and including the series combination of a first diode, the grid-cathode path of a cathode follower having a grid and a second diode, means for connecting a gate source to the grid of the cathode follower, and cathode follower means connecting the plate to the gate source, whereby to utilize the generated sweep to terminate the gate and the sweep.

10. A sweep generator adapted to be actuated by a gate source and comprising an electron discharge device having a grid and a plate, a capacitor connected between said grid and plate, resistance means including a constant current electron discharge device connecting the grid to a negative potential, degenerative direct current feed back means connected between the grid and plate and including a pair of series-connected diodes, means for connecting a gate source between said diodes, and cathode follower means connecting the plate to the gate source, whereby to utilize the generated sweep to terminate the gate and the sweep.

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11. A sweep generator adapted to be actuated by a gate source and comprising an electron discharge device having a grid and a plate, a capacitor, cathode follower means connecting said capacitor between said grid and plate, resistance means connecting the grid to a negative potential, degenerative direct current feed back means connected between the grid and plate and including a pair of series-connected diodes, means for connecting a gate source between said diodes, and means connecting the plate to the gate source, whereby to utilize the generated sweep to terminate the gate and the sweep.

12. A sweep generator adapted to be actuated by a gate source and comprising an electron discharge device having a grid and a plate, a capacitor, cathode follower means connecting said capacitor between said grid and plate, resistance means connecting the grid to a negative potential, degenerative direct current feed back means connected between the grid and plate and including the series combination of a first diode, the grid-cathode path of a cathode follower having a grid and a second diode, means for connecting a gate source to the grid of the last named cathode follower, and cathode follower means connecting the plate to the gate source, whereby to utilize the generated sweep to terminate the gate and the sweep.

13. A sweep generator adapted to be actuated by a gate source and comprising an electron discharge device having a grid and a plate, a capacitor, cathode follower means connecting said capacitor between said grid and plate, resistance means including a constant current electron discharge device connecting the grid to a negative potential, degenerative direct current feed back means connected between the grid and plate and including a pair of series-connected diodes, means for connecting a gate source between said diodes, and cathode follower means connecting the plate to the gate source, whereby to utilize the generated sweep to terminate the gate and the sweep.

14. A sweep generator adapted to be actuated by a gate source and comprising an electron discharge device having a grid and a plate, a capacitor, cathode follower means connecting said capacitor between said grid and plate, resistance means including a constant current electron discharge device connecting the grid to a negative potential, degenerative direct current feed back means connected between the grid and plate and including the series combination of a first diode, the grid-cathode path of a cathode follower having a grid and a second diode, means for connecting a gate source to the grid of the last named cathode follower, and cathode follower means connecting the plate to the gate source, whereby to utilize the generated sweep to terminate the gate and the sweep.

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