

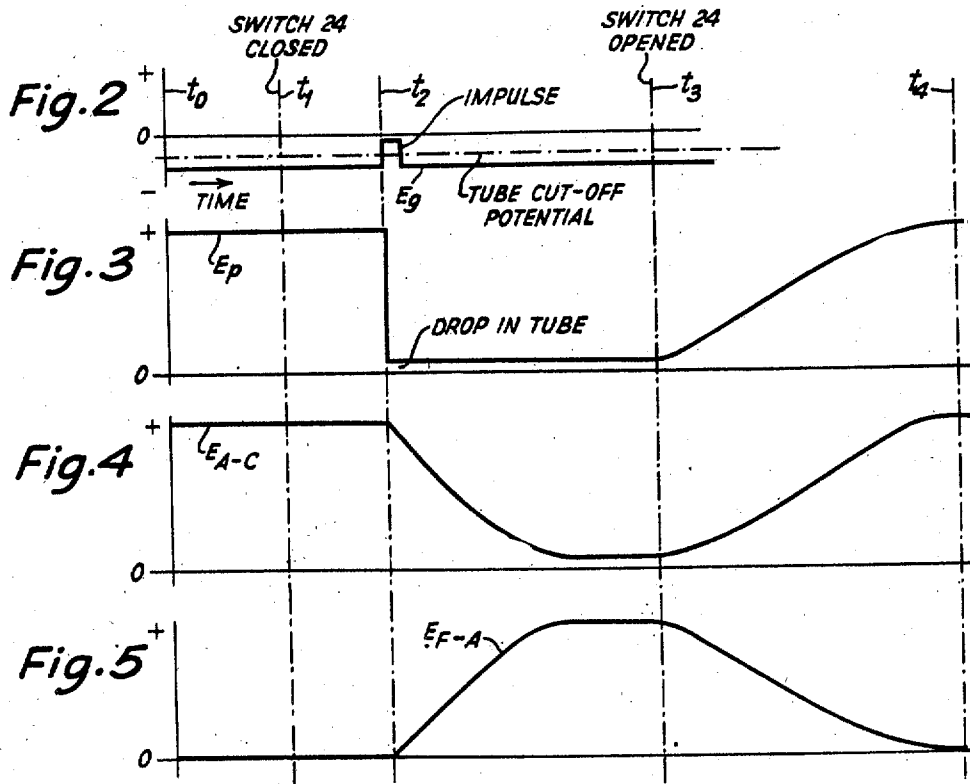
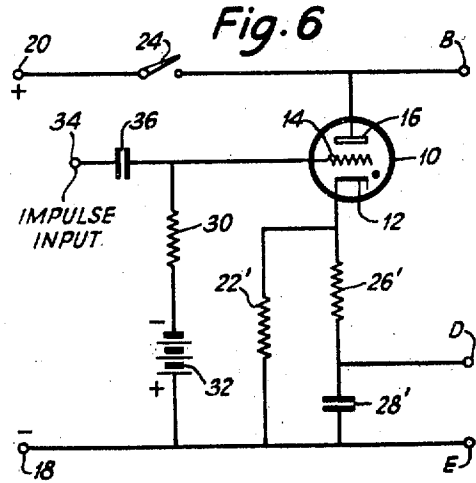
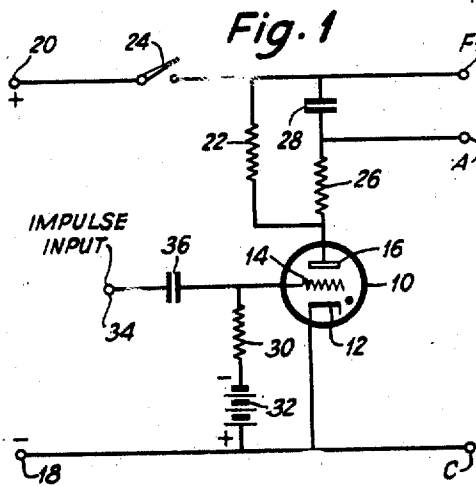
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DEFLECTION GENERATOR

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DEFLECTION GENERATOR

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This invention relates to an improvement in deflection generators for generating voltage variations that are used to deflect the cathode ray beam generated in a cathode ray tube. More particularly the invention relates to an improve-

ment in deflection generators which are to be used in oscilloscopes by means of which oscillographic observations or measurements are made. In the conventional oscilloscope a deflection generator is provided. The deflection generator produces voltage variations of substantially sawtooth wave form and of a predetermined frequency. The deflection frequency is generally controllable within wide limits and one or more adjustable elements are usually provided for this purpose. Accordingly, the cathode ray beam in the cathode ray tube of the oscilloscope is deflected horizontally at a predetermined rate and frequency and is returned at a much more rapid rate.

In making certain oscillographic measurements and observations it is sometimes desirable to deflect the cathode ray beam a single time or, in other words, to permit the deflection generator to operate for one cycle only. In such circumstances the cathode ray beam is deflected relatively slowly in one direction and is then returned rapidly to the starting point where it remains until the next deflection is initiated. Deflection generators of this type are particularly desirable where transient conditions are to be observed and the deflection of the cathode ray beam may be initiated from the beginning of the transient condition or from some entirely independently operating means. Deflecting systems which operate for a single cycle at a time, however, have the disadvantage that the return deflection of the cathode ray beam will often produce a return trace on the screen which may, under certain circumstances, be confusing and prevent accurate recording indications of the transient condition which existed during the scanning or forward stroke.

Accordingly, one object of the present invention is to provide a deflection generator for an oscilloscope in which the cathode ray beam is deflected across the screen of the cathode ray tube at a predetermined rate and in response to a triggering impulse, the deflected cathode ray beam remaining in the full deflected position until the apparatus is reset for a subsequent deflection.

Another purpose of the present invention resides in the provision of a relatively simple and inexpensive deflection generator for use with a

cathode ray tube in an oscilloscope wherein single and/or unrelated transient conditions may be observed by deflecting the cathode ray beam across the screen in one direction only and at one deflection at a time.

Still another purpose of the present invention resides in the provision and means whereby either positive or negative deflection voltage variations may be derived from the apparatus so that the cathode ray beam may be deflected in either direction during the observation stroke.

A still further purpose of the present invention resides in the provision of a circuit which is partly manual and partly automatic in operation so that the initiation of the deflection of the cathode ray beam may be automatic in response to a triggering impulse whereas the return deflection of the cathode ray beam may be in response to a manual operation.

Various other purposes and advantages of the present invention will become more apparent to those skilled in the art from the filing of specification and claims, particularly when considered with the drawing wherein like reference characters represent like elements and wherein:

Fig. 1 represents one form of the present invention.

Figs. 2, 3, 4 and 5 show curves representing certain voltage variations which occur when the circuit operates.

Fig. 6 shows a modified form of the present invention.

Referring now to the drawing and particularly to Fig. 1 thereof, the present invention includes a gas discharge tube 10 which may be of the type 834 or 885 and which includes a cathode 12, a control electrode 14 and an anode 16. A source of supply (not shown) is provided and the negative terminal of the source of supply is connected to the terminal 18 whereas positive terminal of the source of supply is connected to the positive terminal 20. The cathode 12 of the gas discharge tube 10 in Fig. 1 is connected directly to the negative terminal 18 while the anode 16 is connected to the positive terminal 20 by way of resistance 22 and manually operated switch 24. Connected in parallel with resistance 22 is a resistance-condenser combination including a resistance 26 and a condenser 28.

The control grid 14 of the gas discharge tube 10 is connected to the negative terminal 18 through a grid resistance 30 and a biasing potential 32. The potential of the control electrode 14 is normally maintained sufficiently negative with respect to the cathode 12 to prevent con-

duction of the tube 10. An input terminal 34 is also provided which is connected to the control electrode 14 by way of condenser 35. The condenser 36 is used only if relatively rapidly varying impulses are available for initiating operation of the circuit and the condenser is preferably omitted when slow variations are available for triggering. Obviously the cut-off potential of the tube 10 may be approached slowly or rapidly and the circuit will operate equally well in either case.

The operation of the circuit shown in Fig. 1 is relatively simple and can best be understood by an examination of the curves shown in Figures 2-5. When the switch 24 is closed, a positive potential is applied to the anode 16 with respect to the cathode 12 but as previously stated the control electrode 14 is biased to such an extent that the tube 10 is not permitted to conduct. Fig. 2 shows the tube cut-off potential together with the normal potential of the control electrode 14 with respect to the cathode. When the tube 10 is in a non-conducting condition both plates of the condenser 28 will be at full positive potential with respect to the cathode 12.

In order to derive operating potential from the circuit, terminals F, A and C are provided, the terminal F being connected to one plate of the condenser 28, the terminal A being connected to the junction of condenser 28 and resistance 26 while the terminal C is connected to the cathode 12 of the gas discharge tube 10.

With the manually operated switch 24 closed and with the tube 10 in a non-conducting condition the voltages which exist at various points in the circuit are represented at the time t_1 in Figures 2, 3, 4 and 5. In Fig. 3 it may be seen that the potential of the plate or anode 16 with respect to the cathode 12 is at full battery potential while Figures 4 and 5 show the voltage which is available across terminals A-C and F-A, respectively.

Let it be assumed that an impulse is applied to the terminal 34 in a positive direction and of sufficient intensity to permit the tube 10 to conduct. As is well known in all gas discharge tubes once the tube begins to conduct, the control electrode loses control and the tube continues to conduct until the energizing potential is removed. Furthermore, it is to be appreciated that the impedance of the tube 10 is relatively low and, accordingly, the voltage drop through the tube is not appreciable.

When an impulse is applied to the control electrode 14 the tube is permitted to conduct and the condition at this instant is represented in Figures 2-5 by the vertical broken line marked t_2 . As soon as the tube begins to conduct, the potential of the anode 16 with respect to the cathode 12 drops materially as indicated in Fig. 3 so that the potential difference between these electrodes corresponds to the voltage drop in the tube 10.

The voltage which is available across the terminals A-C is represented in Fig. 4 and this voltage decreases substantially linearly for a predetermined length of time and finally assumes a potential corresponding to the voltage across the anode and cathode of the tube. The terminal of the condenser 28 which is connected to the terminal A finally approaches the potential of the anode 16 so that a predetermined charged condition will exist across the condenser 28 which is represented at time t_3 in Fig. 5. If the output potential is derived from the terminals F and A then before the impulse is applied to terminal 34

no difference of potential will exist across these two terminals, however, due to the charging of the condenser when the tube 10 conducts the potential across F and A will increase at first substantially linearly then exponentially until the difference of potential across these terminals is equivalent to the line voltage less the voltage drop through the tube 10. At the time t_3 indicated in Figures 3, 4, and 5, the anode will be positive with respect to the cathode by an amount corresponding to the voltage drop through the tube and the potential of the terminal A, if the condenser 28 has been fully charged, will correspond to the potential of the anode 16. The potential of the terminal F of course remains at full positive potential.

The purpose for providing the resistance 22 is two-fold. One reason for the inclusion of the resistance 22 is to assure conduction of the tube 10 even after condenser 28 has become charged. Accordingly, the value of the resistance 22 should be such as to permit the tube 10 to continue to conduct as long as the switch 24 remains closed. The resistance 22 also offers a discharge path for the condenser 28. The value of the resistance 26 and the size or capacity of the condenser 28 may be valued in accordance with the rate at which the cathode ray beam is to be deflected across the screen. If either or both of these elements is made small the deflection rate will be made rapid whereas if either or both are made large, the deflection rate will be much slower since, as is well known, the time constant is a function of the product of the resistance and the capacity of the condenser.

By observing Figures 4 and 5 it may be seen that a deflection voltage is generated and is available across terminals A and C or F and A. This deflection voltage causes a deflection of the cathode ray beam in one direction only and since tube 10 is maintained in a conducting condition the deflected cathode ray beam is not returned to its initial starting point. Since it is generally desirable to have substantially linear deflection of the cathode ray beam as a function of time, it is preferable to use a cathode ray tube having proper deflection sensitivity or to provide sufficiently intense voltage variations such that the cathode ray beam is deflected completely across the screen by the time the condenser 28 has been charged to about one half the line voltage. After this time the exponential variation in the charging rate materially affects the rate of deflection so that the deflecting rate is considerably slowed up. This disadvantage may also be overcome by using a succeeding stage of amplification between the deflection generator and the cathode ray tube so that only the substantially linear portion of the voltage variation need be used.

After the cathode ray beam has been deflected once across the screen it can be returned only by manually opening the switch 24. When this is done the energizing potential is removed from the tube 10 and it is returned to a non-conducting condition. In Figures 3, 4 and 5 the curves have been drawn to indicate that the switch 24 was opened at the time t_3 . As soon as the switch is opened a condenser 28 discharges through resistances 26 and 22 in series so that the voltage across the condenser decreases as shown in Fig. 5 and the voltage between terminals A and C increases in potential as indicated in Fig. 4. Furthermore, the potential of the anode 16 with respect to the cathode 12 increases in potential until line voltage is ultimately reached. At the time

4 stable conditions have been reached and the circuit is ready for another cycle of operation.

Figures 3, 4 and 5 indicate certain voltage changes which occur as between the terminals A and C and terminals F and C as well as between the anode 16 and the cathode 12. As a matter of fact, when the manual switch 24 is opened the specific voltages indicated in the curves may not actually take place since, when the switch 24 is opened and the tube 10 rendered non-conductive, the resistances 22 and 26 and the condenser 28 are substantially isolated from the remainder of the circuit and no definite voltage relationship is present. The voltages shown in the curves, however, indicate the change which takes place and the voltage conditions which are assumed after the switch 24 has been opened and the condenser 28 discharged. These conditions continue to exist after the switch 24 is closed but before the tube 10 is rendered conductive. The voltage variations indicated in the curves would definitely exist if a relatively high resistance were connected across the switch 24.

From the above it may be seen that a new and improved switch circuit or deflection generator has been devised which is simple in operation and which includes a minimum of circuit components. The device described conveniently performs the function of deflecting the cathode ray beam in one direction only in response to a synchronizing impulse and maintains the beam so deflected until the system is reset for a subsequent cycle of operation. The resetting is accomplished of course by a manipulation of the switch 24 and, furthermore, it is understood that the switch 24 should remain open for a period of time sufficient for the condenser 28 to completely discharge through the resistances 22 and 26. The switch may be reclosed at any time after the tube 10 is rendered non-conductive or after the condenser is completely discharged.

A modification of the present invention is shown in Fig. 6 in which the resistance and condenser combinations are connected in the cathode circuit rather than in the anode circuit. In Fig. 6 the resistance 26', the condenser 28' and the resistance 22' correspond respectively to the elements 26, 28 and 22, in Fig. 1. In Fig. 6 output terminals B, D and E are provided and are connected respectively to the anode or positive terminal, the junction of the resistance 26' and condenser 28', and the negative terminal, respectively. Output voltage variations may be derived across the terminals B-D and D-E as in Fig. 1 and these variations would correspond to those shown in Figures 4 and 5. The circuit shown in Fig. 6 operates substantially identically the same as the circuit shown in Fig. 1 and as in Fig. 1 the control electrode 14 of the tube is normally biased to beyond cut-off potential.

In both figures it will be noticed that the condenser 28 is charged through the resistance 26 whereas during the discharge interval the condenser is discharged through resistance 26 and 22 in series. Accordingly, the discharge time will necessarily be longer than the charging time since the time constant during the discharge interval is increased. The cathode ray beam in its return stroke across the screen will therefore occupy a greater length of time than was occupied during the working or scanning stroke of the beam. By observing the return stroke of the beam it is possible to ascertain when the condenser has discharged sufficiently to permit the switch 24 to be reclosed. Actually it is not necessary to delay

the enclosure of the switch 24 until the condenser 28 has been completely discharged since the operation of the discharge tube 10 is discontinued immediately as soon as the switch 24 is opened and if the proper negative bias is maintained upon the control electrode 14 the tube 10 will remain in non-conducting condition in the absence of a triggering impulse even though the switch 24 is closed before the condenser 28 is discharged. It is necessary, however, that no triggering impulse be applied until after the condenser has been completely discharged otherwise a full deflection stroke will not appear on the screen of the oscilloscope.

Various voltages may be applied to the terminals 18 and 20, the amount of the voltages being determined by the voltage variations desired at the output terminals. It is necessary of course to apply voltage of sufficient intensity to cause the operation of the gas discharge tube 10. The amount of the bias on the control electrode tube to prevent operation of the tube will of course be determined by the potential applied to the tube in accordance with the operating characteristics of the particular gas discharge tube used.

Various other alterations and improvements may be made in the present invention without departing from the spirit and scope thereof and it is desired that any and all such modifications be considered within the purview of the present invention except as limited by the hereinafter appended claims.

I claim:

1. A cathode ray beam deflection circuit comprising a discharge tube having a cathode, a control electrode and an anode, means including an impedance and a switch connected in series for normally maintaining the anode positive with respect to the cathode, means including a resistance for maintaining the control electrode negative with respect to the cathode to normally prevent conduction of said tube, a time constant circuit including a series connected resistance and condenser, means for connecting said time constant circuit in parallel with said impedance, an output terminal connected to the junction of the condenser and the resistance forming the time constant circuit, and means for applying control impulses to the control electrode to render the tube conductive whereby a cathode ray beam deflection voltage may be derived from said terminal.

2. A single sweep cathode ray beam deflection circuit comprising a gas discharge tube having a cathode, a control electrode and an anode, means including a resistance and a switch connected in series for normally maintaining the anode positive with respect to the cathode, means including a source of potential for normally maintaining the control electrode negative with respect to the cathode to prevent conduction of said tube, a time constant circuit including a series connected resistance and condenser, means for connecting said time constant circuit in parallel with said first named resistance, output terminals connected to each plate of the condenser, and means for applying control impulses to the control electrode to render the tube conductive when the switch is in a closed position whereby a single sweep cathode ray beam deflection voltage may be derived across said terminals.

3. A single sweep cathode ray beam deflection circuit comprising a gas discharge tube having a cathode, a control electrode and an anode,

means including a resistance and manually operated switch connected in series for normally maintaining the anode positive with respect to the cathode, means including a source of potential and a resistance for maintaining the control electrode negative with respect to the cathode to normally prevent conduction of said tube, a time constant circuit including a series connected resistance and condenser, means for connecting said time constant circuit in parallel with said first named resistance, an output terminal connected to the junction of the condenser and the resistance forming the time constant circuit, and means for applying positive control impulses to the control electrode to render the tube conductive when the manually operated switch is in a closed position whereby a single sweep cathode ray beam deflection voltage may be derived between said terminal and the cathode of said tube.

4. A single sweep cathode ray beam deflection circuit comprising a gas discharge tube having a cathode, a control electrode and an anode, means including a resistance for normally maintaining the anode positive with respect to the cathode, means including a resistance for maintaining the control electrode negative with respect to the cathode to normally prevent conduction of said tube, a time constant circuit including a series connected resistance and condenser, means for connecting said time constant circuit in parallel with said first named resistance, output terminals connected to each plate of the condenser forming the time constant circuit, means for applying control impulses to the control electrode to render the tube conductive whereby a single sweep cathode ray beam deflection voltage may be derived across said terminals, and manually operable means for subsequently rendering said tube non-conductive.

5. A deflection circuit for a cathode ray beam comprising a source of potential having positive and negative terminals, a discharge tube including a cathode, a control electrode and an anode, means for connecting the cathode to said negative terminal of the source of potential, means including an impedance for connecting the anode to said positive terminal of the source of potential, means including a resistance for maintaining the control electrode sufficiently negative with respect to the cathode to normally prevent conduction of said tube, a time constant circuit including a series connected resistance and condenser, means for connecting said time constant circuit in parallel with said first named impedance, an output terminal connected to the junction of the resistance and the condenser, and means for applying a control impulse to the control electrode to initiate operation of the tube whereby a single sweep cathode ray beam deflection voltage may be derived between said output terminal and either terminal of the source of potential.

6. A single sweep deflection circuit for a cathode ray beam comprising a source of potential having positive and negative terminals, a gas discharge tube including a cathode, a control electrode and an anode, means for connecting the cathode to said negative terminal of the source of potential, means including a resistance for connecting the anode to said positive terminal of the source of potential, means including a second resistance for maintaining the control electrode sufficiently negative with respect to the cathode to normally prevent conduction of said

tube, a time constant circuit including a series connected resistance and condenser, means for connecting said time constant circuit in parallel with said first named resistance, an output terminal connected to the junction of the resistance and the condenser of said time constant circuit, means for applying a control impulse to the control electrode to initiate operation of the tube whereby a single sweep cathode ray beam deflection voltage may be derived between said output terminal and either terminal of the source of potential, and means to subsequently render said tube non-conductive.

7. A single sweep deflection circuit for a cathode ray beam comprising a source of potential having positive and negative terminals, a gas discharge tube including a cathode, a control electrode and an anode, means for connecting the cathode to said negative terminal of the source of potential, means including a series connected resistance and switch for connecting the anode to said positive terminal of the source of potential, means including a second source of potential and a resistance for maintaining the control electrode sufficiently negative with respect to the cathode to normally prevent conduction of said tube, a time constant circuit including a series connected resistance and condenser, means for connecting said time constant circuit in parallel with said first named resistance, an output terminal connected to the junction of the resistance and the condenser of said time constant circuit, and means for applying a positive control impulse to the control electrode to initiate operation of the tube when said switch is in a closed position whereby a single sweep cathode ray beam deflection voltage may be derived between said output terminal and either terminal of the source of potential, said tube being subsequently rendered non-conductive by opening said switch.

8. A deflection circuit for a cathode ray beam including a source of potential having positive and negative terminals, a discharge tube including a cathode, a control electrode and an anode, means for connecting the anode to the positive terminal of said source of potential, means including a resistance for connecting the cathode to the negative terminal of said source of potential, a time constant circuit including a series connected resistance and condenser, means for connecting said time constant circuit in parallel with said cathode resistance, means for normally maintaining said control electrode negative with respect to said cathode, an output terminal connected to the junction of the resistance and condenser forming said time constant circuit, and means for applying a triggering impulse to said control electrode whereby a single sweep cathode ray beam deflection voltage may be derived between said output terminal and either terminal of said source of potential.

9. A single stroke deflection circuit for a cathode ray beam including a source of potential having positive and negative terminals, a gas discharge tube including a cathode, a control electrode and an anode, means including a switch for connecting the anode to the positive terminal of said source of potential, means including a resistance for connecting the cathode to the negative terminal of said source of potential, a time constant circuit including a series connected resistance and condenser, means for connecting said time constant circuit in parallel with said cathode resistance, means includ-

ing a further resistance for normally maintaining said control electrode negative with respect to said cathode to prevent conduction of said tube, and output terminal connected to the junction of the resistance and condenser forming said time constant circuit, and means for applying a positive triggering impulse to said control electrode whereby a single stroke cathode ray beam deflection voltage may be derived between said output terminal and either terminal of said source of potential, the operation of said tube being subsequently discontinued by opening said switch.

10. A single stroke deflection circuit for a cathode ray beam including a source of potential having positive and negative terminals, a discharge tube including a cathode, a control electrode and an anode, means including a manually operated switch for connecting the anode to the positive terminal of said source of potential, means including a resistance for connect-

ing the cathode to the negative terminal of said source of potential, a time constant circuit including a series connected resistance and condenser, means for connecting said time constant circuit in parallel with said cathode resistance, means including a second source of potential and a resistance for maintaining said control electrode negative with respect to said cathode to normally prevent conduction of said tube, an output terminal connected to the junction of the resistance and condenser forming said time constant circuit, and means for applying a triggering impulse to said control electrode to render said tube conductive when said switch is in a closed position whereby a single sweep deflection voltage may be derived between said output terminal and either terminal of said source of potential, said tube being subsequently rendered non-conductive by manually opening said switch.

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