

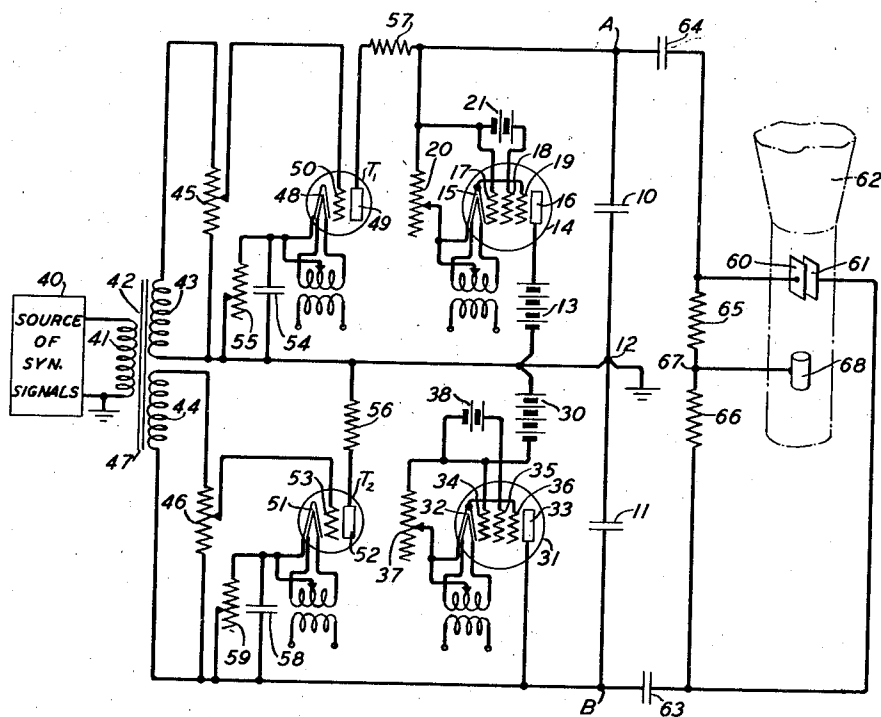
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BIASING POTENTIAL SUPPLY CIRCUIT

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## BIASING POTENTIAL SUPPLY CIRCUIT

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This invention relates to biasing potential supply circuits and more particularly to such circuits when embodied in sweep circuits for television scanning or cathode ray oscillography.

In Patent No. 2,180,365 of F. R. Norton, patented November 21, 1939, there is disclosed a sweep circuit for use in television scanning. The invention described herein comprises novel means for obtaining and applying biasing potential without the use of batteries for certain of the electron discharge tubes used in that circuit which circuit is an improved balanced sweep circuit utilizing gas-filled electron discharge devices.

An object of this invention is to provide an improved circuit arrangement for biasing the control electrode with respect to the cathode of electron discharge tubes.

A further object is to provide a circuit arrangement utilizing the sweep circuit condenser discharge current to provide the biasing potential of an electron discharge tube which controls said condenser discharge.

In one embodiment of this invention now to be described by way of example, a "double" sweep circuit is employed, that is, a sweep circuit in which a plurality of gas-filled grid-controlled electron discharge devices used for producing the discharge strokes in the generation of the saw-tooth wave forms have their plate circuits in series and have their grid biasing potentials provided by the novel circuit arrangement of this invention. By this sweep circuit arrangement the available output voltage may be approximately doubled. Another advantage of this double circuit is that it produces a balanced output without the necessity for amplifiers or a floating power supply. In other words, in this circuit the power supply may be grounded without producing unbalance. In its preferred form the sweep circuit comprises two condensers in series with their common terminal grounded, a constant current device such as a multi-grid electron discharge device having feedback circuits on one or more of its grids and a source of current for charging up each condenser in a substantially linear manner with respect to time, and two grid-controlled gas-filled electron discharge devices which may be, for example, of the type generally known as "Thyratron" tubes, having their plate circuits in a series circuit including the condensers, and suitable means such as a transformer having two secondary windings for discharging the "Thyratron" tubes simultaneously. The change in voltage across the condensers due to their charging and discharging may be applied, for example, across

the deflecting plates of a cathode ray tube through suitable coupling condensers and a resistance, the mid-point of this resistance being connected to the anode of the cathode ray tube. In the novel circuit arrangement according to this invention the grid biasing potential for the gas-filled tubes is obtained from variable cathode resistances and large by-pass condensers, instead of from grid batteries as in the sweep circuit shown in Patent No. 2,180,365, supra. By making the cathode resistances variable, it is possible to easily adjust the grid bias to a suitable value for proper functioning of the circuit whereupon the discharging of the gas-filled tubes occurs in synchronism.

The invention will be described more in detail having reference to the accompanying drawing which shows a balanced sweep circuit embodying this invention.

The drawing shows a balanced sweep circuit which may be used, for example, as a suitable source for generating saw-tooth voltages to be applied to a pair of deflecting plates of a cathode ray oscillograph or a television receiving tube to cause deflection of the cathode ray beam in one direction, as for example, in a horizontal direction. A similar circuit, differing only from this one in the value of the circuit constants, may be used to produce vertical deflection. The circuit comprises condensers 10 and 11 of relatively small capacity having their common terminal 12 connected to ground, and means for charging and discharging these condensers simultaneously.

The charging circuit for condenser 10 comprises a source of potential 13, which may be obtained from a battery or a suitable rectifying device, and a constant current device 14 which may be a saturated diode or a pentode. Preferably, the device 14 comprises a pentode having a cathode 15, an anode 16, a control grid 17, a screen grid 18, and a suppressor grid 19. In series with the plate circuit of the device 14 is the biasing resistance 20, which may be adjustable. This biasing resistance 20 is also in the input circuit between the cathode 15 and the control grid 17 and by means of this arrangement any decrease in voltage in the plate circuit of the device 14 caused by the increase in charge across the condenser 10 which tends to reduce the plate current will decrease the bias of the control grid 17 and tend to keep the current through the tube at a constant value. Thus the rate of charge of the condenser 10 tends to be constant. The biasing resistance 20 may be, if desired, arranged in a feedback relation with respect to the screen grid 18.

A battery 21 is also used in this circuit to produce a constant direct current bias between the cathode and the screen grid 18. The effect of the feed back on the screen and control grid is cumulative. For a more complete description of the method of operation of pentode tubes having feedback circuits on one or more of their grids to produce a constant condenser charging rate, reference is made to Patent No. 2,180,364 of F. R. Norton, patented November 21, 1939.

The circuit for charging the condenser 11 comprises a battery 30 and a constant current source 31 having a cathode 32, an anode 33, a control grid 34, a screen grid 35 and a suppressor grid 36. A biasing resistor 37 is connected in the plate circuit and also in the circuit between the cathode 32 and the grid 34 in a manner similar to the connection for the resistance 20 described above. This biasing resistance 37 is also connected in a circuit between the cathode 32 and the screen grid 35, this circuit also including a battery 38 which is similar to battery 21 described above. Battery 38 may obviously be a part of battery 30, if desired, and both may be replaced by a rectifier or other source of direct current potential.

In order to have a balanced circuit, the capacities between point A and ground and point B and ground represented by the condensers 10 and 11 and including the external connections thereof should be equal, and also the constant current devices 14 and 31 and their connections should be similar.

The circuit for discharging the condensers 10 and 11 at periodic intervals comprises a source of synchronizing signals 40 which is connected to the primary winding 41 of the transformer 42 which has two secondary windings 43 and 44, connected respectively to the grids of "Thyratron" tubes T1 and T2 through potentiometers 45 and 46. The synchronizing signals supplied by the source 40 may be produced by an oscillator or other device which periodically produces current of suitable wave form which may be impressed upon a cathode ray oscillograph or used in a television system.

The source 40 may be located at the transmitter or at the receiver and may take any one of a variety of well-known forms. For example, if the circuit now being described were used in connection with a cathode ray tube at the receiver, and a scanning disc were used to generate the image and synchronizing signals at the transmitter, an arrangement for generating the synchronizing signals may be used similar to the one described in Patent No. 2,050,363, of E. R. Morton, patented August 11, 1936. If a cathode ray device is used at the transmitting station, the return pulses of the horizontal or the vertical deflecting circuits may be used to generate the synchronizing signals for the corresponding sweep circuits at the receiving station.

The "Thyratron" tubes T1 and T2 are of the gas-filled electron discharge type comprising respectively a cathode 48, an anode 49 and a grid 50 for tube T1, and a cathode 51, an anode 52 and a grid 53 for tube T2. Novel biasing circuits are connected in the grid-cathode circuits of these "Thyratron" tubes. These circuits comprise a condenser 54 shunted by a variable resistance 55 placed in the grid-cathode circuit of tube T1, and a condenser 58 shunted by a resistance 59, which may be either fixed or variable, placed in the grid-cathode circuit of tube T2. The values of these condensers and resistances

depend upon various factors such as the other circuit constants and the frequency of operation of the sweep circuit. However, it is important that the capacity of condensers 54 and 58 be very large as compared with that of condensers 10 and 11 whose values are determined by the circuit constants and the frequency of the sweep circuit. Resistances 57 and 56 are placed in the plate circuits of tubes T1 and T2, respectively, in order to limit the peak discharge currents through the "Thyratron" tubes. The plate circuits of tubes T1 and T2 are connected in a series circuit which includes resistance 57, condensers 10 and 11, condenser 58 and resistance 59 in parallel, plate circuit of tube T2, resistance 56, condenser 54 and resistance 55 in parallel, and plate circuit of tube T1. The common terminal of condenser 54 and resistance 55 remote from the cathode of the tube T1 and the terminal of resistance 56 remote from the anode 52 of tube T2 are connected to ground. By means of this arrangement the voltage between points A and B is twice the voltage between either of these points and ground.

For coupling the points A and B to the deflecting plates 60 and 61 of the cathode ray tube 62, an amplifier or a suitable wide-band transformer might be used, or as shown in the drawing, coupling condensers 63 and 64 and coupling resistances 65 and 66 may be utilized. Condensers 63 and 64 are preferably of equal capacity and resistances 65 and 66 should be equal. The mid-point 67 of the high resistances 65 and 66 is connected to the anode 68 of the cathode ray device 62. By means of this balanced circuit arrangement, the average of the voltages applied to the plates 60 and 61 always equals the potential of the anode 68.

In producing the biasing potential for tubes T1 and T2, the condenser 10 is charged through a circuit from positive voltage source 13 through the anode-cathode circuit of constant current tube 14, and condenser 11 is charged through the anode-cathode circuit of tube 31 from negative voltage source 30. Once per cycle the wave impressed upon the input transformer 42 causes the potentials of the grids of T1 and T2 to become sufficiently high to cause the tubes to break down and to discharge condensers 10 and 11, condenser 10 discharging through tube T1 into condenser 54 connected in the grid-cathode circuit of tube T1, and condenser 11 discharging through tube T2 into condenser 58 in the grid-cathode circuit of tube T2. The grid condensers 54 and 58 are shunted by resistances 55 and 59, respectively. The resistance across one of the condensers is made variable to facilitate bringing the discharging of the two tubes into synchronism, and the resistance across the other condenser may also be made variable for making initial circuit adjustment, but need not be used for routine operating adjustment. The "time constant" of condenser 54 and resistance 55, and likewise of condenser 58 and resistance 59, that is, the product of the capacity times the resistance, is made large compared with the period of the sweep, and hence the voltage across each of the condensers 54 and 58 decreases very slightly during each cycle of the sweep current. When the tubes T1 and T2 break down, the condensers 10 and 11 quickly discharge to a very low potential. Suitable biasing potential for tubes T1 and T2 may be obtained by employing condensers 54 and 58 having capacities of the order of 1000 times the capacity of condensers 10 and 11 and

shunting resistances 55 and 59 having resistances such that the average current through them provides the correct value of bias.

5 The operation of the circuit as a whole is as follows:

Condensers 10 and 11 are charged at a substantially linear rate by means of suitable potential sources 13 and 30 and the constant current devices 14 and 31. At periodic intervals, as for  
10 example, at the end of each scanning line, a synchronizing signal is generated by the source 40 and caused to energize the primary 41 of the transformer 42. The voltages in the secondary windings 43 and 44 are made sufficient to overcome the negative bias on the tubes T1 and T2  
15 causing these tubes to discharge the condensers 10 and 11 simultaneously. The cyclic charge and discharge of the condensers 10 and 11 produces across the points A and B a voltage wave of saw-  
20 tooth wave form of the frequency of the synchronizing signals which wave is applied across the plates 60 and 61 of the oscillograph tube 62 by means of the coupling condensers 64 and 63 and the coupling resistances 65 and 66. This voltage  
25 wave, as described above, is balanced with respect to the potential of the anode 68, thus eliminating any loss of focus and distortion which would have resulted had the sweep circuit been unbalanced.

30 The transformer 42, here shown, is an ordinary audio transformer although it may be an impulse transformer as shown in Patent No. 2,180,365, supra.

35 In the arrangement shown, amplifiers are not usually necessary in the sweep circuit. However, the circuit may be connected to the oscillograph tube by any suitable means such as a condenser-resistance coupling, as shown in the drawing, or through other suitable means including amplifiers. Another advantage is that the voltage output is double that which would be produced in  
40 single "Thyratron" sweep circuits. This advantage is important because the trend at present is toward higher and higher sweep voltages, and because the voltage output of the "Thyratron" tubes is limited in circuits where the frequency is so  
45 high that the time allowed for deionization is very short. Another advantage is the elimination of a floating power supply, that is, one terminal of each of the batteries or potential sources 13  
50 and 30 is connected to ground. A further advantage and novel feature is the elimination of biasing batteries for the "Thyratron" tubes T1 and T2.

55 In an actual circuit operated at a frequency of approximately 5760 cycles per second and employing condensers 10 and 11 each having a capacity of the order of .0007 microfarad and resistances 65 and 66 of the order of 10 megohms and  
60 coupling condensers 63 and 64 each having a capacity of the order of 1.0 microfarad, suitable biasing potential was obtained for tubes T1 and T2 by connecting in their grid-cathode circuits

condensers 54 and 58 each having a capacity of the order of 0.7 microfarad and shunting resistances 55 and 59, respectively, each having a resistance of the order of 0.1 megohm. For a different frequency of operation or other changes in  
5 operating conditions, obviously these values will be different.

While the biasing circuits embodying this invention have been described in connection with a general circuit arrangement connecting with the  
10 electrostatic deflecting plates of an oscillograph tube, it is obvious that the invention may be applied in the case of electromagnetic deflecting means as well.

Various modifications may be made without  
15 departing from the spirit of the invention, the scope of the invention being defined by the appended claims.

What is claimed is:

1. A voltage source of saw-toothed wave form  
20 comprising two equal condensers connected in series, means to charge said condensers at uniform and equal rates, two gas-filled electron discharge tubes each having a cathode, a control  
25 grid and an anode, a condenser of relatively large capacity for each of said tubes shunted by a respective resistance connected at one terminal thereof to the cathodes of said tubes respectively,  
30 means to connect the anode of one of said tubes to the non-common terminal of one of said equal condensers, means to connect the other terminal of the large condenser which is connected to the  
35 cathode of said one tube to the anode of said other tube and the junction point of said equal condensers, means to connect the other terminal of the large condenser which is connected to the  
40 cathode of said other tube to the non-common terminal of the other of said equal condensers, means to intermittently and simultaneously impress voltages on the grid-cathode circuits of said  
45 tubes to cause the tubes to break down, and means to vary one of said shunted resistances to cause said tubes to break down simultaneously.

2. A sweep circuit comprising two capacities  
45 having a common terminal, means comprising two electron discharge devices for charging said capacities serially substantially simultaneously, means for maintaining said common terminal at  
50 a fixed potential, two electron discharge elements each having grid circuits for discharging said capacities substantially simultaneously, biasing  
55 circuits for each of said discharge elements comprising a capacity shunted by a resistance in the grid circuit of each of said discharge elements, and means for discharging said first-mentioned  
60 capacities periodically through the said second-mentioned capacities to produce voltages to block said discharge elements during the entire charging period of said first-mentioned capacities, and means to vary one of said resistances to cause said discharge elements to discharge said first-mentioned capacities simultaneously.

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