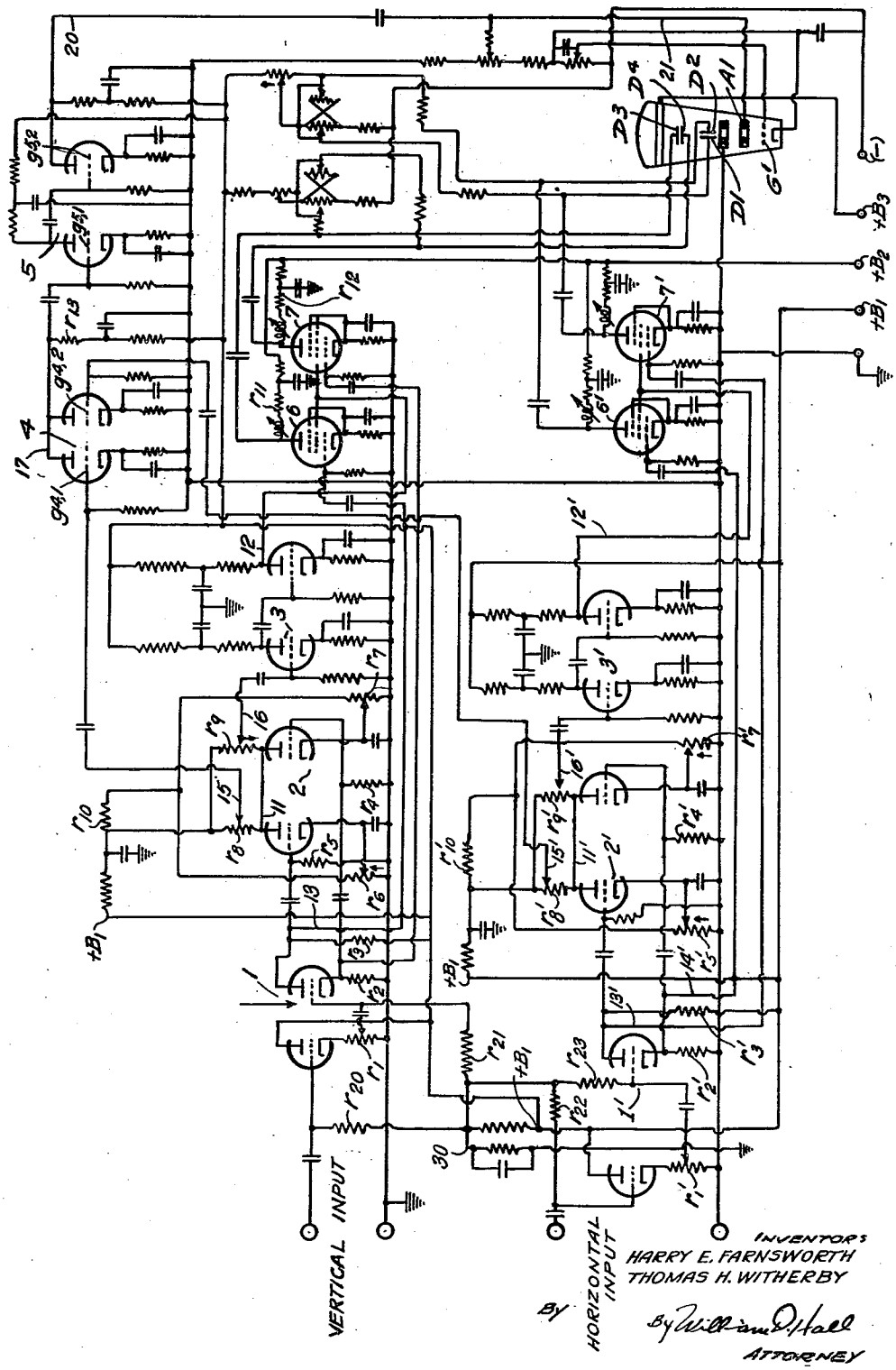
Sept. 14, 1948. T. H. WITHERBY ET AL 2,449,524

OSCILLOSCOPE DEVICE

Filed Nov. 27, 1944



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Patented Sept. 14, 1948

2,449,524

UNITED STATES PATENT OFFICE

2,449,524

OSCILLOSCOPE DEVICE

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Application November 27, 1944, Serial No. 565,378

13 Claims. (Cl. 315—14)

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This invention relates to improvements in devices for focusing electrostatic cathode ray tubes.

The focusing defects encountered in the operation of electrostatic cathode ray tubes are due to the dependence of spot size or line width on (*a*) grid potential, V_G which controls the intensity of the spot; (*b*) potential difference between the deflecting plates which control the position of the spot on the screen; (*c*) mean potentials, $M_{1,2}$ and $M_{3,4}$, of the two pairs of deflecting plates with respect to the second anode and the corresponding adjusted values of the first anode potential, V_{A1}. These defects are interdependent. Thus, in order to keep the spot in best focus as its position on the screen is varied over the whole area, it is necessary to adjust both V_{A1} and the mean potentials of the deflecting plates. Also a variation of the grid potential for a given spot position requires an additional adjustment of V_{A1}.

It is, therefore, an object of this invention to provide a control circuit for automatically adjusting both the mean potentials $M_{1,2}$ and $M_{3,4}$, and the first anode potential, V_{A1}, as the applied deflecting voltages are varied by amounts which correspond to deflections of the spot over the whole area of a screen.

The circuit is constructed on the assumption that the required correction potentials are proportional to the square of the deflection potentials. It is also assumed that the total correction to be applied to the first anode potential V_{A1} is the algebraic sum of the individual corrections for the horizontal and vertical deflections. The correction applied to the mean potential of each pair of deflecting plates is proportional to the square of the instantaneous deflecting potential, the rate being manually adjusted by a potentiometer. The results which have been obtained experimentally show that these assumptions are justified in general, in other words, the circuit is constructed on the assumption that the required correction curves of increment M and increment V_{A1} along the axis of deflection may be approximated by two parabolas, having a common axis, whose curvatures may be varied independently. Corrections along the two axes of deflection may be made independently. It is also assumed that the desired result can be obtained by varying $M_{1,2}$ as a function of the deflection potentials on D_1D_2 only, and similarly for $M_{3,4}$ and D_3D_4, and that the required adjustment of V_{A1} at a point (x, y) is given by the algebraic sum of the adjustments required for the two points (o, y) and (x, o). The results which

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have been obtained show that these assumptions are justified in general.

This and other objects are attained by the circuit and arrangement of elements hereinafter described and shown on the accompanying drawings, forming a part hereof, and in which the figure is a schematic diagram of a circuit embodying the invention.

Referring to the circuit diagram, the system is symmetrical with respect to vertical and horizontal input terminals. Tubes 1, 2, 3, 4 and 5 are of the twin triode type. Considering for the present only the vertical amplifier circuit, the first twin tube 1 is an input cathode follower and amplifier. Twin triode 2 is a generator for producing square law focus correction voltages. Each triode is biased just to cut off by adjustment of cathode potentiometers r_6 and r_7 fed from +B through resistor r_{10}. Since each component tube operates on the curved portion of its characteristic curve, the plate signal output of each tube is proportional to the square of its input grid voltage, and thus provides the type of focus correction voltage required. These corrective voltages appear across plate potentiometers r_8 and r_9. Appropriate portions of voltage drop appearing across r_8 and r_9 are fed to the grids of the following tubes 3 and 4 as shown. The plates of both triodes of tube 2 are connected together by lead 11. Thus a positive signal applied to the grid of either tube gives a negative signal at the combined plates, a negative signal having no effect because of the blocking bias.

The third twin triode 3 is a two stage amplifier whose input is adjusted by potentiometer r_9 of tube 2. Its output is applied through lead 12 to the accelerating grids of pentode tubes 6 and 7, connected in parallel. The control grid of pentode 6 is excited by the voltage drop across plate resistor r_3 of the second part of tube 1, through lead 13, while control grid of pentode 7 is similarly excited by the drop across cathode resistor r_2 through lead 14. Thus the plate output voltages of tubes 6 and 7 appearing across resistors r_{11} and r_{12} are in phase opposition and are applied separately to the vertical deflecting plate D_3 and D_4 of the cathode ray tube, thereby maintaining a balanced potential with respect to ground.

Since the accelerating grids of tubes 6 and 7 are in parallel, the pair of vertical deflecting plates D_3 and D_4, are carried simultaneously above the mean and no signal potential in accordance with the square law potential derived

from correction generator 2 but without disturbing the deflection potential between plates.

Grid bias potentials for tube 1 are supplied by grid resistors r_{20} and r_{21} connected to bias junction 30. Similarly bias potentials for the corresponding tube 1' are determined by grid resistors r_{22} and r_{23}.

The circuit for the horizontal deflection system is identical with that for the vertical system and corresponding numbers are used. The functions of tubes 1', 2', and 3' are identical with those of tubes 1, 2, and 3. The adjusted output of square law correction generator 2' is fed through amplifier 3' through lead 12' to the accelerating grids (in parallel) of output pentodes 6' and 7'. This varies the mean potential of horizontal deflection plates D_1 and D_2 in accordance with the desired horizontal correction.

The adjusted output of first element of square law correction generator 2 is fed from plate resistor r_8 through lead 15 to grid $g_{4,1}$ of tube 4. Similarly the adjusted output of correction generator 2' is fed from plate resistor r_8' through lead 15' to grid $g_{4,2}$. The plates of both elements of tube 4 are corrected in parallel by lead 17, hence the correction effects of both channels are added algebraically in plate resistor r_{13} from which the resultant effect is applied to control grid $g_{5,1}$ of amplifier tube 5. The amplified correction voltage is fed by leads 20 and 21 to the accelerating anode A_1 of the cathode ray tube.

The overall result of the corrective system is to apply a square law correction voltage to the accelerating anode of the cathode ray tube which is the algebraic sum of the corrections for the separate channels and to provide square law correction voltages for the individual pairs of deflecting plates thereby automatically maintaining the electron beam in sharp focus at all parts of the screen.

Referring to the circuit diagram and considering only the vertical amplifier, the first tube 1, is an input cathode follower and a phase splitter. The second tube 2 is the "correction signal detector." Tubes 1, 2, 3 are of the 6SN7 type, twin triode, class A amplifiers. In the second tube 2, the plates are tied together, and each triode of tube 2 is biased separately just to cut-off. There is thus a negative signal at the plates for either a positive or a negative deflection signal. Since the tube is operating on the curved portion of the characteristic Δe_p is approximately proportional to $-(\Delta e_g)^2$ which means the correction curve will be approximately a parabola. e_p is the plate voltage and e_g the grid voltage.

The third tube 3, is a two stage amplifier which drives the screens of the output tubes with a correction signal 180° out of phase. The output pentodes act as mixers for the deflection and correction signals, thus making a mean potential correction.

The circuit for horizontal deflection is identical.

Attenuated correction signals are mixed in tube 4, which is of the variable mu class A amplifier. The following tube 5, which is of the 6SN7 type, was found necessary in order there be sufficient signal voltage at the first anode A1. One stage of amplification would suffice, but then the phase would be inverted.

By means of the above circuit arrangement the various voltages of a cathode ray tube are automatically adjusted to maintain the tube in focus.

The above description is to be considered as illustrative and not restrictive of the invention, of which modifications can be made without departing from the scope and spirit of the invention as set forth in the appended claims.

The invention having been described, what is claimed is:

1. In a circuit including signal input terminals, a cathode ray tube having deflecting plates, and a focusing electrode; means for generating a voltage substantially proportional to the square of the signal input voltage; and vacuum tube means for applying said square law voltage to said focusing electrode for automatically correcting the focus.

2. In a circuit having signal input terminals and including a cathode ray tube having deflecting plates, and a focusing electrode; means for generating a voltage substantially proportional to an exponential power of said signal input voltage; and vacuum tube means for applying a portion of said exponential voltage as a correction to said focusing electrode for automatically correcting the focus.

3. In a circuit having signal input terminals and including a cathode ray tube having deflecting plates, and a focusing electrode; means for generating a non-linear voltage substantially proportion to an exponential power of the signal input voltage; said means comprising an amplifier biased substantially to cut off and excited from said input voltage; and means for applying a portion of said exponential voltage to said focusing electrode for automatically correcting the focus.

4. In a circuit having signal input terminals and including a cathode ray tube, having deflecting plates and a first anode; means for automatically correcting the focus during deflection, said means comprising a biased amplifier excited from said signal input for generating an exponential focus correction voltage and vacuum tube means for applying said correction voltage to said first anode.

5. In a circuit having signal input terminals and including a cathode ray tube having deflecting places and a focusing electrode, means for automatically correcting said focus as a function of said input voltage; said means comprising a biased amplifier excited from said signal input for generating an exponential correction voltage and vacuum tube means for changing the mean potential of one pair of deflecting plates, in accordance with said correction voltage.

6. In a circuit having two input channels and including a cathode ray tube having vertical and horizontal deflecting plates and a first anode; means for automatically correcting the focus as a function of the combined input voltages; said means comprising a biased amplifier for each channel and each excited by its channel input voltage, vacuum tube means for adding the separate correction voltages and for applying the resultant voltage to said first anode.

7. In a circuit having two input channels and including a cathode ray tube having vertical and horizontal deflection plates and a focusing electrode; means for automatically correcting the focus as a function of the deflection voltages of each channel; said means comprising a biased amplifier for each input channel biased substan-

tially to cut off, and vacuum tube means for changing the mean potential of each pair of deflecting plates in accordance with the output of the corresponding biased amplifier.

8. In a cathode ray tube circuit including vertical and horizontal input channels, a cathode ray tube having vertical and horizontal deflecting plates and a first and second anode; means for automatically correcting the focus as a function of the input voltages of each channel; said means comprising an amplifier for each channel biased substantially to cut off for generating a correction voltage, vacuum tube means for changing the mean potential of each of said pairs of deflecting plates in accordance with the correction voltage of the corresponding channel, and means for adding said channel correction voltages and applying the resultant voltage to said first anode.

9. In a cathode ray tube circuit including vertical and horizontal input channels, a cathode ray tube having vertical and horizontal deflecting plates and a first and second anode; means for automatically correcting the focus as a function of the input voltages in each channel; said means comprising an amplifier for each channel biased substantially to cut off for generating a correction voltage, means for manually adjusting the output of each biased amplifier, means for changing the mean potential of each pair of deflecting plates in accordance with the correction voltage of the corresponding channel, and means for adding said channel correction voltages and applying the resultant voltage to said first anode.

10. In a cathode ray tube circuit including vertical and horizontal input channels, a cathode ray tube having vertical and horizontal deflecting plates, a focusing electrode and means for automatically correcting the focus during deflection, including a focus correction generator for each channel; means for adding algebraically said correction generator voltages and applying the resultant to said focusing electrode said adding means comprising a pair of amplifier tubes having a common output resistor each tube having a plate, cathode and grid; said plates being connected in parallel and each grid excited from the output of one of said correction generators.

11. In a cathode ray tube circuit including a cathode ray tube having vertical and horizontal pairs of deflecting plates, first and second input channels for said pairs of deflecting plates respectively; a focusing electrode and means for automatically correcting the focus, said correcting means including first and second focus correction generators for said channels respectively and means for changing the mean potential of each pair of deflecting plates in accordance with the output of the first and second correction generators respectively; each said potential changing means including a pair of amplifier tubes; each tube being provided with at least two grids, a cathode and an anode, the anodes corresponding to the first channel being respectively connected to the vertical deflecting plates, the anodes corresponding to the second channel being respectively connected to the horizontal deflecting plates, and the control grids of each pair of tubes being excited in phase opposition from the corresponding input channel respectively, said second grids in each pair of tubes being connected together, and excited by the corresponding focus correction generator.

12. In a cathode ray tube circuit including vertical and horizontal input channels, a cathode ray tube having vertical and horizontal deflecting plates, focusing electrodes and means for automatically correcting the focus during deflection including a focus correction generator for each channel, means for changing the mean potentials of said deflecting plates in accordance with the respective outputs of said correction generators; said means comprising a pair of amplifier tubes for each channel, each tube being provided with two grids, each pair of control grids being excited in phase opposition from one channel input, said amplifier tubes including anodes respectively connected to the corresponding deflection plates and the second grids of each pair being connected together and respectively excited by their complementary focus correction generator.

13. In a system for a cathode ray tube having means for horizontal and vertical deflection of an electron beam, and vertical and horizontal input channels each including a preamplifier; means for automatically correcting the focus of said beam comprising generator means in each deflection channel adapted to produce focus correction voltages substantially proportional to an exponential power of the signal voltage; means for adding the separate channel correction voltages and applying the resultant to the first anode of said cathode ray tube; and potential changing means for changing the mean potential of each pair of deflecting plates in accordance with the correction voltage for the corresponding channels; said generator means comprising two pairs of amplifier tubes biased substantially to cut off, the plates of each pair being connected in parallel and having an output impedance, and grids excited in phase opposition from their complementary preamplifier; said adding means comprising a pair of amplifier tubes having plates connected together and having grids excited by the complementary correction generators; means for applying anode potential to the plates of said first pair of amplifier tubes including resistance means in series with such plates; means for applying anode potential to the plates of said second pair of amplifier tubes including resistance means in series with such plates of the second pair; said potential changing means comprising a pair of amplifier tubes for each channel each having at least two grids, the control grids of each pair being excited in phase opposition by their complementary preamplifiers and whose plates are separately connected to the corresponding pair of deflecting plates and whose second grids are connected together and excited by the corresponding correction generator.

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