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ELECTRONIC APPARATUS

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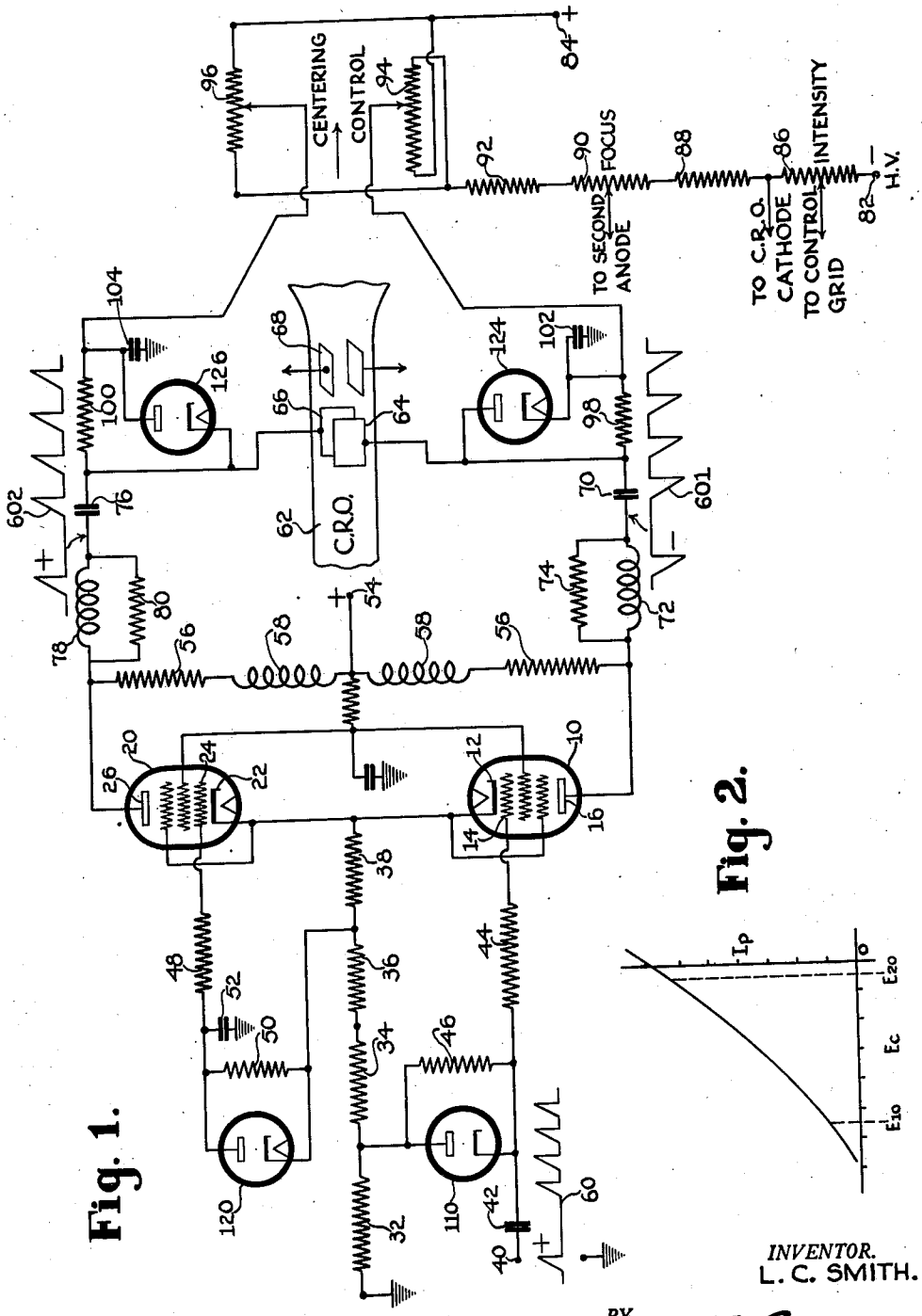


Fig. 1.

Fig. 2.

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ELECTRONIC APPARATUS

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10 Claims. (Cl. 315—26)

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The present invention relates to an improvement in cathode ray oscilloscopes, and more particularly to oscilloscopes wherein single sweep deflection provisions are present.

In U. S. patent application entitled "Deflection circuits" filed by this applicant concurrently herewith as Serial No. 537,275, issued December 10, 1946, as Patent No. 2,412,542, a circuit arrangement is shown and described wherein voltage variations are developed which may be used for deflecting a cathode ray beam in a cathode ray oscilloscope. The circuit arrangement is of such a nature that the cathode ray beam may be deflected across the screen of the viewing tube each time a transient signal to be observed is applied thereto, the beam being normally maintained in a static condition in the absence of such transient conditions. By means of the circuit arrangement, single sweep deflections of a cathode ray beam may be produced.

Since transient phenomena do not, in most instances, occur at regular intervals, single sweep provisions must be made in order that an apparently stationary trace may be produced on the screen or target area of the cathode ray tube used for observation purposes. In some instances, it is possible that a transient phenomena may occur in relatively widely spaced time intervals, whereas in other instances the same transient phenomena may occur in rather rapid succession. If a single sweep deflection generator is used which will respond to each transient condition, then the horizontal deflection of the cathode ray beam in the oscilloscope will be deflected at such intervals when the transient condition occurs, with the result that the horizontal deflections of the cathode ray beam may occur during rather spaced intervals or the sweep deflection may be produced in relatively rapid succession over a period of time. By reason of this inconsistency in the frequency of occurrence of the transient phenomena and the resultant inconsistency in the repetition frequency of the cathode ray beam sweep deflections, certain undesirable effects will result in a conventional deflection amplifier and in the circuits associated with the cathode ray tube which will cause a change in the biasing or static conditions present in the circuit.

More specifically, in cathode ray oscilloscopes a provision is made whereby the horizontal position of a cathode ray beam as well as the area traversed by the beam during its horizontal deflection may be controlled manually

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for centering purposes. This centering control applies a predetermined static bias to the deflecting plates of the cathode ray tube so that when the sweep deflection potentials (of properly adjusted intensity) are superimposed thereon, the cathode ray beam will be deflected between predetermined prescribed limits and over a predetermined portion of the viewing screen. It is naturally desirable that this predetermined bias potential that is applied to the deflecting plates of the cathtode ray tube remain substantially unchanged (unless a change is deliberately made) since any change in the biasing potentials applied to the plates will cause a shifting of the area transversed by the beam during its deflections.

Due to the nature of circuit arrangements usually associated with cathode ray tube in oscilloscopes, when the sweep deflection rates are rapidly varied a gradual change in the average potential of the deflecting plates takes place, with the result that after a series of rapidly successive deflections, the area traversed by the cathode ray beam may shift in one direction or another and the produced image is accordingly shifted. Such an operation is undesirable since it is preferable that the produced image or trace remain apparently stationary.

The same or a similar situation exists in regard to a deflection amplifier tubes that are associated with the deflection plates of the cathode ray tubes.

A purpose of the present invention, therefore, resides in the provision of means in a cathode ray oscilloscope whereby the deflection potentials applied to the cathode ray beam are maintained within the desired range regardless of the frequency at which the cathode ray beam is deflected across the screen of the viewing tube.

Another purpose of the present invention resides in the provision of means in a cathode ray oscilloscope wherein single stroke deflection provisions are available whereby the area or region traversed by the cathode ray beam during its sweep deflections remains unchanged regardless of whether the deflections are widely separated in point of time or whether they occur in rapid succession.

Still another purpose of the present invention resides in the provision of means whereby the centering or bias potential applied to the deflecting electrodes of a cathode ray oscilloscope will remain within the desired range regardless of the particular superimposed deflection voltages applied therefore.

A still further purpose of the present invention resides in the provision of means in a deflection amplifier for a cathode ray oscilloscope whereby the bias potential applied to the deflection amplifier tubes remains within the desired range regardless of the wave form of the applied voltage variations.

Other purposes and advantages of the present invention will become more apparent to those skilled in the art from the following detailed description wherein:

Figure 1 represents a preferred form of the present invention: and

Figure 2 shows a curve used in explaining the operation of the system.

Referring now to the drawing, a pair of deflection tubes **10** and **20** are used for causing horizontal deflections of the cathode ray beam. These tubes each include a cathode, a control electrode and an anode. The cathode **12** of tube **10** and the cathode **22** of tube **20** are connected together, and are connected to ground or a source of fixed potential by means of a series arrangement of resistances **32, 34, 36** and **38**.

The control electrode **14** of tube **10** is connected to input terminal **40** by way of coupling condenser **42** and a relatively small oscillation suppression resistance **44**. A grid resistance **46** is connected to extend between the junction of the coupling condenser **42** and the resistance **44** and the junction of resistances **32** and **34**. This connection affords a certain amount of self bias for tube **10**, the extent of the bias being determined by the combined resistance of the resistance elements **34, 36 and 38.**

The control electrode **24** of tube **20** is connected to the junction of resistances **36** and **38** by means of a relatively small oscillation suppression resistance **48** and grid resistance **50**. This connection affords a bias between the cathode **22** and control electrode **24** of tube **20** in an amount determined by the potential drop across resistance **38**. The junction of the resistance **48** and the grid resistance **50** is connected to ground by means of a relatively large condenser **52**.

The anodes **16** and **26**, respectively of tubes **10** and **20** are connected, by way of a load circuit, to terminal **54** to which a source of positive potential is applied. Each anode load circuit includes a load resistance **56** and may include a peaking coil or inductance **58**. Voltage variations present at the anodes **16** and **26** of the deflection tubes **10** and **20** may then be applied to the horizontal deflecting plates of a cathode ray tube.

In the circuit arrangement so far described, tubes **10** and **20** afford cathode ray beam deflection potentials in an out-of-phase relationship so that a push-pull action may result. Only a single input is provided at terminal **40**, and by reason of the circuit arrangement associated with tubes **10** and **20**, a phase inversion or push-pull operation is accomplished. It will be noticed that the bias potential applied to control electrode **14** relative to the cathode **12** is determined by the potential drop across the three series resistances **34, 36** and **38**, whereas the bias potential applied to the control electrode **24** relative to cathode **22** is determined by the voltage drop across resistance **38** only. By proper choice of the relative size of these resistances, the tubes **10** and **20** may be biased at different static conditions.

It will also be observed that the control electrode **24** is effectively connected to ground insofar as an alternating current component is concerned by means of relative large condenser **52**. This precludes any modulation of the potential applied to the control electrode **24**. The input potentials which are applied to the terminal **40** are impressed upon the control electrode **14** of tube **10** and the electron stream in tube **20** is subjected to cathode modulation.

Referring now to Figure 2, there is shown a curve representing the plate-current/grid-potential characteristic of tubes **10** and **20**, and the resistances **34, 36** and **38** are so chosen that the normal bias applied between the control electrode and cathode of tube **10** is of a value similar to that, for example, represented by the dotted line E_{10} of Figure 2. Furthermore, since only the voltage drop across resistance **38** is utilized in biasing the control electrode **24** of tube **20** relative to its cathode, the bias potential on tube **20** will be materially less than that applied to tube **10** and the value of resistance **38** is chosen such that this bias potential will be approximately as represented by the dotted line E_{20} of Figure 2, indicating a rather low bias condition.

With this arrangement, when signals or voltage variations extending in a positive direction, such as represented by curve **60**, are applied to the input terminal **40**, the potential of the control electrode **14** is modulated in a positive direction relative to the cathode **12** which reduces the bias applied to tube **10**, and accordingly increases the amount of current permitted to pass through the anode circuit of tube **10**. This increased current causes a fluctuation in the potential of the cathodes **12** and **22** in a corresponding positive direction so that the cathode **22** of tube **20** is modulated in a positive direction, which results in a reduction in the amount of current permitted to flow in the anode circuit of tube **20.**

The application of positive impulses or voltage variations to the input terminal **40**, therefore, results in momentary increases in the current permitted to flow in the anode circuit of tube **10** and corresponding momentary decreases in the current permitted to flow in the anode circuit of tube **20.** These momentary increases and decreases in current in the two anode circuits produce, respectively, corresponding negative and positive potential variations in the anode circuits of the two tubes, as indicated by the curves **601** and **602.** A push-pull deflection action is, therefore, produced although only a single input is provided.

Referring again to Figure 2, it will be seen, therefore, that the bias potential on tube **10** is normally that represented by E_{10} and the bias potential on tube **20** is normally that represented by E_{20}. When signal potentials extending in a positive direction are applied to the input terminal, the bias potential applied to tube **10** is decreased from the value represented by the dotted line E_{10} and simultaneously the bias potential of tube **20** is increased from the value represented by the dotted line E_{20}.

Figure 1 also shows a portion of a cathode ray tube **62** which includes horizontal deflecting plates **64** and **66**, as well as a pair of vertical deflecting plates **68**. The signal to be observed is naturally applied to the vertical deflecting plates **68**, and since such circuit arrangements are well known to those skilled in the art no provision is indicated for applying a transient signal or other voltage variation to be observed to the vertical deflecting plates. The horizontal

deflecting plate 64 is connected to the anode 16 of deflection tube 10 by means of a coupling condenser 70. A series connected peaking inductance 72 may be included in the circuit and the inductance may have connected in parallel therewith a resistance element 74.

Similarly, horizontal deflecting plate 66 is connected to anode 26 of deflection tube 20 by means of coupling condenser 76, with the possible inclusion of inductance 78 and resistance 80. The condensers 70 and 76 are preferably made relatively large in order that slow deflection rates may be effectively applied to the horizontal deflecting plates 64 and 66.

For reasons of simplicity the electron gun structure of the cathode ray tube 62 is not shown, but as is the usual custom, negative potentials may be applied to the cathode and control electrode of the electron gun structure, relative to the gun anode, in order that a desired cathode ray beam may be generated. The high voltage negative potential may be connected to terminal 82 with the associated positive potential connected to the terminal 84. Between these two terminals is connected the usual bleeder resistances including potentiometer 86, resistance 88, potentiometer 90, resistance 92, and parallelly connected centering potentiometers 94 and 96.

The cathode of the electron gun structure may be connected to the junction of resistances 86 and 88, as indicated in the drawing, in which case the control electrode would be connected to a movable contact of potentiometer 86. Similarly, the second anode would be connected to the movable contact of potentiometer 90 in order to afford a focus control, and the first anode of the cathode ray tube may be connected to ground or to a potential approximating that applied to the terminal 84.

Due to the current flowing through this series of resistances including the centering controls 94 and 96, the potential along the potentiometers 94 and 96 is variable and the adjustable contact associated with each of these potentiometers is connected to the deflection plates 64 and 66 by way of relatively high resistances 98 and 100, respectively. By an adjustment of the position of the movable contacts along potentiometers 94 and 96, a horizontal adjustment of the position of the cathode ray beam is made possible.

Preferably the two centering controls, i. e., the movable contacts associated with potentiometers 94 and 96 are ganged together for simultaneous operation. Such a procedure is well known to those skilled in the art. The movable contacts associated with these centering potentiometers are connected to ground by way of condensers 102 and 104 in order to preclude the possibility of any possible rapid potential fluctuations on the potentiometers from reaching the deflecting electrodes.

The circuit arrangement as so far described affords a means for causing deflections of a cathode ray beam, the deflecting potentials being applied to the deflecting electrodes in a push-pull manner in response to the application of a single voltage variation to input terminal 40. If the cathode ray oscilloscope is to be used in a conventional manner where the deflection potentials are regularly recurrent at a predetermined rate determined by the frequency of operation of the deflection generator, the cathode ray beam will be deflected repeatedly in a horizontal direction.

If the deflection voltage variations 60 applied to the input terminal 40 are not regularly recurrent

but are derived from a single sweep deflection generator, then, under certain conditions, certain undesired effects will take place. For example, the bias E_{10} normally present between control electrode and cathode of tube 10 is determined by the voltage drop across resistances 34, 36 and 38. This bias is applied to the control electrode by way of grid resistance 46, and a coupling condenser 42 is included between the input terminal 40 and the grid end of the grid resistance 46.

Suppose, for example, that no deflection voltage variations are applied to the input terminal, then the static bias condition will, of course, prevail on tubes 10 and 20. If a recurrent transient condition occurs, then for each transient condition a deflection voltage variation extending in a positive direction will be applied to the input terminal 40 from the single sweep deflection generator (an example of which is shown and described in the above mentioned L. C. Smith application). These deflection voltage variations may occur at rather widely spaced intervals or they may occur in relatively rapid succession. The deflection voltage variations, as applied to input terminal 40, extend in a positive direction to modulate the control electrode 14 of tube 10 in a positive direction from its normal static bias potential E_{10} of Figure 2. If the individual single sweep deflection voltage variations are widely separated in time, then the modulation of the control electrode 14 will be in a positive direction and very little or no distortion will result.

If, however, a series of rapid or closely spaced deflection voltage variations are applied to the input terminal 40, after a few cycles the alternating current axis will shift (due to the presence of condenser 42) with the result that the voltage swing in a negative direction from E_{10} will become appreciable and may in fact approach the swing in positive direction from E_{10}. Such a condition is undesirable since appreciable potential changes in a negative direction from E_{10} would drive the control electrode potential of tube 10 beyond cut-off and result in serious distortion of the deflection wave form.

In order to overcome this undesirable operation some provision must be made to prevent excessive excursions of the control electrode 14 of tube 10 in a negative direction from E_{10}, regardless of the wave form or characteristics of the input signal. For this purpose the diode 110 is included in the circuit as described above. The diode is connected across grid resistance 46 so that any potential change of the control electrode 14 in a direction appreciably negative with respect to the potential E_{10} causes the cathode of the diode 110 to become negative with respect to its anode with the result that the diode becomes conductive. Due to the conduction of the diode 110 a potential is produced across resistance 46 thus causing a charge to accumulate on condenser 42 which displaces the average potential of the control electrode 14 in a positive direction with the result that the control electrode is never driven in a negative direction from potential E_{10} by any appreciable extent. Accordingly, distortion is prevented and the control electrode modulations are always in a positive direction with respect to potential E_{10} regardless of the frequency of occurrence of the sweep deflection potential variations to input terminal 40.

For similar reasons, and in the absence of the diode 120, it is possible for the control electrode 24 of tube 20 to be effectively modulated by a substantial amount in a direction positive with re-

spect to the potential E_{20}. Since it is desired that the potential difference between the control electrode **24** and the cathode **22** of tube **20** be confined primarily to the region between E_{20} and E_{10}, a diode **120** is included in parallel with the grid resistor **58**. The operation of this diode upon the presence of a series of closely spaced deflection potential variations is similar to the operation of the diode **110** and results in precluding any appreciable effective modulations of the control electrode **24** in a direction positive with respect to the potential E_{20}. Actually the modulation of the electron stream in tube **20** is by cathode modulation while the undesired operation is prevented by a change in the potential of the control electrode by reason of the operation of diode **120**. The applied deflection wave form will, therefore, be amplified without distortion regardless of the frequency of occurrence of the sweep deflection voltage variations.

When diodes **110** and **120** are included in the circuit it is possible, therefore, to apply sweep voltage variations to tubes **10** and **20** where such voltage variations are subjected to amplification, and the degree of amplification remains constant and without appreciable or objectionable distortion regardless of the rate or frequency at which the voltage variations are applied and regardless of the rate at which their frequency of application varies. Amplified deflection voltage variations are then present at the anodes of tubes **10** and **20** and at the coupling condensers **70** and **76**.

These deflection voltage variations are applied to the horizontal deflecting plates **64** and **66** of the cathode ray tube **62**.

Since the sweep voltage variations may be rather widely separated or closely spaced in point of time, a change in the position (average) of the trace on the screen of the cathode ray tube may occur by reason of a shift in the alternating current axis of the voltage variations present at the coupling condensers **70** and **76**. If the alternating current axis shifts appreciably, as when a rapid succession of deflection voltage variations occur, the produced trace will gradually shift horizontally across the screen and such shifting is, of course, objectionable.

In order to preclude a horizontal shifting of the position of the trace on the cathode ray oscilloscope tube, diodes **124** and **126** are employed and these are effectively connected in parallel with resistances **98** and **100**, respectively. The anode of diode **124** is connected to the cathode ray beam deflection plate **64**, i. e., to the end of the resistance **98** which is subjected to the deflection voltage variation. The cathode of diode **124** is connected to the centering control end of resistance **98**, which point in the circuit is effectively connected to ground, insofar as any alternating current component is concerned, by reason of the inclusion of condenser **102**.

The diode **126** is poled in an opposite manner since the undesired change in potential of the conductor connected to the deflecting plate **66** is in a direction opposite to that which occurs in connection with the other deflecting plate. In this case, the cathode of the diode **126** is connected to beam deflection plate **66** and to the end of resistance **100** that is subjected to full deflection potential variations. The anode of the diode **126** is connected to the centering control end of resistance **100**, which point in the circuit is effectively connected to ground, insofar as any alternating current component is concerned, by reason of the inclusion of the condenser **104**.

As explained above, under static conditions the potential at the coupling condenser **70** and at the deflecting electrode **64** is maintained at a predetermined value. When a series of deflection voltage variations are successively transmitted through the circuit the alternating current axis of the voltage variations present at coupling condenser **70** shifts and after a few cycles the potential deviations as applied to the deflecting electrode **64** will become effective on both sides of the normal average potential of the electrode **64** with the result that the negative peaks will not cause as great a deflection of the beam from the electrode **64** and the positive portion of the deflection voltage variations will, in fact, cause the beam to be attracted nearer the electrode **64** resulting in a shift of the trace toward the left across the screen. It is desired that the deflection voltage variations cause a repulsion only of the beam and that these variations do not extend in a direction appreciably positive with respect to the normal bias potential of electrode **64**.

When diode **124** is included in the circuit as described above, any variation of the potential of electrode **64** in a direction positive with respect to the normal bias potential determined by potentiometer **94** causes the diode to conduct which results in the production of a potential drop across resistance **98**. The end of the resistance adjacent coupling condenser **70** becoming negative with respect to the other end so that the tendency for the trace to shift is compensated. This change in potential of the end of resistance **98** may be looked upon as resulting in a change in the average potential of the deflecting electrode **64** in a negative direction by an amount corresponding to the shift in the alternating current axis so that the potential deviations of electrode **64** may always extend in a negative direction from the normal static potential of electrode **64** with very little or no deviation in potential in a positive direction from that static potential value. By reason of the diode **124**, the trace remains in a fixed position and does not shift horizontally regardless of the rate or change in rate at which the deflection voltage variations are applied.

Similarly, diode **126** prevents a similar effect from taking place with respect to deflecting electrode **66**. This diode is poled oppositely with respect to diode **124** since the deflection voltage variations present at coupling condenser **76** are in push-pull relation to those at condenser **70**. Diode **126**, therefore, produces a potential across resistance **100** so that the potential deviations of electrode **66** are always in a direction positive with respect to the normal static bias potential of the electrode regardless of the wave form applied thereto.

By reason of the present invention, it is possible to apply single sweep deflection potentials to the deflecting circuit amplifier and to the deflecting plates of a cathode ray tube at any desired rate and in any wave form without in any way affecting the operation of the system. The inclusion of the diodes **110** and **120** prevents a shift in the grid modulation range of tubes **10** and **20**, and the inclusion of the diodes **124** and **126** prevents a shift of the oscillographic trace on the screen of the cathode ray tube. It is, therefore, immaterial whether the deflecting potential variations occur in regular sequence and, in fact, a wide deviation in the rate of application of the deflection potentials to the circuit is entirely possible without affecting the operating characteristics of tubes **10** and **20** and without

causing any shift whatever in the horizontal positioning of the trace on the screen of the cathode ray oscilloscope tube.

Although the invention is described more or less in detail, and although push-pull operation is shown, a single amplifier may also be used in which the present invention is employed and the deflecting potentials may be applied to one plate only of the horizontal deflecting plates. Furthermore, the present invention may be applied to any type amplifier where a similar situation exists and need not be confined to oscilloscope use.

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

Having now described the invention, what is claimed is:

1. A cathode ray oscilloscope including an amplifier tube having a cathode, a control electrode and an anode, means for applying a predetermined static bias potential between the control electrode and the cathode of said tube, condenser means for applying voltage variations extending in a predetermined potential direction and of varying wave form to the control electrode of said tube, a unilateral conducting device associated with the control electrode of said tube to confine the operation of the tube to a predetermined portion of its operating characteristic so that amplified voltage variations are present at the anode of said tube, a cathode ray tube including a pair of cathode ray beam deflecting electrodes, means for applying a predetermined static bias potential to one of the deflecting electrodes relative to a point of fixed potential, condenser means for applying the amplified voltage variations to the said one deflecting electrode, and means including a unilateral conducting device for preventing a shift in the area traversed by the deflected cathode ray beam by reason of changes in the wave form of the applied voltage variations.

2. A cathode ray oscilloscope including an amplifier tube having a cathode, a control electrode and an anode, means for applying a predetermined static bias potential between the control electrode and the cathode of said tube, means for applying voltage variations of varying wave form to the control electrode of said tube, a unilateral conducting device included in the control electrode circuit of said tube to confine the potential variations of the control electrode of the tube to a predetermined potential direction from the bias potential so that consistently uniformly amplified voltage variations are present at the anode of said tube, a cathode ray tube including a pair of cathode ray beam deflecting electrodes, means including a resistance for applying a predetermined static bias potential to one of the electrodes relative to a point of fixed potential, means for applying the amplified voltage variations to the said one deflecting electrode, and means including a unilateral conducting device connected in parallel with said resistance for preventing any alteration in the area traversed by the deflected cathode ray beam by reason of changes in the wave form of the applied voltage variations.

3. A cathode ray oscilloscope including an amplifier tube having a cathode, a control electrode and an anode, means including a resistance for applying a predetermined static bias potential between the control electrode and the cathode of said tube, means for applying voltage variations to the control electrode of said tube, a unilateral conducting device connected in parallel with said resistance to confine the operation of the tube to a predetermined portion of its operating characteristic regardless of the wave form of the applied voltage variations so that amplified voltage variations are present at the anode of said tube, a cathode ray tube including a pair of cathode ray beam deflecting electrodes, means including a second resistance for connecting one of the deflecting electrodes to a point of fixed potential, means for applying the amplified voltage variations to the said one deflecting electrode, and means including a diode connected in parallel with said second resistance for preventing a shift in the deflection limits of the deflected cathode ray beam by reason of changes in the wave form and the applied voltage variations.

4. A cathode ray oscilloscope apparatus including a push-pull deflection amplifier comprising two tubes each including a cathode, a control electrode and an anode, means for connecting the cathodes of the two tubes together, means including a resistance to connect the cathodes to a point of fixed potential, a first grid resistor connecting the control electrode of one of the tubes to one point along said resistance, a second grid resistor connecting the control electrode of the other of the tubes to another point along said resistance, whereby a different bias potential is maintained on the two tubes, means to apply modulating voltage variations of variable wave form to the control electrode of one of the tubes to thereby modulate the bias potential of the tubes in a push-pull manner and in opposite directions by the voltage variations, and means to confine the potential modulation to a predetermined deviation range relative to the bias potential of each tube regardless of the wave form of the applied voltage variations, said last-named means including a unidirectional current conducting device connected across a portion of the resistor in the control electrode circuit of each of the amplifier tubes.

5. A cathode ray oscilloscope including a cathode ray tube having a pair of cooperating deflecting electrodes for deflecting the cathode ray beam in a predetermined plane, means for applying a predetermined static bias potential to the deflecting electrodes to determine the static position of the beam, means for applying a deflection voltage variation in push-pull relationship to the deflecting electrodes in order to cause deflection of the cathode ray beam and means for preventing a shift in the area traversed by the cathode ray beam due to a change in the alternating current axis of the applied voltage variations, said means including a pair of unilateral conducting devices.

6. A cathode ray oscilloscope adapted to include a cathode ray tube having a pair of cooperating deflecting electrodes for deflecting the cathode ray beam in a predetermined plane, means including a high resistance for connecting each deflecting electrode to a point of fixed potential, means for applying a variable wave form deflection voltage variation in push-pull relationship to the deflecting electrodes to cause deflections of the cathode ray beam at variable intervals, and means including a diode associated with each resistance for preventing a shift in

the average position of the cathode ray beam due to a change in the alternating current axis of the deflection voltage variations caused by a change in wave form.

7. A cathode ray oscilloscope adapted to use a cathode ray tube having a pair of deflecting electrodes to which deflection potential variations may be applied comprising, means for applying a predetermined static bias potential to at least one of the electrodes relative to a point of fixed potential, means for applying deflection voltage variations of widely different wave forms to one of the deflecting electrodes relative to a point of fixed potential in order to cause deflection of the cathode ray beam in a predetermined plane, and means for preventing a shift in the area traversed by the deflected cathode ray beam due to changes in applied wave form, said last-named means including a unilateral conducting device for producing a potential difference so that the potential deviations of the said one deflecting electrode will primarily extend in a predetermined direction from the static bias potential of that electrode regardless of the wave form of the applied deflection voltage variations.

8. A cathode ray oscilloscope in which a cathode ray tube is used which includes a pair of deflecting electrodes to which deflection potential variations are applied, means including a resistance for applying a predetermined static bias potential to one of the electrodes relative to a point of fixed potential, means for applying voltage variations of widely different wave forms to said one of the deflecting electrodes relative to a point of fixed potential in order to cause deflection of the cathode ray beam, and means for preventing a shift in the region traversed by the deflected cathode ray beam due to changes in wave form of the applied deflection voltage variations, said last-named means including a unilateral conducting device connected in parallel with said resistance for effectively producing a change in the bias potential of the electrode so that the potential deviations of the deflecting electrode will always extend in a predetermined direction regardless of the wave form of the applied deflection voltage variations.

9. A cathode ray oscilloscope in which a cathode ray tube having a pair of deflecting electrodes may be used including means for applying push-pull deflection voltage variations to the deflecting electrodes in which the voltage variations extend in predetermined and opposed potential direction at the electrodes, circuit means including a pair of resistances for individually applying a predetermined static biased potential to the deflecting electrodes relative to a point of fixed potential, a pair of unilateral conducting devices each including an anode and cathode, and means for respectively connecting each of the unilateral conducting devices in parallel with one of said resistances, whereby the potential deviations of the said deflecting electrodes always extend in a predetermined potential direction from the static bias potential of the electrodes regardless of the wave form of the applied deflection voltage variations.

10. A cathode ray oscilloscope in which a cathode ray tube having a pair of deflecting electrodes may be used including a source of variable wave form deflection voltage variations in which the voltage variations extend in a predetermined potential direction, circuit means including a resistance for applying a predetermined static biased potential to one of the deflecting electrodes relative to a point of fixed potential, means for applying the deflection voltage variations to the said one deflecting electrode, a unilateral conducting device including an anode and cathode, and means for connecting the unilateral conducting device in parallel with said resistance, whereby the potential deviations of the said one deflecting electrode primarily extend in a predetermined potential direction from the static bias potential applied to that electrode regardless of the wave form of the applied deflection voltage variations.

LESTER C. SMITH.

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