

Dec. 31, 1940.

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2,227,076

CIRCUIT ARRANGEMENT FOR ELECTROSTATIC DEFLECTION OF CATHODE RAYS

Filed Feb. 24, 1939

2 Sheets-Sheet 1

Fig. 1

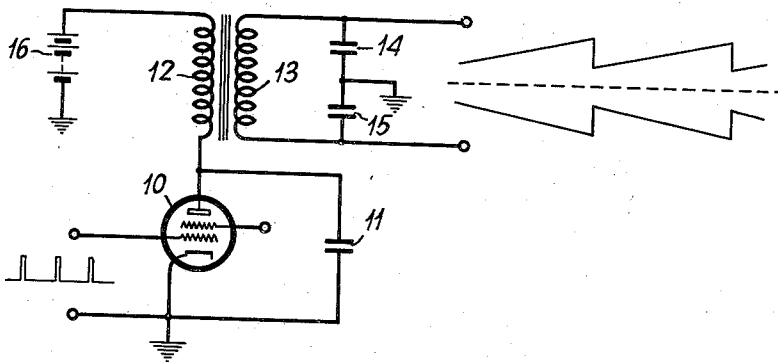


Fig. 2

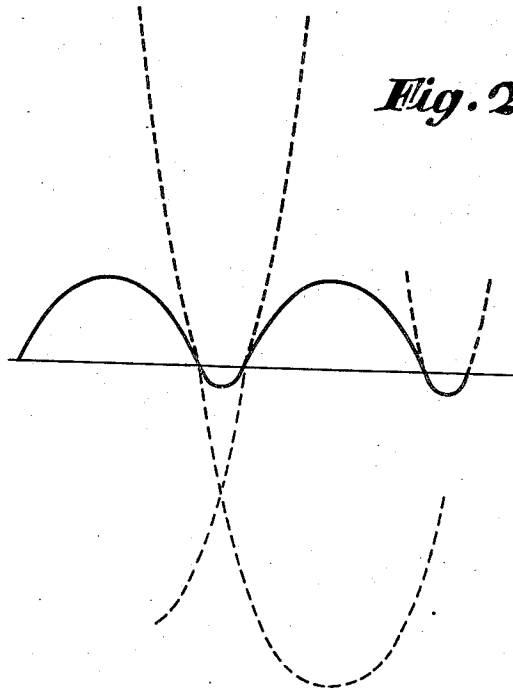


Fig. 3



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Fig. 4

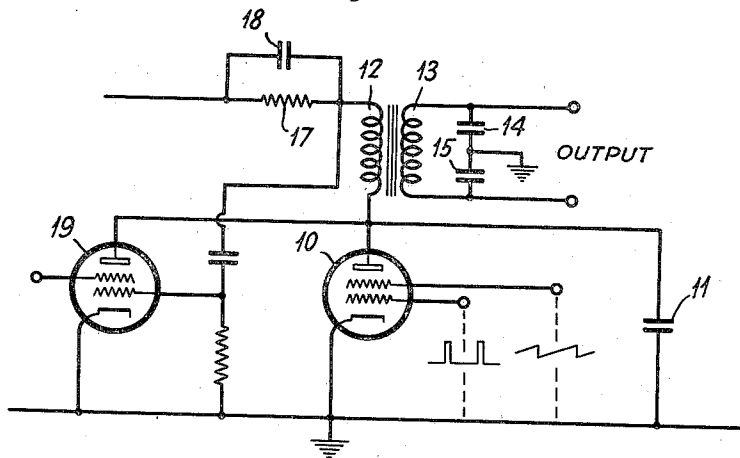
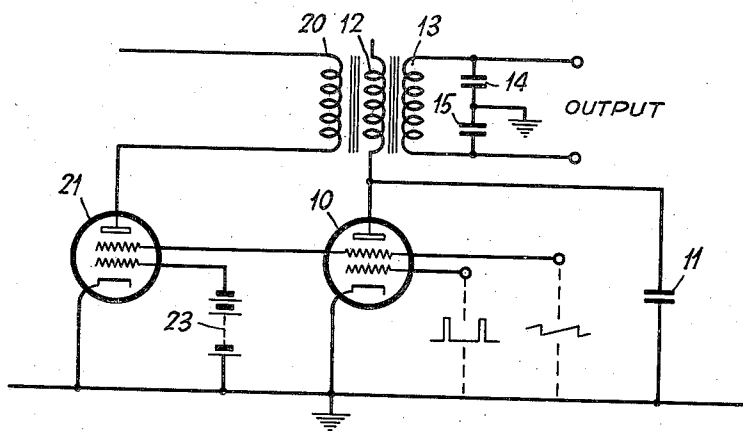


Fig. 5



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UNITED STATES PATENT OFFICE

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CIRCUIT ARRANGEMENT FOR ELECTRO-
STATIC DEFLECTION OF CATHODE RAYS

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3 Claims. (Cl. 178—7.7)

The invention relates to the electrostatic deflection of cathode rays, more especially for purposes of television. It is concerned with a circuit arrangement which produces a raster having a variable length of the line, more especially a trapezoidal raster such as is required for instance in cathode ray scanning means or in projection tubes.

The invention may best be understood by referring to the drawings wherein like reference characters represent like parts and wherein:

Figure 1 shows one embodiment of the present invention.

Figure 2 shows curves of the operation of Figure 1.

Figure 3 illustrates one form of impulses to be applied to the circuit shown in Figure 1, and

Figures 4 and 5 show modifications of the present invention.

For the electrostatic deflection of cathode rays, i. e. for the production of saw-tooth shaped voltage patterns a circuit arrangement is proposed such as shown in Figure 1. A capacitance 11 is placed in parallel to the controlled discharge tube 10 between the cathode and anode thereof, said tube having a high inner resistance. The anode lead furthermore contains the primary winding 12 of a transformer whose secondary winding 13 is placed in parallel with two series connected condensers 14 and 15 whose common pole is grounded. There appears at the outer terminals of these two condensers a respective saw-tooth potential against ground potential (as shown) and both saw-tooth potentials are used for the line deflection of the cathode ray beam.

This circuit operates as follows: The condenser 11 is charged from the plate voltage source 16 of the tube 10 across the inductance 12. The tube 10 is influenced at the control grid by impulses such that during the duration of the impulse the tube 10 conducts current and discharges the condenser 11. At the anode of the tube 10 no unsteady variations can hereby appear since sudden potential changes are prevented by the condenser and sudden current variations are suppressed by the coil 12. Hence all variations at the anode take a sinusoidal course. It is true that no pure sine function will be obtained since the duration of the impulse differs from the interval between impulses, but the various phases are composed of sinusoidal arcs. The various sine arcs belong to functions having always the same frequency, since L and C of the circuit have always the same values. They differ only in regard to their

amplitudes. The frequency determined by L and C is lower than the frequency of the synchronized impulse sequence and hence lower than that of the saw-tooth like potential variations of the condenser 11. The current through the coil 12 takes the course schematically shown in Figure 2, the sine curves whose arcs form the individual sine arcs are added to one another always with the same tangent. It is known that the cosine function as also seen from the development of the progression, can be well represented for small quantities by a parabola. The higher therefore the saw-tooth frequency against the natural frequency of the circuit the more accurately the current follows parabolic arcs. Consequently, the potential

$$\left(\frac{di}{dt}\right)$$

at the coils 12 and 13 becomes a linear function of time, and the said saw-tooth potentials are obtained at the condensers 14 and 15.

In order to produce a trapezoidal raster it is necessary that the length of the line increases in a linear fashion for the duration of the image field. The length of the line depends on the potential at the transformer, and hence on the current impulse in the tube 10. It follows therefrom that the length of the line scanned can be influenced by the value of the impulse effective at the control grid as long as the value of the impulse does not exceed the control range. Therefore, for the production of a trapezoidal screen it is proposed in accordance with the invention to vary in a linear fashion within the duration of the image the value of the impulse such as indicated in Figure 3.

A second method resides in maintaining constant the impulses acting at the control grid and to influence the current of the tube 10 by a variation of the screen grid potential and accordingly a saw-tooth potential having the frequency of the image is applied to the screen grid.

This production of trapezoidal rasters entails that the direct current (the mean current taken across many line durations) is not constant but varies in the rhythm of the image frequency. In order to prevent this low frequency alternating current whose shape is not sinusoidal, from releasing compensating actions or building up actions at the secondary side of the transformer and in the potentials of the condensers 14 and 15, it is proposed in accordance with the invention to compensate in a second tube this low frequency current through counter coupling.

This measure is shown, for example, in the Figures 4 and 5.

In Figure 4, aside from the coil 12 the anode line of the tube 10 contains a resistance-condenser combination (17, 18) so dimensioned that the condenser 18 represents practically no resistance for variations of line frequency, but the current variations having image frequency produce at this RC combination a corresponding potential. This potential serves for controlling a second discharge tube 19 whose plate current likewise passes through the coil 12 and the resistance-condenser combination (17, 18). This plate current contains the same saw-tooth component having image frequency as exists in the current of the tube 10. The current is passed through the coil whereby its phase is opposite to the current of the tube and compensates its component having the image frequency.

Figure 5 shows the transformer 12, 13 containing a further winding 20 passed by the plate current of a tube 21. The screen grid of this tube is directly connected to that of the tube 10, the control grid has a fixed potential as determined by the potential source 23. The plate current of the tube 21 has the same saw-tooth component (picture image frequency) as does the current of the tube 10. The winding 20 is passed by current such that its flux acts in opposition to that of the winding 12 or compensates the latter, so that in the coil 13 the actions having image frequency will not be effective.

The circuit arrangements represented in the Figures 4 and 5 are not only useful where the lengths of the lines are modulated in a saw-tooth like manner, but they can be employed for any kind of modulation of the length of the line scanned. For instance, as has been pointed out at other places, the deflection at right angle to the line coordinate may be caused to take place with a steepness slightly varying in the course of each deflection performance, since at constant angular speed of the scanning ray the line space would not be the same at all places. This leads to a variation of the length of the line likewise deviating from a linear course and which can be represented in proper approximation by an exponential law.

The invention can be applied accordingly in the case of a line interlace scanning system.

I claim:

1. A system for producing voltage variations of saw-tooth wave form comprising a discharge

tube having a cathode, an anode and at least one control electrode, a condenser connected between the anode and cathode of said tube, means including a source of potential for maintaining said anode positive with respect to said cathode, a transformer having a primary and a secondary winding, said primary winding being connected in series between said source of potential and said tube anode, a pair of condensers connected in series across the secondary winding, and means for cyclicly varying the impedance of said tube at two different frequencies whereby the saw-tooth wave form present across the secondary winding may be cyclicly varied in amplitude.

2. A system for producing voltage variations of saw-tooth wave form comprising a discharge tube having a cathode, an anode and a control electrode, a condenser connected between the anode and cathode of said tube, means including a source of potential for maintaining said anode positive with respect to said cathode, a transformer having a primary and a secondary winding, said primary winding being connected in series between said source of potential and said tube anode, a pair of condensers connected in series across the secondary winding, and means for applying regularly recurrent impulses of cyclicly varying amplitude to said control electrode whereby the saw-tooth wave form present across the secondary winding may be cyclicly varied in amplitude.

3. A system for producing voltage variations of saw-tooth wave form comprising a discharge tube having a cathode, an anode, a first control electrode and a second control electrode, a condenser connected between the anode and cathode of said tube, means including a source of potential for maintaining said anode positive with respect to said cathode, a transformer having a primary and a secondary winding, said primary winding being connected in series between said source of potential and said tube anode, a pair of condensers connected in series across the secondary winding, means for applying impulses of constant frequency and amplitude to said first control electrode, and means for applying voltage variations at a subharmonic of the impulse frequency to said second control electrode whereby the saw-tooth wave form present across the secondary winding may be cyclicly varied in amplitude.

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