

Oct. 31, 1933.

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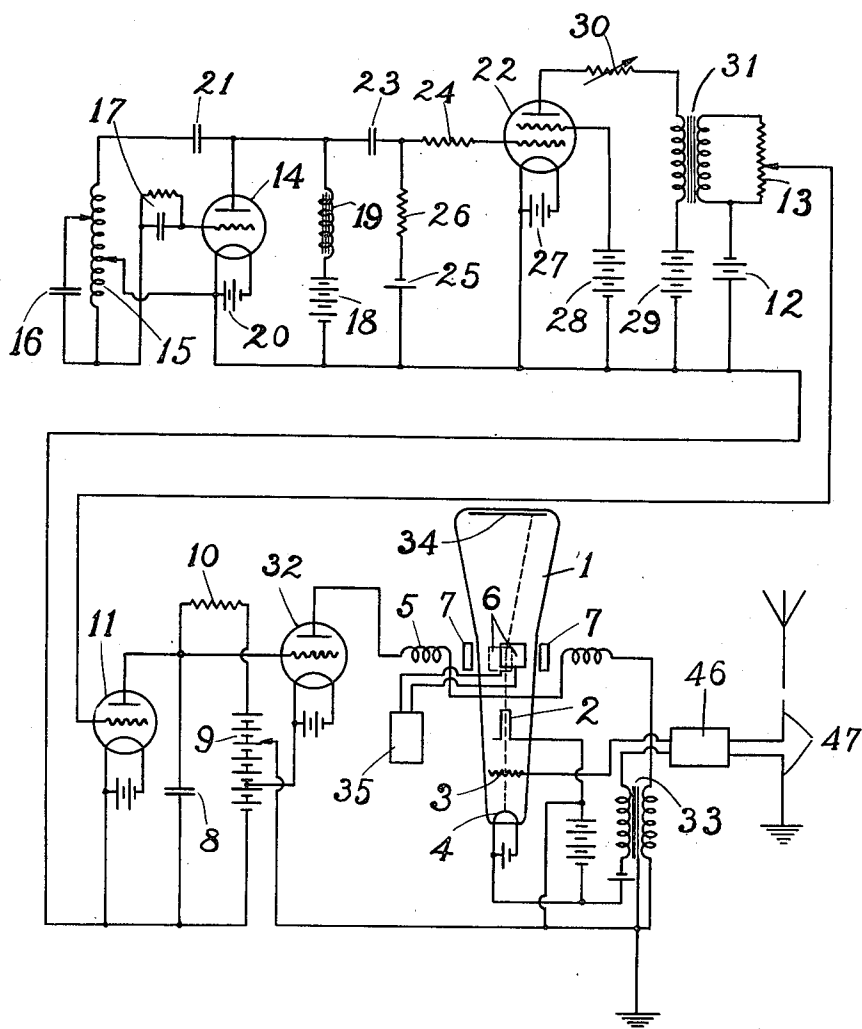
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SYSTEM FOR DEFLECTING ELECTRON PASSAGES IN CATHODE RAY TUBES

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2 Sheets-Sheet 1

Fig. 1



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Fig. 2

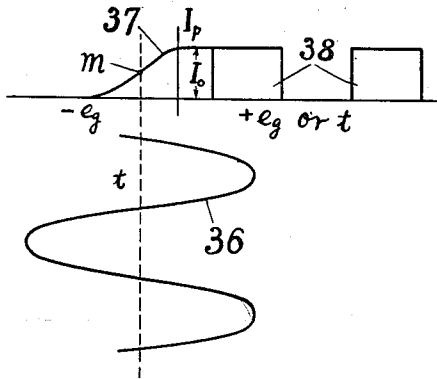


Fig. 3

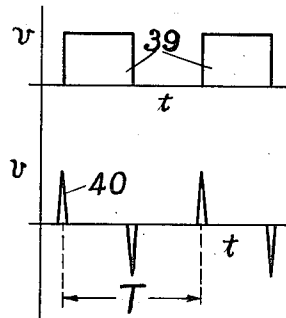


Fig. 4

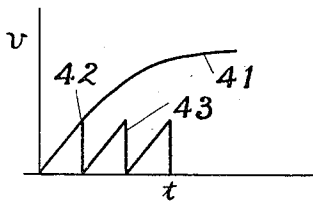


Fig. 5

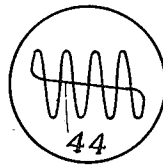
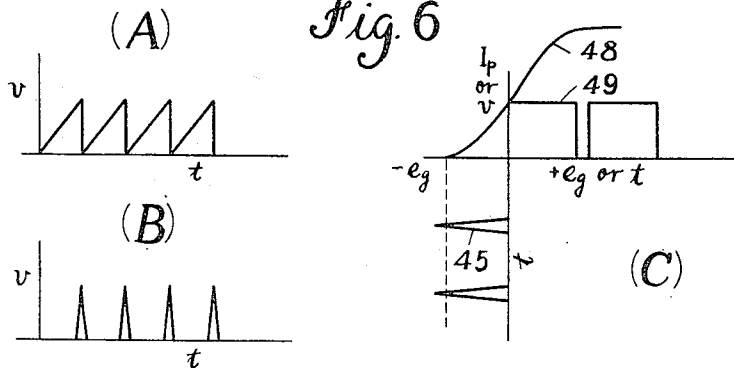


Fig. 6



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SYSTEM FOR DEFLECTING ELECTRON
PASSAGES IN CATHODE RAY TUBESTomomasa Nakajima and Kenjiro Takayanagi,
Hamamatsu, JapanApplication November 10, 1931
Serial No. 574,160

5 Claims. (Cl. 171—95)

Our invention relates to a system for deflecting electron passages in a cathode ray tube, more particularly adapted to be used in electrical measurement or television receiving systems and has for its principal object to provide a device whereby a voltage or current of an accurate saw tooth form may be easily available for deflecting the electron passage in a cathode ray tube.

According to the latest development of the television art, a cathode ray tube such as a Braun tube provided with two sets of crossed deflecting coils or plates is used at the receiving station. Since the variation of light passing through the holes of the scanning disc is resolved into vertical and horizontal saw tooth form movements, if the current or voltage of the saw tooth form corresponding to the movement of the scanning disc is applied to said vertical and horizontal deflecting elements the scanning disc at the transmitting station and the receiving set at the receiving station may easily be synchronized.

In connection with such television synchronizing applications, for instance, the deflection of the linear axis of the tube should take a so-called saw tooth form and the period and the amplitude should be varied at will, the period being maintained constant when it is once regulated. Further, if the polarizing element of the tube is an electro-magnetic device, the current of said saw tooth form should be of considerable value and more difficulty is found in eliminating the return path of the deflected axis of the tube. Moreover, the period should be varied easily over a wide range from a few cycles to several ten kilocycles.

Hence, a further object of our invention is to provide a positive and reliable system whereby all of the above mentioned requirements may well be satisfied.

Our invention will be better understood from the following description referring to the accompanying drawings and the features of novelty which characterize our invention will be pointed out with particularity in the claims appended to and forming a part of this specification.

In the drawings, Fig. 1 is a diagrammatic representation embodying this invention, Fig. 2 shows curves for illustrating the operation of the wave form flattening device, Fig. 3 shows curves for illustrating the operation of the wave form transforming device, Fig. 4 illustrates the manner of obtaining the saw tooth voltage, Fig. 5 is an image taken by the cathode ray tube having no return path eliminating device according to this invention, and Fig. 6—A, B and C illustrate curves

for clearly understanding the operation of the return path eliminating device.

Referring to the drawings, 1 represents a cathode ray tube comprising a plate 2, a grid 3 and a filament 4, the electron passages of which is to be controlled. The grid 3 may, for instance, be connected to a receiving antenna 47 through a receiving set 46. The controlling or deflecting means are represented by two pairs of crossly located polarizing elements, that is, the electro-magnetic deflecting coils 5 adapted to be supplied with low frequency synchronizing current for the horizontal deflection and the similar coils or electro-static deflecting plates 6 supplied with low frequency synchronizing current or voltage for the vertical deflection.

In accordance with this invention, the voltage of a saw tooth form is supplied to said deflecting coils 5 from a source comprising a condenser 8 normally charged at a constant rate from a high tension battery 9 through a high resistance 10, and a short circuiting valve 11 having a plate and a filament connected across the opposite terminals of said condenser 8. The grid of the short circuiting valve 11 is biased sufficiently negative by means of a bias battery 12 so that the valve 11 can never become conductive unless a controlling impulse is applied to the grid from a potentiometer 13.

As the source for causing this impulse a triode self-oscillator valve 14 with Hartley oscillation circuit may be used, for instance. Resonance elements comprising an inductance coil 15 and a condenser 16 connected in shunt therewith are connected across the plate and the grid of the valve 14 through a grid bias 17, the filament of the valve being connected at an intermediate position of the inductance coil 15. A plate battery 18 is connected across the plate and the filament of the valve 14 through a choke coil 19. A filament heating battery and 21 is a block condenser.

According to this invention the output of the oscillator valve 14 is led to the grid of a valve 22, which is particularly inserted for flattening the wave form of the output of the oscillator 14, through a block condenser 23 and a series resistance 24 with or without passing through amplifier stages. The valve 22 is shown as a tetrode valve without any intention to limit this invention thereto. 25 is a grid bias battery connected to the grid of the valve 22 through a bias resistance 26. 27, 28 and 29 are batteries for the filament, auxiliary grid and plate of the valve 22 respectively. The series resistance 24 is used to

limit the saturation of the plate current of the valve 22 to I_0 as shown in Fig. 2 which illustrates the characteristic curve 37 of the valve 22 showing the relation between the plate current I_p and grid bias e_g . The bias 25 of the grid is so selected that the valve 22 may operate at the middle portion m of the straight part of the characteristic curve 37. The plate circuit of the valve 22 includes an adjustable resistance 30 and a transformer 31, and said potentiometer 13 is connected across the secondary circuit of the transformer 31. The voltage of the saw tooth form derived from the condenser 8 is preferably supplied to the deflecting coils 5 of the cathode ray tube 1 through an amplifier 32.

For obviating the return path of the image on a fluorescent plate 34 of the cathode ray tube 1, according to this invention, a transformer 33 is connected in series with the horizontal deflecting coils 5 and the secondary winding of the transformer 33 is connected to the grid 3 of the cathode ray tube 1 in series with the receiving set 46.

35 designates a similar arrangement as above described for supplying the saw tooth high frequency voltage to the vertical deflecting coils or plates 6 and since its details are similar to those of the low frequency saw tooth voltage generating system except that the self-oscillator is controlled by the incoming synchronizing voltage from the transmitting station by coupling the receiving set (not shown) for receiving the same with the grid circuit of the oscillator we have omitted its detailed explanation.

The operation of the above system is as follows: Assuming that the oscillator 14 is in operation, a sine wave 36 having a greater amplitude compared with said saturation value I_0 as shown in Fig. 2 will be supplied to the grid of the flattening valve 22. Then the wave form of the plate current will be flattened and takes a substantial rectangular form 38 with respect to the time t . The plate current of such rectangular wave form is applied to the primary winding of an impulse transformer 31 through an adjustable resistance 30. Thus it will be obvious that the secondary induced voltage v of the transformer 31 will be changed to the impulse 40 as shown in Fig. 3. This impulse has a constant period T so that it may be utilized to control the discharge of the short circuiting valve 11 for the condenser 8. In this respect it should be noticed that the primary and secondary impedances of the transformer 31 must be negligibly small if compared with the total resistance of the plate circuit of the valve 22 since a large inductance has tendency to flatten the wave form of the impulse 40 and for this reason a tetrode valve 22 having high plate resistance is preferably used.

The impulse 40 is applied to the grid of the short circuiting valve 11 through a potentiometer 13 so that the valve 11 becomes conductive and the condenser 8 is discharged with said period T . The potentiometer 13 has additional action of obviating the detrimental effect of the stray capacity of the secondary winding of the transformer 31 liable to cause resonance with the inductance thereof. For the purpose of obtaining a constant charging current, the saturation current of a diode ballast lamp may, of course, be used, but since it is very unstable a constant current is preferably derived through a high resistance 10 from a high tension source 9. The battery 9 also can serve to supply the anode potential to the short circuiting valve 11.

Thus since the condenser 8 is being charged from the high tension battery 9 along the charging curve or the terminal voltage v and the time t curve 41 as shown in Fig. 4, if an impulse 40 is supplied to the grid of the short circuiting valve 11 from the potentiometer 13 at the point 42 on the charging curve 41 the valve 11 will become conductive and the condenser 8 will be short circuited and discharged so that the voltage drops suddenly and there occurs a voltage wave 43 of a so-called saw tooth form between the terminals of the condenser 8. The condenser 8 should have high insulation resistance, or otherwise the straight portion on the curve 41 will be more or less curved due to the high tension battery 9. Thus, since the required current of saw tooth form is obtained by utilizing the straight portion of the charging curve 41, the amplitude of the current or voltage should be very small and since the polarizing or deflecting coils 5 of the cathode ray tube 1 for polarizing its linear axis electro-magnetically necessitates a considerable amount of current this saw tooth voltage should be amplified through an amplifier 32. The amplifier 32 may be any suitable amplifying tube having a large amplification constant if its internal resistance is high compared with the inductance of the deflecting coils 5 of the cathode ray tube 1. Thus the amplified saw tooth form voltage or current will be supplied to the deflecting coils 5 of the cathode ray tube so that the linear axis of the cathode ray tube 1 may be deflected or the focusing point of the cathode ray may be shifted from one end to the other of the fluorescent plate 34 horizontally once every cycle of the saw tooth current. Similarly, the linear axis of the cathode ray tube 1 is deflected vertically by means of the deflecting coils or plates 6 supplied with the saw tooth voltage having a certain frequency different from that of the horizontal deflecting elements from the similar saw tooth voltage generating unit 35. Thus, if the current corresponding to the image of an object at the transmitting station is received by the receiving antenna 47 and is applied to the grid 3 through the receiving set 46 and also if both of the high frequency and low frequency saw tooth voltage generating units are in synchronism with the scanning disc at the transmitting station, the image may be reproduced on the fluorescent plate 34 of the tube 1 as shown in Fig. 5. But since the return path as shown by the numeral 44 in Fig. 5 affect a clear observation, the return path eliminating device 33 is associated therewith.

The principle of this elimination will be more clearly understood by referring to Fig. 6—A, B, and C. As shown in Fig. 6—A, the current passing through the primary winding of the transformer 33 takes the saw tooth form. Then, the secondary induced voltage of the transformer 33 will be as shown in Fig. 6—B, provided the impedances of the primary and secondary windings of the transformer were negligibly small compared with the total resistance of plate circuit valve 32. If the plate current I_p and grid voltage e_g characteristic curve of the cathode-ray tube 1 is shown by the curve 48 of Fig. 6—C and the secondary induced voltage as shown in Fig. 6—B or 45 in Fig. 6—C is applied thereto, the electronic current passing through the cathode-ray tube will be as shown by the curve 49 and the dark space will occur at the end of one saw tooth wave so that the return path may be positively eliminated.

As will be seen from the foregoing description, according to this invention, if the oscillator of the high frequency vertical deflecting current generating device 35 is coupled with the receiving set (not shown) for receiving the high frequency synchronizing or deflecting current from the sending station and the low frequency deflecting current generating device is operated independent of the sending station, but maintaining synchronism with the low frequency horizontal movement of the light spot through the scanning disc located in the sending station, and if the current corresponding to the brightness of the elements of the object to be sent which is located before the scanning disc at the sending station is received through the antenna 47 and the receiving set 46 and is applied to the grid 2 of the cathode ray tube 1, the image may be clearly reproduced on the fluorescent plate 34 of the cathode ray tube 1 without any trace of the return path.

What we claim as new and desire to secure by Letters Patent of the United States, is:

1. A system for deflecting electron passage in a cathode ray tube, comprising in combination a cathode ray tube provided with electron passage deflecting elements, saw tooth voltage generating means consisting of a condenser connected with a direct current source to be charged thereby at a constant rate and a vacuum valve having an anode, at least one grid and a cathode, said anode and cathode being connected to the terminals of said condenser respectively for short circuiting said condenser periodically, and means for generating periodical impulses from an independent oscillator which are supplied to said grid of said short circuiting valve to control the discharge of said short circuiting valve.

2. A system for deflecting electron passage in a cathode ray tube, comprising in combination a cathode ray tube provided with electron passage deflecting elements, means for generating the saw tooth voltage to be applied on said deflecting elements consisting of a condenser connected to a direct current source to be charged thereby at a constant rate and a vacuum valve connected across the terminals of said condenser for short circuiting said condenser periodically, and means for generating periodical impulses from an alternating voltage output of a separate oscillator consisting of a wave form flattening valve, and a transformer inserted in the output circuit of said wave form flattening valve, said impulse being used for controlling the discharge of said short circuiting valve.

3. A system for deflecting electron passage in a cathode ray tube, comprising in combination

a cathode ray tube provided with electron passage deflecting elements, saw tooth voltage generating means consisting of a condenser connected with a direct current source to be charged thereby at a constant rate and a vacuum valve connected across the terminals of said condenser for short circuiting said condenser periodically, means for generating periodical impulses to be applied to the grid of said short-circuiting valve, comprising a wave form flattening valve, a transformer inserted in the output circuit of said wave form flattening valve and a potentiometer inserted across the secondary winding of said transformer for supplying an adjustable grid bias to said short circuiting valve, and an alternating current oscillator supplying its output voltage to the grid of said wave form flattening valve through a resistance for limiting the saturation value of said flattening valve.

4. A system for deflecting electron passage in a cathode ray tube, comprising in combination a cathode ray tube provided with electron passage deflecting elements and a fluorescent plate, saw tooth voltage generating means consisting of a condenser connected with a direct current source to be charged thereby at a constant rate and a vacuum valve connected across the terminals of said condenser for short circuiting said condenser periodically, means for generating periodical impulses which are used to control the discharge of said short circuiting valve, and means in circuit with said deflecting element and associated with the grid circuit of said cathode ray tube for eliminating the return path of the image on the fluorescent plate.

5. A system for deflecting electron passage in a cathode ray tube comprising a cathode ray tube provided with deflecting elements, an alternating current oscillator, means for flattening the wave form of the output of said oscillator, a transformer for converting said flattened voltage to periodical impulses, a condenser charged at a constant rate from a separate direct current source, a short circuiting vacuum valve for said condenser, the discharge thereof being controlled by said periodical impulses for generating saw tooth voltage, an amplifier for said saw tooth voltage to be supplied to said deflecting element of said cathode ray tube, and return path eliminating means consisting of a transformer having its primary member inserted in the circuit of said deflecting element and its secondary member in the grid circuit of said cathode ray tube.

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