Jan. 17, 1939. R. BARTHELEMY 2,143,932

METHOD OF SYNCHRONIZING CATHODE BEAMS

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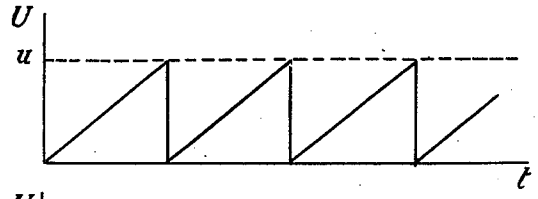


Fig. 3

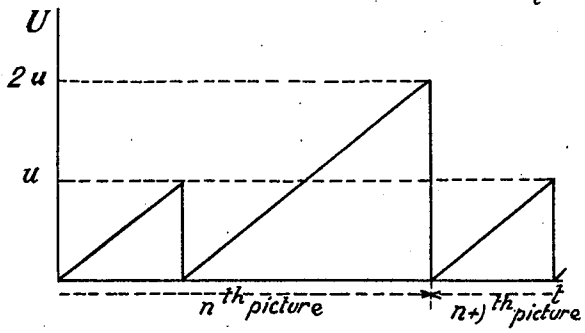


Fig. 4

Fig. 2

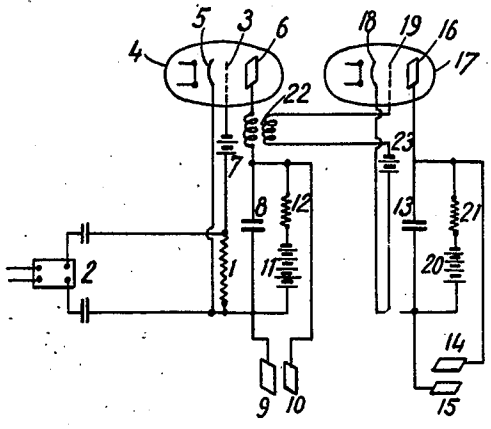


Fig. 5

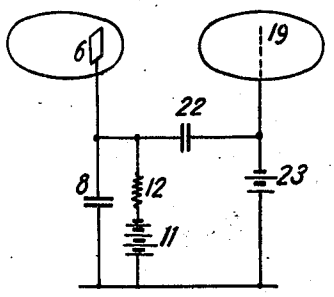
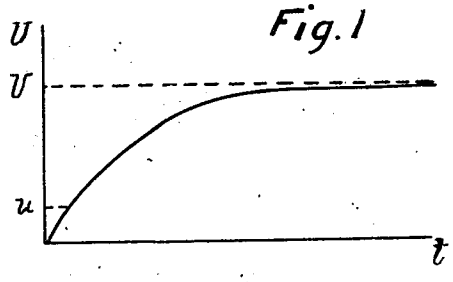


Fig. 1



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METHOD OF SYNCHRONIZING CATHODE BEAMS

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8 Claims. (Cl. 178—69.5)

It is already known in a number of devices for television and other teletransmissions, to impress upon the cathode beam intended to form the luminous image at the receiver, two simultaneous displacements, one very rapid constituting the analysis of the horizontal lines of the image and the other more slow in the vertical direction having the frequency of repetition of the images. These displacements are controlled, generally, by variable voltages applied between two pairs of parallel plates called the deflector plates of the cathode tube, the two pairs of plates being perpendicular to one another.

Two synchronizing channels, with two distinct frequencies, are then utilized for the movement of the beam: one synchronizing channel for the electrodes of the rapid displacement and one synchroninizing channel for the electrodes of the slow displacement.

For the synchronization of the rapid movement, it is known to produce and to utilize a rapid impulse of large amplitude at the end of each line of analysis. Various processes can be utilized for the synchronization of the slow movement, that is to say, in order to produce at the receiver the swinging over of the variable voltage governing the slow displacement, or, in other words, in order to return the beam from the last line of the screen to the first line.

The method of my invention enables me to dispense with the use of two synchronizing channels and to use but a single channel for synchronization. The novel method consists essentially in rendering inoperative at the transmitter, at least once for each image, the signal produced at the end of the lines or to not produce a signal at the end of at least one line per image. I create, in the rhythm of the synchronization of the lines, a variation in the image frequency, and it is this variation which controls, at the receiver, the swinging over of the voltage governing the slow displacement.

The use of that type of gas discharge tubes known by the trade name "Thyratrons" renders the application of the process particularly easy. Such a discharge tube is a gas, or vapor filled tube in which the control electrode can normally only start the discharge or prevent it from starting, but which can regain control if the anode voltage is momentarily reduced below a critical value. Hereafter, for the sake of simplicity, this type of electric discharge tube is called "gas tube".

The invention is illustrated in the accompanying drawing, in which

Figure 1 is the charging curve of a condenser.

One method of carrying out the process is shown in Figure 2.

Figures 3 and 4 are graphs of the voltage of one of the condensers used in the apparatus as a function of the time variation.

In Figure 5 is shown another method of coupling the two discharge tubes used in the device shown in Figure 2.

The variable voltage to be applied to each of the pairs of plates of the cathode tube is obtained by the charging of a condenser which is periodically discharged. The voltage curve of a condenser during the period of charging, as a function of time, is a curve as shown in Figure 1 and having as its asymptote the straight line ordinate U, U being the voltage of the source charging the condenser. In the process forming the object of the present invention, the beginning only of the curve is used in order that the same may assume the form of a straight line. The voltage of the condenser will not be allowed to attain, for example, a value greater than about one-tenth of U.

In order to obtain the discharge of the condenser, the same is inserted in the anode circuit of a gas tube. The discharge is produced by the application of a suitable voltage to the control grid of this discharge tube.

The process according to the present invention consists in producing the discharge of the condenser controlling the rapid movement by the application to the grids of its gas tube of an impulse produced by a signal sent out at the end of the each line except at the end of the penultimate line of analysis or at the end of several consecutive lines preceding the last line. The suppression of the signal enables the condenser controlling the rapid movement to attain at the end of the last line a voltage greater than that which it attains at the end of the other lines. This greater voltage attained by the rapid movement condenser is utilized in order to give to the grid of the gas tube of the slow movement condenser a voltage such that a discharge of this second condenser is produced.

The apparatus is completely shown by Figure 2 and its operation is as follows:

The signals sent out at the end of each line of analysis by the transmitter produce impulses at the line frequency, which impulses are fed to the ends of a resistance 1 through the intermediary of a regulating device 2, which may be as described in my Patent No. 1,940,161, dated December 19, 1933. The resistance 1 is inserted in the circuit of the control electrode 3 of a gas tube 4 which also comprises at least a cathode 5 and an anode

6. The electrode 3 is polarized by a source 7. A condenser 8 of which the terminals are connected to the two rapid movement plates 8 and 9 of the cathode tube, is inserted in the anode circuit 6 of the gas tube 4. The condenser 8 can be charged by a source 11 of electro-motive force U through the intermediary of a resistance 12.

Under the influence of the source 11, the condenser 8 charges itself and the curve of its voltage as a function of time is of the form shown in Figure 1. The source 7 is such that when an impulse is impressed upon the grid 3, the discharge is set up in the gas tube 4. At this moment, the condenser 8, which has attained a voltage u, is sharply discharged. The impulse received by the electrode 3 being almost instantaneous, the condenser 8 immediately recommences to charge itself. The curve representing its voltage as a function of time during the sweeping of an image can be represented by Figure 3. The voltage u is sufficiently small to ensure that the portions of the charging curve of the condenser 8 can be assumed to be straight lines.

At the end of the penultimate scanning line, for example, there is no signal transmitted by the transmitter. No impulse being received by the electrode 3, the voltage of the condenser 8 continues to increase. When the signal at the end of the last line is transmitted, the condenser 8 will have a voltage of about $2u$ substantially double the voltage attained during the discharge at the end of the other lines. A more violent discharge will then take place at the end of the last line. The curve of the voltages of the condenser 8 as a function of time during the passage from one image to the next is of the form shown in Figure 4.

It is so arranged that the cathode beam, the displacements of which are substantially proportional to the voltages applied across the plates 9 and 10, is projected outside of the screen during the scanning of the last line at the transmitter. No useful purpose will then be served by modulating this last line.

A second condenser 13, of which the terminals are connected to the two slow movement plates 14 and 15, is inserted in the circuit of the anode 16 of a second gas tube 17 having moreover at least a cathode 18 and a control electrode 19.

The condenser 13 can be charged from a source 20 of electro-motive force U' through the intermediary of a resistance 21.

The circuit of the control electrode 19 of the gas tube 17 is coupled to the circuit of the anode 6 of the gas tube 4 by a device 22. This device can be in the form of two inductances coupled electro-magnetically or in the form of a transformer, as is shown in Figure 2, or in the form of a condenser as is shown in Figure 5.

The electrode 19 is polarized by a source 23 in such a manner that a discharge is produced in the gas tube 17 when the condenser 8 attains the voltage $2u$. With the method of coupling shown in Figure 2, the anode current set up by the discharge of the condenser 8 having attained the voltage $2u$ induces in the circuit of the electrode 19 a voltage such that a discharge of the condenser 13 is produced to return the beam from the last line of the screen to the first line. The apparatus is adjusted in such a manner that the voltage induced in the circuit of the electrode 19 upon the discharge of the condenser 8 charged to u is insufficient to set up the discharge of the condenser 13 through the gas tube 17.

With the method of coupling shown in Figure 5 the voltage of the electrode 19 increases with that of the condenser 8. When this attains the voltage u, the voltage of the electrode 19 is insufficient for the discharge to be produced. As soon as the condenser 8 attains the voltage $2u$ the voltage of the electrode 19 is such that a discharge of the condenser 13 is produced.

In all cases, the discharges of the two condensers produced simultaneously return the cathode beam which is positioned outside the screen at the level of the last line reproduced to the beginning of the first line of the screen. It, therefore, results that in its return movement, the cathode beam only traverses a small part of the upper region of the screen instead of traversing the same diagonally as is usually the case.

It has been explained above that no useful purpose is served by modulating the last line of analysis at the transmitter. It is even advantageous not to modulate it in order to avoid the production of additional voltages which might cause the gas tube 17 to function before the condenser 8 had attained the voltage $2u$.

The coupling of the two gas tubes by inductances presents an advantage. The discharge of the condenser 8 being very rapid, which corresponds to a very high frequency for the discharge current, it is sufficient to have a very feeble inductive coupling between inductances of a few turns. This coupling is inoperative for the lower frequency and hence operates as a protection for the gas tube 17. The electromotive force which occurs in the inductive couplings, is, due to the great velocity in variation of the discharge current, of relatively substantial magnitude despite the small number of turns of these inductances. Consequently a low-frequency current, the slope of which, in function of time, is less inclined than that of the discharge current, can only produce a negligible electromotive force as compared to that due to the discharge current, also because of the small number of turns of these inductances.

In the above explanation it has been admitted that the rectilinear part of the curve of the condenser 8 only is used. If it were not so, it would be necessary to substitute for the voltage $2u$, that voltage which the condenser 8 attains at the end of a time double that at the end of which it attains the voltage u.

What I claim is:

1. Method for controlling by a single series of signals the periodic discharge of two condensers each of which is progressively recharged by a source of current during the full time interval separating two of its consecutive discharges, consisting in controlling the successive discharges of the first condenser by successive electric impulses, arranging said impulses in groups separated by a time interval greater than the interval separating two successive impulses of the same group whereby said first condenser acquires at the end of the interval separating two groups a voltage greater than the voltage attained at the end of the interval separating two successive impulses of the same group, and utilizing said greater voltage to control the discharge of the second condenser.

2. Apparatus for the periodic discharge of two condensers, comprising means for progressively recharging each condenser during all the time interval separating two of its successive discharges, a source of electric impulses supplying groups of successive impulses, said groups of impulses being separated by a time interval greater than the interval separating two successive impulses of the same group, a first discharge tube comprising an

anode and a control electrode and the circuit of said anode comprising the first condenser, means for applying to the control electrode of said discharge tube the said impulses for the purpose of discharging the first condenser at each of said impulses, a second discharge tube comprising an anode and a control electrode and the circuit of said anode comprising the second condenser, and means for controlling the voltage of the control electrode of the second tube by the intensity of the discharge of the first condenser whereby the discharge of the second condenser is produced at the end of the interval separating two successive groups of impulses.

3. A method of synchronizing the beam of a cathodic oscillograph comprising two pairs of deflecting plates connected respectively to the terminals of two condensers each condenser being periodically discharged, then progressively recharged by a source of current during the whole time interval separating two of its successive discharges, said method consisting in controlling the successive discharges of the first condenser by successive electric impulses, arranging said impulses in groups separated by a time interval greater than the interval separating two successive impulses of the same group whereby said first condenser acquires at the end of the interval separating two groups a voltage greater than the voltage it attains at the end of the interval separating two successive impulses of the same group, utilizing said greater voltage to control the discharge of the second condenser, applying the voltage of said first condenser to one pair of deflecting plates to control the cathode beam in one direction, and applying the voltage of the second condenser to the second pair of deflecting plates to control the cathode beam in a direction perpendicular to the prementioned direction.

4. Apparatus for synchronizing the beams of the cathodic oscillograph of an image receiving device by means of synchronizing signals sent out from a transmitter, comprising a first condenser connected to the plates controlling the rapid movement of the cathode beam, a second condenser connected to the plates controlling the slow movement of said beam, means for charging said two condensers, means for receiving the synchronization signals transmitted by the transmitters, said signals comprising groups of successive impulses the time interval separating two successive groups being greater than the interval separating two successive impulses of the same group, means for discharging the first condenser at each of the impulses, and means controlled by the intensity of the discharge of the first condenser for discharging the second condenser at the end of the interval separating two successive groups of impulses, said means for charging said two condensers recharging each condenser progressively during the whole time interval separating two of its successive discharges.

5. Apparatus for synchronizing the beam of the cathodic oscillograph of an image receiving apparatus by means of synchronizing signals sent out from a transmitter, comprising a first condenser connected to the plates controlling the rapid movement of the cathodic beam, a second condenser connected to the plates controlling the slow movement of said beam, means for charging said two condensers, means for receiving the signals of synchronization transmitted by the transmitters said signals comprising groups of successive impulses the time interval separating two successive groups being greater than the interval separating two successive impulses of the same group, a first discharge tube comprising an anode and a control electrode the circuit of said anode comprising the first condenser means for applying said impulses to the control electrode of said discharge tube to discharge the first condenser at each of said impulses, a second discharge tube comprising an anode and a control electrode the circuit of which anode comprises the second condenser, and means to control the voltage of the control electrode of the second tube by the discharge of the first condenser to effect the discharge of the second condenser at the end of the interval separating two successive groups of impulses, said means for charging said two condensers recharging each condenser progressively during the whole time interval separating two of its successive discharges.

6. Apparatus for synchronizing the beam of the cathodic oscillograph of an image receiving apparatus by means of synchronizing signals sent out from a transmitter, comprising a first condenser connected to the plates controlling the rapid movement of the cathode beam, a first source of electricity in series with a resistance for charging said first condenser, a second condenser connected to the plates controlling the slow movement of the cathode beam, a second source of electricity in series with a resistance for charging said second condenser, means to receive the synchronizing signals transmitted by the transmitters, said signals comprising a group of successive impulses the time interval separating two successive groups being greater than the interval separating two successive impulses of the same group, a first gas discharge tube comprising an anode and a control electrode the circuit of said anode comprising the first condenser, means to apply said impulses to the control electrode of said first tube, a third source of electrical energy to polarize said control electrode said third source having a value such that the first condenser is discharged at each impulse, a second gas discharge tube comprising an anode and a control electrode the circuit of said last mentioned anode comprising the second condenser, means to couple the anode circuit of the first tube to the circuit of the control electrode of the second tube, a fourth source of electrical energy to polarize said control electrode of said second tube, said coupling means and the voltage of said fourth source being regulated whereby the second condenser is discharged at the end of the interval separating two groups of successive impulses.

7. A device according to claim 6, comprising two coupled inductances as coupling means between the anode circuit of the first tube and the control electrode circuit of the second tube.

8. A device according to claim 6, comprising a third condenser as coupling means between the anode circuit of the first tube and the control electrode circuit of the second tube.

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