March 20, 1945. U. KNICK 2,371,897

COMPENSATING ARRANGEMENT FOR TELEVISION TUBES

Filed Nov. 12, 1941

FIG. 1

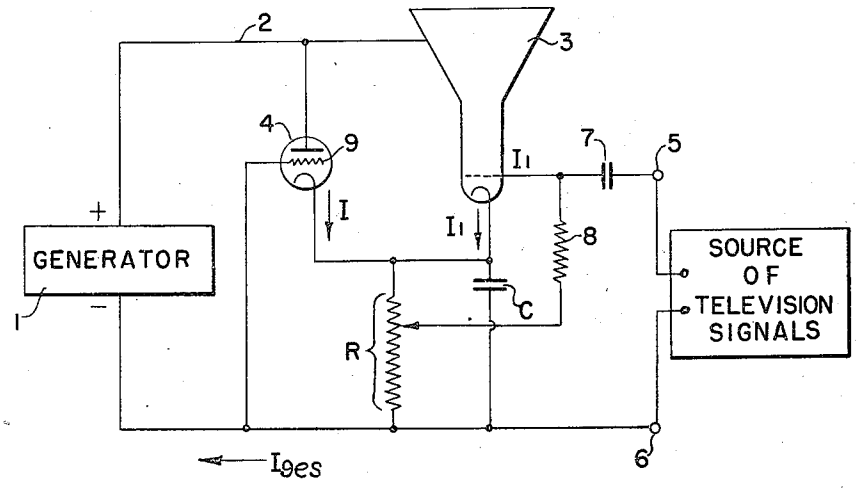
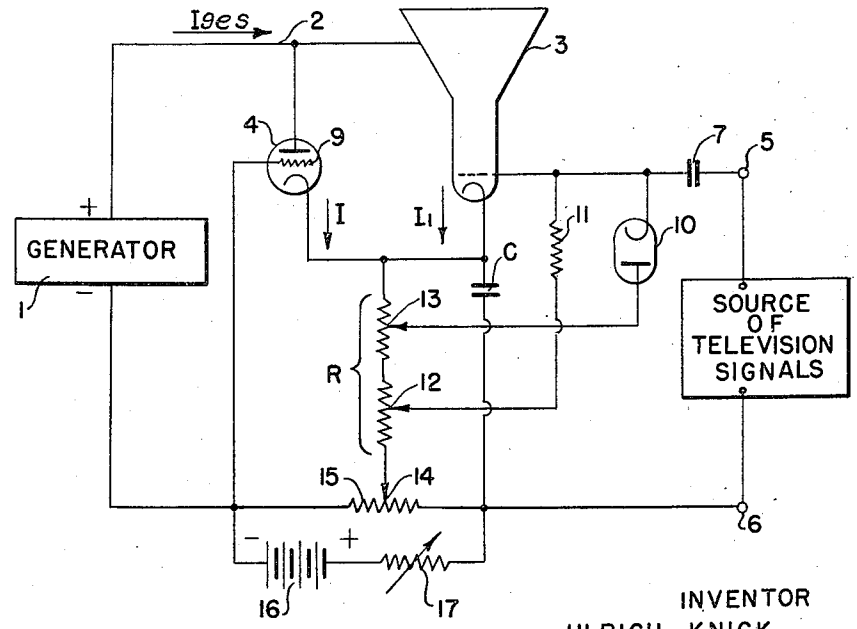



FIG. 2




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## COMPENSATING ARRANGEMENT FOR TELEVISION TUBES

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3 Claims. (Cl. 315—28)

The present invention relates to arrangements for operating Braun tubes and has special reference to devices for compensating the fluctuations in anode voltage caused by the luminosity control of television tubes.

In television tubes the anode voltage, which mostly amounts to several thousands of volts, is usually taken from a transformer and, then, rectified and smoothed out by filtering means. It is well known, that such power supply systems will not give a constant voltage at the varying loads caused by the changes occurring in the subject-matter of the picture to be transmitted.

It was tried to neutralize these disturbing voltage fluctuations by the use of considerably bigger power supply systems, that is by connecting, in parallel to the television tubes, a constant resistor, through which is flowing a current considerably larger than that flowing through the television tube. It is true that, owing to this constant and continuous current, the fluctuation percentage of the current taken from the power supply system is rendered considerably smaller, but this procedure, let alone the high expenditure, ensures also very high losses in the parallel resistor, which in many cases renders impossible the use of said procedure. Moreover, it has been proposed to have a parallel D. C. connection of the television tube and a compensating tube, the latter being controlled in phase opposition with respect to the television tube. In practice, however, extraordinary difficulties will result, because the characteristic curves showing the grid-voltage as a function of anode-current of these two tubes must be in exact coincidence. This requires an extremely expensive mode of construction of the compensating tube, since a special type of compensating tube must be made for each type of television tubes and since, owing to the disparity of technical data occurring in single piece manufacture, only very few out of a great number of compensating tubes will possess the characteristic curve required for compensation.

Further it has been proposed to connect, in parallel with the television tube, a compensating tube which has a constant grid biasing value and is controlled by the fluctuations occurring in the anode voltage. By this method a decrease in the anode voltage fluctuations may, in fact, be obtained in a very simple way, but such decrease may be effected only, since a fluctuation in anode voltage is required for anode control of the compensating tube and a residual fluctuation of voltage will always remain. Therefore this procedure may not be employed in those cases where the requirements made upon the constancy of the anode voltage are more severe.

It is an object of the invention to combine a television tube, the corresponding power supply system, and a compensating tube in such a way that the above mentioned disadvantages will not make themselves felt and, therefore, the current taken from the power supply system will, at minimum expenditure, be held upon a value independent from the anode current of the television tube.

In accordance with the invention and in order to produce a high constant voltage, practically independent of anode fluctuations, for operating television tubes, there is connected, between the output terminals of the anode current system, a grid-controlled auxiliary tube and, between the cathode of the television tube and the negative terminal of the anode voltage system, there is connected a resistor R, which, at the same time, is situated in the grid-control circuit of the auxiliary tube. That end of the resistor which, in its direction, is away from the cathode of the television tube will be directed towards the control grid of the auxiliary tube. It is of advantage to choose the resistor R such, that the arithmetical product of the slope of the auxiliary tube and of R, measured in ohms, is bigger than 1

In the drawing, Figs. 1 and 2 show schematically two illustrative embodiments of the invention.

In Fig. 1, the current, supplied by generator 1 and having the intensity $I_{ges}$, is led, by way of line 2, on the one hand, to the anode of television tube 3, and, on the other hand, to the anode of auxiliary tube 4, the internal resistance of which will, subsequently, be indicated by $R_i$ and the slope of which by S. Into the cathode circuit of the television tube is inserted a resistor R, which is so connected with the cathode of auxiliary tube 4, that it is traversed by the anode voltage of the television tube as well as the anode voltage of the compensating tube. The modulation voltages are led in by way of terminals 5 and 6 and conducted to the Wehnelt cylinder, provided with the leak resistor 8 of the television tube. For this reason the electron stream of the television tube is modulated as a function of the actually existing picture luminosity, and the voltage drop at resistor R will, therefore, also fluctuate in the same rhythm. At this resistor R, however, is produced the grid biasing potential for controlling grid 9 of tube 4 and, therefore, auxiliary tube 4 is controlled in

the same rhythm as the television tube, but with opposite polarity.

Resistor R is in parallel with the apparent internal cathode resistance of tube 4, which is equal to the reciprocal value of the slope of this tube. Thus the voltage drop resulting at resistor R is kept practically constant, the constancy being the better, the smaller the apparent cathode resistance (the steeper the slope) with respect to resistor R. The constant potential at resistor R will produce a constant current, flowing through this resistor, this current being, at the same time, the total current which is taken from the generator.

Resistor R is bridged, as regards A. C., by a condenser C, and thereby it is obtained that the rapidly succeeding changes in luminosity, that is the so-called A. C. component of picture modulation, is led directly to the grid cathode space of the television tube, a substantial portion of the signal voltage put in would, possibly, be consumed in resistor R, without an effect.

If an impulse of e. g. positive polarity is, by way of terminal 5, fed into the controlling grid of the television tube, anode current $I_1$ of the television tube will increase by the amount $\Delta I_1$, and at cathode resistor R there will arise an additional voltage drop $R \cdot \Delta I_1$. But as the voltage drop at resistor R is decisive of the potential of controlling grid 9 of the auxiliary tube, said potential will be more negative by the amount $R \cdot \Delta I_1$ and, the slope of the auxiliary tube being S, anode current I is decreased by the amount $S \cdot R \cdot \Delta I_1$. By a convenient selection of R and S it will be feasible to compensate the increase in anode current $I_1$ by a decrease in anode current I in such a way that the total current ($I_{ges} = I + I_1$) will, practically, be constant.

By the above-described combination of current supply system 1 and auxiliary tube 4 there will be achieved an effect as if the apparent internal resistance $R'_{gen}$ of the current supply system, feeding the television tube, had come to be

$$R'_{gen} = \frac{\Delta Ua}{\Delta I_1} = \frac{1}{\left(\frac{S.R}{R_{gen}}\right) + \frac{1}{R_i} + \frac{1}{R_{gen}}}$$

wherein $R_i$ indicates the internal resistance of the auxiliary tube and $R_{gen}$ the inner resistance of the current supply system without auxiliary tube.

In the illustrated circuit arrangement only the changes of the anode D. C. caused by the fluctuations in the average luminosity of the picture are compensated by the auxiliary tube, while the rapid fluctuations in the anode voltage caused by the different luminosities of the single picture spots, fluctuating around the average luminosity of the picture at a relatively high frequency, are compensated by the filtering means arranged in the anode current supply system. The time constant of R and condenser C must, however, be smaller than the period of time relating to one line change of the television transmission.

In certain cases it may be convenient to further reduce the required expenditure in filtering means by not only compensating the fluctuations in average picture luminosity, but also the anode current fluctuations caused by the picture modulation. In this case the condenser, bridging resistor R, must be left out.

The arrangement in accordance with the invention is used, to particular advantage, in combination with television tubes which are controlled in a correct ratio with respect to their luminosities, that is such to which is fed a variable D. C. component dependent upon the picture subject-matter existing at the respective instant. In television tubes, controlled in such a way, the anode current fluctuations are particularly wide and abrupt. These fluctuations can, especially, make themselves felt in sets not under control and in which picture quality is not being constantly examined by the viewer or by service people. Such sets are e. g. used for testing the quality of television transmissions, wherein single scans or successions of lines are, at certain periodically recurring times or under the influence of a remote control device, selected from a television transmission and recorded photographically.

In Fig. 2 is illustrated the wiring in which luminosity control of television tube 3 is effected by means of so-called black control. The wiring, in several details, is equivalent to the above-described wiring and corresponding parts in the two figures bear the same reference numerals. The arriving video signals are led to the controlling electrode of the television tube by way of terminals 5 and 6 and coupling condenser 7. The cathode of a diode 10 is connected to this controlling electrode, the anode of said diode being linked up with tap 13 of resistor R. By means of resistor 11, linked up with tap 12 of resistor R, the diode is under a corresponding biasing potential, whereby the television tube control of correct luminosity is secured in a manner known per se. In certain cases it may be of advantage that suitable devices be provided in order to adjust the point of operation of auxiliary tube 4, that is in order to obtain an operation within the range of steepest slope. To this effect the end of resistor R, not directed towards the television tube, is led to the slidable tap of resistor 15, which is so connected to the source of auxiliary voltage 16, that it is traversed by a current. The intensity of this current may, if necessary, be adjusted by changing the control resistor 17, and thereby or by sliding tap 14, the grid biasing potential and, therefore, the point of operation of the auxiliary tube is usually adjusted to the most advantageous voltage.

The invention is of particular advantage in combination with transformer relaxation oscillators, in which the high voltage impulses generated during the feed-back period are rectified and serve for generating high voltage for television tubes, since these devices for obtaining anode voltage have a very high apparent internal resistance, particularly if the constant potential is generated in a multiple stage system.

What I claim is:

1. In combination, a cathode ray tube comprising an anode, cathode and control electrode, a source of potential connected to the anode of said tube, a source of signals connected to the control electrode of said tube and means for compensating the fluctuations in the anode voltage caused by the fluctuations of said signals comprising a grid controlled auxiliary tube connected in parallel with the anode-cathode circuit of said cathode ray tube and a resistor connected between the cathode of said cathode ray tube and said source of potential and also between the cathode of said auxiliary tube and grid of said auxiliary tube.

2. In combination, a cathode ray tube comprising an anode, cathode and control electrode, a source of potential connected to the anode of said tube, a source of signals connected to the

control electrode of said tube and means for compensating the fluctuations in the anode voltage caused by the fluctuations of said signals comprising a grid controlled auxiliary tube connected to the anode-cathode circuit of said cathode ray tube and a resistor connected to the cathode of said cathode ray tube and said source of potential and also between the cathode of said auxiliary tube and grid of said auxiliary tube.

3. In apparatus of the character described for compensating the fluctuations in voltage impressed across a cathode ray tube caused by changes in the current flowing through the tube, the combination of, a cathode ray tube having a cathode and an anode and a control electrode, a source of signals connected to said control electrode, a source of current connected between said cathode and said anode, and circuit means connected between said source of current and said cathode and anode for preventing a fluctuation in the voltage across said cathode and anode which would result from a change in the current flowing through said tube due to the action of said control electrode comprising an auxiliary tube having an anode connected to the anode of the cathode ray tube and a cathode connected to the cathode of the cathode ray tube, a resistor connected between said cathodes and the source of current, and a control electrode in said auxiliary tube to control the flow of current therethrough and connected to said source of current between the source and said resistor.

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