TX 63.23

June 8, 1943. W. A. TOLSON 2,321,335

ELECTRICAL APPARATUS

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X 1339

X 1345

X 319

Fig. 1.

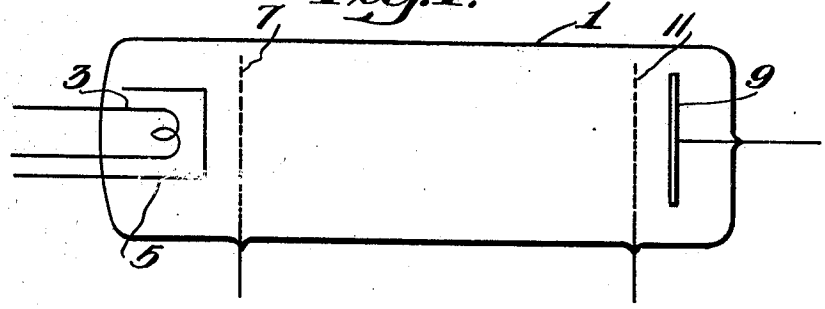



Fig. 2.

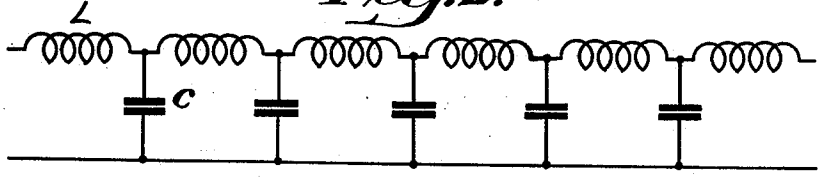
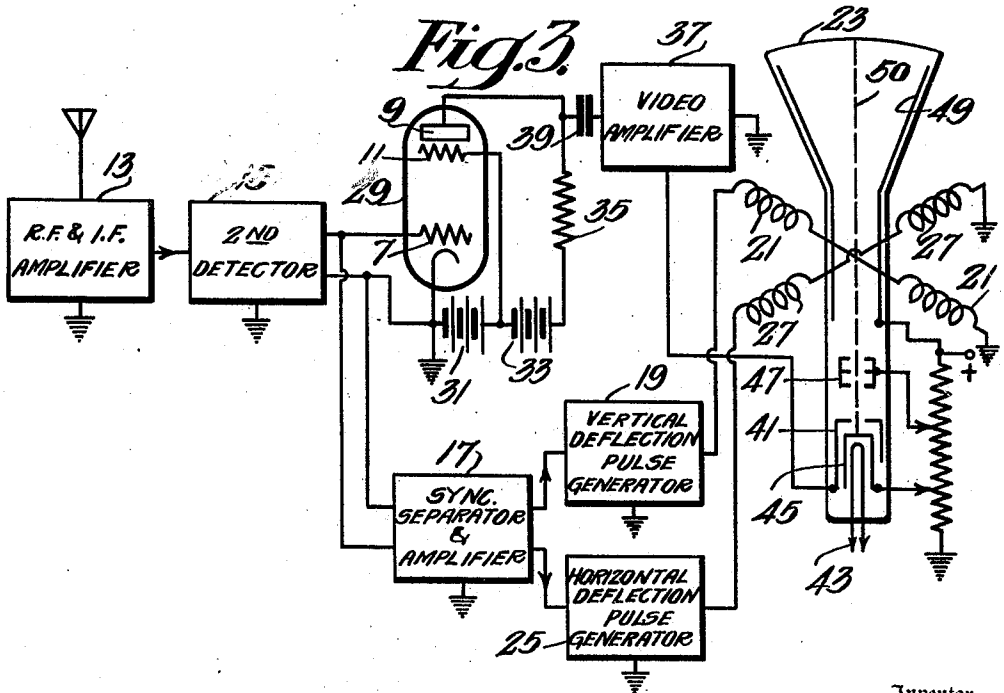



Fig. 3.




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Fig. 4.

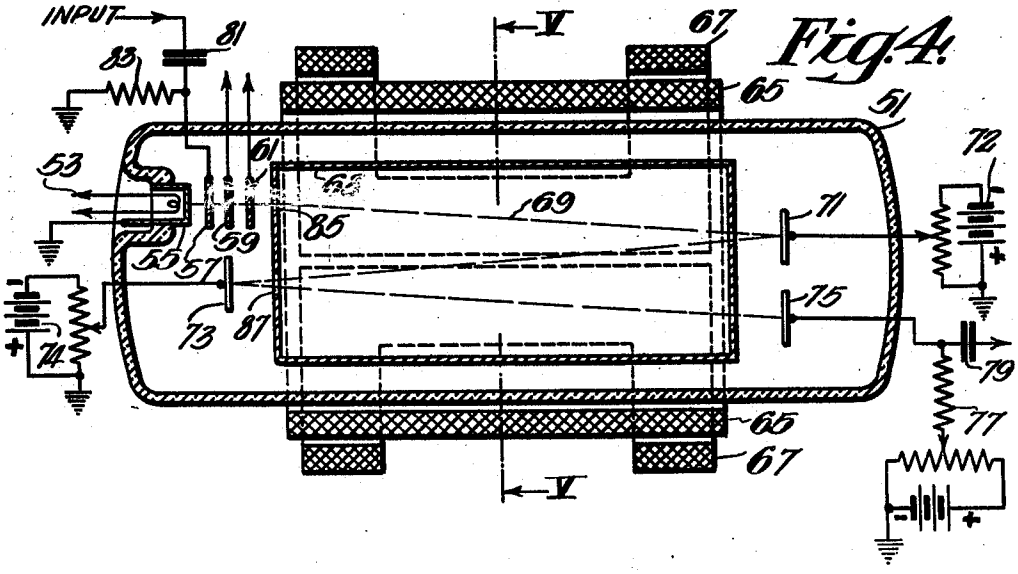
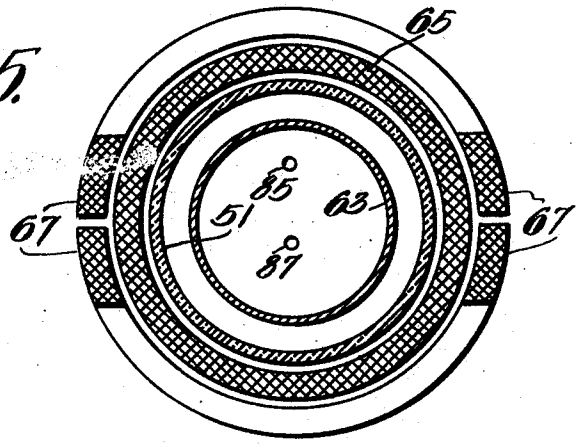



Fig. 5.




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Patented June 8, 1943

2,321,335

# UNITED STATES PATENT OFFICE

2,321,335

## ELECTRICAL APPARATUS

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Application September 30, 1940, Serial No. 359,170

2 Claims. (Cl. 178—7.5)

This invention relates to delay circuits, and, more particularly, to an electronic time delay device.

In the transmission of television pictures, a serious loss in picture transmission time is occasioned by the loss in time required for the synchronizing signal to actuate the deflecting oscillator and for the transmission of the saw-tooth deflecting signal to the picture tube. It has been estimated that the total time lost in the horizontal scanning circuit represents about 5 percent of the total picture time exclusive of the time lost due to the "return line" time.

It has been proposed that a time delay network be included in the video amplifier circuit of the television receivers to delay the video signals on the control electrode of the picture tube by a time equivalent to the time lost in the synchronizing and deflecting circuits. In this manner, approximately 5 percent of the total picture transmission time would be saved. In practice, however, a time delay network comprising inductance and capacity would be extremely elaborate and very critical of adjustment if the attenuation and phase-delay characteristics were to be maintained constant over the wide frequency band required for the production of a high definition television picture.

It has been found that a low velocity electron beam can be produced by using an electron discharge device having a cathode adapted to emit electrons and an anode adjacent the cathode and subjected to a relatively low positive potential with respect to the cathode. In such a device the transit time of the electrons may be increased by employing known types of electron guns and projecting the stream of electrons upon an element located at a relatively large distance from the cathode.

According to this invention, a transmission time delay is secured through the use of such a low velocity electron beam. An electronic delay device has the advantage over a filter network in that the delay characteristic would be completely independent of frequency and the amount of delay may be very conveniently adjusted.

The primary object of the present invention is to provide an electronic transmission-time delay device.

Another object of this invention is to provide a transmission-time delay device whose delay characteristic is completely independent of frequency.

Still another object of this invention is to provide a transmission-time delay device whose delay characteristic may be easily adjusted.

Other and incidental objects of the invention will be apparent to those skilled in the art from a reading of the following specification and an inspection of the accompanying drawings in which

Figure 1 is a cross-sectional view of an electronic transmission-time delay device,

Figure 2 is a circuit diagram of an equivalent transmission-time delay network,

Figure 3 is a circuit diagram showing one embodiment of this invention,

Figure 4 is a cross-sectional view of another form of electronic transmission-time delay device, and

Figure 5 is a sectional view of Figure 4.

Referring now in more detail to Fig. 1, an elongated envelope 1 contains a heater element 3 and a cathode 5, a control electrode 7, an anode 9 and an auxiliary electrode 11.

The cathode 5 is widely separated from the anode 9, and, by using an extremely low anode potential, an extremely low velocity beam of electrons is caused to pass from the cathode 5 to the anode 9. The control electrode 7 is used to modulate the intensity of the electron beam flowing from the cathode 5 to the anode 9.

Since a load would normally be included in the anode circuit, the anode voltage would vary in accordance with the signals impressed upon the control electrode 7. For this reason, a screen electrode or accelerating electrode 11 is positioned adjacent the anode 9 to prevent modulation of the electron velocity due to the resulting signal voltages on the anode.

Fig. 2 shows a circuit comprising a plurality of inductances L and capacitors C whose electrical characteristics are equivalent to the electron discharge device shown and described under Fig. 1.

Fig. 3 shows the use of an electron time delay device in a television image reproducer wherein the signal from the radio frequency and intermediate frequency amplifier 13 is fed to a second detector 15. Signal from the second detector 15 is fed through the synchronizing signal separator and amplifier shown as block 17. The vertical pulses are fed through the vertical deflection pulse generator 19 to the vertical deflecting coils 21 of the picture tube 23. The horizontal pulses from the synchronizing signal and separator 17 are fed through the horizontal deflecting pulse generator 25 to the horizontal deflecting coils 27 of the picture tube 23.

A portion of the signal from the second detector 15 is impressed upon the control electrode 7 of the electronic time delay device 29. An auxiliary electrode 11 is supplied with a small positive potential by voltage source 31 and the anode 9 is supplied with a small positive potential through voltage source 33 and coupling resistor 35. The delayed signal from the electronic time delay device 29 is fed to the video amplifier 37 from the anode 9 and through the coupling condenser 39. The delayed video signal is then

fed to the control electrode 41 of the picture tube 23. The picture tube 23 contains the usual heater element 43, cathode 45, first anode 47, and second anode 49 to generate and accelerate the electron beam 50.

The video signals that are impressed upon the control electrode 41 of the picture tube 23 are delayed in the electronic time delay device 29 by an amount equivalent to the time lost in the transmission of the synchronizing pulses through the synchronizing signal separator and amplifier circuit 17, and the deflection pulse generator circuits 19 and 25, so that approximately 5 percent of the total picture transmission time will be saved by eliminating the necessity for blanking out the picture signal during the additional time required for the transmission of the synchronizing pulses through their associated circuits.

The transit time of the electrons may be still further increased by so arranging the elements and circuit constants that the electron stream does not actually reach the "target" element but is caused to return to a second "target" element adjacent to the cathode. This effect is produced in known types of tubes by means of a magnetic or static field. Such an electron device is shown and described in a United States patent to Harley A. Iams, No. 2,213,177, issued August 27, 1940.

Figure 4 shows an electronic transmission-time delay device having an envelope 51 containing an electron gun having a heater element 53, a cathode 55, a control electrode 57, an auxiliary electrode 59, and a first anode 61, which generates an electron beam 69. The second anode 63 is in the shape of a cylinder and surrounding the envelope 51 is the directing coil 65 and the deflecting coils 67.

The magnetic effect of the deflecting coils 67 directs the electron beam 69 toward an auxiliary anode 71 positioned at an opposite end of tube 51 from the cathode 55. An auxiliary anode 71 is maintained at a slightly negative potential with respect to the cathode 55 by potential source 72 such that it will cause the electrons of the beam 69 to reverse their direction before they have come into direct contact with the auxiliary anode 71.

The electrons of beam 69 are then directed toward another auxiliary anode 73 at the same end of the tube as the cathode 55 but displaced therefrom by a distance equal to the lateral distance which the electrons will travel due to the effect of the deflecting coils 67. This auxiliary anode 73 is also maintained at a slightly negative potential with respect to the cathode 55 by potential source 74, so that the electron beam is again repulsed before it is allowed to come in contact with the auxiliary anode 73 and returned again to the opposite end of the tube 51 where it is again deflected by deflecting coils 67 to still another auxiliary anode 75, which is maintained at a slightly positive potential with respect to the cathode 55 such that the electrons of the electron beam 69 are allowed to strike the auxiliary anode 75 to produce a signal across resistor 77 to be transmitted through coupling condenser 79. The effect of the directing coil 65 is to maintain the electron beam 69 in its concentrated form throughout its path.

The electron beam 69 is modulated by a signal fed to the control electrode 57 through coupling condenser 81. The resistor 83 is connected to the control electrode 57 to allow accumulated electrons to leak off to ground.

Figure 5 is a sectional view of Fig. 4 showing more clearly the deflection coils 67 which take the form of rectangular coils bent over the envelope 51. The directing coil 65 is in the form of a circular coil surrounding the envelope 51. The anode 63, as previously described, takes the shape of a cylinder whose ends are closed with the exception of small openings 85 and 87 which are positioned in front of the electron gun and the auxiliary anode 73, respectively. Similar openings are positioned in front of the auxiliary anodes 71 and 75.

Thus, by employing a sufficiently long path and by employing "reflection" of the electron beam, the transit time of the electrons may be made very long.

Other applications of such a device immediately suggest themselves. For example, in synchronizing signal generators for use in the transmission of television signals, the delay device would provide for easy and continuous adjustment of time delay between the vertical and horizontal synchronizing impulses.

In single frequency duplex telephony, such a device would provide for the necessary delay in the speech input circuits to allow the transmission-actuating circuits to function.

While several systems for carrying this invention into effect have been indicated and described, it will be apparent to one skilled in the art that this invention is by no means limited to the particular organizations shown and described, but that many modifications may be made without departing from the scope of this invention as set forth in the appended claims.

I claim as my invention:

1. In a picture reproducing system including an electron beam tube having a control electrode and beam deflecting circuits, a picture signal channel having a signal amplifier connected to said control electrode, a synchronizing signal channel connected to said beam deflecting circuits and wherein the signal passing through said synchronizing signal channel and said beam deflecting circuits is delayed more than the signal passing through said signal amplifier, the combination in said signal channel of an electronic time delay device comprising an electron discharge device having an electron transit time substantially equal to the difference in time delay in said synchronizing signal channel and said picture signal amplifier.

2. In a picture reproducing system including an electron beam tube having a control electrode and beam deflecting circuits, a picture signal channel having a signal amplifier connected to said control electrode, a synchronizing signal channel connected to said beam deflecting circuits wherein the signal passing through said synchronizing signal channel and said beam deflecting circuits is delayed more than the signal passing through said picture signal channel, means for equalizing the time delay comprising an electron discharge device having means therein for controlling the electron transit time through a range including the difference between the time delay in said synchronizing signal channel and said picture signal channel.

WILLIAM A. TOLSON.