April 8, 1941. A. H. BROLLY 2,237,334

MEANS FOR GENERATING A PULSE IN A CATHODE RAY TUBE

Original Filed Oct. 16, 1933 2 Sheets-Sheet 1

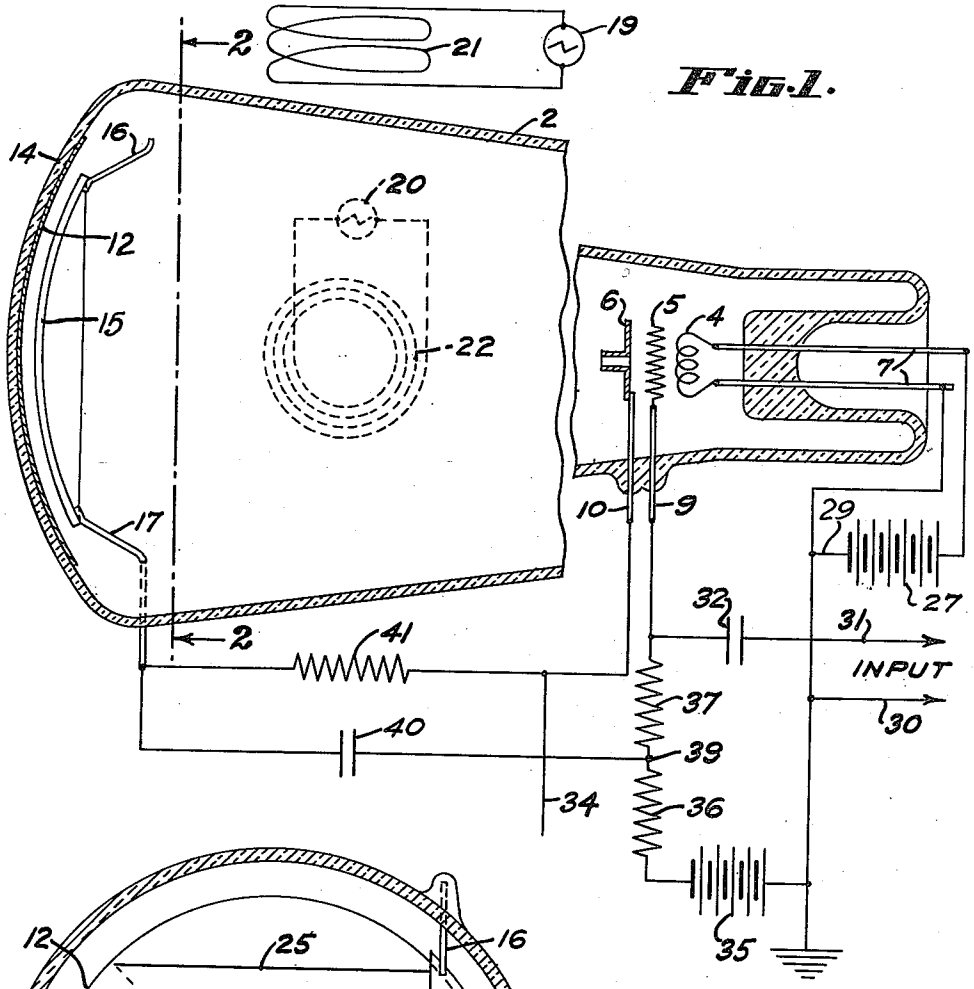


Fig. 1.

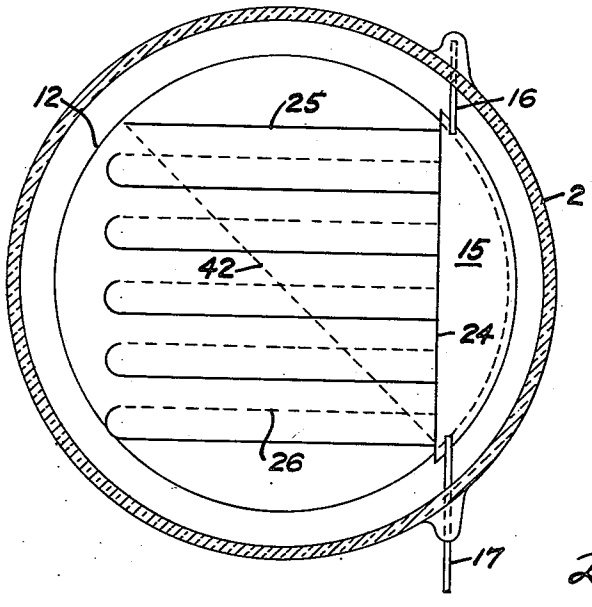


Fig. 2.

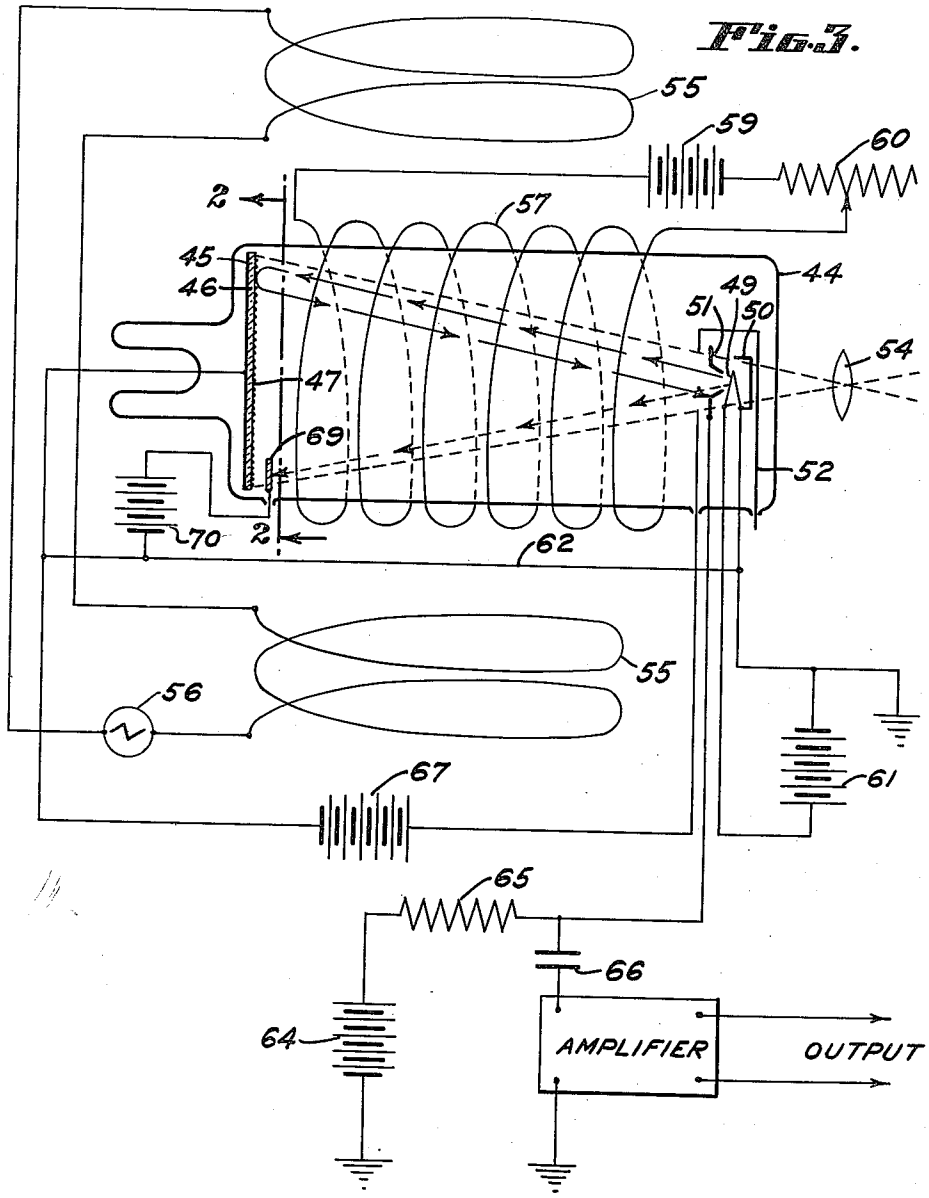
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Fig. 1.



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2,237,334

MEANS FOR GENERATING A PULSE IN A CATHODE RAY TUBE

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Original application October 16, 1933, Serial No. 693,710. Divided and this application December 23, 1937, Serial No. 181,302

3 Claims. (Cl. 250—164)

My invention relates to a means and method of generating a pulse in a cathode ray tube, with particular reference to cathode ray tubes used for the transmission and reception of television signals.

This application is a division of my co-pending application Serial No. 693,710, filed October 16, 1933, now United States Patent No. 2,107,778 issued February 8, 1938.

Among the objects of my invention are:

To provide a simple means for generating a pulse in a cathode ray tube; to provide a simple method of generating a pulse in a cathode ray tube; to provide a means for and method of generating a synchronizing pulse in a cathode ray image dissector tube; to provide a method of cathode ray tube image dissection and restoration wherein a pulse is generated; to provide a method of modifying a cathode ray beam during the scanning cycle; and to provide a simple and efficient means for and method of producing pulses which may be desirably utilized in the operation of cathode ray television apparatus.

Other objects of my invention will be apparent or will be specifically pointed out in the description forming a part of this specification, but I do not limit myself to the embodiment of my invention herein described, as various forms may be adopted within the scope of the claims.

In the drawings which illustrate the methods of my invention as applied to the structure of cathode ray tubes for television:

Figure 1 is a longitudinal sectional view of a cathode ray receiving tube, with an associated diagrammatic operating circuit.

Figure 2 is a cross-sectional view taken as indicated by the line 2—2 in Figure 1, showing in an exaggerated and diagrammatic form the paths followed by the cathode ray beam.

Figure 3 is a diagrammatic longitudinal section, and operating circuit of television transmitting apparatus employing a cathode ray image dissector tube. The tube and circuit, except for the additional structure and circuit of my invention is that disclosed in United States Patent to Philo T. Farnsworth, 2,087,683, issued July 20, 1937, for an Image dissector.

In this specification the term "cathode ray tube" is deemed to include all electrical discharge tubes in which electrons emanating from a source are largely confined to one general direction of travel, or travel in two opposing directions along substantially parallel paths.

I wish to describe my invention as applied to a television system to produce pulses for two purposes. The first purpose is to provide a synchronizing pulse at the transmitter, the second to provide a pulse at the receiver adapted to modify or extinguish the cathode ray beam during a portion of the scanning cycle. It is obvious, however, that other uses may be found in the television system for pulses generated by the cathode ray tubes, and the uses shown serve merely as an illustration in describing the means and method of my invention.

In broad terms my invention comprises in method, the interception of the energy of a moving cathode ray beam during a portion of its cycle of movement, and the subsequent utilization of the energy thus obtained to generate preferably a synchronizing pulse at the transmitter and a pulse adapted to modify or extinguish the cathode ray beam at the receiving end. The complete or partial removal of energy in the receiver beam is of great aid where scanning is done at differential speeds, namely, scanned slowly, and returned at high speed. The pulse may be used to remove the return or back lines, thus greatly improving the image.

The apparatus, broadly, is the same in transmitter and receiver. It comprises an electrode placed within the tube in a position as if at one of the edges of the image, the beam being so deflected that it will contact the electrode at intervals during the scanning cycle. The energy intercepted by the electrode is then transferred through the proper electrical connections to be utilized in the preferred manner.

The expression "as if at one of the edges of the image" is used because of the three-dimensional character of the beam. The image has only two dimensions. The electrode, however, may obviously be placed either at the actual edge of the image as seen in the cathode ray tube or at substantially any point between the image and the source of electrons where the beam will fall on the electrode after it has traversed the image area. The term "image area" therefore will be deemed to mean that area occupied by the beam during scansion of the image irrespective of the plane of section.

In Figure 1 my invention is shown as applied to a preferred form of cathode ray receiving tube. An envelope 2 is provided with the usual electron gun comprising a cathode 4, a control grid 5, and apertured anode 6 with their respective leads 7, 9 and 10 sealed through the walls.

The apertured anode 6 is directed toward a luminescent screen 12 deposited on an expanded viewing end 14 of envelope 2.

At one side of the image area, placed to intercept the electron beam after it has traversed the area, is an intercepting electrode 15, held in place by an electrode support 16 and an electrode lead 17 passing through the wall to provide external connection.

Scanning oscillators 19 and 20 with their respective coils 21 and 22 are positioned to direct their fields on the beam at substantially right angles to cause the beam to scan the screen 12 cyclically to produce the image. I prefer to use a saw-tooth scanning current whereby the beam is moved relatively slowly across the screen when modulated, the return being at relatively high speed, with either modulated or unmodulated energy in the beam.

I prefer to adjust the scanning coils so that an edge 24 of electrode 15 is substantially at right angles to the path of the beam during the higher scanning frequency, as shown in Figure 2. Here the path of the beam during the production of the image is shown by a heavy line 25, the return being indicated by the dotted line 26. In normal operation the lines 26 would be of sufficient brilliancy to cause an annoying effect, unless blanked out. I prefer, therefore, to utilize the energy picked up by the intercepting electrode 15 to modify or extinguish entirely the beam during its return. If extinguished, it will not matter whether or not the beam is modulated during that portion of the cycle, whatever the beam may carry during that time being unable to affect the image. By extinguishing the beam, therefore, I release that portion of the cycle for the carrying of other currents used elsewhere than in the image, with the assurance that such currents will not affect the image in any manner.

The circuit which I prefer for utilizing the energy arriving on the intercepting electrode in the receiving tube is shown in Figure 1.

The cathode 4 is energized through the cathode leads 7 by a cathode source 27, one side 29 of which goes to ground and to the grounded leg 30 of the input. The live leg 31 of the input passes to the grid 5 of the tube through the blocking condenser 32.

The anode 6 is energized, preferably from a source of high potential not shown, through the anode supply wire 34.

The grid 5 is biased to the desired negative potential by a bias source 35, the negative end leading to the grid through a bias resistor 36 and a load impedance resistor 37. The junction 39 between these resistors is connected to the intercepting electrode 15 through a storage condenser 40, and the anode supply wire 34 is also connected to the intercepting electrode 15 through a leak resistor 41.

In operation, let it be assumed that the scanning oscillators, the anode and the catohde are energized, and that a television signal is coming in through the input. The scanning oscillators are adjusted to cause the beam to land on the intersecting electrode 15 at the end of each line while the image is being reconstructed. The intersecting electrode thus receives a negative charge from the beam each time the beam is applied thereto.

When the tube is energized, the storage condenser 40 charges up from the anode supply 34 through the leak resistor 41. The leak resistor is of a high value compared with the bias resistor 36, and when the negative charge is received by the intercepting electrode, it tends to discharge the storage condenser, current then passing through the bias resistor 36. The voltage drop across this resistor created by the current flow therein is applied to the grid through resistor 37 to block the electron flow.

The beam is thus reduced or totally extinguished as the scanning coils return it across the screen. The storage condenser in the meantime is slowly charging again through the leak resistor 41 until the beam is ready to come back again for the next line. At that time the storage condenser is fully charged, and the grid has returned to the proper bias again. The cycle is repeated at each traversal.

With the proper selection of values for the storage condenser 40, the leak resistor 41 and the bias resistor 36, the beam may be reduced to an average value during the return trip wherein the illumination of the screen is so small as to be unseen throughout the greater part of the path. It is realized that the illumination will be gradually increasing throughout the return, but the grid may be biased so that as far as the eye is concerned the return to full illumination takes place at the extreme edge of the beam travel.

Some energy will pass through the blocking condenser 32, but as the lead 31 is from the plate of the amplifier, no harm will be done, a small loss in the energy being the only result. As powerful beams are customarily used in tubes of this character, some carrying as high as 75 watts, a considerable amount of energy can be obtained by the interception.

It should also be noted that the scanning can be adjusted so that the beam may be modified during the return trip of the beam after having scanned the full picture area. This return path is indicated by the diagonal dotted line 42 in Figure 2.

A pulse may be obtained in a similar manner by the insertion of an intercepting electrode in an image dissector of the general type described by Farnsworth in his above-mentioned patent.

In the tube therein disclosed, shown in Figure 3, an envelope 44 is provided at one end with a conductive plate 45 covered with an insulator 46, on which is deposited a mosaic of discrete photoelectric islands 47.

At the opposite end of the tube an electron gun assembly is inserted from one side, comprising a gun cathode 49 backed by a cathode shield 50, an apertured gun anode 51 and an apertured finger sleeve 52. The apertures of the gun anode and finger are in line and are directed toward the photoelectric mosaic.

The entire gun assembly is usually cylindrical in shape and relatively small so that it does not unduly disturb an image thrown on the photoelectric surfaces by an exterior lens 54.

Only a single pair of scanning coils 55 energized by a transmitter scanning oscillator 56 is here shown, as the addition of other coils at right angles to the ones shown would only confuse the drawings.

It is also preferable to focus the beam in the plane of the cathode by means of a focusing solenoid 57 energized by a focusing battery 59 controlled by a variable resistor 60.

In operation the cathode is heated by a cathode battery 61, one side of which is grounded. The same side leads through a plate wire 62 to the conductive plate 45. The gun anode is energized by a grounded gun anode battery 64 through an anode resistor 65. The input to the amplifier is taken off across the resistor 65 and

battery 64 through a transmitter blocking condenser 66.

It is preferable that the potential of the gun anode battery be relatively low, 50 volts for example.

The finger sleeve is energized by a sleeve battery 67, the negative end of which is connected to the plate wire 62 which connects cathode and plate.

It is preferable that the potential of the sleeve battery be relatively high, such as 500 volts.

In normal operation, a stream of electrons is formed at the gun cathode, and accelerated toward the gun anode, accelerated by the 50 volt potential thereon. A beam of electrons passes through the gun anode aperture and is again accelerated by the 500-volt potential of the sleeve. The beam is projected through the sleeve aperture into the main body of the tube and decelerates along the decreasing field.

As the electrons in the beam approach the mosaic surface they lose their velocity and if they are not further influenced they will return again being re-accelerated along substantially the same path as they had previously taken, to finally pass through the sleeve aperture, be decelerated by the difference in potential between sleeve and anode, and land on the anode to be thereby collected. It is preferable to make the sleeve aperture larger than the anode aperture to allow the returning electrons to reach the anode, the slight dispersion acquired during their journey preventing the greater part of the electrons from getting back to the cathode through the anode aperture.

If, however, an image is projected on the mosaic surface, each discrete particle is losing electrons during scansion, proportional to the illumination of the particle, thus acquiring a positive charge.

During scansion of the mosaic surface by the beam, electrons will be abstracted therefrom by the charged particles contacted by the beam, the number of return electrons being less by the number abstracted. The current between anode and cathode, therefore, will be proportional to the illumination of the particles scanned, but a large amplification is obtained due to the fact that each particle is charging during the entire scanning cycle. A very efficient dissector tube is thus obtained.

If a scanning beam intercepting electrode 69 be inserted along one edge of the image area, and positively charged, as for example, by a battery 70, when the beam contacts that electrode the electrons in the beam may be completely, or, if desired, partially collected. In this case, none, or a predetermined quantity will be returned to the anode, thus giving rise to a definite pulse in the output circuit. This pulse, being obtainable at will by the positioning of the electrode, at the end of each line, at the end of one complete cycle or both, may be desirably utilized as a synchronizing pulse in the transmitted signal train going to the receiver.

The above are examples of the means and methods involved in my invention. It is obvious that others within the scope of the appended claims will be apparent to those skilled in the art.

I claim:

1. A cathode ray tube having an envelope containing a concave picture area capable of becoming illuminated upon electron bombardment thereof, said picture area having a plurality of edges, an electron gun including a source of electrons, an apertured anode and a control electrode therebetween positioned to direct electrons from said source through said aperture onto said picture area, means positioned to act on said beam when energized to cause said beam to scan the concavity of said picture area line by line, and a single conductive collecting electrode aligned with a single edge of said picture area and shaped to follow said concavity in spaced relation thereto.

2. A cathode ray device comprising an envelope and having a concave picture area toward one end thereof, said picture area having a plurality of edges, an electrode in said envelope effectively aligned with a single edge of said picture area and shaped to follow the concavity of said picture area in spaced relation thereto, means for rigidly supporting said electrode to said envelope at a plurality of widely spaced points, said means constituting an electrical connection to said electrode at one of said points.

3. A cathode ray device comprising an envelope containing a concave picture area capable of becoming illuminated upon electron bombardment thereof, an electron gun for bombarding said picture area with a beam of electrons, and a conductive electron collector adapted to be impinged by said beam of electrons extending in an area parallel to said picture area and spaced adjacent thereto, said collector having a concave curvature in the direction of said beam of electrons substantially equal to the curvature of said picture area.

ARCHIBALD H. BROLLY.