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CATHODE RAY TUBE SYSTEM

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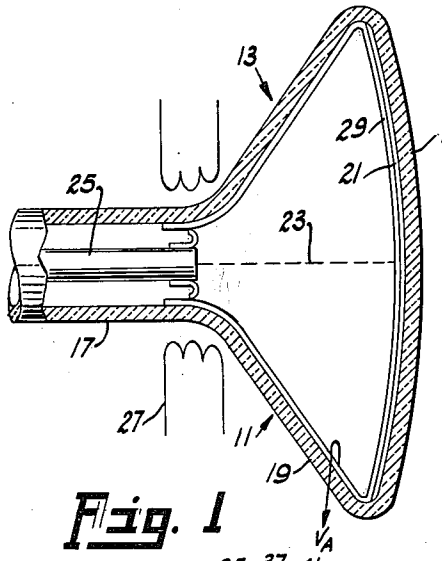

Fig. 1

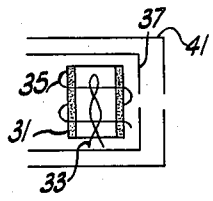

Fig. 3

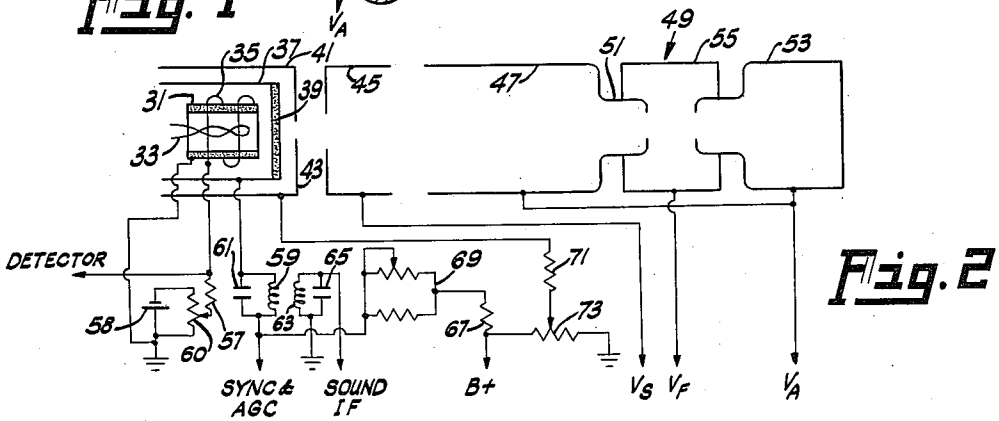

Fig. 2

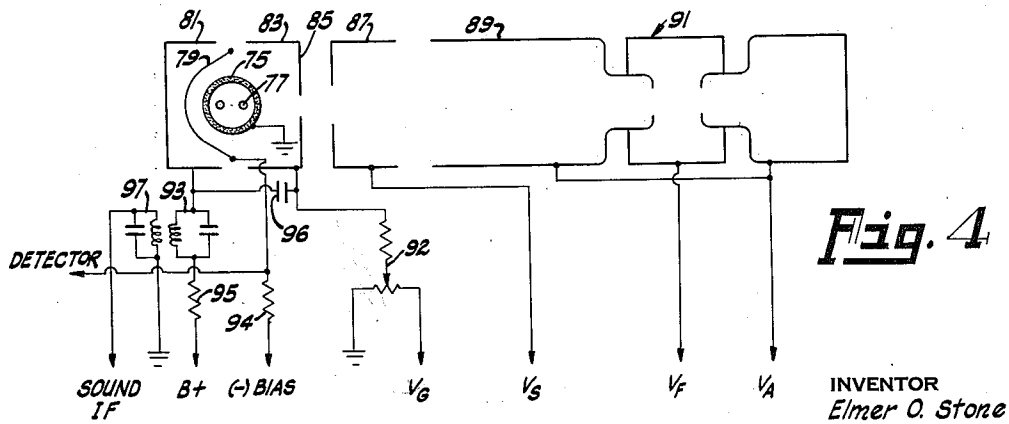

Fig. 4

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CATHODE RAY TUBE SYSTEM

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This invention relates to image display devices such as cathode ray tubes and to circuits adapted to be used therewith in the reproduction of television images.

In a television receiver, it is conventional to employ an amplification stage subsequent to video detection for the purpose of providing an amplified video signal which is used to drive the cathode ray tube. This amplification is necessary since present tubes are not adapted to operate under low video drive conditions. The amplification stage is also used to amplify the signal which is coupled to the sound section of the receiver. Without this stage, it would be necessary to add another amplifier tube to the sound section.

Accordingly, an object of the invention is to reduce the number of tubes needed to reproduce the image and sound in a television receiver.

Another object is to increase the transconductance of a cathode ray tube.

A further object is to increase the gain of the receiver for a given band width by reducing the stray capacitance normally existing in the circuit wiring between the video amplifier and the cathode ray tube.

The foregoing objects are achieved in one aspect of the invention by the provision of a cathode ray tube having a video amplifier tube structure formed as part of the electron gun.

For a better understanding of the invention, reference is made to the following description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a plan view of a cathode ray tube;

FIG. 2 is a sectional view of a cathode ray gun structure adapted to be used in the cathode ray tube of FIG. 1 and the associated circuits therefor;

FIG. 3 is a modification of the structure of FIG. 2; and

FIG. 4 is another embodiment of a gun structure adapted to be used in the tube of FIG. 1.

Referring to the drawings, a cathode ray tube 11 is shown comprising an envelope 13 having a face plate 15 and neck 17 interconnected by cone 19. The face plate has a phosphor screen 21 formed thereon which is excited upon impingement of the electron beam 23 originating from gun structure 25. Deflecting coils 27 are used to scan a raster on the screen. A high potential V_A, e.g. 16 kv., is imposed upon certain electrodes in gun 25 as well as upon screen 21 by means of the internal conductive coating 29.

One embodiment of a cathode ray tube electron gun structure constructed in accordance with the invention is shown in FIG. 2. This structure comprises a first tubular cathode 31 heated by filament 33. Surrounding the cathode is a helical control grid 35 and a cylindrical multi-purpose electrode 37 having electron emissive material disposed on the end wall 39 thereof. Electrode 37 serves as an anode for the amplifier tube including cathode 31, grid 35 and as the cathode for the electron beam producing assembly to be hereafter described.

The electrode assembly which provides the source, modulation, acceleration and focusing for the electron beam includes multi-purpose electrode 37 and a cylindrical grid 41 having an apertured end wall 43. A screen grid 45, anode 47 and a uni-potential electrostatic focusing assembly 49 are arrayed in sequence toward screen 21 of the tube. Focusing assembly 49 comprises a first

lens cup 51 formed as part of anode 47, a second lens cup 53 and lens ring 55.

The cathode ray tube gun structure shown in FIG. 2 has a high transconductance, thereby allowing the video signal derived from the conventional second detector to be coupled directly to the gun. Cathode 31, grid 35 and multi-purpose electrode 37, which serves in this instance as an anode, provide a video amplifier. The detected signal fed to grid 35, which is biased by supply 58 and variable resistance 60, is developed across resistance 57. The amplified signal on electrode 37 is coupled to the sync and automatic gain control stages of the television receiver through the parallel inductance 59 and capacitance 61 circuit and to the sound I.F. by means of inductive coupling to the inductance 63 and capacitance 65 sound trap. The power supply for electrode 37 is derived from B+ through load resistance 67 and the variable resistance contrast network 69.

Multi-purpose electrode 37 also serves as the cathode of the cathode driven picture tube. The heat for this cathode results from heater 33 and from the heat produced by current which leaves cathode 31 and strikes the inner wall of the electrode 37. The amplified video signal imposed upon this electrode modulates the electron beam originating from emissive material 39. Grid 41 is maintained at a biasing potential relative to electrode 37 by virtue of the coupling to B+ through load resistance 71 and the variable brightness control 73.

In operation, with cathode 31 at ground, grid 35 adjusted to several volts negative, and electrode 37 connected to B+ of about 180 volts through network 69 and resistance 67, current will flow from cathode 31 to electrode 37 in accordance with the modulating video signal on grid 35, which is derived from the detector. In addition, electrons are being emitted from coating 39 and accelerated by grid 45 to provide the cathode ray beam for tube 11. The varying voltage on electrode 37 relative to control grid 43 and screen grid 45 provides video modulation of the beam. Typical cathode ray tubes have a transconductance of 20 micro-mhos whereas a tube structure formed in accordance with the invention may be in the order of 300 micro-mhos.

The potential V_s on screen grid 45 may be approximately 300 volts while anode 47 and lens cups 51 and 53 may have an electron accelerating voltage V_A of 16 kv. imposed thereon. With approximately 200 volts V_F on lens ring 55, the electron beam will be focused at the tube screen by means of a unipotential electrostatic saddle-field lens formed by assembly 49.

If desired, a single cathode 31 may be used as shown in FIG. 3. In this instance, the circuit connections and the remaining tube structure is the same as in FIG. 2. However, the cathode ray beam and the amplifying video modulated current flowing to electrode 37 have the same source, i.e. cathode 31.

FIG. 4 illustrates another embodiment of a high transconductance gun structure capable of being employed in tube 11. In this gun, a common cathode 75 heated by filament 77 provides the source of electrons for both the video amplifier and the cathode ray beam producing assembly. A helical half grid 79 is spaced from the amplifier anode 81 on one side of cathode 75. Grid 83 is provided with an apertured end wall 85 through which the electron beam passes. The screen grid 87, anode 89 and the focusing assembly electrodes 91 are formed and operated in the manner described in conjunction with the FIG. 2 structure.

The detected video signal derived from the receiver is coupled to grid 79 to provide amplification of the video signal on anode 81. The amplified signal is coupled to the parallel L-C circuit 93, load resistance 95 and to the B+ power supply. If desired, the sync and automatic

gain control stages for the receiver may derive their modulating signals from anode **81**. The sound trap **97** is inductively coupled to circuit **93** to provide the sound I.F. signal. Variable biasing for grid **79** is provided across resistance **94** and for control grid **83** from source V_g developed across resistance network **92**. This grid driven cathode ray tube has the amplified video signal imposed on control grid **83** by virtue of the coupling from anode **81** through capacitance **96**.

Cathode ray tubes constructed in accordance with the invention have high transconductance, thereby relieving the necessity of a video amplifier stage in the receiver. In addition, an increase in gain for a given band width is achieved due to the elimination of stray capacitance between the conventional video amplifier and the cathode ray tube.

Although several embodiments of the invention have been shown and described, it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the scope of the invention as defined by the appended claims.

What is claimed is:

1. In a television receiver employing a video and sound modulated signal and a sound trap coupled to a sound reproducing section, a cathode ray tube having an electron gun structure disposed within the envelope thereof comprising an amplifier including a cathode, control grid and an anode, said signal being coupled to the control grid, and an electron beam producing assembly including an electron source, a control electrode and a constant potential screen grid, said anode being coupled to the sound trap to provide said sound modulated signal for the sound reproducing section and to said assembly to provide a video modulated bias between said source and the control electrode.

2. In a television receiver employing a video and sound modulated signal and a sound trap coupled to a sound reproducing section, a cathode ray tube having an electron gun structure disposed within the envelope thereof comprising an amplifier including a cathode, control grid and an anode, said signal being coupled to the control grid, and an electron beam producing assembly including an electron source, a control electrode and a constant potential screen grid, said anode being coupled to the sound trap to provide said sound modulated signal for the sound reproducing section and to said electron source to provide video modulation of the electron beam.

3. In a television receiver employing a video and sound modulated signal and a sound trap coupled to a sound reproducing section, a cathode ray tube having an electron gun structure disposed within the envelope thereof comprising an amplifier including a cathode, control grid and an anode, said signal being coupled to the control grid, and an electron beam producing assembly including an electron source, a control electrode and a constant potential screen grid, said anode being coupled to the sound trap to provide said sound modulated signal for the sound reproducing section and to said control electrode to provide video modulation of the electron beam.

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