Oct. 6, 1959 E. R. WAGNER 2,907,918

TELEVISION PICTURE TUBES

Filed July 16, 1956

Fig. 1

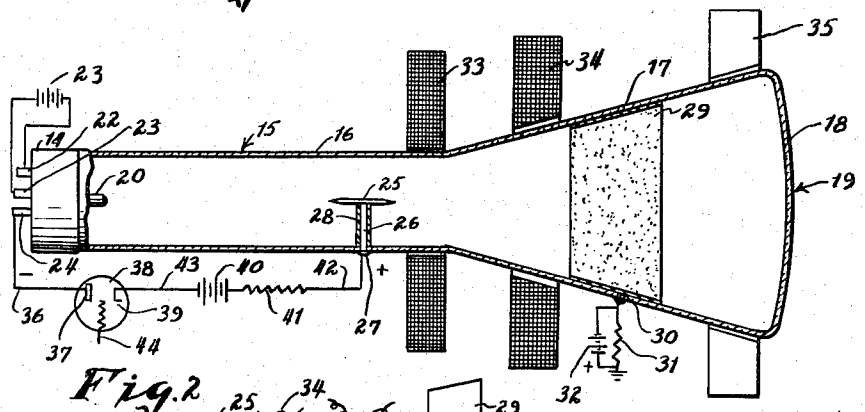


Fig. 2

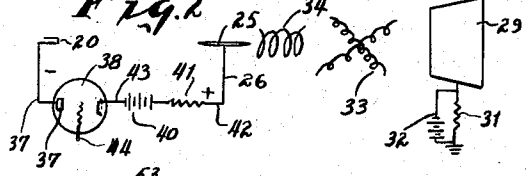


Fig. 3

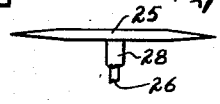


Fig. 6

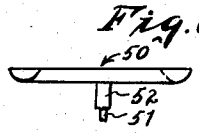


Fig. 4

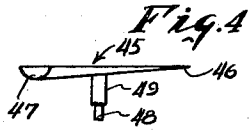


Fig. 5

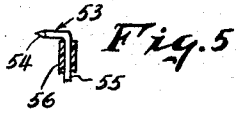


Fig. 7

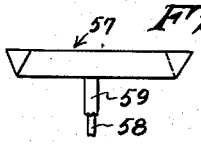


Fig. 8

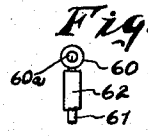
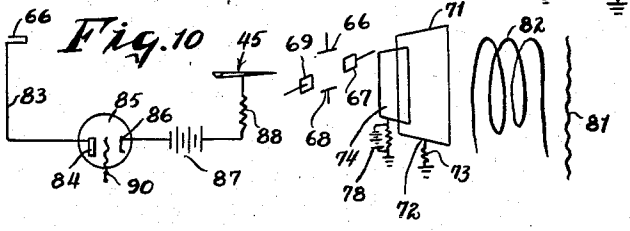


Fig. 9

Fig. 10



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TELEVISION PICTURE TUBES

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Application July 16, 1956, Serial No. 597,961

12 Claims. (Cl. 315—22)

This invention relates to improvements in television tubes and relates more particularly to gas filled tubes. This application is a continuation in part of copending application Serial No. 212,220, filed February 23, 1951, now Patent No. 2,755,413, dated July 17, 1956.

One of the objects of this invention is the provision, of a gas filled television picture tube, having pressures that lie below those at which convection becomes appreciable, but far above those ordinarily used in the so-called "gas-focussed" tubes. I find that best results are obtained between one and ten millimeters Hg pressure, with anode structures which encourage or abet beam formation therein.

Another object of the invention is the provision in a gas filled television picture tube, of beam forming means, deflector means and an interior conducting coating within a predetermined zone in said tube between an anode therein and the screen end thereof and adapted to be connected to ground potential through a high resistance for maintaining a space charge, at a level sufficient to concentrate the charged particles into a beam but below that potential at which the passage of electrons beyond the anode is discouraged.

Yet another object of the invention is the provision in a gas filled television picture tube, of an internal conductive coating in a zone in the envelope thereof between the anode and the viewing end of the tube, a static focus cone at least partially within said zone, a magnetic focus means adjacent to the viewing end of said tube, and static beam deflection means between said anode and said cone.

Another object of the invention is the provision in a gas filled picture tube, of an internal conductive coating in a zone in the envelope, a static focus cone in said zone, beam forming means, beam deflecting means, frosted window means on the end of said tube, and an external color screen spanning said window.

Other objects and advantages of the invention will be apparent to those skilled in the art, upon a study of this specification and the accompanying drawings.

Referring to the drawings, which are given by way of example to illustrate the invention:

Figure 1 is a cross-section of one form of gas filled picture tube made according to the invention;

Figure 2 is a schematic representation purely diagrammatic of the components of the tube of Figure 1;

Figure 3 is an elevational view of one form of anode that I employ in the tube;

Figure 4 is a view of another form of anode which gives excellent results;

Figure 5 is a view of yet another form of anode which gives excellent results in a gas filled tube of the type described herein;

Figure 6 shows another excellent anode which is in the form of a half cylinder;

Figure 7 shows another of my anodes which is in the form of a trough of V cross-section;

Figure 8 shows still another anode I employ which is in the form of a ring or "eye";

Figure 9 is a view, similar to Figure 7, showing a modified form of gas filled picture tube with additional novel features and including internal static deflectors and a special window on the viewing end thereof; and

Figure 10 is a purely diagrammatic, schematic representation of the components of the tube of Figure 9.

Before describing the invention in connection with the above-mentioned figures, the following remarks are made as pertinent and should help to convey a better understanding of the invention.

In the prior art many attempts to use gas in tubes of this type were discarded because only "fuzzy" images were obtained. Extremely low gas pressures of only a few microns were employed, and electron velocities toward phosphor windows were employed, without obtaining satisfactory results. In addition to this the tubes were controlled by internal grids and the gas pressures had to be kept to or below said "few microns."

Since I do not have to use an internal control grid, such difficulties and limitations are not present, so the main consideration is the formation of beams, and in this connection I discovered that the shape of the anode had great influence upon whether a beam could be caused to form within a gas filled tube or not.

I also noted that anodes of certain shapes that give good beam formation at very low pressures (around 10 to 20 microns) actually prevented beam formation at pressures of .1 to 10 millimeters.

Examples of shapes of anodes are shown in Figures 3 to 8, inclusive, and will be described hereinafter.

I have also discovered that where, at the very low pressures of the order of 10 to 20 microns, the anode structures alone determine beam formation and at the higher pressures additional focussing action was necessary.

I also found that the beam could be formed or prevented from forming by the accumulated space charge in the tube space between the anode and the window end of the tube.

Further, by coating the interior wall of the tube with a conductive material, and connecting the coating (negative, as shown in Fig. 1) to ground through a high resistance, the beam formation is assured.

The magnitude of the resistance employed in grounding said coating determines the rate of leakage of the space charge. Now if the resistance is too high (20 megohms or higher) the leakage rate is too low and the space charge builds up a potential sufficiently high to prevent any electrons from passing beyond the anode.

On the other hand if the value of the resistor is too small, the leakage rate is too great and the space charge density falls below the focussing value.

While the size of the resistance varies somewhat with tube dimensions and with anode voltages, it has been found experimentally that at potentials in the neighborhood of 5000 the resistances lie between .5 and 20 megohms. I find that this gives a sharply defined beam of high luminous intensity when viewed end-wise, and low intensity across the beam.

I employ external magnetic focussing for sharpening the beam still more whenever desired and note that in such case the best results are obtained by placing the entire portion or zone between the anode and the window within the magnetic field.

Good results are also obtained by having the coil that surrounds the end of the tube adjacent to the screen, deflection may be effected in the usual manner, with magnetic deflecting coils. Static deflection may also be em-

ployed by properly insulating the deflecting plates so that no conductivity can occur between the deflectors or plates at deflection potentials.

When I use a tube, the end window of which has been frosted, the side illumination from the beam is at a minimum and therefore the eye is only influenced by the "end on" high intensity illumination.

Now in respect to the gases, I have found that if a suitable mixture of xenon, neon and argon, for example, is used, a white light results and this light contains the three primary colors.

Viewing this through a transparent screen ruled with vertical lines of the three primary colors for direct color reproduction or with complementary colors for the subtractive system of color transmission, the image reproduced is a duplicate of the transmitted image that has been scanned through an identical filter.

Obviously the standard color sequence can be reproduced by proper order of colors in the filter screen. The filter screen of course may be adjusted to bring it into proper color relationship with the transmission.

When black and white images are to be obtained the elimination of the color screen provides the images in black and white.

When a potential that is higher than the ionizing potential is applied to a gas filled tube, a glow fills the tube and this is the so-called luminous "plasma" which is the source of light in neon and similar types of tubes.

When a television picture tube contains gas at similar pressures, namely, .1 to 10 millimeters, the grid becomes inoperative and with the usual polarities, a low level glow permeates the structure, with the result that no beam is obtained. When the inner conducting surface of a television stream is positive (+) as usual, it accelerates the electron tube in a regular vacuum tube, but in a gas filled tube conduction occurs through the gas in all directions and the current density in any one direction is very attenuated with the result that no beam can occur and only a general glow of low density is obtained.

Now when the inner conducting surface of the gas filled tube is made negative (—), and further if a high resistance is interposed between this internal coating and ground, a negative space charge that repels the electron beam equally in all directions is built up, and further this charge concentrates the beam and thus the discharge is focussed.

The structures of my tubes are such that no control grid functions within the envelope. However, this is impractical at the higher gas pressures. Now since I want to produce a sharp beam beyond the anode, the latter must be so shaped and positioned as to give sufficient acceleration to the electron beam to carry it into the field beyond it.

When any appreciable surface which is positively charged is presented to the cathode in the first electron field no beam results because the secondary or "recoil" electrons prevent the primary electrons from passing beyond the anode, and while this might be prevented by means of a screen grid, I find that it is easier to obtain a concentrated beam by so shaping the anode that a little or no surface is presented at right angles to the path of the beam or stream of electrons.

This is accomplished by shaping the electrode so that no flat surface facing across the line from the cathode is present. Anodes such as I show in Figures 3 to 8, inclusive, present points or sharp edges which facilitate beam formation.

Referring now to the drawings, and particularly Figure 1, which shows a cross-section of a gas filled beam type picture tube for video reception and reproduction, the beam is adapted to be deflected and also to be modulated. An envelope **15** has a straight cylindrical wall portion **16**, one end of which joins a "press" (not shown) that supports a cathode **20**. The other end of the tubular portion **16** joins a conical wall portion **17** which carries on its outer end **17** a screen **19**.

The heater of the cathode **20** may have terminal pins **21** and **22**, to which a source **23** of heater current may be connected to a terminal pin **24**.

Spaced apart from the cathode **20** within the wall portion **16** is an anode **25** which has, in this case, needle points pointing fore and aft. It will be understood that I may use other forms of anodes, such as those illustrated in Figures 3 to 8, inclusive, instead.

The anode **25** is carried on a lead **26** mounted on a terminal support **27** in the wall of the tube, and the lead is covered with insulation **28**.

Within the tapered wall **17** of the tube I provide a conducting coating **29** which is spaced apart from or may extend to the window end **19** and which is also spaced apart from the anode **25**. A lead **30**, connected to said coating, passes through the wall **17** of the tube in fluid tight relation, and it may be connected through a high resistance **31** and to ground potential in some instances. In other instances I may dispose of the resistance **31** and use a battery or other source of current **32**.

A focus coil **33** may be positioned on the exterior of the envelope forwardly of the anode **25** so as to concentrate the electrons and focus the beam.

Spaced apart from the focus coil **33** is a deflector winding **34** which is connected to receive control currents for causing the beam to scan the screen in a wanted manner.

Spaced apart from the deflector winding **34** is a second deflector winding **35**, which may almost embrace the screen when in the extreme position, shown in dot-dash lines in the drawing, but which may be adjusted axially of the tube, and which may aid and abet the action of the deflector winding **34**.

In other instances one or more additional focus coils may be positioned between the focus coil **33** and the window **18**, and mounted so that it or they may be adjusted axially along the envelope.

Connections between the anode **25** and the cathode **20** include, a conductor **36** between the cathode and the plate **37** of a thermionic tube **38**, a conductor **43** between the cathode **39** of the tube **38** and a source of current **40**, a resistor **41** (which may be variable) between said source and a conductor **42**, which is in turn connected to the support **26** of the anode **25**. The tube **38** has a grid **44**, which functions both to control the picture tube and to stabilize the same.

Figure 2, as stated above is a schematic representation of the picture tube of Figure 1, and all of the elements of the tube are indicated by the same numerals in said schematic.

Figure 3 is an enlarged view of the anode **25** shown in Figure 1, and the sharply pointed end encourages the formation of an electron beam.

Figure 4 shows an anode in the form of a scoop, which is curved or angular on one end and in a sharp point on the other end, which tends to concentrate the electron beam. This anode has a supporting rod **48** which carries insulation **49**.

In Figure 5, I show an anode **53** which may comprise a rod **55**, the upper end of which is bent through an angle approaching 90° and this bent portion has its extremity in the form of a point **54**. This point is to be directed toward the cathode **20**.

The anode **50** in Figure 6 is like a section of a hollow cylinder, either end of which can present a sharp arcuate curved surface to the cathode. It is supported on a rod **51** which carries insulation **52**.

In Figure 7, the anode **57** is in the form of an angular trough of V cross-section, and either end may face the cathode **66**. A rod **58** supports the anode and carries insulation **59**.

In Figure 8, I show a rod **61** supporting a small annular ring **60** which has a central hole **60***a* formed therein. The rod **61** also carries insulation **62**.

Referring now to Figure 9, the tube shown therein

has an envelope 63 which has a tubular portion 64 and a tapered portion 65 and it carries on its larger end a screen 80 which is frosted.

In the opposite end of the tube is carried a cathode 66 which has a heater connected to the terminal 68 and 69 supported in the end cap 67. A source of current 71 is connected to the terminals 68 and 69 for furnishing heater current.

The cathode per se is connected to the terminal pin 70 and there is in turn connected via a wire 83 to the plate 84 of a thermionic tube 85.

The cathode 86 is connected to a source of current 87 and this is in turn connected via a resistor and a conductor 89 to the support 48 of an anode 45 (which is in this case the same as the one shown in Figure 4).

The tube 85 may be in series with the last stage of the video amplifier. This gives plate modulation of the video signal, and the tube acts as a limiting resistance for video tube current.

Although in some instances, I may employ external magnetic deflectors such as I have shown at 34 in Figure 1, I may also use static deflectors and I have mounted such static deflectors 66, 67, 68 and 69 between the anode 45 and the frosted screen 80, but nearer to the said anode.

I provide a conductive coating 71 on the interior wall of the envelope portion 65 between the deflector plates 66 to 69 and the frosted window and electrically connected to this conductive coating is a terminal 72 on the outer wall of the envelope and I show a high resistor 73 connected between the terminal 72 and ground. This resistor may have a value between .5 and 20 megohms.

Mounted within the tube portion 65 and partially overlapped by conducting coating 71 is a frusto cone 74 which has a conductor 75 electrically connected thereto and connected to a terminal on the outer wall of the tube.

The conductor 75 has an insulating sleeve 76. This terminal may be connected to ground potential through a high resistance 77 which may also have a value of between .5 and 20 megohms.

In some instances, I may omit either of the resistors 73 and 77 and may substitute in the place thereof a battery 78.

The tube portion 65 may be embraced by a magnetic focus coil 82 which may be moved axially and which functions to concentrate the beam. In this instance, near the interior surface of the end screen 80.

In some instances, I may employ several of the magnetic focussing coils along the outer wall of the envelope where very sharp concentration of the beam is necessary.

The color screen 81 is positioned externally to the frosted end of the tube and as described above herein, produces pictures in color, whereas the screen may be omitted for black and white pictures.

Figure 10 is a schematic of the tube shown in Figure 9 and all of the elements described above carry the same numerals as those applied to the corresponding elements of the tube of Figure 9.

While one embodiment of the invention and a modification thereof have been herein shown and described in detail it will be understood that many variations of the arrangements of these details may be changed or omitted without departing from the spirit of the invention and within the scope of the following claims.

I claim:

1. In a gas filled picture tube, an envelope having an external viewing screen at one end thereof, monatomic gas means in said envelope at a pressure of between .1 mm. and 10.0 mm., a cathode in the other end of said tube, an anode positioned intermediate said ends and having a substantially sharp portion facing said cathode to encourage beam formation, an inner conductive coating within said envelope in a zone between said anode and said screen end and having a terminal on the outside of said envelope for further control of the quality of the beam, magnetic focussing means embracing said envelope, and deflecting means for said beam.

2. In a gas filled picture tube, an envelope having an external viewing screen at one end thereof, monatomic gas means in said envelope at a pressure of between .1 mm. and 10.0 mm., a cathode in the other end of said tube, an anode positioned intermediate said ends and having a substantially sharp point facing said cathode to encourage beam formation, an inner conductive coating within said envelope in a zone between said anode and said first end and having a terminal on the outside of said envelope for further control of the quality of the beam, magnetic focussing means embracing said envelope, and deflecting means for said beam external to said envelope.

3. In a gas filled picture tube, an envelope having an external viewing screen at one end thereof, monatomic gas means in said envelope at a pressure of between .1 mm. and 10.0 mm., a cathode in the other end of said tube, an anode positioned intermediate said ends and having a substantially sharp edge portion facing said cathode to encourage beam formation, an inner conductive coating within said envelope in a zone between said anode and said first end and having a terminal on the outside of said envelope for further control of the quality of the beam, magnetic focussing means embracing said envelope between said anode and one edge of said zone, and deflecting means for said beam external to said envelope.

4. In a gas filled picture tube, an envelope having an external viewing screen at one end thereof, monatomic gas means in said envelope at a pressure of between .1 mm. and 10.0 mm., a cathode in the other end of said tube, an anode positioned intermediate said ends and having a substantially sharp edge portion facing said cathode to encourage beam formation, an inner conductive coating within said envelope in a zone between said anode and said first end and having a terminal on the outside of said envelope for further control of the quality of the beam, magnetic focussing means embracing said envelope both between said anode and one edge of said zone and between said first end and said zone, and deflecting means for said beam external to said envelope.

5. In a gas filled picture tube, an envelope having an external viewing screen at one end thereof, monatomic gas means in said envelope at a pressure of between .1 mm. and 10.0 mm., a cathode in the other end of said tube, an anode generally in the form of a scoop having one end pointed and the other end sharp and arcuate, said anode being positioned intermediate said ends and having said sharp arcuate portion facing said cathode to encourage beam formation, an inner conductive coating within a zone between said anode and said first end, said envelope having a terminal on the outside of said envelope for further control of the quality of the beam, magnetic focussing means embracing said envelope, and deflecting means for said beam.

6. In a gas filled picture tube, an envelope having an external viewing screen at one end thereof, a combination of inert gases in said envelope at a pressure of between .1 mm. and 10.0 mm., a cathode in the other end of said tube, an anode generally in the form of a section of a hollow cone having sharp arcuate ends, said anode being positioned intermediate said ends and having either of said arcuate ends facing said cathode to encourage beam formation, an inner conductive coating within a zone between said anode and said screen end of said envelope and having a terminal on the outside of said envelope for further control of the quality of the beam, magnetic focussing means embracing said envelope, and deflecting means for said beam.

7. In a gas filled picture tube, an envelope having an external viewing screen at one end thereof, a combination of inert gases in said envelope at a pressure of between .1 mm. and 10.0 mm., a cathode in the other end of said tube, an anode generally in the form of a rod bent L-shaped and having sharp point, said anode being positioned intermediate said ends and having said sharp point facing said cathode to encourage beam formation, an inner conductive coating within a zone between said anode and said first end, said envelope having a terminal on the outside of said envelope for further control of the quality of the beam, magnetic focussing means embracing said envelope, and deflecting means for said beam.

8. In a gas filled picture tube, an envelope having an external viewing screen at one end thereof, a combination of inert gases in said envelope at a pressure of between .1 mm. and 10.0 mm., a cathode in the other end of said tube, an anode generally in the form of an open trough having angular sides, said anode being positioned intermediate said ends and having said sides in axial alignment with said cathode and presenting sharp V shaped edges toward said cathode to facilitate beam formation, an inner conductive coating within a zone between said anode and said first end and having a terminal on the outside of said envelope for further control of the quality of the beam, magnetic focussing means embracing said envelope, and deflecting means for said beam.

9. In a gas filled picture tube, an envelope having a viewing screen at one end thereof, a combination of inert gases in said envelope at a pressure of between .1 mm. and 10.0 mm., a cathode in the other end of said tube, an anode positioned intermediate said ends and having a substantially sharp portion facing said cathode to encourage beam formation, an inner conductive coating in said envelope in a zone between said anode and said first end and having a terminal on the outside of said envelope for further control of the quality of the beam, a thermionic tube having a plate connected to said cathode and a cathode connected to said anode through a source of current, and a grid in said thermionic tube adapted to be connected to a source of video currents, magnetic focussing means embracing said envelope, and deflecting means for said beam.

10. In a gas filled picture tube, an envelope having a viewing screen at one end thereof, an inert gaseous atmosphere in said tube at a pressure of between .1 mm. and 10.0 mm., a cathode in the other end of said tube, an anode positioned intermediate said ends and having a substantially sharp portion facing said cathode to encourage beam formation a conductive coating within said envelope in a zone between said anode and said first end and having a terminal on the outside of said envelope for further control of the quality of the beam, a hollow frusto-conical electrode in said envelope overlapped by said conductive coating, a terminal on said envelope connected to said electrode and adapted to have external elements connected thereto for additional control of said beam, magnetic focussing means about said envelope, and deflecting means for said beam.

11. In a gas filled picture tube, an envelope having a viewing screen at one end thereof, an inert gaseous atmosphere in said tube at a pressure of between .1 mm. and 10.0 mm., a cathode in the other end of said tube, an anode positioned intermediate said ends and having a substantially sharp portion facing said cathode to encourage beam formation a conductive coating within said envelope in a zone between said anode and said first end and having a terminal on the outside of said envelope for further control of the quality of the beam, a hollow frusto-conical electrode in said envelope concentric with and overlapped by said conductive coating and having a terminal on the outside of said envelope connected thereto for further and additional control over said beam, magnetic focussing means about said envelope, and deflecting means for said beam.

12. The invention according to claim 11, in which the viewing screen is frosted and in which said picture tube is arranged for use with an external filter for color.

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