

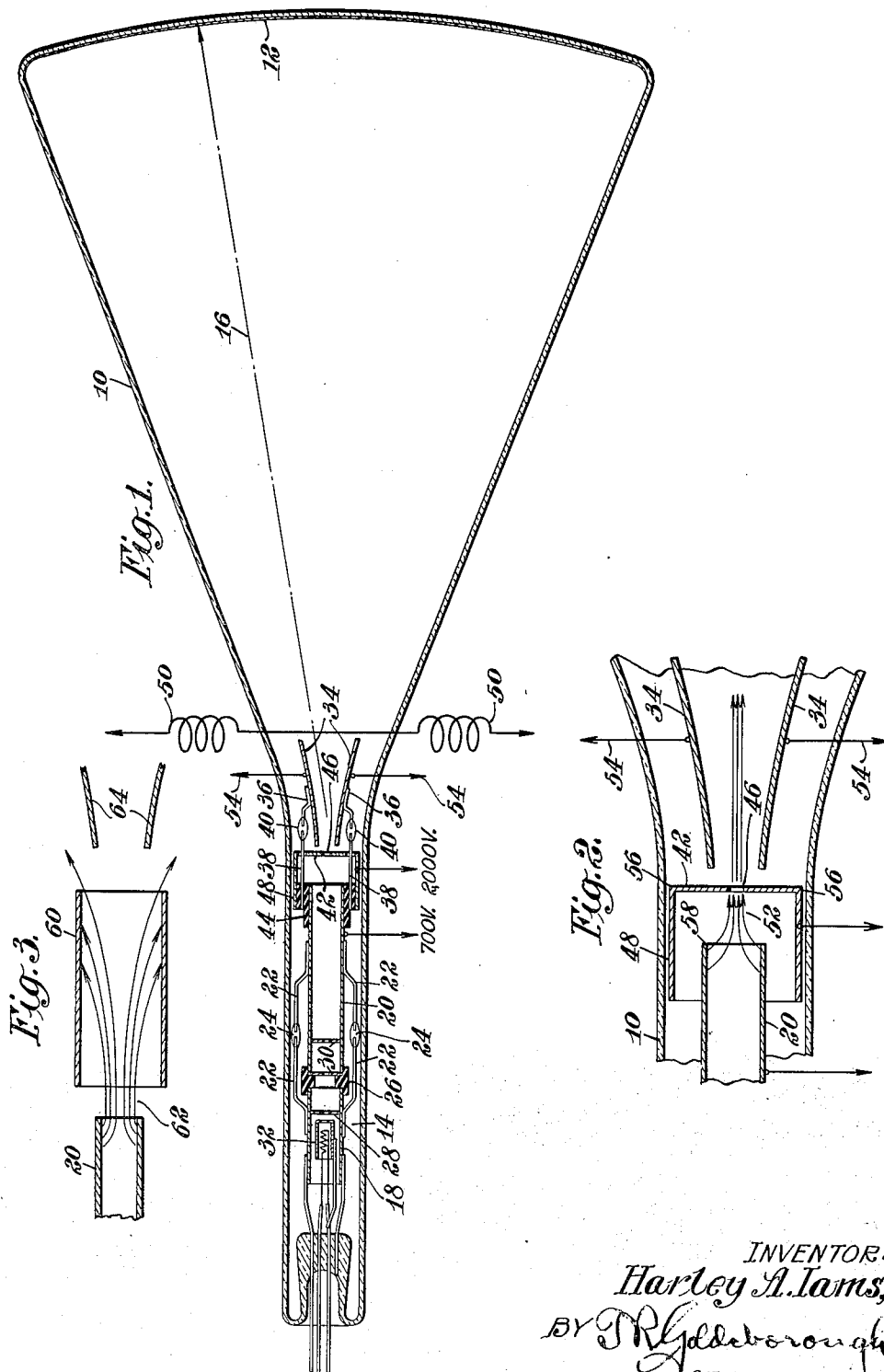
Feb. 7, 1939.

H. A. IAMS

2,146,017

CATHODE RAY APPARATUS

Filed June 27, 1934



INVENTOR:
Harley A. Iams,
BY *R. Goldborough*
ATTORNEY.

UNITED STATES PATENT OFFICE

2,146,017

CATHODE RAY APPARATUS

Harley A. Iams, East Orange, N. J., assignor to
Radio Corporation of America, a corporation of
Delaware

Application June 27, 1934, Serial No. 732,586

13 Claims. (Cl. 250-162)

My invention relates to improvements in cathode ray apparatus.

In the development of cathode ray apparatus for television communication, one of the problems has been to develop a ray of electrons and cause it to come always to a sharp focus on the screen within the tube without interfering action due to the electrical fields developed for deflecting the ray. In one form of cathode ray apparatus proposed, and embodying a pair of complementary plates supported within the tube for deflecting the ray in one direction, difficulty has been encountered due, particularly, to defocusing of the ray on account of interfering action between the focusing field and the electrostatic deflecting field. In such apparatus, furthermore, it has been proposed to interpose a relatively long focusing cylinder between the inside deflecting plates and the electron gun. This construction and arrangement necessitates a relatively great distance between the screen and the end of the electron gun, which makes conditions that much more unfavorable for causing the ray of electrons to come to a sharp focus on the screen.

With the foregoing in mind, it is one of the objects of my invention to provide an improved construction of cathode ray apparatus of the character referred to wherein inside deflecting plates can be used to advantage without interference with the focusing field, and wherein the dimensions can be such as to bring the end of the electron gun substantially closer to the screen than has been possible in the various constructions proposed heretofore.

Other objects and advantages will hereinafter appear.

In accordance with my invention, a disc provided with a central aperture is supported between the inside deflecting plates and the output end of the electron gun, and cooperates with the latter to develop a focusing field. The disc, besides serving as means for causing the ray of electrons to come to a sharp focus on the screen, is also effective as a shield to prevent interfering action between the electrostatic deflecting field and the focusing field.

My invention resides in the construction of the character hereinafter described and claimed.

For the purpose of illustrating my invention, an embodiment thereof is shown in the drawing, wherein

Figure 1 is an elevational sectional view of a cathode ray tube for television reception, constructed and operating in accordance with my invention; and

Figs. 2 and 3 are diagrammatic, fragmentary, sectional views, illustrative of the principle of operation in Fig. 1.

In the drawing, the reference numeral 10 designates a tube provided with a fluorescent screen 12 and with means in the form of an electron gun 14 for developing a ray 16 of electrons and directing the ray toward the screen. Cylindrical electrodes 18 and 20 are supported in alignment as shown, and are held together by wire sections 22 and insulating glass beads 24. A collar 26 of insulating material is interposed between and is recessed to receive the adjacent ends of the cylinders 18 and 20 to maintain alignment thereof.

The electrode 18 serves as a grid by which the intensity of the ray can be varied. The electrode 20 serves to accelerate the electrons toward the screen 12 and also to cause the ray to come to a sharp focus on the screen.

The electrodes 18 and 20 are provided with the apertured discs 28 and 30 through which the electrons must pass.

A cathode 32 provides a source of electrons.

The ray 16 is deflected vertically by a pair of plates 34 supported from the end of the gun by wire sections 36 and 38 and insulating glass beads 40. The wire sections 38 extend through openings in a disc 42 and into an insulating collar 44 fitted on the end of the cylindrical electrode 20.

The disc 42 is provided with a central aperture 46 and with a flange 48 which has a snug fit on the collar 44.

The ray 16 is deflected horizontally by electromagnetic coils 50 through which a saw-tooth current wave at the desired frequency is caused to pass.

The electrode 20 and the disc 42 are supplied with the operating potentials, as indicated.

In operation, an electrostatic field, indicated at 52 in Fig. 2, is developed between the disc 42 and the open end of the cylindrical electrode 20, the lines of this field terminating at this disc and being effective to cause the electrons to converge as they pass through the aperture 46 and to come to a sharp focus on the screen 12.

A suitable voltage wave is applied to the plates 34 by connections 54 to develop an electrostatic deflecting field between these plates.

The edge 56 of the disc 42 is in close proximity to the wall of the tube 10, and the flange 48 extends well back of and embraces the tip 58 of the electrode 20. With this arrangement, and since the lines of the focusing field indicated at 52 terminate at the surface of the disc 42, the latter is effective as a shield to prevent interfering ac-

tion between the electrostatic deflecting field and the focusing field. Such action, otherwise, would have a tendency to cause defocusing of the ray.

Furthermore, since the disc 42 has practically no dimension axially of the tube, and since the disc is supported in close proximity to the tip 58 of the electrode 28, the dimensions can be such that the tip of the gun 14 is closer to the screen than has been possible in the various constructions proposed heretofore. It is therefore possible to cause the ray to come to a sharper focus on the screen 12.

In Fig. 3, the reference numeral 60 designates the relatively long cylindrical electrode used in the various constructions proposed heretofore to focus the ray of electrons on the screen, and corresponds to the disc 42 in Fig. 2. With the required operating potentials applied to the focusing electrode 60 and the electrode 28, an electrostatic field, indicated at 62, is developed. The lines of this field diverge as represented in the drawing, and for this reason are not as effective in focusing the ray as the construction in Figs. 1 and 2. Furthermore, some of the lines of force in the prior construction as shown in Fig. 3 extend entirely through the electrode 60 and mix with the lines of the electrostatic deflecting field between the deflecting plates 64. This action causes some degree of defocusing of the ray. In the construction shown in Fig. 3, further, the relatively great length of the focusing tube 60 requires that the tip of the electron gun be just that much further removed from the screen. Under the same operating conditions, therefore, the ray in the construction shown in Fig. 3 does not come to as sharp a focus on the screen as is the case in my improved construction in Figs. 1 and 2.

From the foregoing it will be seen that I have provided improved cathode ray apparatus in which provision is made for the use of inside deflecting plates without producing conditions to cause interfering action with the focusing field, and that this is accomplished by a construction which permits location of the tip of the electron gun closer to the screen than has been possible in the various constructions proposed heretofore.

While but one embodiment of my invention has been disclosed, it will be understood that various modifications, within the conception of those skilled in the art, are possible without departing from the spirit of my invention or the scope of the claims.

I claim as my invention:

1. Cathode ray apparatus comprising a tube provided with a screen and with means for developing a ray of electrons and directing the ray at said screen, said ray-developing means comprising a plurality of aligned cylindrical electrodes, a centrally-apertured disc disposed between said screen and said ray-developing means and in close proximity to the adjacent end of said means, ray-deflecting means comprising a pair of complementary plates supported within said tube and between said disc and said screen, connections for applying operating potentials to said plates to develop an electrostatic deflecting field between the same, and connections for applying operating potentials to said disc and the adjacent cylindrical electrode to develop an electrostatic field between the disc and said electrode for bringing the electrons of the ray to a focus in substantially the plane of said screen, the edge of said disc being in close proximity to the wall of said tube whereby said disc is effective as a shield to

prevent interfering action between the deflecting and focusing fields.

2. Cathode ray apparatus comprising a tube provided with a screen and with means for developing a ray of electrons and directing the ray at said screen, the output end of said means being in the form of an elongated open-ended cylinder from which the electrons issue, ray-deflecting means comprising a pair of complementary plates supported within said tube and between said screen and the output end of said means, a centrally-apertured disc supported from the output end of said ray-developing means and disposed between the latter and said plates, and connections for applying operating potentials to said elements to develop a focusing field between said disc and said cylinder and a deflecting field between said plates, the edge of said disc being in close proximity to the wall of said tube to shield the focusing field from the deflecting field.

3. Cathode ray apparatus comprising a tube provided with a screen and with means for developing a ray of electrons and directing the ray at said screen, a centrally-apertured disc disposed between said screen and said ray-developing means and in close proximity to the adjacent end of said means, said disc being provided with a flange embracing said end of said means, and connections for applying operating potentials to said disc and said end of said means to develop an electrostatic field between the same to bring the electrons of the ray to a focus in substantially the plane of said screen.

4. Cathode ray apparatus comprising a tube provided with a screen and with means for developing a ray of electrons and directing the ray at said screen, the output end of said means being in the form of an elongated open-ended cylinder from which the electrons issue, ray-deflecting means comprising a pair of complementary plates supported within said tube and between said screen and the output end of said means, a centrally-apertured disc supported in axial alignment with the output end of said ray-developing means and disposed between the latter and said plates, and connections for applying operating potentials to said elements to develop a focusing field between said disc and said cylinder and a deflecting field between said plates, said disc being provided with a flange embracing the output end of said ray-developing means to shield the focusing field from the deflecting field.

5. Cathode ray apparatus comprising a tube envelope, a luminescent material coating one end interior surface of the envelope, means positioned within the tube envelope at the opposite end from the coating for developing a ray of electrons and directing the ray at the coating, an apertured disc electrode positioned within the tube envelope intermediate the ray developing means and the coating and substantially adjacent the ray developing means and extending substantially to the wall of said envelope, an annular electrode having one edge thereof attached to said disc electrode and the opposite edge thereof surrounding substantially the ray developing means, and ray deflecting electrodes positioned intermediate the apertured disc electrode and the luminescent coating.

6. Cathode ray apparatus comprising a tube provided with a screen and with means for developing a ray of electrons and directing the ray at said screen, the output end of said means being in the form of an elongated open-ended cylinder from which the electrons issue, ray-deflecting

means comprising a pair of complementary plates supported within said tube and between said screen and the output end of said means, a centrally-apertured disc supported in axial alignment with the output end of said ray-developing means and disposed between the latter and said plates, and connections for applying operating potentials to said elements to develop a focusing field between said disc and said cylinder and a deflecting field between said plates, said disc being provided with a flange embracing the output end of said ray-developing means to shield the focusing field from the deflecting field.

7. Cathode ray apparatus comprising a tube having a luminescent screen and means for developing a beam of electrons and directing the beam at said screen, said beam developing means including an electron emitting cathode and a tubular anode, a control electrode interposed between the tubular anode and the electron emitting cathode for controlling the intensity of the developed electron beam, electron beam deflecting plate electrode members interposed between the said anode and the screen, and an apertured disc beam accelerating electrode element adapted to be maintained at a high potential relative to the anode, said apertured member being located between the anode and the deflecting plates and adapted to form with the anode electrode a focusing means to focus the developed electron beam to a sharply defined spot upon the screen, said beam accelerating electrode having provided thereon a cylindrical flange element of a diameter greater than that of the tubular anode and surrounding and enclosing at least a portion of the end of said tubular anode toward said screen.

8. Cathode ray apparatus comprising a tube provided with a screen and with means for developing a ray of electrons and directing the ray at said screen, said ray-developing means comprising a plurality of aligned cylindrical electrodes, a centrally-apertured disc disposed between said screen and said ray-developing means and in proximity to the adjacent end of one of said cylindrical electrodes, ray-deflecting means comprising a pair of complementary plates supported within said tube and between said disc and said screen, connections for applying operating potentials to said plates to develop an electrostatic deflecting field between the same, and connections for applying operating potentials to said disc and the adjacent cylindrical electrode to develop an electrostatic field between the disc and said electrode for bringing the electrons of the ray to a focus in substantially the plane of said screen, said disc being positioned transversely of the axis of said adjacent cylindrical electrode and extending substantially beyond the periphery of said adjacent electrode towards the wall of the tube whereby said disc is effective as a shield to prevent interfering action between the deflecting and focussing fields.

9. Cathode ray apparatus according to claim 8 in which said disc is provided with an annular flange partially overlapping the adjacent end of said adjacent electrode.

10. Cathode ray apparatus comprising a tube provided with a screen and with means for developing a ray of electrons and directing the ray at said screen, the output end of said means being in the form of an elongated open-ended cylinder from which the electrons issue, ray-deflecting means comprising a pair of complementary plates supported within said tube and between said screen and the output end of said means, a cen-

trally-apertured disc supported adjacent the output end of said ray-developing means and disposed between the latter and said plates, and connections for applying operating potentials to said elements to develop a focussing field between said disc and said cylinder and a deflecting field between said plates, said disc being positioned transversely of said cylinder and extending substantially beyond the periphery thereof towards the wall of the tube.

11. Cathode ray apparatus comprising a tube provided with a screen and with means for developing a ray of electrons and directing the ray at said screen, the output end of said means being in the form of an elongated open-ended cylinder from which the electrons issue, ray-deflecting means comprising a pair of complementary plates supported within said tube and between said screen and the output end of said means, a centrally-apertured disc supported adjacent the output end of said ray-developing means and disposed between the latter and said plates, and connections for applying operating potentials to said elements to develop a focussing field between said disc and said cylinder and a deflecting field between said plates, said disc being provided with a flange embracing the output end of said ray-developing means to shield the focussing field from the deflecting field.

12. Cathode ray apparatus comprising a tube envelope, a luminescent material coating one end interior surface of the envelope, means positioned within the tube envelope at the opposite end from the coating for developing a ray of electrons and directing the ray at said coating, an apertured disc electrode positioned within the tube envelope intermediate the ray developing means and the coating and substantially adjacent the ray developing means and extending laterally beyond the peripheral boundary of the ray-developing means, an annular metal member having one end thereof attached to said disc electrode and the opposite end thereof surrounding substantially the ray developing means, and ray deflecting electrodes positioned intermediate the apertured disc electrode and the luminescent coating.

13. An electron tube comprising an envelope having a target element at one end thereof and an electron beam developing means at the opposite end thereof for directing a beam of electrons toward the target, said electron beam developing means comprising an electron emitting element and at least one tubular electrode member, a centrally apertured disc element disposed between the target and the ray developing means and in proximity to one of the cylindrical electrode elements of said ray developing means, said disc element having an outer diameter greater than that of the tubular electrode element adjacent thereto, electron beam deflecting means comprising a pair of complementary plates supported within the envelope and intermediate the disc and the target, and connections for applying operating potentials to the deflecting plates to develop an electrostatic field between the said plates, connection for applying operating potentials to said disc and cylindrical electrode elements to develop an electrostatic field between the disc and said tubular electrodes to bring the electrons of the developed beam normally to focus substantially in the plane of the target, and an annular electrode element of an internal diameter greater than the outer diameter of the tubular electrode element adjacent said disc element, said last named tubular member being positioned in

axial alignment with the first named tubular electrode elements, and having one end thereof extend partially over the length of the adjacent tubular electrode element and the other end extend toward said target, said tubular member also providing a means for supporting said disc

element within an area of the tubular element intermediate the ends thereof and substantially at the end thereof toward said target whereby the focussing field developed is substantially undisturbed by said deflecting field.

HARLEY A. IAMS.