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N. GLYPTIS ET AL

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ION FILTER

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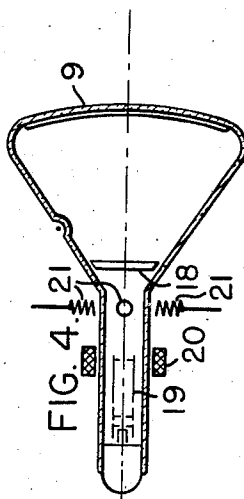
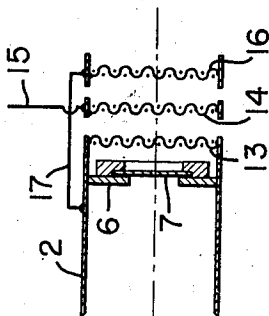
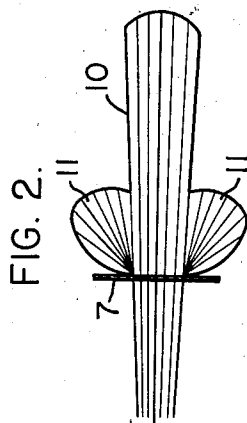


FIG. 1.

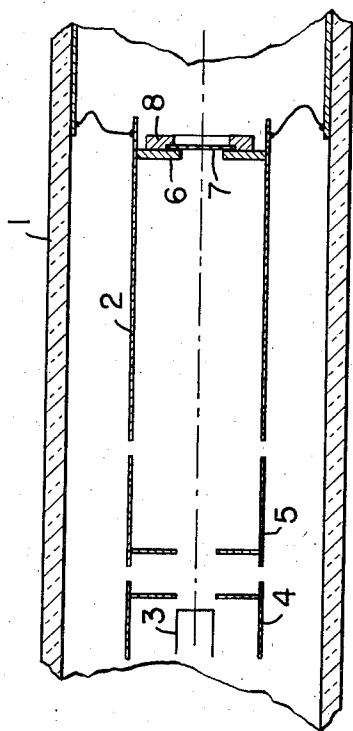
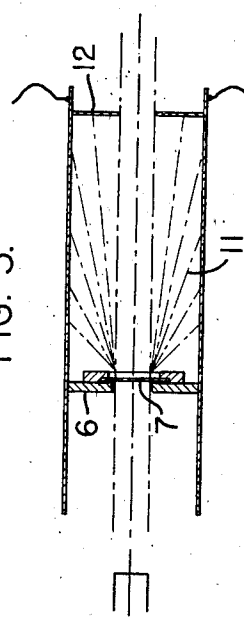


FIG. 3.



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ION FILTER

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This invention has to do with cathode ray tubes and more particularly with an ion filter for such tubes.

A troublesome problem in the operation of cathode ray tubes is the formation of the so-called "ion spot" on the viewing screen. In one type of device for eliminating the "ion spot," magnetic fields were used to trap the ions. However, the coils or permanent magnets required to produce the magnetic field had to be precisely positioned outside the tube and increased the bulk and cost of the tube. In another device a thin aluminum layer which acted as an ion filter was deposited on the fluorescent screen. However, it is difficult to produce a uniform aluminum layer free of holes and wrinkles and of the desired thickness over a large area like a fluorescent screen of a cathode ray tube.

The object of our invention is to overcome these and other disadvantages and to provide a cathode ray tube in which the screen will be free from the "ion spot."

With this object in view we provide a relatively small aluminum film away from the screen and at a point where the electron and ion beams are not yet diffused over a large area. This film, while acting as a filter for the ions, permits the electrons to reach the fluorescent screen.

According to one embodiment of our invention the aluminum film is placed in the path of the beam of electrons intermediate the gun and the screen, and is formed by first evaporating it on a thin plastic membrane and dissolving the membrane. The resulting film is preferably mounted over the aperture in the conventional anode.

In order more fully to explain our invention a detailed description will be given with the aid of the drawings, in which:

Fig. 1 is a longitudinal cross section of a portion of the neck of the glass envelope of a cathode ray tube;

Fig. 2 is a polar diagram of electrons passing through a filter;

Fig. 3 is a modification of Fig. 1;

Fig. 3a is another modification of Fig. 1; and

Fig. 4 shows a cathode ray tube with an ion filter in its conical or flaring part.

1 is a wall portion of the neck of the glass envelope of a cathode ray tube having an anode 2, a cathode 3, a control grid 4 and a conventional screen grid 5. One or more plates or diaphragms 6, each having an aperture through which a focused beam of electrons emitted from cathode 3 passes, form part of the electron gun structure. The diameter of the aperture in dia-

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phragm 6 depends on the diameter of the beam of electrons and may be of the order of 1-4 mm.

In one embodiment of the invention shown in Fig. 1, a thin aluminum film 7 is placed over the limiting aperture of anode 2 formed in diaphragm 6, and secured to the surface of the diaphragm by suitable means, such as washer 8. The beam of electrons emitted from cathode 3 is focused in a conventional way and directed so as to pass through the aperture in diaphragm 6. As the beam travels towards film 7 it sets in motion and carries along with it free ions present in the tube. When the beam comprising electrons and ions reaches film 7 it has almost attained its full velocity and the electrons penetrate the film 7 with only slight deviation, but substantially all the ions are stopped by the film which, therefore, acts as a filter. Only a few scattered ions will get through but will cause very little disturbance on the fluorescent screen 9 (Fig. 4). All the undesired free ions which would form a spot on the screen are stopped.

The following is one satisfactory way of producing film 7:

A material such as aluminum, which has been found to permit electrons but not ions to pass through it, is evaporated onto a mold or thin plastic membrane large enough to cover the aperture in diaphragm 6 and part of its surrounding surface. After the aluminum has formed a coating on the membrane it is placed in a solvent which dissolves the membrane but does not affect the aluminum film. A delicate aluminum film having a uniform thickness of 1000 to 4000 Å can thus be formed. If the film is thicker than the given specifications, too many electrons are stopped by it and heat the film to evaporation temperature. If it is thinner the ions are not filtered out.

The aluminum film is not destroyed by the cathode beam, because the film is of such thickness that the electrons pass through it without giving up a substantial part of their energy, whereby not enough heat will be generated to destroy the film. We have found that the thickness is self-adjusting because if thicker films are inserted in the tube then after brief operation the heat generated in them will evaporate the excess.

Polar diagram, Fig. 2, of electrons passing through filter 7 shows that electrons 10 pass through the filter with only slight deviation. The main bundle of electrons 10 is not slowed by the filter; however, some electrons are slowed and result in fringing electrons 11 around the main

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bundle. The fringing electrons are undesirable since they interfere with clear projection on the screen. They may be eliminated by placing the ion filter comprising diaphragm 6 and film 7 near cathode 3 as shown in Fig. 3. In this embodiment, the aperture covered by film 7 is well within anode 2. Fringing electrons are effectively stopped by the surfaces of another diaphragm, such as 12, or diaphragms similar to 6 which are located further from the cathode than the ion filter. Diaphragm 12 will permit only the fast moving electrons to pass through its aperture and the slow moving electrons which are deviated are effectively masked. In this connection it should be remembered that though the surfaces of diaphragms or cylinders are effective masking means they may also act as focusing means for the main bundle of electrons. In some cases this may not be desirable.

Another way of eliminating the fringing electrons is by providing an opposing electrical field at a point remote from the screen but close to the ion filter as shown in Fig. 3a. Electrodes, preferably having little surface area which would reflect the electrons, such as fine wire meshes, provide the opposing electrical field. One electrode, mesh 13, is placed around the limiting aperture in anode 2 and connected to the anode. A second electrode, mesh 14, is placed in the tube adjacent mesh 13 on the side opposite from that of the ion filter and charged by means of conductor 15 from a source of low potential which may conveniently be the customary second grid or cathode of the tube. A third electrode, mesh 16, is placed in the tube adjacent mesh 14 and connected by conductor 17 to anode 2. Meshes 12, 13 and 14 being very near the point at which the fringing electrons are produced prevent their reaching the screen because the slow electrons flow to the meshes and are conducted back to the cathode as soon as they appear.

As customary in the art, the mesh electrodes 13, 14 and 16 may be replaced by diaphragms which are appropriately perforated.

In Fig. 4 schematically represented ion filter 18 is suitably mounted between the limiting aperture in schematically represented cathode ray gun 19 and screen 9 at a point within the tube where the beam begins to fan out. Customary focusing coils 20 and deflection coils 21 are located along the neck of the tube. A screen grid (not shown) may be located between 18 and 9 to trap scattered corpuscles.

It is possible that the filter prevents the ions from reaching the fluorescent screen not only by absorbing them, but also by differential scattering. The effective cross section of the ions for atomic or molecular interactions is much larger than for electrons, whereby the thickness of the film can be reduced to a point where the ions undergo multiple scattering with minimum absorption, and scattering for the electrons. The filter causes multiple scattering of the ions while the electrons undergo single scattering and only the electrons will emerge from the diaphragm while the ions are stopped.

It will be obvious to one skilled in the art that further modifications are possible without departing from the principles of the invention defined in the claims.

What is claimed is:

1. In a cathode ray tube in which there may be undesired free ions and fringing electrons, a fluorescent screen, a cathode directed towards said screen, an ion filter between said cathode

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and said screen, and means for eliminating the fringing electrons.

2. A cathode ray tube having a fluorescent screen and an electron gun including an anode and a cathode adapted to emit a focused beam of electrons towards said screen and also producing undesired free ions which move with the beam, an ion filter between said cathode and said screen comprising an aluminum membrane through which said beam of electrons may pass with a deviation causing fringing electrons, and means for eliminating the fringing electrons comprising at least one charged electrode adapted to attract and receive slow electrons.

3. A cathode ray tube according to claim 2, and in which said means for eliminating the fringing electrons comprises at least one electrode connected to a source of low potential to attract and receive slow electrons.

4. A cathode ray tube according to claim 2, and in which said means for eliminating the fringing electron comprise three wire meshes situated near said filter at the point where said fringing electrons exist, and means for connecting two of said meshes to the anode and the third to the cathode.

5. A cathode ray tube according to claim 2, and in which said means for eliminating fringing electrons comprise masking means having at least one surface with an aperture of such size and location with respect to said beam that the beam may pass through and the fringing electrons will be intercepted by said surface.

6. A cathode ray tube having a fluorescent screen and an electron gun including a cathode adapted to emit a focused beam of electrons towards said screen and also producing undesired free ions which move with the beam, an ion filter between said cathode and said screen including an aluminum membrane through which said beam of electrons may pass with slight deviation causing fringing electrons, and masking means for eliminating the fringing electrons comprising an integral portion of said electron gun.

7. A cathode ray tube according to claim 6, and in which said gun includes at least one anode having a limiting aperture and the masking means comprises said aperture.

8. A cathode ray tube according to claim 2, and in which said tube has an envelope provided with a neck and said filter is situated in the neck.

9. A cathode ray tube according to claim 2, and in which said ion filter is situated in said electron gun.

10. A cathode ray tube according to claim 2, and in which said beam is caused to fan out over the surface of the filter and said filter is situated in a portion of the envelope where the beam fans out.

11. A cathode ray tube according to claim 6, and in which said tube has an envelope provided with a neck and said filter is situated in the neck.

12. In a cathode ray tube according to claim 6, and in which said ion filter is situated in said electron gun.

13. In a cathode ray tube according to claim 6, and in which said tube has an envelope provided with a flared-out portion and said filter is situated in the flared-out portion.

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