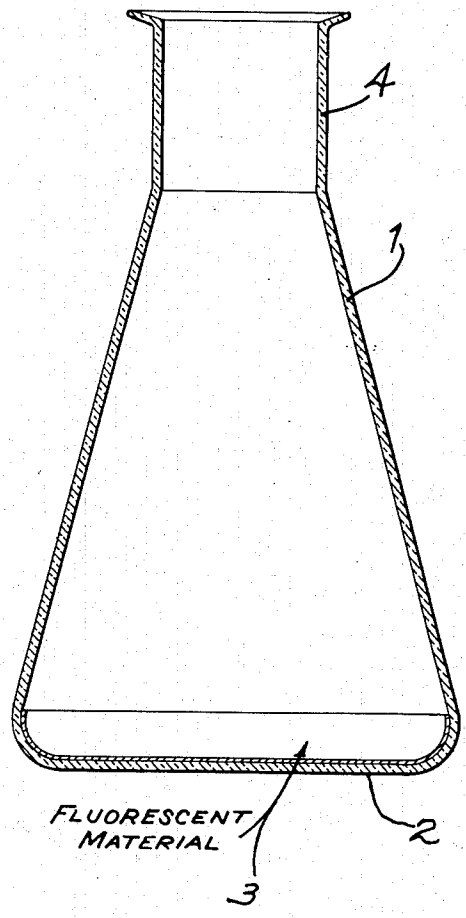
Nov. 12, 1940. B. C. GARDNER 2,221,474

METHOD OF DEPOSITING FLUORESCENT MATERIAL

Filed May 10, 1937

Fig. 1.



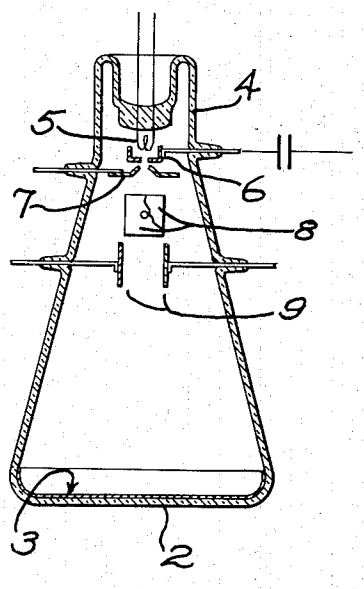


Fig. 2.

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METHOD OF DEPOSITING FLUORESCENT MATERIAL

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Application May 10, 1937, Serial No. 141,759

3 Claims. (Cl. 91—68)

My invention relates to a method of depositing fluorescent material, and more particularly to a method whereby fluorescent material is deposited on an interior wall of a vitreous container, the material later to be fluoresced by the impact of a cathode ray beam.

Among the objects of my invention are: to provide a fluorescent screen for a cathode ray tube of exceptional uniformity; to provide a cathode ray tube fluorescent screen of extreme thinness; to provide a method of obtaining a uniform cathode ray tube screen; and to provide a simple method of depositing a cathode ray tube screen on the interior of an envelope, whereby the screen produced is of uniform thickness over the extent thereof.

My invention possesses numerous other objects and features of advantage, some of which, together with the foregoing, will be set forth in the following description of specific apparatus embodying and utilizing my novel method. It is therefore to be understood that my method is applicable to other apparatus, and that I do not limit myself, in any way, to the apparatus of the present application, as I may adopt various other apparatus embodiments, utilizing the method, within the scope of the appended claims.

Referring to the drawing:

Fig. 1 is a sectional view of a cathode ray tube envelope blank on which a screen of fluorescent material has been deposited in accordance with my method.

Fig. 2 is a diagrammatic sectional view of a cathode ray tube embodying my invention.

The ordinary cathode ray tubes, particularly those designed to produce an oscillographic trace of the movement of a cathode ray beam, are usually provided with a thin layer of fluorescent material on one end of the tube against which a beam of electrons is projected from an electron gun mounted in the other end of the tube. Inasmuch as such guns are usually of relatively low power, and the electrons impact only the interior surface of the fluorescent material while the trace produced thereon by the impact is viewed from outside the tube, it is obvious that it is highly desirable to have the fluorescent material deposited on the inner wall in a relatively thin coating and in a coating uniform over the entire field covered by the trace.

There have been a large number of processes heretofore evolved for the deposition of this material, and while the deposition might seem to be a minor matter in the final operation of the cathode ray tube, it has been found that the particular method of depositing the screen material is of extreme importance in obtaining maximum light from the limited power available in the electron gun. For example, some of the prior methods utilize a spray gun and mix the fluorescent material with a wet binder, and deposit the screen in a fine spray on the end of the tube. It has been found, however, that inasmuch as most fluorescent materials are relatively heavy, they do not stay properly mixed in the binder and the screen is very apt to be non-uniform, even when only a short time is taken during the spraying step. Furthermore, such spraying involves very careful shielding of the remainder of the interior of the tube during the spraying, and unless the spray is carefully controlled, the surface, after deposition, will run and thicken at the lowest portion of the tube. This happens even though the end surface is placed parallel to the ground, because almost never is the end of the tube perfectly flat, there generally being a slight curvature due to the blowing or molding of the vitreous blank.

Other methods involve the mixing of a fluorescent material with a wet binder, pouring this into the end of the tube, and rotating the tube during the drying in order to distribute the material over the area to be covered. Any such motion, however, tends to concentrate material in spots or rings, and only approximates a uniform coating. Utilizing my improved method, however, an extremely uniform and thin coating may be produced, without tendency to run and without the accumulation of excess material in any part of the screen.

My method involves, first, the deposition of a binder alone on the area to be covered by the screen. It is relatively easy to distribute the binder in a uniform coating. This is because the binder itself is uniform in density, whereas the binder, mixed with fluorescent material, is not uniform, and the fluorescent material is constantly tending to settle out of the binder. Furthermore, if desired, the binder may be sprayed on in a uniform coat and just enough placed on the area to be covered so that the binder does not run.

After the binder has been distributed over the surface, dry fluorescent material is dusted onto the entire surface wet by the binder. Only the amount of powder in proportion to the thickness or wetting power of the binder is deposited, and a thin uniform layer will be formed, without

streaks or rotation marks. As soon as the binder is dry the tube may then be placed in service.

Referring to the drawing for a more detailed description of my method, a cathode ray tube blank 1, preferably of glass and usually having a shape comparable to that of an Erlenmeyer flask, has deposited on the large end 2 thereof a thin layer of wet binder covering the surface of the area upon which a fluorescent screen is desired. This binder may be, for example, plain water, and in some cases I may desire to deposit the water thereon in a thin uniform layer by condensation, the surface being first, of course, treated to prevent the formation of droplets; or, I may deposit the binder thereon by spraying; or again, I may place the proper amount of binder thereon and rotate the tube to spread it properly, the binder being easily spread in a uniform layer because it is homogeneous throughout. In all events, I prefer to deposit a layer of binder that is too thin to run.

As soon as the binder is deposited in the proper uniform layer, a quantity of dry fluorescent material, such as, for example, powdered calcium tungstate or willemite, is gently sifted onto the surface of the binder. As the powder enters the binder, the powder particles of course absorb, probably by capillary attraction, the wet binder, and a thin uniform film is built up. This layer may have a thickness determined in accordance with the thickness of the original binder material and its ability to be absorbed by the powder grains. In other words, if the binder is partially dried until it becomes slightly tacky, the then resultant screen may be made thinner than if the binder layer had more liquid in it. By properly controlling the amount of liquid in the binder layer, and the amount of powder sifted onto the layer, the thickness of the screen may be rather accurately controlled.

As the screen dries, the binder holds the powder grains to the wall of the tube, and even when water alone is used the material adheres, although for many purposes I prefer to use a binder such as gum arabic or sodium silicate, mixed with water. The resultant fluorescent screen 3 is then dried and an electron gun is sealed in the narrow neck 4 of the tube blank, this gun comprising, as an example, the usual cathode 5, grid 6, and accelerating anode 7. The tube is then usually provided with means to move the cathode ray beam, which may be electromagnetic or electrostatic deflecting elements, and I have shown electrostatic deflecting elements 8 and 9 surrounding the path of the beam between the electron gun and the screen 3.

By the use of my improved method I have been able to greatly increase the efficiency of light production in a cathode ray tube, where the electron impact occurs on one side of the screen and the visual trace is watched from the other. Inasmuch as the light has to pass through the material of the screen itself, a thin screen is desirable; and inasmuch as the light production is, in part, the function of the amount of fluorescent material and the thickness of the fluorescent material at any one point, it is obvious that, if the screen is of uniform thickness over the entire area covered by the trace, traces produced thereon will be an accurate reproduction of the energy within the beam at any point in its path.

I claim:

1. The method of forming a thin and uniform fluorescent screen on the inner wall of a vitreous container, which comprises condensing on said wall a uniform coating of liquid binder thin enough to be self-adhering, forming a cloud of finely divided dry fluorescent material above said wall, and permitting said finely divided dry fluorescent material to settle by gravity over said uniform self-adhering coating of liquid binder.

2. The method of forming a thin and uniform fluorescent screen on the inner wall of a vitreous container, which comprises condensing on said wall a uniform coating of liquid binder comprising water thin enough to be self-adhering, forming a cloud of finely divided dry fluorescent material above said wall, and permitting said finely divided dry fluorescent material to settle by gravity over said uniform self-adhering coating of liquid binder.

3. The method of forming a thin and uniform fluorescent screen on the inner wall of a vitreous container, which comprises condensing on said wall a uniform coating of liquid binder thin enough to be self-adhering, sifting powdered fluorescent material on said wall, and permitting said finely divided dry fluorescent material to settle by gravity over said uniform self-adhering coating of liquid binder.

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