Oct. 12, 1954 R. R. CAHEN 2,691,612

METHOD FOR FORMING THIN LAYERS OF A SUBSTANCE ON CURVED WALLS, FOR INSTANCE ON THE WALLS OF TELEVISION TUBES

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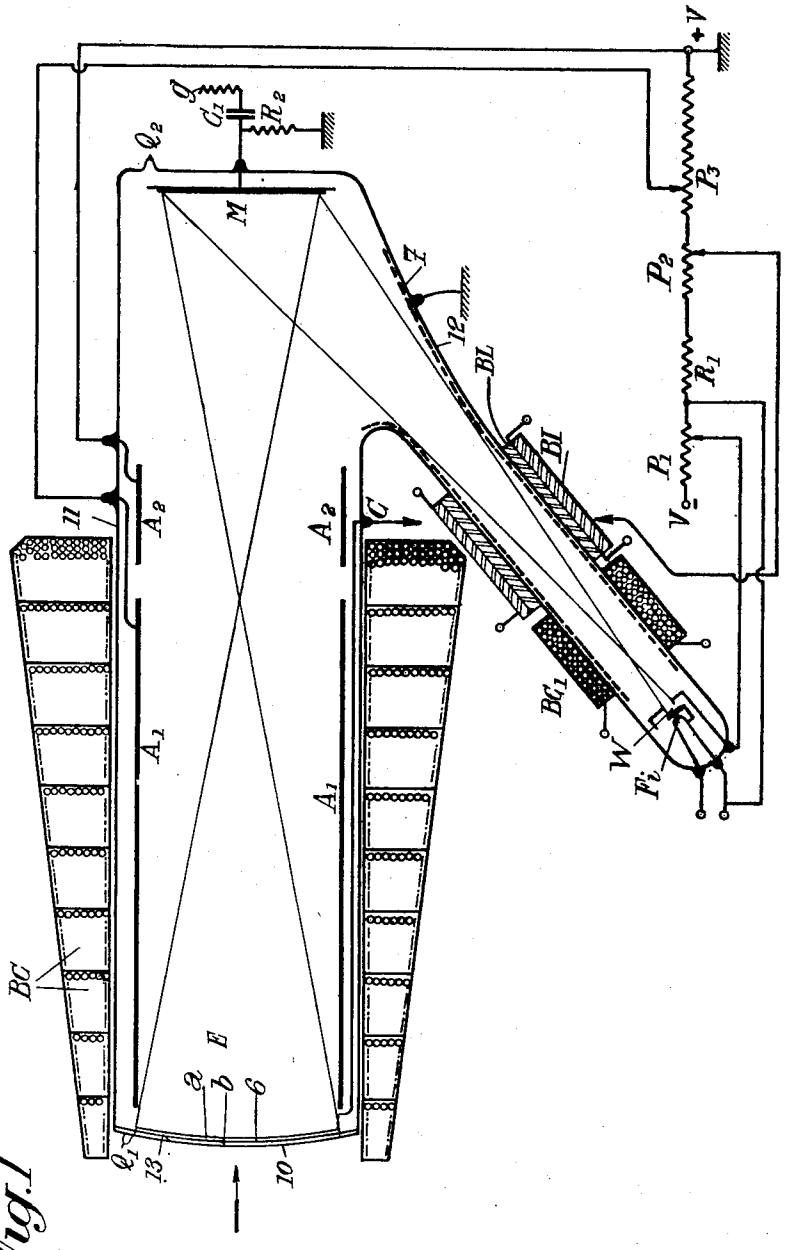


Fig. 1

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Fig. 3

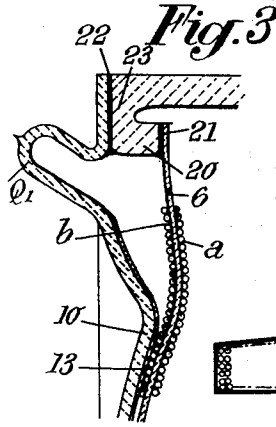


Fig. 4

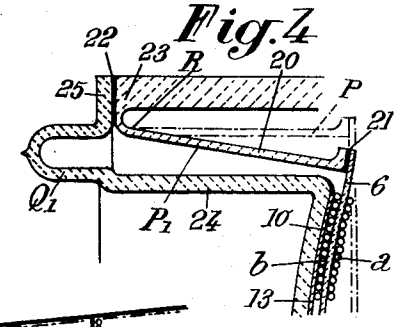
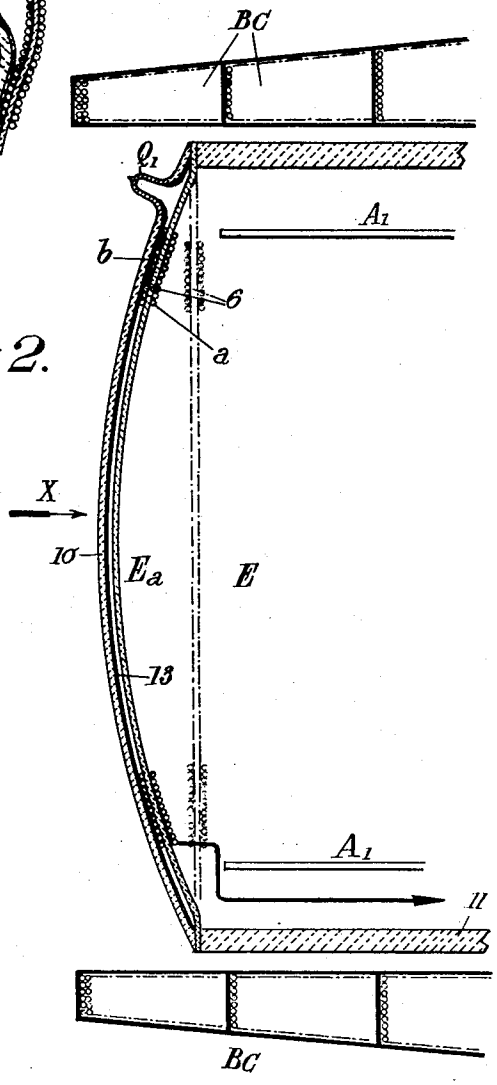


Fig. 2.



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METHOD FOR FORMING THIN LAYERS OF A SUBSTANCE ON CURVED WALLS, FOR INSTANCE ON THE WALLS OF TELEVISION TUBES

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7 Claims. (Cl. 154—110)

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The present invention is concerned with a method of forming, on a portion of the concave side of a curved wall, for instance the wall of a vacuum tube and especially a television camera tube or picture amplifying or transforming tube, a thin layer of a substance, for instance of a luminescent, photosensitive, photoemissive substance or the like, which is to be protected against certain contacts.

The object of my invention is to provide a method which can be carried out in a relatively simple manner and imparts advantageous features to the structure obtained therethrough.

It consists essentially in forming a thin layer of the substance in question on one face of a thin sheet of a deformable material, applying said sheet against the concave face of the curved wall element to be coated with said layer, the layer of substance provided on said sheet being turned toward said wall element, and securing said sheet element against said wall.

Advantageously, according to my invention, the supporting sheet provided with the layer of substance is fixed in fluidtight fashion along its edge over the periphery of the curved wall element on which it is to be applied, the layer of said substance being turned toward this wall element. Then the closed space formed between said wall and the support sheet is subjected to the action of air evacuating means, so that the partial vacuum formed therein draws said sheet into contact with the concave face of the curved wall element.

A preferred embodiment of my invention will be hereinafter described with reference to the accompanying drawings, given merely by way of example, and in which:

Fig. 1 is a sectional view of a television camera tube intended to receive incident rays other than those of the visible ray range of the spectrum, in particular X-rays, this tube being made according to my invention;

Fig. 2 is a view on an enlarged scale of a portion of this tube, this view illustrating, in dotted lines and in solid lines respectively, two successive steps of the method according to my invention;

Figs. 3 and 4 are part views on a still larger scale, showing modifications.

In order to illustrate the method according to my invention, I will refer to my U. S. Patent No. 2,527,913 for "Improvements in Photoelectric Systems," which disclosed a structure to which the present invention is applicable.

This structure includes essentially a television

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camera tube inside which two sensitive layers are disposed on the opposed faces of a very thin partition, one of these layers being made of a luminescent substance which transforms incident rays of a radiant energy into visible rays and the other layer being made of an electron emitting photosensitive substance to project an electronic image onto the mosaic of the tube.

As indicated in this patent, this very thin partition divides the inside of the tube into two spaces wholly separate from each other and in which the same vacuum is formed, whereby the partition is subjected to the same pressure on both of its faces.

Such an arrangement has the double advantage of preventing soiling of either of the layers by the other and of avoiding, owing to the very great thinness of the partition, any reflection or refraction therethrough.

However, experience taught that it is advantageous to locate the partition which supports the two above mentioned layers as close as possible to the wall of the tube through which the incident rays are passing (this wall being generally in the form of a spherical surface of large radius) and even to give this partition a corresponding spherical shape and to have it applied against said wall. This makes it unnecessary to provide the special electronic optics which are necessary to project the image of the photocathode onto the mosaic when the partition is of plane shape.

I will now describe how this partition is given the desired shape according to my invention, in the case of a tube such as disclosed in my above mentioned prior patent.

Fig. 1 shows such a tube, the general lay-out of which is conventional.

10 is the spherical end wall through which the incident rays arrive, this wall belonging to a glass tube or bulb 11 in which is disposed the mosaic M, of conventional construction.

BC are the electronic image concentrating coils, cooperating with anodes A_1, A_2.

12 is the part of the tube forming the electron gun, this part being metallized over its inner wall, as shown at 7; Fi is the filament and W the Wehnelt electrode of this electron gun, the concentration coils being shown at BC_1 and the line and frame scanning coils at BL and BI.

P_1, P_2, P_3, R_1 are the resistors of a potentiometer which supplies the voltages impressed upon photocathode a (terminal C), anodes A_1, A_2, and the Wehnelt electrode W.

R_2 is a load resistor across which is collected

the videofrequency voltage due to the effect of the electrons released by the scanning of the mosaic and which acts upon the grid *g* of a first amplifier tube, through condenser C_1.

In order to constitute the photocathode which essentially comprises a thin support 6 provided, on the opposed faces thereof, with a photo-sensitive layer *a* and a luminescent layer *b*, respectively, I proceed as follows, according to my invention.

Support 6 is constituted by a thin sheet of a relatively flexible material, for instance mica, obtained by cutting in the direction of cleavage.

This support 6 is coated, on the face thereof intended to face wall 10, with the luminescent layer *b*, while the inner concave face of this wall 10 is coated with a layer 13 of a transparent enamel or varnish having a melting point ranging approximately from 300 to 400° C. Wall 10 is provided, in its peripheral portion, with a seal-off nipple Q_1. The rear portion of bulb 11 is also provided with a similar seal-off nipple Q_2.

Support 6 is fixed, along its peripheral edge, to the line of junction of the cylindrical wall portion of bulb 11 with the spherical wall portion 10 thereof (Fig. 2), by sealing or in any other suitable way, so as to divide the inside of said bulb into two chambers Ea and E having no communication whatever with each other. Chamber Ea is then evacuated by means of a vacuum pump connected with nipple Q_1. As the pressure is becoming lower and lower in this chamber, the mica support 6 gradually curves in toward wall 10 until it comes into contact therewith, at least over most of its area, including the central part thereof. Experience teaches that this operation can be carried out successively, without breaking the mica sheet, if, initially, said sheet is already sufficiently close to wall element 10 in its central portion. This is the case of camera tubes where the radius of curvature of wall 10 averages 100 mm. with an approximation of about 0.5%, with a diameter of said wall portion 10 of about the same value (say from 100 to 150 mm.). This of course does not exclude applying the method according to my invention to tubes of larger diameter.

The front portion of the tube is then heated so that the layer 13 of enamel melts and thus secures luminescent layer *b* and its mica support 6 to wall 10. The luminescent layer is thus imprisoned between two translucent plates 10 and 6, and plate 6, although very thin, fully insulates layer *b* from the inside of the bulb. Chamber Ea has now practically disappeared, consisting only of a small annular volume in the zone of junction of support 6 with the bulb.

The remainder of the tube can then be treated in the usual way, to deposit the photo-emissive layer *a*, to activate it, to mount and activate mosaic M, to add the electron gun portion 12, to form the cathode of this gun, and so on, until the tube is completed.

In order to achieve a strong and fluidtight sealing of mica support 6 on bulb 11, it may be advantageous to fold in the edge of the cylindrical wall portion of this bulb as shown at 20 by Fig. 3. The mica disc 6 is then sealed at 21 against this inwardly facing edge, while the glass wall element 10 is sealed at 22 (glass against glass) on the frontwardly facing periphery of the cylindrical wall portion of bulb 11.

I may also, as shown by Fig. 4, arrange support 6 so that its peripheral part can shrink to compensate for the spherical deformation thereof.

For this purpose, the inwardly folded portion 20 of the bulb cylindrical wall is made relatively thin so that it can deform elastically from its initial position P, shown in dotted lines (before evacuation of chamber Ea) into its final position P_1, shown in solid lines (after evacuation).

Furthermore, as shown by Fig. 4, wall 10 may be shaped to include a kind of flange 24—25, whereby practically the whole of the area of mica support 6 is applied against the spherical portion of wall 10.

Of course where glass portions are folded the angles are suitably rounded, for instance at R, to improve the elasticity of portion 20.

Of course also, the enamel which serves to fix support 6 against the inner concave face of wall portion 10 is chosen so as to be chemically neutral and of sufficiently low melting temperature to give the certainty that no detrimental chemical or other action is exerted on layer *b* and that the weld between glass and mica is not destroyed.

A camera tube for X-rays or other rays (or a light transformer tube) made as above described is relatively easy to manufacture. It gives sharp images, has a high efficiency and is very strong.

It should be well understood that my method is not limited to the particular example above described and that, for instance, supporting plate 6 might be given the desired curved shape before it is fitted in the tube. Likewise, my method is not limited to the manufacture of tubes such as above described.

What I claim is:

1. The method of forming on the concave side of a curved wall element a thin layer of a substance covered with a protective sheet which comprises forming a thin layer of this substance on one face of a sheet of a deformable material, applying said sheet against the concave face of said curved wall element, with the layer of substance turned toward said wall element, and securing said sheet to said wall element.

2. The method of forming on the concave side of a curved wall element a thin layer of a substance covered with a protective sheet which comprises forming a thin layer of this substance on a plane disc-shaped sheet of a deformable material, fixing the edge of said disc in a fluidtight fashion along the periphery of the curved wall element to form a fluidtight closed space between said sheet and said wall element, the layer of substance being turned toward said wall element, evacuating air from said closed space to draw said sheet into contact with said curved wall element concave face, and securing said sheet to said wall element.

3. The method of forming on the concave side of a curved wall element a thin layer of a substance covered with a protective sheet which comprises forming a thin layer of this substance on one face of a sheet of a deformable material, coating said wall element concave face with a glueing material, applying said sheet against the concave face of said curved wall element, with the layer of substance turned toward said wall element, and securing said sheet to said wall by means of said glueing material.

4. The method of forming on the concave side of a curved wall element a thin layer of a substance covered with a protective sheet which comprises forming a thin layer of this substance on a plane disc-shaped sheet of a deformable material, coating the concave side of said wall element with an enamel melting at about 300–400° C., fixing the edge of said disc in a fluidtight fashion along the periphery of the curved wall element

to form a fluidtight closed space between said sheet and said wall element, the layer of substance being turned toward said wall element, evacuating air from said closed space to draw said sheet into contact with said curved wall element concave face, and heating said wall element to melt said enamel to secure said sheet to said wall element concave face.

5. A method according to claim 2 in which the edge of the sheet is sealed against the turned in edge of a substantially cylindrical wall adjoining the wall element and belonging to the same bulb as said wall element.

6. A method according to claim 5 in which the turned in edge portion of said cylindrical wall is elastically deformable to make allowance for shrinking of the periphery of the sheet.

7. A method according to claim 5 in which said wall element is connected to said cylindrical wall by a kind of flange so that practically the whole of the area of the sheet is applied against the curved wall element.

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