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PROCESS OF ALUMINIZING CATHODE RAY TUBE SCREEN

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This invention relates to the production of cathode ray tubes and, more specifically, to improved methods of fabrication of the picture reproducing screen employed in cathode ray tubes designed for television purposes.

A recent development in the television picture tube industry has been the use of an aluminized coating applied to the side of the phosphor picture screen normally away from the viewer, in order to produce a mirror reflecting finish for reflecting light, which would otherwise be lost in the tube itself, out toward the viewer. It has been found that such tubes have an improved brightness over tubes which do not employ the reflecting coating and so have enhanced picture contrast with resulting overall improvement in the picture presented to the viewer.

The art of laying down the aluminized mirror on the back of the phosphor screen is a highly complicated and relatively delicate one. Briefly, it involves laying a thin film of lacquer over the back of the phosphor screen coating in order to provide a smooth surface on which to form the mirror, laying the aluminum film on the lacquer, and then removing the lacquer by baking so as to leave the aluminum supported directly by the phosphor. It is necessary to utilize the lacquer as an intermediate processing support in this way so that the aluminum will not be laid directly over the irregular surface of the phosphor crystals, as this would prevent the achievement of the mirror effect desired.

The above described process of film application and mirror production, when properly carried out, results in black and white or color pictue tubes whose superiority to unaluminized tubes is well recognized. Naturally, the added steps necessary to produce the aluminized coating on the tube result in higher manufacturing costs and higher customer expense. This increase in cost is even further aggravated by various imperfections which occur during the processing. Among the imperfections which may occur is the porduction of faulty lacquer films, that is, lacquer films which contain holes, strings, tears, swirls or other defects. Imperfections such as these may, after aluminization, occasion rejection rates of as high as 25% of tubes in process. Some saving in cost could be made if inspection of the lacquer film for these imperfections could be accomplished prior to aluminization. However, because of the transparent nature of the lacquer and the finely divided texture of the phosphor screen lying below the lacquer, it is extremely difficult and sometimes impossible, even with the best lighting available, to determine by visual inspection whether or not the required satisfactory lacquer film has been produced. In fact, with some tubes it has been impossible to tell by eye whether or not a lacquer film has been applied. As a result, heretofore, the most reliable test of lacquer film perfection has been inspection of the finished aluminum coating.

It is an object of this invention to facilitate the visual inspection of such lacquered screens, thereby preventing wasted production effort on further processing of tubes to which a faulty lacquer coating has been applied. It is a further object of the invention to provide a way of readily identifying tubes which have received a lacquer coating, in order to simplify the identification of cathode ray tube blanks at various stages in the processing. Considerable savings in time, labor and expense may be made by using only properly lacquered tubes for aluminization, rather than aluminizing them all as was done heretofore. Further, the added steps of marking or otherwise identifying tubes which have been lacquered are eliminated from the manufacturing process.

A further object of applicant's invention is the smoothing out of production flow. This results from preventing processing at one time the large numbers of faultily lacquered bulbs which may occasionally occur, occupying the bulk of the production facilities.

As was indicated previously, in order to form a smooth mirror surface of aluminum in the cathode ray tube, it is necessary to deposit a smooth surface behind the phosphor screen on which the aluminum coating is to be deposited, for if the aluminum were to be deposited directly on the screen, the coating would follow the microscopically rough contour of the phosphor screen and therefore would be of poor reflective quality. The necessary smooth surface to which the aluminum reflective coating is applied, is, therefore, ordinarily obtained by the application of a lacquer film or coating. Such a coating is ordinarily applied by dispensing a small amount of lacquer solution onto the surface of a layer of water poured onto the phosphor screen while the bulb in process is mounted screen downward. The layer of water is about two inches deep and the water itself thoroughly deionized. Prior to dispensing the lacquer solution onto the surface of the water, a small amount of amyl acetate is dispensed into the bulb. Floating on top of the water, the amyl acetate performs three functions, namely, saturation of the bulb atmosphere to regulate the lacquer drying rate, lubrication of the water surface so as to facilitate spreading of the lacquer film as it is applied, and minimization of the tendency of the amyl acetate in the lacquer solution to dissociate itself from the lacquer solution and thereby disturb the proper lacquer solution proportions.

The lacquer solution, which is then deposited onto the surface of the water, may comprise a 7% (weight per volume) solution of nitrocellulose in amyl acetate, additional acetate being added to achieve the desired "spreadability" or spreading characteristic in the lacquer. The stretching characteristic of the lacquer is controlled by the addition of a plasticizer such as di-octal phthalate, tri-cresyl phosphate, or polyalkalene glycol. The various amounts of different ingredients called for are known in the art and need not be expanded upon here as they are not particularly relevant to this invention.

The lacquer solution is allowed to stand on the water surface for about eighteen minutes, it already having spread over the surface of the water, leaving a thin, even film. As the lacquer stands, it assumes a plastic state and when the proper degree of plasticity is achieved, the cathode ray tube blank is tilted. As the tilted bulb is gradually inverted, the heretofore floating lacquer film attaches itself to the phosphor screen, starting at one edge of the face of the tube and continuing gradually across the phosphor screen as the water level recedes. During this process, the film in its plastic state is stretched and achieves the smooth surface desired for the aluminizing process.

It will be understood that the lacquer, once the aluminization step has been accomplished, is no longer retained in the bulb, it being baked out by placing the tube in an oven for a suitable period of time. The presence of lacquer, such as that above described, in a finished cathode ray tube would be extremely undesirable as gas would be evolved from it and the achievement of the desired degree of vacuum rendered almost impossible.

Upon completion of manufacture of the lacquer film, it is desirable, as was indicated above, to inspect the finished film so as to prevent losing valuable processing time in aluminizing faulty films and so producing faulty mirror structures. I have found that, by the addition of a dye or pigmentation to the lacquer solution prior to dispensing the lacquer onto the glass bulb, defects in the finished lacquer film may be made readily recognizable. The dye used may be any color, although some colors may be more visible than others, and is preferably volatile so that it may be baked out along with the lacquer during the bakeout operation subsequent to aluminization. A red dye of the azobenzene type such as tetrazobenzene-B (beta) -naphthol has been found satisfactory in concentrations of about 0.05% to 0.15%. Concentrations less than 0.05% give too pale a coloration to the lacquer to be of much value, while concentrations of greater than 0.15% will likely result in an unduly gassy tube. Other lacquer soluble dyes may, of course, be used, within the scope of the invention. With the dye presently employed, it has been found that no traces of the dye remain behind after the bakeout to color the screen undesirably.

The effect of the added dye material is to render a coloration to the lacquer film which is sufficient to make the film visible and yet which, upon baking out of the film, will not leave behind any trace of undesirable coloring which would adversely affect the color of the cathode ray tube screen. The presence of the coloring not only makes the lacquer film visible, but also tends to improve

even further the visiblity of flaws such as strings, tears, swirls, or other film defects where the nature of the defect is such as to produce thickening or doubling over of the lacquer film. This, of course, results in a deepening of color of the lacquer at the point of the imperfection, thus rendering it readily visible.

I claim:

1. The process of aluminizing a cathode ray tube screen which includes the steps of coating the previously applied phosphor screen with a thin film of lacquer bearing a volatile dye, aluminizing the surface of the lacquer and the dye, and removing the lacquer by baking.

2. The method of aluminizing the phosphor screen of a cathode ray tube which includes the steps of applying a volatile lacquer film containing a volatile azobenzene type dye to the screen, aluminizing the surface of said lacquer, and then removing the lacquer and the dye by baking.

3. The method of aluminizing the phosphor screen of a cathode ray tube which includes the steps of applying a volatile lacquer film containing tetrazobenzene-B (Beta) -naphthol in concentrations of approximately 0.05 to 0.15% to the screen, applying an aluminum coating to said film, and then substantially removing the lacquer film and dye by baking.

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