United States Patent

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[72] Inventors **Andrew Glovatsky**
Seneca Falls, New York;
Joseph B. Shinal, Seneca Falls, New York;
Walter W. Slobbe, Seneca Falls, New York

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[73] Assignee **Sylvania Electric Products Inc.,**
a Corp. of Delaware

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[54] **APPARATUS FOR THE FABRICATION OF IMAGE DISPLAY SCREENS**
3 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **118/302,** 118/318, 118/321, 118/326
[51] **Int. Cl.** **B05b 15/02**
[50] **Field of Search** 118/302, 321, 318, 326, 300; 117/105.4, 33.5C, 33.5CA

[56] **References Cited**

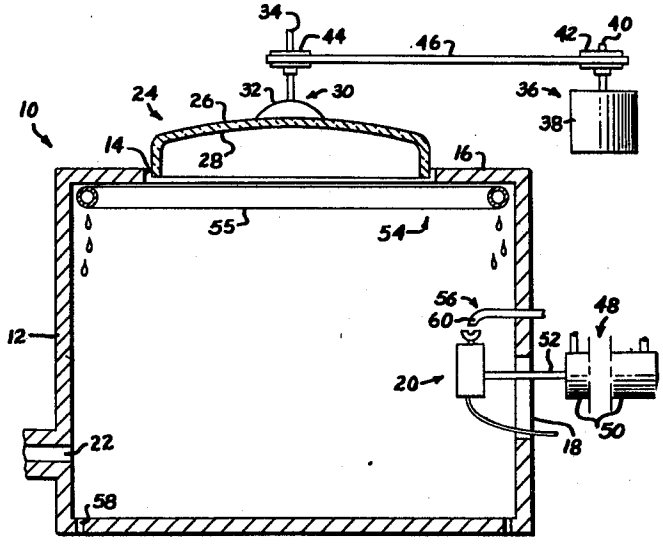
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Primary Examiner—John P. McIntosh
Attorney—Norman J. O'Malley, Cyril A. Krenzer and William H. McNeill

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ABSTRACT: Method and apparatus are disclosed for applying a substantially uniform coating of viscous material to a cathode ray tube face plate in a series of sequential passes each of which encompasses approximately half of the face plate area. The spraying passes are performed with the inner surface of the face plate downwardly oriented and by spraying the viscous material upwardly thereon. The spraying takes place in an enclosure provided with a saturated atmosphere to retard evaporation of the solvent contained in the viscous material.



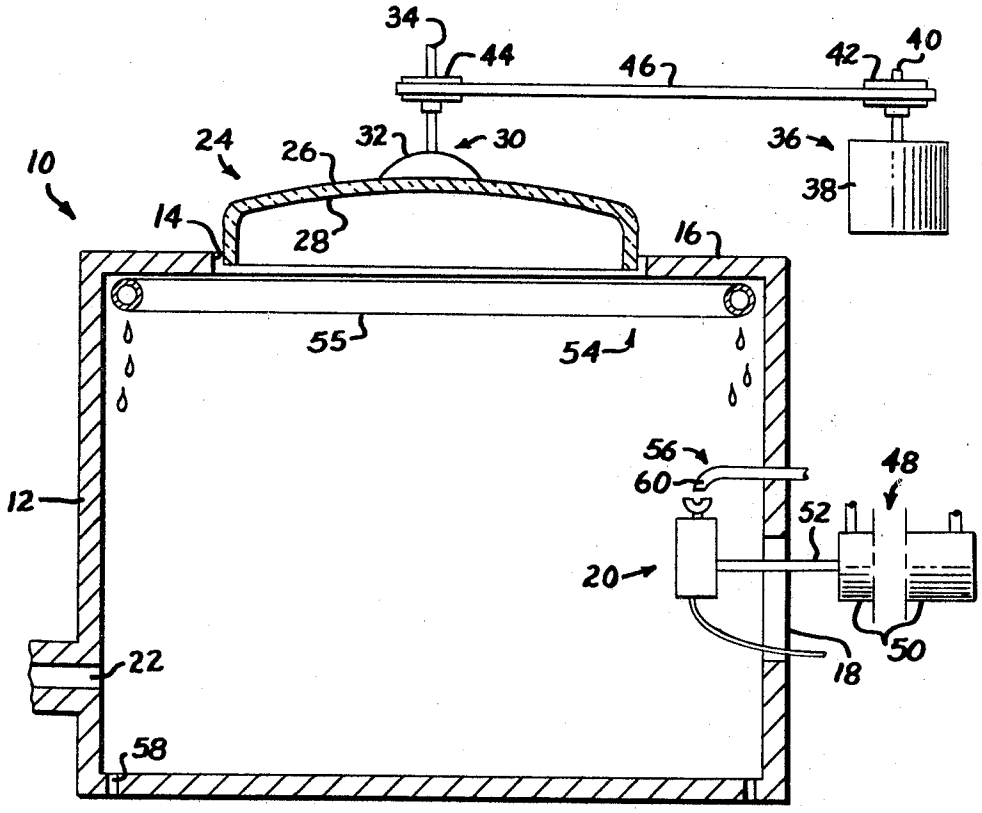


Fig. 1

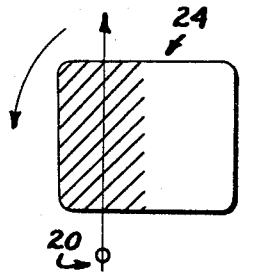


Fig. 2

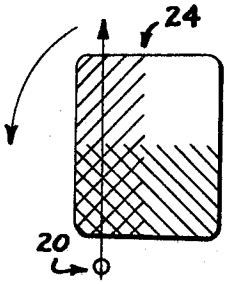


Fig. 3

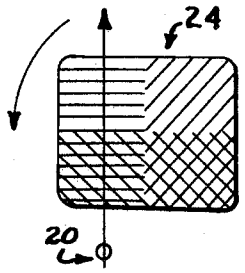


Fig. 4

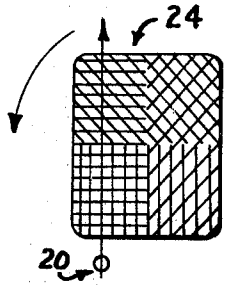


Fig. 5

INVENTORS
ANDREW GLOVATSKY,
JOSEPH B. SHINAL, &
WALTER W. SLOBBE
BY
Cyril A. Krenzer
ATTORNEY

APPARATUS FOR THE FABRICATION OF IMAGE DISPLAY SCREENS

CROSS-REFERENCES TO RELATED APPLICATIONS

This application is a division of application Serial Number **514,901** filed: December **20, 1965**, now Patent No. **3,440,081**, assigned to the assignee of the present invention.

BACKGROUND OF THE INVENTION

This invention relates to an apparatus adaptable for use in the screen fabrication process.

Image display screens of the type used in color television picture tubes usually comprise a transparent viewing panel having thereon a plurality of phosphor dots or stripes which will luminesce in various colors when excited by a proper source of energy. Screens of this type may be fabricated by photosensitive printing techniques wherein a photosensitive material is utilized to adhere the luminescent dots or stripes to the viewing panel. In one such process a photosensitive material, such for example as polyvinyl alcohol (PVA) may be applied to the viewing panel and a luminescent material in the form of a dry phosphor powder disposed thereover. The screen thus prepared is then exposed through a suitable negative to provide a predetermined pattern of exposed and unexposed areas. After exposure the panel is suitably developed to remove unexposed areas of phosphor and photosensitive material. The above steps are then duplicated for each of the colored light emitting phosphors desired in the finished device.

The application of the photosensitive material presents unique problems in that substantial uniformity of thickness and freedom from contaminants or foreign matter are required. One method previously used to apply this coating has been to position the viewing panel with the inner surface or screen surface positioned upwardly. A spray nozzle positioned over the panel is caused to spray the coating material downward upon the panel in a predetermined manner. This approach works quite well but requires periodic shut-downs so that the spraying area may be cleaned of foreign matter; thus it is not suited to the high production capabilities demanded by present and future needs. Much of this foreign matter consists of dried particles of the material being applied which have accumulated around the spray nozzle and the various hoses associated therewith and which occasionally flake off and fall to the screen positioned below. A dried particle falling onto the screen tends to dry out the areas immediately adjacent thereto by absorbing some of the solvent therein. These dried areas will not have sufficient adhesiveness to adequately bond the dry phosphor material and thus, after the exposure and subsequent development of the screen, these dried areas will be washed away leaving gaps in the final phosphor pattern of the tube which will make the tube unacceptable.

OBJECTS AND SUMMARY OF THE INVENTION

Accordingly, it is an object of this invention to enhance the fabrication of image display screens.

It is another object of the invention to improve the quality of image display screens.

Yet another object of the invention is to reduce the amount of foreign matter ordinarily accumulated by such screens during processing.

Still another object of the invention is the provision of apparatus for achieving the above objects.

These and other objects are achieved in one aspect of the invention by applying a coating of material on the inner surface of an image display device viewing panel by positioning the viewing panel with the inner surface downward and spraying the material on the inner surface by directing a spray upwards to the viewing panel while effecting relative longitudinal movement between the viewing panel and the spray.

This method substantially reduces the amount of foreign matter accumulated by the viewing panels since the force of gravity attracts foreign particles away from the viewing panels and greatly enhances the fabrication thereof.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a diagrammatic elevational view of apparatus for carrying out the process; and

FIGS. 2 thru 5 are diagrammatic representations of sequential steps in the process.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

For a better understanding of the present invention, together with other and further objects, advantages, and capabilities thereof, reference is made to the following disclosure and appended claims in connection with the above-described drawings.

Referring now to the drawings with greater particularity, in **FIG.** 1 there is shown an apparatus **10** for spraying image display device viewing panels. Apparatus **10** comprises a substantially closed container **12** provided with a panel receiving aperture **14** in the upper surface **16** thereof. A lower portion of container **12** is provided with entry means **18** for spraying means **20**. Exhaust means **22** is also formed in container **12** and is preferably positioned beneath the plane of operation of spraying means **20**.

A viewing panel **24** having an outer surface **26** and an inner surface **28** is mounted over aperture **14** by panel positioning means **30**, which may comprise a suction cup **32** and a vertically projecting shaft **34**. Means for supplying angular movement to panel **24** is designated generally **36** and may include a motor **38** having a shaft **40** and a pulley **42** mounted thereon. A mating pulley **44** is mounted on shaft **34** and is connected to pulley **42** by belt **46**. Means for imparting longitudinal movement to spraying means **20** is indicated generally at **48** and may include a fluid motor **50** having a shaft **52** to which is attached spraying means **20**. Also provided, within container **12**, are humidity control means **54** and spray head cleaning means **56**.

The operation of apparatus **10** will now be described. A viewing panel **24** is positioned over aperture **14** with its inner surface **28** downward. Energizing means, not shown, will activate fluid motor **50** and spraying means **20**. As the spraying means **20** makes a longitudinal pass beneath panel **24** a coating of the sprayed material is applied to inner surface **28**. After a complete traverse of the panel the spray is shut off and the spraying means **20** retracts to its starting position. Obviously, the spray may also be energized during the retraction of spraying means **20** if desired. While it would, of course, be possible to apply the coating in the desired thickness in one longitudinal pass, it is desirable, for purposes of applying a more uniform thickness of material having a more uniform wetness, to apply the material sequentially in a series of passes. One manner of sequential build-up is shown diagrammatically in **FIGS.** 2 through 5. In **FIG.** 2 is shown a panel **24** and spraying means **20** which is offset from the center of the panel. The width of the spray emanating from spraying means **20** is such that it extends approximately to the center of the screen. The arrow indicates the direction of the first pass of the spraying means and the cross hatched area indicates the area sprayed.

After the completion of this first pass, motor **38** is energized, by means not shown, and accomplishes, through pulleys **42, 44** and belt **46**, a desired amount of angular movement of panel **24**. While in this instance the movement is **90°**, and four such movements will be used to completely coat a panel, it will be shown hereinafter that other angular movements may be used. When the angular movement of the panel is completed, fluid motor **50** and spraying means **20** are again energized and a second pass is made, as is shown in **FIG.** 3. The cycle of angular movement of the panel and longitudinal movement of the spraying means is continued until the entire inner surface is coated to the desired thickness. In the embodiment illustrated in **FIGS.** 2 thru 5 the panel is coated in a sequence of four passes with substantially one-half the finally desired

thickness being applied on each pass. Generally speaking then, it may be said that if the finished thickness of the coating of material is substantially uniformly equal to Y; the number of angular movements is equal to X (where X is any even integer); the number of longitudinal spraying movements per angular movement is equal to Z; then the total number of spraying movements per panel is equal to XZ and the thickness of the material applied on any one spraying pass is substantially equal to 2Y/XZ.

This method of spraying produces viewing panels having thereon a coating of material characterized by a substantially uniform thickness and virtual freedom from particles of foreign matter. Exhaust means **22**, which operates during the spraying cycle serves to remove from the atmosphere particles of sprayed material which were not deposited on the screen.

Further improvements with regard to this invention include means for retarding the formation of dried particles of sprayed material. As stated hereinbefore, the photosensitive materials with which this invention is chiefly concerned usually comprise a solute and a relatively volatile solvent. Since a substantially uniform wetness of the applied coating is necessary to insure an even distribution of phosphor during subsequent processing, the importance of this wetness will be readily understood.

In prior techniques the spraying operation took place in dry air. The effect of this on the sprayed material may be better understood from the following example. Four hundred fifty-four grams of dry air at **70°F.** which contain no moisture has a capacity at saturation of holding **7.1278** grams of moisture. If a photosensitive solution of **20** grams is used for spraying and **20%** of this solution is solute then there are **4** grams of solute and **16** grams of solvent. Therefore, four hundred fifty-four grams of dry air has the capacity to absorb approximately **45%** of the solvent thereby causing an excessive drying rate of the sprayed material. To alleviate this problem there is incorporated in apparatus **10** the before mentioned humidity control means **54** which functions to maintain the atmosphere within container **12** at substantially its saturation point, thereby reducing the amount of evaporation of solvent. The means **54** may comprise a perforated tube **55** which extends substantially around the inside perimeter of container **12** near its upper surface and which releases a suitable atmosphere saturating fluid, such as water. The amount of fluid released is such that the sides of container **12** are continually wetted thereby. Suitable drainage means, such as holes **58**, are provided in the base of container **12**.

To insure a consistent uniformity in the spray itself, means **56** for periodically cleaning the spray head is also provided. The means may comprise a hose **60** through which a flushing solution, such as warm water, may be directed upon the spray head during inoperative periods thereof.

There has thus been provided by this invention a method and apparatus for enhancing the techniques of viewing panel fabrication. The uniformity of the thickness of the applied material and the uniformity of its wetness together with its substantial freedom from dried spots and accumulated foreign matter combine to provide superior results unobtainable with prior art processes.

While there has been shown and described what is at present considered the preferred embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the scope of the invention as defined by the appended claims.

We claim:

1. An apparatus for providing a coating of material on the inner surface of an image display device viewing panel comprising:

means for positioning said viewing panel at a location with said inner surface downward;

means for effecting periodic angular movement of said viewing panel at said location;

spraying means for depositing said material on said inner surface of said viewing panel during rest periods of said angular movement by directing a spray upwards to said viewing panel while effecting relative longitudinal movement between said viewing panel and said spray, said spray comprising particles of atomized solute and volatile solvent; and

means for saturating at least the atmosphere immediately surrounding said spray whereby evaporation of said volatile solvent is retarded.

2. An apparatus according to Claim **1** wherein said spraying means comprises at least a spray head; and means for cleaning said spray head during inoperative periods thereof.

3. The apparatus of Claim **1** wherein said spraying means is offset from the longitudinal center of said panel.