Dec. 23, 1969 HARUKI NAKAMICHI 3,485,407

REINFORCED TYPE CATHODE RAY TUBE

Filed Nov. 7, 1966

FIG. 1

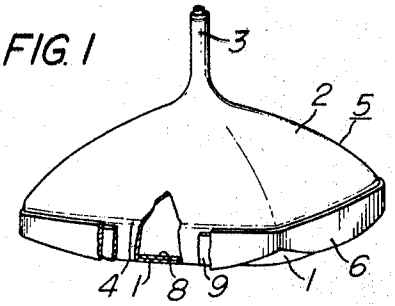


FIG. 2

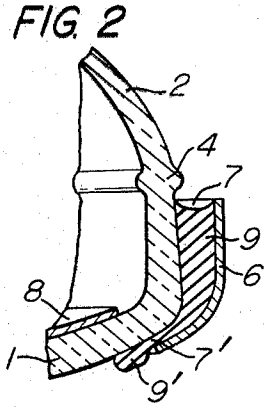


FIG. 3

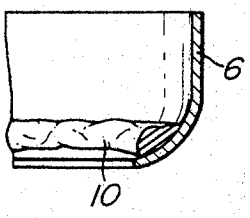


FIG. 4

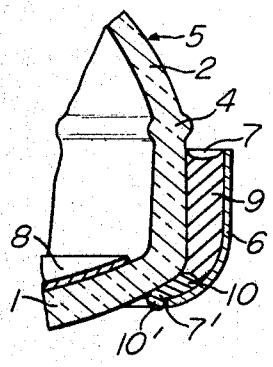
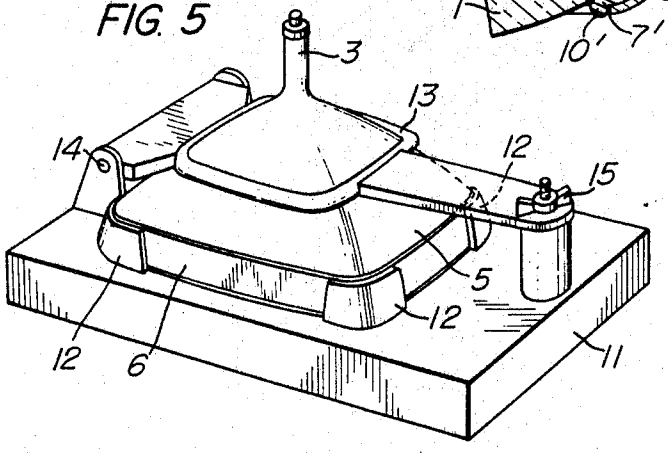


FIG. 5



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3,485,407

REINFORCED TYPE CATHODE RAY TUBE

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Int. Cl. H01j 61/30
U.S. Cl. 220—2.1 6 Claims

ABSTRACT OF THE DISCLOSURE

A reinforced type cathode ray tube comprising a face panel and a reinforcing frame fitted on the upper peripheral edge of the face panel with a filler disposed in the gap formed between the panel and frame. The filler comprises at least two layers with the closest layer to the tube being made of a resin having a thixotropy which is much higher than that of the adjacent layer.

The present invention relates to an improved type of reinforced cathode ray tube equipped with a reinforcing frame extending along the entire perimeter of the face panel, and to the method of manufacturing the improved cathode ray tube.

The greatest danger inherent in the devices which utilize cathode ray tubes is the implosion of the cathode ray tube. Implosion tends to occur not only when mechanical shocks are given to the cathode ray tube, but also when large strains remain in the glass of the glass bulb of the cathode ray tube.

As an advantageous measure for the prevention of implosion, it has been proposed to fit a reinforcing frame over the perimeter of the face panel of the tube. This measure is now being put into practice. The present invention has solved the problems which have been encountered particularly in the process of manufacturing the reinforced cathode ray tube of the type specified above.

The means for accomplishing the foregoing objects and other advantages which will be apparent to those skilled in the art, are set forth in the following specification and claims, and are illustrated in the accompanying drawings with a basic embodiment of the present invention. Reference is made now to the drawings in which:

FIG. 1 is a side view of a conventional reinforced cathode ray tube with a portion broken away;

FIG. 2 is a fragmentary side view, in vertical cross section, of the cathode ray tube shown in FIG. 1;

FIG. 3 is a fragmentary side view, in vertical cross section, of the cathode ray tube according to the present invention and showing the relationship between the reinforcing frame and a sealing resin provided in association therewith;

FIG. 4 is a fragmentary side view, in vertical cross section, of the critical portion of the cathode ray tube shown in FIG. 3; and

FIG. 5 is a perspective view of a jig, with the cathode ray tube mounted thereon, by means of which the relative positions of a glass bulb of the cathode ray tube and a reinforcing frame are set.

FIGS. 1 and 2 show a conventional reinforced type cathode ray tube, in which a face panel **1** has its inside surface coated with a fluorescent film **8** and is connected to a funnel **2** with a neck tube **3** having an electron gun

(not shown) disposed therein. The face panel **1**, funnel **2** and neck tube **3** are joined together in an air-tight fashion by welding or other means, to form a glass bulb **5** of the cathode ray tube. The joint between the face panel **1** and the funnel **2** is indicated at **4**.

The conventional reinforced type cathode ray tube is generally manufactured by a method comprising fitting a ring-shaped iron reinforcing frame **6** to the perimeter of the face panel **1** and thereafter filling the gap **7** between the face panel **1** and the reinforcing frame **6** with a resin **9**. The reinforcing frame **6** is integrally connected to the glass bulb **5** of the cathode ray tube as the resin **9** is cured.

However, in the conventional method described above, in which the reinforcing frame **6** is pressed against the front surface of the face panel using a special tool designed for this purpose, the application of an excessively strong pressure tends to result in breaking the face panel. For this reason, the pressing force applied to the reinforcing frame is limited with the result that it is difficult to completely eliminate a slight gap **7'** formed around the entire circumference of frame **6** between the front surface of the face panel **1** and the front edge of the reinforcing frame **6**. Consequently, a part **9'** of the resin **9**, poured into the gap **7**, flows down onto the front surface of the face panel **1**, i.e., on the image-receiving surface, greatly impairing the commercial value of the cathode ray tube. Therefore, the part **9'** of the resin must be removed during the manufacturing process of the cathode ray tube. However, removal of the resin hardened on the glass face panel is not an easy task and lowers the manufacturing efficiency. Furthermore, since the removal of the resin must be carried out by mechanical means, it sometimes happens that the glass face panel is scratched thereby presenting a further cause of implosion.

The present invention has eliminated the aforementioned drawbacks possessed by the conventional method. Now, the present invention will be described in further detail with reference to FIGS. 3 and 4.

Referring first to FIG. 3, the reinforcing frame **6** is shown before being fitted over the perimeter of the face panel. A bead of sealing resin **10** extends around the frame adjacent the front edge thereof. The sealing resin **10** is a thermosetting resin in which an additive, such as a fine powder of silicic acid or calcium carbonate, which will promote the thixotropy of resin, is suspended. The proportion of the additive in the resin is advantageously determined, for the reason as will be mentioned later, such that its curing time is longer than that of the resin **9** which will be filled in the gap later in the manufacturing process.

As is well known, a resin having a great thixotropy has the property of reversibly converting from a sol into a gel simply by being subjected to a mechanical shock, without being subjected to a temperature change. In other words, such a resin has a lower viscosity when subjected to a mechanical force and has a higher viscosity when stationary. The sealing resin **10**, having a high thixotropy, is first applied to the inner circumferential surface of the reinforcing frame **6**, at the inwardly flexed front end portion, by means of a spatula, a nozzle or the like, before the reinforcing frame **6** is fitted over the face panel **1**. In the inventive process, the sealing resin **10** thus applied does not readily flow down from the point at which it is applied because of its high thixotropy. Next, the relative positions of the glass bulb **5** of the cathode ray tube and the reinforcing frame **6**, to which the sealing resin **10** has previously been applied, are set as shown in FIG. 4, us-

ing a jig in such a manner as will be explained later. Because of its high thixotropy, the sealing resin **10**, when the reinforcing frame **6** is fitted on the face panel **1**, is easily deformed by being compressed therebetween and flows into the small gap **7'** between the front surface of the face panel and the front edge of the reinforcing frame so as to fill said gap completely. Thereafter, the filling resin **9** is poured into the gap **7**. The resin **9** is such a thermosetting resin as, for example, epoxy resin, with an expander, a catalyzer and an accelerator previously blended therein in an optimum proportion. In the inventive process, the filling resin **9**, poured into the gap **7**, will not flow out to the front surface or the image-receiving surface of the face panel **1** because the bottom end of the gap was previously sealed by the high thixotropy sealing resin **10** which filled the gap **7'** and is now stationary and highly viscous. The reinforcing frame **6** is integrally fastened to the glass bulb of the cathode ray tube as the curing of the filling resin **9** proceeds. Then, the glass bulb **5** of the cathode ray tube is removed from the jig.

As described hereinbefore, the curing time of the sealing resin **10** is made longer than that of the filling resin **9**, so that the sealing resin **10** has not cured completely in the gap between the reinforcing frame **6** and the face panel **1** when the glass bulb of the cathode ray tube is removed from the jig. This is advantageous because a part of the sealing resin **10** may possibly be forced out on the front face of the face panel **1** through the gap **7'**, as indicated at **10'**, and may be easily removed by wiping with a cloth or a paper soaked with an appropriate solvent. Such an extrusion of the sealing resin **10** tends to occur at the time of setting the relative positions of the glass bulb **5** of the cathode ray tube and the reinforcing frame **6**. In order to reduce the amount of the sealing resin being extruded through the gap **7'**, consideration should be given as to the amount of the sealing resin **10** and the location where it is applied to the frame during the step of applying the sealing resin to the inner peripheral wall surface of the reinforcing frame **6**.

Although the composition of the sealing resin **10** is not specifically restricted, it has been found through experiments that the sealing resin may preferably be composed of the following:

EXAMPLE 1

	Percent by weight
Epoxy resin	95–90
Fine powder of silicic acid ("Aerosil," a product of Degussa in Germany)	5–10

EXAMPLE 2

Epoxy resin	85–70
Fine powder of silicic acid ("Carplex," a product of Shionogi Pharmaceutical Co. in Japan)	15–30

EXAMPLE 3

Epoxy resin	60–50
Fine powder of calcium carbonate (not larger than 4.0 μ in diameter)	40–50

The curing time of the sealing resin of the composition set forth above may be suitably adjusted by the addition thereto of additives. The highly thixotropic sealing resins of the compositions shown in Examples 1 to 3 above, after curing, will have substantially the same hardness as the aforementioned filling resin **9** and therefore the effect of reinforcing the cathode ray tube will not be reduced at all. In the sealing resin compositions shown in Examples 1 to 3 above, epoxy resin is employed as the matrix thereof. Preferably the matrix of the sealing resin **10** is of the same type as the resin **9** which is to be filled in the gap **7**, in which case, the compatibility between the sealing resin **10** and the filling resin **9** is promoted as they are cured, with the result that the reinforcing effect is further enhanced.

Setting of the relative position between the glass bulb **5** of the cathode ray tube and the reinforcing frame **6** may be accomplished by fitting the reinforcing frame **6**, with the sealing resin **10** thereon, on the perimeter of the front of the face panel of the glass bulb **5** at a predetermined location, by using a jig **11** as shown in FIG. 5. The jig **11** comprises fixed members **12** for positioning and securing reinforcing frame **6**, and a glass bulb depressing frame **13**, having one end pivotally connected for vertical swinging movement to the base of the jig by a pin **14** and having the other end adapted to be fixed by a fastening means **15**.

As described hereinabove, according to the present invention, the gap formed between the front surface of the face panel and the front edge of the reinforcing frame, during mounting of the reinforcing frame on the glass bulb of the cathode ray tube, is filled with a sealing resin, having a high thixotropy, which has previously been applied to the inner wall surface of the reinforcing frame, and thereafter pouring a filling resin into the air space between the face panel and the reinforcing frame. There is no fear of the filling resin flowing out onto the image-receiving surface and impairing the appearance or function of the image-receiving surface. In addition, while, according to conventional methods, it is inevitable that a blank zone must be provided on the face panel between the front edge of a reinforcing frame and an image-receiving area in order that image observation will not be impaired by a trace of the resin which has seeped out and hardened on the face panel during manufacture. The provision of such a blank zone reduces the reinforcing effect somewhat. It is not necessary, according to the present invention, to provide such a blank zone and the reinforcing effect is enhanced accordingly. Still further, according to the present invention, the force which has heretofore been applied, in order to reduce the gap between the front face of the face panel and the front edge of the reinforcing frame, can be reduced, so that it is possible to eliminate the danger of scratching the glass of the face panel. Another advantage of the invention is, since the relative position between the glass bulb of the cathode ray tube and the reinforcing frame is set by means of a simple jig, the production cost of the cathode ray tube can be lowered remarkably and yet, since such a setting may be carried out on a cathode ray tube conveyor during the manufacturing process, the production efficiency can be enhanced. As will be appreciated from the foregoing, the present invention is of great advantage in the production of reinforced type cathode ray tubes.

It is to be understood that the above-described embodiments of the invention are merely illustrative of the principles of the invention. Numerous other arrangements and modifications may be devised by those skilled in the art without departing from the spirit and scope of the invention.

What is claimed is:

1. A reinforced type cathode ray tube comprising a face panel, a reinforcing frame fitted on the outer peripheral edge of said face panel and a filler disposed in a gap formed between said face panel and said reinforcing frame, said filler comprising at least two layers consisting of a first layer closer to and a second layer remote from the face panel of said tube, both said layers consisting of resins of the same type, the first layer being made of a thermosetting resin and an additive to promote the thixotropy of the first layer to be higher than that of the second layer, said layers having substantially the same hardness after curing and serving to contribute to the reinforcement of said tube.

2. A reinforced type cathode ray tube according to claim **1**, in which said first layer of the filler is located in the proximity of an inwardly turned front end portion of said reinforcing frame.

3. A reinforced type cathode ray tube according to claim **1**, in which said first layer of the filler has a curing time longer than that of the second layer.

4. A reinforced type cathode ray tube according to claim 1, in which said first layer of the filler contains a thermosetting resin, such as epoxy resin, and a fine powder of silicic acid.

5. A reinforced type cathode ray tube according to claim 1, in which said first layer of the filler contains a thermosetting resin, such as epoxy resin, and a fine powder of calcium carbonate.

6. A reinforced type cathode ray tube according to claim 1, in which said first layer of the filler and said second layer of the filler are made of resin which are chemically similar.

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