Sept. 18, 1973 R. J. PEKOSH 3,759,735

METHOD FOR CLEANING THE SEALING LAND OF A CATHODE RAY TUBE FACEPLATE PANEL

Filed Sept. 11, 1970 2 Sheets-Sheet 1

FIG. 1

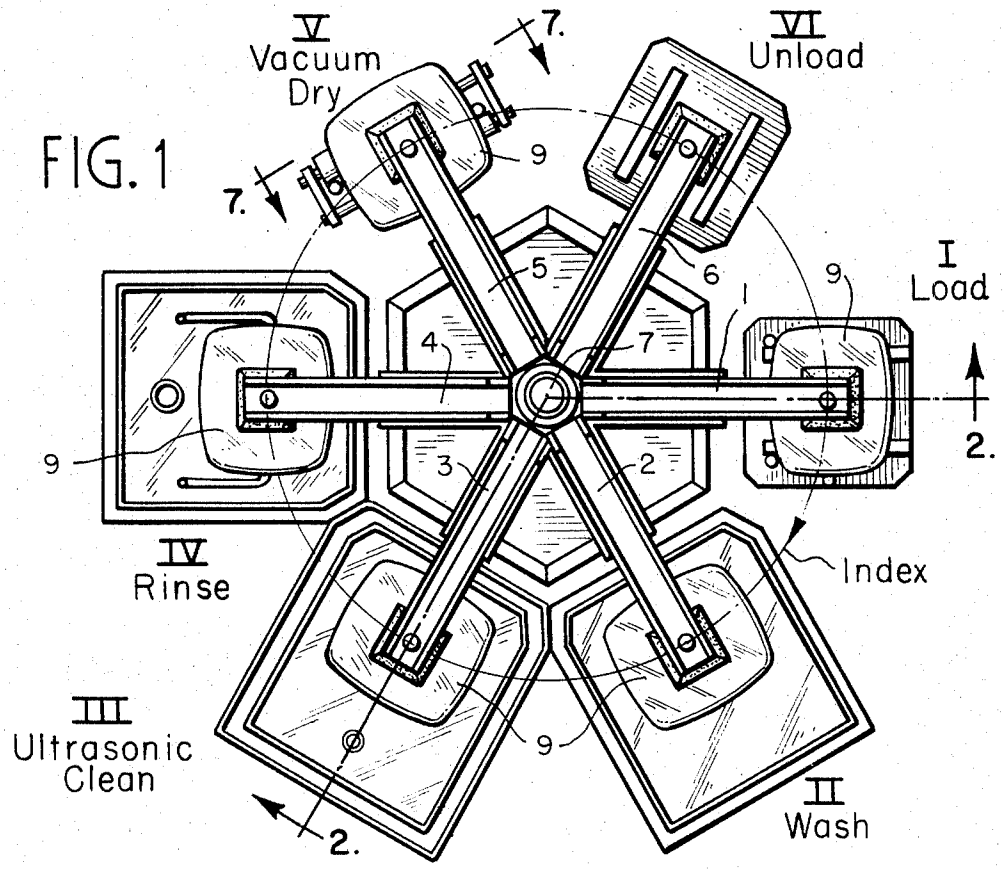
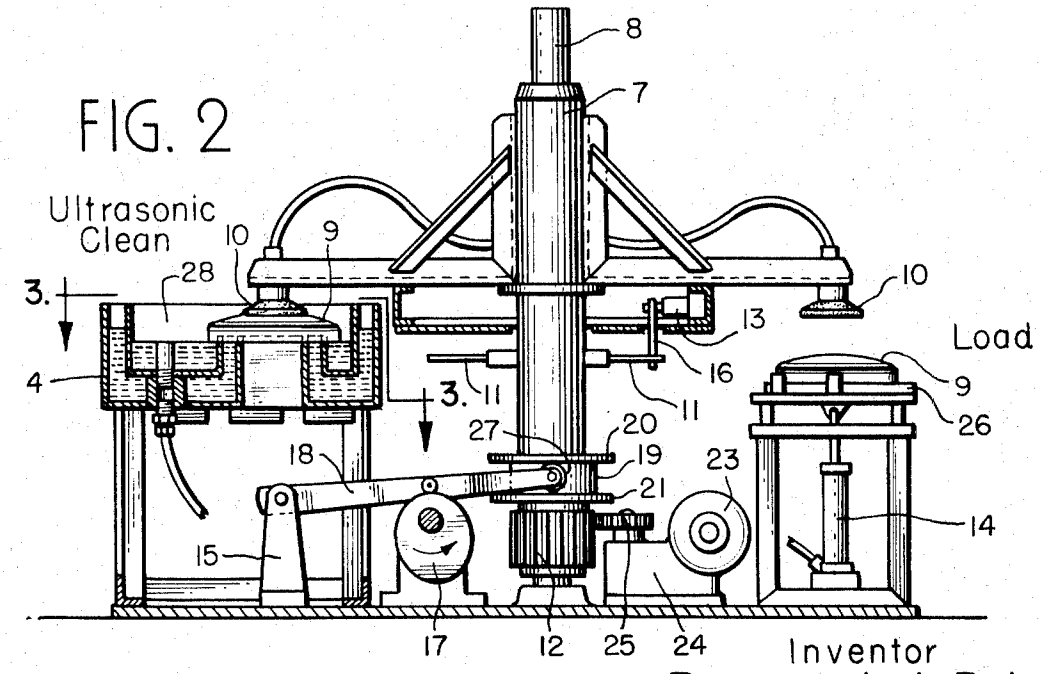


FIG. 2



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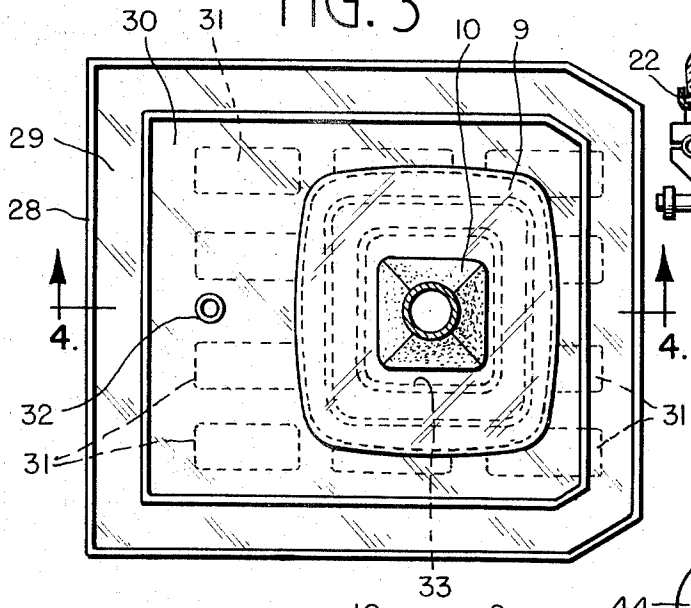
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FIG. 3



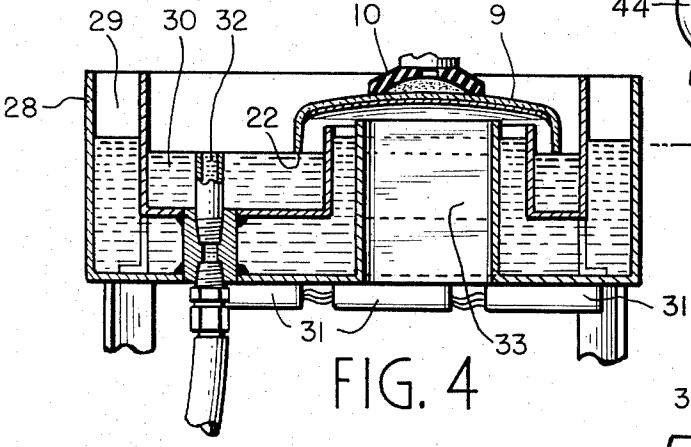


FIG. 4

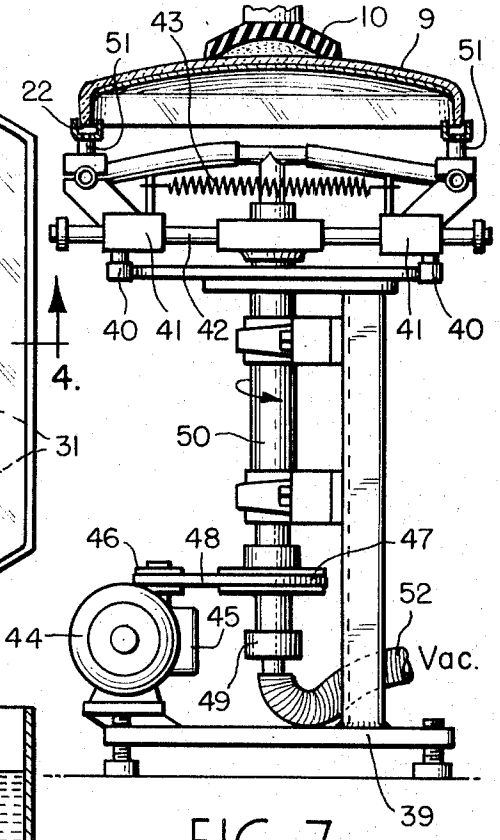


FIG. 7

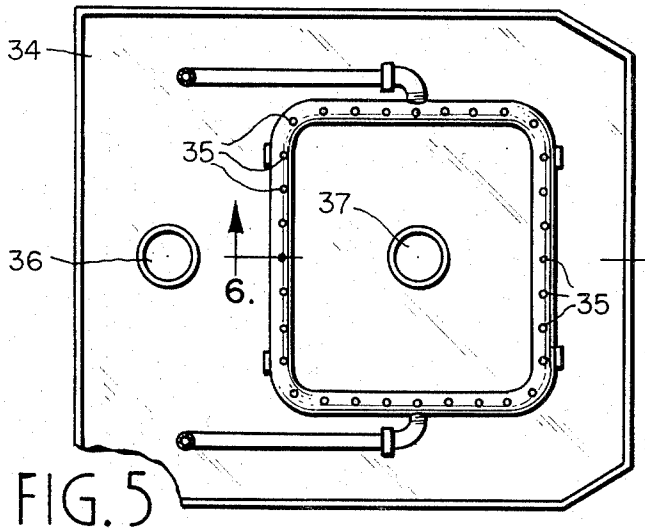


FIG. 5

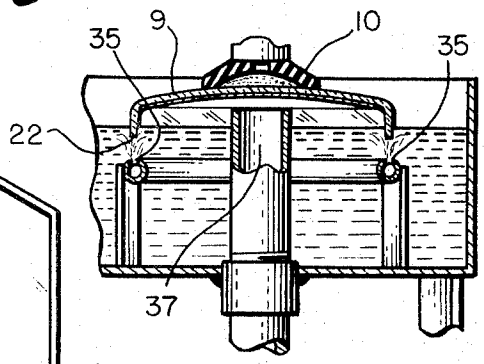


FIG. 6

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United States Patent Office 3,759,735 Patented Sept. 18, 1973

3,759,735

METHOD FOR CLEANING THE SEALING LAND OF A CATHODE RAY TUBE FACEPLATE PANEL

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Filed Sept. 11, 1970, Ser. No. 71,538
Int. Cl. B44d 5/02
U.S. Cl. 117—33.5 C 3 Claims

ABSTRACT OF THE DISCLOSURE

A method of manufacturing a cathode-ray tube of a type comprising a glass faceplate panel section to be frit sealed to another envelope section containing an electron gun system for energizing a phosphor screen deposited on the faceplate panel section, while substantially preventing localized failure of the frit seal between the sections upon high-voltage operation of the completed tube. After the phosphor screen is formed, the sealing land of the faceplate panel section is dipped in a liquid cleaning bath which is ultrasonically agitated to remove residue from the screen forming process from the sealing land. The sealing land is then rinsed with deionized water and vacuum dried. The faceplate panel section is then ready to be frit sealed to the other envelope section containing an electron gun system, completing the manufacture of the cathode-ray tube.

BACKGROUND OF THE INVENTION

In the manufacture of a cathode-ray tube a glass faceplate panel section is frit sealed to another envelope section containing an electron gun system. This electron gun system energizes a phosphor screen deposited on the faceplate panel section. During the process of depositing the phosphor screen on the faceplate panel section, small amounts of residue collect onto the sealing land of the faceplate section. More recently, with the introduction of the color cathode-ray tubes affording increased brightness of the type which have light-absorbing areas between the phosphor elements on the faceplate panel screen, the amount of residue remaining on the sealing land of the faceplate panel section has been found to be greatly increased.

If the residue from the phosphor screen deposition is allowed to remain on the sealing land of the faceplate panel section during the frit sealing of the faceplate panel section to the envelope section containing the electron gun system, the residue may contaminate the frit seal material causing failure of the finished tube upon high-voltage operation.

Heretofore it has been attempted to clean the sealing land of the faceplate panel section by hand prior to the frit sealing operation. The sealing land is wiped off using a cloth which has been dipped into a mild acidic solution of 2% hydrofluoric acid, .2% sulfuric acid, and 97.8% water, and then hand rinsed in deionized water.

Hand-cleaning of the sealing land of the faceplate panel section has not been totally effective. The monotony of cleaning many faceplate panel sections leads to occasional hunman error. Also, the sealing land of the faceplate panel sections may not always be completely smooth, and hand cleaning may fail to remove small pieces of residue in the crevices of the rough surface. These conditions may result in failure of the frit seal between the sections of the completed cathode-ray tube upon high-voltage operation. Because such defects cannot be detected until the cathode-ray tube is completed and tested under high-voltage operation, even occasional failures can be quite costly because the value of a finished tube is lost.

Accordingly, it is an object of the present invention to provide a method of manufacturing a cathode-ray tube which avoids or minimizes the aforementioned difficulties of prior methods.

A more specific object of the invention is to provide a new and improved apparatus for cleaning the sealing land of cathode-ray tube faceplate panel section which avoids human error.

A further object of the invention is to provide a method of substantially preventing localized failure of the frit seal between the faceplate panel and the remainder of the envelope upon high-voltage operation.

SUMMARY OF THE INVENTION

The present invention pertains to the manufacture of a cathode-ray tube of the type comprising a glass faceplate panel section to be frit sealed to another envelope section containing an electron gun system for energizing a phosphor screen deposited on the faceplate to the panel section, and provides a method of substantially preventing localized failure of the frit seal between the sections upon high-voltage operation of the completed tube. In accordance with the inventive method, a phosphor screen is first formed on the glass faceplate panel section. Thereafter, the sealing land of the faceplate panel section is dipped in a liquid cleaning bath which is ultrasonically agitated to remove residue from the screen forming process from the sealing land. The sealing land is then rinsed with deionized water under localized forced circulation.

The invention also provides an apparatus comprising a rotatable turret having a plurality of radially extending support arms for holding faceplate panel sections in an inverted position with the sealing land extending downwardly. A plurality of stationary operating positions are circumferentially spaced around the turret. The apparatus has means for rotating the turret and sequentially indexing the support arms in cooperative relationship with the operating stations. The apparatus also has an ultrasonic cleaning apparatus at one of the stations for receiving the sealing land of the faceplate panel sections held by the cooperating support arm in a liquid cleaning bath and for ultrasonically agitating the cleaning bath, and a rinsing apparatus at a subsequent operating station for receiving the sealing land in deionized water and for effecting localized forced circulation of the deionized water at its interface with the sealing land.

BRIEF DESCRIPTION OF THE DRAWINGS

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. The invention, together with further objects and advantages thereof, may best be undestood by reference to the following description taken in connection with the accompanying drawings, in the several figures of which like reference numerals identify like elements, and in which:

FIG. 1 is a top view of a cleaning machine embodying the invention;

FIG. 2 is a cross-sectional view, taken on line 2—2 of FIG. 1;

FIG. 3 is a top view of the ultrasonic cleaning apparatus at one of the operating stations of the machine of FIG. 1;

FIG. 4 is a cross-sectional view, partly cut away, taken on line 4—4 of FIG. 3;

FIG. 5 is a top view of the rinsing apparatus at another operating station of the machine of FIG. 1;

FIG. 6 is a fragmentary cross-sectional view, partially cut away, taken on line 6—6 of FIG. 5; and

FIG. 7 is a side view, partially cut away, of the vacuum

drying apparatus at still another operating station of the machine of FIG. 1.

The machine of FIG. 1 has a rotatable turret having six radially extending support arms **1–6** and a corresponding number of stationary operating stations I–VI respectively. If desired, a different number of arms and operating stations may be selected to suit the individual requirements of the manufacturing installation.

The turret includes a hub **7** which rotates about a stationary post **8** in a clockwise direction and is sequentially indexed for every 60-degree rotation, in cooperative relationship with the operating stations. This enables each panel section to stop sequentially at each individual operating station of the machine, the indexing time being sufficient for the process at each station to be completed.

The six process stations of this preferred embodiment are load station I where the panel is loaded onto the machine, wash station II where the sealing land of the screen undergoes a preliminary wash to remove large pieces of dirt, ultrasonic clean station III where the sealing land is ultrasonically cleaned to completely clean the sealing land of the screen, rinse station IV where the sealing land of the panel is rinsed with deionized water, vacuum dry station V where the deionized water left from the rinse station is removed by vacuum means, and unload station VI where the panel is unloaded.

A typical faceplate panel **9** is shown suspended from the support arm at load station I. The screen is suspended in an inverted position with its sealing land extending downwardly from the end of the support arm and is held by a suction cup **10** which can be more clearly seen in FIG. 2. The machine, as it rotates, suspends the screens above the processing stations until its indexing point is reached. Then the machine arms lower so that the panels may be processed in their respective operating stations, as shown in FIG. 2. The machine arms attached to hub **7** are raised and lowered by the mechanism comprising an eccentric cam **17** which pushes up and controls the downward motion of a pivot arm **18** which is pivoted to a support member **15**. Wheel **27** at the end of pivot arm **18** is fitted between flanges **20** and **21** of collar **19** of hub **7**. When an indexing point is reached, cam **17** rotates thus controlling the speed in which the turret descends by retarding the pull of gravity on the turret with pivot arm **18**.

When the machine is at the lowered position, the panels are processed at their respective operating stations. During each indexing, when the machine is at its lowered position, a panel is loaded and unloaded.

Panel **9** has been placed on load table **26** and is loaded onto the machine by air piston **14** which pushes the load table upward so that panel **9** comes into contact with suction cup **10**. Then, load table **26** is lowered leaving panel **9** suspended by suction cup **10**. After sufficient time has elapsed for the individual panel processes to be completed, hub **7** is pushed up stationary post **8** by the mechanism of cam **17**, pivot arm **18**, and support member **15**. Once cam **17** has turned sufficiently to raise the turret to its maximum height and allow the panels suspended from each arm to clear the various operating stations, the machine is then rotated another 60° until the next indexing point is reached. When the next indexing point is reached, indexing pin **11** contacts solenoid lever **16** making solenoid **13** stop the rotation of the machine and actuate cam **17** so that the arms of the machine may once again be lowered. The indexing interval can be adjusted to match the rate of the overall manufacturing process.

The rotation of the machine is accomplished by motor **23** which is coupled through gear reducer **24** to drive output gear **21**. Output gear **21** is coupled to turret gear **12** to rotate the turret around.

The ultrasonic cleaning apparatus **28**, as shown in FIGS. 3 and 4, comprises a dual-cavity tank having an outer cavity **29** and an inner cavity **30**. Outer cavity **29** contains water and inner cavity **30** contains an acidic ultrasonic cleaning bath of approximately 2% hydrofluoric acid, .2% sulfuric acid and 97.8% water. The water contained in outer cavity **29** provides a safety feature which protects the other parts of the machine in the event that inner cavity **30** should suffer a leak by diluting any acid which escapes from inner cavity **30**.

Ultrasonic transducers **31** are in contact with the bottom of ultrasonic cleaning tank **28** and may be of any known construction. They set up ultrasonic waves which are transmitted through the water of outer cavity **29** to the acid cleaning bath.

Panel **9** suspended from suction cup **10** is shown in its lowered position in ultrasonic cleaning apparatus **28**. The immersion depth of the sealing land **22** at the edge of panel **9** during the ultrasonic cleaning operation is approximately ⅛ inch which is held constant by an overflow pipe **32** and the lowered position repeatability of the machine. Any cleaning solution which runs off into overflow pipe **32** is circulated through a filter (not shown) and then introduced back into the inner tank **30**. This provides a constant level of cleaning solution which is relatively free of residue.

Air outlet **33** prevents an air pocket from forming within the panel when it is lowered into the cleaning solution, thus allowing the sealing land to break through the surface of the cleaning solution and ducting out the air from within the panel which is displaced by the cleaning bath.

The apparatus used for the preliminary wash of the panel is identical to the ultrasonic cleaning apparatus just described. It has been discovered that if the panel is air-baked, for example at 450° F. for 30 minutes prior to the preliminary wash operation, more effective sealing land cleaning results.

The rinsing apparatus **34**, which is used at rinse station IV comprises a single-cavity tank containing deionized water maintained at a constant level by an overflow pipe **36** (FIG. 5). The rinsing apparatus, like the ultrasonic cleaning apparatus, is provided with an air outlet pipe **37** which ducts the air displaced by the deionized water when the sealing land is lowered into the tank. Water jets **35** are positioned below the surface of the deionized water and are arranged to conform to the periphery of the faceplate panel **9**. Jets **35** spray deionized water upwards to create localized forced circulation around the sealing land **22** for optimum rinsing effectiveness. This can be more clearly seen in FIG. 6. Panel **9** is in its lowered position suspended from suction cup **10** and is immersed in the deionized water at a depth of approximately ¼ inch.

After cleaning and rinsing, the panel is transported to the vacuum dry apparatus of FIG. 7. Panel **9** is suspended from suction cup **10** over vacuum heads **51**. Base **39** supports cam plate **40**. Guide rod **42** is provided with blocks **41** which are held against cam plate **40** by spring **43**. Cam plate **40** has the same peripheral size and shape as faceplate panel **9**. Therefore, as guide rod **42** rotates, blocks **41** travel along cam plate **40** causing air jets **51** to travel along the periphery of panel **9**. Guide rod **42** is rotated by shaft **50** which is turned by the combination of motor **44**, gear reducer **45**, pulley **46**, belt **48** and pulley **47**. Vacuum hose **52** is connected to slip joint **49** and provides the vacuum for jets **51**. After completion of the vacuum drying operation, which avoids any possibility of contamination by airborne foreign particles as in prior forced-air drying procedures, the panel is transported to unload station VI where it is taken from the machine and is ready to be frit sealed to the remaining envelope section which contains the electron gun system for completion of the tube.

The present invention provides a novel apparatus for cleaning the sealing land of a faceplate panel section for a cathode-ray tube which is economical and avoids human error. The described apparatus replaces four full-time experienced human operators. Ultrasonic cleaning, followed by rinsing with forced local circulation and vacuum dry-

ing, reduces the number of cathode-ray tubes destroyed under high-voltage operation by two-thirds.

While a particular embodiment of the invention has been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from the invention in its broader aspects and, therefore, the aim in the appended claims is to cover all such changes and modifications as fall within the true spirit and scope of the invention.

I claim:

1. In the manufacture of a cathode-ray tube of the type comprising a glass faceplate panel section which has a sealing land to be frit sealed to another envelope section containing an electron gun system for energizing a phosphor screen deposited on said faceplate panel section, the method of substantially preventing localized failure of the frit seal between said sections upon high voltage operation of the completed tube, which method comprises:

forming said phosphor screen on said glass faceplate panel section;

thereafter dipping only the sealing land of said panel section in a liquid cleaning bath and ultrasonically agitating said cleaning bath to remove residue from the screen forming process from said sealing land;

and rinsing said sealing land with deionized water under localized forced circulation.

2. A method of manufacturing a cathode-ray tube in accordance with claim 1, which comprises the additional step of vacuum drying said sealing land after rinsing with deionized water.

3. A method of manufacturing a cathode-ray tube in accordance with claim 1, which comprises the step of air-baking said panel section after formation of the phosphor screen but prior to dipping the sealing land in said liquid cleaning bath.

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EDWARD G. WHITBY, Primary Examiner

U.S. Cl. X.R.

117—102 R, 113, DIG. 8; 134—79