

[54] **METHOD FOR FILLING AN
EVACUATED ELECTRON TUBE WITH
GAS TO ATMOSPHERIC PRESSURE**

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[51] Int. Cl. **H01J 9/50**
[58] Field of Search **316/2, 1, 24; 29/413, 427; 53/7, 35**

[56] **References Cited**

UNITED STATES PATENTS

2,730,472 1/1956 Osborn, Jr. 29/413
3,124,872 3/1964 Knodel, Jr. 29/413

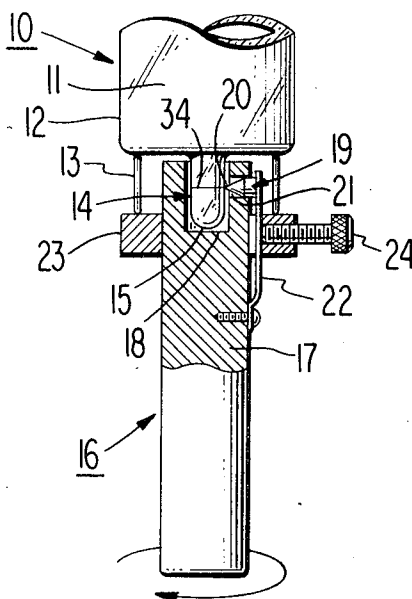
3,316,685 5/1967 Hansel 29/413 X
3,390,033 6/1968 Brown 29/427 X
3,404,933 10/1968 Weideman 316/2

Primary Examiner—John F. Campbell
Assistant Examiner—Richard Bernard Lazarus
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[57] **ABSTRACT**

Method includes scribing a circumferential cut on the glass exhaust tubulation of an electron tube, positioning the tubulation inside a close-fitting, closed chamber, cracking the tubulation on the cut, and slowly filling the chamber and tube with gas at a low rate of inflow to atmospheric pressure. Apparatus includes a close-fitting, closed chamber having a flexible portion that seals over the tubulation, a solid portion that closely fits over the tubulation, and a means to fill the tube and chamber with gas at a low rate of inflow to atmospheric pressure.

3 Claims, 3 Drawing Figures



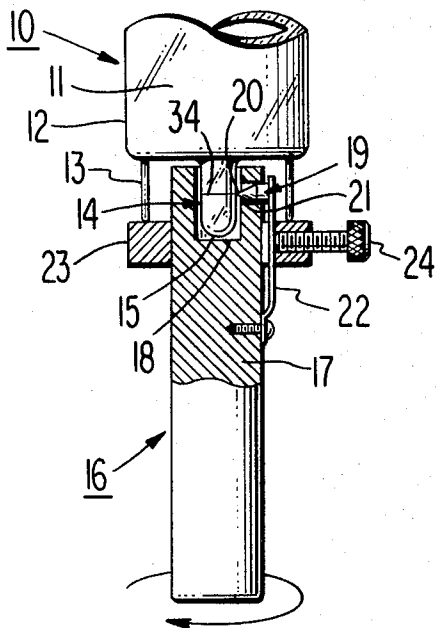


Fig. 1.

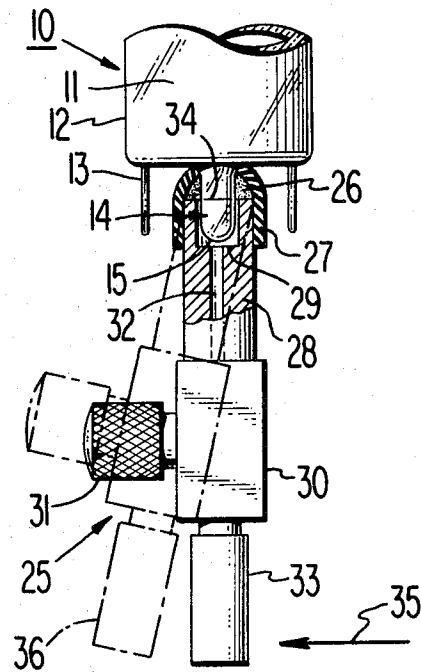


Fig. 2.

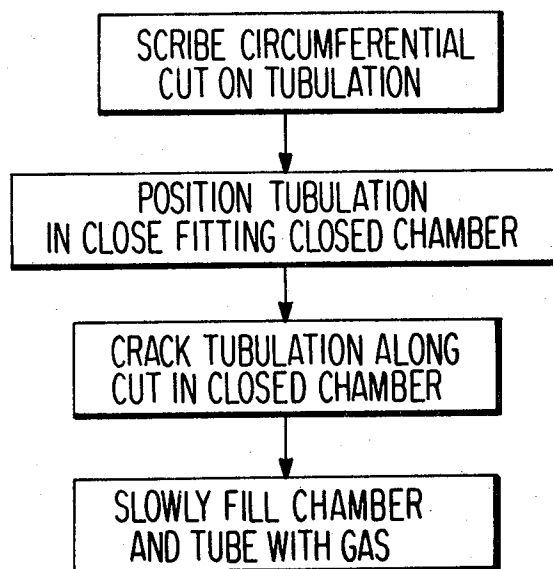


Fig. 3.

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METHOD FOR FILLING AN EVACUATED ELECTRON TUBE WITH GAS TO ATMOSPHERIC PRESSURE

BACKGROUND OF THE INVENTION

This invention relates to a novel method for filling an evacuated electron tube with gas to atmospheric pressure during the repairing of a defective tube. The invention relates particularly, but not exclusively, to a novel method for opening an evacuated cathode-ray tube of the aperture-mask type to air at atmospheric pressure so that the tube may be regunned.

In one prior method for opening an evacuated cathode-ray tube described in U.S. Pat. No. 3,063,777 to A. M. Trax, a portion of the neck is cracked off with a hot wire and discarded. Cracking off the neck permits entry of gas at atmospheric pressure. When this method is applied to regunning shadow-mask-type color-television-picture tubes, the gas enters so rapidly that glass particles obtained from cracking the neck may be swept into the tube and may result in blocked mask apertures.

In a second method for opening an evacuated cathode-ray tube described in U.S. Pat. No. 3,404,933 to R. J. Weideman, a portion of the tube and the tipoff tabulation are positioned in a chamber. The chamber is evacuated, after which the tabulation is broken by impact from a pointed end of a plunger. A dry inert noncontaminating gas is then admitted into the evacuated envelope. This second prior method requires evacuation equipment since a substantially large chamber must be evacuated. Only after the chamber is evacuated may the exhaust tubulation be broken in order to prevent particles from being swept into the opened tube by the inrush of gas at atmospheric pressure. In addition, when the tubulation is broken by impact from a plunger, many small glass particles are generated, some of which may enter the tube as a result of the impact force of the plunger and be further swept into the tube during gas filling of the tube. These particles may contaminate the tube, which may result in defective performance of the tube after reevacuation.

SUMMARY OF THE INVENTION

The novel method includes scribing or otherwise making a circumferential cut on the glass exhaust tubulation of an electron tube, positioning the tubulation inside a close-fitting, closed chamber, cracking the tubulation on the cut, and slowly filling the tube with gas at a low rate of inflow to atmospheric pressure.

Unlike the prior methods, the exhaust tubulation of the tube is placed in a small close-fitting, closed chamber containing a small internal gas volume. By enclosing the tubulation in a close-fitting, closed chamber having a minimum volume, no substantial inrush of gas occurs upon opening the tube in the chamber, and there is no requirement to evacuate the chamber to prevent an initial inrush of gas.

In addition, the novel process provides for opening the tube by cracking the tubulation on a previously prepared cut. By cracking the tubulation on the cut, a minimal quantity of glass particles is formed. By cracking the tubulation inside the close-fitting chamber, particles are not swept inside the tube from the initial inrush of gas, thereby avoiding blocking of the mask apertures and particle contamination. This novel process permits cost reduction in opening of evacuated tubes for repair by obviating the need for evacuation equipment, an evacuated chamber, or a gas filled chamber, resulting in more economical rebuilding of electron tubes.

The novel apparatus includes a means for cracking the tubulation comprising a closed chamber having a flexible portion and a solid portion. The flexible portion seals over the tubulation, and the solid portion fits over the tubulation substantially conforming and closely spaced from the tubulation. The apparatus includes a means to fill the tube chamber at a substantially low rate of inflow to atmospheric air pressure. The novel apparatus is of a simple structure, which is economical to operate and maintain.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional elevational view of a scribing assembly used in practicing the novel method.

FIG. 2 is an elevational view, partially in broken sections, of a tube-filling assembly used in practicing the novel method.

FIG. 3 is a flow diagram showing the steps of the novel method.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 and FIG. 2 include the bottom portion of an electron tube 10 (partially shown) having a glass envelope 11 including a neck 12, stem leads 13, and glass exhaust tubulation 14 with tipoff 15 positioned in apparatus for opening the tube 10 to air at atmospheric pressure.

The apparatus shown in FIG. 1 is a tubulation-scribing assembly 16. The scribing assembly 16 includes a handle 17 having a handle hole 18 in one end slightly larger than the maximum diameter of the tubulation 14. A cutting tool 19 having a cutting point 20 extends through the handle 17 in a radial hole 21. The scribing assembly 16 includes a means for radially moving the cutting tool 19 in the radial hole 21 comprising a spring 22 attached between the cutting tool 19 and the handle 17 and a collar 23 mounted over the handle 17 having a spring adjustment 24 in contact with the spring 22. The collar 23 also slides axially on the handle 17 to act as an adjustable stop when against the stem leads 13.

Referring to FIG. 2, a tube-filling assembly 25 includes a small, close-fitting hermetic chamber 26 formed by a flexible tubular portion 27 and a cylindrical rigid portion 28. The flexible portion 27 has a slightly smaller inner diameter than the outer diameter of the tubulation 14. One end of the flexible portion 27 is stretched to fit over the tubulation 27, and the other end is stretched to fit over the rigid portion 28. The rigid portion 28 has an axial hole 29 in one end of slightly larger diameter than the maximum diameter of the tubulation 14.

In the preferred embodiment, the diameter of the tubulation 14 is in the range of 0.349 - 0.365 inch, the inner diameter of the flexible portion 27 is approximately one-fourth inch, the wall thickness of the flexible portion 27 is approximately one-sixteenth inch, and the diameter of the axial hole 29 is approximately three-eighths inch. The flexible portion 27 may be a rubber or plastic tubing. The preferred tubing is marketed by U.S. Stoneware Inc., Akron, Ohio, under the trade name "tygon" flexible plastic tubing. A needle valve 30 having a flow-control knob 31 is attached to the other end of the rigid portion 28. An axial passage 32 connects the axial hole 29 and the needle valve 30. An air filter 33 is connected to the other end of the needle valve 30.

In the operation of the apparatus, the steps of the novel method are shown in FIG. 3. The tubulation-scribing assembly 16 shown in FIG. 1 is positioned with the handle hole 18 over the tubulation 14, the collar 23 in contact with the end of the stem leads 13, and the cutting point against the side of the tubulation 14. The spring adjustment 24 is then rotated to apply pressure on the spring 22 to maintain the cutting point 20 in contact with the side of the tubulation 14. The scribing assembly 16 is then rotated, making a circumferential cut 34 on the outer surface of the tubulation 14. It is preferred that the circumferential cut 34 be about half way the length of the tubulation 14.

After the circumferential cut 34 is made, the scribing assembly 16 is removed from the tubulation 14, and the filling assembly 25 is placed over the tubulation 14, as shown in FIG. 2, with the tubulation 14 positioned in the chamber 26. In this position, the axial hole 29 in the rigid portion 28 fits over the tubulation 14 enclosing the tubulation 14 between the cut 34 and the tipoff 15. The flexible portion 27 fits over the tubulation 14, between the cut 34 and the neck 12, sealing against the tubulation 14, making the chamber 26 airtight. The open end of the flexible portion 27 also contacts the end of the neck 12 to position the end of the rigid portion 28 approximately aligned with or slightly below the cut 34.

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With the tubulation 14 in the chamber 26 and the needle valve 30 closed, the tubulation 14 is cracked at the cut 34 by supporting the tube 10 and applying a traverse pressure on the tube-filling assembly 25 as shown by the direction arrow 35. This traverse pressure moves the filling assembly 25 to the position 36 (shown in phantom), which cracks the tubulation 14 completely through at the cut 34.

Since the tube is opened only to a small, close-fitting hermetic chamber, substantially no inrush of air occurs. In addition, by cracking on the previously prepared cut 34, a minimum number of particles are created. The needle valve 30 is then opened by rotating the knob 31 to slowly admit air into the chamber 26 and tube, subsequently filling the tube 10 with air to atmospheric pressure. The needle valve 30 is adjusted to slowly bleed air into the tube 10 and chamber 26 at a low inflow rate to atmospheric pressure. It is preferred that the inflow for a 25-inch color-picture tube fill the tube with air in 30 minutes minimum, and preferably longer to prevent particles from being swept inside the tube 10.

I claim:

1. A method for opening to a gas at atmospheric pressure an evacuated electron tube including an envelope having a glass

exhaust tubulation with tipoff projecting therefrom comprising the steps of:

1. making a circumferential cut on said tubulation, said cut about midway the length of said tubulation,
2. positioning said tubulation with said cut portion contained within a close-fitting, closed hermetic chamber,
3. cracking said tubulation along said cut in said closed chamber,
4. and slowly filling said chamber and tube with said gas at a low inflow rate.

2. The method defined in claim 1 wherein said chamber includes a flexible portion and a rigid portion, said flexible portion sealing with said tubulation between said cut and said glass envelope, and said rigid portion enclosing and substantially conforming to and spaced from said tabulation between said cut and said tipoff, and said cracking step comprises applying a traverse pressure on said rigid portion, said flexible portion distorting to remain sealed with said tubulation.

3. The method of claim 1 wherein said inflow rate fills said tube to atmospheric pressure in 30 minutes minimum time.

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