

MANUFACTURING COLOUR SCREEN STRUCTURES FOR CATHODE RAY TUBES

This invention relates to methods of manufacturing colour screen structures for cathode ray tubes (CRTs), to such structures and to CRTs including such structures.

A colour screen structure for a colour CRT, for example, a so-called aperture grill assembly as shown in Figure 6 of the accompanying drawings, may comprise an aperture grill member 9 formed of a thin metallic plate, such as a cold rolled thin steel plate, provided with a plurality of strips 7 defining slits 6 for passing electron beams therethrough. The plate is placed on a metallic frame 5 comprising a pair of opposite supporting members 1 and 2 and a pair of substantially U-shaped resilient connecting members 3 and 4 interconnecting the respective opposite ends of the supporting members 1 and 2. An external force is applied to the supporting members 1 and 2 so as to stress them towards each other by a fixed deflection, and a moderate tensile load is applied to the aperture grill member 9 to hold it tight with respect to the Y directions. The aperture grill member 9 is then seam welded to the supporting members 1 and 2, the external force is removed, and then the unnecessary peripheral portions 8 of the aperture grill member 9 are removed. The aperture grill member 9 is provided with slots 10 in the opposite sides thereof, outside the central region. The respective upper surfaces of the supporting members 1 and 2 of the frame 5 in contact with the aperture grill member 9 have a radius of curvature R_z and the respective outer side surfaces of the supporting members 1 and 2 have a radius of curvature R_y .

In the usual method of manufacturing such a colour screen structure, the peripheral portions 8 of the aperture grill member 9 are removed by shearing the aperture grill member 9 with a roller cutter 11 as shown in Figure 7 of the accompanying drawings. In cutting the aperture grill member 9, the reduced portion of the roller cutter 11 rolls along the curved surface of the aperture grill member 9 and cuts off the peripheral portion 8 by shearing the aperture grill member 9 between the cutting edge thereof and the corner of the supporting member 1 and 2. In such cutting, it is possible that metallic scraps, such as burrs 13, form in the cut surface of the aperture grill member

9 as shown in Figure 7, and/or chips 14 are produced due to an inappropriate combination of the size of the frame 5 and the roller cutter 11, variation in the inclination $\ominus$ of the side walls of the supporting members 1 and 2, or the use of an abraded roller cutter 11.

5 These metallic scraps may stick firmly to the aperture grill assembly 9, be not removed completely from the aperture grill assembly 9 by the subsequent washing and demagnetizing processes and, in the worst cases, remain on the aperture grill assembly 9 even after it has been placed within the vacuum interior of a CRT, so causing a discharge which

10 deteriorates the voltage rating of the CRT.

It is also possible to tear off the peripheral portions 8 along a welded seam 16, as shown in Figure 8 of the accompanying drawings, by taking advantage of the strength of the welded seam 16, after seam-welding the aperture grill member 9 to the frame 5. This method

15 does not produce metallic scraps. However, since the tearing force necessary for tearing off the peripheral portions 8 is proportional to the thickness of the aperture grill member 9, the larger the aperture grill member 9, the greater the tearing force required. Moreover, this method requires scrupulous attention to the quality of the weld, and to

20 abrasion caused by the welding electrode roller.

According to the present invention there is provided a method of manufacturing a colour screen structure for a cathode ray tube, the method comprising the steps of:

forming a frame by placing a pair of supporting members substantially

25 parallel to each other and interconnecting the respective opposite ends of the supporting members by a pair of connecting members;

forming, in a peripheral portion of a colour screen member having a plurality of parallel slits in a colour screen region thereof and a pair of slots outside and parallel to the slits, a pair of grooves so

30 as to extend respectively along lines corresponding to the upper edges of the pair of supporting members;

welding the colour screen member to the pair of supporting members of the frame at such a location that the grooves of the colour screen member are spaced from the welds and extend respectively along the

35 outer upper edges of the supporting member; and

tearing off the unnecessary peripheral portions of the colour screen member along the grooves.

The grooves may be formed with a uniform width and uniform depth along the contour of the frame in a curve having a radius of curvature corresponding to the radius of curvature of the frame. The depth d of the grooves is in the range of 20 to 50%, preferably 22 to 40%, of the thickness t of the colour screen member, and the width w of the grooves is about 100 μ m.

Thus, since the grooves are previously formed in the colour screen member, and the peripheral portions are torn off along the grooves after welding the aperture grill member to the frame, the tearing force necessary is only about one-tenth of that necessary for tearing off the peripheral portions along the welded seam in the foregoing method. Moreover, the peripheral portions can properly be torn off regardless of the inclination of the side walls of the supporting members.

The invention will now be described by way of example with reference to the accompanying drawings, throughout which like parts are referred to by like references, and in which:

Figure 1 is a perspective view for explaining an embodiment of a method of manufacturing a colour screen structure for a CRT according to the invention;

Figure 2 is a sectional view of part of Figure 1;

Figure 3 is a plan view of a colour screen member;

Figure 4 is an enlarged fragmentary plan view showing a portion A of Figure 3;

Figure 5 is a fragmentary sectional view of part of a colour screen member;

Figure 6 is a perspective view of a colour screen structure of previously proposed kind;

Figure 7 is a fragmentary perspective view of the colour screen structure of Figure 6; and

Figure 8 is another fragmentary sectional view of a colour screen structure of previously proposed kind.

Referring to Figure 1, there are shown a frame 5 comprising a pair of opposite supporting members 1 and 2 and substantially U-shaped resilient connecting members 3 and 4 fixedly interconnecting the opposite ends of the supporting members 1 and 2, and an aperture grill member 21 attached to the frame 5. As shown in Figures 3 and 4, the

aperture grill member 21 is formed of a thin metallic plate, such as a cold rolled thin steel plate, and is provided with an arrangement of a plurality of parallel vertical slits 6 defined by a plurality of narrow metallic strips 7 vertically extending from the upper and lower peripheral portions 8 of the aperture grill member 21. Slots 22A and 22B having a length sufficiently longer than that of the strips 7 are formed in the aperture grill member 21 outside the respective opposite outermost slits 6. Grooves 23 are formed in the rear of the aperture grill member 21, so as to extend along the outer edges of the supporting members 1 and 2 respectively, between the opposite ends of the slots 22A and 22B in a curve having a radius corresponding to the radius of curvature R_y . The opposite ends of the grooves 23 merge into the corresponding end portions of the slots 22A and 22B. In this embodiment, the aperture grill member 21 has a thickness t of 0.1 mm and the grooves 23 have a depth d of 0.4 t , and a width w of 0.1 mm (Figure 5).

As shown in Figure 4, the slots 22A and 22B extend parallel to the slits 6, and the opposite end portions of the slots 22A and 22B extending outside the extremities of the slits 6 are offset outwards and have a width greater than the width x_0 of the intermediate portions extending alongside the slits 6. The slits 6 and the slots 22A and 22B are formed by an etching process. The intermediate portions of the slots 22A and 22B are formed with the relatively small width x_0 , so that a reduced amount of sediment is produced informing the slots 22A and 22B, to prevent the slits 6 from being clogged with the sediment produced in etching the slots 22A and 22B. Bends at the junction of the intermediate portion and the end portion of each of the slots 22A and 22B project to form recesses 24 to reduce the strength of elongate portions 25 of the aperture grill member 21, respectively extending alongside the intermediate portions of the slots 22A and 22B. Accordingly, elongate marginal portions 26 of the aperture grill member 21, respectively extending alongside the outermost slits 6 are not damaged by the elongate portions 25 in tearing off the unnecessary peripheral portions 8, even if the elongate portions 25 touch the elongate marginal portions 26.

The slits 6, the slots 22A and 22B and the grooves 23 are formed simultaneously by a selective etching process. As shown in Figure 5,

both sides of a thin metallic plate 27 for forming the aperture grill member 21 are etched to form the slits 6 and the slots 22A and 22B simultaneously, while the grooves 23 are formed by etching the rear of the plate 27. Accordingly, the grooves 23 can be formed in the aperture grill member 21 without requiring any additional process. The grooves 23 can thus be formed in a depth d and a width w with an accuracy of $\pm 10\mu\text{m}$.

In assembling the colour screen structure, an external force is applied to the supporting members 1 and 2 of the frame 5 to deflect the supporting members 1 and 2 towards each other by a fixed deflection, the aperture grill member 21 is placed on the supporting members 1 and 2 with a tensile force applied thereto in directions Y to hold it tight, and then it is seam-welded to the supporting members 1 and 2. In Figure 1, welded seams 16 are shown. After welding the aperture grill member 21 to the frame 5, the external force is removed from the supporting members 1 and 2, and then a tearing force F of about 300g is applied to the aperture grill member 21 to tear off the unnecessary peripheral portions 8 along the grooves 23. In this embodiment, the opposite ends of the grooves 23 merge into the slots 22A and 22B. However, if the bottom walls of the grooves 23 are unable to withstand a tensile stress of at least $10\text{kg}/\text{m}^2$, which is applied to the aperture grill member 21 in extending it on the frame 5, the opposite ends of the grooves 23 may be terminated before the slots 22A and 22B to form ungrooved portions having a width l (Figure 4) in the range of 0.2 to 1 mm between the opposite ends of the grooves 23 and the slots 22A and 22B.

Preferably, the depth d of the grooves 23 is $30\mu\text{m}$ or less when the thickness t of the aperture grill member 21 is $80\mu\text{m}$, and is $40\mu\text{m}$ or less when the thickness t is $180\mu\text{m}$.

Thus, the unnecessary peripheral portions 8 of the aperture grill member 21 can be torn off along the grooves 23 extending along the outer upper edges of the supporting member 1 and 2 simply by applying a small tearing force of about 300g to the aperture grill member 21 without producing metallic scraps such as burrs and chips, after welding the aperture grill member 21 to the supporting members 1 and 2 of the frame 5.

Embodiments of the invention may have the following advantages.

Tearing the unnecessary peripheral portions 8 parallel to the welded seams 16 by the method shown in Figure 1 requires a very small tearing force, which is approximately one-tenth of the tearing force in the range of 3 to 5kg required by the method described with reference to Figure 8. Accordingly, the method does not require a large investment in equipment but merely modification of the existing manufacturing equipment.

Since the method is simple and stable, the yield of the product is improved.

10 Whereas the inclination θ of the outer side walls of the supporting members 1 and 2 of the frame 5 must be controlled strictly in carrying out the method described with reference to Figure 7 employing the roller cutter 11, this is not necessary with the present method.

15 Furthermore, whereas using the roller cutter 11 for shearing off the unnecessary peripheral portions 8 as shown in Figure 7 inevitably entails metallic scraps adhering to the aperture grill member 9 being scattered over the working area, and dropping into the washing tank of the subsequent washing process causing pollution of the washing liquid, 20 this is avoided with the present method.

Moreover, since no roller cutter 11 is used, the present method eliminates the work of inspecting and repairing the cutting edge of the roller cutter 11.

CLAIMS

1. A method of manufacturing a colour screen structure for a cathode ray tube, the method comprising the steps of:
 - 5 forming a frame by placing a pair of supporting members substantially parallel to each other and interconnecting the respective opposite ends of the supporting members by a pair of connecting members;
 - forming, in a peripheral portion of a colour screen member having a plurality of parallel slits in a colour screen region thereof and a pair of slots outside and parallel to the slits, a pair of grooves so as to extend respectively along lines corresponding to the upper edges of the pair of supporting members;
 - 10 welding the colour screen member to the pair of supporting members of the frame at such a location that the grooves of the colour screen member are spaced from the welds and extend respectively along the outer upper edges of the supporting member; and
 - 15 tearing off the unnecessary peripheral portions of the colour screen member along the grooves.
- 20 2. A method according to claim 1 wherein said grooves are formed in the rear of the colour screen member.
3. A method according to claim 1 or claim 2 wherein the opposite ends of each groove merge into the slots.
- 25 4. A method according to claim 1 or claim 2 wherein the opposite ends of each groove terminate before the respective slots.
5. A method according to any one of the preceding claims wherein the grooves are formed by etching.
- 30 6. A method according to any one of the preceding claims wherein the slots are formed by etching.
- 35 7. A method of manufacturing a colour screen structure for a cathode ray tube, the method being substantially as hereinbefore described with reference to Figures 1 to 5 of the accompanying drawings.



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8. A colour screen structure made by a method according to any one of the preceding claims.

9. A cathode ray tube including a colour screen structure according
5 to claim 8.
