April 30, 1968 J. H. JOHNSON 3,381,156

ELECTRODES FOR CATHODE RAY TUBES WITH ABUTTED ENDS MEETING IN A SEAM

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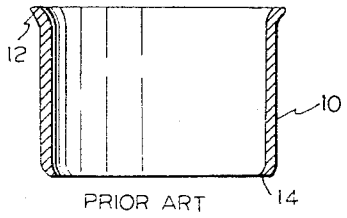

PRIOR ART

FIG.1

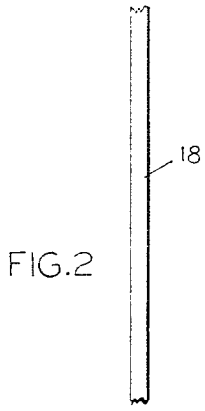

FIG.2

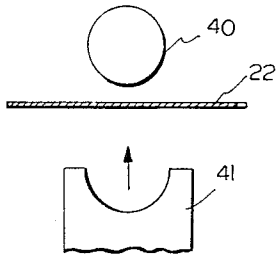

FIG.5

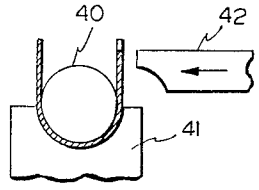

FIG.6

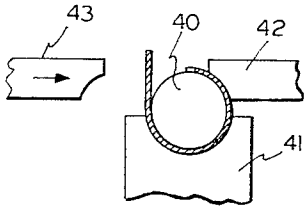

FIG.7

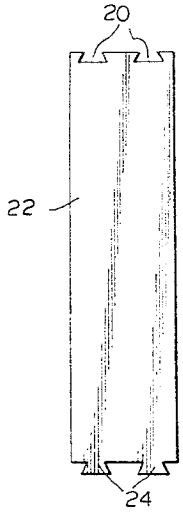

FIG.3

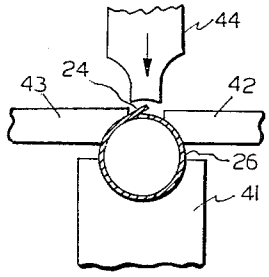

FIG.8

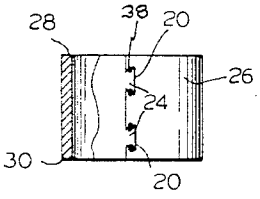

FIG.4

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ELECTRODES FOR CATHODE RAY TUBES WITH ABUTTED ENDS MEETING IN A SEAM

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Continuation-in-part of application Ser. No. 221,601, Sept. 5, 1962. This application Dec. 30, 1965, Ser. No. 517,679

1 Claim. (Cl. 313—82)

ABSTRACT OF THE DISCLOSURE

Improved structure for cathode ray tube electrodes is disclosed, wherein the electrode is formed from a flat strip having edges rounded to eliminate burrs and being rolled around a mandrel to form a cylindrical body through which the electron beam passes, with ends abutting at a single seam generally aligned along the beam path.

This application is a continuation-in-part of my copending applications Ser. No. 221,600 and Ser. No. 221,601, filed Sept. 5, 1962, now respectively U.S. Patent No. 3,231,959 and abandoned.

This invention relates to the manufacture of parts for electron tubes and more particularly, to forming cylindrical electrodes for electron guns in cathode ray tubes.

In the prior art, various methods were employed to fabricate annular focusing anodes for electron guns which have been conventionally formed heretofore of seamless cylindrical stock. For example, one such method of forming a cylindrical electrode such as the focusing anode is to form a cup from strip material on an eyelet machine by puncturing the strip before forming it in a progressive die-drawing operation. Next, the upper flange of the cup is trimmed to proper dimension and then the bottom of the cup is pierced to complete the annular ring. When the upper flange is trimmed, an outer lip is produced. The piercing of the end wall of the cup leaves a lip on the lower flange or opposite flange of the anode. These irregularities tend to cause an out of roundness which disturbs proper beam-shaping operation, for example, in the case of a cylindrical focus anode, because they produce irregularities in the electrostatic field surrounding the anode so that the field along the axis of the cylinder is irregular. Furthermore, any sharp edges or projections can cause corona since some of the electrodes are operated at very high potential.

In addition to other defects of electrodes made by prior art methods which produce difficulty in meeting roundness and dimensional tolerances, a simpler more efficient manufacturing technique is desirable to reduce the possibility of rejects which increases when more processing steps are introduced. Also a method of manufacturing electrodes is desirable which does not involve the use of tools and dies in formation of critical tolerance dimensions such as roundness which are subject to significant wear and deformation by abrasive action against the parts when they are drawn or reshaped.

An object of the invention is to produce an electrode formed from a single flat metal blank formed into a cylinder and secured along a seam joining the ends of the blank which extends in a direction generally the same as the electron beam passing through the electrode.

Briefly, in accordance with aspects of this invention, I provide a cylindrical electrode member with a seam extending along the direction of beam travel, which I find does not interfere with processing of the beam, and thus obviates the disadvantages of the prior art methods of

cylindrical electrode construction by forming a flat blank the desired length, rolling the blank into a cylinder and joining it at the ends by any convenient means such as by an interlocking arrangement of teeth and notches. When the blank is formed by rolling from a round wire or rod, the edges are rounded without further processing and undesirable lip structure on the edge of the annular ring produced by the prior art methods is eliminated.

These and various other objects and features of the invention are set forth in the detailed description of the invention with reference to the accompanying drawing in which:

FIGURE 1 is a view in section of an annular anode produced by the above described prior art method;

FIGURE 2 is a view in elevation of a rod employed in this novel method;

FIGURE 3 is a blank formed from the rod of FIGURE 2 and including interlock structure for joining the ends of the blank;

FIGURE 4 is a side view of an annular ring formed from a flat blank such as shown in FIGURE 3; and

FIGURES 5 through 8 show typical tools for forming the cylinder from a flat blank in a typical operational sequence.

Referring now to FIGURE 1, there is depicted a view in section of an annular ring **10** formed by the prior art method described above. This ring **10** has an outer lip **12** on one edge and an inner lip **14** on the opposite edge. The lip **12** is formed when this edge is trimmed. The lip **14** is formed when the end wall of the cup is pierced to define an annular ring. In each instance, the flange must be subsequently machined to a very close tolerance. In addition, to the elimination of the lips **12** and **14**, the internal and external diameters of focus anodes must be held within close tolerances for the entire length of the ring and it has been difficult to maintain tolerances of ±.001 on both internal and external diameters for the entire length of the ring under the prior art.

The novel focus ring according to this invention remains within an out-of-round tolerance of ±.001 both before and after firing (heat-treating to remove impurities and gas from the ring prior to assembly of the cathode ray tube) even when fired in a bulk container. The prior art focus rings are work-hardened and subjected to stresses by the repeated drawing and machining process. Unless they are individually stacked for firing, the hardening and stresses tend to be relieved unevenly and cause the rings to become misshapen. They cannot, therefore, be fired as simply in bulk to meet the exacting roundness tolerances imposed upon electrodes for electron guns.

Referring now to FIGURE 2, there is depicted a rod or wire **18** which is employed in this novel method to produce an annular anode. The first step in this method is to roll and flatten a wire of proper diameter to produce the desired round edges (**28**, **30** FIGURE 4) while obtaining the desired flat blank having a typical width such as .500 inch±.005 inch and thickness of .025 inch. After the desired width is obtained, notches or grooves **20** preferably are cut in one end of the blank **22**, while interlock members or tongues **24** are cut on the opposite end of the blank. The blank **22** is now rolled over a suitable form, as later described to form annular ring **26** shown in FIGURE 4, with the interlocks **24** engaged in the notches **20** to secure the ends of the blank to each other thereby preventing any change of circumferential dimension during firing or use in an electron gun. The beam passes through this electrode in a general direction substantially the same as that of the seam.

Alternatively, the blank may be secured together by other structural methods such as abutting together non-interlocking tongues and grooves for securing by spot

welding together at the overlapped seams in the same manner as shown at 38 in FIGURE 4. It is noted, however, that the preferable construction of interlock members and notches prevents any misshaping of the cylindrical tolerances either by expansion or contraction due to heat expansion or other stresses over a more stable surface area than reliance upon the spot weld position alone. Thus, in interlocked structure of FIGURE 4 the spot weld serves to retain the interlock members against radial changes of the end portions to prevent any change in roundness during handling or assembly of the electrode and does not need to bear the greater circumferential stresses that may be imposed during heating of the electrode and its mounts in the tube or during processing.

With this novel method, both internal and external diameters of the annular ring 26 of .625 inch inner diameter easily can be held within tolerances of plus and minus .001 inch, which tolerances are not readily achieved by prior art methods. Further, because the blank 22 was rolled from a round wire 18, the edges 28 and 30 of the blank are round and thus, do not require subsequent machining to eliminate irregularities which might cause corona or out of roundness.

The flat electrode blank 22 is rolled over a cylindrical mandrel 40 by sequential movement of die members 41, 42, 43, and 44 in the manner illustrated in FIGURES 5 through 8. Note in FIGURE 7 that die 42 is inserted before die 43 to permit the interlock members 24 to overlap the top of the rolled cylindrical blank 26 of FIGURE 8, where they are pressed into fit by die members 44. Note that little abrasive action against the blank 22 is introduced by the rolling action. Thus, the present method causes little wear of the dies or mandrel, as distinguished over prior art methods of deep drawing or die-forming, and there results a manufacturing process which produces electrodes held more closely within tolerances over long periods of time.

Therefore, this invention has provided a new electrode configuration for cylindrical electron gun electrodes which have a seam along the region of abuttment of the ends of a single flat material blank wrapped into cylindrical form, together with methods of forming the electrode.

Contrary to possible exception, the seam produced by the abutting ends of the blank does not materially affect the action of the electrode upon the beam, since there is

no difference of potential on opposite sides of the seam to serve as a focusing member, it is generally oriented along the cylinder in the direction of beam travel and there is very little change of radial dimension of the cylinder to effect the beam passing through the cylindrical electrode by changing the field configuration at the position of the beam. Thus, it has been found that the seamed cylinder is an entirely satisfactory replacement for the prior art solid tubular equivalents.

Having therefore particularly described the advantages and nature of the invention and its method of operation, those features believed descriptive of the scope and spirit of the invention are set forth with particularity in the appended claims.

What is claimed is:

1. An electrode for processing an electron beam in the electron gun of a cathode ray tube comprising in combination, a thin flat blank shaped into a hollow electrode cylinder with a constant thickness wall and a cylindrical inner electrode surface of constant diameter for establishing a uniform inner electric field processing said beam through an obstructed longitudinal inner beam path through the cylinder with two ends of the blank meeting in abuttment at a single seam generally oriented longitudinally along the path of the beam through the inner surface, and structure securing the two ends of the blank together against any circumferential movement at the seam which might produce a change in the diameter of said internal electrode surface wherein the edges of the rectangular blank metal member are rounded.

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