

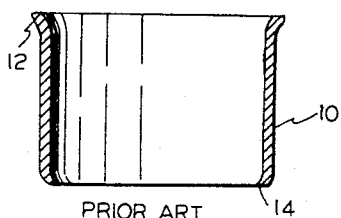
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3,442,008

METHODS OF MANUFACTURING ELECTRODES FOR CATHODE RAY TUBES

Original Filed Dec. 30, 1965



PRIOR ART

FIG. 1

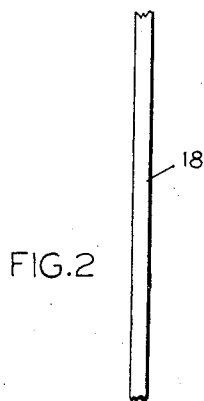


FIG. 2

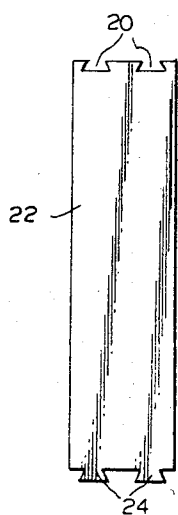


FIG. 3

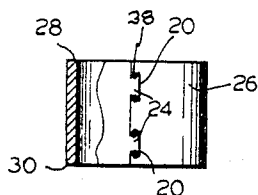


FIG. 4



FIG. 5



FIG. 6

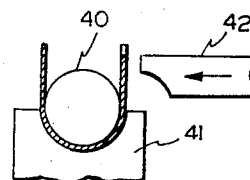


FIG. 7

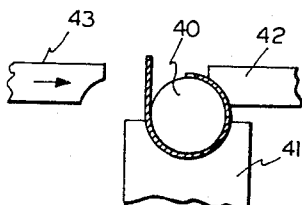
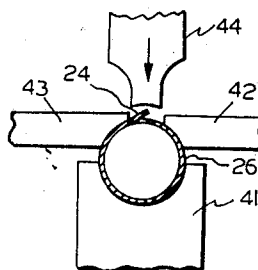


FIG. 8



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3,442,008

METHODS OF MANUFACTURING ELECTRODES FOR CATHODE RAY TUBES

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Application Dec. 30, 1965, Ser. No. 517,679, now Patent No. 3,381,156, dated Apr. 30, 1968, which is a continuation-in-part of applications Ser. No. 221,600, Sept. 5, 1962, and Ser. No. 221,601, Sept. 5, 1962. Divided and this application Jan. 8, 1968, Ser. No. 696,230

Int. Cl. H01j 9/02

U.S. Cl. 29—477

7 Claims

ABSTRACT OF THE DISCLOSURE

The method of forming cathode ray tube electrodes by rolling a thin flat blank into cylindrical form with two ends abutting at a seam is disclosed. The seam may be notched or welded to interlock and the blank may have its edges rounded to prevent possibility of burrs and resulting corona discharge. The latter may be accomplished by forming the blank of a wire which is rolled and flattened to a constant width blank with rounded edges.

This application is a divisional application from the co-pending application of Jay H. Johnson, filed Dec. 30, 1965, Ser. No. 517,679, now Patent No. 3,381,156 for "Manufacture of Electrodes for Cathode Ray Tube," which in turn is a continuation-in-part of applications Ser. No. 221,600, now Patent No. 3,231,959 and No. 221,601, filed Sept. 5, 1962 now abandoned.

This invention relates to methods of manufacturing 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.

Accordingly, it is an object of this invention to provide an improved method for constructing electrodes for an electron tube.

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It is another object of this invention to provide an improved method for constructing an annular ring electrode for an electron gun.

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 drawings 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 $\pm .001$ 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 $\pm .001$ 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 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 $\pm .005$ 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 member 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 abutment of the ends of a single flat metal blank wrapped into cylindrical form, together with methods of forming the electrode.

Contrary to possible expectation, 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. The method of processing a metal blank to form thereof a cylindrical electrode with characteristics permitting operation in a cathode ray tube at a high voltage to direct and accelerate the electron beam axially there-through without significant electric field distortion, beam

distortion or corona; comprising in combination the steps of producing a thin flat blank of substantially constant width equal to the axial length of the electrode, rolling the blank over its faces to provide a constant thickness thereby to distribute stresses to substantially eliminate misshaping when subjected to firing and thermal stress, processing two ends of the blank to interfit at a single seam, rolling the blank to form an annular ring with an internal cylindrical surface of constant diameter over the entire inner surface for establishing a uniform electric field for processing the electron beam passing through the cylinder with the ends of the blank meeting at the seam in a direction generally parallel with the axis of the cylinder and along the path of the electron beam through the electrode, securing the ends of the blank together at the seam to prevent circumferential movement at the seam which might tend to change said constant diameter in the vicinity of the seam when subjected to thermal or physical stresses encountered within a cathode ray tube, and thereafter firing a plurality of said electrodes in bulk.

2. The method defined in claim 1, including the additional step of processing the blank to round the edges.

3. The method of manufacturing a cylindrical electrode for passing an electron beam axially therethrough in an electron gun having precise roundness and surface tolerances, comprising the steps of forming a strip of rectangular cross-sectioned flat blank of a width equal to the length of the electrode along the beam path and of a length equal to the circumference of the electrode to be formed, rolling the blank about a mandrel to form a cylinder, with ends of the blank abutting along a seam to extend generally in the direction of beam travel through the electrode to form a cylindrical electron gun electrode member with a substantially constant internal diameter for the entire length of the electrode, securing the ends of the blank together to establish a stable circumferential dimension and firing a plurality of electrodes so formed in bulk after being formed.

4. The method of claim 3, wherein the step of cutting the blank includes the formation of at least one tongue at the end of the blank and at least one groove on the opposite end of the blank whereby the tongue and groove are engaged during the rolling step to connect the ends of the blank.

5. The method of claim 4, wherein the step of cutting the blank includes the shaping of the tongue and groove to interlock when the blank is rolled about the mandrel to thereby constitute the step of securing the ends of the blank together.

6. The method of claim 3, comprising the additional step of spot welding the two ends of the blank together along the seam.

7. The method of claim 3, wherein the flat blank is formed by the steps of rolling a rod member to thereby produce rounded edges on the blank without further processing steps.

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U.S. Cl. X.R.

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