Dec. 6. 1938. C. E. HALLER 2,138,918

CATHODE

Filed March 24, 1938

Fig. 1

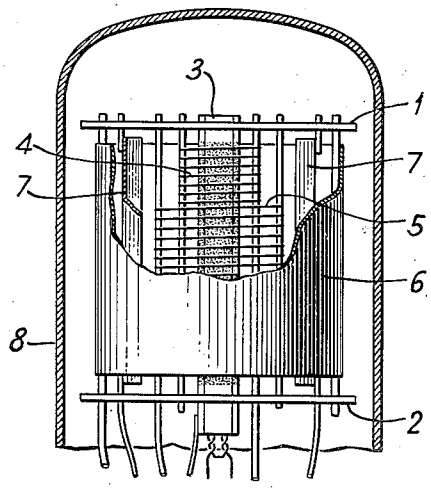


Fig. 2

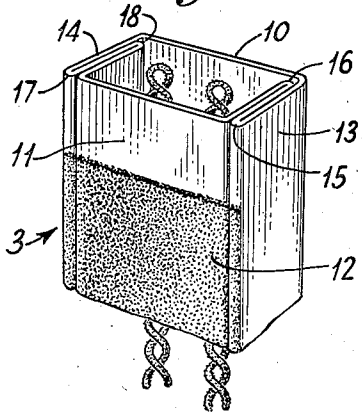


Fig. 3

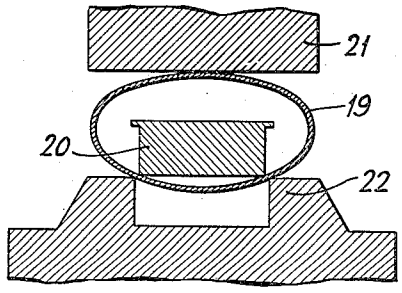


Fig. 4

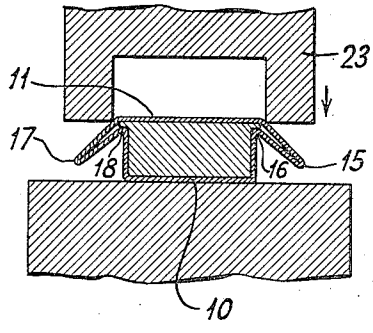


Fig. 5

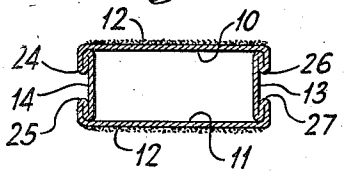


Fig. 6

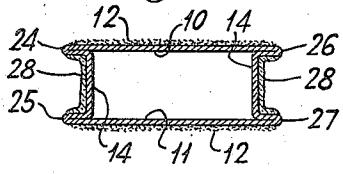
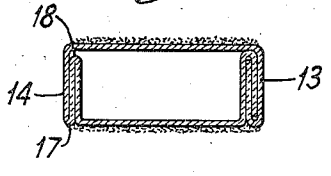


Fig. 7



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UNITED STATES PATENT OFFICE

2,138,918

CATHODE

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Application March 24, 1938, Serial No. 197,757

5 Claims. (Cl. 250—27.5)

My invention relates to thermionic cathodes, particularly indirectly heated cathodes for use in electron discharge devices.

The usual indirectly heated cathode comprises a metal tube or sleeve surrounding a heating element, activated on its outer surface with an electron emitting coating, and supported at its ends by the insulating spacers of the electrode assembly. The metals commercially suitable for carrying the electron emitting coating are not particularly strong at the operating temperature of the cathode, which may suffer deformation caused by thermal and mechanical stresses in use. A cathode sleeve made from a strip of metal rolled into tubular form and closed with a welded or locked seam along one side of the sleeve bows considerably at its center between its end supports apparently because of the asymmetrical cross section of the sleeve. Seamless tubing of electrolytic nickel sufficiently thin to permit quick heating lacks strength and is particularly difficult to maintain in close spaced relation to other electrodes in the tube especially when the cathode is long with respect to its cross sectional dimensions.

An object of my invention is to make an indirectly heated cathode that is strong and will not bow at operating temperatures, and is easy and inexpensive to manufacture.

A further object of my invention is to make a cathode which is easy to position in the mount, which will remain a fixed and predetermined distance from adjacent electrodes, and which is of thin metal to reduce heating time.

Further objects will appear in the following specification of my invention, a more complete understanding of which may be obtained in the description of specific embodiments set forth in the following specification and shown in the accompanying drawing in which—

Figure 1 shows an electron discharge device with a cathode embodying my invention,

Figures 2, 5, 6 and 7 are detailed views of indirectly heated cathodes constructed according to my invention, and

Figures 3 and 4 are schematic representations of means for making cathode sleeves according to my invention.

The tube of the beam forming type shown in Figure 1 comprises the conventional parallel insulating spacers 1 and 2 engaging in perforations the ends of tubular cathode 3 containing heating elements, and side rods of helically wound grids 4 and 5, anode 6 and beam forming deflection electrodes 7 positioned parallel to opposite edges of the cathode. The electrode assembly is supported upon a re-entrant stem of envelope 8.

Cathode 3 is preferably rectangular in cross section with the sides 10 and 11 of the sleeve activated by the conventional barium strontium oxide coating 12 and parallel to the plane of the side rods of the grids. The uncoated walls 13 and 14 of the sleeve face upon deflecting electrodes 7, which in the particular beam forming type of tube illustrated serve to direct the electrons laterally in fan-shaped beams, well-known in such radio tubes commercially known as the 6L6. In tubes of this type the cathode is relatively long and slender and when heated to high emission temperatures is apt to deform or buckle at the center. Slight displacement of the cathode sleeve where the cathode to grid spacing is small, often as small as .005 inch, results in short circuiting contacts between the cathode and grid. It has been proposed to stiffen indirectly heated cathode sleeves by making the sleeve with a relatively heavy lock seam along one side. This seam, however, results in an asymmetrical distribution of metal in the cross section of the sleeve, causing uneven heating of the sleeve after the heating element is lighted, unequal expansions of opposite sides of the sleeve, and bowing or buckling.

According to my invention the cathode sleeve is provided with reinforcing means which permit the sleeve to uniformly heat and uniformly expand. Wall 13 of my improved cathode sleeve is joined to contiguous edges of sides 10 and 11 by integral folds 15 and 16. Opposite wall 14 likewise is joined to the sides by folds 17 and 18. The three layers of the cathode sleeve material on walls 13 and 14 are, in the embodiment shown in Figure 2, pressed tightly together to strengthen the walls. The cross sectional symmetry of the sleeve insures uniform expansion and the thin sides 10 and 11 permit quick heating of the oxide coated surfaces.

Figures 3 and 4 show means for making the particular cathode sleeve of Figure 2. Seamless tubing 19, preferably of electrolytic nickel, and of the desired length is slipped over a mandrel 20 and pressed between the dies 21 and 22 of a press which flattens the two sides 10 and 11 and forms folds 15, 16, 17 and 18, as shown in Figure 4. Folds 15 and 17 may then be forced into snug engagement with folds 16 and 18 by forming tool 23, the inside transverse dimension of which is equal to the desired outside dimension of the sleeve.

The reinforcing folds may, if desired, be rel-

atively short as shown in Figure 5, the length of each fold preferably being less than one-half the width of walls 13 and 14. Folds 24, 25, 26 and 27 may be formed by dies similar to those shown in Figure 3 and forced into close engagement with sides 13 and 14 by the dies in Figure 4.

The folds 24, 25, 26 and 27 may, if desired, remain extended and in a plane parallel to the sides 10 and 11 as shown in Figure 6. Walls 13 and 14 are preferably masked while the cathode activating material is sprayed upon sides 10 and 11 and to insure against primary or secondary electron emission from the walls 13 and 14, they may be coated with insulating material 28.

If desired the cathode sleeve may be made of strip material and formed with a conventional lock seam along wall 13 as shown in Figure 7 and provided with folds 17 and 18 along wall 14. While in this embodiment of my invention wall 13 is four layers of the sleeve material thick and wall 14 is three layers thick, the cross sectional configuration of the sleeve is sufficiently symmetrical to prevent objectionable unevenness in heating.

Cathodes constructed according to my invention are strong, will not bow or deform at operating temperatures, are quick heating, and are easy and inexpensive to manufacture.

I claim:

1. A cathode for an electron discharge device comprising a cylinder of rectangular cross section, said cylinder comprising two opposed sides exteriorly coated with an electron emissive material, and two walls joining contiguous edges of said sides, the material of said cylinder being formed throughout its length with integral folds at said contiguous edges for stiffening said cylinder.

2. A cathode for an electron discharge device comprising a metal cylinder rectangular in cross section with two parallel sides exteriorly coated with an electron emissive material and two spaced walls with their edges contiguous to the the edges of said sides, folds in the cathode material along registering edges of said sides and said walls integral with said sides and walls, and a heating element in said cylinder.

3. A cylindrical cathode sleeve for an electron discharge device comprising two opposed side portions of relatively thin metal, means for stiffening said cathode sleeve without increasing the heating time of said side portions comprising a wall integrally joined to two edges of said side portions with folds in said material, said side portions being exteriorly coated with an electron emissive material, and a heating element in said cylinder.

4. A cathode for an electron discharge device comprising a metal cylinder of rectangular cross section, said cylinder comprising two parallel side members exteriorly coated with an electron emissive material, and two spaced parallel walls joining contiguous edges of said side members, means for stiffening said cylinder comprising integral folds throughout the length of said cylinder joining the edges of the side members and walls, the folds being pressed into snug engagement with said walls.

5. A cathode for an electron discharge device comprising a cylinder of rectangular cross section, said cylinder comprising two parallel sides of relatively thin metal, said sides being held in parallel spaced relation by two parallel walls spaced inwardly from the edges of said sides and joined to said sides by integral folds joining adjacent edges of said sides and walls, electron emissive material on said sides and insulating material on said walls.

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