Dec. 6, 1932. E. RÖMHILD 1,890,339

CATHODE STRUCTURE

Filed May 3, 1932

Fig. 1.

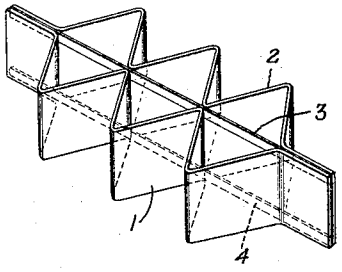



Fig. 2.

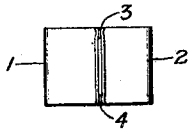



Fig. 3.

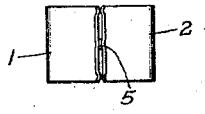



Fig. 4.

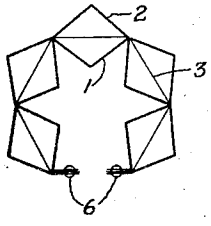
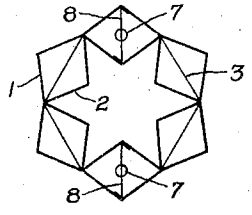



Fig. 5.




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# UNITED STATES PATENT OFFICE

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## CATHODE STRUCTURE

Application filed May 3, 1932, Serial No. 608,987, and in Germany May 4, 1931.

The present invention relates to cathode structures, more especially to those of the directly heated type designed for large units.

Cathodes composed of strips of metal, for example, nickel-chromium alloy, platinum-iridium alloy, tungsten, molybdenum, etc., are frequently employed to obtain a large electron-emitting surface in a simple constructional form. One disadvantage of such strips, as employed by the prior art, is the relatively low resistance of the cathode as a whole, hence high current consumption, which can be avoided only by the use of very thin strips, i. e., strips of relatively small cross-section. However, when cathodes of the thin strip form are heated, their strength may be so reduced that the force exerted on them by the electrostatic field within the tube tends to bend and distort them out of shape, particularly during the inverse voltage cycle when applied to a rectifier. The cathodes may also be deformed by the magnetic field of the heating current which affects them most deleteriously when the heating circuit is first closed.

An object of the present invention is to provide a strip form of cathode which is mechanically strong and resists the tendency to be pulled out of shape during operation. This object is attained in accordance with the present invention by securing together in any suitable manner, several metal strips of different lengths and cross-sections so as to form a rigid lattice work or grid structure. Several exemplary embodiments are shown in the drawing in which Fig. 1 is a plan view in perspective of an improved cathode structure, while Fig. 2 shows an end view of the structure. Fig. 3 is an end view of a modified arrangement and Figs. 4 and 5 are diagrammatic plan views of several typical forms which the cathode may take.

Referring to Figs. 1 and 2, numerals 1 and 2 designate a pair of relatively thin metal strips bent into a series of short, sharp turns or angles and having a configuration which as a whole may be considered a "zig-zag" shape. The turns may be of equal or unequal length and when fitted together, preferably has a symmetrical design about the center line or plane of contact. There are two metal strips 3 and 4 of smaller cross-section than the main strips positioned between the latter where they are fitted together, at the upper and lower edges of the main strips and spanning the points of contact. The strips 1, 2, 3, and 4 are rigidly secured together in any suitable manner, for example, by welding or riveting. The ends of the strips 1 and 2 are drawn out to form flat rectilinear surfaces which conveniently may serve as terminals for attachment to leading-in conductors.

The narrow strips 3 and 4 are employed chiefly for the purpose of enhancing the rigidity of the structure. The resistance of these strips should be predetermined by suitable choice of material and cross-section so that the strips reach approximately the same temperature, i. e., no higher temperature than the main strips 1, 2. Instead of employing a pair of narrow strips secured to the upper and lower edges of the main strips, one strip 5 positioned at the center, as shown in Fig. 3, may sometimes be used to advantage.

From the foregoing, it is evident that the design and construction of the improved cathode is such as to afford considerable rigidity in all directions notwithstanding the large surface offered and the small cross-section of conductor, also the small current required. If desired, the cathode may be coated with an electron-emitting substance such as alkaline earth oxide in any suitable and well-known manner.

If it is desired to design a cathode of the type described that will occupy a relatively small space, the improved structure may be bent into circular form, as shown in Figs. 4 and 5, without loss of mechanical strength. Fig. 4 shows the cathode as conforming to an incomplete circle with the terminals 6 positioned relatively close together. In Fig. 5, the circle design is complete and current may be supplied to the cathode through two terminals 7, diametrically positioned on a pair of strips 8 which cross the opposite corners of the main strips normal to the corners spanned by the narrow strips 3, 4. It is apparent that instead of employing only two terminals, additional terminals may be located on cross

strips equidistantly spaced about the cathode so that the structure is readily adapted to a three- or more-phase current supply, employing any standard form of connection.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. A cathode for an electric discharge device comprising a plurality of main metal strips bent into recurrent angular portions, said strips being substantially in abutting relation at the ends of each strip and at intermediate portions, an auxiliary strip of metal secured to the main strips at the places of contact therebetween whereby all of the strips are secured together and the structure as a whole is rendered rigid.

2. A cathode for an electric discharge device comprising a plurality of main metal strips bent into recurrent angular portions, said strips being substantially in abutting relation at the ends of each strip and at intermediate portions, a plurality of auxiliary strips secured to the edges of the main strips at the places of contact therebetween, whereby all of the strips are secured together and the structure as a whole is rendered rigid.

3. A cathode for an electric discharge device comprising a plurality of main metal strips bent into recurrent angular portions, said strips being substantially in abutting relation at the ends of each strip and at intermediate portions, a plurality of auxiliary strips secured to the edges of the main strips at the places of contact therebetween, whereby all of the strips are rigidly secured together, said auxiliary strips having a smaller cross-section than the main strips whereby to preclude the attainment during operation of a temperature higher than that of the main strips.

4. A cathode for an electric discharge device comprising a plurality of main metal strips bent into recurrent angular portions, said strips being substantially in abutting relation at the ends of said strip and at intermediate portions, an auxiliary strip of metal secured to the main strips at the places of contact therebetween whereby all of the strips form a rigid unit, all of said strips being designed as to cross-section and material to pass respective currents which produce approximately equal heating effects.

5. A cathode for an electric discharge device comprising a plurality of main metal strips bent into recurrent angular portions, said strips being substantially in abutting relation at the ends of each strip and at intermediate portions, an auxiliary strip of metal secured to the main strips at the places of contact therebetween whereby all of the strips form a rigid unit, said strips having relative resistances which preclude the auxiliary strip reaching a higher operating temperature than the main strips, said cathode being bent at the places of contact between the strips to a circular form whereby the space occupied by the unit is minimized.

6. A cathode for an electric discharge device comprising a plurality of main metal strips bent into recurrent angular portions, said strips being substantially in abutting relation at the ends of each strip and at intermediate portions, an auxiliary strip of metal secured to the main strips at the places of contact therebetween whereby all of the strips are rigidly secured together, the relative resistances of the respective strips being such that the currents in the strips produce approximately equal heating effects, said cathode being bent at the places of contact between the strips to a circular form whereby the space occupied by the cathode is minimized, and terminals for the cathode located at opposite diametral points.

In witness whereof, I have hereunto set my hand.

EDGAR RÖMHILD.