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2,471,298

CATHODE CUP CONSTRUCTION

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Fig. 1

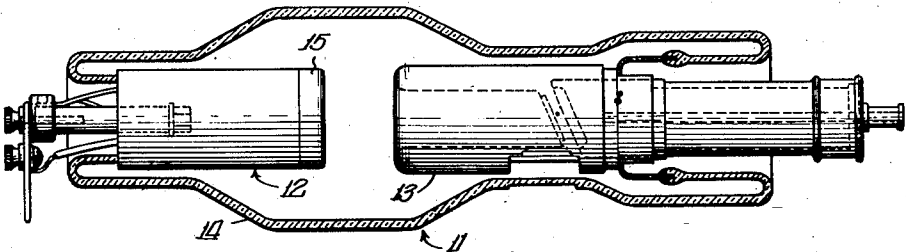


Fig. 2

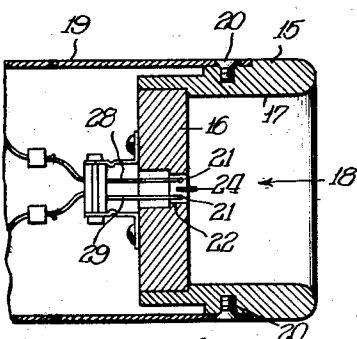


Fig. 3

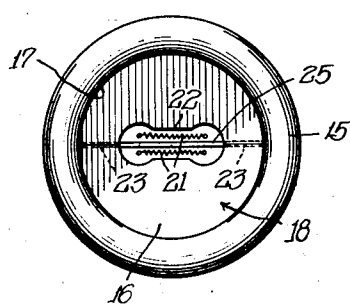


Fig. 4

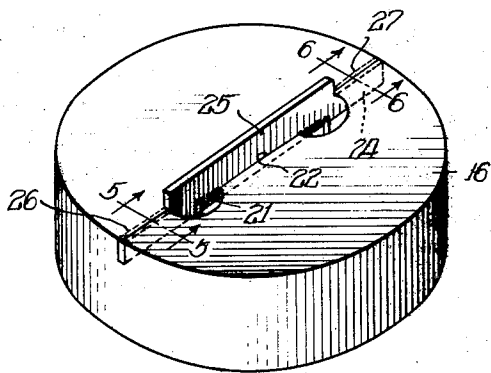


Fig. 5

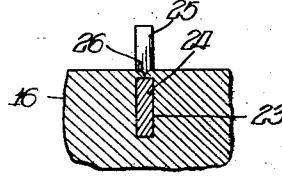


Fig. 6

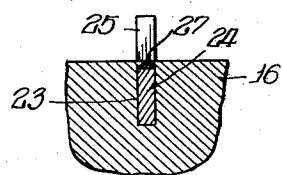
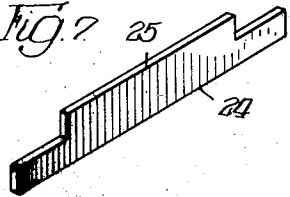


Fig. 7



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CATHODE CUP CONSTRUCTION

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5 Claims. (Cl. 250—144)

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This invention relates in general to electron flow and particularly to the control of the flow of electrons and the focusing of them upon the anode target of an X-ray generator.

An important object of the present invention is to provide means for causing electrons to flow in predetermined paths from an electron source so as to focus them upon the anode target of an X-ray generator in the manner generally described in United States Letters Patent No. 2,316,214, granted April 13, 1943, for operation in industrial radiography at voltages of the order of 200 kilovolts and higher. In those operations it is frequently desirable to use tubes of relatively small physical dimensions. In such cases, when a plurality of electron emission elements is used, it is necessary to partition the filaments of the cathode by material of a higher melting point than the iron or cold rolled steel of which the cathode cup described in those Letters Patent is usually made.

A further important object of this invention, therefore, is to provide means in a cathode cup structure for controlling the flow of electrons to provide line focus focal spots, of the order of 5 millimeters in diameter, more or less, during such high voltage operations.

Another important object of this invention is to provide a metal dividing strip between the filaments of a cathode cup structure for the generation of electrons in an X-ray tube of relatively small physical dimensions for high voltage operation so as to enable electrons to be focused upon a target area in line focus focal spots of the order of five millimeters in diameter and smaller.

This invention further resides in the combination, construction and arrangement of parts illustrated in the accompanying drawings, and while there is shown therein preferred embodiments of the invention, it is to be understood that the same are susceptible of modification and change without departing from the spirit of the invention.

The accompanying drawings illustrate a selected embodiment of the invention, and the views therein are as follows:

Fig. 1 is a side elevation of an illustrative embodiment of the invention;

Fig. 2 is a central vertical sectional view of a portion of the device shown in Fig. 1;

Fig. 3 is an end view of the portion of the device shown in Fig. 2, looking to the left in that figure;

Fig. 4 is a detail perspective view of a portion of the device shown in Figs. 2 and 3;

Fig. 5 is a sectional view along the line 5—5 of Fig. 4;

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Fig. 6 is a sectional view along the line 6—6 of Fig. 5;

Fig. 7 is an enlarged detail perspective view of a portion of the device shown in Fig. 4.

The illustrative embodiment of the invention shown in the drawings comprises an X-ray generator 11 having a cathode 12, and an anode 13, of any usual or preferred form, supported within a sealed evacuated envelope 14.

The cathode 12 comprises a cup shaped element 15 having a flat bottom 16 and generally cylindrical walls 17 defining a cavity 18 opening toward the anode 13. The side walls and bottom of the cup, instead of being formed integrally as shown in the above mentioned Letters Patent, comprise separate parts, preferably made of cold rolled steel, the side walls being secured in one end of a tubular cathode body 19 by means of screws 20. In other respects, including predetermined diameter to depth ratio, the structure of the cup is as described in the above mentioned Letters Patent.

The electron emitting source comprises a plurality of parallel filaments 21. The filaments are arranged in an enlarged portion or pocket 22 of a diametrically extending slot 23 provided in the bottom 16 of the cup 15. The pocket 22 is generally centrally located, as shown in Fig. 3.

The slot 23 is arranged to receive a metallic strip 24, preferably made of molybdenum, tantalum, or tungsten, which have a high melting point, and having a central portion 25 of increased width or height. The edges of the slot 23 adjacent one end of the strip 24 are solidly peened over the adjacent portion of the strip, as indicated at 26 in Figs. 4 and 5, tightly to anchor that end of the strip in the slot. The edges of the slot 23 adjacent the opposite end of the strip 24 are lightly peened over the adjacent portion of the strip, as indicated at 27 in Figs. 4 and 6, to keep the strip within the slot but permitting longitudinal movement of that portion of the strip upon expansion thereof when heated. To this end the strip 24 is slightly shorter in length than the slot 23 so as to avoid buckling of it upon expansion.

The portion 25 of the strip 24 serves not only in assisting in the focusing of electrons emitted by the filaments 21 but in partitioning the heat generated upon their being energized through leads 28, 29. For providing a focal spot of the order of five millimeters in diameter the portion 25 may extend about ten one-thousandths (0.010) of an inch outwardly from the bottom 16 of the cup 15. If a focal spot of greater magnitude be

desired, this dimension will be increased and the filament raised. If a focal spot of less magnitude be desired, this dimension will be reduced and the filament depressed.

Changes may be made in the form, construction and arrangement of the parts without departing from the spirit of the invention, and the right is hereby reserved to make all such changes as fairly fall within the scope of the following claims.

The invention is hereby claimed as follows:

1. An electronic device embodying an anode and a cooperating cathode comprising an electron guiding member forming a cup providing a cavity having an opening facing said anode, and a closed bottom having a slot forming a pocket, a plurality of elongated electron emission elements disposed in side by side, spaced apart relationship in said pocket, at the bottom of said cavity, and a partition comprising a strip of metal extending between an adjacent pair of said emission elements, said partition having a medial portion extending in said pocket and end portions supported in sockets comprising grooves formed in said bottom of the cup at and opening into the opposite ends of said pocket, said end portions being retained in said sockets by peened portions of said bottom at the edges of said grooves.

2. An electronic device embodying an anode and a cooperating cathode comprising a disc forming an electron guiding member, said disc having an elongated pocket formed in the surface thereof facing said anode, a plurality of elongated electron emission elements disposed in side by side spaced apart relationship in said pocket, said plate being formed with relatively narrow grooves at the opposite ends of said pocket and in alignment with the medial axis thereof, and a partition comprising a strip of metal extending between an adjacent pair of said emission elements, said partition having a medial portion extending in said pocket and end portions mounted in said grooves.

3. An electronic device embodying an anode and a cooperating cathode comprising a disc forming an electron guiding member, said disc having an elongated pocket formed in the surface thereof facing said anode, a plurality of elongated electron emission elements disposed in side by side spaced apart relationship in said pocket, said plate being formed with relatively narrow grooves at the opposite ends of said pocket and in alignment with the medial axis thereof, and a partition comprising a strip of metal extending between an adjacent pair of said emission elements, said partition having a medial portion extending in said pocket and end portions mounted in said grooves, at least one of said end portions of the partition being free to move in its supporting groove, in a longitudinal direction to accommodate expansion of the partition when heated.

4. An electronic device embodying an anode and a cooperating cathode comprising a disc forming an electron guiding member, said disc having an elongated pocket formed in the surface thereof facing said anode, a plurality of elongated electron emission elements disposed in side by side spaced apart relationship in said pocket, said plate being formed with relatively narrow grooves at the opposite ends of said pocket and in alignment with the medial axis thereof, said grooves extending outwardly of the opposite ends of the pocket and having outer ends opening at the marginal surfaces of the disc, and a partition comprising a strip of metal extending between an adjacent pair of said emission elements, said partition having a medial portion extending in said pocket and end portions mounted in said grooves, and a sleeve member having a skirt portion snugly embracing the marginal surfaces of the disc in position overlying the outer ends of said grooves.

5. An electronic device embodying an anode and a cooperating cathode comprising a disc forming an electron guiding member, said disc having an elongated pocket formed in the surface thereof facing said anode, a plurality of elongated electron emission elements disposed in side by side spaced apart relationship in said pocket, said plate being formed with relatively narrow grooves at the opposite ends of said pocket and in alignment with the medial axis thereof, said grooves extending outwardly of the opposite ends of the pocket and having outer ends opening at the marginal surfaces of the disc, and a partition comprising a strip of metal extending between an adjacent pair of said emission elements, said partition having a medial portion extending in said pocket and end portions mounted in said grooves, and a sleeve member having a skirt portion snugly embracing the marginal surfaces of the disc in position overlying the outer ends of said grooves, said grooves, inwardly of the marginal edges of the disc, opening on the surface of the disc facing said anode, and said sleeve having a shoulder in position engaging the anode facing surface of the disc at the marginal edge thereof in position overlying said grooves.

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