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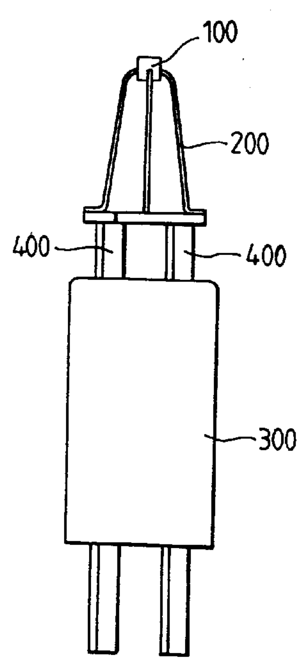
(54) **Direct-heating-type dispenser cathode structure.**

(57) A direct heating type-cathode structure is provided with filaments (200) which are secured to at least three points on the side surfaces of a porous pellet (100) formed of tungsten or molybdenum, and the cathode material thereof includes an alkaline earth metal oxide of barium. The thus-structured direct-heating-type cathode structure requires a temperature of only 950°C to 980°C to obtain the current density of 10A/cm^2 and is suitable for use in a color cathode ray tube and specifically in wide-screen televisions and industrial cathode ray tubes.

FIG.14



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The present invention relates to a direct-heating-type dispenser cathode structure, and more particularly, to a direct-heating-type dispenser cathode structure of an electron gun for use in a color cathode ray tube where rapid thermion emission is possible.

A cathode emits thermions by thermal energy and is largely divided into two types. One is an indirect-heating type in which indirect heating is used, which has a separated filament and thermion emission source. Another is a direct-heating type in which direct heating is used, which has a connected filament and thermion emission source.

In general, an indirect-heating-type cathode is applied to an electron gun which needs a large amount of thermions. Examples of such include an oxide cathode and a dispenser cathode. The indirect-heating-type cathode comprises a sleeve in which a filament is provided, and a base metal or a cathode material reservoir fixed onto the sleeve. The base metal is mainly applied to an oxide cathode while the reservoir is applied to a dispenser cathode.

A direct-heating-type cathode is applied to an electron gun for use in a small cathode ray tube, like the viewfinder of a video camera, and generally comprises a base metal or a medium for carrying cathode material which is to be directly fixed to the filament. In general, cathode material is deposited on the surface of the base metal, and the cathode material carrying media can be applied to large or industrial cathode ray tubes which require a large amount of current. A porous pellet impregnated with a dispenser-type cathode material is an example of the carrying medium.

A U.S. patent application (filed September 14, 1993) based on Korea Patent Application No. 91-9461 (by the present Applicant) discloses a structure in which a porous pellet is directly fixed onto a filament and is as shown in FIG.1 of the accompanying drawings. Referring to FIG.1, filament 2 is directly secured to both sides of a porous pellet 1 which contains cathode material. Filament 2 is directly secured to the side of pellet 1 as shown in FIG. 2 of the accompanying drawings, and filament 2' is buried in the body of porous pellet 1 as shown in FIG. 3 of the accompanying drawings.

The porous pellet of the conventional direct-heating-type dispenser cathode structure is directly heated by the filament which is directly secured to the body of a pellet, and directly emits heat by the filament current. Therefore, it takes a very short time to start thermion emission after current is applied, and particularly, high-density thermion emission can be obtained.

However, a cathode structure which is structurally stabilized and has an improved thermion emission characteristic has been realized by repeated experiments of the inventor of the present invention.

It is an object of the present invention to provide a direct-heating-type cathode structure wherein a more stabilized supporting structure is provided so as to enable faster thermion emission.

It is another object of the present invention to provide a direct-heating-type cathode structure wherein the image fading-in time of a color cathode ray tube is greatly reduced.

According to the present invention, there is provided a direct-heating-type cathode structure comprising a porous pellet which includes cathode material, and at least three filaments extending from the outer surfaces of the porous pellet.

According to an embodiment of the invention, the direct-heating-type cathode structure further comprises a supporter which supports the filaments, and an insulating block for supporting the supporter.

An embodiment of the direct-heating-type cathode structure of the present invention for use in an electron tube comprises a porous pellet is manufactured from either one selected from the group consisting of tungsten and molybdenum powders, and the cathode material includes an alkaline earth metal oxide of barium.

In cathode structures of embodiments of the present invention, the porous pellet can be formed so as to have a circular cross-section or polygonal cross-section.

In an embodiment of the invention, the filaments are disposed to be directly secured to the pellet body and spaced by a predetermined angle from one another. Thus, the filaments form a supporting structure having three or more contact points with respect to the pellet.

The filament can also be formed of a material which penetrates the pellet body. However, several filaments which are exposed to the exterior of the pellet body can be obtained from a single material.

Application to color cathode ray tubes is possible since a plurality (specifically, three) of pellets are prepared for a single insulating block in addition to the above structure.

In embodiments of the cathode structure of the present invention, it is desirable that the material of the pellet includes a binder, for example Al_2O_3, for combining the metal powders.

The cathode material preferably includes at least one metal oxide powder selected from the group consisting of europium (Eu) oxide, scandium (Sc) oxide, indium (In) oxide and iridium (Ir) oxide. It is characteristically advantageous also to include $SrCO_3$ in the amount of 2~29wt %.

A pellet obtained by compression molding and sintering the mixture of the cathode material and other materials therefor gives an advantage in manufacturing. It is more desirable to form a coating layer on the pellet surface, by at least one element selected from the group consisting of iridium (Ir), indium (In), osmium (Os), ruthenium (Ru) and rhenium (Re), so as to suppress the evaporation of barium (Ba) oxide and the resulting decrease in work function.

When the filament passes through the pellet, the filaments are installed inside the pellet so as to cross each other. It is desirable to install the filaments so as to contact each other in the pellet, and it is most desirable that the filaments are integrally formed.

Embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is an extract perspective illustration of the conventional direct-heating-type dispenser cathode structure;

FIGs. 2 and 3 are sectional views showing different types of the conventional cathode structure shown in FIG.1;

FIG. 4 is an extract perspective illustration of the direct-heating-type dispenser cathode structure according to an embodiment of the present invention;

FIG. 5 is a plan view showing the dispenser cathode structure shown in FIG.4;

FIG. 6 is a side sectional view of the dispenser cathode structure shown in FIG.4;

FIGs. 7 to 9 are plan sectional views showing different types of the cathode structure of the form shown in FIG.4;

FIGs. 10 to 13 are extract plan views of the cathode structure of various other embodiments of the present invention;

FIG. 14 is a side view of a cathode structure according to an embodiment of the present invention assembled for use in a monochromatic cathode ray tube;

FIG. 15 is a plan view of the cathode structure shown in FIG.14, and

FIG.16 is a schematic perspective view of a cathode structure according to an embodiment of the present invention assembled for use in a color cathode ray tube.

Referring to FIGs.4 and 5, a porous pellet 100, i.e., a source of electron emission, consists of a porous material obtained by compression-molding and sintering the powder of refractory metals such as molybdenum or tungsten. The porous portion of pellet 100 is filled with cathode material. Porous pellet 100 is a hexahedron obtained by compression-molding and sintering a mixture of tungsten and/or molybdenum powder, an alkaline earth metal oxide including barium, Al_2O_3 powder and at least one metal oxide powder selected from Eu oxide, Sc oxide, In oxide or Ir oxide. If molybdenum and tungsten are mixed so as to be used, the molybdenum powder should kept below 50wt%. Each end portion of four filaments 200 is secured to each side of pellet 100 while the other ends extend downward, thereby to form a structure for supporting the raised pellet 100. Pellet 100 can be regarded as having four feet-like components when the four filaments are viewed as one filament. However, these four filaments 200 are installed so as to cross one another, passing through the body of pellet 100. Therefore, in practice, the four filaments exposed to the outside of the pellet are obtained by two filaments passing through pellet 100. The two filaments 200 make contact with each other when they cross inside pellet 100, but the two filaments may cross without contacting each other.

A coating layer 400 is formed on the upper surface of pellet 100 so as to prevent a decrease in work function and the evaporation of the cathode material, as shown in FIG.6. Coating layer 400 is formed of at least one element selected from the group consisting of Ir, In, Os, Ru and Re.

FIGs.7 and 8 show two examples of the connecting structure of filament 200 with respect to pellet 100. In Fig. 7, filaments 200 are respectively welded to the sides of pellet 100. As shown in FIG. 8, opposing filaments 200 are coupled to form a single body, and hence two filaments crossing each other are installed so as to pass through the body of pellet 100. As a result, the four filaments 200 exposed on the outside of pellet 100 can be obtained from two filaments passing through pellet 100. Thus, as filaments 200 pass through pellet 100, two filaments cross in contact with or separated from each other inside pellet 100.

FIG. 9 shows another embodiment in which filaments 200 pass through pellet 100. The four filaments 200 extending down the sides of pellet 100 are combined into one. As a result, filament 200 forms a cross-shaped single unit.

The cathode structure described above has four filaments, but the formation of a single pellet having three filaments is possible with a slight modification. However, it is preferable to prepare four filaments for a single pellet, considering various points. The filaments act as supports for supporting both the pellet and heater, and accordingly, the pellet can be kept stable since at least three filaments support the pellet to maintain balance, even though filament strength is weakened by the applied current which heats the filament. Thus, pellet 100 is not greatly affected by external impacts, thereby to reduce an unstableness of the screen and lessen the occurrence of color variations in the CRT.

In configurations in which each filament is directly welded to the side of a pellet, the pellet heats simultaneously with the filament since the current passes directly through the pellet as well as the filament. Such a filament configuration has the effect of faster heating than that in which the filament passes through the pellet, which also emits thermions relatively fast.

Pellet 100 can be modified into various shapes. For example, pellet 100 can be formed so as to have a circular cross-section, as shown in FIG.10, or a polygonal cross-section as shown in FIGs.11 and 12. As shown in FIG.11, in the case of pellet 100 having eight side surfaces, filaments 200 are secured to every other side surface, to provide four filaments. If necessary, the filament can be installed onto each surface, which results in a total of eight filaments. FIG. 12 shows pellet 100 having six side surfaces. Here, the pellet has three filaments 200. However, a filament can be attached to each surface, so as to form a single pellet 100 having six filaments as shown in FIG. 13.

FIGs. 14 and 15 show an embodiment of the direct-heating-type cathode structure of the present invention which can be used for a monochromatic cathode ray tube.

Referring to FIG. 14, filaments 200 are provided on each of four side surfaces of the hexahedron pellet 100. Filaments 200 are fixed by welding to two supporters 400 installed directly onto a fixed block 300. As shown in FIG.15, two welding surfaces 401 and 402 are provided for each support 400, and a respective single filament 200 is fixed to each welding surface 401 and 402. As shown, in this structure, two filaments are connected in common. Therefore, the current flows in via two filaments and flows out via the remaining two filaments. This kind of current application structure can be applied to the above-described filament structure of the present invention. In this structure, since heat is simultaneously provided to the pellet from four filaments, the pellet can quickly reach the temperature at which thermion emission is possible.

When the filament is welded to the pellet, the pellet is self-heated since the pellet is located in the current path. At this time, a plurality of filaments are divided into two groups through which voltage is applied to the pellet, since the two filaments are connected in common. That is, the current flows into a single pellet through the filament of group 1, and the current flows out from a single pellet through the filament of group 2. Accordingly, the combined resistance of the filament decreases, which results in an increase in the distribution voltage for the pellet. Thus, since the heating of the filament decreases due to the increase in distribution voltage while the heating of the pellet increases, the pellet reaches the thermion emission point faster, thereby to enable thermion emission immediately after current is applied.

In a cathode structure of the present invention described thus far, in which a plurality of filaments is divided into two groups, a voltage is applied via the two groups, in the voltage application structure. That is, current flows into a single pellet via the filament of group 1, and the current flows out via the remaining filament of group 2.

As a result, a pellet has two current application terminals, and since each terminal consists of a plurality of filaments, the line resistance of each terminal is lowered. In the present invention, lower line resistances are more advantageous in the prompt heating of the pellet, conversely to the conventional direct-heating-type cathode. This decrease in resistance causes an increase in the distribution voltage ratio with respect to a pellet. Therefore, the amount of heat radiating outside the pellet decreases while the internal heating of the pellet is increased.

According to an experiment of the inventor for the cathode structure of the present invention, a temperature of 950~980°C is sufficient to obtain a current density of 10A/cm^2. These temperature characteristics are equal to that of the existing indirect-heating impregnation-type cathode.

In a cathode structure of the type shown in FIG.14, three cathode structures can be provided for a single electron gun, thereby to constitute an electron gun for use in a color cathode ray tube. Since the above cathode structure has an independent support block, means for fixing the supporting block for each cathode structure is required for the electron gun, when the above cathode structure is applied to an electron gun for use in a color cathode ray tube.

FIG.16 shows another embodiment of a cathode structure of the present invention which can be used for a color cathode ray tube. The three cathode structures respectively having pellet 100 and filament 200 are positioned on a single insulating block 300. In order to fix the unit cathode structure, three pairs of supporters 400 for fixing the filaments of each pellet are provided on the insulating block 300.

The structure for supporting the pellet having three or more filaments according to the present invention is very suitable for supporting pellets having considerable weight. That is, the pellet resists shock since it is supported by at least three filaments, thereby decreasing the potential deforming thereof. Additionally, the relative location for a first grid in an electron gun changes much less due to this shock-suppression effect. The cathode structure and the reduced change of the first grid location together prevent the unstableness of the screen and the abnormal color generation due to minor impacts, thereby maintaining a stable screen quality. Particularly, the abnormal and permanent deformation according to extended operation is effectively suppressed. Thus, a cathode structure of the present invention is more appropriate for use in a color cathode ray tube, and specifically in wide-screen televisions or industrial CRTs, rather than the general subminiature black-and-white cathode ray tube.

Claims

1. A direct-heating-type dispenser cathode structure comprising:

   a porous pellet (100) which includes cathode material, and

at least three filaments (200) extending from the outer surfaces of said porous pellet.

2. A direct-heating-type dispenser cathode structure according to claim 1 further comprising:

a supporter (400) which supports said filaments, and

at least one insulating block (300) for supporting said supporter.

3. A direct-heating-type dispenser cathode structure according to claim 1 or 2, wherein the porous pellet (100) is manufactured using any one selected from the group consisting of tungsten and molybdenum, and said cathode material includes an alkaline earth metal oxide including barium.

4. A direct-heating-type dispenser cathode structure according to any preceding claim, wherein each of said filaments (200) extends into said pellet (100) and connects with at least one of the other filaments.

5. A direct-heating-type dispenser cathode structure according to any of claims 1 to 3, wherein said filaments are secured to the outer surfaces of said porous pellet.

6. A direct-heating-type dispenser cathode structure according to any of claims 1 to 5, wherein said pellet (100) is a hexahedron and four filaments (200) extend from a respective one of four sides of said pellet (100).

7. A direct-heating-type dispenser cathode structure according to any preceding claim, wherein said pellet (100) includes Al_2O_3.

8. A direct-heating-type dispenser cathode structure according to any preceding claim, wherein a coating layer of at least one selected from the group consisting of Ir, In, Os, Ru and Re is formed on the upper surface of said pellet (100).

9. A direct-heating-type dispenser cathode structure according to any preceding claim, wherein a coating layer of at least one selected from the group consisting of Ir, In, Os, Ru and Re is formed on the surface of said pellet (100).

10. A direct-heating-type dispenser cathode structure according to any preceding claim, wherein said cathode material includes a metal oxide of at least one selected from the group consisting of europium oxide, scandium oxide, indium oxide and iridium oxide.

11. A direct-heating-type dispenser cathode structure according to claim 10, wherein said cathode material further comprises $SrCO_3$ of 2~29wt%.

FIG.1(PRIOR ART)

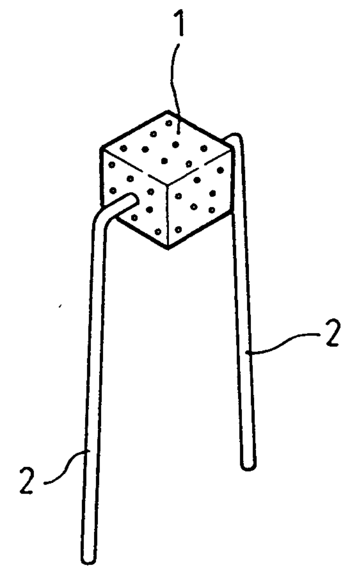

FIG.2(PRIOR ART)

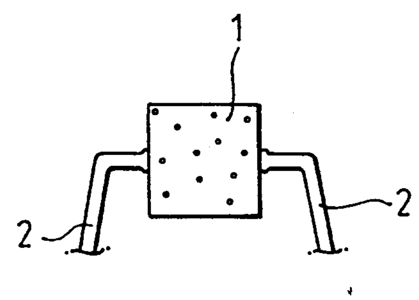

FIG.3(PRIOR ART)

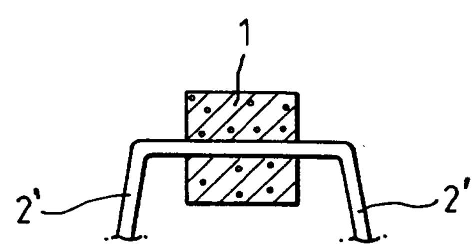

FIG.4

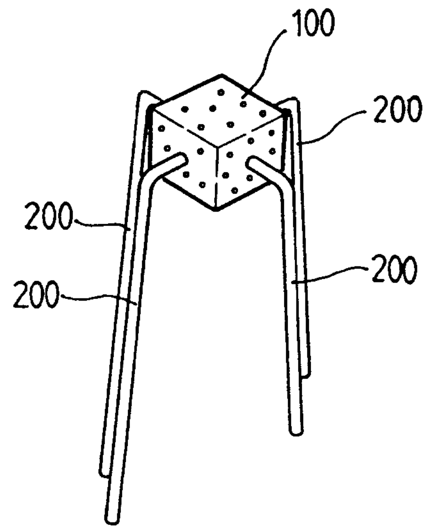

FIG.5

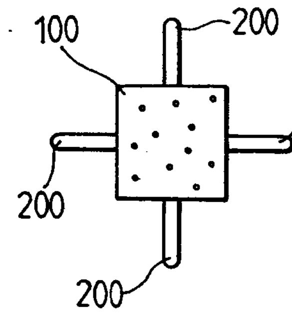

FIG.6

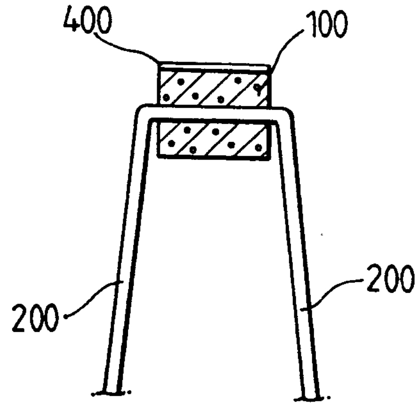

FIG.7

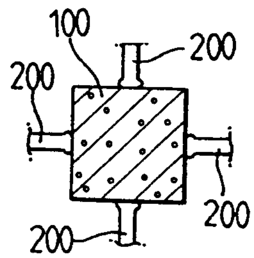

FIG.8

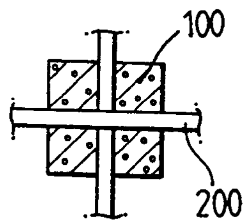

FIG.9

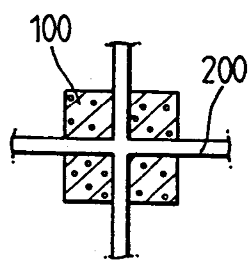

FIG.10

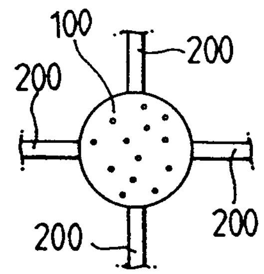

FIG.11

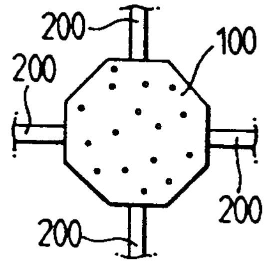

FIG.12

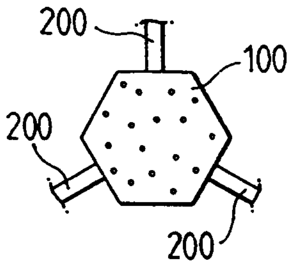

FIG.13

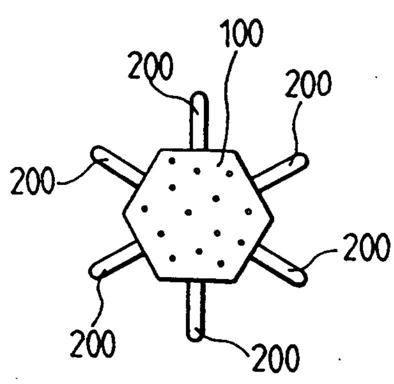

FIG.14

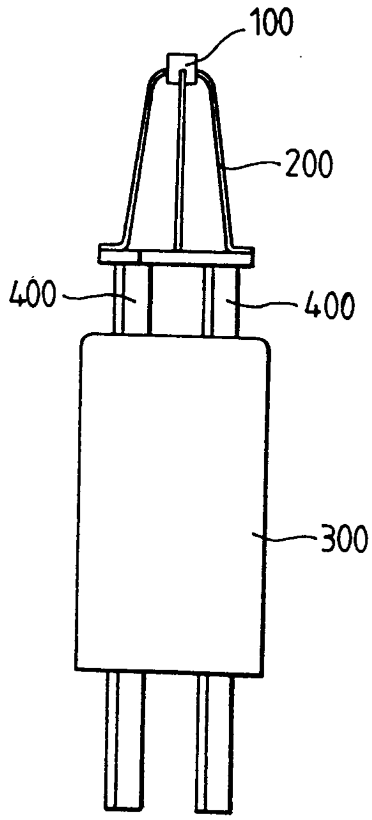
100
200
400
400
300

FIG.15

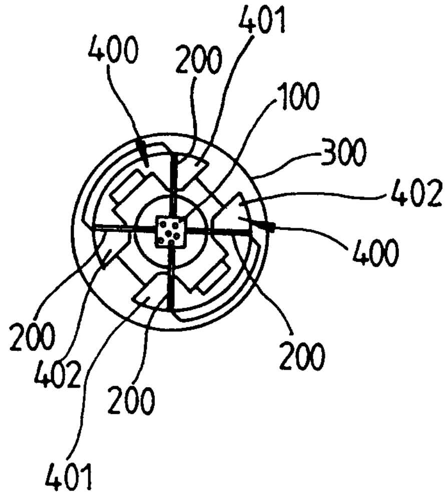
400
200
401
100
300
402
400
200
402
200
200
401

FIG. 16