

GETTER SPRING AND CATHODE-RAY TUBE USING GETTER SPRING

The present invention relates to a getter spring and a cathode-ray tube (CRT) using a getter spring.

Cathode-ray tubes are widely used in television receivers, display devices for computer system or the like. The inside of the CRT is kept in highly vacuum state. High vacuum degree is attained by getter flash process used at the time the CRT is manufactured.

The getter flash process is carried out after an exhausting process for producing vacuum in a CRT assembly when the CRT is manufactured. In the getter flash process, a getter made of a metal mainly made of barium Ba and previously disposed in the CRT is heated by high-frequency heating from the outside of the CRT assembly (i.e., eddy current is generated at the getter to heat the latter). When the evaporated metal condenses to absorb a residual gas in the CRT assembly. Thus, a degree of vacuum in the CRT assembly is increased to obtain high vacuum. In the getter flash process, the evaporated metal catches some materials, such as dusts, remaining in the CRT assembly, thereby the materials being evaporated on the inner peripheral surface of the funnel of the CRT assembly.

A getter spring has an end portion fixed at an electron gun incorporated in the CRT and is extended along the inside inclined surface of the funnel. The getter spring serves as a supporting body which supports at its tip end portion a container for mounting (housing) the getter thereon (therein).

Figures 1A to 1D show a getter spring 81. Figures 2A to 2D show a container 15 and the getter spring 81 supporting the container 15. Figure 3 shows a CRT incorporating therein the getter spring 81 supporting the container 15.

The getter spring 81 is made of a suitable material having a certain strength and satisfactory heat resistance and conductivity, e.g., SUS 304 (spring material). The container 15 is made of a material which is resistant to a high temperature generated upon getter flash process, e.g., SUS 304.

Figure 1A is a front view showing the getter spring 81 which has not been processed. As shown in Figure 1A, the getter spring 81 is cross-shaped. The getter spring 81 has a long stripe portion formed of long stripe portions 81a, 81b, and a short stripe portion 81c. A total length of the long stripe portions 81a, 81b extended in the lateral direction in Figure 1A is about 118 mm, and a length of the short stripe portion 81c extended in the longitudinal direction in Figure 1A, i.e., along a line D - D' is about 22 mm. The long stripe portion is divided at a position 82 into the long stripe portions 81a, 81b which are jointed by an insulating member 21 as will be described later on.

Figure 1B is a side view of the long stripe portion 81a of the getter spring 81. As shown in Figure 1B, the long stripe portion 81a is bent stepwise so as to be extended along the inclined surface of the funnel portion when the getter spring 81 is disposed inside the funnel body of the CRT. As shown in Figure 1B, the getter spring 81 is bent at a plurality

of bent portions, e.g., six positions I, II, III, IV, V and VI at angles of 10° , 20° , 20° , 20° , 15° and 12° , respectively.

Figure 1C shows a head end (shown by a broken-line circle C in Figure 1B) of the long stripe portion 81a in detail. As shown in Figure 1C, the head end has a spoon-shaped, curved portion 83 whose convex surface is brought in contact with an inner conductive coating film of the funnel portion of the CRT as shown in Figure 3. The curved portion 83 is spoon-shaped in order that the convex portion is reliably brought in contact with the inner conductive coating film. Also, the spoon-shaped curved portion 83 can protect the inner conductive coating film from being damaged.

The short stripe portion 81c of the cross-shaped getter spring 81 has curved portions 84a, 84b formed at its respective ends as shown in Figure 1D which shows the short stripe portion 81c in detail. The curved portions 84a, 84b have respective convex surfaces which are reliably brought in contact with the inner conductive coating film 8.

As shown in Figures 2A, 2B, the container 15 is annular in outer shape and has a groove (concave portion) 91 formed to mount (or store) a getter 92 thereon (or therein). Figure 2B is a perspective view showing the container 15 which mounts (or stores) the getter 92 thereon (or therein).

The two curved portions 84a, 84b of the short stripe portion 81c of the getter spring 81 are engaged with a bottom surface 15a of the container 15 for mounting (or storing) the getter 92 thereon (or therein). The container 15 is connected

to the getter 92 at portions 93a, 93b by welding as shown in Figure 2C. Accordingly, when the getter spring 81, the insulating material 21 and the container 15 are assembled, an assembly is arranged as shown in Figure 2D.

Figure 3 is a schematic cross-sectional view illustrating a manner in which the assembly is assembled into the CRT. The getter spring 81 has one end connected to an inner deflection electrode plate 3b of an electron gun 2. The getter spring 81 jointed by the insulating plate 21 is extended along the inside inclined surface of the funnel portion with a distance from the inside inclined surface. The getter spring 81 is brought in contact with the inner conductive coating layer 8 of the funnel portion only at the convex surfaces of the curved portions provided at the tip end of the long stripe portion 81a and both the ends of the short stripe portion 81c.

The getter spring 81 is made of the spring material and has a resiliency. Also, a total angle formed by a plurality of bent portions is greater than an angle of the interior inclined surface of the funnel portion. Therefore, when the assembly formed of the getter spring 81, the insulating material 21 and the container 15 is attached to the inner deflection electrode plate 3b of the electron gun 2 of the CRT, the getter spring 81 is floated over the funnel portion of the CRT assembly 1 except that only the convex surfaces of the curved portions 83, 84a, 84b of the tip end portion of the long stripe portion 81a and both the ends of the short stripe portion 81c of the getter spring 81 are brought in contact with the inner

conductive coating film 8.

The insulating material 21 joints the one long stripe portion 81a of the getter spring 81 with the other long stripe portion 81b thereof attached to the electron gun 2 of the CRT. Since, when the CRT is used as a display device, the getter spring 81 may discharge electricity unless it is electrically insulated from the electron gun 2 (i.e., the inner deflection electrode plate 3b), such arrangement is used in order to insulate the getter spring 81 from the electron gun 2 so that a potential of the electron gun 2 can be prevented from influencing electron beam through the getter spring 81.

Moreover, since, while the getter spring 81 is floated in the CRT, it is charged with electricity to influence the direction in which electron beam travels, a part of the getter spring 81 is electrically brought in contact with the inner conductive coating film 8 of the funnel portion of the CRT. Accordingly, when a part of the getter spring 81 is electrically brought in contact with the inner conductive coating film 8, the electron beam normally impinges on the fluorescent screen.

The getter 92 supported by the getter spring 81 is disposed within the CRT. The getter 92 is heated by high-frequency heating from the outside of the CRT in getter flash process carried out at the time the CRT is manufactured.

In getter flash process, the getter 92 is heated by high-frequency heating to high temperature and evaporated. There is then the risk such that a high temperature produces a

crack at a contact portion of the funnel glass 1a with which the getter spring 81 is in contact.

Specifically, when the temperature of the getter 92 mounted on (or stored in) the container 15 is measured, it reaches about 1200°C. If the container 15 is directly in contact with the funnel glass 1a of the CRT assembly 1, then the high temperature produces the crack at the contact portion of the funnel glass 1a. In order to prevent the crack from being produced, the getter spring is floated as described above so that the container 15 should not be brought in direct contact with the funnel portion of the CRT assembly 1 and that only the tip end portion 83 of the long stripe portion 81a of the getter spring 81 and both the end portions 84a, 84b of the short stripe portions 81c thereof are brought in contact with the funnel glass 1a.

However, even if this arrangement is employed, the temperature at the contact portion of the funnel glass 1a of the tube body 1 with which the getter spring 81 is in contact reaches about 740 °C on the average.

On the other hand, in view of heat resistance of the funnel glass 1a, it is confirmed that, if the temperature of the contact portion of the funnel glass 1a with which the getter spring 81 is in contact increases in excess of about 750 °C, then the funnel glass 1a is cracked. Accordingly, in the getter flash process using the getter spring 81, a difference (i.e., a temperature margin) between the temperature of the funnel glass 1a upon getter flash process (i.e., about 740 °C) and the

temperature at which the funnel glass 1a can be resistant to a high temperature (i.e., about 750°C) is only about 10°C. In actual practice, it is frequently observed that the funnel glass 1a is cracked due to difference of CRT specifications, dispersion in manufacturing process such as a getter amount, a heating time, an attachment position of the getter spring 81 or the change of factors such as an ambient temperature.

Moreover, since the getter spring 81 and the container 15 are connected to each other by welding at both of the ends of the short stripe portion 81c as shown in Figure 2C, the getter spring 81 and the container 15 are thermally expanded at different rates resulting from their different temperatures thereof, which sometimes deforms the getter spring 81 and, in worst cases, detaches the getter spring 81 from the container 15 at its welded portions.

It is an object of the present invention to provide a getter spring which applies less heat to a CRT assembly, i.e., a funnel glass of a CRT in the getter flash process carried out when the CRT is manufactured, and a CRT using getter spring.

It is another object of the present invention to provide a getter spring and a CRT using getter spring in which the funnel glass can be prevented from being cracked without modifying the getter spring and the CRT so much.

It is a further object of the present invention to reduce costs required when a getter spring is manufactured, a container is attached the getter spring and when the getter spring is located with respect to the CRT as compared with those

of the arrangement described above.

According to a first aspect of the present invention, a getter spring includes a container for storing a getter therein and a spring member for supporting the container. The container is connected to the spring member by fixing the former on the latter at one portion and bringing the former in contact with the latter at a point of the other portion, thereby an amount of heat conducted to the spring member upon getter flash process being made negligible.

According to a second aspect of the present invention, a getter spring includes a spring member having a small hemispherical portion or projection. The container is connected to the spring member by fixing the former on the latter at one portion by welding, by bringing the former in slidable contact with the small hemispherical portion or projection of the latter at one point of contact of the other portion, and by disposing the rest of portions of the former away from the latter. With this arrangement, difference in thermal expansion between the container and the spring member is made negligible and the amount of the heat conducted to the spring member upon the getter flash process is reduced.

According to a third aspect of the present invention, a getter spring disposed in a cathode-ray tube having a funnel glass and an electron gun includes a container for housing a getter therein and the spring member for supporting the container. The spring member has the small hemispherical portion or projection and the convex portion. The spring member

is formed of a resilient material and shaped so as to have a total angle which is larger than an angle of an inclined surface of the funnel glass of the cathode-ray tube. The spring member is fixed in the funnel glass by fixing it on the electron gun at its one end by welding so as to be extended along the inclined surface of the funnel glass at an interval, and by bringing it in contact with the funnel glass at a concave portion provided at the other end of the spring member at one point. The container is connected to the spring member by fixing the former on the latter by welding at a position comparatively away from the concave portion provided at the other end and by bringing the former in slidable contact with the small hemispherical of the latter at one point of contact of the other portion comparatively close thereto. With this arrangement, the difference in thermal expansion between the container and the spring member is made negligible and the amount of the heat conducted to the spring member upon a getter flash process is reduced.

According to a fourth aspect of the present invention, a cathode-ray tube having a getter which is to be used upon a getter flash process and which is disposed in its tube body includes one of the above getter springs for supporting the getter.

The above, and other features and advantages of the present invention, will be apparent in the following detailed description of preferred embodiments of the invention when read in conjunction with the accompanying drawings, in which like

reference numerals are used to identify the same or similar parts in the several view. In the drawings:-

Figures 1A to 1D are diagrams showing a getter spring, wherein Figure 1A is a plan view showing a getter spring which has not been shaped, Figure 1B is a side view showing the getter spring and used to explain a bent state of the getter spring which has been shaped, Figure 1C is a cross-sectional view showing in detail a portion shown by a broken-line circle C shown in Figure 1A and Figure 1D is a cross-sectional view showing in detail the getter spring cut along the line D - D' in Figure 1A;

Figures 2A to 2D are diagrams showing a container and the above getter spring, wherein Figure 2A is a cross-sectional view showing the container, Figure 2B is a perspective view showing the container containing a getter therein, Figure 2C is a perspective view showing the getter spring with the container attached thereto from its rear side, and Figure 2D is a perspective view showing the container, the getter spring and an insulating material presented when they are assembled;

Figure 3 is a cross-sectional view showing a cathode-ray tube using the above getter spring;

Figure 4 is a cross-sectional view showing a getter spring and a cathode-ray tube using getter spring according to an embodiment of the present invention;

Figures 5A to 5D are diagrams showing the getter spring, wherein Figure 5A is a plan view showing the getter spring which has not been shaped, Figure 5B is a side view

showing the getter spring and used to explain a bent state of the getter spring which has been shaped, Figure 5C is a cross-sectional view showing the getter spring cut along the line C - C' shown in Figure 5A and Figure 5D is a cross-sectional view showing the getter spring cut along the line D - D' shown in Figure 5A;

Figures 6A and 6B are respectively perspective and cross-sectional views showing a joint portion of the getter spring;

Figure 6C is a characteristic graph showing a relationship between an interval of the joint portion and a discharge start voltage;

Figures 7A to 7C are diagrams showing the getter spring to which the container is attached, wherein Figure 7A is a view showing the getter spring to which the container is attached and viewed from its rear side, Figure 7B is a side view showing the getter spring to which the container is attached and Figure 7C is a side showing a cathode-ray tube to which the getter spring is attached;

Figures 8A and 8B are diagrams used to explain shapes of the getter springs obtained when the getter spring according to the present invention and the getter spring shown in Figure 1 are formed, respectively;

Figure 9 is a diagram used to explain an assembly process of the cathode-ray tube using the getter spring according to the present invention; and

Figure 10 is a flowchart showing a process of

attaching the getter spring to the cathode-ray tube and an assembly process of the cathode-ray tube.

A getter spring and a cathode-ray tube (CRT) using a getter spring according to the present invention will be described with reference to the drawings.

Initially, the getter spring and the CRT according to the present invention will be described in brief.

Figure 4 is a cross-sectional view showing a main portion of a color CRT of Trinitron (registered trademark) type, for example, according to this embodiment. Roughly classified, the CRT is composed of a panel portion, a funnel portion and a neck portion. The funnel portion and the neck portion are welded at a neck welding portion. The funnel portion and the neck portion are often referred to as a funnel.

As shown in Figure 4, the CRT includes a CRT assembly 1 (otherwise referred to as "funnel glass") and an electron gun 2 disposed within the neck portion. The electron gun 2 comprises a first grid G1, a second grid G2, a third grid G3, a fourth grid G4, a fifth grid G5 and a convergence plate (deflection electrode plate) 3. In a typical arrangement of the CRT, the first grid G1 and the second grid G2 form a cathode lens, i.e., an object point forming region. The second grid G2 and the third grid G3 form a pre-focusing lens (pre-stage lens). The third grid G3, the fourth grid G4 and the fifth grid G5 form a main focusing lens (main lens).

In the case of the Trinitron picture tube, the electron gun 2 incorporated in its neck portion is of a single

electron gun. Electron beams emitted from three cathodes KR, KG and KB once cross one another at a center of the main focusing lens and then diverge from one another. The diverged electron beams are electrostatically or electromagnetically converged again through an aperture grill (denoted at reference numeral 62 in Figure 9), which is a color selection mechanism, whereafter they are converged on a point to impinge upon a fluorescent screen 17.

There are known a large number of electron lens arrangements. A single main lens type electron lens using a uni-potential focus (UPF) system will be described below. The third grid G3 and the fifth grid G5 are electrically connected by a conductive lead wire 5. An anode voltage (high voltage) HV is applied to the third and fifth grids G3, G5 from an anode button (not shown) through an outer conductor 12a of a coaxial cable 12, a plate spring 13 formed of a C-shaped metal plate connected to the outer conductor 12a, the inner conductive coating layer 8, and a conductive contact 15 brought in contact with the inner conductive coating layer 8, in that order.

The fourth grid G4 is supplied with a comparatively low voltage ranging from 0 to several 100s of volts from a terminal formed through a stem 1c provided at an end portion of the neck portion to conductive lead wires 7. Thus, the third grid G3, the fourth grid G4 and the fifth grid G5 form the main focus lens of the UPF system.

The convergence means 3 is formed of inner deflection electrode plates 3a, 3b opposed to each other and outer

deflection electrode plates 3c, 3d respectively disposed outside of the inner deflection electrode plates 3a, 3b. The inner deflection electrode plates 3a, 3b are supplied with the anode voltage HV from the fifth grid G5 mechanically and electrically connected thereto. The outer deflection electrode plates 3c, 3d are supplied with a convergence voltage CV from the anode button (not shown) through a central conductor 12b of the coaxial cable 12. The convergence voltage CV is lower than the anode voltage HV by several 100s of Volts.

A relationship between the CRT and the getter spring will be described more in detail. The above-mentioned CRT incorporates therein a getter spring 16 formed of a stripe metal plate and having one end connected to either of the inner deflection electrode plates 3a, 3b (e.g., the inner deflection electrode plate 3b). The getter spring 16 has a container which is attached to a portion around the other end thereof and mounts (or stores) a getter thereon (or therein). The getter spring 16 is formed of two getter spring members 16a, 16b jointed by an insulating material 21. The getter spring 16 is extended along and over the inclined surface of the funnel glass 1a at an interval of about 2 mm, for example. The getter spring 16 is extended at the other end side a little longer beyond an attachment portion of the container 15, being brought in contact with the inner conductive coating film 8 coated on the inner surface of the funnel portion of the CRT (see Figure 7C).

The getter spring 16 and the container 15 will be described more in detail below. The getter spring is formed by

shaping a stripe metal such as stainless steel SUS 304 (spring material). While a getter spring 81 shown in Figure 1A is cross-shaped, the getter spring 16 according to the present invention is long-rectangular-shaped (stripe) without having a short stripe portion extended in the direction perpendicularly to a long stripe portion. Thus, the getter spring 16 is simplified as compared with the getter spring 81 shown in Figure 1A. Similarly to a container 15 shown in Figures 2A, 2B, the container 15 fixed on the getter spring 16 has a ring-shaped concave portion (groove). A getter 92 is mounted on (or stored in) the concave portion.

Sizes of the getter spring 16, the container 15 and the insulating material 21 used in this embodiment are as follows. However, the following sizes may of course be changed depending upon some factors such as CRT specification and size of the CRT.

The getter spring 16 is made of SUS 304 (spring material) and is 114.2 mm (length) x 4 mm (width) x 0.25 mm (thickness). The container 15 is made of SUS 304 and is of 21 ϕ (outer diameter) x 13 ϕ (inner diameter) x 2 mm (height). The insulating material 21 is made of an alumina ceramic material and is 15 mm (length) x 4 mm (width) x 1.8 mm (thickness).

As shown in Figure 5A, the getter spring 16 is cut into two getter spring members 16a and 16b at a position 27 near its one end where it is fixed to the inner deflection electrode plate 3b by a suitable method such as welding. Similarly to the getter spring 81 shown in Figure 1A, the two getter spring

members 16a and 16b are jointed by the insulating material 21 and thereby electrically insulated from each other.

The insulating material 21 is formed of an alumina insulating material similarly to the insulating material shown in Figure 2D. As shown in Figure 6B, the insulating material 21 has apertures 23a, 23b defined thereon to receive hollow rivets 22a, 22b and conical convex projections 24a, 24b projected from its one main surface and respectively positioned at outer sides of the apertures 23a, 23b.

The two getter spring members 16a, 16b forming the getter spring 16 respectively have apertures 25a, 25b defined at their end portions so as to oppose the apertures 23a, 23b of the insulating material 21. The two getter spring members 16a, 16b respectively have engagement apertures 26a, 26b defined at their end portions so as to be engaged with the convex projections 24a, 24b of the insulating material 21. As shown in Figure 6A, the getter spring members 16a, 16b are disposed on one major surface of the insulating material 21 at an interval D between the end portions thereof. At this time, the convex projections 24a, 24b of the insulating material 21 are engaged with the engagement apertures 26a, 26b of the getter spring members 16a, 16b, respectively. Concurrently therewith, the apertures 23a, 23b of the insulating material 21 are positioned so as to be agreed with the apertures 25a, 25b of the getter spring members 16a, 16b, respectively.

As shown in Figure 6B, in the above-mentioned state, the hollow rivets 22a, 22b made of aluminum are inserted into

the apertures 23a, 23b of the insulating material 21 and the apertures 25a, 25b of the getter spring members 16a, 16b from the rear surface side of the insulating material 21, respectively. Then, the rivets 22a, 22b are squeezed from the getter spring 16 side with application of a pressure to the rivets 22a, 22b.

According to this joint method, when the two getter spring members 16a, 16b are jointed, the rivets 22a, 22b are squeezed and the respective convex projections 24a, 24b are engaged with the engagement apertures 26a, 26b. Therefore, it is possible to reliably fix the getter spring members 16a, 16b on the insulating material 21 only with the rivets 22a, 22b, respectively. Thus, the getter spring members 16a, 16b can be prevented from being rotated relative to the insulating material 21. Since the convex projections 24a, 24b of the insulating material 21 are conical, even if the sizes of the engagement apertures 26a, 26b of the getter spring members 16a, 16b are changed a little, the convex projections 24a, 24b can be firmly fitted into the engagement apertures 26a, 26b.

While the spacing D between the getter spring members 16a, 16b on the insulating material 21 should preferably be narrowest in order to prevent the surface of the insulating material 21 from being charged, the spacing D should be larger than a certain length in order to avoid a discharge along the surface between the getter spring members 16a, 16b. In this embodiment, the spacing D is set to about 5 mm. However, if a used voltage is comparatively low depending upon difference of

CRT specification, then the spacing D can be reduced more. Figure 6C is a characteristic graph showing a relationship between the spacing D (mm) between the getter spring members 16a, 16b of the getter spring 16 and a discharge start voltage (kV) obtained when the getter spring members 16a, 16b are disposed on the insulating material 21 at the spacing D. The interval D is properly determined based on measured results of a characteristic graph showing the relationship between the interval D and the discharge start voltage.

The insulating material 21 should preferably be attached to the portion which is distant from the container 15 as much as possible in order to prevent the insulating material 21 from being damaged by evaporated getter scattered upon getter flash. Therefore, in this embodiment, the getter spring 16 is divided into the getter spring members 16a, 16b at the position 27 near the inner deflection electrode plate 3b of the electron gun 2, the getter spring members 16a, 16b being jointed by the insulating material 21.

After the getter spring members 16a, 16b have been jointed by the insulating material 21, one end of the getter spring member 16b is fixed on either of the inner deflection electrode plates 3a, 3b of the electron gun 2 by a suitable method such as welding.

When the getter spring 16 is disposed within the funnel portion of the CRT, the getter spring member 16a connected to the insulating material 21 is successively bent at a plurality of bent portions I, II, III, IV, V, VI and VII at

angles of 10°, 20°, 20°, 20°, 15°, 11° and 3°, in that order, as shown in Figure 5B so as to be extended along the inclined surface of the funnel portion of the CRT assembly 1.

As shown in Figures 5A, 7A, a substantially 4 mm-wide wide portion 28 may be formed at a portion between the bent portion VI and the bent portion VII of the getter spring member 16a in order to couple the container 15 to the getter spring 16 by a suitable method such as welding. For example, while the width of the getter spring 16 is about 4 mm, the width of the wide portion 28 thereof is about 5 mm. A concave portion or groove 22 extended in the longitudinal direction of the getter spring member 16a as shown in Figure 5C which is a cross-sectional view thereof may be provided in the getter spring member 16a from a portion displaced slightly away from the wide portion 28 toward the engagement portion to the wide portion in order to improve a bending strength of this portion of the getter spring 16.

A small hemispherical portion (or projection) 23 with a radius of about 1 mm, for example, projected toward a bottom surface 15a of the container 15 is formed at a portion which is displaced slightly toward the end portion from the bent portion VII. The small hemispherical portion 23 can be formed by pressing a proper projection to the getter spring member 16 from the back surface side when the getter spring 16 is formed by punching. An interval or spacing S between the small hemispherical portion 23 and the wide portion 28 (see Figure 7A) is substantially equal to a mean value of a diameter of an outer

peripheral circle and a diameter of an inner peripheral circle of the annular container 15. Therefore, when the bottom surface 15a of the container 15 is positioned on the wide portion 28, a top of the small hemispherical portion 23 contacts with the bottom surface 15a of the container 15 with portions other than the small hemispherical portion 23 and the wide portion 28 being located away from the container 15. In such positional relationship between the getter spring 16 and the container 15, as shown in Figure 7A, the container 15 is fixed by a suitable method, such as welding, on the wide portion 28 of the getter spring 16 at two positions 41a, 41b located close to width-direction end portions and at substantial center positions in the direction perpendicular to the width direction. The bottom surface 15a of the container 15 and the small hemispherical portion 23 of the getter spring 16 are slidably brought in contact with each other. Accordingly, even if the getter spring 16 and the container 15 are thermally expanded at different rates, then the getter spring 16 is prevented from being deformed and from being applied with unnecessary stress.

As shown in Figure 7C, the other end of the getter spring member 16a is extended further from a position to which the container 15 is attached as compared with the getter spring 81 shown in Figure 1A. The getter spring member 16a has a curved portion 24 formed at its tip end. The curved portion 24 is in contact with the inner conductive coating film 8 coated on the inner surface of the CRT at one point. The getter spring 16 according to the present invention has a total length longer by

about 8 mm than that of the getter spring 81 shown in Figure 1A and is bent at seven bent positions increased by one as compared with the getter spring 81 to thereby slightly increase the total angle of the bent positions. Thus, the getter spring 16 according to the present invention can be reliably fixed to the CRT even by one-point contact.

A manufacturing method of the getter spring 16 and a method of attaching the getter spring 16 to the CRT will be described below. To make the getter spring inexpensive by improving working efficiency, the getter spring 16 is formed by punching and shaping the SUS 304 (spring material) with a thickness of 0.25 mm, for example. The small hemispherical portion 23, the curved portion 24 and the concave portion 22 extended in the longitudinal direction of the getter spring 16 should preferably be formed at the same time punching is made.

Since the getter spring 81 shown in Figure 1A is cross-shaped while the getter spring 16 according to this embodiment is substantially rectangular (stripe) without using the short stripe portion, the materials can be used efficiently, the getter spring can be manufactured with a material of which amount is about 1/3. Therefore, the getter spring according to the present invention can be produced inexpensively from a material cost standpoint. When the getter spring 81 is manufactured, the getter spring 81 is cut diagonally out of the material as shown in Figure 8B in order to improve the waste of materials. However, if so, then the getter spring 81 is twisted by a heat generated upon getter flash process. On the other

hand, since the getter spring 16 according to this embodiment is cut out of the material perpendicularly to the width direction of the material as shown in Figure 8A, the getter spring 16 according to this embodiment is prevented from being twisted upon getter flash process.

A manner in which the getter spring 16 is attached to the CRT will be described with reference to Figures 9 and 10.

A fluorescent slurry is coated on the inner surface of the panel 61 and then developed (process 711 shown in Figure 10). An intermediate layer is coated thereon (process 712). A reflecting film formed of an aluminum thin film is evaporated thereon by metal-backing (process 713). An aperture grill 62 is assembled (process 714).

A funnel 63 manufactured independently is coupled to the panel 61 (process 715) and fixed to the panel 61 by fusing and crystallizing frit (solder glass) on a bonded surface (process 716).

The getter spring 16 is attached to the electron gun 2 (process 741). The electron gun 2 is disposed within a neck portion 64 and a stem portion and the neck portion 64 are sealed (process 717). The CRT assembly 1 is exhausted and evacuated (process 718).

After the exhausting process 718, the inside of the CRT assembly 1 is kept at highly vacuum state in a getter flash process (process 719).

An aging process (process 720) and an inspection process are carried out. Then, the assembling process of the

CRT is completed.

In the above-mentioned getter flash process, the getter mounted on the container 15 is heated by a high-frequency heating device 41 (shown in Figure 7C) disposed outside the funnel and thereby evaporated. Barium Ba (getter) is evaporated on the inner surface of the CRT assembly to form a film. In the aging process, if the voltage is applied to the first and second grids G1, G2 and a current is flowed to the cathode at the same time the heater is energized, then a gas remaining in the CRT assembly is easily absorbed by the getter in the CRT treated by the getter flash process, resulting in the inside of the CRT assembly being kept at higher vacuum state.

Function and action of the getter spring according to this embodiment will be described.

A most specific feature of the present invention is to prevent a heat, generated from the getter upon getter flash, from being conducted to the funnel glass 1 as much as possible.

As shown in Figure 7B, a thermal barrier is formed at the surface on which the container 15 mounted with the getter 92 thereon and the getter spring 16 contact with each other. Specifically, the getter spring 16 supports the container 15 in a state that the positions 41a, 41b of the wide portion 28 are fixed by welding on the bottom surface 15a of the container 15, the tip end of the small hemispherical portion 23 is brought in contact therewith at a point 41 and other portions thereof are not in contact therewith. With this arrangement, even if the getter 92 stored in the container 15 is heated to a high

temperature, e.g., about 1200°C by high-frequency heating from the outside of the CRT assembly, then there is a space serving as a thermal barrier between the container 15 and the getter spring 16 except the welded portions 41a, 41b and the point contact portion 23 thereof. The space is kept at a vacuum state by the exhausting process, thereby avoiding a convection. Therefore, a heat is not conducted therebetween. Moreover, since the contact portion therebetween is limited to the above welded portions and the point contact portion, it is possible to considerably reduce an amount of the thermal conduction therebetween. In particular, since the point contact portion is a very small area, a large amount of heat can be prevented from being conducted rapidly.

As shown in Figure 7C, a length of thermal conduction path is devised. Specifically, when a heat is conducted from the welded portions 41a, 41b to the curved portion 24 (at which the getter spring 16 is brought in contact with the funnel glass 1a of the CRT assembly 1) in the longitudinal direction of the getter spring 16, the heat conduction path is considerably long. Therefore, it can be expected that the temperature at the curved portion 24 is lowered considerably. Although the other thermal conduction path from the bottom surface 15a of the container 15 through the small hemispherical portion 23 to the curved portion 24 is comparatively short, the bottom surface 15a and the small hemispherical portion 23 are in contact with each other at a point having a very small area. Therefore, it is difficult for the other thermal conduction path to conduct a large amount of

heat rapidly.

Moreover, since the curved portion 24 provided at the head end of the getter spring 16 is convex-shaped and curved, the getter spring 16 and the funnel glass 1a are in contact with each other at a point. Therefore, the contact area therebetween is limited.

Since an amount of heat radiated directly from the getter 92 and the container 15 is very small as compared with an amount of heat conducted through the getter spring 16, it is possible to disregard the amount of the heat of the thermal radiation.

Effects of the getter spring 16 according to this embodiment will be described.

When the getter spring 16 according to the present invention was used, the temperature measured at the contact surface between the curved portion 24 of the getter spring 16 and the funnel glass 1a upon getter flash process was about 640 °C which was a mean value of measured values. When the getter spring 81 shown in Figure 1A was used, the temperature measured at the contact surface of the getter spring 81 and the funnel glass 1a was about 740 °C which was a mean value of measured values. As can be understood from the compared results, the temperature obtained when the getter spring 16 was used is lowered by about 100 °C as compared with the temperature obtained when the getter spring 81 was used. Moreover, since the temperature at which the funnel glass 1a can be resistant to heat is about 750 °C, the difference (temperature margin)

between the temperature and the above means value (i.e., 740 °C) obtained when the getter spring was used was only about 10 °C. However, when the getter spring 16 according to this embodiment was used, the difference between the temperature at which the funnel glass 1a can be resistant to a heat and the means value (i.e., about 640 °C) obtained when the getter spring 16 was used increases to 110 °C. Therefore, even if the above difference in temperature (i.e., about 110 °C) is lowered by some factors such as difference in CRT specification and dispersion in manufacturing process or the like, it is possible to provide the CRT in which the funnel glass 1a can be prevented from being cracked upon getter flash process.

According to this embodiment, the container 15 is fixed on the getter spring 16 at one portion thereof and slidably supported by the getter spring 16 at a contact point. Therefore, even when the getter 92 was heated upon getter flash process and the container 15 with the getter 92 stored therein was heated to a relatively high temperature as compared with the getter spring 16, the getter spring 16 was not deformed due to difference in thermal expansion between the getter spring 16 and the container 15 and they were not detached from each other at the welded portion.

According to the getter spring 16 and the CRT using the same, it is possible to solve the problem of the crack produced on the funnel glass 1a of the getter spring 81 and the CRT using the same without modifying considerably the arrangements of the getter spring 16 and the CRT using the same.

from the arrangements of the getter spring 81 and the CRT using the same but with simply changing the shape of the getter spring 81 to that of the getter spring 16.

According to this embodiment, while the getter spring 81 has a short stripe portion extended in the direction perpendicular to the longitudinal direction thereof, the getter spring 16 does not have such a short stripe portion. Therefore, it is possible for the getter spring 16 to consume about one-thirds material as compared with the getter spring 81 (see Figure 8A) and it is possible to reduce costs of the material.

According to this embodiment, while the getter spring 81 is welded to the container 15 at two portions (see Figure 2C), the getter spring 16 is welded thereto at two positions of the one portion by simultaneous welding (see Figure 7A). Therefore, it is possible to reduce the manufacturing costs. The small hemispherical portion 23 contacting the bottom surface 15a of the container at a contact point can be formed at the same time the getter spring 16 is cut from the material.

Some modifications of this embodiment will be described below. While the getter spring 16 and the CRT using the same according to the present invention have been described so far, the present invention is not limited to the above-described embodiment and a principle of the present invention can also be applied to the following modifications.

For example, while the present invention is applied to the CRT of a specific type in the above-mentioned embodiment, the present invention is not limited thereto and can be applied

to CRTs of any kinds which use the getter flash process to improve the vacuum state therein.

While one end of the getter spring 16 is fixed on the inner deflection electrode plate 3b of the electron gun 2 in the above embodiment, the present invention is not limited thereto. It is sufficient that the getter spring 16 is fixed on any portion in the CRT. For example, the getter spring 16 may be fixed on a proper, arbitrary portion of the electron gun 2.

While the getter spring 16 is welded to the container 15 at one portion including two positions and connected thereto at the other portion which is a contact point, the present invention is not limited thereto because an object of the present invention is to reduce the thermal conduction therebetween. Even when the getter spring 16 is welded to the container 15 at only one position with the wide portion 28 of the getter spring 16 being set sufficiently wide, it is possible to stably fix the container 15 to the getter spring 16. Conversely, the getter spring 16 may be welded to the container 15 at three positions or greater if necessary.

While the getter spring 16 is brought in contact with the container 15 at a point of the small spherical portion (or projection) 23 as described above, the present invention is not limited thereto and the getter spring 16 can be brought in contact with the container 15 at a point. Such point contact can be achieved by shaping either or both of the getter spring 16 and the container 15 properly. For example, instead of forming the small hemispherical portion (or projection) 23 on

the getter spring 16, the small hemispherical portion 23 may be formed on the bottom surface 15a of the container 15 with the getter spring 16 being flat. Alternatively, if one of the getter spring 16 and the container 15 is provided with a ridge-shaped convex portion extended by a proper length and the other thereof is provided with a convex portion extended by a proper length in the direction perpendicular to the above ridge-shaped convex portion, then the getter spring 16 and the container 15 are brought in contact with each other at a point. While they are brought in contact with each other at one point in this embodiment, the present invention is not limited thereto and the number of the contact portions is not limited to one. It is sufficient in the present invention that the point contact therebetween is effected. They may be brought in contact with each other at two points or greater.

While the spoon-shaped curved portion 24 provided at the head of the getter spring 16 is brought in contact with the funnel glass 1a in this embodiment, the present invention is not limited thereto. The present invention requires only reduction of the area of the contact portion between the getter spring 16 and the funnel glass 1a. It is possible to consider various shapes or designs of the getter spring 16 which can reduce the area of the contact portion.

The above-mentioned changes and modifications may be arbitrarily effected in consideration of some necessary factors, such as a temperature at which a funnel glass can be resistant to a heat, a temperature of a getter spring upon the getter

flash process, a margin of temperature determined by CRT specification, manufacturing costs or the like, of the CRT of a specific type to which the present invention is applied.

According to the CRT of the present invention, since the CRT using the getter spring which reduces an amount of the thermal conduction upon getter flash process, there is then the advantage that a quality of the CRT can be improved.

According to the present invention, it is possible to prevent the funnel glass from being cracked without considerably modifying the getter spring 81 shown in Figure 1A and the CRT using the same. As a result, it is possible to considerably increase a yield of the manufactured CRTs.

Moreover, according to the present invention, it is possible to reduce the manufacturing costs as compared with those of the getter spring shown in Figure 1A and the CRT using the same.

Having described preferred embodiments of the present invention with reference to the accompanying drawings, it is to be understood that the present invention is not limited to the above-mentioned embodiments and that various changes and modifications can be effected therein by one skilled in the art without departing from the spirit or scope of the present invention as defined in the appended claims.

CLAIMS

1. A getter spring comprising:
a container for storing a getter therein; and
a spring member for supporting said container,
wherein said container is connected to said spring member by
fixing the former on the latter at one portion and bringing the
former in contact with the latter at a point of the other
portion, thereby an amount of a heat conducted to said spring
member upon a getter flash process being reduced.

2. A getter spring according to claim 1 comprising a
spring member having a small hemispherical portion or
projection, wherein said container is connected to said spring
member by fixing the former on the latter at one portion by
welding, by bringing the former in slidable contact with said
small hemispherical portion or projection of the latter at one
point of the other portion, and by disposing the rest of
portions of the former away from the latter, thereby difference
in thermal expansion between said container and said spring
member being made negligible and an amount of a heat conducted
to said spring member upon getter flash process being reduced.

3. A getter spring disposed in a cathode-ray tube
having a funnel glass and an electron gun, comprising:
a container for storing a getter therein; and
a spring member for supporting said container, said



spring member having a small hemispherical portion or projection and a convex portion, wherein said spring member is formed of a resilient material, shaped so as to have a total angle which is larger than an angle of an inclined surface of said funnel glass of said cathode-ray tube, and fixed in said funnel glass by fixing it on said electron gun at its one end by welding so as to be extended along said inclined surface of said funnel glass at an interval, and by bringing it in contact with said funnel glass at a concave portion provided at the other end of said spring member at one point, and wherein said container is connected to said spring member by fixing the former on the latter by welding at a position comparatively away from said concave portion provided at the other end and by bringing the former in slidable contact with said small hemispherical of the latter at one point of contact of the other portion comparatively close thereto, thereby difference in thermal expansion between said container and said spring member being made negligible and an amount of heat conducted to said spring member upon getter flash process being reduced.

4. A cathode-ray tube having a getter which is to be used upon getter flash process and which is disposed in its cathode ray tube assembly, comprising

a getter spring according to any one of claims 1 to 3 for supporting said getter.

