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(54) **Flat cathode ray tube and picture display device using the same**

(57) A flat cathode ray tube (CRT) capable of producing clear pictures and a picture display device using the flat CRT. A light-attenuation film (17) having a light-attenuating action is attached to the front surface of a front panel (12). The quantity of light of an extraneous ray passing into the front panel (12) is reduced by the light-attenuation film (17) when passing through the front panel (12) and when reflected by a phosphor layer. The quantity of light of a ray for picture formation is also reduced by the light-attenuation film (17). However, the quantity of light reduced in the case of the ray for picture formation is smaller relatively to that of the extraneous ray. Thus, a picture observed becomes clearer.

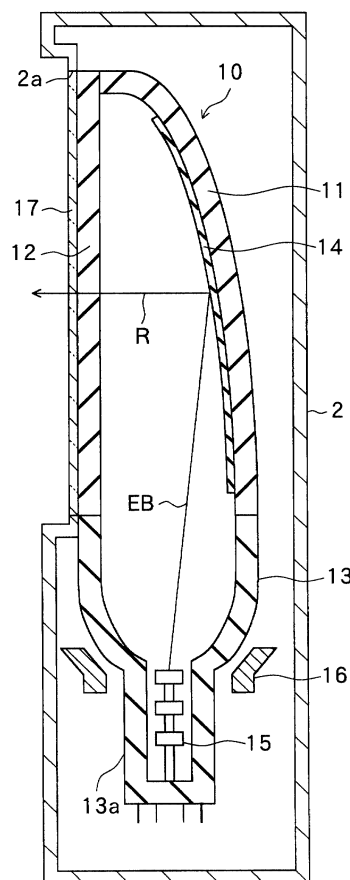


FIG.3

EP 1 104 001 A2

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The invention relates to a flat CRT (Cathode Ray Tube) which produces an optical picture made visible by phosphors excited through the scanning of an electron beam. The invention also relates to a picture display device using the flat CRT.

2. Description of the Related Art

[0002] In recent years, wall-hung television sets of small depth dimensions have received the attention of the market. Reflection-mode or transmission-mode flat CRTs, liquid crystal displays, plasma display panels or others have been developed. Especially, flat CRTs are known for their low manufacturing cost and high picture quality. Applications of flat CRTs include picture display devices such as a monitor of a front-door intercom.

[0003] In the related art, a picture display device (for example, a monitor of a front-door intercom) having a display unit using this type of reflection-mode flat CRT has a configuration as illustrated in, for example, Fig. 1. The picture display device 200 comprises a flat CRT 100 incorporated inside a casing 201. The casing 201 has a window 201a in the front. The flat CRT 100 comprises a screen panel 101, a front panel (a display panel) 102 and a funnel 103 having a neck 103a, which conjointly form a three-part structure defining a flat glass bulb. Inside the screen panel 101, an electrode layer, although not shown, is provided. Over the electrode layer, a phosphor layer 104 is provided. In the funnel 103, an electron gun 105 is incorporated in the neck 103a. An electron beam EB emitted by the electron gun 105 is deflected under control of a deflection yoke 106 and strikes the phosphor layer 104. In the window 201a of the casing 201, a filter 202 made of a resin is provided for protection of the front panel 102 of the flat CRT 100 and for contrast control.

[0004] In the picture display device 200, the electron beam EB emitted by the electron gun 105 strikes the phosphor layer 104 to cause the phosphor layer 104 to be excited for light emission, and thereby a picture ray R is produced. The picture ray R is observed as a picture from in front, through the front panel 102 and the filter 202.

[0005] As noted above, in the related art picture display device 200, the filter 202 is provided in the window 201a of the casing 201. Such configuration has some problems, which are explained below. First, as shown in Fig. 1, an extraneous ray R1 is reflected by the front surface of the filter 202 (i.e., the interface of the filter 202 and the atmosphere) and by the back surface of the filter 202 (i.e., the interface of the filter 202 and the inside of the casing 201). The reflected rays R10 and R11

cause what is called ghost images of the surroundings over the picture produced on the front panel 102, preventing one from seeing the picture clearly. In addition, in the flat CRT 100 itself, the extraneous ray passes through the filter 202 and is reflected by the front surface of the front panel 102 and by the back surface of the front panel 102 (i.e., the interface between the front panel 102 and the inside of the flat CRT 100). The reflected rays R12 and R13 cause a deterioration in the contrast of the picture produced on the front panel 102, resulting in poor sharpness.

SUMMARY OF THE INVENTION

[0006] The invention has been made to overcome the foregoing problems. An object of the invention is to provide a flat CRT capable of suppressing occurrences of reflected rays of extraneous rays to provide clear pictures and a picture display device using the flat CRT.

[0007] A flat CRT according to the invention comprises reflected ray reducing means for reducing the quantity of light of a reflected ray which occurs when an extraneous ray passing into the display panel is reflected by the display panel or by the fluorescent screen. Specifically, the reflected ray reducing means is a light-attenuation film which is provided on the front surface of the display panel, and reduces the quantity of light of a transmitted ray occurring when the extraneous ray is transmitted through the display panel, and reduces the quantity of light of a reflected ray occurring when the transmitted ray is reflected by the fluorescent screen. In another alternative, the reflected ray reducing means is an anti-reflection film which prevents the extraneous ray from being reflected by the display panel.

[0008] Another flat CRT according to the invention is one wherein the display panel has a reflected ray reducing function of reducing the quantity of light of a reflected ray which occurs when an extraneous ray passing into the display panel is reflected by the display panel or by the fluorescent screen.

[0009] A picture display device according to the invention comprises a casing and a flat CRT which comprises a display panel arranged facing a fluorescent screen and is installed in the casing, wherein the flat CRT comprises reflected ray reducing means for reducing the quantity of light of a reflected ray which occurs when an extraneous ray passing into the display panel is reflected by the display panel or by the fluorescent screen.

[0010] In a flat CRT or a picture display device, by the reflected ray reducing means, the quantity of light of a reflected ray which occurs when an extraneous ray passing into the display panel is reflected by the display panel or by the fluorescent screen is reduced. This makes a picture clearer.

[0011] Other and further objects, features and advantages of the invention will appear more fully from the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] Fig. 1 is a sectional view for illustrating the structure of a picture display device according to a related art.

[0013] Fig. 2 is a perspective view of an overall configuration of a picture display device according to a first embodiment of the invention.

[0014] Fig. 3 is a sectional view of the picture display device shown in Fig. 2.

[0015] Fig. 4A is a sectional view for illustrating a flat CRT in the related art.

[0016] Fig. 4B is a sectional view for illustrating the action of a light-attenuation film in a flat CRT shown in Fig. 3, in comparison with Fig. 4A.

[0017] Fig. 5A is a sectional view for illustrating a flat CRT in the related art.

[0018] Fig. 5B is a sectional view for illustrating the action of an anti-reflection film in a flat CRT according to a second embodiment of the invention, in comparison with Fig. 5A.

[0019] Fig. 6 is a sectional view for illustrating a modification of the flat CRT shown in Fig. 5B.

[0020] Fig. 7 is a schematic perspective view of an overall configuration of a flat CRT according to a third embodiment of the invention.

[0021] Fig. 8A is a sectional view for illustrating a flat CRT in the related art.

[0022] Fig. 8B is a sectional view for illustrating the action of a light-attenuation film and an adhesive film in the flat CRT shown in Fig. 7.

[0023] Fig. 9 is a sectional view for illustrating the structure of a flat CRT according to another embodiment of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0024] Preferred embodiments of the invention will now be described in detail below with reference to the drawings.

First Embodiment

[0025] As shown in Fig. 2, a picture display device 1 (for example, a monitor of a front-door intercom) according to a first embodiment of the invention comprises a reflection-mode flat CRT 10 incorporated in a casing 2. In the picture display device 1, the flat CRT 10 produces a picture in a window 2a for image display. On top of the casing 2, positioned is a handset 3 for sending and receiving audio information.

[0026] Referring to Fig. 3, the flat CRT 10 comprises a screen panel 11, a front panel (a display panel) 12 and a funnel 13 having a neck 13a, which conjointly form a three-part structure defining a flat glass bulb. The screen panel 11 is made of, for example, clear glass and is curved in form. The front panel 12 is also made of

clear glass. In the funnel 13, an electron gun 15 is incorporated in the neck 13a. An electron beam EB emitted by the electron gun 15 is deflected under control of a deflection yoke 16.

[0027] Over the inner wall of the screen panel 11, i.e., the surface facing the front panel 12, provided is an electrode layer, although not shown. The electrode layer is deposited by depositing, for example, aluminum (A1). The electrode layer also serves as a reflecting layer. The electrode layer is coated with a phosphor layer 14 to define an available picture area. The phosphor layer 14 is comprised of a fluorescent material such as yttrium oxide sulfate (Y_2O_3S).

[0028] Over the inner surface of the funnel 13, provided is a conductive film, although not shown. The conductive film is comprised of indium-tin oxide (ITO), i.e., a film of a mixture of oxides of indium and tin. The electrode layer deposited over the inner wall of the screen panel 11 is electrically coupled to a voltage application terminal, although not shown, through the conductive film. The configuration as noted above is the same as that of a flat CRT according to the related art.

[0029] In the flat CRT 10 according to the embodiment, a light-attenuation film 17 having a light-attenuating action is attached to the outer surface of the front panel 12 using, for example, acrylic pressure-sensitive adhesive. The light-attenuation film 17 is comprised of an achromatic (i.e., gray) polyethylene terephthalate (PET) material. The configuration of the light-attenuation film is not limited to a single-layered structure; for example, the light-attenuation film may have a laminated structure in which a coating made of a metal oxide such as chromium oxide is laid over a colorless, clear film. The light-attenuation film is arranged facing the window 2a provided in the casing 2.

[0030] In the flat CRT 10 according to the embodiment, the electron beam EB emitted by the electron gun 15 passes through the open end of the funnel 13, and is accelerated toward the electrode layer of the screen panel 11, and strikes the phosphor layer 14. This causes the phosphor layer 14 to be excited for light emission. The light emitted is reflected by the reflecting layer, i.e., the electrode layer, and thereby a picture ray R is produced. The picture ray R produces a picture for display, through the front panel 12 and the light-attenuation film 17.

[0031] Description now moves to the action of the light-attenuation film 17, referring to Figs. 4A and 4B.

[0032] In the flat CRT 100 according to the related art, as shown in Fig. 4A, the extraneous ray R1 is transmitted through the front panel 102, and is reflected by the phosphor layer 104. The reflected ray R2 is transmitted through the front panel 102 again to be released to the outside of the flat CRT 100. The reflected ray R2 causes a phenomenon in which black grows fainter, preventing one from seeing clearly a picture produced on the front panel 102.

[0033] In contrast, as shown in Fig. 4B, in the flat CRT

10 according to the embodiment, the extraneous ray R1 is attenuated by the light-attenuation film 17 before arriving at the front panel 12, resulting in a reduction in the quantity of light of the extraneous ray R1 transmitted through the front panel 12. The transmitted ray R1a strikes the phosphor layer 14. The transmitted ray R1a is reflected by the phosphor layer 14, and the reflected ray R3a is transmitted through the front panel 12 again. Then, the reflected ray R3a is transmitted through the light-attenuation film 17, which further reduces the quantity of light of the reflected ray R3a. Thus, the transmitted ray R3b having less quantity of light is released to the outside.

[0034] Let the transmittance of the light-attenuation film 17 according to the embodiment be $t\%$, and let the quantity of light of the extraneous ray R1 be L . Then, the quantity of light of the transmitted ray R1a and the reflected ray R3a is equal to Lt , and the quantity of light of the transmitted ray R3b is equal to Lt^2 . Further, let the quantity of light of the picture ray R (see Fig. 3) be 1. Then, the quantity of light of the extraneous ray R1 transmitted through the front panel 12 and through the light-attenuation film 17 is equal to Lt . Thus, to illustrate, for the conditions where $L=1$ and $t=50\%$, the quantity of light reduced when the picture ray R is transmitted through the front panel 12 and through the light-attenuation film 17 is one-half ($1/2$) the quantity of light reduced when the extraneous ray R1 is reflected by the phosphor layer 14 and then released to the outside through the front panel 12 (that is, the transmitted ray R3b).

[0035] As described above, in the flat CRT 10 according to the embodiment, the light-attenuation film 17 is attached directly to the front surface of the front panel 12. Therefore, the extraneous ray R1 passing into the flat CRT 10 is reduced in the quantity of light by the light-attenuation film 17 when passing through the front panel 12 and when reflected by the phosphor layer 14. Obviously, the quantity of light of the picture ray R is reduced by the light-attenuation film 17, but the quantity of light reduced is small relatively to that of the extraneous ray R1. Thus, a picture observed becomes clearer as compared to the related art.

[0036] In the embodiment, the light-attenuation film 17 is attached to the front panel 12. However, instead of attachment of the light-attenuation film, the front panel 12 may be made of a glass material having a light-attenuating action, for example, a glass material referred to as tint or dark tint having transmittance of the order of 55 % or less per unit thickness (i.e., 10.16 mm). The effect obtained in this case is the same as described above.

[0037] Furthermore, it is possible to provide not only the light-attenuation film 17 but also the adhesive for attaching the light-attenuation film 17 to the front panel 12 with a light-attenuating action by coloring the adhesive for attaching the light-attenuation film 17 to the front panel 12.

Second Embodiment

[0038] In the embodiment, as shown in Fig. 5B, an anti-reflection film (an anti-reflection (AR) filter) 18 is attached to the outer surface of the front panel 12. Otherwise, the configuration in the embodiment is the same as that in the first embodiment, and like reference characters refer to like parts and the description thereof will be omitted.

[0039] As the anti-reflection film 18, one disclosed in, for example, Publication of Japanese Unexamined Patent Application No. Hei 11-250805 or Publication of Japanese Unexamined Patent Application No. Hei 10-187056 may be of use; specifically, one in which a metal film made of, for example, chromium (Cr) is deposited by, for example, sputtering over a plastic film base material such as a polyethylene terephthalate (PET) film and then a dielectric film (SiO_2) is deposited over the metal film. The anti-reflection film 18 is attached to the front panel 12 using, for example, acrylic pressure-sensitive adhesive. Preferably, the film thickness of the metal film of the anti-reflection film 18 is selected to be one-quarter or an odd multiple of one-quarter the wavelength of the light in terms of the optical film thickness so that the transmittance will be small. As used herein, the optical film thickness is given by the product of the refractive index of the coating material and the film thickness of the coating.

[0040] Reference is now made to Figs. 5A and 5B, explaining the action of the anti-reflection film 18.

[0041] In the flat CRT 100 according to the related art, as shown in Fig. 5A, the extraneous ray R1 passing into the flat CRT 100 is reflected by the front surface of the front panel 102 (i.e., the interface between the front panel 102 and the atmosphere) and by the back surface of the front panel 102 (i.e., the interface between the front panel 102 and the inside of the flat CRT 100). Reflected rays R4 and R5 prevent one from seeing clearly a picture produced on the front panel 102.

[0042] In contrast, in the embodiment, as shown in Fig. 5B, the extraneous ray R1 is reflected by the front surface of the front panel 12 (i.e., the interface between the front panel 12 and the atmosphere) and the back surface of the front panel 12 (i.e., the interface between the front panel 12 and the inside of the flat CRT 10). Thus, reflected rays R6 and R7 occur. As distinct from the case of Fig. 5A, in the embodiment, the anti-reflection film 18 is provided over the front surface of the front panel 12. Therefore, the quantity of light of the reflected ray R6 reflected by the front surface of the front panel 12 is reduced as compared to the case of the reflected ray R4 in the related art.

[0043] As described above, in the embodiment, since the anti-reflection film 18 is provided over the front surface of the front panel 12, the reflected ray of the extraneous ray R1 reflected by the front panel 12 is reduced. Therefore, a picture observed becomes clearer, as compared to the related art.

[0044] In the embodiment, the light-attenuation film 17 or the anti-reflection film 18 is attached to the front surface of the front panel 12. However, as shown in Fig. 6, an anti-reflection/light-attenuation film 19 having both an anti-reflective action and a light-attenuating action may be attached to the front panel 12. As the anti-reflection/light-attenuation film 19, one having a laminated structure of the light-attenuation film and the anti-reflection film as described above may be of use.

[0045] In the embodiment, the extraneous ray R1 is reflected in part by the anti-reflection/light-attenuation film 19 and by the front panel 12, and thereby a reflected ray R8 occurs. The remaining extraneous ray R1 transmitted through the anti-reflection/light-attenuation film 19, i.e., a transmitted ray R14, strikes the phosphor layer 14. As explained in the second embodiment, the quantity of light of the reflected ray R8 is reduced as compared with the case without the anti-reflection/light-attenuation film 19. Also, as explained in the first embodiment, the quantity of light of the transmitted ray R14 is reduced, and therefore the quantity of light of a ray which is reflected by the phosphor layer 14 and is transmitted again through the front panel 12 is also reduced. Thus, a picture observed becomes clearer, as is the case in the embodiment described above.

[0046] In general, the front panel 12 as mentioned above is formed by cutting a glass plate. Therefore, the cutting process or assembly of flat CRTs often causes scratches on the surfaces of the front panel 12. If the front panel 12 has been scratched before the above-mentioned light-attenuation film 17, the anti-reflection film 18 or the anti-reflection/light-attenuation film 19 is attached to the front surface of the front panel 12, the scratches prevent one from seeing clearly a picture produced on the front panel 12. Scratched front panels or flat CRTs having scratched front panels are disposed of without being used as final products, resulting in the possibility of increasing waste and the manufacturing cost of flat CRTs. The following description relates to a flat CRT capable of making a picture observed clearer and making scratches inconspicuous.

Third Embodiment

[0047] Referring to Fig. 7, in a flat CRT 10a according to a third embodiment of the invention, the light-attenuation film 17 as explained related to the first embodiment is attached to the front panel 12a having a scratch 21, with an adhesive film 20 in between. Otherwise, the configuration of the embodiment is the same as the first embodiment.

[0048] The adhesive film 20 is provided for attaching the light-attenuation film 17 to the front panel 12a. At the same time, if the front panel 12a has a scratch 21, the adhesive film 20 fills in the scratch 21. The adhesive film 20 is made of, for example, a UV-setting resin which sets when irradiated with ultraviolet radiation. Preferably, the material of the UV-setting resin is radical polymerization

type and mainly contains photopolymerizing oligomer, photopolymerizing monomer, photopolymerization initiator. The adhesive film 20 is made of such a material, and thereby the scratch 21 is filled in and the light-attenuation film 17 is preferably attached to the front panel 12a.

[0049] Preferably, the refractive index of the adhesive film 20 is substantially the same as the refractive index of the front panel 12a. More preferably, the difference between the refractive index of the adhesive film 20 after setting and the refractive index of the front panel 12a is equal to or smaller than 0.8 %. The adhesive film 20 has such a refractive index, and thereby the scratch 21 is made inconspicuous.

[0050] Preferably, the viscosity coefficient of the material of the adhesive film 20 is set to a suitable value so that the adhesive film 20 can fill in the groove of the scratch 21. Specifically, if the light-attenuation film 17 is made of a polyethylene terephthalate (PET) film having a refractive index of 1.56 to 1.65, it is preferable that the viscosity coefficient of the adhesive film 20 is equal to or smaller than 2 Pa·s.

[0051] The light-attenuation film 17 is attached to the front panel 12a in the following manner. First, the adhesive film 20 is attached to one surface of the light-attenuation film 17. Next, with the surface of the adhesive film 20 contacted with the front panel 12a, the adhesive film 20 is irradiated with ultraviolet radiation through the light-attenuation film 17. Thus, the adhesive film 20 cures, and the light-attenuation film 17 is attached to the front surface of the front panel 12a.

[0052] In the flat CRT 100a according to the related art, as shown in Fig. 8A, the extraneous ray R1 is transmitted through the scratch 121 on the front panel 102a, and is reflected by the phosphor layer 104. The reflected ray R2 prevents one from seeing clearly a picture produced on the front panel 102a. The extraneous ray R1 is also reflected by the area with the scratch 121, and a reflected ray R15 is released to the outside. The reflected ray R15 makes the scratch 121 conspicuous, which detracts from the appearance of a product having the flat CRT 100a or prevents one from seeing clearly a picture produced on the front panel 102a.

[0053] In contrast, in the flat CRT 10a according to the embodiment, as shown in Fig. 8B, the quantity of light of the extraneous ray R1 is reduced by the light-attenuation film 17 before the extraneous ray R1 arrives at the scratch 21 on the front panel 12a, and thereby the quantity of light of the extraneous ray R1 transmitted through is reduced. The scratch 21 is filled in by the adhesive film 20 while the refractive index of the adhesive film 20 is equal to that of the front panel 12a. Therefore, the transmitted light R1a is transmitted through the adhesive film 20 and through the scratch 21 without being reflected by the area with the scratch 21, and strikes the phosphor layer 14. As explained in the first embodiment, the transmitted ray R1a is reflected by the phosphor layer 14. The reflected ray R3a is transmitted through the

front panel 12a and through the adhesive film 20. Then, the reflected ray R3a is transmitted through the light-attenuation film 17 again, and thereby the quantity of light of the reflected ray R3a is further reduced. Thus, the reflected ray R3a with less quantity of light is released to the outside.

[0054] As described above, in the embodiment, the light-attenuation film 17 is attached to the front surface of the front panel 12a with the adhesive film 20 in between. This causes a reduction in the reflected light which occurs when the extraneous ray R1 is reflected by the phosphor layer 14. Also, since the scratch 21 is filled in by the adhesive film 20 having a refractive index approximately equal to that of the front panel 12a, the scratch 21 becomes inconspicuous. This makes a picture observed clearer, as compared with the related art, while enabling the utilization of the front panel 12a with the scratch 21 as a final product, resulting in the effective use of components and a reduction in the manufacturing cost of flat CRTs. In the related art practice, scratched front panels made of glass have been disposed of because they are not used as components of other products. However, the embodiment enables such front panels to be used, resulting in a reduction in waste while achieving the effective use of resources.

[0055] The adhesive film 20 is not limited to UV-setting resins but may be comprised of other materials.

[0056] In the embodiment, first, the adhesive film 20 is attached to the light-attenuation film 17 and then the light-attenuation film 17 is attached to the front panel 12a. However, it is possible to attach the adhesive film 20 to the front surface of the front panel 12a and then attach the light-attenuation film 17 thereto.

[0057] In the embodiment, the light-attenuation film 17 is attached to the front panel 12a having the scratch 21, with the adhesive film 20 in between. However, it is obvious that the light-attenuation film 17 is attached to the front panel with no scratches, with the adhesive film 20 in between.

[0058] In addition, in the embodiment, the light-attenuation film 17 is attached to the front panel 12a. However, the anti-reflection film or the anti-reflection/light-attenuation film as explained in the second embodiment may be used.

[0059] In the first, second and third embodiments as described above, the light-attenuation film 17 or the anti-reflection film 18 is attached to the front surface of the front panel 12 or 12a. This prevents ghost images of the surroundings caused by extraneous rays, offering the effects of enhancing the contrast of a picture and making a picture clearer. Further, as secondary beneficial effects, these films prevent glass-made panels from being scratched or broken, resulting in higher reliability and easy handling. Since the films increase the strength of panels, it becomes possible to make panels thinner, enabling a cost reduction. In addition, since the filter 202 as used in the related art is no longer required for the casing 2, it becomes possible to reduce the thickness

of the casing as compared with the related art, which enables further cost reduction.

[0060] Clearly, in addition to the light-attenuation film or the anti-reflection film as described above, it is possible to lay over these films a protection film for preventing explosion disclosed in, for example, Publication of Japanese Unexamined Patent Application No. Sho 52-87352 or Publication of Japanese Unexamined Patent Application No. Sho 52-87353.

[0061] The invention has been described by referring to the embodiments above. However, the invention is not limited to the embodiments above but various changes and modifications are possible. For example, the above-described embodiments relate to examples where the invention is applied to a reflection-mode flat CRT. However, the invention is also applicable to a transmission-mode flat CRT as shown in Fig. 9. The basic configuration of the transmission-mode flat CRT is the same as that of the reflection-mode flat CRT as shown in Fig. 2, except that no reflecting film is provided over the back surface of the phosphor layer 14 and that the front panel 12 in Fig. 2 serves as a back panel 12b in Fig. 9. In the transmission-mode flat CRT, the light-attenuation film 17 as explained in the first embodiment is attached to the outer surface of the screen panel 11. The electron beam EB emitted by the electron gun 15 strikes the phosphor screen 14, which causes the phosphor screen 14 to be excited for light emission. The light emitted, i.e., the picture ray R, is observed as a picture through the screen panel 11 and through the light-attenuation film 17. The action and effects of the light-attenuation film 17 are the same as those explained related to the first embodiment, and the description thereof will be omitted.

[0062] In the first and second embodiments, a film such as the light-attenuation film 17 is attached to the front panel. However, it is possible to deposit a film having the same functions as the film, over the surface of the front panel by sputtering or deposition.

[0063] The embodiments as described above relate to an example where the invention is applied to a monitor of a front-door intercom. However, it is clear that the invention is also applicable to other picture display devices such as portable television sets or car-mounted monitors.

[0064] Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

Claims

1. A flat cathode ray tube comprising a display panel (12) arranged facing a fluorescent screen (14), the flat cathode ray tube (10) comprising:

reflected ray reducing means (17;18;19) for reducing the quantity of light of a reflected ray which occurs when an extraneous ray passing into the display panel (12) is reflected by the display panel (12) or by the fluorescent screen (14).

2. A flat cathode ray tube as claimed in claim 1, wherein the reflected ray reducing means is a light-attenuation film (17) which is provided over the front surface of the display panel (12), and reduces the quantity of light of a transmitted ray occurring when the extraneous ray is transmitted through the display panel (12), and reduces the quantity of light of a reflected ray occurring when the transmitted ray is reflected by the fluorescent screen (14).
3. A flat cathode ray tube as claimed in claim 1, wherein the reflected ray reducing means is an anti-reflection film (18) which is provided over the front surface of the display panel (12), and prevents the extraneous ray from being reflected by the display panel (12).
4. A flat cathode ray tube as claimed in claim 1, wherein the reflected ray reducing means is a film (19) which is provided over the front surface of the display panel (12), and reduces the quantity of light of a transmitted ray occurring when the extraneous ray is transmitted through the display panel (12), and reduces the quantity of light of a reflected ray occurring when the transmitted ray is reflected by the fluorescent screen (14), while having a function of preventing the extraneous ray from being reflected by the display panel (12).
5. A flat cathode ray tube as claimed in claim 1, further comprising a film (20) which is provided over the front surface of the display panel (12a) and has a function of protecting the display panel (12a).
6. A flat cathode ray tube as claimed in claim 4, wherein the film (19) is provided over the front surface of the display panel (12a) with an adhesive film (20) in between.
7. A flat cathode ray tube as claimed in claim 6, wherein the refractive index of the adhesive film (20) is substantially equal to the refractive index of the display panel (12a).
8. A flat cathode ray tube comprising a display panel (12) arranged facing a fluorescent screen (14), wherein the display panel (12) has a reflected ray reducing function of reducing the quantity of light of a reflected ray which occurs when an extraneous ray passing into the display panel (12) is reflected by the display panel (12) or by the fluorescent screen (14).

9. A flat cathode ray tube as claimed in claim 8, wherein the display panel (12) is comprised of a glass material having transmittance of 55 % or less per unit thickness.
10. A picture display device (1) comprising a casing (2) and a flat cathode ray tube (10) which comprises a display panel (12) arranged facing a fluorescent screen (14) and is installed in the casing (2), wherein the flat cathode ray tube (10) comprises reflected ray reducing means (17;18;19) for reducing the quantity of light of a reflected ray which occurs when an extraneous ray passing into the display panel (12) is reflected by the display panel (12) or by the fluorescent screen (14).
11. A picture display device as claimed in claim 10, wherein the reflected ray reducing means (17;18;19) is a film provided over the display panel (12) and the casing (2) has a window (2a) provided facing the film.
12. A picture display device as claimed in claim 11, wherein the film is a light-attenuation film (17) which reduces the quantity of light of a transmitted ray occurring when the extraneous ray is transmitted through the display panel (12), and reduces the quantity of light of a reflected ray occurring when the transmitted ray is reflected by the fluorescent screen (14).
13. A picture display device as claimed in claim 11, wherein the film is an anti-reflection film (18) which prevents the extraneous ray from being reflected by the display panel (12).
14. A picture display device as claimed in claim 11, wherein the film (19) reduces the quantity of light of a transmitted ray occurring when the extraneous ray is transmitted through the display panel (12), and reduces the quantity of light of a reflected ray occurring when the transmitted ray is reflected by the fluorescent screen (14), while having a function of preventing the extraneous ray from being reflected by the display panel (12).
15. A picture display device as claimed in claim 10, wherein the flat cathode ray tube (10) further comprises a film (20) which is provided over the front surface of the display panel (12a) and has a function of protecting the display panel (12a).
16. A picture display device as claimed in claim 14, wherein the film (17;18;19) is provided over the front surface of the display panel (12a) with an adhesive film (20) in between.
17. A picture display device as claimed in claim 16,

wherein the refractive index of the adhesive film (20) is substantially equal to the refractive index of the display panel (12a).

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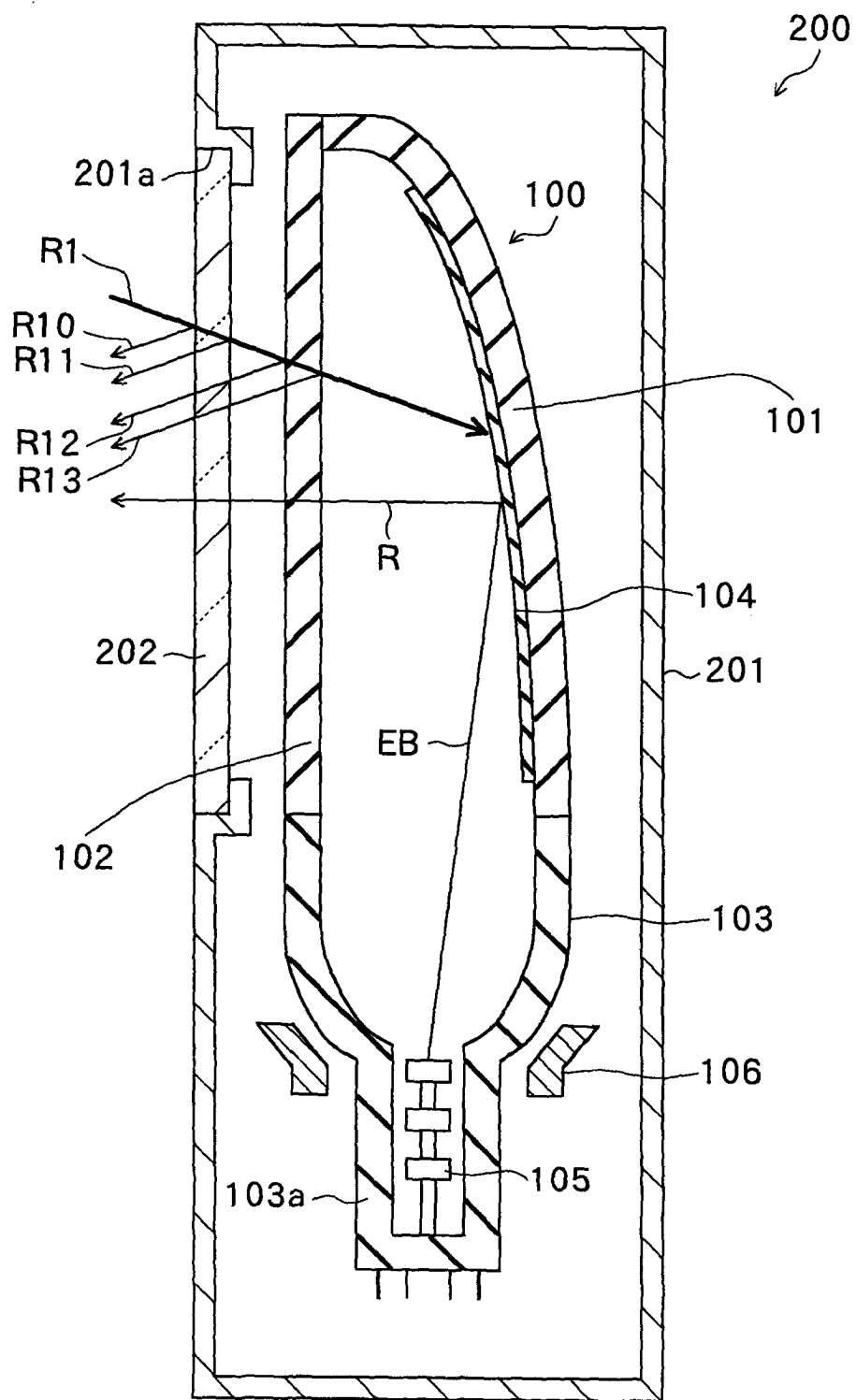


FIG.1
RELATED ART

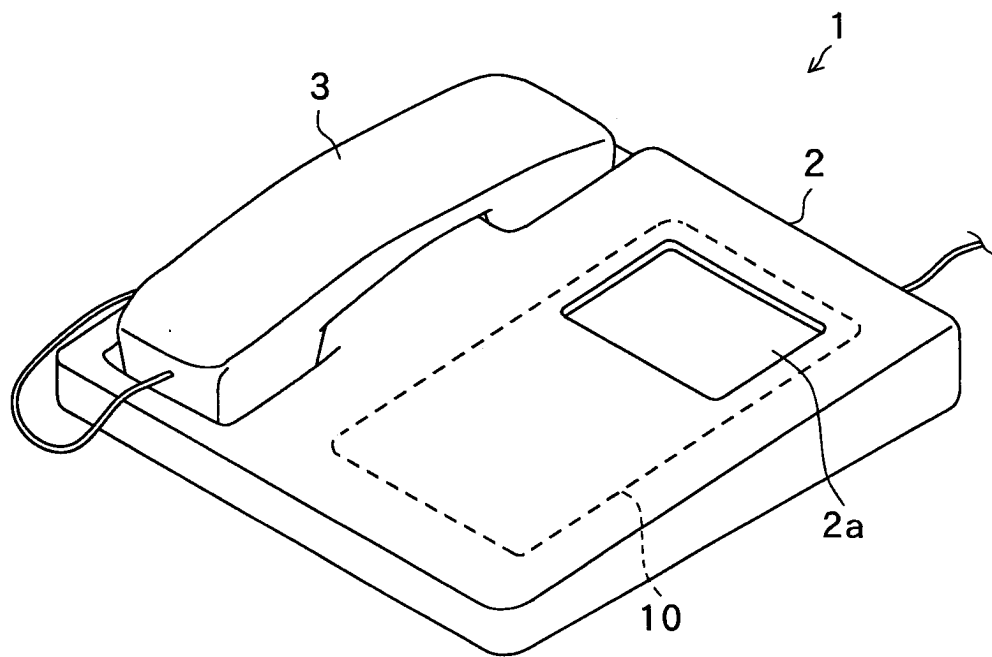


FIG.2

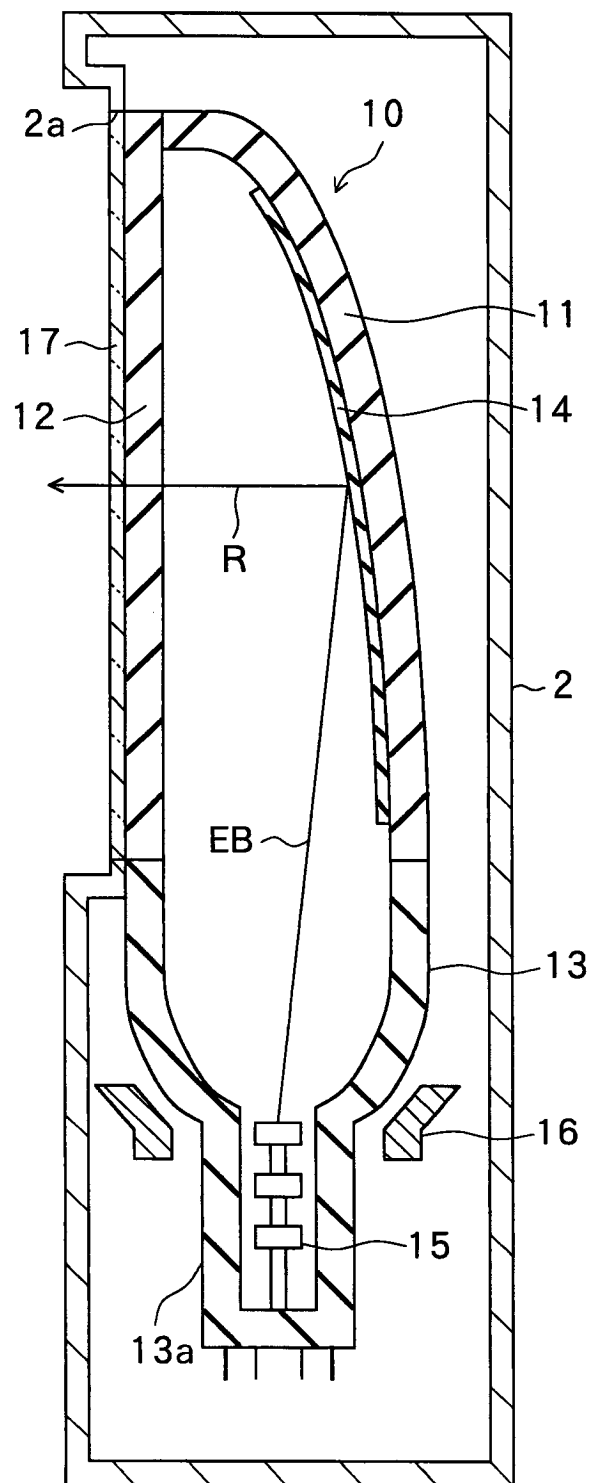


FIG.3

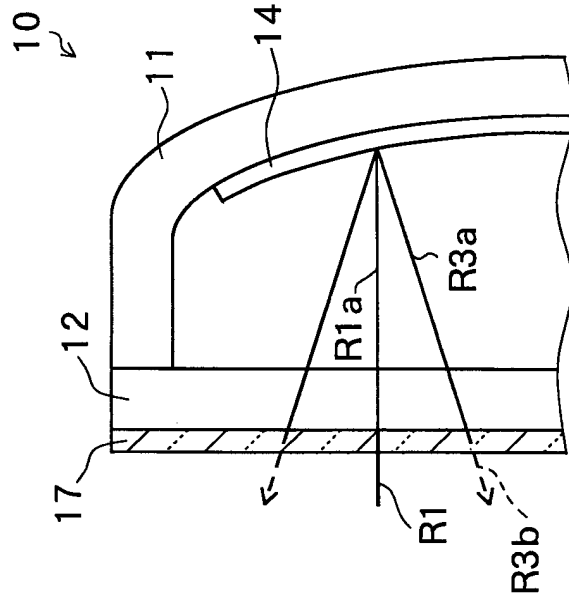


FIG. 4B

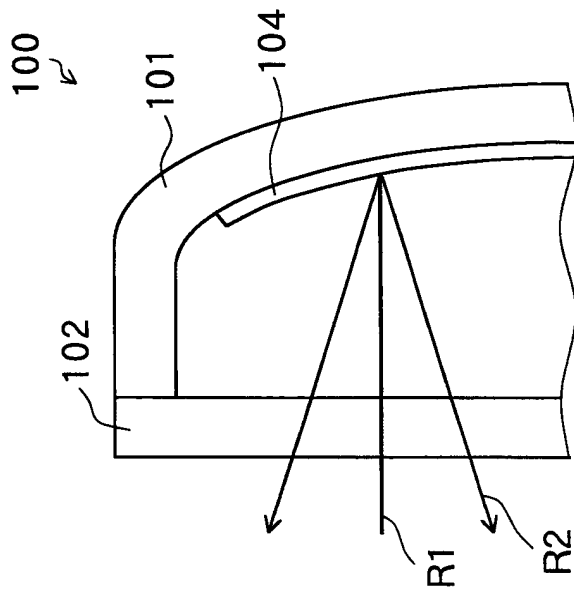


FIG.4A
RELATED ART

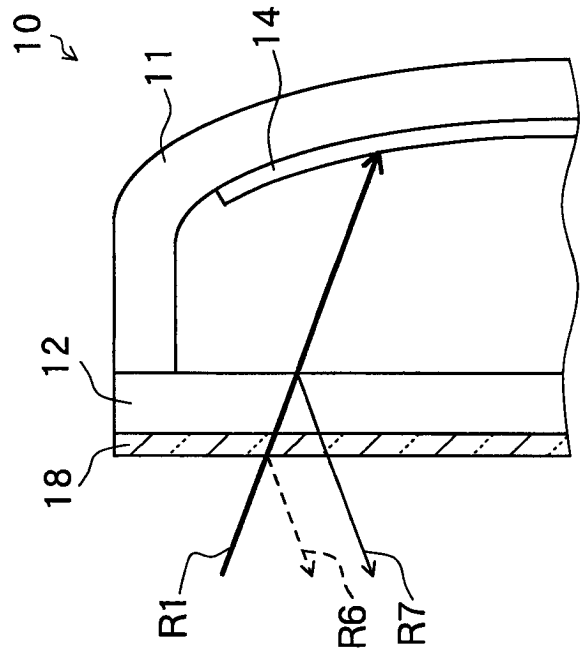


FIG. 5A
RELATED ART

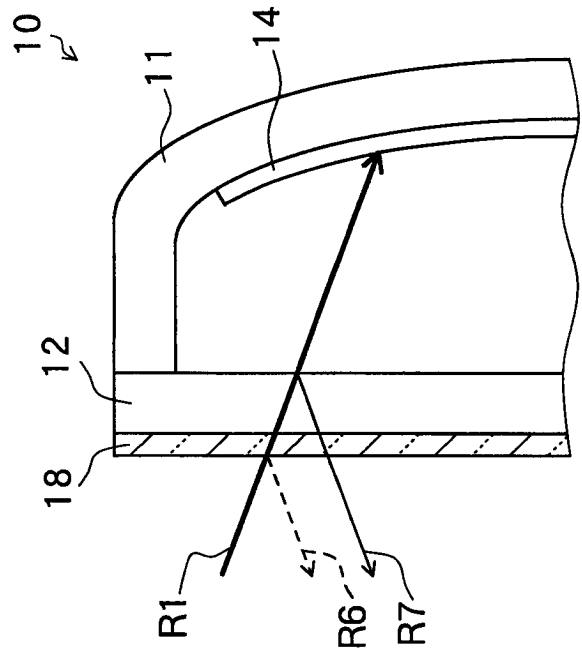


FIG. 5B

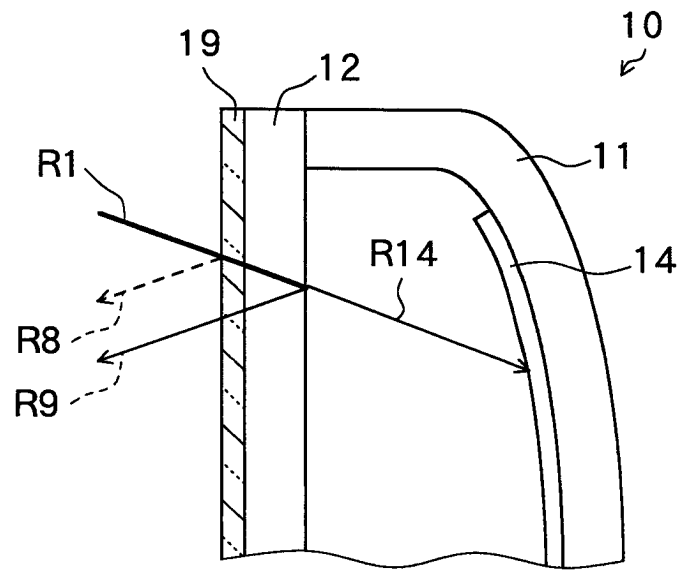


FIG. 6

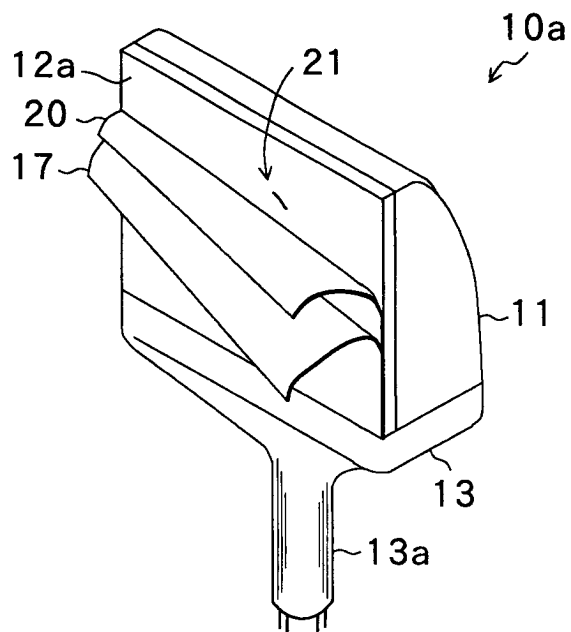


FIG. 7

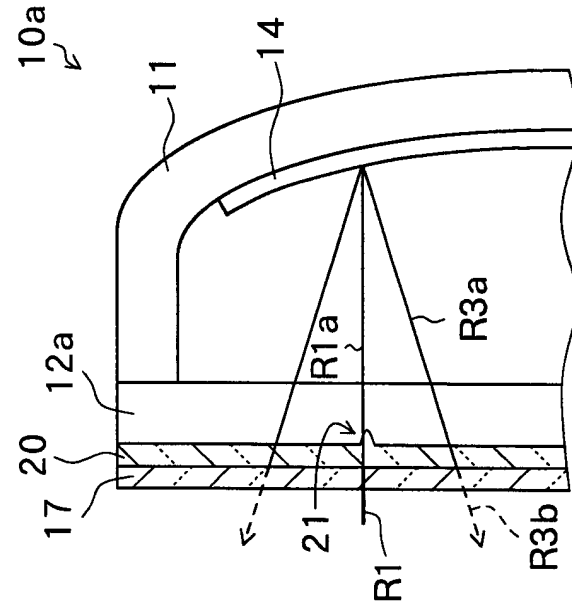
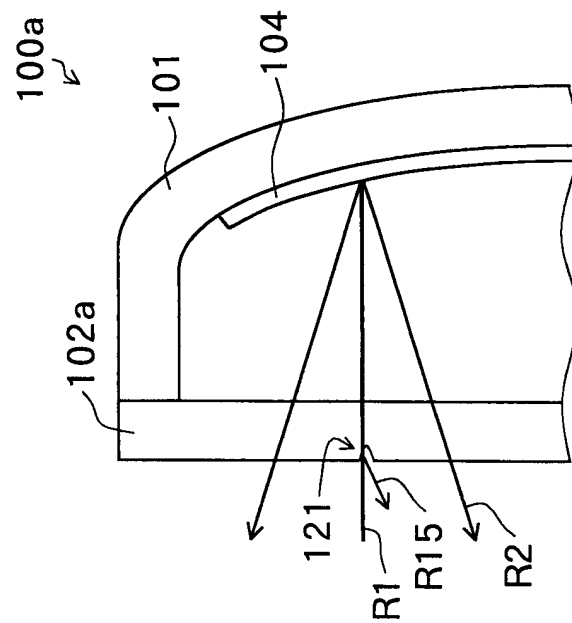


FIG. 8B



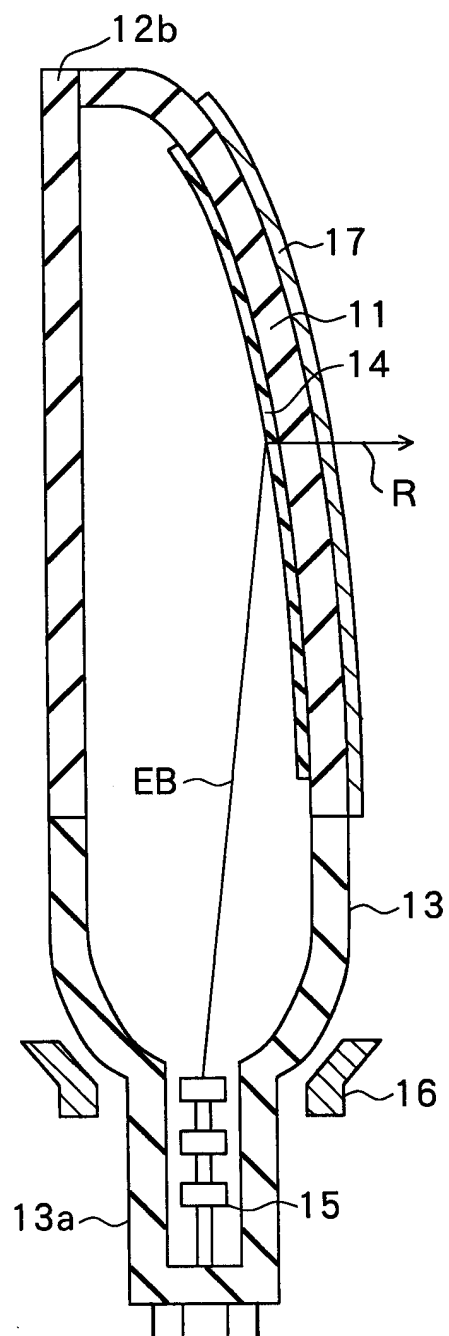


FIG.9