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TITLE OF THE INVENTION

PROJECTION DISPLAY APPARATUS AND HEAT DISSIPATING
METHOD

BACKGROUND OF THE INVENTION

5 The present invention relates to a projection
display apparatus in which a projection tube and screen
are arranged in its housing and a heat dissipating
method therefor and, more particularly, to a projection
display apparatus in which an opening for dissipating
10 heat of a projection tube is formed in its housing and
a heat dissipating method therefor.

 Recently, as the size of a television set
increases, a projection television set has been
developed and become very popular as a projection
15 display apparatus. In a projection television set, a
screen and projection tube are arranged in a housing.
A larger screen than that in a television set using a
cathode-ray tube is provided.

 FIGS. 7A, 7B, and 7C are views showing an
20 embodiment of a conventional projection television set,
in which FIGS. 7A and 7B are its rear and side views,
respectively, and FIG. 7C is a view of a projection
tube used in it. This projection television set 1 is
constituted by a projection box T and light box L. A
25 reflecting mirror 20 shown in FIG. 7B is formed in the
projection box T. A projection tube 21 shown in
FIG. 7C is set in the light box L. The light box L has



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ventilation ports H in its side and rear surfaces. For example, the projection tube 21 is constituted by a projection lens 8, radiator/picture projection tube fixing metal member 9, picture projection tube phosphor screen 10, picture projection tube 11, deflecting yoke 12, and the like. An example of the projection television set is disclosed in Jpn. Pat. Appln. KOKAI Publication No. 2-94784.

Heat dissipation of this projection television set is performed as follows. Air heated by electric circuit components on a circuit board, the picture projection tube, and the deflecting yoke for scanning an image from the picture projection tube by deflection is taken in through the ventilation ports H in the bottom surface (not shown) and side surfaces (lower than the phosphor screen of the picture projection tube) of the television set. Heat is then dissipated from the ventilation ports H in the rear surface and side surfaces (lower than the phosphor screen of the picture projection tube) of the television set. This causes convection of air in the television set, so an increase in internal temperature is decreased.

In a conventional projection television set, the heat dissipating openings of the television set cabinet are formed in the light box L where the projection tube 21 and the like are set. Accordingly, these openings can only be formed lower than the phosphor screen of

the picture projection tube. Thus, heat generated by the picture projection tube and deflecting yoke cannot be exhausted to the outside of the television set efficiently. This is because no openings are formed above the heat source (the picture projection tube, the deflecting yoke), and because heat generating components of the electric circuit on the circuit board exist on the bottom surface side of the cabinet. If any opening is to be formed above the phosphor screen of the picture projection tube, external light entering from the opening enters a projection optical path extending from the picture projection tube to the projection screen. This degrades the resolution and contrast of a projection image on the screen.

BRIEF SUMMARY OF THE INVENTION

It is an object of the present invention to provide a projection display apparatus in which a heat dissipating opening and light-shielding plate are arranged in a projection box to dissipate heat of a projection tube and the like without causing interference of external light with a projection optical path, and the heat dissipation effect of the projection tube and the like is improved without degrading the resolution and contrast of a projection image on a screen, leading to improved operating characteristics.

According to the present invention, there is

provided a projection display apparatus comprising a housing including a first box and a second box placed on the first box, a screen formed on a front surface of the second box, projection means for projecting image light toward the screen and arranged such that a main body thereof is mounted in the first box and that a projection surface for the image light is located in the second box, an opening formed in that surface of the second box which is opposite to a surface where the screen is formed, and a light-shielding plate arranged in the second box to extend from the opening toward the projection means so external light from the opening does not enter a projection optical path extending from the projection surface of the projection means to the screen.

The present invention has the above arrangement. Even if an opening 13 for exhausting heat is formed in the projection box T with the screen, since the light-shielding plate 17 (25) is prepared, external light from the opening does not interfere with the projection optical path 14. The opening 13 can thus be formed at a position higher than in the conventional case. Accordingly, the opening can be set higher than the phosphor screen of the projection tube. Hot air and the like rising from the deflecting yoke which scans an image from the projection tube by deflection can also be exhausted and dissipated efficiently from

the opening at a high position. Thus, a projection display apparatus which has an improved heat dissipating efficiency and a high operation stability can be provided.

5 BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

FIG. 1 is a rear view showing a projection television set according to an embodiment of the present invention;

10 FIGS. 2A to 2C are views showing the projection television set according to the embodiment of the present invention;

FIG. 3 is a view showing the arrangement of picture projection tubes in the projection television set according to the embodiment of the present
15 invention;

FIG. 4 is a side view showing the projection television set according to the embodiment of the present invention;

20 FIG. 5 is a side view showing a projection television set according to another embodiment of the present invention;

FIG. 6 is a side view showing a projection television set according to still another embodiment of the present invention; and

25 FIGS. 7A to 7C are views showing a conventional projection television set.

DETAILED DESCRIPTION OF THE INVENTION

A projection television set according to an embodiment of the present invention will be described in detail with reference to the accompanying drawings. FIGS. 1 to 2C are views showing a projection television set according to an embodiment of the present invention, in which FIGS. 2A, 2B, and 2C are plan, front, and side views, respectively. FIG. 3 is a view showing the layout of picture projection tubes in the projection television set according to the present invention. FIG. 4 is a side view showing the projection television set according to the embodiment of the present invention.

<Projection Television Set of the Present Invention>

Referring to FIGS. 1 to 4, the housing of a projection television set 1 according to the present invention is divided into two portions, i.e., a projection box T and light box L. The light box L mainly incorporates a projection tube 21 and an electric equipment unit 23 including a tuner unit and audio unit. The projection tube 21 has a lens 5, and is attached to either the light box L or projection box T side with a picture projection tube setting metal member 7.

FIG. 2B is a front view of the projection television set 1. A screen S is formed on one surface

of the projection box T. A front panel 26 is formed at the center of the light box L. A control panel 27, power switch 28, and the like are arranged on the front panel 26. Loudspeakers 19 are set on the left and right of the light box L. An audio signal reproduced by the tuner unit and audio unit is reproduced by the loudspeakers 19.

The screen S for receiving an image projected by the projection tube 21 and displaying it is formed on the front surface of the projection box T. A reflecting mirror 20 for receiving image light projected from the projection tube 21 is formed in the projection box T. As shown in FIG. 4, the projection box T as the characteristic feature of the present invention has an opening 13 in its rear surface. A light-shielding plate 17 and the wall surface of the projection box T form a duct 15. The light-shielding plate 17 has projection lens duct holes 18 (see FIG. 3) at, e.g., three portions. The lens 5 of each projection tube 21 described above is exposed from the corresponding duct hole 18 to the inside of the projection box T. A blower 22 may be suitably provided, as shown in FIG. 4. This can promote the heat dissipation effect.

In the projection television set with the arrangement according to the present invention, for example, a reception signal received by an antenna is

decoded by the tuner unit and reproduced to form a video signal. Alternatively, a video signal is supplied from a VTR (a video tape recorder) or the like. The electric equipment unit 23 receives such a video signal, amplifies it, and supplies it to the projection tube 21. The projection tube 21 projects image light.

The image light projected by the projection tube 21 irradiates the reflecting mirror 20 once, and its reflected light is projected to the screen S to form an image.

In this projection television set 1, the exhaust duct 15 as the characteristic feature of the present invention has the opening 13 described above. Since the light-shielding plate 17 is arranged to shield external light entering from the opening 13, the external light does not enter a projection optical path 14. When heat in the box is exhausted by the blower 22 or the like, heat generated by the projection tube 21, a deflecting yoke, and the like can be sufficiently dissipated. Alternatively, outer air may be taken into the box through the opening 13 to cool the projection tube 21, deflecting yoke, and the like.

It should be noted that in the arrangement of the exhaust duct 15 of the present invention, the opening 13 of the duct 15 can be set at almost the same height or higher than a picture projection tube phosphor

screen 10 and deflecting yoke 12 which particularly require heat dissipation. As a heat component tends to diffuse upward, the duct 15 can show a higher heat dissipation effect than in the conventional device.

5 With the light-shielding plate 17, interference of external light with the projection optical path 14 can be prevented. A drawback in that the resolution, contrast, and brightness of an image projected onto the screen may be degraded can be removed. Thus, the
10 exhaust duct 15 with a high heat dissipation effect can be provided.

Besides, the temperature increase of a cooling liquid in the radiator/picture projection tube fixing metal member 9 can be suppressed. A change in focus
15 quality of the projection image on the screen which is caused by a change in the refractive index for light accompanying the temperature increase of the cooling liquid can be decreased. Also, a change in the convergence quality caused by a distortion due to
20 expansion and shrinkage of the screen upon a temperature increase in the television set can also be decreased.

<Other Embodiments of the Present Invention>

As other embodiments of the present invention,
25 FIG. 5 shows an exhaust duct with a different shape, and FIG. 6 shows a liquid crystal projection type projection display apparatus.

In FIG. 5, the projection tube 21 does not project light through the projection lens duct hole 18 formed in the light-shielding plate 17, like in FIGS. 1 and 3. In FIG. 5, a light-shielding plate 25 is bent before a
5 projection tube 21. Thereby it realizes heat dissipation while shielding external light.

An exhaust duct with this shape is used due to the following reason. When a power supply 28 of a projection television set 1 is turned off, the
10 temperature in the television set 1 decreases. At this time, a reverse air flow from the exhaust duct into the television is generated. On this flow, dust enters the projection television set 1 from the outside. As the
15 dust attaches to the surface of the projection lens, the contrast, brightness, and resolution of an image projected onto the screen decrease.

This dust attaching to the surface of the projection lens can be prevented by setting the distal end of the exhaust duct below the surface of the
20 projection lens by means of the light-shielding plate 25 with the above shape. That is, when the power supply is turned off, dust enters from an opening immediately under the reflecting mirror. As the distal end of the duct extends below the surface of the
25 projection lens, the entering dust is guided by the duct and cannot flow toward the surface of the projection lens. As a result, dust can be prevented

from attaching to the surface of the projection lens.

Naturally, in the same manner as in FIG. 1 described above, this projection display apparatus can improve the heat dissipating efficiency and shows a
5 high operation stability without impairing the display image quality.

FIG. 6 is a side view showing a liquid crystal projection type projection television set according to an embodiment of the present invention. Referring to
10 FIG. 6, the television set has a liquid crystal projection unit 31. The liquid crystal projection unit 31 has a liquid crystal display panel 33, back light 34, and projection lens 32. Even in this case, in the same manner as in the picture projection tube type
15 projection display apparatus described above, an exhaust duct 15 with an opening at a high position is formed without causing a decrease in image quality by interference of external light. Hence, a projection display apparatus is provided which has an excellent
20 heat dissipation effect, so it operates stably. Furthermore, if a dust filter is arranged in the opening or duct, dust will not enter from the outside when the power supply is OFF.

A person skilled in the art can realize the
25 present invention by referring to various embodiments described above. Various modifications of these embodiments are apparent to the person skilled in the

art. The disclosed principle in a broad sense can be applied to various embodiments without requiring an inventive ability. In this manner, the present invention covers a wide range which is not
5 contradictory to the disclosed principle and novel features, and is not limited by the embodiments described above.

As has been described above in detail, according to the present invention, an opening for heat
10 dissipation is formed in the projection box of a projection display apparatus (projection television set). A light-shielding plate as part of the exhaust duct is provided so external light from the opening does not enter a projection optical path. As a result,
15 there can be provided a projection display apparatus in which an adverse influence of the external light to the projection optical path is suppressed, the heat dissipation effect is improved, and the operating stability is excellent, and a heat dissipating method
20 for the projection display apparatus.

WHAT IS CLAIMED IS:

1. A projection display apparatus comprising:
a housing including a first box and a second box
placed on the first box;

5 a screen formed on a front surface of the second
box;

projection means for projecting image light toward
the screen and arranged such that a main body thereof
is mounted in the first box and that a projection
10 surface for the image light is located in the second
box;

an opening formed in that surface of the second
box which is opposite to a surface where the screen is
formed; and

15 a light-shielding plate arranged in the second box
to extend from the opening toward the projection means
so that external light from the opening does not enter
a projection optical path extending from the projection
surface of the projection means to the screen.

20 2. An apparatus according to claim 1, wherein the
light-shielding plate has a through hole, the
projection surface of the projection means projects
light into the second box through the through hole, and
external light from the opening does not enter the
25 image light emerging from the projection surface.

3. An apparatus according to claim 1, wherein the
light-shielding plate extends from the opening toward

the projection means, and has a distal end which is bent before the projection means toward the first box.

4. An apparatus according to claim 1, wherein a space surrounded by the light-shielding plate and a wall surface of the second box forms a duct, the duct being utilized as a heat dissipation path.

5. An apparatus according to claim 1, wherein a reflecting mirror is arranged on an inner surface of a rear portion of the second box, to reflect and project the image light to the screen from the projection means, and the opening is formed at a boundary between the first box and the reflecting mirror on a rear surface of the second box.

6. An apparatus according to claim 1, wherein the projection lens includes a projection tube driven by a video signal, and a projection lens mounted on a display surface of the projection tube, the projection lens being located in the second box.

7. An apparatus according to claim 1, wherein the projection means includes a light source, a liquid crystal which receives light from the light source and modulates exit light with a video signal, and a projection lens which projects light emerging from the liquid crystal, the projection lens being located in the second box.

8. A projection display apparatus comprising:
a housing including a first box and a second box

placed on the first box;

a screen formed on a front surface of the second box;

projection means for projecting image light toward
5 the screen and arranged such that a main body thereof
is mounted in the first box and that a projection
surface for the image light is located in the second
box;

an opening, formed in that surface of the second
10 box which is opposite to a surface where the screen is
formed, at a position higher than the projection
surface of the projection means; and

a light-shielding plate arranged in the second box
to extend from the opening toward the projection means
15 so that external light from the opening does not enter
a projection optical path extending from the projection
surface of the projection means to the screen.

9. A heat dissipating method for a projection
display apparatus having a first box and a second box
20 placed on the first box, for projecting image light
from projection means to a screen formed on a front
surface of the second box, comprising the steps of:

arranging the projection means such that a main
body thereof is mounted in the first box, locating a
25 projection surface for the image light in the second
box, and forming an opening in that surface of the
second box which is opposite to a surface where the

screen,

providing a light-shielding plate in the second box to extend from the opening toward the projection means so that external light from the opening does not enter a projection optical path extending from the projection surface of the projection means to the screen, and

drawing in or exhausting air through the opening.

10. A method according to claim 9, comprising a step of arranging a reflecting mirror on an inner surface of a rear portion of the second box to reflect and project image light to the screen from the projection means, and forming the opening at a boundary between the reflecting mirror on a rear surface of the second box and the first box to draw in or exhaust air through the opening.

11. A method according to claim 9, comprising a step of utilizing a duct formed by the space surrounded by the light-shielding plate and a wall surface of the second box as a heat dissipation path.

12. A method according to claim 11, comprising a step of dissipating heat in the first box from the main body of the projection means toward the duct to dissipate heat through the opening.

13. A method according to claim 11, comprising a step of attaching a blower to the opening to dissipate heat in the first box from the main body of the

projection means toward the duct and dissipate heat through the opening.

14. A heat dissipating method for a projection display apparatus having a first box and a second box placed on the first box, for projecting image light from projection means to a screen formed on a front surface of the second box, comprising the steps of:

arranging the projection means such that a main body thereof is mounted in the first box, locating a projection surface for the image light in the second box, and forming an opening in that surface of the second box which is opposite to a surface where the screen is formed, at a position higher than the projection surface of the projection means,

providing a light-shielding plate in the second box to extend from the opening toward the projection means so that external light from the opening does not enter a projection optical path extending from the projection surface of the projection means to the screen, and

drawing in or exhausting air through the opening.