US009139308B2

(12) **United States Patent**
Hayashi et al.

(10) **Patent No.: US 9,139,308 B2**
(45) **Date of Patent: Sep. 22, 2015**

(54) **DISPLAY DEVICE AND UNMANNED HELICOPTER**

(71) Applicant: **Yamaha Hatsudoki Kabushiki Kaisha**, Iwata-shi, Shizuoka (JP)

(72) Inventors: **Toshiyuki Hayashi**, Shizuoka (JP); **Masanori Yoshihara**, Shizuoka (JP)

(73) Assignee: **Yamaha Hatsudoki Kabushiki Kaisha**, Shizuoka (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **14/415,180**

(22) PCT Filed: **Jul. 18, 2013**

(86) PCT No.: **PCT/JP2013/069561**

§ 371 (c)(1),
(2) Date: **Jan. 16, 2015**

(87) PCT Pub. No.: **WO2014/014071**

PCT Pub. Date: **Jan. 23, 2014**

(65) **Prior Publication Data**

US 2015/0183526 A1 Jul. 2, 2015

(30) **Foreign Application Priority Data**

Jul. 20, 2012 (JP) 2012-161591

(51) **Int. Cl.**
B64D 47/02 (2006.01)
B64C 39/02 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ***B64D 47/02*** (2013.01); ***B64C 39/024*** (2013.01); ***B64D 45/00*** (2013.01); ***F21S 48/215*** (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC B64D 47/02; B64D 45/00; B64C 39/024; B64C 2201/024; F21S 48/215; F21S 48/2212; F21V 5/007; F21V 5/043; F21V 5/045; F21V 5/046; F21V 3/02; F21V 3/049; G09F 21/06; G09F 21/10; G09F 21/14
See application file for complete search history.

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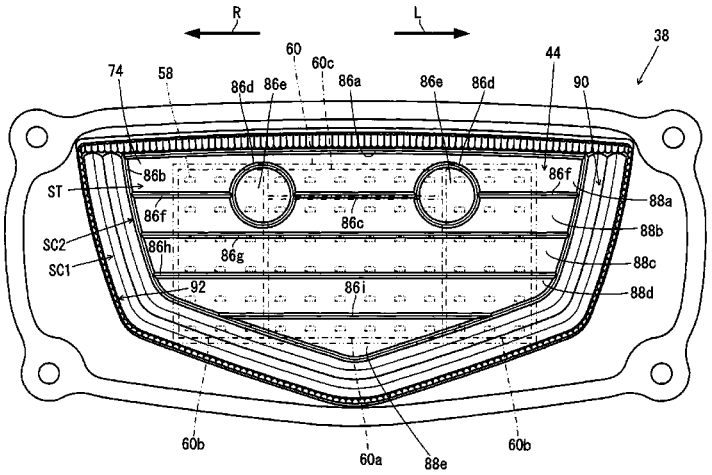
Primary Examiner — Alan Cariaso
(74) *Attorney, Agent, or Firm* — Keating & Bennett, LLP

(57) **ABSTRACT**

A display device includes a light source portion including a plurality of LEDs, and cover portions that cover the light source portion. Each cover portion includes an opposed portion and a side wall portion. The opposed portion includes a straight-through portion which allows light emitted from the light source portion to travel straightly, whereas the side wall portion includes a first scatter portion which scatters the light emitted from the light source portion. A portion of the light emitted from the light source portion to the straight-through portion leaves the cover portion to the outside without being scattered. A different portion of the light emitted to the straight-through portion repeats reflection inside the opposed portion, reaches the side wall portion, and is scattered in the first scatter portion. Of the light emitted from the light source portion, a portion of the light reflected by an inner surface of the cover portion is directed to the side wall portion, and then scattered in the first scatter portion.

11 Claims, 17 Drawing Sheets



(51) **Int. Cl.**

F21S 8/10	(2006.01)
F21V 3/02	(2006.01)
F21V 3/04	(2006.01)
F21V 5/04	(2006.01)
B64D 45/00	(2006.01)
G09F 21/06	(2006.01)
G09F 21/14	(2006.01)

(52) **U.S. Cl.**

CPC ***F21S 48/2212*** (2013.01); ***F21V 3/02*** (2013.01); ***F21V 3/049*** (2013.01); ***F21V 5/045*** (2013.01); ***G09F 21/06*** (2013.01); ***G09F 21/14*** (2013.01); *B64C 2201/024* (2013.01); *B64C 2201/146* (2013.01)

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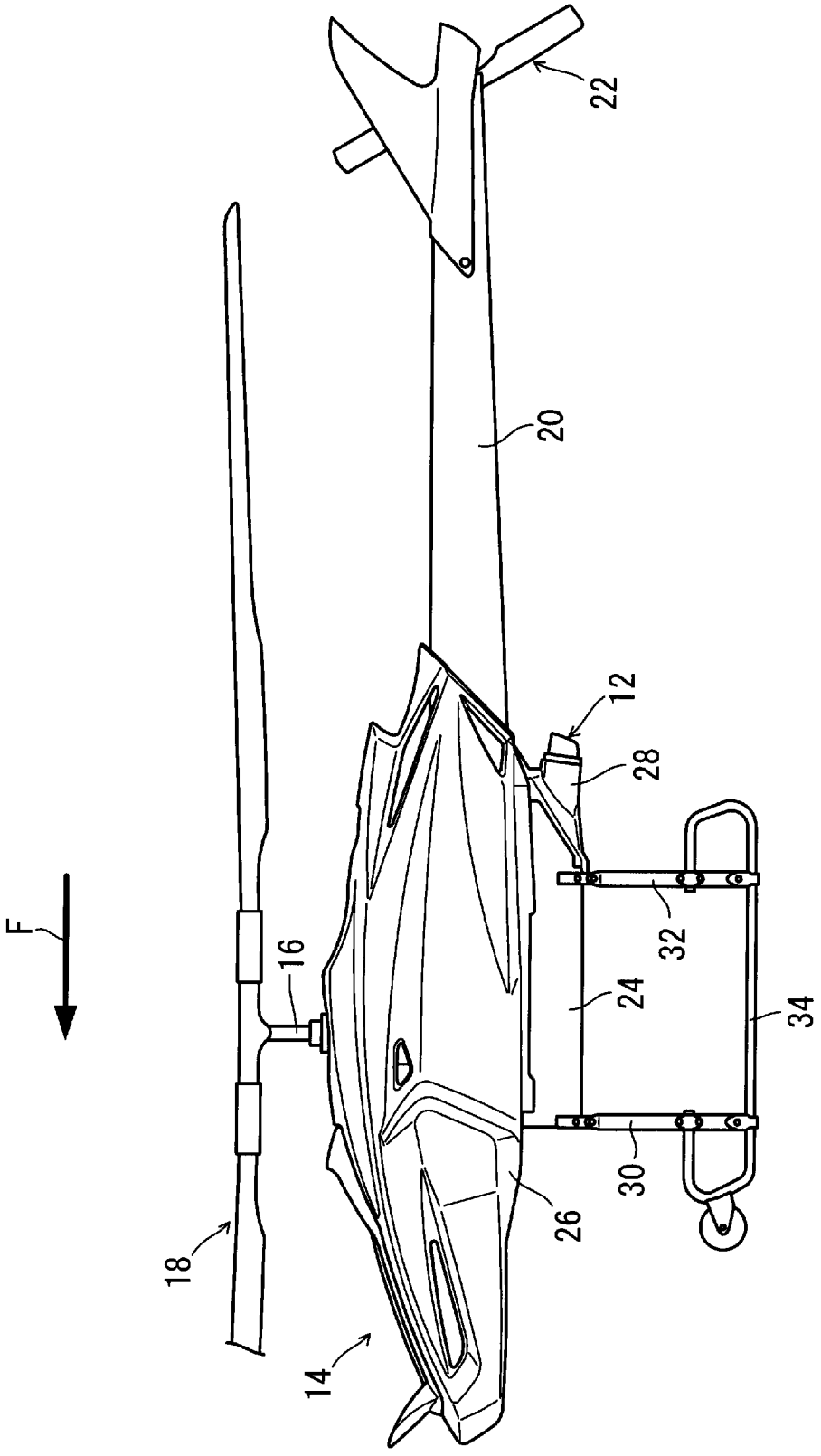

FIG. 1

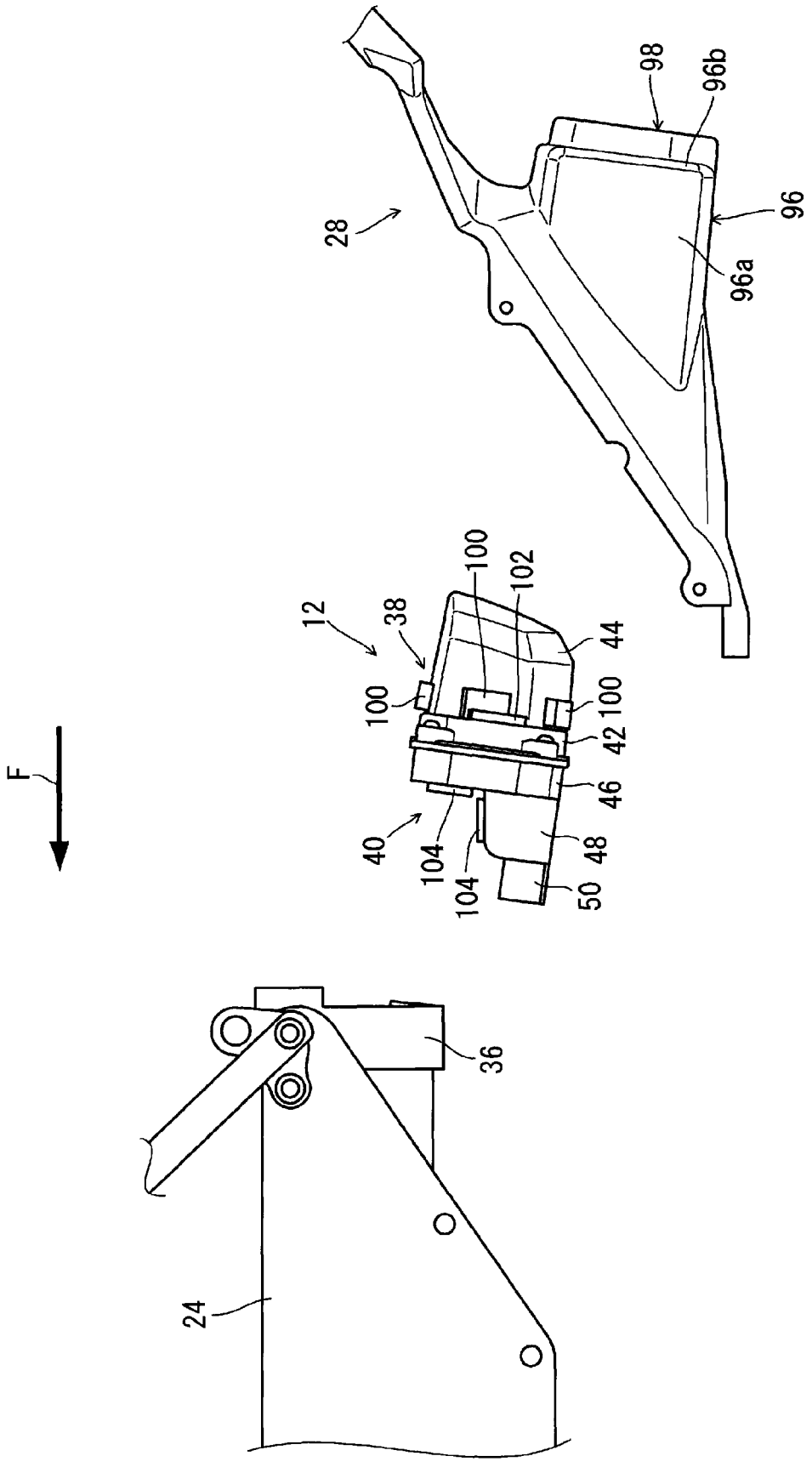
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FIG. 2

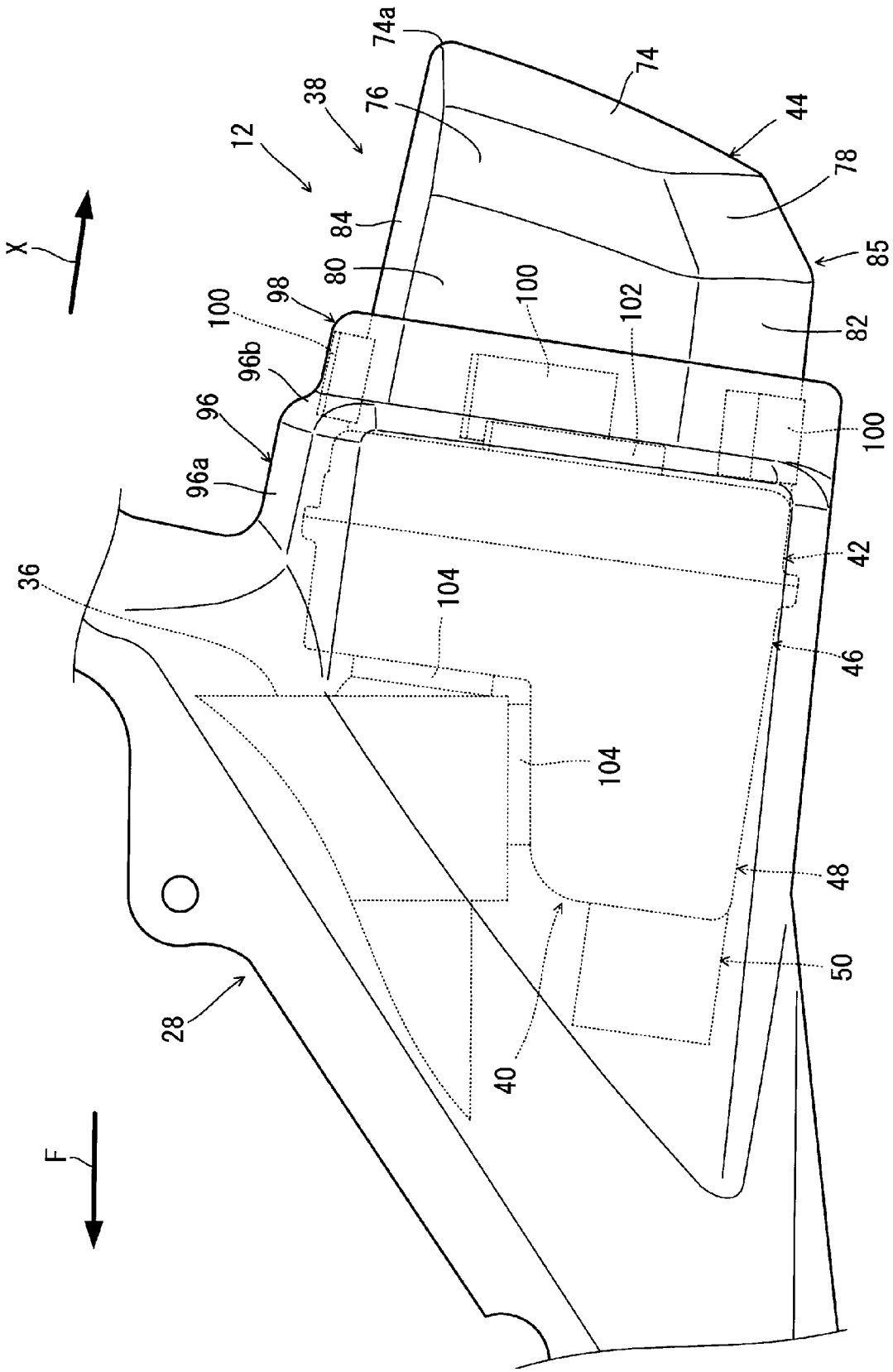
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FIG. 3

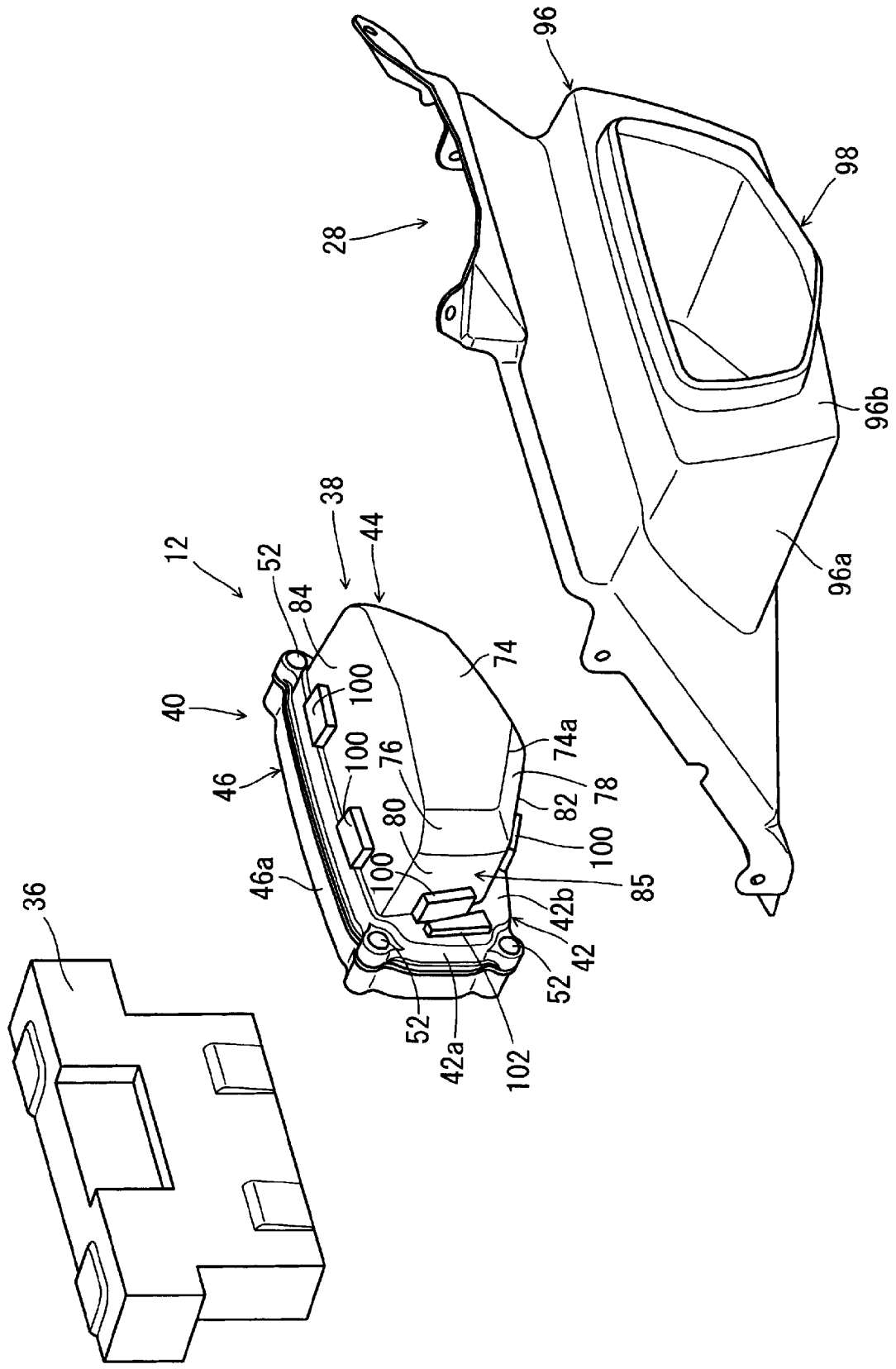
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FIG. 4

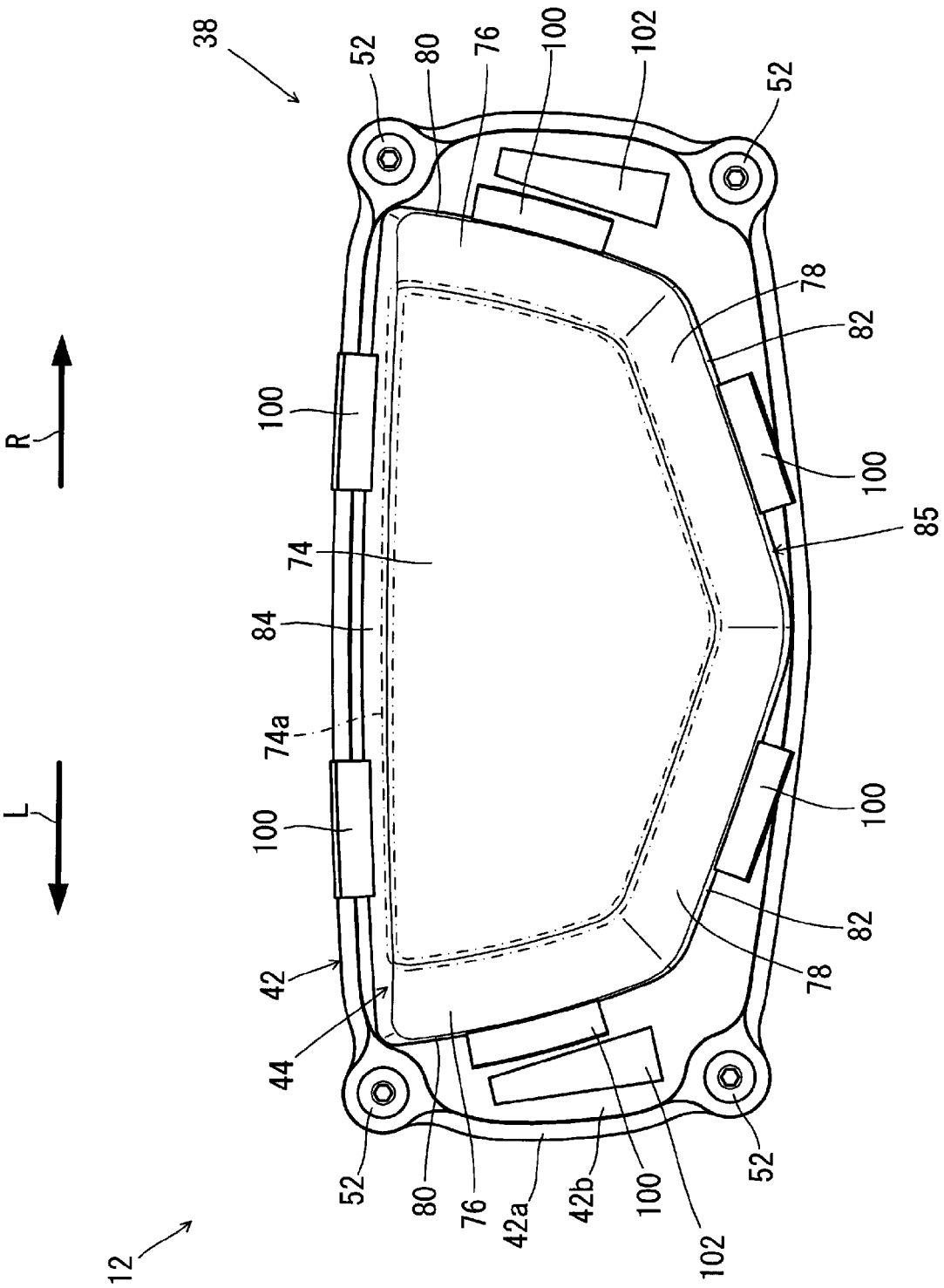
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FIG. 5

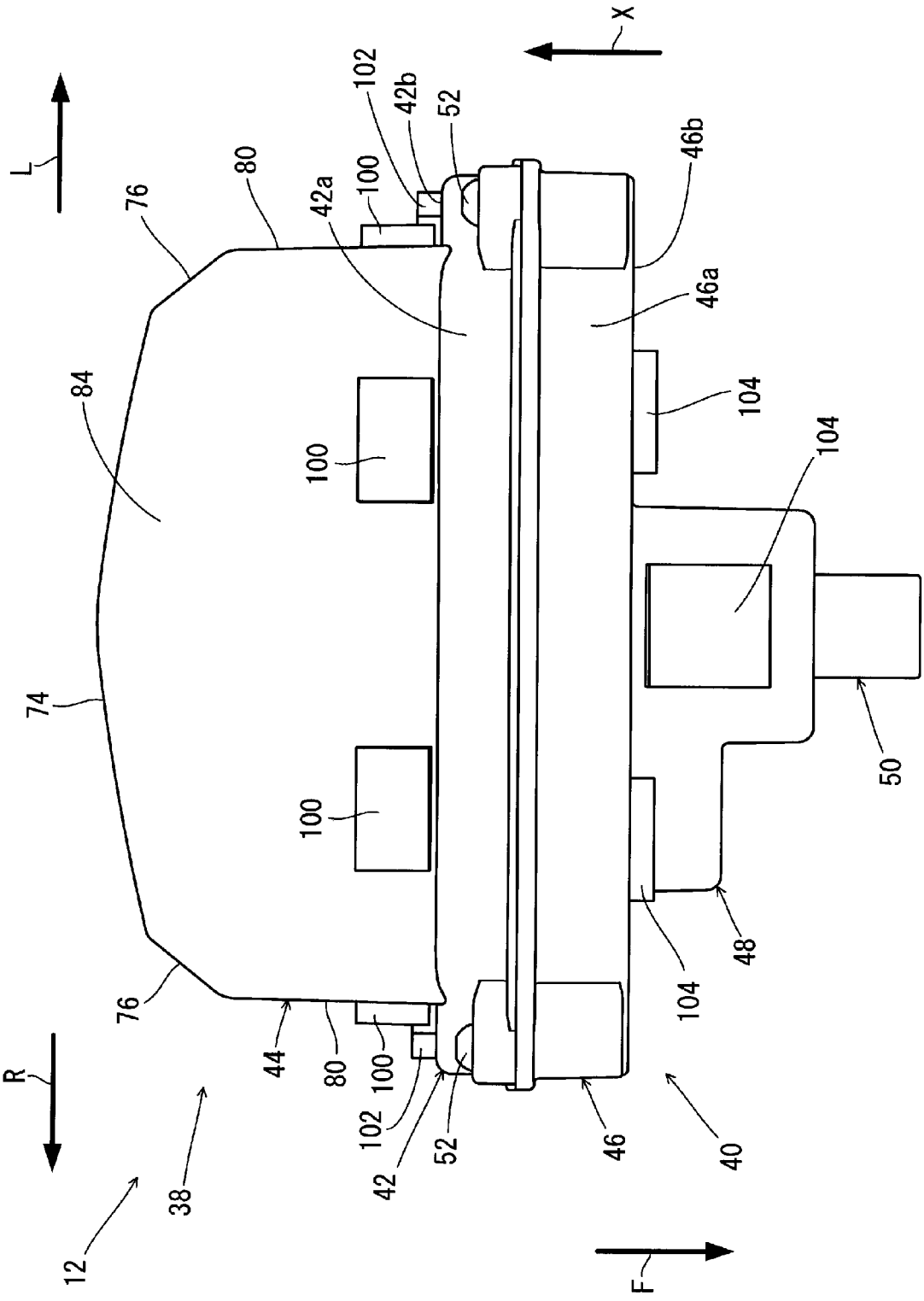
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FIG. 6

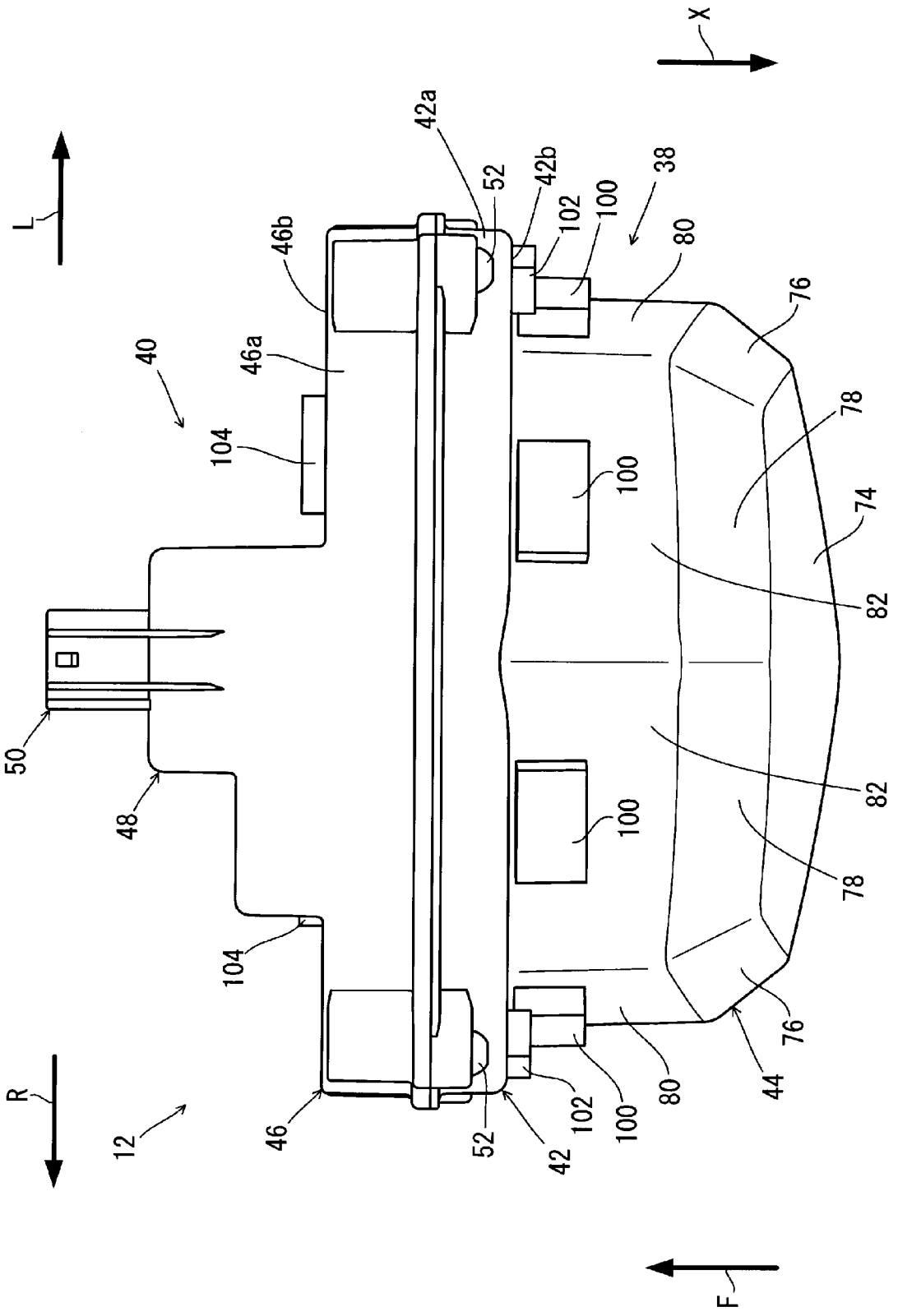
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FIG. 7

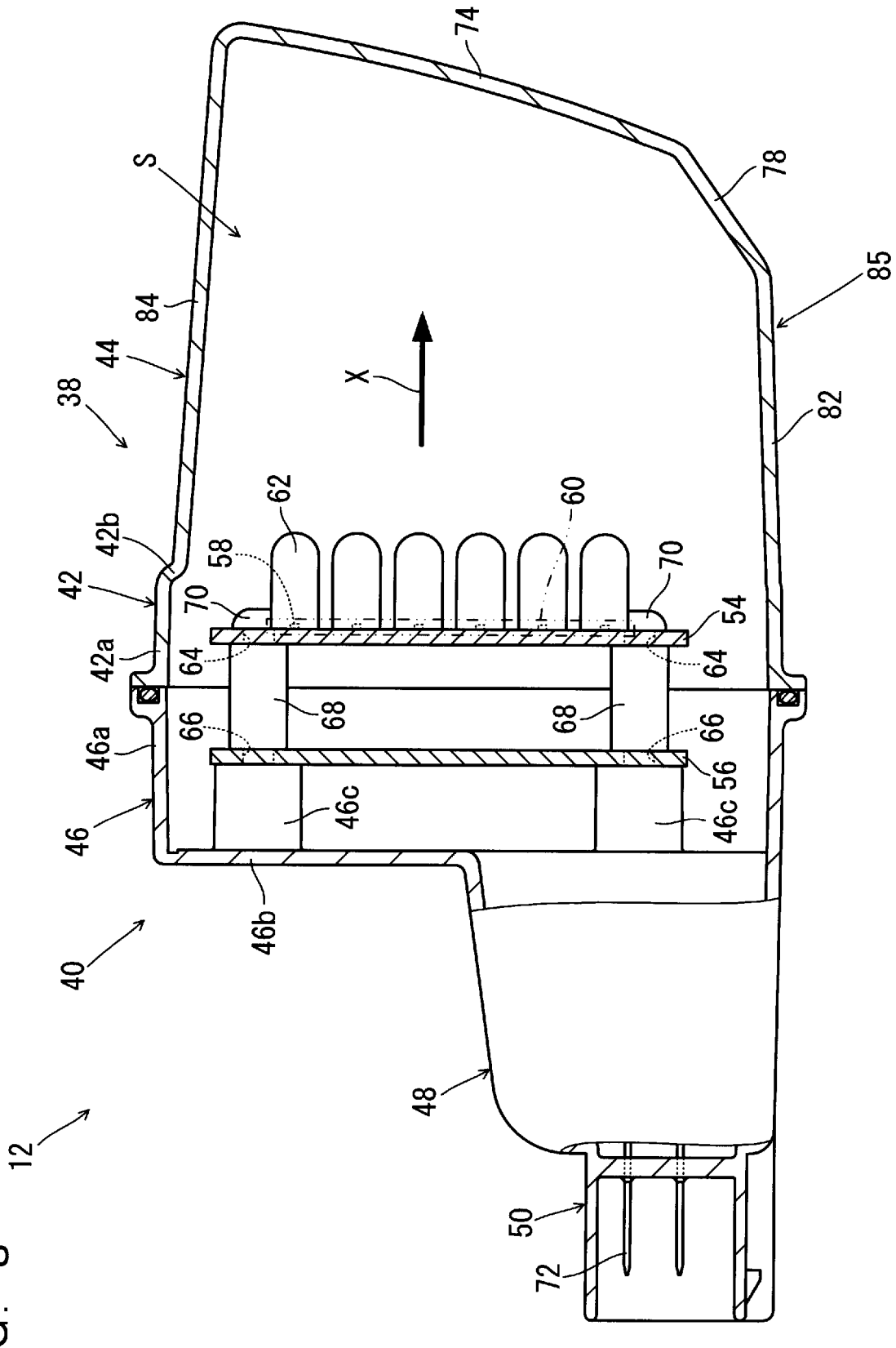
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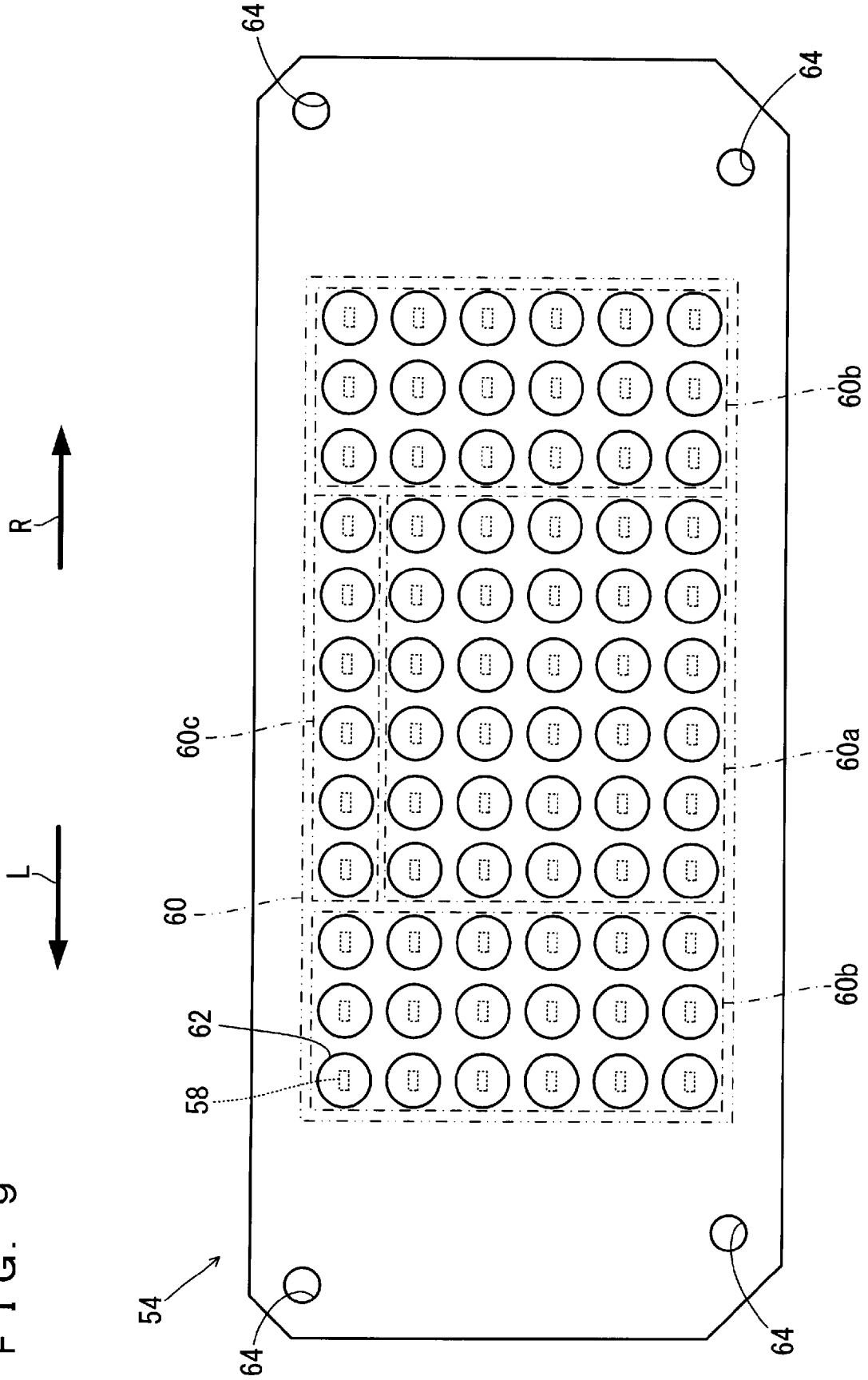
FIG. 8



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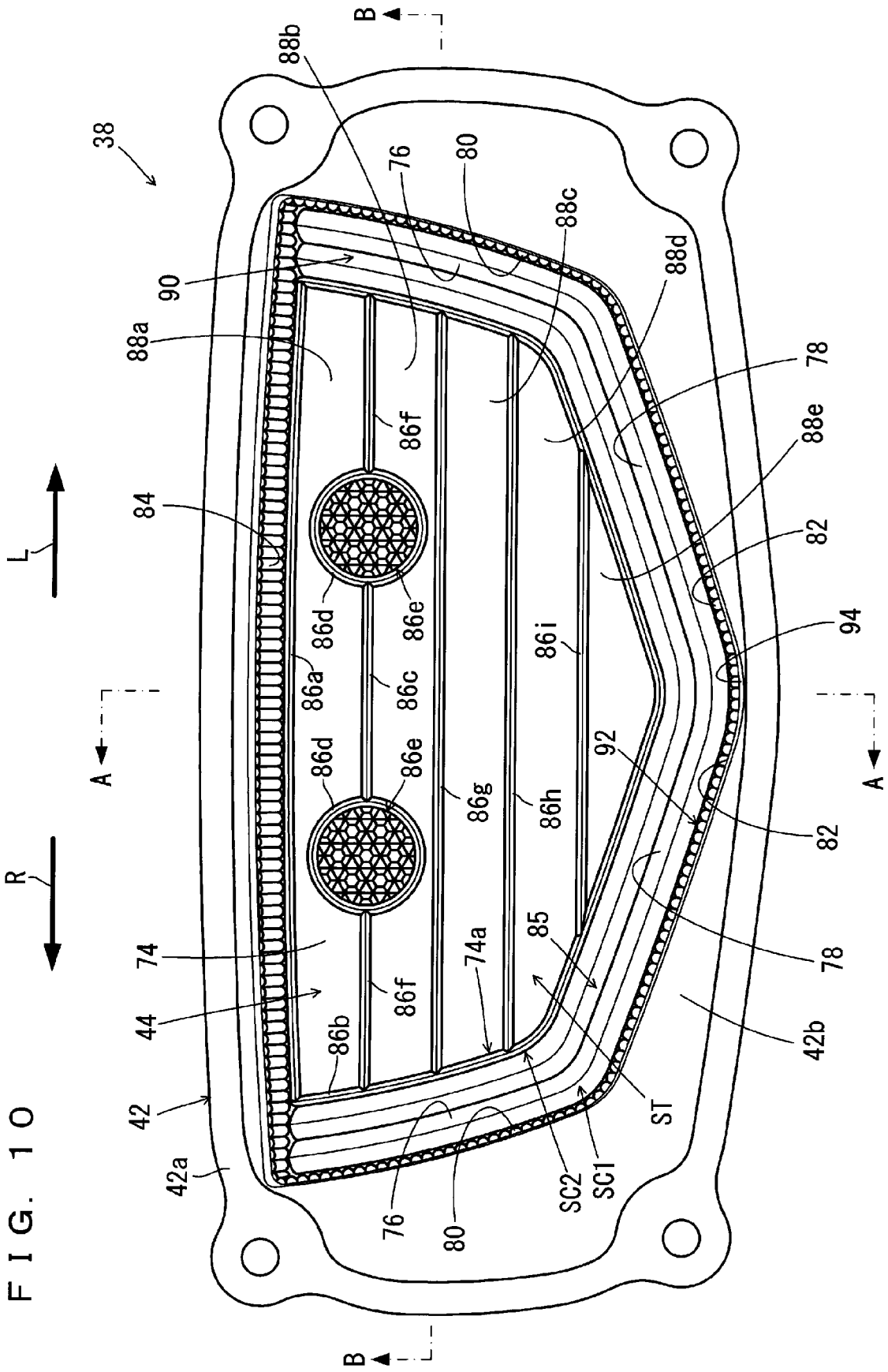
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FIG. 10

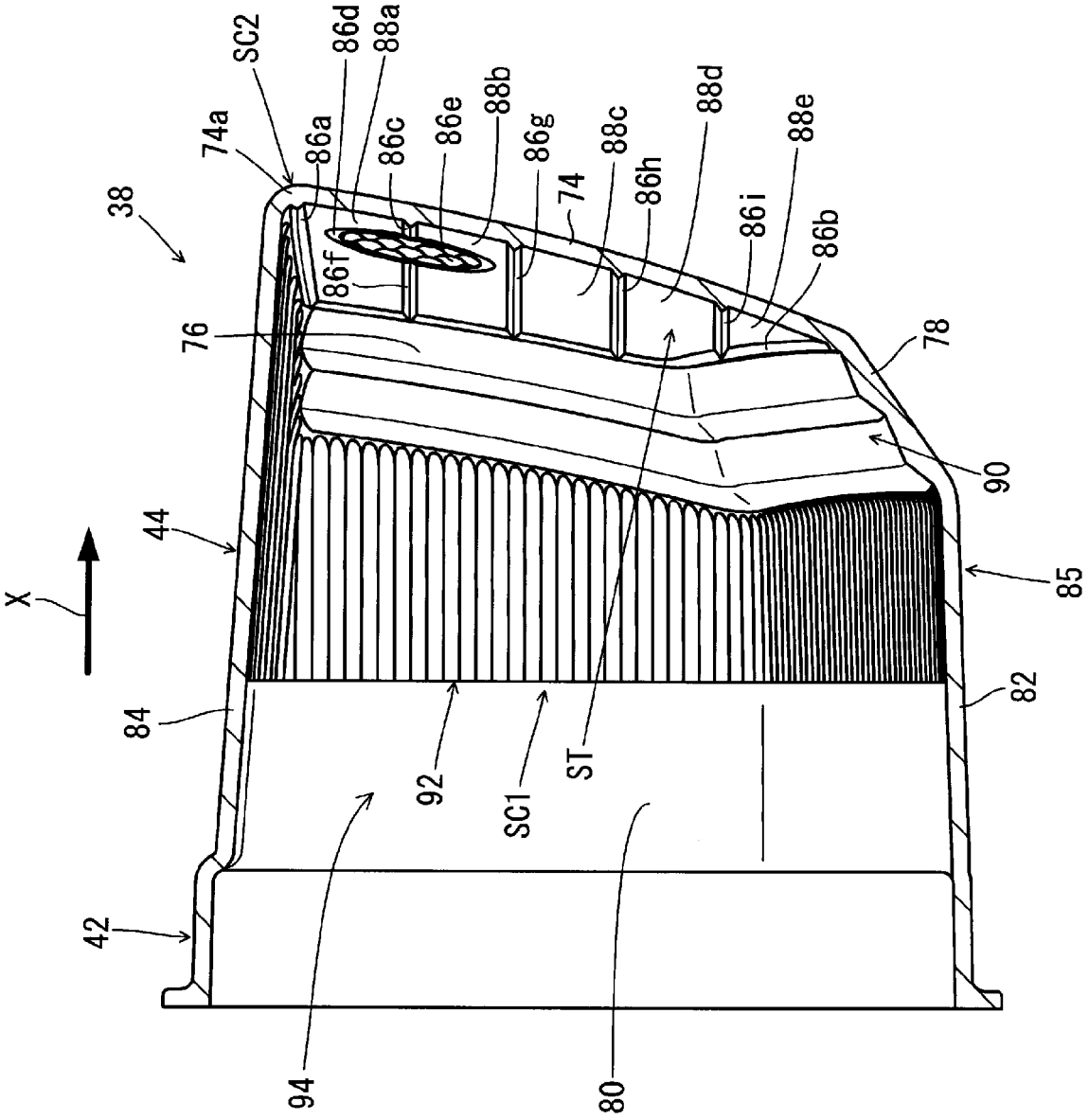
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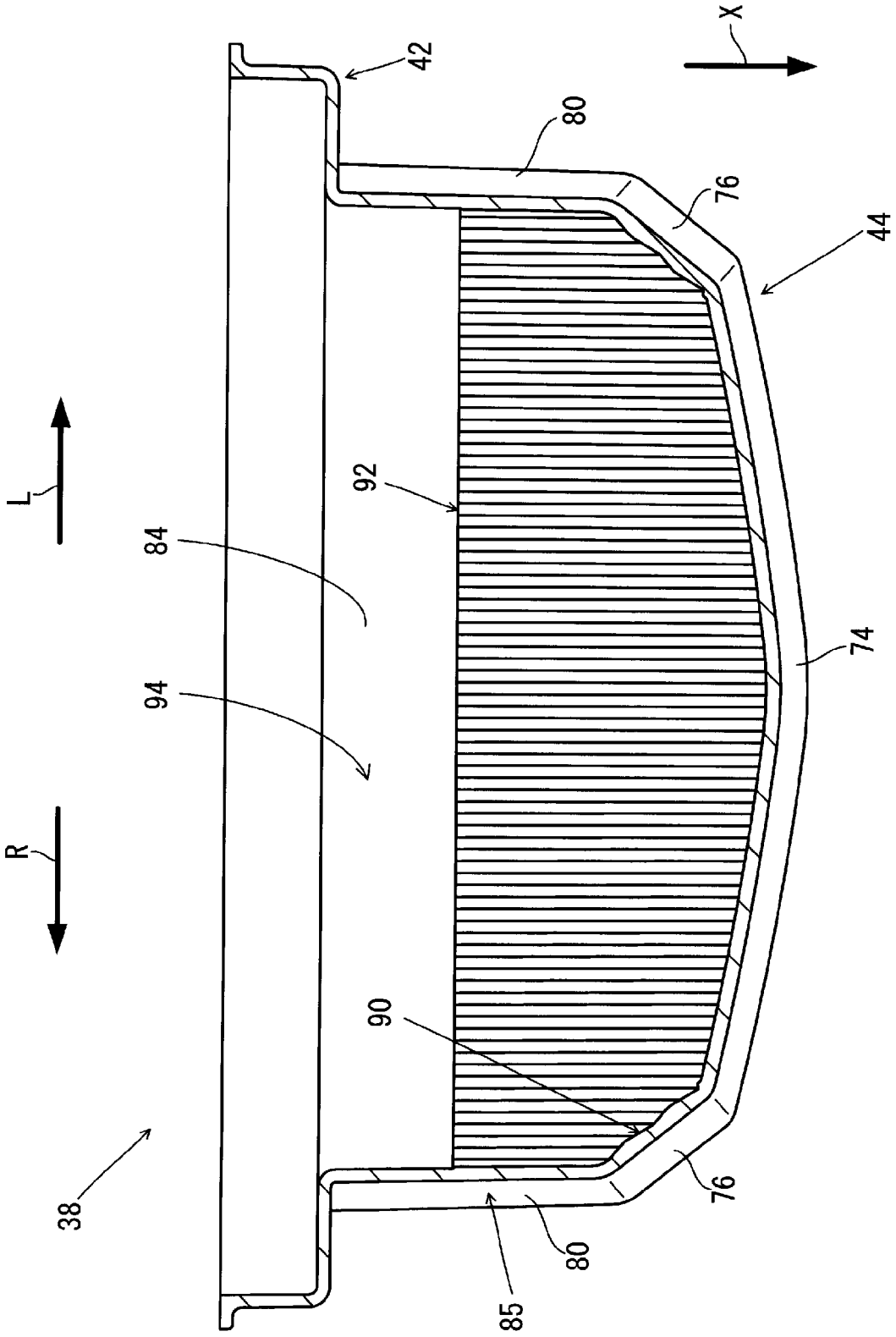
FIG. 11



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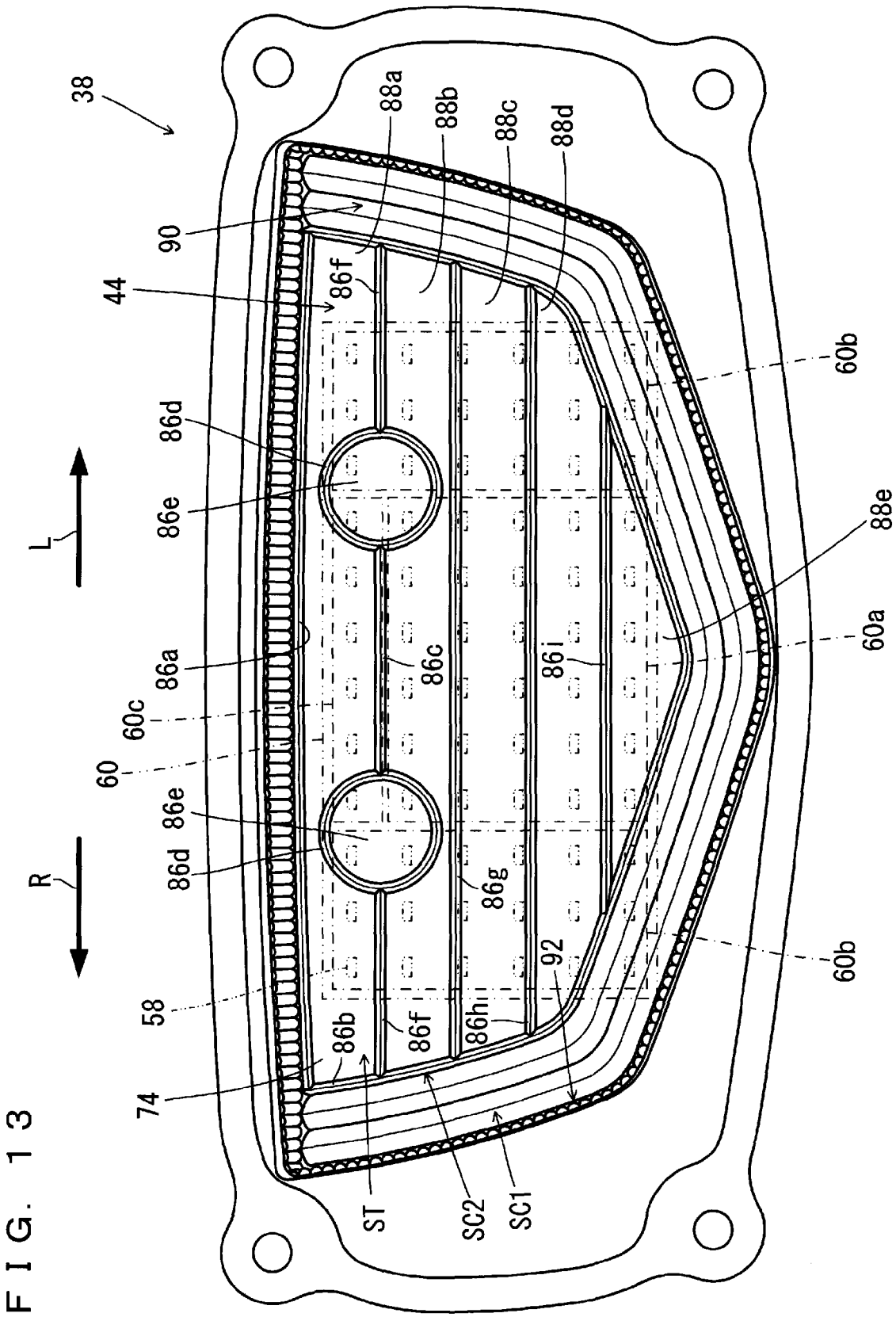
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FIG. 13

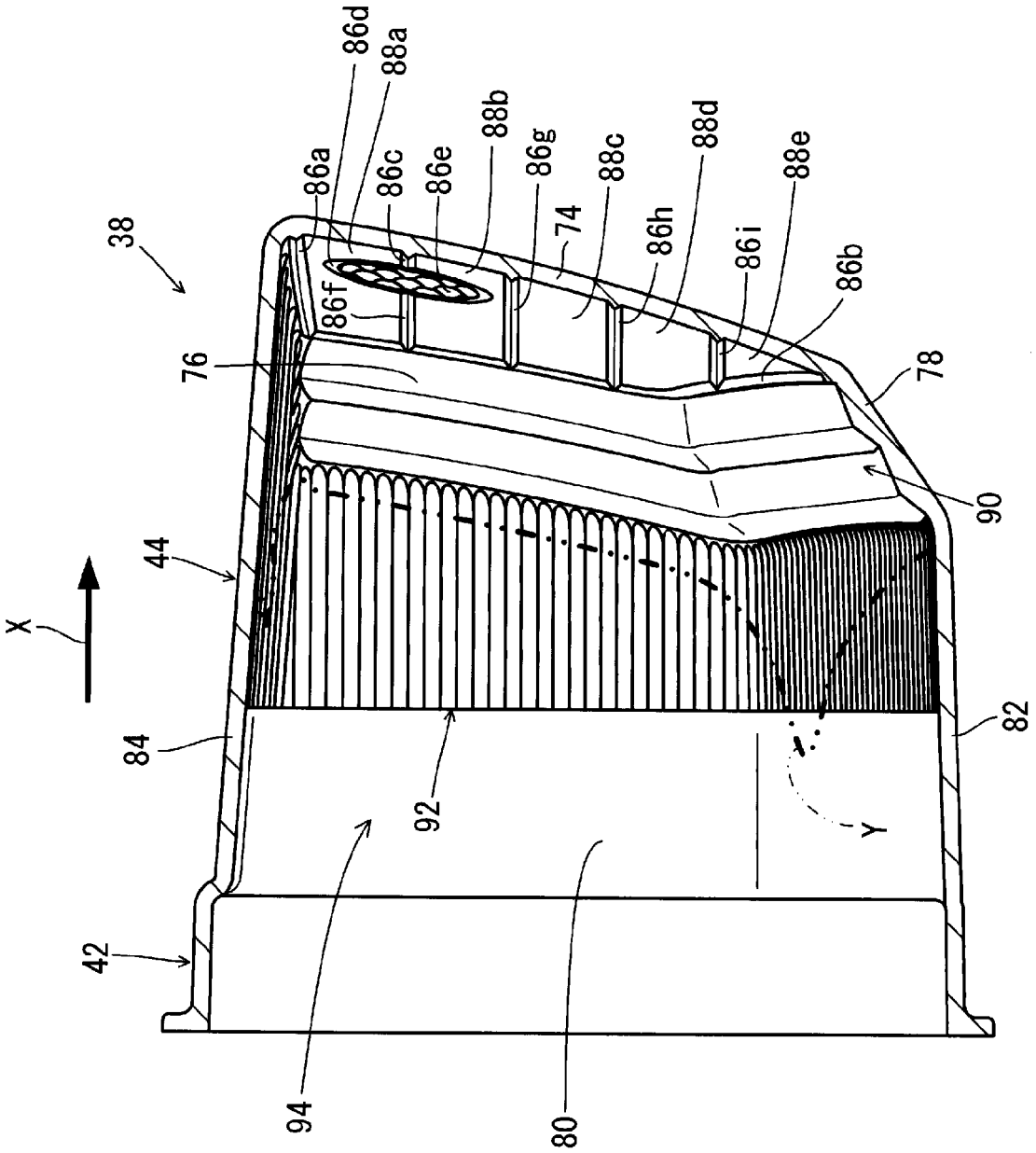
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FIG. 14

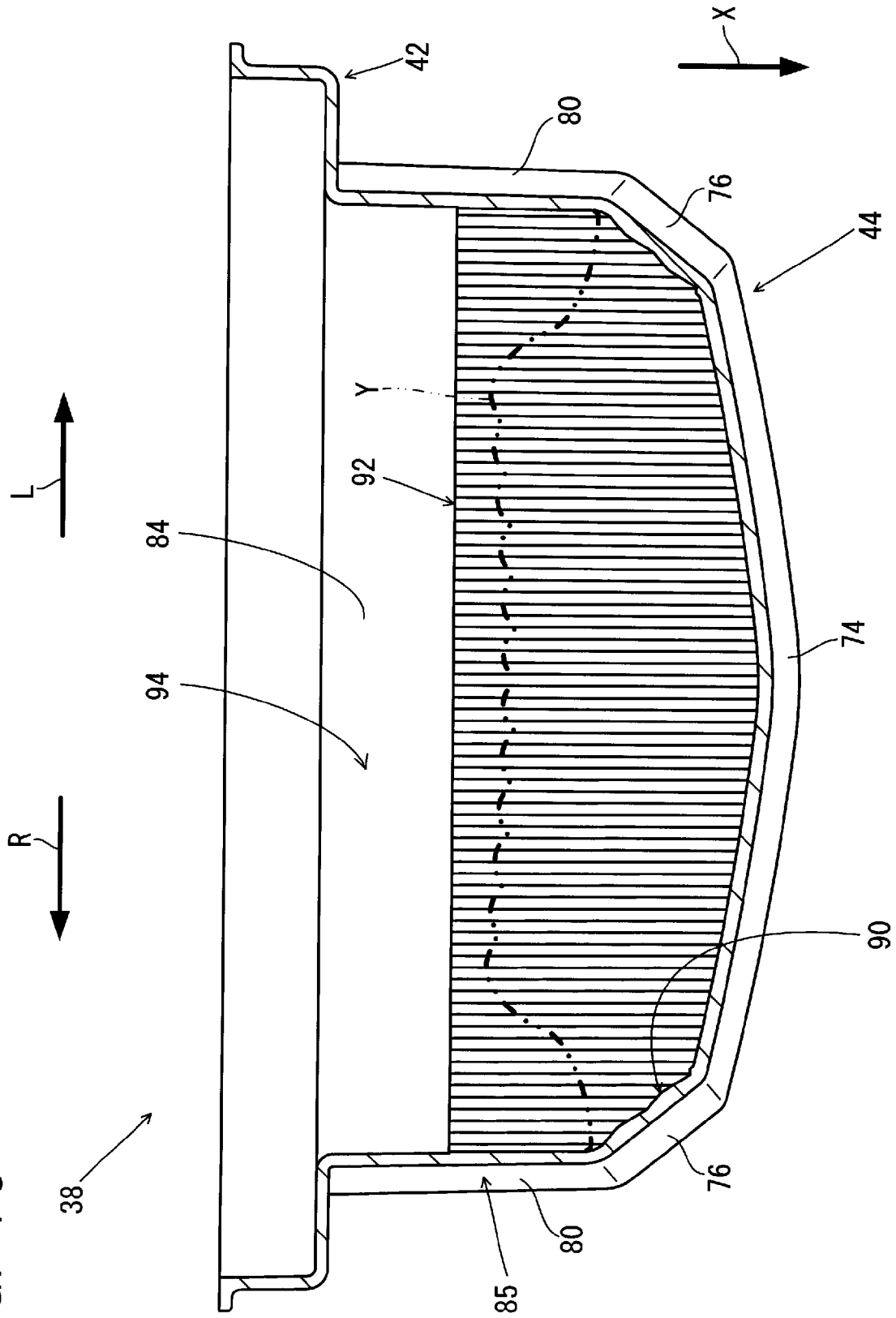

FIG. 15

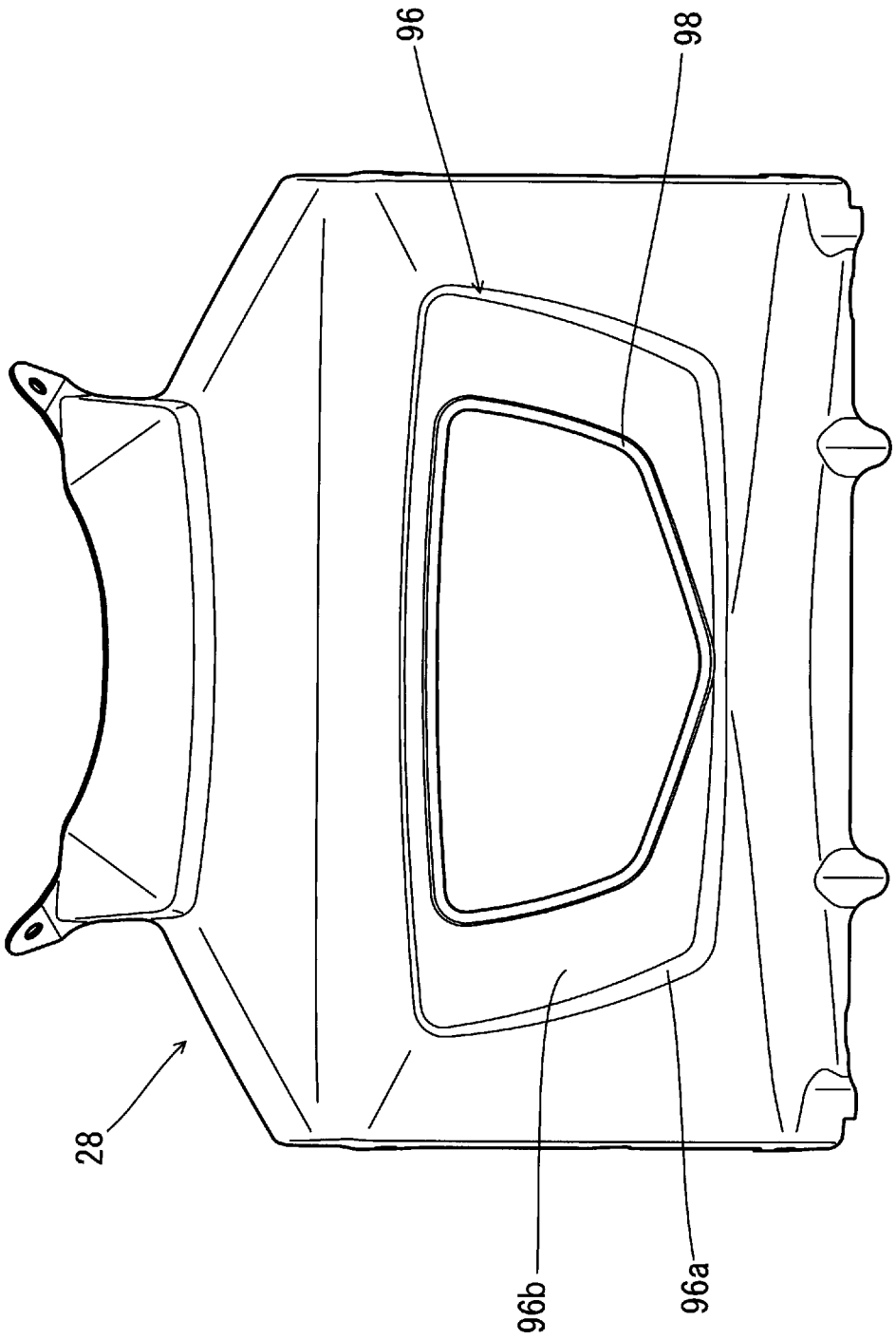

FIG. 16

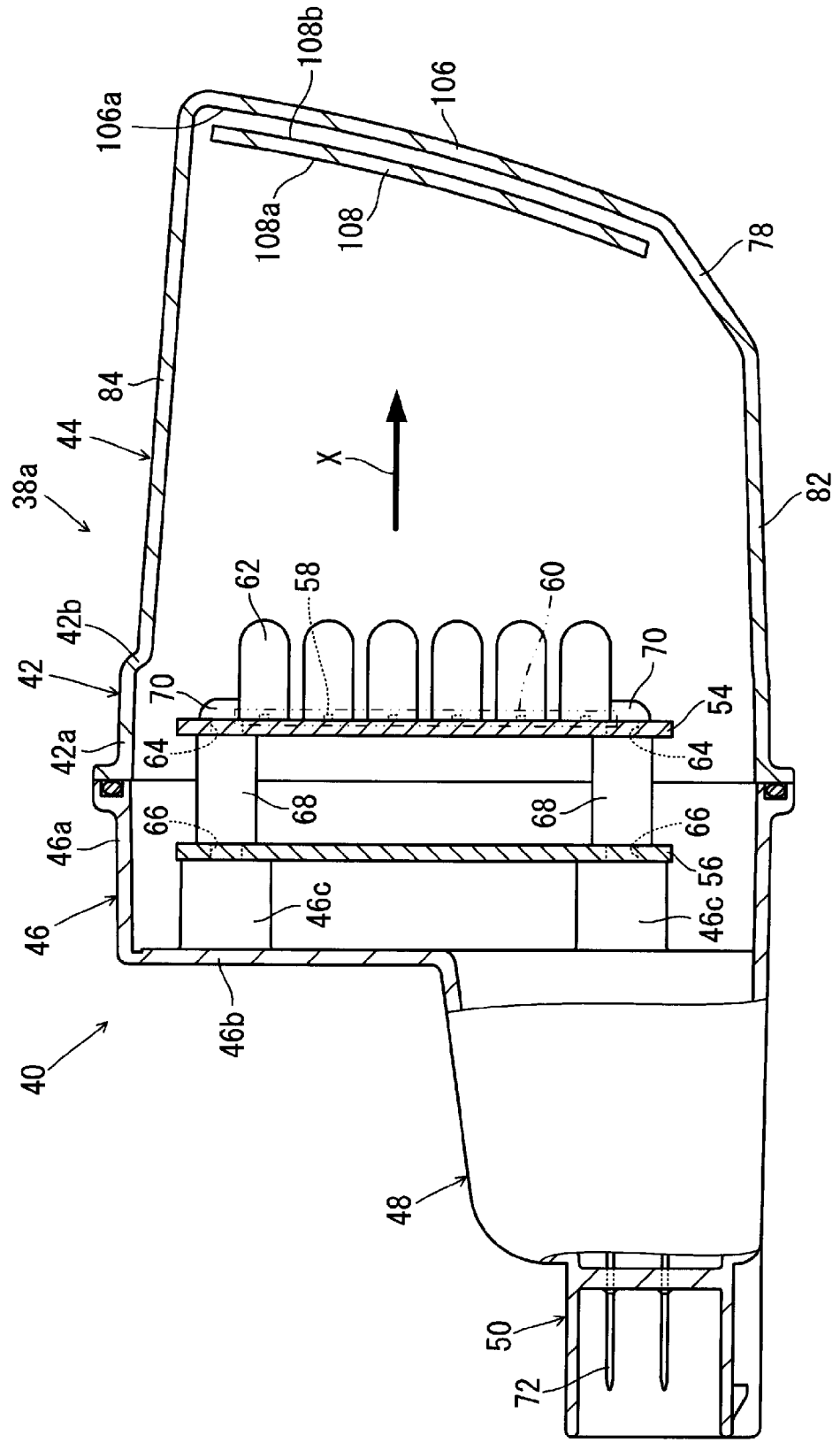
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FIG. 17

DISPLAY DEVICE AND UNMANNED HELICOPTER

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to display devices and unmanned helicopters including the same. More specifically, the present invention relates to a display device including a light source portion including an LED, and a cover portion which allows light from the light source portion to pass therethrough. The present invention also relates to an unmanned helicopter including the display device.

2. Description of the Related Art

Conventionally, display devices are used in unmanned helicopters. For example, JP-B No. 4116476 discloses a display device for an unmanned helicopter, which includes a GPS display lamp, a warning lamp, and a mounting frame for mounting the GPS display lamp and the warning lamp. Each of the GPS display lamp and the warning lamp includes a plurality of LEDs.

In this display device, it is possible to turn ON the GPS display lamp and the warning lamp separately from each other. Therefore, the operator of the unmanned helicopter can recognize an operation status of GPS control and an abnormality status of the helicopter without confusion.

The display device according to JP-B No. 4116476 uses a plurality of LEDs disposed in the same orientation (facing rearward in the case of the unmanned helicopter disclosed in JP-B No. 4116476). This arrangement improves the visibility of the display device from the rear at a distance. However, in this case, the visibility of the display device from the sides is decreased. Display devices for unmanned helicopters require especially good visibility in a wider range (angle) since the operator often varies the flying direction and/or the attitude of the helicopter during operation.

SUMMARY OF THE INVENTION

Therefore, preferred embodiments of the present invention provide a display device which has a good visibility from a distance and improved visibility from a wide range, and provide an unmanned helicopter including the same.

According to a preferred embodiment of the present invention, a display device includes a light source portion including an LED which emits light at least in a first direction, and a cover portion covering the light source portion. In this display device, the cover portion includes an opposed portion opposed to the light source portion in the first direction of the light source portion, and a side wall portion extending from an outer edge of the opposed portion in a reverse direction from the first direction. Further, the opposed portion includes a straight-through portion which allows light emitted from the light source portion to travel straightly, and the side wall portion includes a first scatter portion which scatters the light emitted from the light source portion.

It should be noted here that the "side wall portion extending in a reverse direction from the first direction" is not limited to a side wall portion which extends in exactly the reverse direction from the first direction, but includes any side wall portion which extends at least in the reverse direction. In other words, the present invention may include a side wall portion extending obliquely with respect to the reverse direction.

In a preferred embodiment of the present invention, an opposed portion of the cover portion is provided in the first direction of the light source portion. The opposed portion includes a straight-through portion which allows light to travel straightly. A portion of the light emitted from the light source portion is directed to the straight-through portion of the opposed portion. A portion of the light directed to the straight-through portion travels straightly through the straight-through portion, and then out of the cover portion to an outside. In other words, a portion of the light emitted from the light source portion to the opposed portion passes through the cover portion and to the outside without being scattered in the cover portion. This arrangement improves the visibility of the display device from a distance in the first direction. A different portion of the light directed to the straight-through portion of the opposed portion repeats reflection inside the opposed portion, and reaches the side wall portion. A portion of the light which reaches the side wall portion is scattered in the first scatter section. Of the light emitted from the light source portion, a portion of the light is reflected by an inner surface of the cover portion and is directed to the side wall portion. A portion of the light which is directed to the side wall portion is scattered in the first scatter section. This improves the visibility of the display device from directions across the first direction (from a side, for example). As a result, it is possible to improve the visibility of the display device in a wide range while improving the visibility of the display device from a distance. In the cover portion, if the opposed portion and the side wall portion are provided by separate members, it is preferable that the light source portion should be disposed at a place which ensures that at least a portion of light emitted from the light source portion is directed directly to the side wall portion. This scatters the light from the light source portion more reliably in the first scatter section.

In preferred embodiments of the present invention, side directions preferably include left-right directions and up-down directions.

Preferably, the opposed portion further includes a second scatter portion which scatters the light emitted from the light source portion. In this case, it is possible to scatter another portion of the light emitted from the light source portion in the second scatter portion. This further improves the visibility of the display device from directions (especially from sides) other than from the first direction.

Further preferably, the second scatter portion overlaps the light source portion when viewed from the first direction. In this case, it is possible to reliably scatter a portion of the light which is emitted in the first direction from the light source portion with the second scatter portion.

Further preferably, the light source portion includes a plurality of LEDs, and the straight-through portion overlaps a portion of the plurality of LEDs whereas the second scatter portion overlaps another portion of the plurality of LEDs when viewed from the first direction. In this case, light emitted by a portion of the plurality of LEDs in the first direction is directed to the straight-through portion, and is allowed to travel out of the cover portion without being scattered in the opposed portion. The arrangement sufficiently improves the visibility of the display device from a distance in the first direction. On the other hand, light emitted from another portion of the plurality of LEDs in the first direction is directed to the second scatter portion, and is scattered in the second scatter portion. This also sufficiently improves the visibility of the display device from directions (especially from sides) other than from the first direction.

Preferably, the light source portion includes a first light source portion, and a pair of second light source portions which emit light of a different color from that emitted by the first light source portion, the first light source portion is located between the pair of second light source portions and

each of the second light source portions is located between the first light source portion and the side wall portion when viewed from the first direction, and the second scatter portion overlaps the first light source portion when viewed from the first direction. In this case, when viewed from the first direction, the pair of second light source portions are closer to the side wall portion than is the first light source portion. This improves the visibility of light emitted from the pair of second light source portions from the sides. Also, it is possible to scatter a portion of the light which is emitted in the first direction from the first light source portion with the second scatter portion. This also improves the visibility of the light emitted from the first light source portion from the sides.

The case where "the first light source portion is located between the pair of second light source portions" includes a case where the first light source portion and the pair of second light source portions are located on a straight line, a case where the first light source portion is located at a higher or a lower position than the pair of second light source portions, and also a case where one of the second light source portions is located at a higher or a lower position than the other of the second light source portions and the first light source portion.

Further preferably, the second scatter portion further overlaps the second light source portion when viewed from the first direction. In this case, it is possible to reliably scatter not only the light which is emitted from the first light source portion in the first direction but also the light which is emitted from the second light source portion in the first direction in the second scatter portion. This further improves the visibility of the light emitted from the second light source portion from the sides.

Further preferably, the pair of second light source portions include warning LEDs. When viewed from the first direction, if the pair of second light source portions are closer to the side wall portion than is the first light source portion, the light which is emitted from the pair of second light source portions has better visibility from the sides than does the light which is emitted from the first light source portion. Therefore, in this case, the arrangement that the pair of second light source portions include warning LEDs improves the visibility of the light which is emitted from the warning LEDs from the sides.

Preferably, the second scatter portion includes a bent portion. In this case, it is possible to scatter the light emitted from the light source portion also in the bent portion and therefore it is possible to scatter light with a simple arrangement.

Further preferably, the first scatter portion includes a first non-flat portion on an inner surface of the side wall portion. In this case, the arrangement prevents dust and dirt from depositing on the first non-flat portion. This makes it easy to clean the cover portion.

Further preferably, the second scatter portion includes a second non-flat portion on an inner surface of the opposed portion. In this case, the arrangement prevents dust and dirt from depositing on the second non-flat portion. This makes it easy to clean the cover portion.

According to another preferred embodiment of the present invention, a remote-controlled unmanned helicopter is provided with a display device which has good visibility so that the operator appropriately understands the state of the unmanned helicopter. Therefore, the display device described thus far, which has an improved visibility from a distance and an improved visibility from a wide range, is suitably applicable to unmanned helicopters.

The above and other elements, features, steps, characteristics and advantages of the present invention will become more apparent from the following detailed description of the preferred embodiments with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a side view of an unmanned helicopter equipped with a display device according to a preferred embodiment of the present invention.

FIG. **2** is a side view showing the display device, a frame, and an under cover.

FIG. **3** is an enlarged side view showing a relationship between the display device, the under cover, and a battery box.

FIG. **4** is a perspective view showing the display device, the under cover, and the battery box.

FIG. **5** is a rear view of the display device.

FIG. **6** is a plan view of the display device.

FIG. **7** is a bottom view of the display device.

FIG. **8** is an illustrative side view showing an internal structure of the display device.

FIG. **9** is a rear view of an LED substrate.

FIG. **10** is a front view of a cover portion.

FIG. **11** is a sectional view taken along lines A-A in FIG. **10**.

FIG. **12** is a sectional view taken along lines B-B in FIG. **10**.

FIG. **13** shows a positional relationship between a translucent portion and a light source portion.

FIG. **14** is a drawing for describing a range of light radiated by the light source portion.

FIG. **15** is a drawing for describing a range of light radiated by the light source portion.

FIG. **16** is a rear view of the under cover.

FIG. **17** is an illustrative side view of a display device according to another preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Hereinafter, preferred embodiments of the present invention will be described with reference to the drawings. Hereinafter, an unmanned helicopter **10** which includes a display device **12** according to a preferred embodiment of the present invention will be described. It is noted that the terms front and rear, left and right, up and down as used in the description of preferred embodiments are determined from a basic attitude of the unmanned helicopter **10** (an attitude of the unmanned helicopter **10** when its mast **16** is parallel or substantially parallel to the vertical direction). In the drawings, Arrow F indicates a forward direction, Arrow R indicates a right direction, and Arrow L indicates a left direction.

FIG. **1** is a side view which shows the unmanned helicopter **10** (hereinafter, will be simply called helicopter **10**). Referring to FIG. **1**, the helicopter **10** includes the display device **12**, a main body **14**, the mast **16**, a main rotor **18**, a tail body **20**, and a tail rotor **22**. Details of the display device **12** will be described below.

The main body **14** includes a frame **24**, a body cover **26**, an under cover **28**, a pair of leg portions **30** (FIG. **1** shows only the left leg portion **30**), a pair of leg portions **32** (FIG. **1** shows only the left leg portion **32**), and a pair of skids **34** (FIG. **1** shows only the left skid **34**).

The frame **24** is preferably rectangular or substantially rectangular in a front view, and extends in a fore-aft direction. The body cover **26** is supported by the frame **24**. The body cover **26** preferably includes therein, various unillustrated devices (such as an engine, a transmission, a radiator, a control device, and an attitude detector).

The under cover **28** is attached to the tail body **20** and the frame **24** so as to cover a portion of the display device **12**. Details of the under cover **28** will be described below. The pair of leg portions **30** are attached to two side surfaces of the frame **24**. The pair of leg portions **32** are attached to the two side surfaces of the frame **24** at more rearward positions than the pair of leg portions **30**. The pair of skids **34** are attached side by side in a left-right direction to the pair of leg portions **30** and the pair of leg portions **32**. Specifically, the skid **34** on one side (left side) is attached to the leg portions **30**, **32** on one side (left side), whereas the skid **34** (not illustrated) on the other side (right side) is attached to the leg portions **30**, **32** (not illustrated) on the other side (right side).

The mast **16** protrudes upward from the body cover **26** and is rotatable. The mast **16** includes an upper end portion where the main rotor **18** is fixed. Thus, the mast **16** and the main rotor **18** rotate integrally with each other.

The tail body **20** is preferably cylindrical or substantially cylindrical, and extends to a more rearward position than the main body **14**. The tail body **20** includes a forward end portion which is supported by the frame **24** inside the body cover **26**. The tail rotor **22** is rotatable and is located at a rearward end portion of the tail body **20**. Inside the tail body **20**, a connecting member (not illustrated) is provided to connect the above-mentioned transmission (not illustrated) and the tail rotor **22** to each other. In the present preferred embodiment, the connecting member is provided by a rotating shaft (not illustrated) extending in a fore-aft direction. The tail rotor **22** rotates as the rotating shaft rotates.

The engine (not illustrated) generates a driving force, which is transmitted to the transmission (not illustrated), and then supplied to the mast **16** and the rotating shaft (not illustrated). This causes rotation of the mast **16** and the rotating shaft (not illustrated) causing the main rotor **18** and the tail rotor **22** to rotate.

FIG. **2** is a side view showing the display device **12**, the frame **24**, and the under cover **28**. Referring to FIG. **2**, the frame **24** includes a rearward end portion which supports a battery box **36**. The battery box **36** supplies electric power to electric components (including the display device **12**) of the helicopter **10**.

FIG. **3** is an enlarged side view showing a relationship between the display device **12**, the under cover **28**, and the battery box **36**, whereas FIG. **4** is a perspective view showing the display device **12**, the under cover **28**, and the battery box **36**. FIG. **5** is a rear view showing the display device **12**, FIG. **6** is a plan view showing the display device **12**, and FIG. **7** is a bottom view showing the display device **12**. FIG. **8** is an illustrative side view showing an internal structure of the display device **12**. In FIG. **8**, the internal structure of the display device **12** is illustrated in a simplified manner in order to avoid a complicated view. In the present preferred embodiment, a front surface of the display device **12** is a surface which appears in a view of the display device **12** taken from Arrow X direction (see FIG. **3**). A front surface, a back surface, a plane surface, a bottom surface, and side surfaces which appear in FIG. **5** and the following drawings are defined accordingly to this front surface. In the present preferred embodiment, Arrow X direction is a direction perpendicular or substantially perpendicular to an LED substrate **54** which will be described below. Also, as shown in FIG. **3**, in the present preferred embodiment, Arrow X direction is a direction which is slightly inclined downward with respect to the fore-aft direction.

Referring to FIG. **2** through FIG. **8**, the display device **12** includes a cover portion **38** and a cover portion **40**. The cover portion **38** includes a flange portion **42** and a translucent portion **44** protruding rearward from the flange portion **42**. Referring to FIG. **8**, each of the flange portion **42** and the translucent portion **44** is hollow.

In the present preferred embodiment, the flange portion **42** is made of, for example, a carbonate resin (such as polycarbonate (PC)), an acrylic resin (such as polymethylmethacrylate (PMMA)), or a polyamide (PA) resin. The translucent portion **44** lets light, which is emitted from a light source portion **60** to be described below, pass therethrough. The translucent portion **44** is made of, for example, a carbonate resin (such as polycarbonate (PC)), an acrylic resin (such as polymethylmethacrylate (PMMA)), or a polyamide (PA) resin. In the present preferred embodiment, the translucent portion **44** is made of the same material as is the flange portion **42**. Details of the translucent portion **44** will be described below.

Referring to FIG. **2**, FIG. **3**, and FIG. **6** through FIG. **8**, the cover portion **40** includes a flange portion **46**, a projected portion **48** protruding forward from the flange portion **46**, and a connecting portion **50** protruding forward from the projected portion **48**. Referring to FIG. **8**, each of the flange portion **46**, the projected portion **48**, and the connecting portion **50** is hollow. The cover portion **40** is made of, for example, a polybutylene terephthalate (PBT) resin, an acrylonitrile butadiene styrene copolymerization synthetic resin (ABS resin), or aluminum (Al).

Referring to FIG. **4** through FIG. **8**, the flange portion **42** includes a frame shaped circumferential wall portion **42***a* and a plate shaped rear wall portion **42***b*. The rear wall portion **42***b* connects a rear edge of the circumferential wall portion **42***a* and a front edge of the translucent portion **44** to each other. Referring to FIG. **6** through FIG. **8**, the flange portion **46** includes a frame shaped circumferential wall portion **46***a* and a plate shaped front wall portion **46***b*. The front wall portion **46***b* connects a front edge of the circumferential wall portion **46***a* and a rear edge of the projected portion **48** to each other.

The circumferential wall portion **46***a* is shaped to correspond to the circumferential wall portion **42***a*. Referring to FIG. **4** through FIG. **7**, the circumferential wall portion **42***a* and the circumferential wall portion **46***a* are fixed together with a plurality of screws **52**, for example. In the present preferred embodiment, four screws **52** preferably are used to fix four corners of the circumferential wall portion **42***a* and four corners of the circumferential wall portion **46***a* to each other, for example. Thus, the cover portion **38** and the cover portion **40** are fixed to each other.

Referring to FIG. **8**, the cover portion **38** and the cover portion **40** provide an internal space S of the display device **12**. In the internal space S, an LED substrate **54** and a control substrate **56** are provided.

FIG. **9** is a rear view of the LED substrate **54**. FIG. **8** and FIG. **9** show the LED substrate **54** in a simplified manner in order to avoid complicating the drawing.

Referring to FIG. **9**, the LED substrate **54** is preferably rectangular or substantially rectangular. Referring to FIG. **8** and FIG. **9**, the LED substrate **54** includes a plurality of LEDs (Light Emitting Diodes) **58**. Referring to FIG. **9**, in the present preferred embodiment, the plurality of LEDs **58** are disposed preferably in twelve arrays extending in the left-right direction, with each array preferably including six of the LEDs **58** arranged in an up-down direction, for example. In other words, the LED substrate **54** preferably includes seventy-two LEDs **58**, for example.

The LED substrate **54** includes the light source portion **60**. The light source portion **60** includes a plurality of LEDs **58**. In the present preferred embodiment, the light source portion **60** preferably includes the above-described seventy-two LEDs

58. Referring to FIG. 8, the light source portion 60 emits light at least in Arrow X direction. In the present preferred embodiment, each LED 58 emits light at least in Arrow X direction.

Referring to FIG. 9, the light source portion 60 includes a first light source portion 60*a*, a plurality (for example, two, in the present preferred embodiment) of second light source portions 60*b*, and a third light source portion 60*c*. The plurality of second light source portions 60*b* are disposed to sandwich the first light source portion 60*a* from the left and right. The third light source portion 60*c* is disposed above the first light source portion 60*a* and is sandwiched by the plurality of second light source portions 60*b* from the left and right. In the present preferred embodiment, the first light source portion 60*a* includes thirty of the LEDs 58 in the light source portion 60, located in six arrays (consisting of thirty-six LEDs 58) in an intermediate region, excluding six of the LEDs 58 located in an upper end region. Of the two second light source portions 60*b*, the right-side second light source portion 60*b* includes three arrays (eighteen LEDs 58) in a right end region of the light source portion 60. The left-side second light source portion 60*b* includes three arrays (eighteen LEDs 58) in a left end region of the light source portion 60, for example. The third light source portion 60*c* includes six LEDs 58 in the upper end region of the six arrays (thirty-six LEDs 58) in the intermediate region of the light source portion 60, for example.

The plurality of LEDs 58 which belong to the first light source portion 60*a*, the plurality of LEDs 58 which belong to the second light source portions 60*b*, and the plurality of LEDs 58 which belong to the third light source portion 60*c* may emit light in different colors from each other, or light of the same color. In the present preferred embodiment, for example, each LED 58 in the first light source portion 60*a* illuminates in orange, each LED 58 in each of the second light source portions 60*b* illuminates in red, and the LED 58 in the third light source portion 60*c* illuminates in blue or green.

In the present preferred embodiment, each LED 58 in each of the second light source portions 60*b* functions as a light source for warning purposes to provide an emergency warning signal to the operator of the helicopter 10. Specifically, the second light source portions 60*b* let the operator of the helicopter 10 know of an essential problem, for example, regarding the flight of the helicopter 10 (such as a failure of various devices including the engine and the control device). Each LED 58 in the first light source portion 60*a* functions as a light source for cautioning purposes to provide a caution sign, which is not as urgent as the warning sign, to the operator of the helicopter 10. Specifically, the first light source portion 60*a* provides the operator of the helicopter 10, for example, signals such as one indicating a low fuel level, abnormal speed (e.g., overspeed) of the helicopter 10, and a signal reception malfunction of a GPS receiver (not illustrated). Each LED 58 in the third light source portion 60*c* functions as a light source to inform the operator the state of the helicopter 10 and to provide signs from the helicopter 10 to the operator of the helicopter 10. Specifically, the third light source portion 60*c* provides the operator of the helicopter 10, for example, with signals such as a signal indicating a control mode of the GPS receiver (not illustrated) mounted on the helicopter 10, a control state of the GPS receiver, and an operation status of a sprayer (not illustrated) mounted on the helicopter 10.

Referring to FIG. 8 and FIG. 9, a plurality (for example, seventy-two, in the present preferred embodiment) of sealing portions 62 are provided to seal the plurality of LEDs 58, respectively. The sealing portions 62 extend perpendicularly or substantially perpendicularly with respect to the LED substrate 54. In the present preferred embodiment, the sealing portions 62 are preferably columnar or substantially columnar, and each includes a tip portion which is hemispherical or substantially hemispherical. The sealing portions 62 allow, for example, the light emitted from the LEDs 58 to pass therethrough without scattering. The sealing portions 62 are made of, for example, a carbonate resin (such as polycarbonate (PC)), an acrylic resin (such as polymethylmethacrylate (PMMA)), a polyamide (PA) resin, or glass.

Referring to FIG. 9, the LED substrate 54 includes four corners each including a through-hole 64. Referring to FIG. 8, the control substrate 56 preferably has the same shape (for example, rectangular or substantially rectangular) as the LED substrate 54. The control substrate 56 includes four corners each provided with a through-hole 66 (FIG. 8 only shows two of the through-holes 66). The four through-holes 66 in the control substrate 56 are located at positions corresponding to the four through-holes 64 in the LED substrate 54. The LED substrate 54 and the control substrate 56 are electrically connected to each other with unillustrated connection members (e.g., electric wires). The control substrate 56 controls the plurality of LEDs 58 of the LED substrate 54. The control substrate 56 is preferably a conventional control substrate, so details of the control substrate 56 will not be described.

The flange portion 46 of the cover portion 40 includes a plurality of cylindrical boss portions 46*c*. In the present preferred embodiment, four boss portions 46*c* preferably are provided correspondingly to the four through-holes 64 in the LED substrate 54 and four through-holes 66 in the control substrate 56. The boss portions 46*c* extend perpendicularly or substantially perpendicularly from the front wall portion 46*b* inside the internal space S.

A plurality of collars 68 are sandwiched by the LED substrate 54 and the control substrate 56. In the present preferred embodiment, four collars 68 preferably are provided correspondingly to the four through-holes 64 in the LED substrate 54 and four through-holes 66 in the control substrate 56, for example. The LED substrate 54, the collars 68, and the control substrate 56 are fixed to the plurality of boss portions 46*c* with a plurality (for example, four, in the present preferred embodiment) of screws 70, for example. Specifically, each screw 70 is inserted through the through-hole 64, the collar 68 and the through-hole 66, into the boss portion 46*c*, and a tip portion of the screw 70 is threaded into the boss portion 46*c*.

The connecting portion 50 includes a plurality (four, for example) of terminals 72. The plurality of terminals 72 are electrically connected to the control substrate 56 via unillustrated connection members (such as electric wires) laid inside the projected portion 48. Without going into detail, the plurality of terminals 72 are electrically connected to the control device disposed inside the battery box 36 (see FIG. 2) and the body cover 26 (FIG. 1). Thus, electric power is supplied to the control substrate 56 and the LED substrate 54, and control signals are supplied to the control substrate 56.

Hereinafter, details of the translucent portion 44 in the cover portion 38 will be described.

Referring to FIG. 3 through FIG. 5, the translucent portion 44 is symmetrical in the left-right direction. The translucent portion 44 includes an opposed portion 74, a pair of first side wall portions 76, a pair of second side wall portions 78, a pair of third side wall portions 80, a pair of fourth side wall portions 82, and a fifth side wall portion 84. In the present preferred embodiment, the pair of first side wall portions 76, the pair of second side wall portions 78, the pair of third side wall portions 80, the pair of fourth side wall portions 82, and the fifth side wall portion 84 define a side wall portion 85.

Referring to FIG. 5, the opposed portion 74 is preferably pentagonal or substantially pentagonal in a rear view. Refer-

ring to FIG. **8**, the opposed portion **74** is opposed to the light source portion **60** in Arrow X direction of the light source portion **60**. In the present preferred embodiment, Arrow X direction represents the first direction.

Referring to FIG. **6** and FIG. **7**, the opposed portion **74** is configured such that its intermediate region slightly bulges in Arrow X direction in a plan view (bottom view). Referring to FIG. **8**, the opposed portion **74** extends from top to bottom so that its lower end portion is closer to the light source portion **60** (reverse direction from Arrow X direction) than is its upper end portion in a side view.

Referring to FIG. **3** through FIG. **5**, the opposed portion **74** includes a bent portion **74***a* in its outer edge region. The bent portion **74***a* bends toward a substantially reverse direction from Arrow X direction (see FIG. **6** through FIG. **8**). The pair of first side wall portions **76**, the pair of second side wall portions **78**, and the fifth side wall portion **84** are connected to the bent portion **74***a*.

Referring to FIG. **5**, the pair of first side wall portions **76** extend from two side regions of the opposed portion **74** in a substantially reverse direction from Arrow X direction (see FIG. **6** through FIG. **8**). More specifically, the pair of first side wall portions **76** extend from top to bottom so that its lower end portion is on a more inward side of the cover portion **38** in terms of the left-right direction than is its upper end portion in a rear view. Referring to FIG. **6** and FIG. **7**, the pair of first side wall portions **76** extend from two side regions of the opposed portion **74** outward and obliquely forward in the left-right directions of the cover portion **38** in a plan view (bottom view).

Referring to FIG. **5**, the pair of second side wall portions **78** extend from two side regions of the opposed portion **74** in a substantially reverse direction from Arrow X direction (see FIG. **6** through FIG. **8**) at lower positions than the pair of first side wall portions **76**. More specifically, the pair of second side wall portions **78** extend from top to bottom so that its lower end portion is on a more inward side of the cover portion **38** in a left-right direction than is its upper end portion in a rear view. Referring to FIG. **8**, the pair of second side wall portions **78** extend from top to bottom so that its lower end portion is closer to the light source portion **60** (reverse direction from Arrow X direction) than is its upper end portion in a side view. The upper end portions of the pair of second side wall portions **78** are connected to the lower end portions of the pair of first side wall portions **76**. The lower end portions of the pair of second side wall portions **78** are connected to each other.

Referring to FIG. **3** through FIG. **7**, the pair of third side wall portions **80** extend from forward end regions of the pair of first side wall portions **76** in a substantially reverse direction from Arrow X direction (see FIG. **6** and FIG. **7**). The forward end portions of the pair of third side wall portions **80** are connected to the rear wall portion **42***b* of the flange portion **42**. Referring to FIG. **5**, the pair of third side wall portions **80** extend from top to bottom so that its lower end portion is on a more inward side of the cover portion **38** in terms of the left-right direction than is its upper end portion in a rear view.

Referring to FIG. **3** through FIG. **5**, and FIG. **7**, the pair of fourth side wall portions **82** extend from forward end regions of the pair of second side wall portions **78** in a substantially reverse direction from Arrow X direction (see FIG. **7**). Referring to FIG. **5**, the pair of fourth side wall portions **82** extend from top to bottom so that its lower end portion is on a more inward side of the cover portion **38** in terms of the left-right direction than is its upper end portion in a rear view. The upper end portions of the pair of fourth side wall portions **82** are connected to the lower end portions of the pair of third side wall portions **80**. The lower end portions of the pair of fourth side wall portions **82** are connected to each other. The forward end portions of the pair of fourth side wall portions **82** are connected to the rear wall portion **42***b* of the flange portion **42**.

Referring to FIG. **3** through FIG. **6**, the fifth side wall portion **84** extends from an upper end region of the opposed portion **74** in a substantially reverse direction from Arrow X direction (see FIG. **6**). Two side portions of the fifth side wall portion **84** are connected to upper end portions of the pair of first side wall portions **76** and upper end portions of the pair of third side wall portions **80**. The forward end portion of the fifth side wall portion **84** is connected to the rear wall portion **42***b* of the flange portion **42**.

Next, detailed description will be made for a structure of an inner surface of the translucent portion **44**. FIG. **10** is a front view of the cover portion **38**. FIG. **11** is a sectional view taken along lines A-A in FIG. **10**, whereas FIG. **12** is a sectional view taken along lines B-B in FIG. **10**. FIG. **11** and FIG. **12** show the flange portion **42** in a simplified manner in order to avoid complicating the drawing.

Referring to FIG. **10** and FIG. **11**, the inner surface of the opposed portion **74** includes a plurality of non-flat portions **86***a*, **86***b*, **86***c*, **86***d*, **86***e*, **86***f*, **86***g*, **86***h*, **86***i*. The non-flat portion **86***a* is a convex surface protruding toward the internal space S (see FIG. **8**), and extends in the left-right direction along an upper end region of the opposed portion **74**. Referring to FIG. **11**, the non-flat portion **86***a* is defined by a salient which preferably has a triangular or substantially triangular section protruding toward the internal space S (see FIG. **8**) on the inner surface side of the opposed portion **74**. Likewise, the non-flat portions **86***b*, **86***c*, **86***d*, **86***f*, **86***g*, **86***h*, **86***i* are also convex surfaces protruding toward the internal space S (see FIG. **8**), which are defined by salients that also preferably have triangular or substantially triangular sections on the inner surface side of the opposed portion **74**.

Referring to FIG. **10**, the non-flat portion **86***b* extends along an outer edge region (excluding the upper end region) of the opposed portion **74** and is U-shaped or substantially U-shaped in a front view. The non-flat portion **86***b* has its two end portions connected to two end portions of the non-flat portion **86***a*. In the present preferred embodiment, the non-flat portions **86***a*, **86***b* are provided on an inner surface of the bent portion **74***a* (see FIG. **11**).

The non-flat portion **86***c* extends in the left-right direction at a lower position than the non-flat portion **86***a*. The pair of non-flat portions **86***d* are connected to two end portions of the non-flat portion **86***c*. Each of the pair of non-flat portions **86***d* is annular in a front view. The non-flat portion **86***e* is provided inside each of the non-flat portions **86***d*. The non-flat portion **86***e* is a concave-convex surface provided on the inner side of the non-flat portion **86***d*. The non-flat portion **86***e* includes a plurality of polygonal concave-convex patterns in a front view on the inner surface side of the opposed portion **74**. FIG. **11** shows the non-flat portions **86***d*, **86***e* in a simplified manner in order to avoid complicating the drawing.

The pair of non-flat portions **86***f* extend in the left-right direction to connect the non-flat portion **86***b* and the pair of non-flat portions **86***d* to each other. The non-flat portions **86***g*, **86***h*, **86***i* extend in a left-right direction at a lower position than the non-flat portions **86***c*, **86***d*, **86***e*, **86***f*. The non-flat portions **86***g*, **86***h*, **86***i* have their two end portions connected to the non-flat portion **86***b*. In the present preferred embodiment, each of the non-flat portions **86***g*, **86***h*, **86***i* is parallel or substantially parallel to the non-flat portions **86***c*, **86***f*.

A plurality (five, in the present preferred embodiment) of flat portions **88***a*, **88***b*, **88***c*, **88***d*, **88***e* are provided in regions of

the inner surface of the opposed portion **74** excluding the non-flat portions **86***a*, **86***b*, **86***c*, **86***d*, **86***e*, **86***f*, **86***g*, **86***h*, **86***i*.

Referring to FIG. **10** and FIG. **11**, a non-flat portion **90** extends along the non-flat portion **86***b* and is U-shaped or substantially U-shaped in a front view. The non-flat portion **90** is a concave-convex surface which extends over a range from inner surfaces of the pair of first side wall portions **76** to inner surfaces of the pair of second side wall portions **78**. Referring to FIG. **11**, the non-flat portion **90** includes a plurality (two, in the present preferred embodiment) of salients each preferably having a triangular or substantially triangular section on the inner surface side of the pair of first side wall portions **76** and the inner surface side of the pair of second side wall portions **78** to protrude toward the internal space S (see FIG. **8**) and extending along the non-flat portion **86***b*. In the present preferred embodiment, almost all areas in the inner surface of the pair of first side wall portions **76** and the inner surface of the pair of second side wall portions **78** function as the non-flat portion **90**.

Referring to FIG. **10** through FIG. **12**, a non-flat portion **92** is provided throughout inner surfaces of the pair of third side wall portions **80**, inner surfaces of the pair of fourth side wall portions **82** (see FIG. **10** and FIG. **11**), and an inner surface of the fifth side wall portion **84**. Referring to FIG. **10**, the non-flat portion **92** is a concave-convex surface which is provided throughout the inner surfaces of the pair of third side wall portions **80**, the inner surfaces of the pair of fourth side wall portions **82**, and the inner surface of the fifth side wall portion **84**. The non-flat portion **92** includes a plurality of salients each preferably having a shape of a semicircular column protruding toward the internal space S (see FIG. **8**) and extending in a fore-aft direction, in the inner surfaces of the pair of third side wall portions **80**, the inner surfaces of the pair of fourth side wall portions **82**, and the inner surface of the fifth side wall portion **84**. The non-flat portion **92** extends from rearward end regions of the third side wall portions **80**, rearward end regions of the fourth side wall portions **82**, and a rearward end region of the fifth side wall portion **84** in a substantially reverse direction from Arrow X direction (see FIG. **11** and FIG. **12**). A region other than the non-flat portion **92**, in the inner surfaces of the pair of third side wall portions **80**, in the inner surfaces of the pair of fourth side wall portions **82**, and in the inner surface of the fifth side wall portion **84** is a flat portion **94**.

Referring to FIG. **10** and FIG. **11**, the cover portion **38** includes a straight-through portion ST which allows the light emitted from the light source portion **60** to travel straightly, and a first scatter portion SC**1** and a second scatter portion SC**2** which scatter the light emitted from the light source portion **60**. More specifically, the opposed portion **74** includes the straight-through portion ST and the second scatter portion SC**2**, whereas the side wall portion **85** includes the first scatter portion SC**1**. In the present preferred embodiment, the straight-through portion ST includes the flat portions **88***a*, **88***b*, **88***c*, **88***d*, **88***e*; the first scatter portion SC**1** includes the non-flat portion **90** and the non-flat portion **92**; and the second scatter portion SC**2** includes the bent portion **74***a* (which includes the non-flat portions **86***a*, **86***b*) and the non-flat portions **86***c*, **86***d*, **86***e*, **86***f*, **86***g*, **86***h*, **86***i*.

In the present preferred embodiment, the non-flat portions **90**, **92** correspond to the first non-flat portion, whereas the non-flat portions **86***a*, **86***b*, **86***c*, **86***d*, **86***e*, **86***f*, **86***g*, **86***h*, **86***i* correspond to the second non-flat portion.

FIG. **13** is a diagram which shows a positional relationship between the translucent portion **44** and the light source portion **60**. The positional relationship between the translucent portion **44** and the light source portion **60** shown in FIG. **13** is a relationship when the translucent portion **44** and the light source portion **60** are viewed in Arrow X direction (see FIG. **8**). In order to avoid complicating the drawings, FIG. **13** shows the pair of non-flat portions **86***e* in a simplified manner.

Referring to FIG. **13**, when the translucent portion **44** and the light source portion **60** are viewed in Arrow X direction (see FIG. **8**), a plurality of the LEDs **58** in the LEDs **58** of the light source portion **60** overlap the non-flat portions **86***b*, **86***d*, **86***e*, **86***g*, **90**, whereas the other plurality of the LEDs **58** overlap the flat portions **88***a*, **88***b*, **88***c*, **88***d*, **88***e*.

When the translucent portion **44** and the light source portion **60** are viewed in Arrow X direction (see FIG. **8**), each of the non-flat portions **86***e* overlaps a plurality (for example, four, in the present preferred embodiment) of LEDs **58**. In the present preferred embodiment, each of the non-flat portions **86***e* overlaps one LED **58** which belongs to the first light source portion **60***a*, two LEDs **58** which belong to the second light source portion **60***b*, and one LED **58** which belongs to the third light source portion **60***c*.

FIG. **14** and FIG. **15** are drawings for describing a range of light radiated by the light source portion **60**. Referring to FIG. **14** and FIG. **15**, in the display device **12**, all regions in the inner surface of the translucent portion **44** which are on the side of Arrow X direction with respect to an alternate long and two short dashes line Y are irradiated by the light emitted from the light source portion **60**. Specifically, in the display device **12**, all regions of the non-flat portions **86***a*, **86***b*, **86***c*, **86***d*, **86***e*, **86***f*, **86***g*, **86***h*, **86***i*, all regions of the plurality of flat portions **88***a*, **88***b*, **88***c*, **88***d*, **88***e*, all regions of the non-flat portion **90**, and at least a portion of the non-flat portion **92** are irradiated by the light emitted from the light source portion **60**. It should be noted here that the range of light radiation by the light emitted from the light source portion is adjusted appropriately by changing the number of LEDs **58** and the pattern in which the LEDs **58** are disposed.

FIG. **16** is a rear view of the under cover **28**.

Referring to FIG. **2** through FIG. **4** and FIG. **16**, the under cover **28** includes a holder portion **96** and a guide portion **98** protruding rearward from the holder portion **96**. The holder portion **96** includes a tube shaped portion **96***a* and a flange shaped portion **96***b*. The tube shaped portion **96***a* preferably has a substantially inverse-trapezoidal shape in a rear view, and extends in a fore-aft direction. The flange shaped portion **96***b* connects a rearward end portion of the tube shaped portion **96***a* and a forward end portion of the guide portion **98** to each other. The guide portion **98** is tube shaped, and pentagonal or substantially pentagonal in a rear view.

Referring to FIG. **2** through FIG. **7**, when the display device **12** is attached to the helicopter **10**, first, a plurality of buffer members **100** and a plurality of buffer members **102** are attached to the cover portion **38**; and a plurality of buffer members **104** (see FIG. **2**, FIG. **3**, FIG. **6** and FIG. **7**) are attached to the cover portion **40**. In the present preferred embodiment, referring to FIG. **5**, one buffer member **100** is attached to each of the third side wall portions **80**, one buffer member **100** is attached to each of the fourth side wall portions **82**, two buffer members **100** are attached to the fifth side wall portion **84**, and two buffer members **102** are attached to the rear wall portion **42***b*. Referring to FIG. **6**, two buffer members **104** are attached to the front wall portion **46***b*, and one buffer member **104** is attached to the projected portion **48**.

Referring to FIG. **3**, the flange portion **42** of the cover portion **38** and the cover portion **40** are housed in the holder portion **96**, and the translucent portion **44** protrudes rearward from the guide portion **98** when the under cover **28** is placed over the display device **12** from rear. In the present preferred embodiment, the area of the side wall portion **85** provided

with the non-flat portion **92** (see FIG. **11**) protrudes to a more rearward position than the guide portion **98** under the state where the under cover **28** is attached. In this state, the plurality of buffer members **100**, **102** are sandwiched by the under cover **28** and the cover portion **38**.

While the display device **12** with the under cover **28** is being held, the display device **12** is pressed onto the battery box **36** so that the opposed portion **74** faces obliquely rearward and downward. At this time, the plurality of buffer members **104** are sandwiched by the battery box **36** and the cover portion **40**. Under this state, the under cover **28** is attached to the tail body **20** and the frame **24** as shown in FIG. **1**. As a result, the display device **12** is supported by the tail body **20** and the frame **24**. As described above, the display device **12** is placed in a rear portion of the main body **14**, below the tail body **20** so that the human operator who remotely operates the helicopter **10** can see the display device **12** from the rear of the helicopter **10**.

Hereinafter, description will describe the functions and advantages of the display device **12**.

The display device **12** includes the light source portion **60** which includes a plurality of LEDs **58**; and the cover portions **38**, **40** which cover the light source portion **60**. The cover portion **38** includes the opposed portion **74** which is opposed to the light source portion **60** in Arrow X direction of the light source portion **60**; and the side wall portion **85** which extends from an outer edge of the opposed portion **74** in a substantially reverse direction from Arrow X direction. The opposed portion **74** includes the straight-through portion ST, whereas the side wall portion **85** includes the first scatter portion SC**1**.

In the arrangement described above, according to the display device **12**, a portion of light emitted from the light source portion **60** is directed to the straight-through portion ST of the opposed portion **74**. A portion of the light directed to the straight-through portion ST travels straightly through the straight-through portion ST, and then out of the cover portion **38** (the opposed portion **74**). In other words, the portion of the light emitted from the light source portion **60** to the cover portion **38** passes therethrough and then leaves the cover portion **38** to the outside without being scattered in the cover portion **38**. This improves the visibility of the display device **12** from a distance in Arrow X direction. Namely, this improves the visibility of the display device **12** from the rear of the helicopter **10**.

A different portion of the light directed to the straight-through portion ST of the opposed portion **74** repeats reflection inside the opposed portion **74**, and reaches the side wall portion **85**. The portion of the light which arrived at the side wall portion **85** is then scattered by the first scatter portion SC**1**. Of the light emitted from the light source portion **60**, a portion of the light reflected by the inner surface of the cover portion **38** is directed to the side wall portion **85**. The portion of the light which is directed to the side wall portion **85** is then scattered by the first scatter portion SC**1**. This improves the visibility of the display device **12** from directions across Arrow X direction (from a side, for example). Namely, this improves the visibility of the display device **12** from the sides of the helicopter **10**.

As a result of these, it is possible to improve the visibility of the display device **12** in a wide range while improving the visibility of the display device **12** from a distance.

The opposed portion **74** includes the second scatter portion SC**2**. In this case, it is possible to scatter another portion of the light emitted from the light source portion **60** in the second scatter portion SC**2**. This further improves the visibility of the display device **12** from directions other than from Arrow X direction (especially from the sides).

When the cover portion **38** and the light source portion **60** are viewed from Arrow X direction, the light source portion **60** overlaps the non-flat portions **86***b*, **86***d*, **86***e*, **86***g* of the second scatter portion SC**2**. In this case, it is possible to reliably scatter a portion of the light emitted from the light source portion **60** in Arrow X direction with the non-flat portions **86***b*, **86***d*, **86***e*, **86***g*. In other words, it is possible to further improve the visibility of the display device **12**.

When the cover portion **38** and the light source portion **60** are viewed from Arrow X direction, the straight-through portion ST overlaps a portion of the plurality of LEDs **58** whereas the non-flat portions **86***b*, **86***d*, **86***e*, **86***g* of the second scatter portion SC**2** overlap another portion of the plurality of LEDs **58**. In this case, light emitted by a portion of the plurality of LEDs **58** in Arrow X direction is directed to the straight-through portion ST, and is allowed to travel out of the cover portion **38** without being scattered in the opposed portion **74**. This sufficiently improves the visibility of the display device **12** from a distance in Arrow X direction. On the other hand, light emitted from another portion of the plurality of LEDs **58** in Arrow X direction is directed to the non-flat portions **86***b*, **86***d*, **86***e*, **86***g* of the second scatter portion SC**2** and scattered in the non-flat portions **86***b*, **86***d*, **86***e*, **86***g*. This also sufficiently improves the visibility of the display device **12** from directions other than from Arrow X direction (especially from the sides).

The light source portion **60** includes the first light source portion **60***a* and the pair of second light source portions **60***b* which emit light in a color different from that emitted from the first light source portion **60***a*. When the cover portion **38** and the light source portion **60** are viewed from Arrow X direction, the first light source portion **60***a* is located between the pair of second light source portions **60***b*, and each of the second light source portions **60***b* is located between the first light source portion **60***a* and the side wall portion **85**. Also, when the cover portion **38** and the light source portion **60** are viewed from Arrow X direction, the pair of non-flat portions **86***e* and the non-flat portion **86***g* of the second scatter portion SC**2** overlap a plurality of the LEDs **58** of the first light source portion **60***a*. According to the arrangement described above, when the cover portion **38** and the light source portion **60** are viewed from Arrow X direction, the pair of second light source portions **60***b* are closer to the side wall portion **85** than is the first light source portion **60***a*. This improves the visibility of light emitted from the pair of second light source portions **60***b* from the sides. Also, a portion of the light emitted from the first light source portion **60***a* in Arrow X direction is scattered by the pair of non-flat portions **86***e* and the non-flat portion **86***g*. This also improves the visibility of the light emitted from the first light source portion **60***a* from the sides. Further, when the cover portion **38** and the light source portion **60** are viewed from Arrow X direction, the pair of non-flat portions **86***e* and the non-flat portion **86***g* of the second scatter portion SC**2** overlap a plurality of the LEDs **58** of the second light source portions **60***b*. In the arrangement described above, a portion of the light emitted from the second light source portions **60***b* in Arrow X direction is scattered by the pair of non-flat portions **86***e* and the non-flat portion **86***g*. This improves the visibility of the light emitted from the second light source portion **60***b* sufficiently from the sides.

When the cover portion **38** and the light source portion **60** are viewed from Arrow X direction, the non-flat portion **86***e* in the second scatter portion SC**2** overlaps the first light source portion **60***a*, the second light source portion **60***b*, and the third light source portion **60***c*. In this case, it is possible to reliably scatter not only the light which is emitted by the first

light source portion **60***a* in Arrow X direction but also the light which is emitted by the second light source portion **60***b* and the third light source portion **60***c* in Arrow X direction in the non-flat portion **86***e*. This further improves the visibility of light which is emitted from the second light source portions **60***b* and the third light source portion **60***c* from the sides.

The second light source portions **60***b* includes the warning LEDs **58**. In the display device **12**, in a view from Arrow X direction, the pair of second light source portions **60***b* are closer to the side wall portion **85** than is the first light source portion **60***a*. For this reason, the light which is emitted from the pair of second light source portions **60***b* has better visibility from the sides than does the light which is emitted from the first light source portion **60***a*. Therefore, the arrangement that the pair of second light source portions **60***b* include warning LEDs **58** improves the visibility of the light which is emitted from the warning LEDs **58** from the sides.

The opposed portion **74** also scatters the light which is emitted from the light source portion **60** in the bent portion **74***a*. As described above, according to the display device **12**, it is possible to scatter light with a simple arrangement.

The non-flat portions **90**, **92** are provided on the inner surface of the side wall portion **85**, whereas the non-flat portions **86***a*, **86***b*, **86***c*, **86***d*, **86***e*, **86***f*, **86***g*, **86***h*, **86***i* are provided on the inner surface of the opposed portion **74**. In this case, the arrangement prevents dust and dirt from depositing on the non-flat portions **86***a*, **86***b*, **86***c*, **86***d*, **86***e*, **86***f*, **86***g*, **86***h*, **86***i*, **90**, **92**, making it easy to clean the cover portion **38**.

When the cover portion **38** and the light source portion **60** are viewed from Arrow X direction, the non-flat portion **90** of the first scatter portion SC**1** overlaps a portion of the plurality of LEDs **58** in the pair of second light source portions **60***b*. In this case, the arrangement reliably scatters the light which is emitted from the second light source portions **60***b* in Arrow X direction in the non-flat portion **90**. This sufficiently improves the visibility of the light emitted from the second light source portions **60***b* from the sides. It should be noted here that the first light source portion may be arranged so that the LEDs **58** in the first light source portion and the non-flat portion **90** overlap each other when viewed from Arrow X direction.

A plurality of buffer members **100**, **102**, **104** preferably are provided between the display device **12**, the under cover **28**, and the battery box **36**. This prevents large vibrations from developing in the display device **12** and thus, further improves the visibility of the display device **12**.

The display device **12** includes the control substrate **56**, as a separate component from the LED substrate **54**, configured or programmed to control the light source portion **60**. In this case, the operational cost of the display device **12** is reduced because only the LED substrate **54** should be repaired or replaced if a failure occurs in the light source portion **60**.

In the display device **12** there is a gap (space) between the LED substrate **54** and the control substrate **56**. This prevents the control substrate **56** from being affected by heat generated by the plurality of LEDs **58**.

In the display device **12**, the number of LEDs **58** in the pair of second light source portions **60***b* is preferably greater than the number of LEDs **58** in the first light source portion **60***a*, and preferably greater than the number of LEDs **58** in the third light source portion **60***c*. With this arrangement, the operator of the helicopter **10** recognizes the light (warning light, for example) which is emitted by the second light source portions **60***b* more reliably.

In the display device **12** described above, there may be an arrangement that a reflection member is adhesively attached or a reflection coating is applied at any place on the inner surface of the cover portion **38** (for example, upper portions of inner surfaces in the pair of first side wall portions **76**, upper portions of inner surfaces in the pair of third side wall portions **80**, or an inner surface of the fifth side wall portion **84**). This further improves the visibility of the display device **12**.

In the preferred embodiments described above, the opposed portion **74** and the side wall portion **85** are preferably integral with each other. However, there may be an arrangement that the opposed portion and the side wall portion are separate from each other.

In the preferred embodiments described above, the non-flat portion **92** is preferably provided also in the fifth side wall portion **84**. However, it is not necessary to provide a non-flat portion in the fifth side wall portion.

In the preferred embodiments described above, the display device **12** preferably includes the LED substrate **54** and the control substrate **56**. However, there may be an arrangement that a single substrate which includes the function of the LED substrate **54** and the function of the control substrate **56** is utilized in place of the LED substrate **54** and the control substrate **56**.

In the preferred embodiments described above, the first scatter portion SC**1** and the second scatter portion SC**2** are preferably provided by a convex surface and a concave-convex surface on the inner surface of the cover portion **38**. However, there may be an arrangement that the first scatter portion and/or the second scatter portion are provided by a concave surface (s) on the inner surface of the cover portion. Also, the first scatter portion and/or the second scatter portion may be provided by a convex surface, a concave surface, or a concave-convex surface on an outer surface of the cover portion. Also, the first scatter portion and/or the second scatter portion may be formed by applying a scattering agent on a portion of the cover portion.

In the preferred embodiments described above, the bent portion **74***a* is preferably provided on the outer edge of the opposed portion **74**, such that the opposed portion **74** and the side wall portion **85** are clearly bordered from each other. However, it is not necessary to provide the bent portion on the outer edge of the opposed portion. Therefore, it is acceptable, for example, that the translucent portion is hemispherical or substantially hemispherical and does not have a clear border between the opposed portion and the side wall portion.

In the preferred embodiments described above, the light emitted from the light source portion **60** preferably travels straightly inside of the translucent portion **44** (excluding the outer surface and the inner surface) without being scattered. However, there may be an arrangement in which a scatter portion that scatters light is provided inside the translucent portion.

FIG. **17** is an illustrative side view of a display device **12***a* according to another preferred embodiment of the present invention. The display device **12***a* shown in FIG. **17** differs from the above-described display device **12** in that a cover portion **38***a* is utilized in place of the cover portion **38**. The cover portion **38***a* differs from the cover portion **38** in that it includes an opposed portion **106** in place of the opposed portion **74**, and further includes an opposed portion **108**. Therefore, no more description will be given about the cover portion **38***a* other than for the opposed portions **106**, **108**.

The opposed portion **106** differs from the opposed portion **74** in that the opposed portion **106** has its inner surface **106***a* not provided with the non-flat portions **86***a*, **86***b*, **86***c*, **86***d*, **86***e*, **86***f*, **86***g*, **86***h*, or **86***i*. In other words, all regions in the inner surface **106***a* of the opposed portion **106** are flat surfaces.

The opposed portion **108** is opposed to the light source portion **60** in Arrow X direction, between the light source portion **60** and the opposed portion **106**. The opposed portion **108** has its inner surface **108***a* the same as the inner surface of the opposed portion **74**, including a plurality of non-flat surfaces and a plurality of flat surfaces. As another arrangement, a plurality of non-flat surfaces and a plurality of flat surfaces may be provided on an outer surface **108***b* of the opposed portion **108**, or both surfaces (inner surface **108***a* and outer surface **108***b*) thereof.

The display device **12***a* scatters the light emitted from the light source portion **60** in the plurality of non-flat surfaces of the opposed portion **108**. Therefore, the display device **12***a* provides the same functions and advantages as offered by the display device **12**. Also, since the display device **12***a* does not require a plurality of non-flat surfaces in the opposed portion **106**, it offers an advantage that the opposed portion **106** is simple. The opposed portion **108** may be spaced from the opposed portion **106**, or may be attached adhesively onto the inner surface **106***a* of the opposed portion **106**. In addition, the side wall portion may also be configured like the opposed portions **106**, **108**.

The arrangements in the first scatter portion and the second scatter portion to scatter the light from the light source portion **60** are not limited to those described above, and may be changed as appropriate.

While preferred embodiments of the present invention have been described above, it is to be understood that variations and modifications will be apparent to those skilled in the art without departing from the scope and spirit of the present invention. The scope of the present invention, therefore, is to be determined solely by the following claims.

The invention claimed is:

1. An unmanned helicopter comprising:

a display device, the display device including:

a light source portion including an LED that emits light at least in a first direction; and

a cover portion covering the light source portion while being exposed to an outside; wherein

the cover portion includes an opposed portion opposed to the light source portion in the first direction of the light source portion, and a side wall portion extending from an outer edge of the opposed portion in a reverse direction from the first direction;

the opposed portion includes a straight-through portion which allows light emitted from the light source portion to travel straightly;

the side wall portion includes a first scatter portion which scatters the light emitted from the light source portion; and

the first scatter portion is provided on a portion of the side wall portion which extends from top to bottom so that its lower end portion is on a more inward side of the cover portion in terms of a left-right direction than is its upper end portion in a rear view, and the first scatter portion is visible in a bottom view.

2. The unmanned helicopter according to claim **1**, wherein the first scatter portion is provided on a pair of second side wall portions of the side wall portion, which extend from top to bottom so that their lower end portions are on a more inward side of the cover portion in terms of a left-right direction than are their upper end portions in a rear view, with the lower end portions of the pair of second side wall portions being connected to each other.

3. The unmanned helicopter according to claim **1**, wherein the opposed portion further includes a second scatter portion which scatters the light emitted from the light source portion; and

the second scatter portion is provided on a portion of the opposed portion which extends from top to bottom so that its lower end portion is closer to the light source portion than is its upper end portion in a side view, and the second scatter portion is visible in a bottom view.

4. The unmanned helicopter according to claim **3**, wherein the second scatter portion overlaps the light source portion when viewed from the first direction.

5. The unmanned helicopter according to claim **3**, wherein the light source portion includes a plurality of LEDs, the straight-through portion overlaps a portion of the plurality of LEDs, and the second scatter portion overlaps another portion of the plurality of LEDs when viewed from the first direction.

6. The unmanned helicopter according to claim **3**, wherein the light source portion includes a first light source portion and a pair of second light source portions which emit light of a different color from that emitted by the first light source portion;

the first light source portion is located between the pair of second light source portions and each of the second light source portions is located between the first light source portion and the side wall portion when viewed from the first direction; and

the second scatter portion overlaps the first light source portion when viewed from the first direction.

7. The unmanned helicopter according to claim **6**, wherein the second scatter portion further overlaps the second light source portion when viewed from the first direction.

8. The unmanned helicopter according to claim **6**, wherein the pair of second light source portions include warning LEDs.

9. The unmanned helicopter according to claim **3**, wherein the second scatter portion includes a bent portion.

10. The unmanned helicopter according to claim **1**, wherein the first scatter portion includes a non-flat portion on an inner surface of the side wall portion.

11. The unmanned helicopter according to claim **3**, wherein the second scatter portion includes a non-flat portion on an inner surface of the opposed portion.

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