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(54) **Flashlight including two reflecting mirrors for one light source**

Taschenlampe mit zwei Reflektoren für eine einzige Lichtquelle

Lampe de poche comportant deux miroirs pour une seule source de lumière

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(56) References cited:
DE-A- 1 497 305
FR-A- 2 390 673
GB-A- 2 079 435
US-A- 3 443 086

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Description

The present invention relates to a flashlight including a light source and reflecting mirrors.

Description of the Background Art

Fig. 3 is a cross sectional view showing a structure of a conventional flashlight.

Referring to Fig. 3, a conventional flashlight includes a body 13 protecting a battery housing portion 15, a battery cover 17 covering a battery housed in housing portion 15, and a body 21 protecting a lamp bulb 7. In body 21, a reflecting mirror 1 is attached around lamp bulb 7 for reflecting forward emitted light from lamp bulb 7, and a lens 19 for expanding the irradiation range is attached in front of lamp bulb 7.

Fig. 4 is an enlarged cross sectional view showing a structure of and around the lamp bulb and reflecting mirror of the flashlight in Fig. 3.

First, as the reference basis, a line passing through the center of lamp bulb 7 is indicated as an X-Y axis and the position of a filament 9 of lamp bulb 7 is indicated as an origin O. The front end of reflecting mirror 1 is indicated as C, and the rear end is indicated as D. Since the structure is symmetric with respect to X-Y axis, only the upper half will hereinafter be described.

In this example, an angle COY is 37.5°, and an angle DOY is 92.4°. Luminous flux of filament 9 emitted in the range of the angle COY is directed forward without being reflected by reflecting mirror 1. Luminous flux of filament 9 emitted in the range of the angle DOC is reflected by reflecting mirror 1 to be made parallel to the axis OY and directed forward.

Consequently, only the luminous flux in the range of the angle DOY (92.4°) emitted from filament 9 is directed forward. A solid angle ANG defined by the range of the luminous flux to be directed forward by reflecting mirror 1 is determined as follows:

ANG = 5.248 (steradians)

Assuming that filament 9 irradiates uniformly all the directions, the utilization efficiency of luminous flux R of reflecting mirror is determined as follows, based on the solid angle ANG:

R = 41.8%

In the conventional flashlight described above, when a lamp bulb in which a filament irradiates backward (which indicates a light source with a solid angle over 6.28 steradians) is used, it can not be said that the backward luminous flux is effectively utilized.

Fig. 5 shows an example in which backward luminous flux should be utilized for forward irradiation. In Fig. 5, the angle COY is 37.5°, which is the same as in Fig. 4, while the angle DOY is 125.0°, which is larger than the corresponding angle in Fig. 4. Here, a solid angle ANG_1 and a utilization efficiency of luminous flux R_1 of reflecting mirror 1 are determined as follows:

ANG_1 = 8.5887 (steradians)

R_1 = 68.3%,

showing large increase in the utilization efficiency of luminous flux. However, for increasing a utilization efficiency of luminous flux with the angle COY being constant, reflecting mirror 1 must be made larger compared to Fig. 4, as can be seen from Fig. 5 (compare the dimensions L in the figures). Fig. 6 is a cross sectional view of a flashlight with the reflecting mirror of Fig. 5 incorporated therein. In Fig. 6, the structure around a lamp bulb is considerably larger compared to that in Fig. 3, which can not be lead to a compact lighting apparatus with a high utilization efficiency of luminous flux.

A lighting apparatus according to the preamble of claim 1 is known from DE-A-14 97 305. The second reflecting mirror is formed as a spherical zone shaped extension concentrically surrounding the light source. The spherical shape of the extension provides limitations for a compact design of the lighting apparatus. The lighting apparatus may be used in a flashlight.

A beam forming system comprising a first parabolic reflector and a second hemispherical reflector on the rear side of the parabolic reflector is known from US-A-3 443 086.

A reflector lamp comprising a concave reflector having a parabolic rear section, a spherical intermediate section and a parabolic front section is known from GB-A-2 079 435.

A reflector made of a transparent plastic material for partly reflecting and partly transmitting the light of a light source of a direction indicator is known from FR-A-2 390 673.

SUMMARY OF THE INVENTION

One object of the present invention is to increase a utilization efficiency of luminous flux in a flashlight.

Another object of the present invention is to make a flashlight compact while maintaining a utilization efficiency of luminous flux.

In order to accomplish the above objects, the flashlight in accordance with the present invention includes a light source with a solid angle over 6.28 steradians defined by its irradiation range, a first reflecting mirror for reflecting light emitted from the light source to direct the reflected light forward, and a second reflecting mirror which is formed of transparent material including a reflex reflecting portion having a plurality of rectangular projections formed on the external surface of the second reflecting mirror provided at least at the back of the light source, for reflecting the emitted light from the light source to direct the reflected light toward the light source.

In the flashlight configured as described above, light emitted backward from the light source is reflected by the second reflecting mirror to be directed toward the

light source, so that the utilization efficiency of luminous flux can be enhanced while the apparatus being made compact.

The foregoing and other objects, features, aspects and advantages of the present invention will become more apparent from the following detailed description of the present invention when taken in conjunction with the accompanying drawings.

Fig. 1 is a cross sectional view showing a structure of a flashlight according to one embodiment of the present invention.

Fig. 2 is an enlarged cross sectional view showing a structure around a lamp bulb of Fig. 1.

Fig. 3 is a cross sectional view showing a structure of a conventional flashlight.

Fig. 4 is an enlarged cross sectional view showing a structure around a lamp bulb of Fig. 3.

Fig. 5 is an enlarged cross sectional view showing another example of a structure around a lamp bulb of a conventional flashlight.

Fig. 6 is a cross sectional view showing a structure of another conventional flashlight with the structure around the lamp bulb of Fig. 5 incorporated thereinto.

Fig. 1 is a cross sectional view showing a structure of a flashlight according to one embodiment of the present invention, and Fig. 2 is an enlarged cross sectional view of a structure around a lamp bulb and a reflecting mirror of Fig. 1.

Since an exterior portion of the flashlight is the same as that of the conventional one shown in Fig. 3, the description is not repeated and the structure around a light source will hereinafter be described with reference to Fig. 2.

In the figure, a reflecting mirror 1 is provided approximately in front of the position of a filament 9 of a lamp bulb 7, and a reflex reflecting portion 5 is provided between reflecting mirror 1 and a socket 11 in which lamp bulb 7 is inserted and fixed thereto.

The structure and function of reflecting mirror 1 to which a fitting piece 3 is connected are basically the same as those of reflecting mirror 1 shown in Fig. 4. Specifically, an angle COY is 37.5°, and an angle DOY is 92.4°. Luminous flux emitted from filament 9 in the range of the angle COY is directed forward as it is, while luminous flux emitted from filament 9 in the range of the angle DOC is reflected by reflecting mirror 1 to be made parallel to an axis OY and directed forward.

Reflex reflecting portion 5 is a reflector of transparent resin and the like, molded so as to have a plurality of rectangular projections formed on the sphere centered on a filament 9 as shown in the figure. For example, light directed from filament 9 to an A point of reflex reflecting portion 5 is reflected by an inner surface of the rectangular protruding portion, to be made parallel to OA and directed toward filament 9. The light passing near filament 9 is then incident to a B point on the lower surface of reflecting mirror 1 and reflected to be made approximately parallel to the axis OY and directed forward.

As described above, provision of reflex reflecting portion 5 enables light emitted backward from filament 9 to be utilized as light to be directed forward. In this case, luminous flux in the range of an angle EOY (125.0°) is directed forward, and thus its solid angle ANG_2 and its utilization efficiency of luminous flux R_2 of reflecting mirror 1 and reflex reflecting portion 5 are as follows:

$ANG_2 = 8.5887$ (steradians)
$R_2 = 68.3\%$

Consequently, according to the present invention, lighting apparatus having the same L dimension of the reflecting mirror portion as in Figs. 3 and 4 shown as conventional examples, while having the equivalent reflection efficiency to those in Figs. 5 and 6 can be realized.

In the above embodiment, a reflex reflecting portion having a plurality of rectangular steps is provided, while instead, a reflecting element, such as a spherical mirror, may be provided for reflecting back light from filament 9.

Although the present invention has been described and illustrated in detail, it is clearly understood that the same is by way of illustration and example only and is not to be taken by way of limitation, the scope of the present invention being limited only by the terms of the appended claims.

Claims

1. A flashlight, comprising:

   a light source (9) having a solid angle over 6.28 steradians defined from its irradiation range;
   a first reflecting mirror (1) for reflecting light emitted from said light source to direct the reflected light forward; and
   a second reflecting mirror (5) provided at least at the back of said light source, for reflecting the light emitted from said light source to direct the reflected light toward said light source,
   characterized in that
   said second reflecting mirror is formed of transparent material including a reflex reflecting portion having a plurality of rectangular projections formed on the external surface of the second reflecting mirror.

2. The flashlight according to claim 1, wherein

   said second reflecting mirror includes a spherical mirror.

Patentansprüche

1. Taschenlampe mit:

einer Lichtquelle (9) mit einem Raumwinkel von über 6.28 Steradiant, der durch ihren Abstrahlungsbereich definiert ist;
einem ersten reflektierenden Spiegel (1) zum Reflektieren von Licht, welches von der Lichtquelle ausgesandt wird, zum Richten des reflektierten Lichtes nach vorne; und
einem zweiten reflektierenden Spiegel (5), der wenigstens an der Rückseite der Lichtquelle vorgesehen ist, zum Reflektieren des Lichtes, welches von der Lichtquelle ausgesandt wird, zum Richten des reflektierten Lichtes gegen die Lichtquelle,
dadurch gekennzeichnet, daß
der zweite reflektierende Spiegel aus einem durchsichtigen Material gebildet ist und einen Rückstrahlerabschnitt aufweist, der eine Mehrzahl von rechtwinkligen Vorsprüngen, die auf der äußeren Oberfläche des zweiten reflektierenden Spiegels gebildet sind, aufweist.

2. Taschenlampe nach Anspruch 1, dadurch gekennzeichnet, daß der zweite reflektierende Spiegel einen sphärischen Spiegel aufweist.

Revendications

1. Lampe de poche comprenant :

une source de lumière (9) ayant un angle solide de plus de 6,28 stéradians défini à partir de sa portée de rayonnement ;
un premier miroir (1) pour réfléchir la lumière émise par ladite source de lumière et diriger vers l'avant la lumière réfléchie ; et
un deuxième miroir (5) prévu au moins à l'arrière de ladite source de lumière, pour réfléchir la lumière émise par ladite source de lumière et diriger la lumière réfléchie vers ladite source de lumière, caractérisée en ce que
ledit deuxième miroir est formé d'un matériau transparent comprenant une partie réfléchissante réflex ayant une pluralité de saillies rectangulaires formées sur la surface extérieure du deuxième miroir.

2. Lampe de poche selon la revendication 1, dans laquelle ledit deuxième miroir comprend un miroir sphérique.

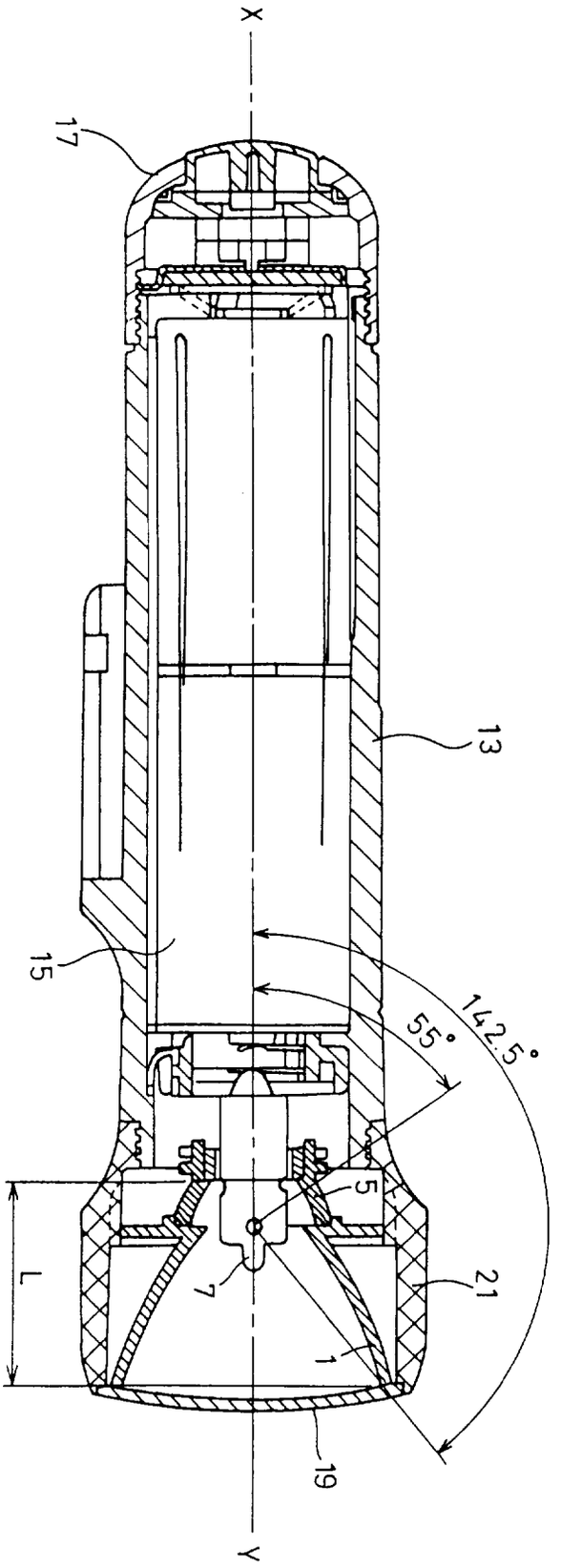
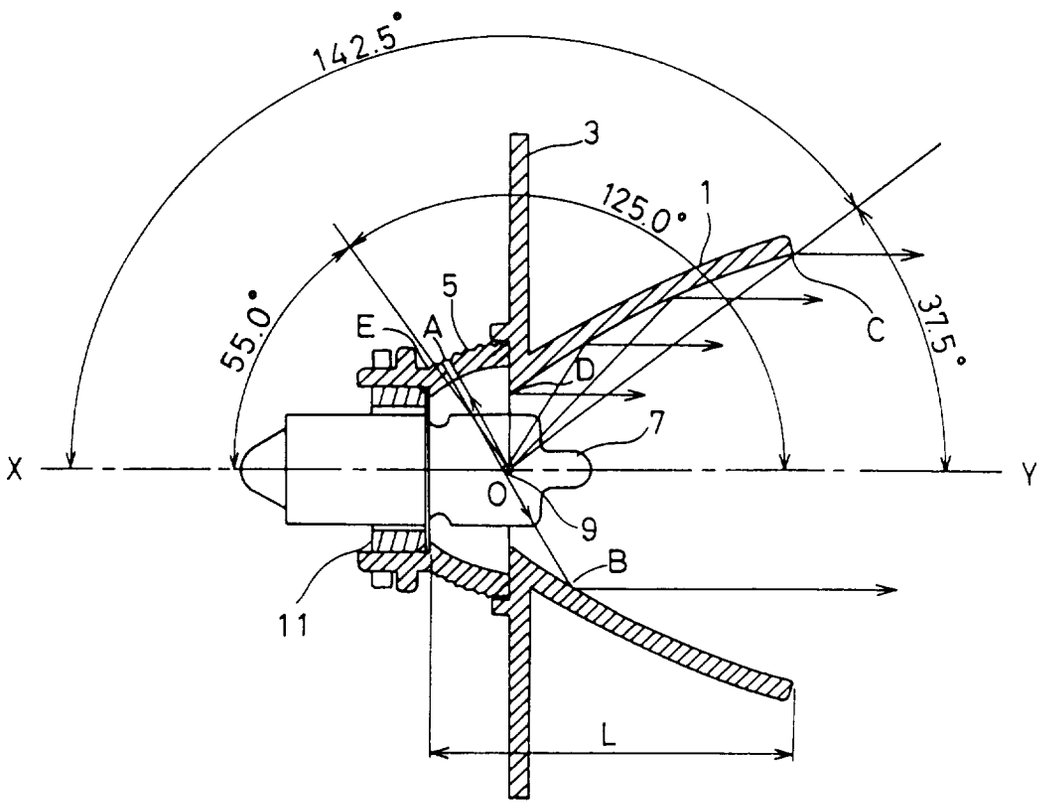


FIG.1

FIG. 2



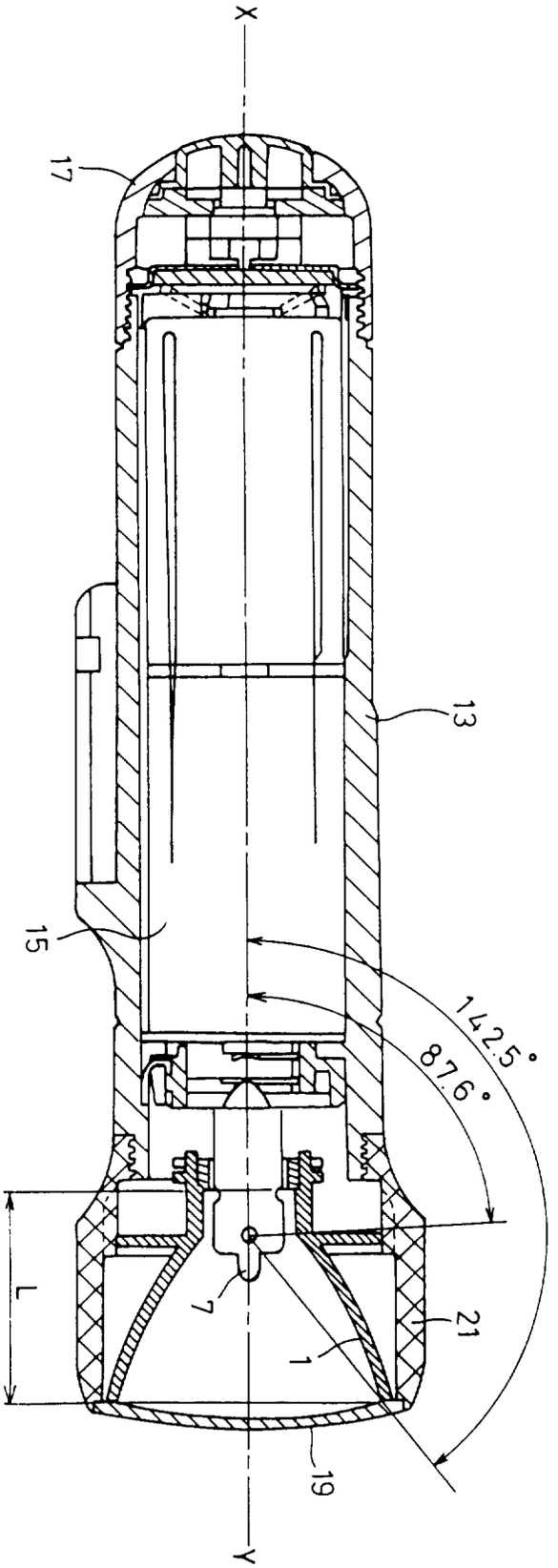


FIG. 3

FIG. 4

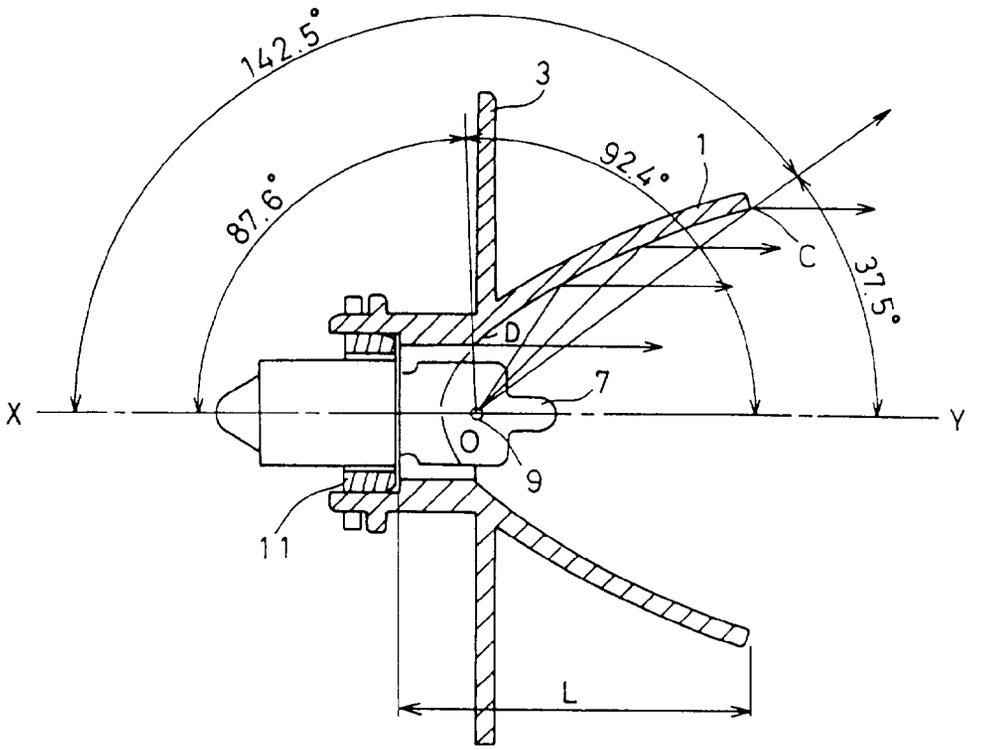
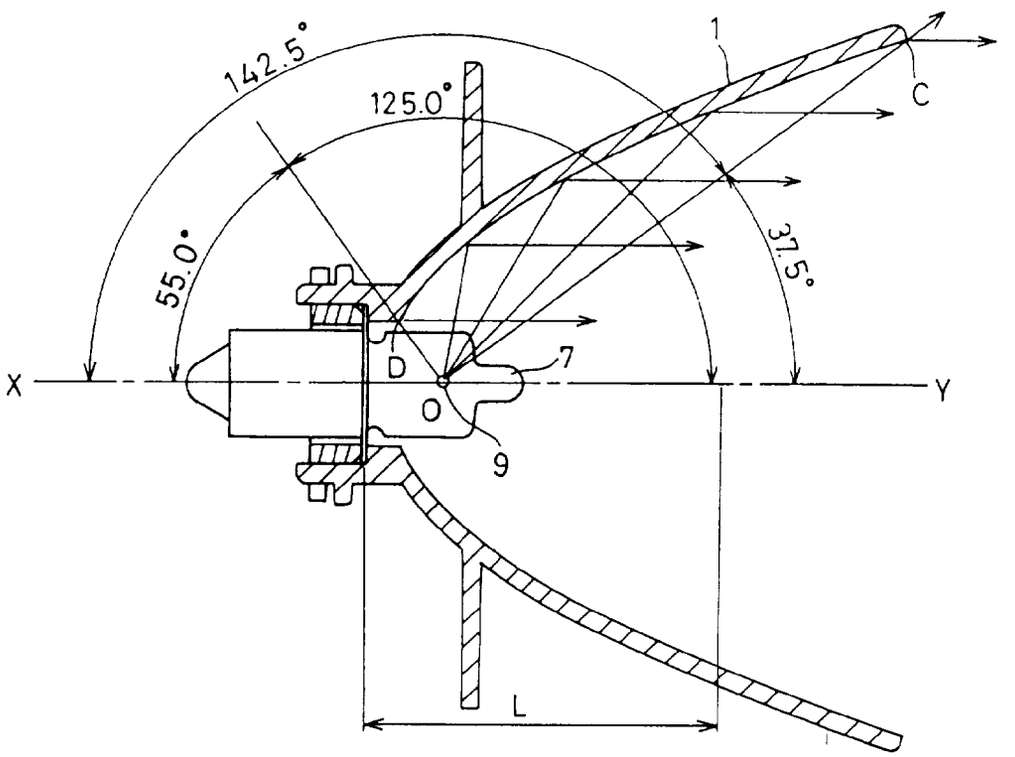


FIG. 5



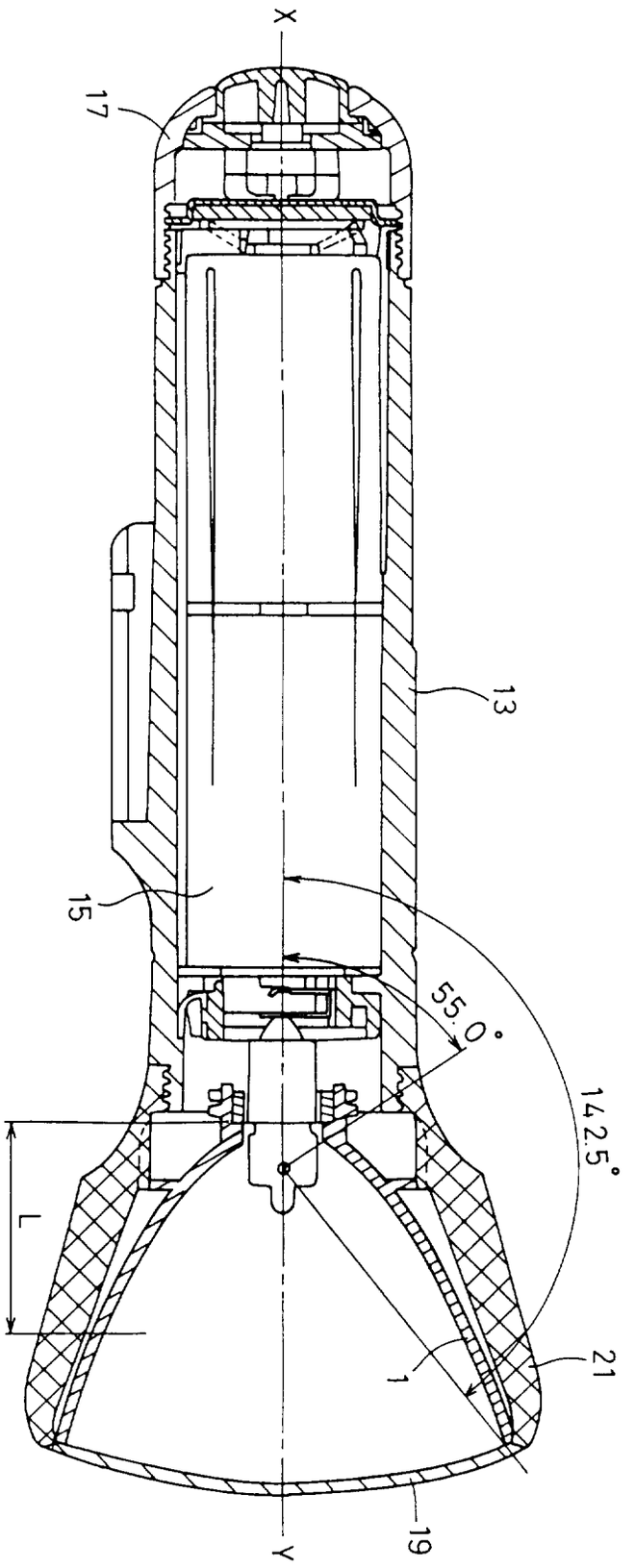


FIG.6