(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 195 553 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
10.04.2002 Bulletin 2002/15

(51) Int Cl.[7]: **F21V 7/00**

(21) Application number: **00120689.5**

(22) Date of filing: **22.09.2000**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(71) Applicant: **Stanley Electric Co., Ltd.**
Meguro-ku Tokyo (JP)

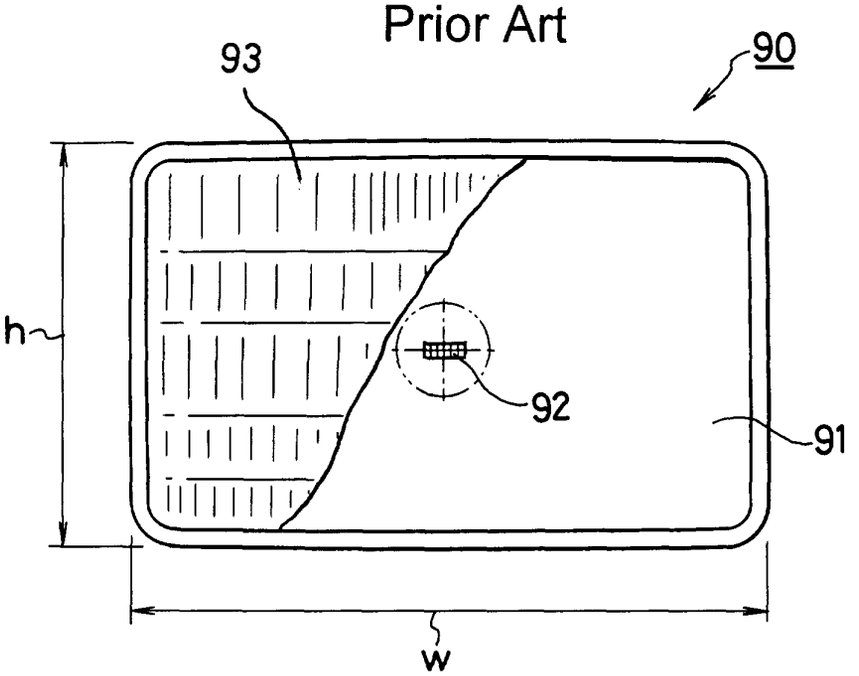
(72) Inventors:
- **Oyama, Hiroo**
  Tokyo (JP)
- **Akutagawa, Takashi**
  Tokyo (JP)

(74) Representative: **Leitner, Waldemar, Dr. techn. et al**
Zerrennerstrasse 23-25
75172 Pforzheim (DE)

(54) Oblong headlamp

(57) A headlamp (1) having at least one two-times-reflection optical system which is composed of a first reflector (3) constituted by an elliptical reflector where a light source (2) is disposed at a first focal (f31) point thereof, and a second reflector (4) constituted by a parabolic reflector where a focal point thereof is disposed in the vicinity of a second focal point of the first reflector (f32). In at least one two-times-reflection optical system of this headlamp, the second focal point (f32) of the first reflector (3) is shifted in the lateral direction and the optical axis (z3) passing the focal point of the second reflector (4) is also shifted in the same direction. Consequently, in the headlamp having a narrow width in the lateral direction, light is transferred to the second reflector (4) by the first reflector (3) constituted by an elliptic reflector, which is excellent in convergence, to provide a sufficient quantity of light and an excellent luminous intensity distribution property.

Fig. 1
Prior Art



EP 1 195 553 A1

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a vehicular headlamp for irradiating light ahead of a vehicle such as a headlight, auxiliary headlight or the like. Specifically, the present invention relates to the constitution of a headlamp having a vertically long shape in a state where it is mounted to a vehicle.

2. Detailed Description of the Prior Art

[0002] Fig. 1 shows a constitution example of a conventional headlamp. This headlamp 90 is composed of a reflector 91, a light source 92 and a lens 93. The reflector 91 is composed of a parabolic reflector such as a revolved parabolic surface, a columnar parabolic surface, a free curved surface and the like and a light source 92 is arranged generally at the position of a focal point thereof. The light source 92 is, for example, a C-6 type or C-8 type filament (the figure shows a C-6 type as an example). The reflector 91 of the headlamp 90 used in this state provides a projected surface area having a width w in the horizontal direction of 150 - 300 mm and a height h in the vertical direction of 80 - 150 mm.

[0003] At this time, upward light is generated on the side of the opposite lane by the C-6 type light source 92, which is provided orthogonally to the optical axis of the headlamp. In recent years, a C-8 type filament is often used as a light source 92 as a countermeasure because there is provided inside the light bulb a hood for shielding light which is in parallel with the optical axis and reaches generally the lower half part of the reflector 91 (an halogen lamp called H4 and a discharge lamp called HID also have a light source generally in the same shape). In this case, however, the luminous flux efficiency of the light source 92 inevitably decreases due to the hood.

[0004] The match with the design of a vehicle to which this headlamp 90 is mounted is emphasized in the design of the headlamp 90 such as the aspect ratio of the reflector 91 or the like. For example, a so-called vertically long design having a width w smaller than a height h can be required.

[0005] However, a headlamp 90 of this kind usually requires a luminous intensity distribution property having a width greater in the horizontal direction. If the width w necessary for securing a quantity of light in the horizontal direction is set narrow, the quantity of light substantially decreases including the case where a C-6 type filament is used. Thus, there is caused a problem that the quantity of light obtained is only half of that of a conventional one if the width w is made as narrow as, for example, about 50 mm. Such a headlamp is practically impossible to use.

[0006] If a C-8 type filament (or H4 or HID), in particular, is used as a light source 92, the hood provided for preventing generation of upward light does not function. As a result, the luminous intensity distribution property is deteriorated. Additionally, since the hood is provided, the quantity of light further decreases. In either case, the requirement of the vertically long design has not been met and thereby there has been a problem that the vehicle design is also restricted.

SUMMARY OF THE INVENTION

[0007] Accordingly, an object of the present invention is to provide a vertically long headlamp having a narrow width in the horizontal direction, with which the quantity of light does not decrease and a favorable luminous intensity distribution property can be obtained, so as to solve the above problems.

[0008] In order to achieve the above object, the present invention provides a headlamp which is composed of a light source, a first reflector formed of an elliptic reflector having a first focal point at which the light source is arranged, and a second reflector formed of a parabolic reflector having a focal point which is disposed in the vicinity of a second focal point of the first reflector. The headlamp also has at least one two-times-reflection optical system in which the first reflector and the second reflector are disposed generally along the vertical direction in a state that the headlamp is mounted. The headlamp is characterized in that at least one of the two-times-reflection optical systems is constituted such that the second focal point of the first reflector is shifted from the vertical center line passing the optical axis of the headlamp in the lateral direction and because of this the optical axis passing the focal point of the second reflector is also shifted in the same direction.

[0009] The headlamp of the present invention having the above constitution can be used to achieve a vertically long headlamp capable of securing a sufficient quantity of light by transmitting light to the second reflector from the first reflector, which has an elliptic shape excellent in convergence, even when the vertically long headlamp requires a narrow width in the horizontal direction. Thus, the vehicle design is not restricted.

[0010] Also, the luminous intensity distribution property of a vertically long headlamp of this kind can be readily obtained by tilting the first reflector.

[0011] In the above constitution, it is preferable that a side-face mirror is provided generally perpendicular to the vertical direction and generally in parallel with the optical axis in the front and back direction at least on the side surface of the second reflector on the side towards which the optical axis is shifted.

[0012] In this headlamp, it is preferable that there is provided a shielding plate for forming a cutoff line in the luminous intensity distribution property in the vicinity of the second focal point of the first reflector as a plate generally in parallel with the major axis of the first reflector and that the surface thereof facing the first reflector is

subjected to a reflection treatment to constitute an inner-face mirror.

[0013] At this time, the shielding plate may have been bent or curved, by which the luminous intensity distribution property can be controlled.

[0014] Also, the first reflector may be divided to constitute a composite reflector. According to the constitution of the present invention, loss in the quantity of light is prevented by providing a side-face mirror. Therefore, a vertically long headlamp of this kind can be readily achieved. Furthermore, a required luminous intensity distribution property can be obtained. Thus, an excellent effect is made on the improvement in performance of the vertically long headlamp of this kind.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] These and other objects and advantages of the present invention will become clear from the following description with reference to the accompanying drawings, wherein:

Fig. 1 is an illustration showing a headlamp according to the prior art;
Fig. 2 is a cross-sectional view showing a first embodiment of the headlamp according to the present invention;
Fig. 3 is a front view of the first embodiment;
Fig. 4 is an illustration of a luminous intensity distribution property showing an action of the first embodiment;
Fig. 5 is a perspective view showing an essential part of a second embodiment of the headlamp according to the present invention;
Fig. 6 is a perspective view showing an essential part of a third embodiment of the headlamp according to the present invention;
Fig. 7 is a plan view showing an essential part of a fourth embodiment of the headlamp according to the present invention;
Fig. 8 is an illustration of a luminous intensity distribution property showing an action of the fourth embodiment;
Fig. 9 is a plan view showing an essential part of a fifth embodiment of the headlamp according to the present invention; and
Fig. 10 is a front view showing an essential part of a sixth embodiment of the headlamp according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0016] The present invention will be described in detail below with reference to the embodiments shown in the drawings. It is noted that terms referring to directions such as front, back, right, left and vertical in the present specification are based on a vehicle to which a headlamp is mounted unless otherwise defined. In Fig. 2, reference numeral 1 denotes a headlamp of a first embodiment according to the present invention. This figure shows a cross-sectional view in the vertical direction of this headlamp 1 in a state that it is mounted to a vehicle. In the headlamp 1, there is provided a light source 2 such as a filament, a discharge lamp arc or the like so that the longitudinal direction thereof is along the horizontal direction and orthogonally to the irradiating direction. That is, the light source 2 provided is of the same form as the C-6 type filament.

[0017] Additionally, there are provided a first reflector 3 constituted by an elliptic reflector such as a spheroid or the like and a second reflector 4 constituted by a parabolic reflector such as a revolved paraboloid or the like above the light source 2 of this headlamp 1. There are provided a third reflector 5 constituted by an elliptic reflector and a fourth reflector 6 constituted by a parabolic reflector below the light source 2. Further, there is provided a fifth reflector 7 constituted by a parabolic reflector below and frontward the light source 2.

[0018] At this time, the first reflector 3 has a first focal point f31 at the position where the light source 2 is disposed. This first reflector 3 images the light source 2 at a second focal point f32 thereof. The second reflector 4 has a focal point f4 in the vicinity of the second focal point f32. Therefore, the light reflected by the first reflector 3 is further reflected by the second reflector 4 and emitted in the irradiating direction of the headlamp 1 as a generally parallel light beam.

[0019] Since the second reflector 4 is formed such that the most part thereof is above the center line (optical axis) z4 passing the focal point f4, the light reflected from the second reflector 4 is emitted downward and is suitable for the luminous intensity distribution for passing-by if the focal point f4 of the second reflector 4 is appropriately set at the back of the second focal point f32 of the first reflector 3.

[0020] Both the third reflector 5 and the fourth reflector 6, which are provided below the light source 2, also have the same constitution as above. Consequently, the headlamp 1 can be formed in a relatively small size. Additionally, the constitution is such that the light captured on the first reflector 3 and the third reflector 5 both constituted by an elliptic reflector, which has an excellent luminous flux capture rate, is reflected by the second reflector 4 and the fourth reflector 6 in the irradiating direction. Therefore, even if the width in the horizontal direction is made, for example, about 50 mm, a headlamp 1 having a sufficient quantity of light can be obtained.

[0021] Also, the fifth reflector 7 is formed by a parabolic reflector such as a revolved parabolic surface or the like, where the focal point thereof is positioned generally at the light source 2. Therefore, the fifth reflector 7 captures a part of the light which cannot be captured by the first reflector 3 or the third reflector 5 and reflects it in the irradiating direction as a generally parallel light beam. Consequently, the luminous flux capture rate of

the light source 2 is further increased. It is noted that the position of the focal point of this fifth reflector 7 may also be appropriately adjusted so as to obtain a required luminous intensity distribution property as a reflected light which is directed slightly downward.

[0022] The above is the basic constitution of the headlamp 1 according to the present invention. This constitution has already been filed by the same applicant as the applicant of Japanese Patent Application No. Hei 11-82052. In the present invention, the constitution described below is added to the above constitution so as to readily and precisely provide a luminous intensity distribution property and further improve the luminous flux efficiency of the light source 2.

[0023] First, as a part of the added constitution, a shielding plate 8 for shielding a part of the light which is unnecessary in the formation of a luminous intensity distribution property is provided in the vicinity of the second focal point f32 of the first reflector 3 as seen in a conventional projector-type headlamp. In the present invention, this shielding plate 8 is formed generally in parallel with the major axis z3 of the first reflector 3 and in the vicinity of the first reflector 3. At this time, the end surface of the shielding plate 8 on the side closer to the second focal point f32 constitutes a shielding part 8a.

[0024] In addition, the surface of the shielding plate 8 facing the first reflector 3 is subjected to an appropriate reflection treatment such as aluminum vapor deposition or the like to form an inner-face mirror part 8b. Therefore, in the constitution of the shielding plate 8 of the present invention, unnecessary light is eliminated by the shielding part 8a and thus generation of dazzling light from a headlamp 1 obtained can be further reduced. Also, the light which is conventionally invalid because it is shielded by the shielding plate upon contact is reflected at the inner-face mirror part 8b and directed to the second reflector 4. Consequently, the brightness of the headlamp 1 is further enhanced. It is noted that, as also shown in Fig. 2, the shielding plate 8 can also be used for the third reflector 5 and that any of the other embodiments described below can be used similarly.

[0025] Fig. 3 shows the second part of the constitution added according to the present invention. The figure is a front view of the headlamp 1 seen from the side of the irradiating direction. The present invention is characterized in that the major axis z3 including the first focal point f31 and the second focal point f32 of the first reflector 3 is inclined to the right or left of the first focal point f31, which is the center of rotation (the figure shows the leftward inclined state when viewed from the front side). That is, the second focal point f32 of the first reflector 3 is provided off the vertical center line passing the optical axis of the headlamp 1, and because of this the optical axis z4 passing the focal point f4 of the second reflector 4 is also shifted in the same direction.

[0026] Fig. 4 is an illustration of the luminous intensity distribution property showing an action when the aforementioned major axis z3 is inclined. The luminous intensity distribution of the irradiated light, which is first reflected by the first reflector 3, for which the above-described shielding plate 8 is provided, and then further reflected by the second reflector 4 has a generally heart-shaped pattern when the light is not diffused by a lens 10 (see Fig. 2) or the like. When the major axis z3 is vertical, the heart-shaped pattern is erected.

[0027] As shown in the figure, the heart-shaped pattern F is also inclined by inclining the major axis z3. Consequently, no upward light is generated on the opposite lane side (upper right side in the figure) while, at the same time, upward light is secured on the shoulder side (upper left side in the figure) so that road signs or the like can be easily read. This basic shape of the luminous intensity distribution property can be obtained only by the first reflector 3 and the second reflector 4. The case of the left-side traffic has been described above. In the case of the right-side traffic, the first reflector 3 can be inclined toward the opposite side.

[0028] Fig. 3 will be described in detail below. If the major axis z3 is inclined when the width w of the headlamp 1 is narrow, the quantity of light is lost because the light directing to the left of the major axis z3 in a state shown in the figure does not have a second reflector 4 on which the light should be made incident. The present invention solves this problem as well. As a means for solving this problem, there is provided a side-face mirror 9 on the side surface on the side toward which the optical axis z3 is inclined.

[0029] The side-face mirror 9 is formed such that it is perpendicular to the vertical direction and in parallel with the optical axis z4 of the second reflector 4 in the front and back direction. Preferably, the second focal point f32 of the first reflector 3 coincides with the surface of the side-face mirror 9. Thus, by providing a side-face mirror 9, the light reflected at the right half part of the first reflector shown in the figure is returned by the side-face mirror 9 and reaches the second reflector 4.

[0030] At this time, if the surface of the side-face mirror 9 coincides with the second focal point f32 of the first reflector 3, the light from the right half part of the first reflector 3 becomes equivalent to the light from the left half part. Consequently, the loss of light is not only compensated, but, rather, the brightness of the headlamp 1 is further enhanced due to an action like doubling the area of the second reflector 4.

[0031] Fig. 5 shows a second embodiment of the present invention. The above-described embodiment is constituted such that the shielding plate 8 is formed as a plane plate, but the present invention is not limited to this constitution. In this embodiment, the shielding plate 18 is in a slightly bent shape to obtain an action of positively increasing the quantity of light on the shoulder side as is the shielding plate of a conventional projector-type headlamp.

[0032] At this time, it is preferable that a folding line 18c for bending is formed generally in parallel with the major axis z3 of the first reflector 3. As in the first em-

bodiment, the end part of the shielding plate 18 which is closer to the second focal point f32 constitutes a shielding part 18a and the surface facing the first reflector 3 constitutes an inner-face reflection mirror 18b.

[0033] As shown in Fig. 6 as a third embodiment, there is provided a shielding plate 28 formed by a resin injection molding or metal die casting. The shielding plate 28 is formed, for example, as a wedge shape having a thickness which increases as the distance from the light source 2 increases and the plane shape is freely formed in a trapezoid or the like so as to give more flexibility in the shape of the shielding part 28a. Further, the side surface part 28c adjacent to and continued with the inner-face reflection mirror 28b may also be subjected to a reflection treatment to radiate light to, for example, the first reflector 3, second reflector 4 or side-face mirror 9.

[0034] Thus, by elaborating the shape of the shielding plate, the shape of a border between light and shade, which is the upper end part of the luminous intensity distribution property for passing-by, is freely formed, and thereby the required luminous intensity distribution property can be obtained. The shape can also be set more accurately and the performance of a headlamp 1 is further improved.

[0035] Figs. 7, 8 and 9 show still other embodiments of the present invention. In these embodiments, the luminous intensity distribution property is further improved by modifying the shape of the first reflector. Originally, in a vehicular headlamp, the luminous intensity distribution property having an irradiation width which is narrow in the vertical direction and wide in the lateral direction is preferable in all aspects including improvement of the visibility or the like.

[0036] In consideration to the above, as the first reflector shown in Fig. 7 as a fourth embodiment, the first reflector 31 is constituted by three segments along the major axis z3 in the present invention. At this time, the divided right side part 31a and left side part 31c thereof are constituted by a spheroidal reflector having a first focal point f31 and second focal point f32 as focal points as in the first embodiment. The central part 31b thereof is constituted by an elliptic columnar surface. On the elliptic columnar surface, there are generated an ellipse having the first focal point f31 and the second focal point f32 as focal points in the direction in parallel with the major axis z3 and a straight line in the direction orthogonal to the major axis z3.

[0037] Therefore, the light reflected at the central part 31b does not converge in the lateral direction in a state shown in the figure and the angle of radiation from the light source remains. Thus, as shown in Fig. 8, a luminous flux S generated at the second focal point f32 of the first reflector 31 has a dimension which is narrow in the vertical direction and wide in the lateral direction. This shape is optimal to form a luminous intensity distribution property of a vehicular headlamp.

[0038] As shown in Fig. 9 as a fifth embodiment, the first reflector 32 can be divided into radial segments using the first focal point f31 as the origin and formed as a combination of a plurality of divided spheroids each having a second focal point f32a - f32d on the axis of each divided segment. At this time, as shown in Fig. 8, a luminous flux S which is narrow in the vertical direction and wide in the lateral direction can be obtained. In order to obtain such a luminous flux S, any of the above embodiments can be employed. Furthermore, a free curved surface may be employed to obtain a similar luminous flux S.

[0039] Fig. 10 shows a sixth embodiment of the present invention. In the first embodiment, the side-face mirror 9 is formed as a plane, but the side surface is not limited to a plane in the present invention. For example, there may be provided steps 19a on the side-face mirror 19 as shown in the figure. The formation of the luminous intensity distribution property may be positively influenced by providing a direction to the light reaching the second reflector 4 from this side-face mirror 19.

[0040] When the above constitution is used, not only steps 19a are added but also the side-face mirror itself may be formed as a curved surface although it is not shown in the figure. Further, the surfaces facing the side-face mirrors 9, 19 may also be subjected to a reflection treatment to prepare auxiliary side-face mirrors 9b (see Fig. 3), 19b. In addition, steps may be added to the auxiliary side-face mirrors 9b, 19b.

[0041] While the presently preferred embodiments of the present invention have been shown and described, it will be understood that the present invention is not limited thereto, and that various changes and modifications may be made by those skilled in the art without departing from the scope of the invention as set forth in the appended claims.

Claims

1. A headlamp having at least one two-times-reflection optical system comprising:

a light source;
a first reflector constituted by an elliptic reflector where the light source is disposed at a first focal point thereof; and
a second reflector constituted by a parabolic reflector where a focal point thereof is disposed in the vicinity of a second focal point of the first reflector, wherein
the first reflector and the second reflector are disposed generally along the vertical direction in a state that the headlamp is mounted, the second focal point of the first reflector is shifted from a vertical center line passing the optical axis of the headlamp in the lateral direction and at the same time the optical axis passing the focal point of the second reflector is also shifted

in the same direction.

2. The headlamp according to claim 1, wherein a side-face mirror generally perpendicular to the vertical direction and generally in parallel with the optical axis in the front and back direction is provided on the side surface on the side towards which at least the optical axis of the second reflector is shifted.

3. The headlamp according to claim 1 or 2, wherein a shielding plate for forming a cutoff line to a luminous intensity distribution property is provided in the vicinity of the second focal point of the first reflector as a plate generally in parallel with the major axis of the first reflector and the surface of the shielding plate facing the first reflector is subjected to a reflection treatment to constitute an inner-face mirror part.

4. The headlamp according to claim 3, wherein the shielding plate is processed to be bent or curved.

5. The headlamp according to claim 1, wherein the first reflector is a composite reflector which is divided.

6. The headlamp according to claim 2, wherein the first reflector is a composite reflector which is divided.

7. The headlamp according to claim 3, wherein the first reflector is a composite reflector which is divided.

8. The headlamp according to claim 4, wherein the first reflector is a composite reflector which is divided.

Fig. 1
Prior Art

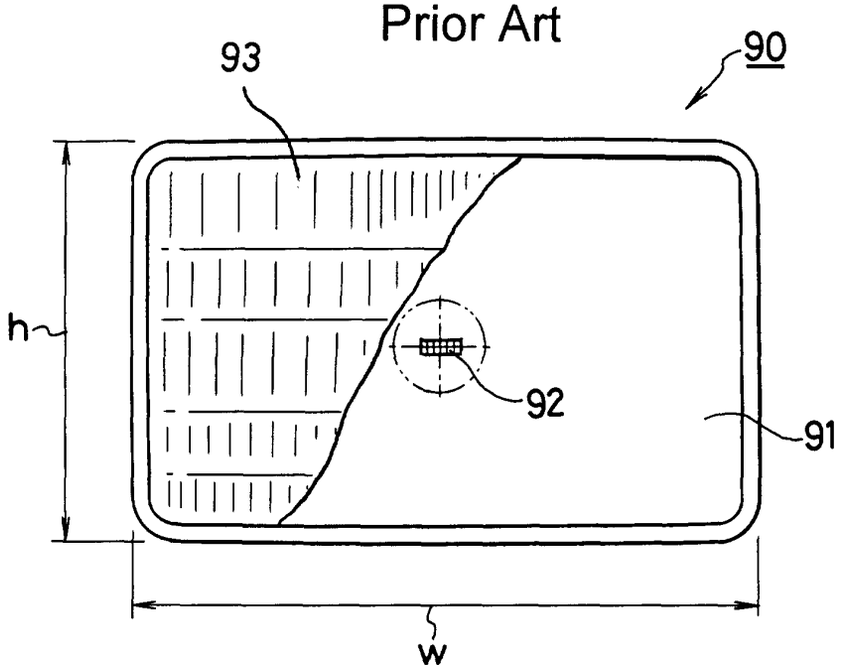


Fig. 2

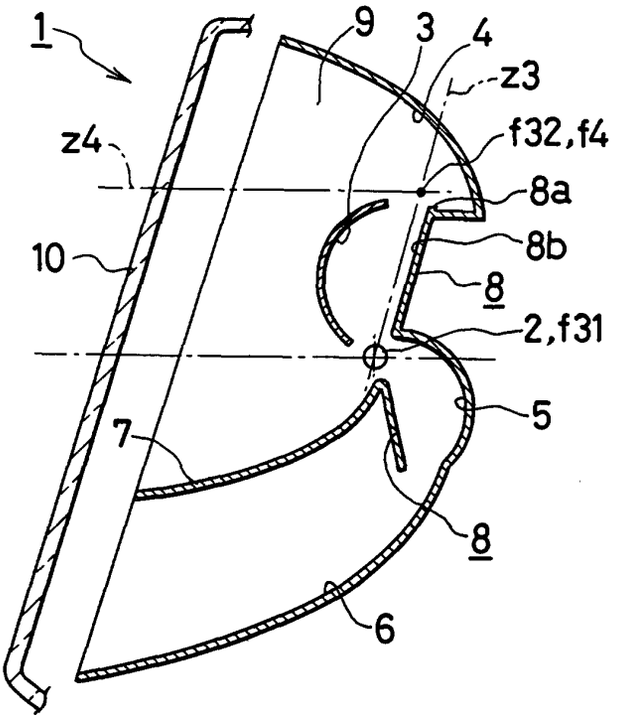


Fig. 3

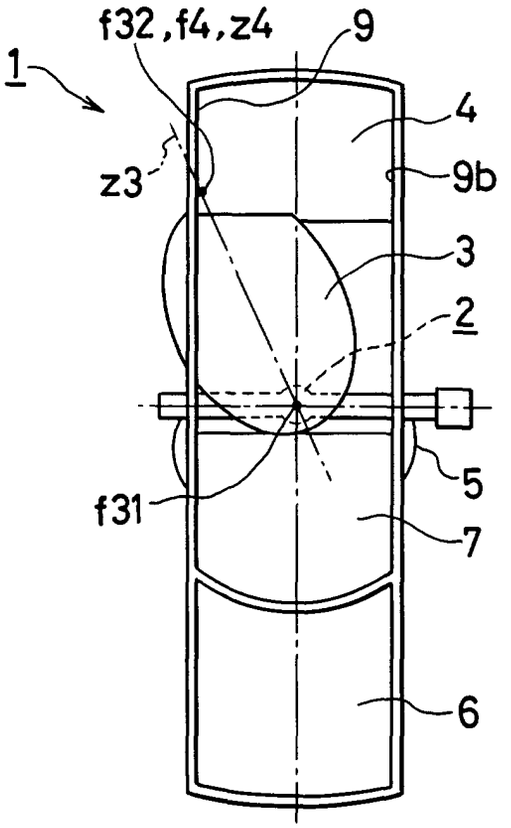


Fig. 4

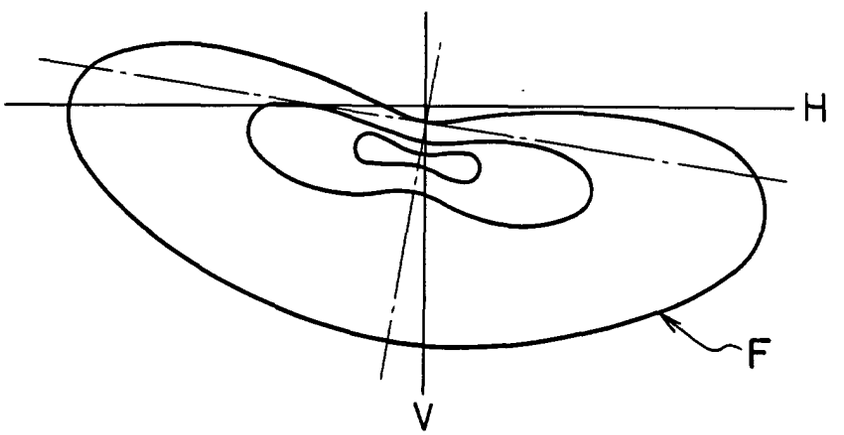


Fig. 5

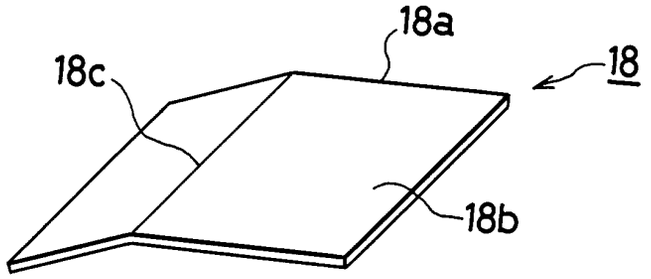


Fig. 6

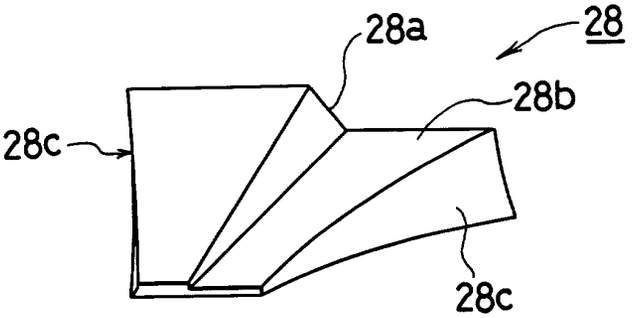


Fig. 7

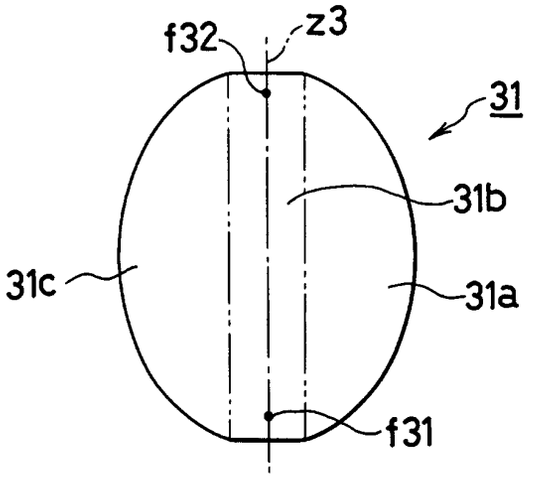


Fig. 8

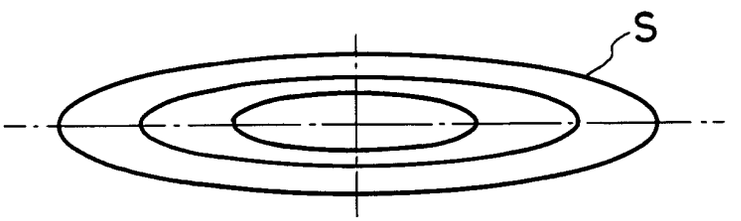


Fig. 9

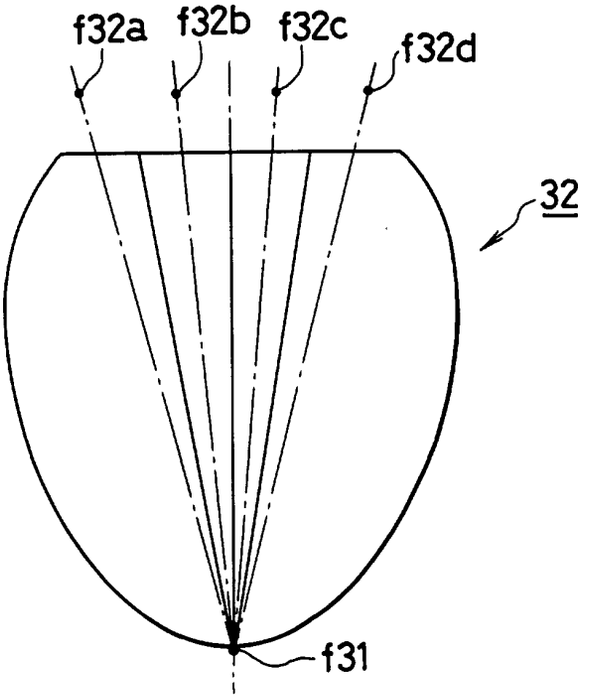
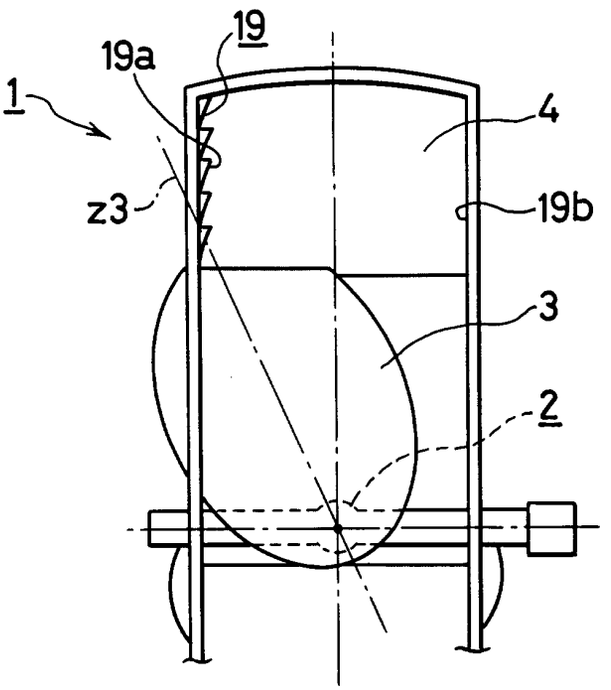


Fig. 10



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 12 0689

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	FR 711 306 A (RIVIER LOUIS) 5 September 1931 (1931-09-05) * page 2, line 40-51 * * page 2, line 78 - page 3, line 10 * * page 3, line 101 - page 4, line 15 * * figures 3,5,6 *	1	F21M3/16 F21M3/14
A	US 3 752 408 A (TIXIER M) 14 August 1973 (1973-08-14) * abstract * * column 3, line 42-60 * * figures 1,2,4 *	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

F21M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	9 January 2001	Aubard, S

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 00 12 0689

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

09-01-2001

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
FR 711306 A	05-09-1931	NONE	
US 3752408 A	14-08-1973	FR 2067925 A	20-08-1971
		DE 2056996 A	27-05-1971
		ES 193019 Y	16-11-1975
		GB 1322037 A	04-07-1973
		OA 3516 A	30-03-1971

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82