



(22) Date de dépôt/Filing Date: 1996/12/23

(41) Mise à la disp. pub./Open to Public Insp.: 1998/06/23

(45) Date de délivrance/Issue Date: 2001/11/06

(51) Cl.Int.⁶/Int.Cl.⁶ G02B 5/10

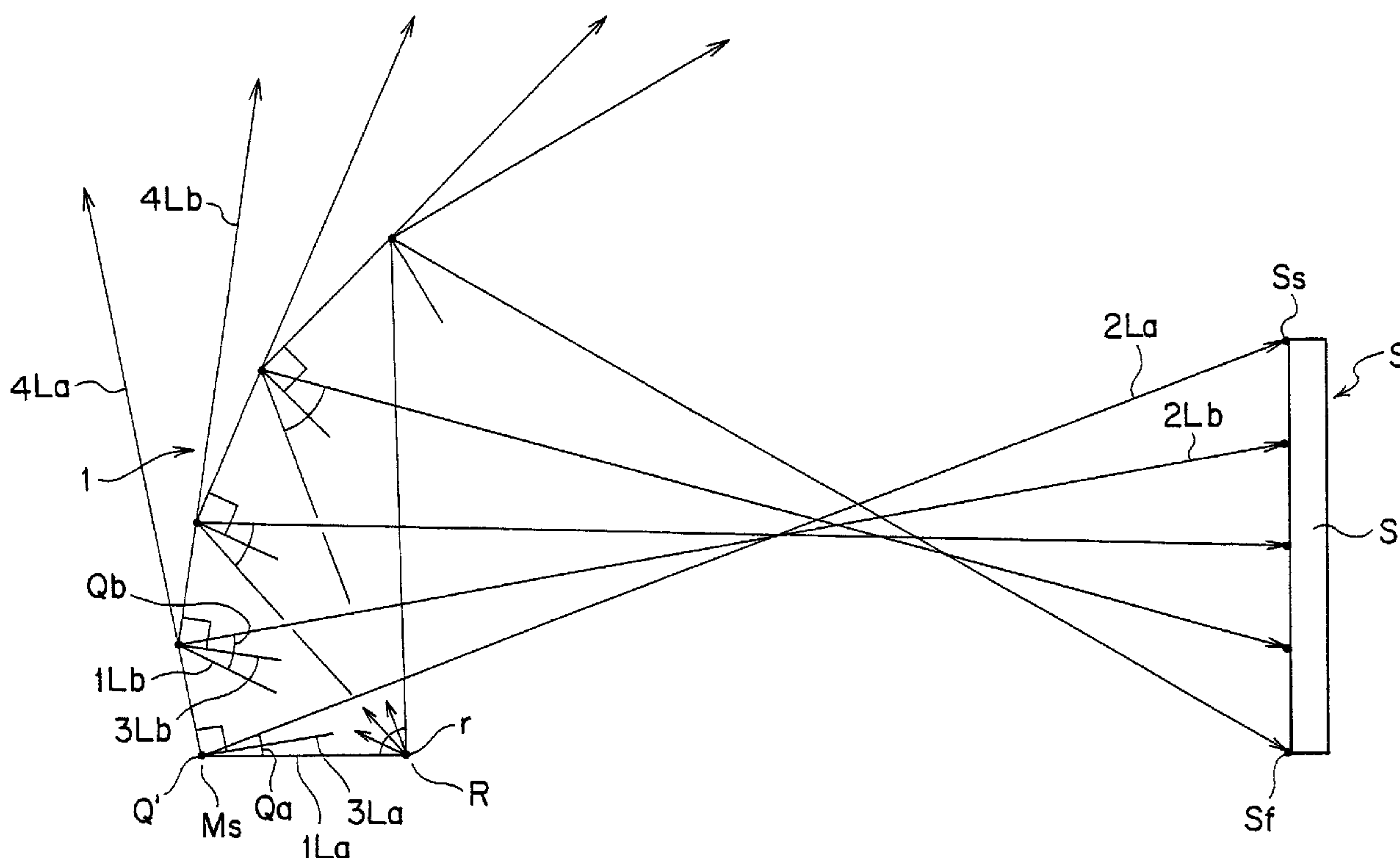
(72) Inventeur/Inventor:
Shimada, Takehiko, JP

(73) Propriétaire/Owner:
EQUESTRIAN CO., LTD., JP

(74) Agent: ROBIC

(54) Titre : METHODE DE FABRICATION D'UN MIROIR REFLECHISSANT D'ECLAIRAGE

(54) Title: METHOD OF MANUFACTURING AN ILLUMINATING REFLECTION MIRROR



(57) Abrégé/Abstract:

A mirror has a reflective surface, which corresponds to a desired illumination intensity pattern to be projected by the mirror on an illumination object. The method includes the step of defining a plurality of illumination points which correspond to the desired illumination intensity pattern on the illumination object, wherein a greater density of illumination points corresponds to a greater illumination intensity applied to the illumination object. The mirror may have an oval contour with a curved reflection surface which modifies a cylindrical incident ray beam into a substantially rectangular contour illumination.



ABSTRACT OF THE DISCLOSURE

A mirror has a reflective surface, which corresponds to a desired illumination intensity pattern to be projected by the mirror on an illumination object. The method includes the step of defining a plurality of illumination points which correspond to the desired illumination intensity pattern on the illumination object, wherein a greater density of illumination points corresponds to a greater illumination intensity applied to the illumination object. The mirror may have an oval contour with a curved reflection surface which modifies a cylindrical incident ray beam into a substantially rectangular contour illumination.

METHOD OF MANUFACTURING AN ILLUMINATING REFLECTION MIRROR

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a method of manufacturing an illuminating reflection mirror that throws light of a light source upon an object, and more specifically to a method of manufacturing an illuminating reflection mirror, which determines dimensions of the mirror by using four or more points for calculating a range of illumination of the object and light distribution thereof.

2. Description of the Prior Art

Among conventional reflection mirrors installed in typical illuminating equipment are oval or parabolic mirrors. They are used for photographing, stage and screen illumination, lighting for such locations to be seen particularly at night, and illuminating assembling parts in a factory and product goods in show rooms.

In a typical conventional reflection mirror, as shown in FIG. 5, first, a base point r' of a light source R' is determined with respect to a reflection mirror M' for scattering the light on a screen S' . Only two points-the base point r' of the light source R' and a central position point MS of the reflection mirror M' -are used as data to determine a light distribution on the screen S' .

In such conventional reflection mirrors, dimensions of the mirror are determined based on data of only two points-the base point r' of the light source R' and the central position point MS of the reflection mirror M' . This determination method does not consider to obtain a light distribution of a desired pattern on a screen.

Further, when the light source projects a cylindrical ray beam, the associated reflection mirror provides a circular illumination on a screen.

10

SUMMARY OF THE INVENTION

Therefore, it is an object of the invention to provide a method of making an illuminating reflection mirror which can provide a desired light distribution on a screen or an object to be illuminated.

Another object of the invention is to provide a method of making an illuminating reflection mirror which can easily give a desired shade on an object to be illuminated.

20 Moreover, in an additional object of the invention, even if a light source projects a cylindrical ray beam, an associated reflection mirror can modify it to provide a rectangular illumination on a screen, in which illumination intensity is still uniform in its projected area on the screen.

According to this invention, there is provided a method of designing an illuminating reflection mirror having a reflective surface, said reflective surface having a shape corresponding to a desired illumination intensity pattern to
30 be projected by the mirror on an illumination object, said method comprising the steps of:

- a) providing an illumination object;

b) defining a plurality of illumination points which correspond to said desired illumination intensity pattern on said illumination object wherein a greater density of illumination points corresponds to a greater illumination intensity to be applied to said illumination object;

c) locating a light source (R) at a given distance from said illumination object (S);

d) selecting an initial one of said plurality of illumination points (Ss) on said illumination object (S) and
10 a curvature starting point (Ms) on a remote side of said light source (R) and drawing a first straight line (1La) to produce an imaginary incident ray from said light source (R) to said curvature starting point (Ms) and a second straight line (2La) to produce a reflected ray from said curvature starting point (Ms) to said initial illumination point (Ss) to define an angle (Qa) between said first straight line (1La) and said second straight line (2La);

e) drawing a third straight line (3La) to produce an incident normal by bisecting said angle (Qa) equally into two
20 angles;

f) drawing a tangential line (4La) extending through said curvature starting point (Ms) perpendicularly to said third straight line (3La) to produce an imaginary reflected light emitted from said light source (R) that is reflected at said curvature starting point (Ms) toward said initial illumination point (Ss) by reflection;

g) selecting an adjacent one of said plurality of illumination points on said illumination object;

h) locating a first subsequent straight line (1Lb)
30 from said light source extending at an angle from the preceding imaginary incident ray and to produce a subsequent imaginary incident ray and to locate a subsequent curvature point on said tangential line (4La) while simultaneously

drawing a second subsequent straight line (2Lb) from said subsequent illumination point by reflection such that a subsequent angle (Qb) is defined between said first subsequent straight line (1Lb) and said second subsequent straight line (2Lb);

i) drawing a third subsequent straight line (3Lb) to produce a subsequent incident normal by bisecting said subsequent angle (Qb) equally into two angles;

10 j) drawing a subsequent tangential line (4Lb) extending through said subsequent curvature point perpendicularly to said third subsequent straight line (3Lb);

k) repeating the steps g) through j) to produce a series of curvature points which represent a reflective mirror surface; and

l) designing the mirror with its reflective surface based on the series of curvature points defined in steps a) to k).

According to the present invention, there is also provided a method of manufacturing an illuminating reflection
20 mirror from data which is used to produce a curvature of a reflective surface of said mirror, said reflective surface having a shape corresponding to a desired illumination intensity pattern to be projected by said mirror on an illumination object, from data, said method comprising determining said data by the steps of:

a) providing an illumination object;

b) defining a plurality of illumination points which correspond to said desired illumination intensity pattern on said illumination object wherein a greater density of
30 illumination points corresponds to a greater illumination intensity to be applied to said illumination object;

c) locating a light source (R) at a given distance from said illumination object (S);

d) selecting an initial one of said plurality of illumination points (Ss) on said illumination object (S) and a curvature starting point (Ms) on a remote side of said light source (R) and drawing a first straight line (1La) to produce an imaginary incident ray from said light source (R) to said curvature starting point (Ms) and a second straight line (2La) to produce a reflected ray from said curvature starting point (Ms) to said initial illumination point (Ss) to define an angle (Qa) between said first straight line
10 (1La) and said second straight line (2La);

e) drawing a third straight line (3La) to produce an incident normal by bisecting said angle (Qa) equally into two angles;

f) drawing a tangential line (4La) extending through said curvature starting point (Ms) perpendicularly to said third straight line (3La) to produce an imaginary reflected light emitted from the light source (R) that is reflected at said curvature starting point (Ms) toward said initial illumination point (Ss) by reflection;

20 g) selecting an adjacent one of said plurality of illumination points on said illumination object;

h) locating a first subsequent straight line (1Lb) from said light source extending at an angle from the preceding imaginary incident ray and to produce a subsequent imaginary incident ray and to locate a subsequent curvature point on said tangential line (4La) while simultaneously drawing a second subsequent straight line (2Lb) from said subsequent illumination point by reflection such that a subsequent angle (Qb) is defined between said first
30 subsequent straight line (1Lb) and said second subsequent straight line (2Lb);

i) drawing a third subsequent straight line (3Lb) to produce a subsequent incident normal by bisecting said subsequent angle (Qb) equally into two angles;

j) drawing a subsequent tangential line (4Lb) extending through said subsequent curvature point perpendicularly to said third subsequent straight line (3Lb);

k) repeating the steps g) through j) to produce a series of curvature points which are used as data to manufacture a reflective mirror surface; and

10 l) manufacturing said mirror, the curvature of the reflective surface of said mirror being determined by the series of curvature points defined in steps a) to k).

The curvature thus obtained can be used as data for determining a concave shape of a reflection mirror in a mirror making process. It is also possible to give a desired shade on an object to be illuminated. Further, since a blurred illumination of the object can be eliminated by the
20 method, products in a show window can be exhibited under a bright illumination.

Moreover, the light source can be reduced in size, thus

contributing to an energy saving. In the case of printing developed pictures, the invention eliminates variations in their final quality to substantially improve its
30 productivity.

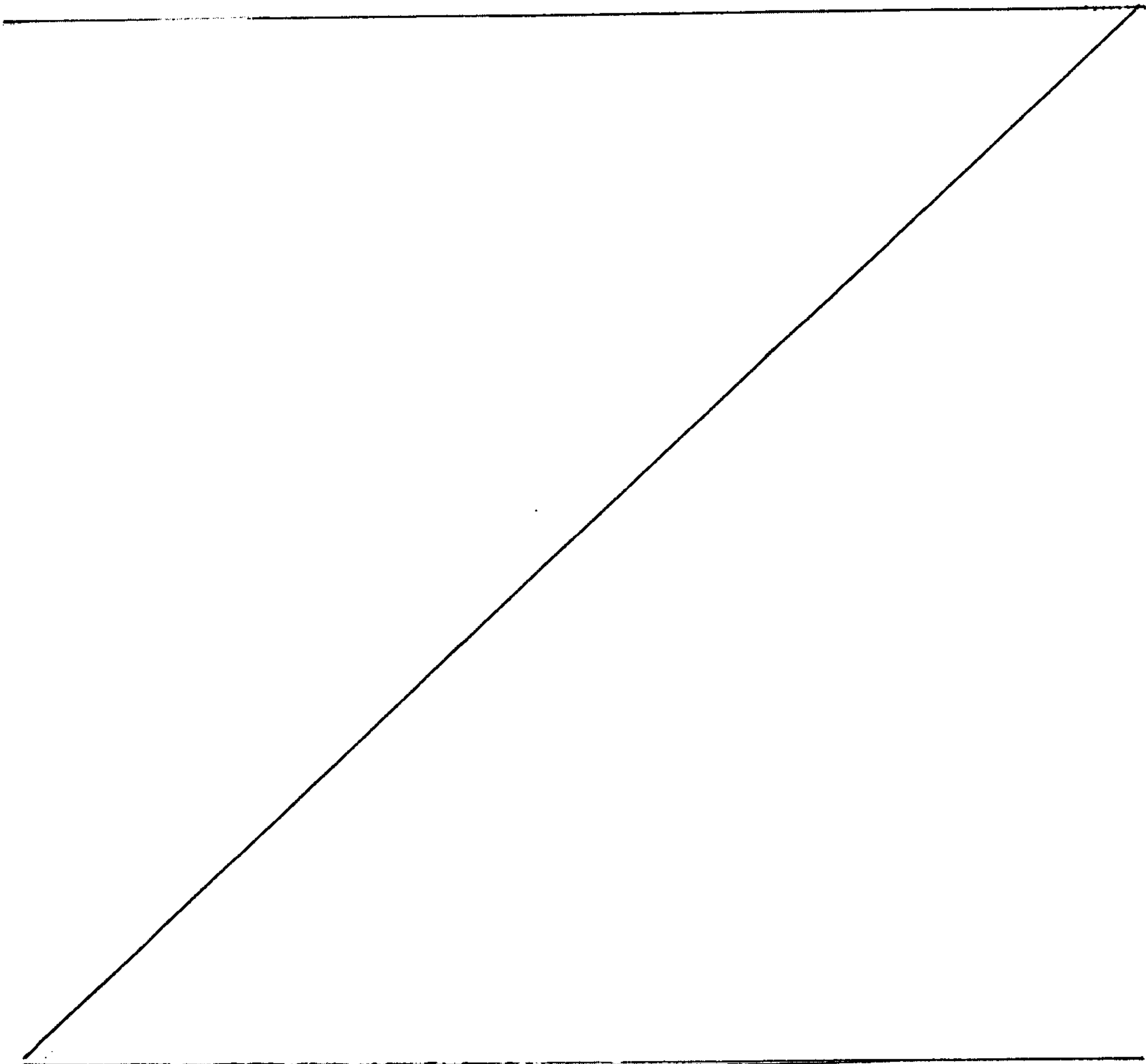
BRIEF DESCRIPTION OF THE DRAWINGS

The drawings show embodiments of the invention, illustrating a method of manufacturing an illuminating reflection mirror;

FIG. 1 is an explanatory view showing a method of manufacturing a virtual reflection minor according to this invention;

FIG. 2 is a partially enlarged view of an essential portion of FIG. 1;

FIG. 3 is an explanatory view showing a luminous



intensity distribution according to this invention;

FIG. 4 is an explanatory view showing another luminous intensity distribution according to this invention;

FIG. 5 is an explanatory view showing a method of manufacturing a conventional illuminating reflection mirror.

FIG. 6 is the front view of a mirror with an oval external shape according to this invention; and

FIG. 7 is a sectional side view of the mirror illustrated in FIG. 6 according to the invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

The above object and features of the invention will become apparent from the following description and attached drawings.

Referring to FIGS. 1 and 2, a method of manufacturing an illuminating reflection mirror M according to this invention firstly sets three point: a base point r of a light source R ; a curvature starting point M_s of a virtual reflection mirror M at a certain distance from the base point r ; and an illumination starting point S_s of an object S to be illuminated by a reflected light. This method then draws a first straight line $1La$ from the base point r of the light source R ; a second straight line $2La$ jointing the curvature starting point and the start point S_s on the illuminated object S to define an angle Qa in cooperation with the first straight line $1La$; a third straight line $3La$

bisecting the angle Qa ; and a fourth straight line $4La$ that is perpendicular to the third straight line $3La$.

Subsequent illumination points are located on the object

5 S at an infinitely small distance away from preceding illumination points. Each times, a subsequent straight line (e.g., $1Lb$) is located to produce a subsequent imaginary incident ray extending at an infinitely small angle from the preceding imaginary incident ray to locate a subsequent curvature point on the tangential line (e.g., $4La$) by
10 simultaneously drawing a straight line (e.g., $2Lb$) from the subsequent illustration point by reflection such that a subsequent angle (e.g., Qb) is defined between the subsequent straight line ($1Lb$) and the straight line ($2Lb$).

15 A straight line (e.g., $3Lb$) is drawn to produce a subsequent incident normal by dividing the subsequent angle (Qb) equally into two. Next a subsequent tangential line (e.g., $4Lb$) which extends through the subsequent curvature point perpendicularly to the straight line ($3Lb$) is drawn.
20 These steps are repeated to draw a curvature representing a mirror surface by use of numerous tangential lines obtained from the repetition of the steps.

In accordance with a desired luminous intensity distribution on the screen S' , higher density subsequent
25 illumination points are selected for a greater luminous

intensity zone . Further, based on thus determined curved reflection surface of the mirror, an actual luminous intensity distribution can be easily predicted by use of a computer.

5 FIG. 3 shows the luminous intensity distribution obtained from a method of this invention, in which the light intensity is high at both ends of the illumined object S and low at the central portion . FIG. 4 shows another luminous intensity distribution obtained from this invention, which
10 shows that the light distribution can be determined so that the entire object S can be illuminated uniformly.

 Moreover, substantially based on the above-mentioned one dimensional design of a reflection mirror, a two dimensional curved surface of a reflection mirror can be
15 determined by applying the same method to another dimensional direction.

Referring to FIGS. 6 and 7, an oval surface 102 of a mirror body B is cut out by a bit positioned and controlled by a computer having a data determined from the above-mentioned
20 method. Thereby, the shape of the mirror reflection surface RS is elliptic in X-X' direction. Meanwhile, the reflection surface RS is also elliptic or parabolic in an perpendicular direction to X-X' line. This can provide a reflection mirror modifying a cylindrical incident beam into a rectangular
25 reflected one.

CLAIMS

1. A method of designing an illuminating reflection mirror having a reflective surface, said reflective surface having a shape corresponding to a desired illumination intensity pattern to be projected by the mirror on an illumination object, said method comprising the steps of:

a) providing an illumination object;

b) defining a plurality of illumination points which
10 correspond to said desired illumination intensity pattern on said illumination object wherein a greater density of illumination points corresponds to a greater illumination intensity to be applied to said illumination object;

c) locating a light source (R) at a given distance from said illumination object (S);

d) selecting an initial one of said plurality of illumination points (Ss) on said illumination object (S) and a curvature starting point (Ms) on a remote side of said light source (R) and drawing a first straight line (1La) to
20 produce an imaginary incident ray from said light source (R) to said curvature starting point (Ms) and a second straight line (2La) to produce a reflected ray from said curvature starting point (Ms) to said initial illumination point (Ss) to define an angle (Qa) between said first straight line (1La) and said second straight line (2La);

e) drawing a third straight line (3La) to produce an incident normal by bisecting said angle (Qa) equally into two angles;

f) drawing a tangential line (4La) extending through
30 said curvature starting point (Ms) perpendicularly to said third straight line (3La) to produce an imaginary reflected light emitted from said light source (R) that is reflected at

said curvature starting point (Ms) toward said initial illumination point (Ss) by reflection;

g) selecting an adjacent one of said plurality of illumination points on said illumination object;

h) locating a first subsequent straight line (1Lb) from said light source extending at an angle from the preceding imaginary incident ray and to produce a subsequent imaginary incident ray and to locate a subsequent curvature point on said tangential line (4La) while simultaneously
10 drawing a second subsequent straight line (2Lb) from said subsequent illumination point by reflection such that a subsequent angle (Qb) is defined between said first subsequent straight line (1Lb) and said second subsequent straight line (2Lb);

i) drawing a third subsequent straight line (3Lb) to produce a subsequent incident normal by bisecting said subsequent angle (Qb) equally into two angles;

j) drawing a subsequent tangential line (4Lb) extending through said subsequent curvature point
20 perpendicularly to said third subsequent straight line (3Lb);

k) repeating the steps g) through j) to produce a series of curvature points which represent a reflective mirror surface; and

l) designing the mirror with its reflective surface based on the series of curvature points defined in steps a) to k).

2. A method according to claim 1, wherein said desired illumination intensity pattern is higher at both ends of the
30 illumination object than at a central portion thereof.

3. A method according to claim 1, wherein said desired illumination intensity pattern is uniform over the entire illumination object.

4. A method of manufacturing an illuminating reflection mirror from data which is used to produce a curvature of a reflective surface of said mirror, said reflective surface having a shape corresponding to a desired illumination intensity pattern to be projected by said mirror
10 on an illumination object, from data, said method comprising determining said data by the steps of:

a) providing an illumination object;

b) defining a plurality of illumination points which correspond to said desired illumination intensity pattern on said illumination object wherein a greater density of illumination points corresponds to a greater illumination intensity to be applied to said illumination object;

c) locating a light source (R) at a given distance from said illumination object (S);

20 d) selecting an initial one of said plurality of illumination points (Ss) on said illumination object (S) and a curvature starting point (Ms) on a remote side of said light source (R) and drawing a first straight line (1La) to produce an imaginary incident ray from said light source (R) to said curvature starting point (Ms) and a second straight line (2La) to produce a reflected ray from said curvature starting point (Ms) to said initial illumination point (Ss) to define an angle (Qa) between said first straight line (1La) and said second straight line (2La);

30 e) drawing a third straight line (3La) to produce an incident normal by bisecting said angle (Qa) equally into two angles;

f) drawing a tangential line (4La) extending through said curvature starting point (Ms) perpendicularly to said third straight line (3La) to produce an imaginary reflected light emitted from the light source (R) that is reflected at said curvature starting point (Ms) toward said initial illumination point (Ss) by reflection;

g) selecting an adjacent one of said plurality of illumination points on said illumination object;

h) locating a first subsequent straight line (1Lb) from said light source extending at an angle from the preceding imaginary incident ray and to produce a subsequent imaginary incident ray and to locate a subsequent curvature point on said tangential line (4La) while simultaneously drawing a second subsequent straight line (2Lb) from said subsequent illumination point by reflection such that a subsequent angle (Qb) is defined between said first subsequent straight line (1Lb) and said second subsequent straight line (2Lb);

i) drawing a third subsequent straight line (3Lb) to produce a subsequent incident normal by bisecting said subsequent angle (Qb) equally into two angles;

j) drawing a subsequent tangential line (4Lb) extending through said subsequent curvature point perpendicularly to said third subsequent straight line (3Lb);

k) repeating the steps g) through j) to produce a series of curvature points which are used as data to manufacture a reflective mirror surface; and

l) manufacturing said mirror, the curvature of the reflective surface of said mirror being determined by the series of curvature points defined in steps a) to k).

5. A method according to claim 4, wherein the desired illumination intensity pattern is higher at both ends of the illumination object from at a central portion thereof.

6. A method according to claim 4, wherein the desired illumination intensity pattern is uniform over the entire illumination object.

7. A method according to claim 4, wherein said
10 plurality of illumination points are determined along a basic coordinate axis and then are determined along straight lines parallel to another coordinate axis perpendicular to the basic coordinate axis, the steps a) through k) being applied firstly to the illumination points along the basic axis and secondly to the illumination points on the lines parallel to the another axis.

FIG. 1

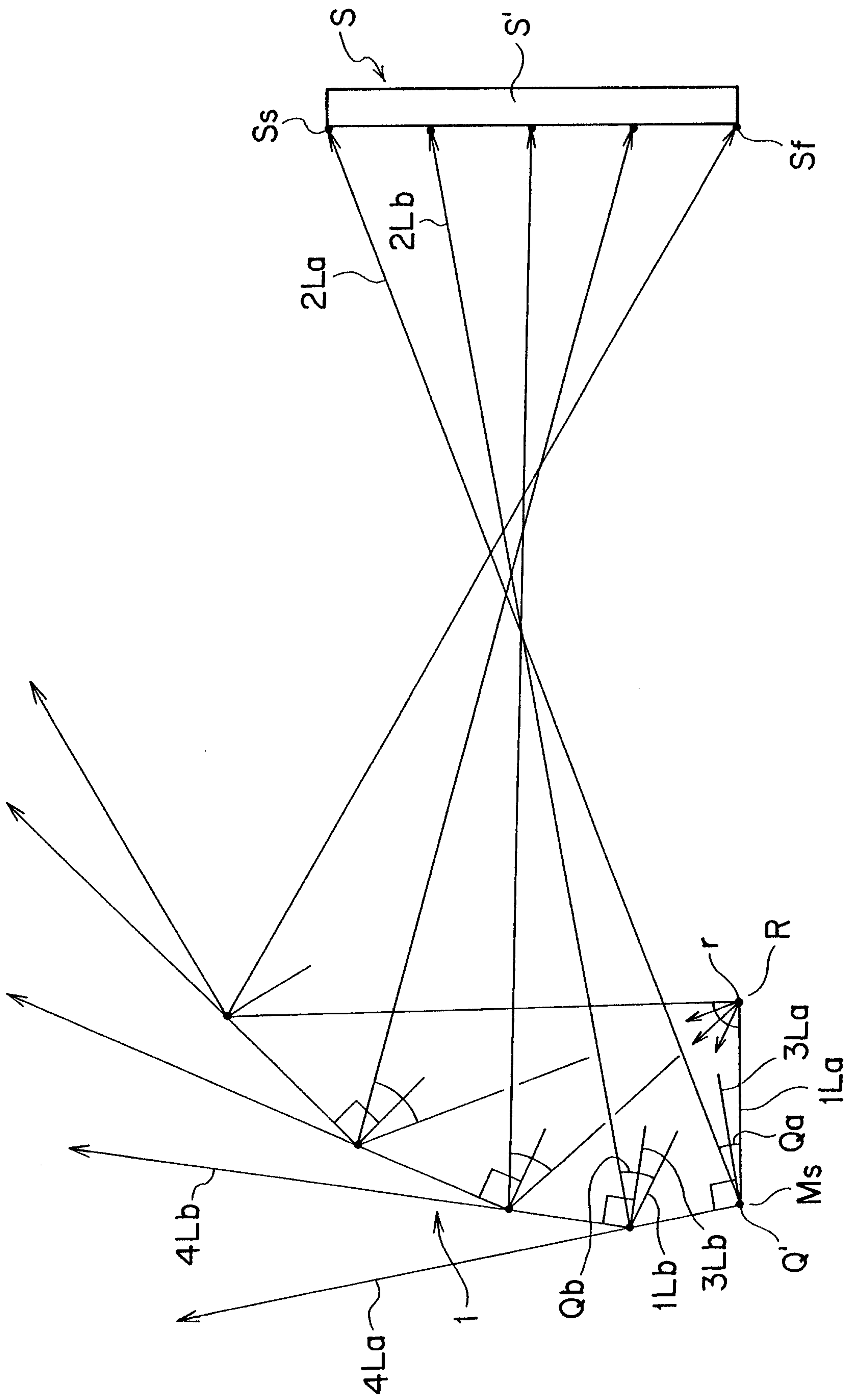


FIG. 2

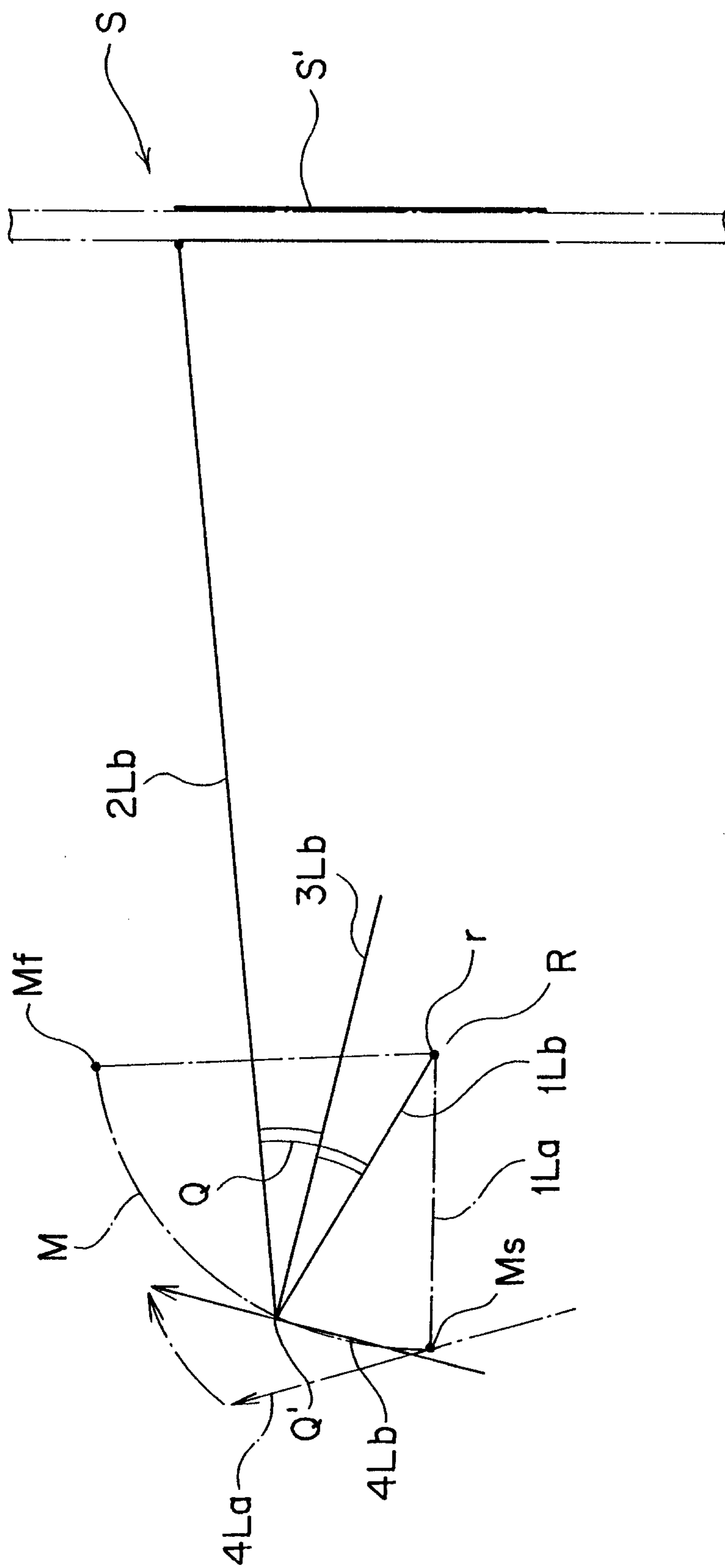


FIG. 3

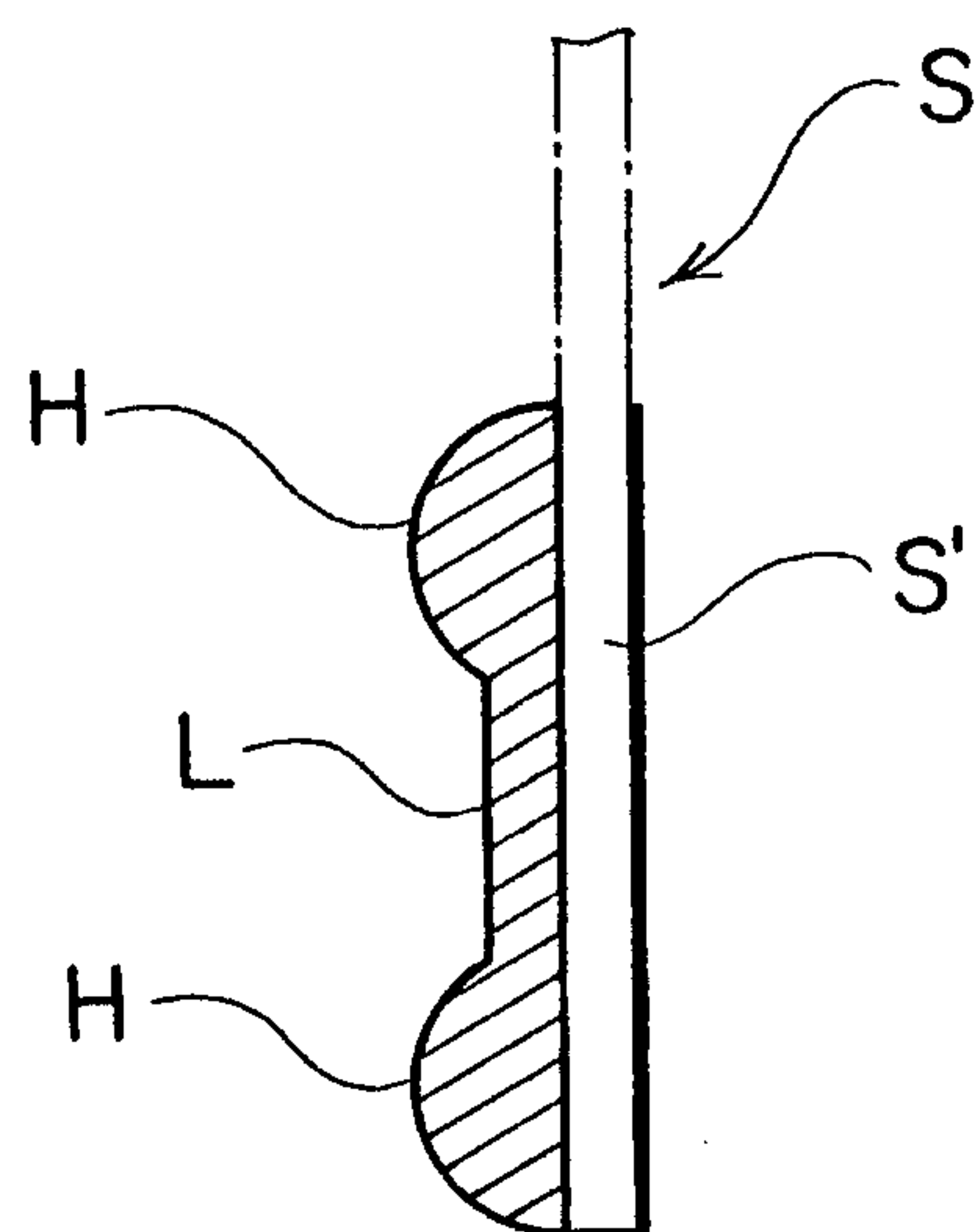
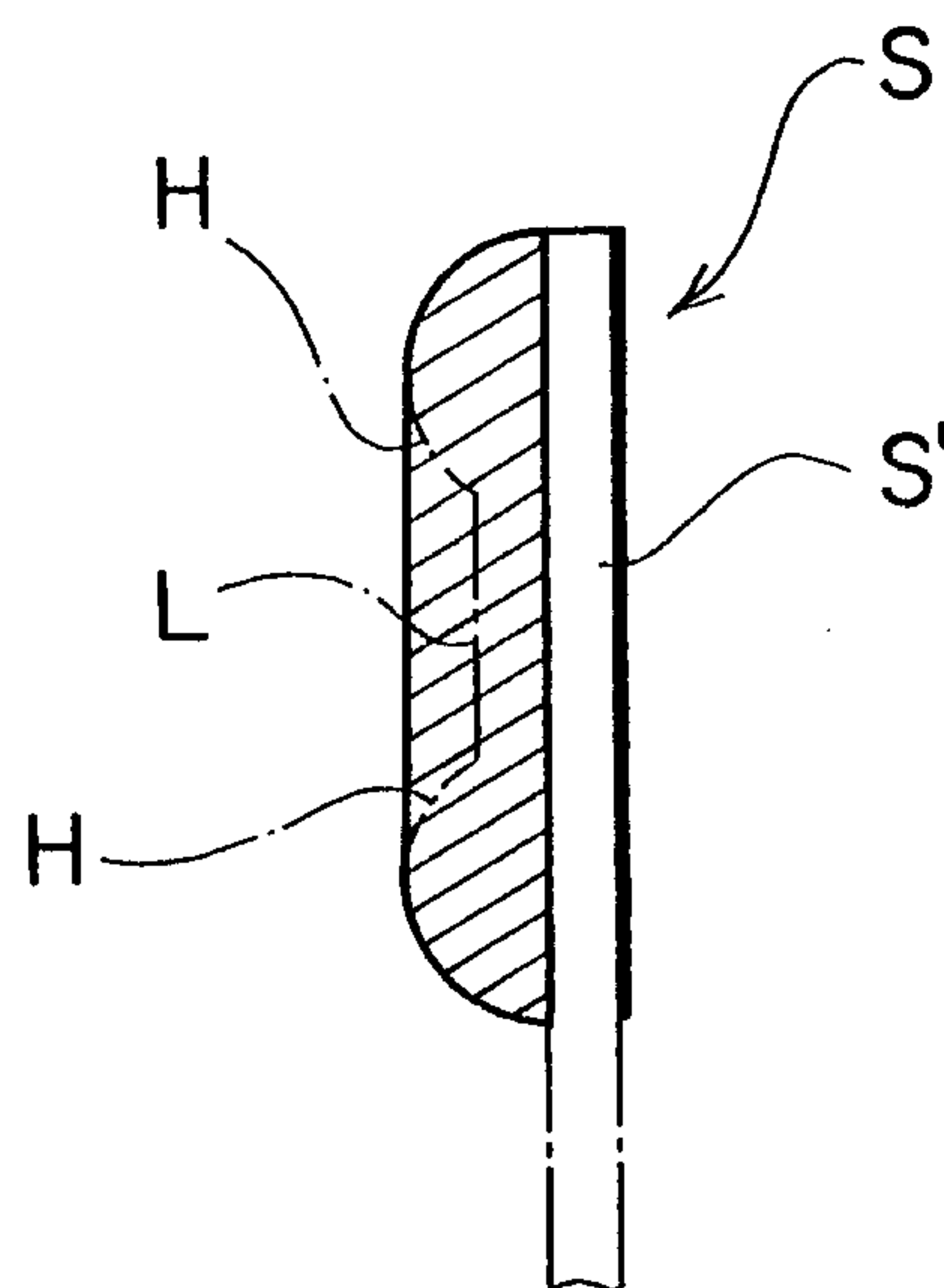
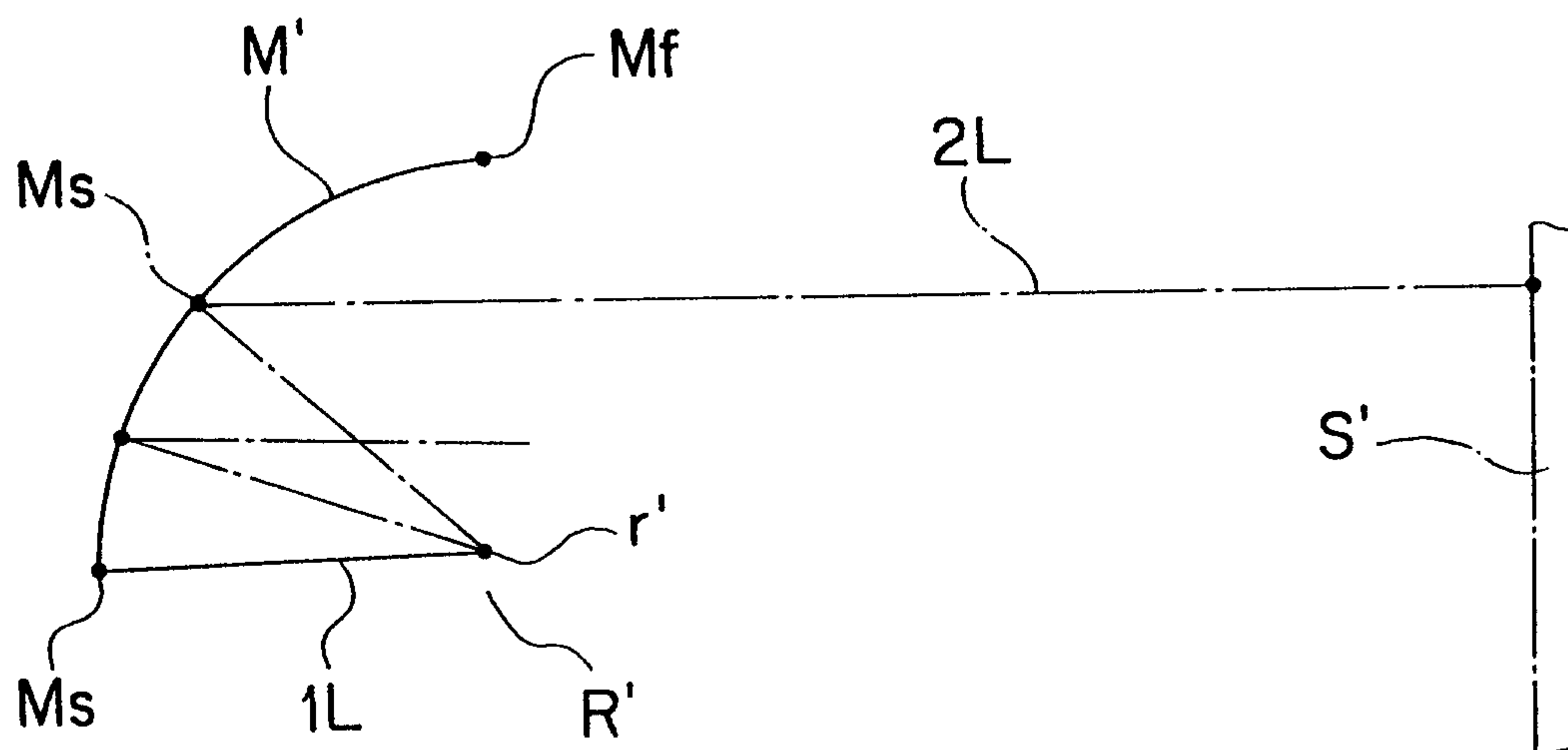
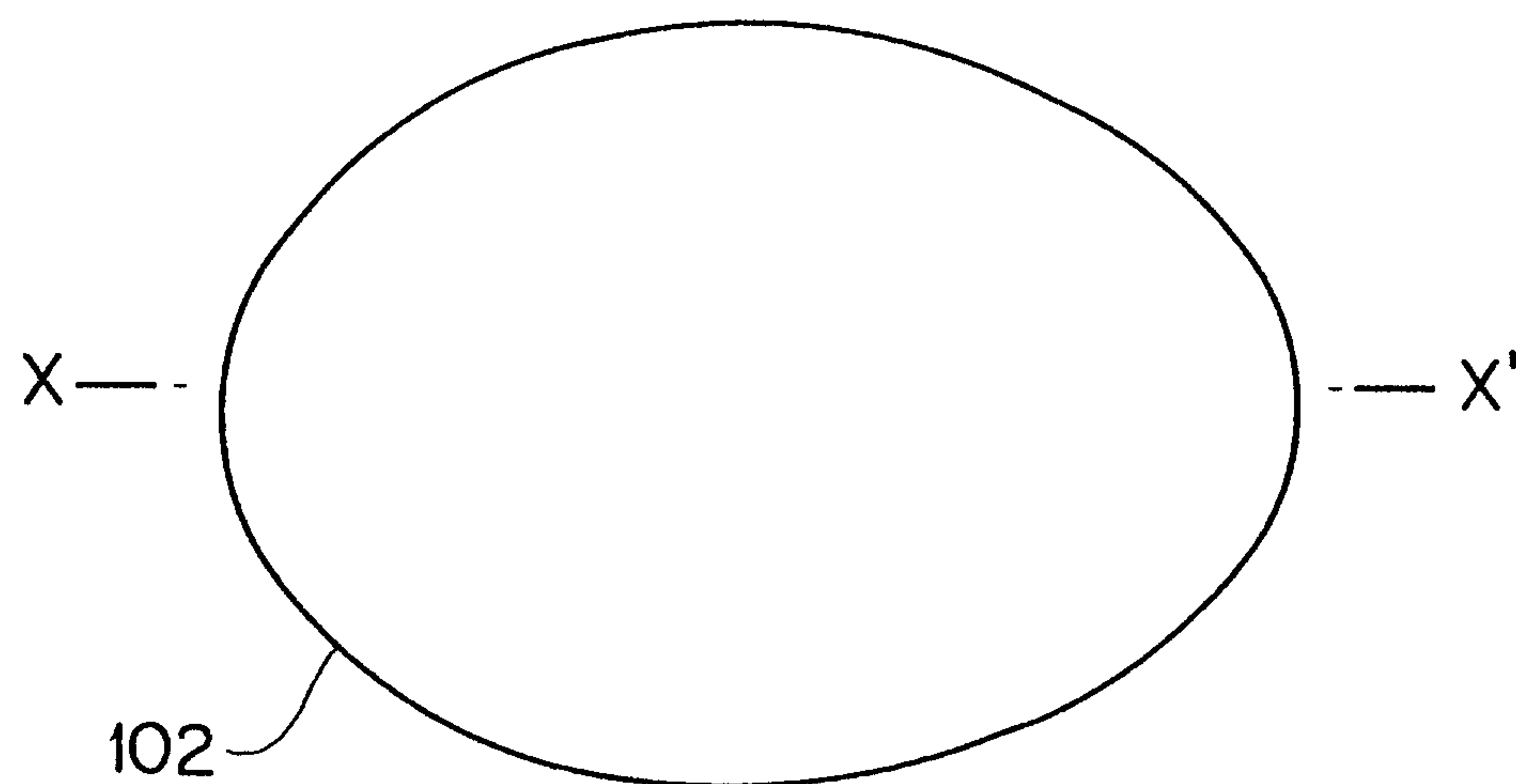


FIG. 4

FIG. 5
PRIOR ART

F I G . 6



F I G . 7

