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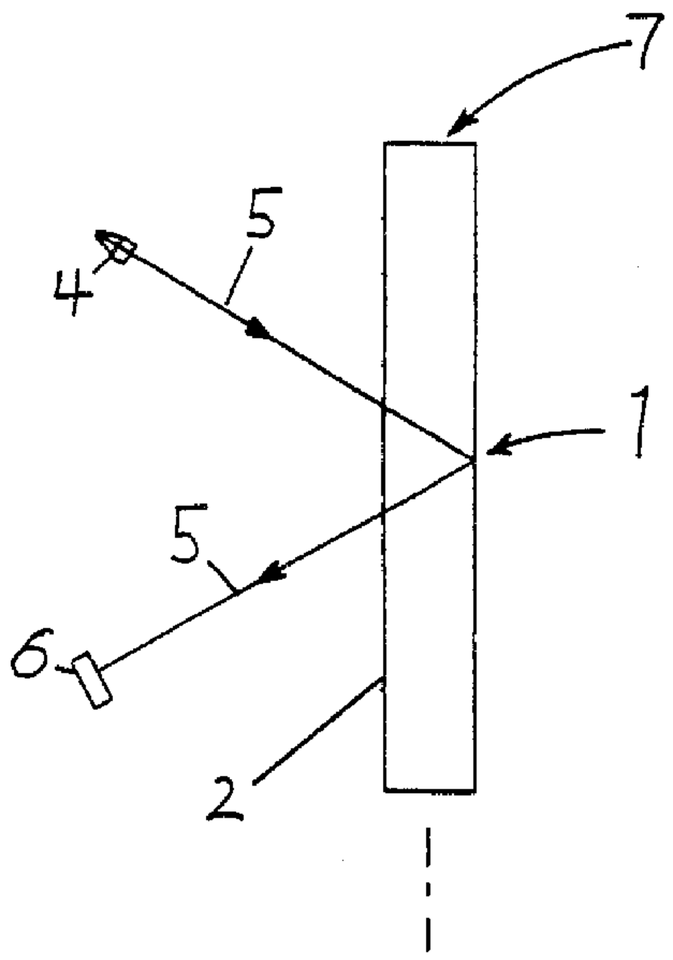
(54) **DETECTEUR D'HUMIDITE POUR PARE-BRISE ET ESSUYAGE AUTOMATIQUE**

(54) **SENSING MOISTURE ON SCREEN AND AUTOMATED CONTROLLED WIPING**



(57) La présence d'eau (3) sur la surface externe (1) du pare-brise (7) d'un véhicule déclenche la transmission partielle d'un faisceau lumineux (5) à travers le pare-brise (7), tandis qu'un pare-brise sec (7) permet une réflexion interne sensiblement totale du faisceau (5). Cette différence est détectée par un capteur de lumière (6). La présence d'eau est utilisée initialement pour mettre en route les essuie-glaces du pare-brise et, ces derniers ayant été activés, les caractéristiques du signal provenant du capteur (6) et reçu pendant une première action des essuies-glace sont utilisées pour déterminer les caractéristiques de l'action suivante des essuie-glaces, telles que temporisation ou vitesse des balais d'essuie-glaces. Le faisceau (5) est un rayon infra-rouge.

(57) Water (3) on the outside surface (1) of a vehicle windscreen (7) causes a light beam (5) to be partially transmitted through screen (7), while a clean screen (7) provides substantially total internal reflection of beam (5). This difference is detected by light sensor (6). The presence of water is used initially to trigger the windscreen wipers and once activated, the characteristics of the signal from sensor (6) received during one wiper action are used to set the characteristics of the next wiper action, e.g. time delay, or wiper blade speed. The light beam (5) is an infra-red light.

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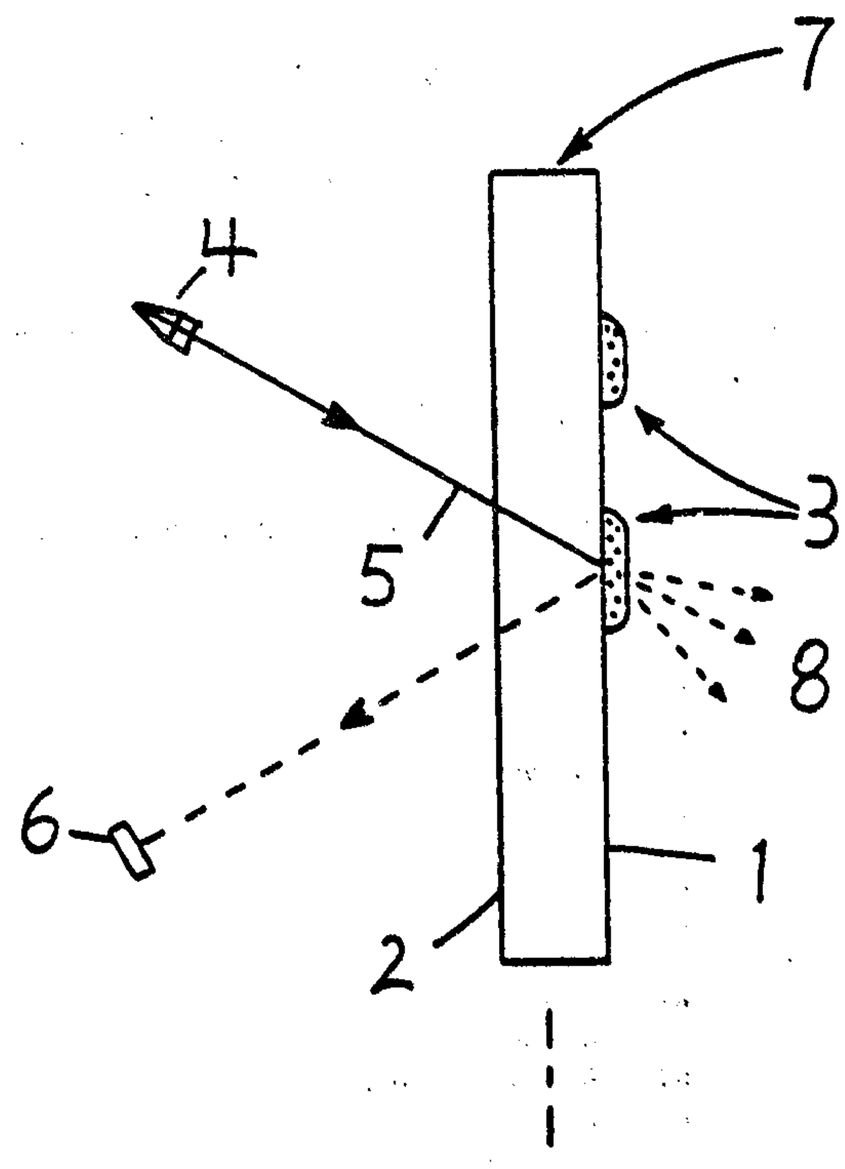

(57) Abstract

Water (3) on the outside surface (1) of a vehicle windscreen (7) causes a light beam (5) to be partially transmitted through screen (7), while a clean screen (7) provides substantially total internal reflection of beam (5). This difference is detected by light sensor (6). The presence of water is used initially to trigger the windscreen wipers and once activated, the characteristics of the signal from sensor (6) received during one wiper action are used to set the characteristics of the next wiper action, e.g. time delay, or wiper blade speed. The light beam (5) is an infra-red light.

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"SENSING MOISTURE ON SCREEN AND AUTOMATED CONTROLLED WIPING"

This invention relates to a system controlling the wiping of automotive windscreens at a rate corresponding to the determined amount of water on the screen.

BACKGROUND ART

In Australian patent 546327, a detector mounted externally of the vehicle continuously monitors rain to provide a value for the amount of rain fallen since the completion of the last wipe of the windscreen wiper blade. Once that rain total impinging on the detector reaches some predetermined level the wiper blade is again actuated. Such is typical of prior art automatic windscreen controls which integrate actual rain fall signals falling on the detector in order to determine the rate of frequency or windscreen wiper operation.

An example of prior art is JP-A-57118952 in which a windscreen wiper controller functions in response to rain drops falling upon a detector as a result of a calculation of the quantity of rain that has fallen on the detector itself. Another example of the art is US-A-4859867 which also employs a detector arrangement which is merely responsive to the quantity of rain which falls directly on the detector.

However, such systems are in general deficient at least with regard to the fact that the windscreen needs to be wiped, not only in consideration of rain fall, but also in consideration of other water sources such as spray from nearby cars which does not necessarily directly impinge on the detector but which nevertheless creates an obstacle to driver vision.

DISCLOSURE OF INVENTION

The present invention recognises that the magnitude of a wall of water pushed ahead of a sweeping wiper blade can provide an accurate and reliable measure of the quantity of rain that falls on a windscreen during successive sweeps of the wiper blade. With such an accurate measurement of the rate of rainfall it is possible to provide a better control of the motion of the wiper blade to clear the rain from the windscreen in an optimal way.

Accordingly, in one broad form, the present invention can be described as providing a device for controlling a vehicle windscreen wiper comprising:

means for detecting the magnitude of a wall of water pushed by a windscreen wiper across a region of the windscreen as the wiper is in motion across said region; and

means for controlling the next cycle of motion of the windscreen wiper in dependence upon the detected magnitude of the wall of water.

In accordance with the present invention there is disclosed a method of controlling a vehicle windscreen wiper comprising:

directing light energy from the vehicle interior to a point of incidence of the windscreen, swept by the windscreen wiper, at a preselected angle such that the directed light energy will be substantially totally internally reflected by the windscreen only when the exterior surface is dry;

detecting the light energy reflected by the windscreen and determining the amount of the reflected light energy;

electronically processing the determined amount of reflected light energy that is detected during at least one portion of each action of the windscreen wiper to produce a signal; and

controlling the speed of motion of the windscreen wiper, or a time delay from one action of the windscreen wiper to the next action, according to said

signal: characterised in that said portion at least includes a period when light energy is reflected as a result of a wall of water in advance of the wiper as the wiper passes the point of incidence and wherein said signal is indicative of the magnitude of the wall of water.

An embodiment of the present invention provides a device for controlling a vehicle windscreen wiper comprising:

a light energy source for directing light energy onto a surface of the windscreen, at a point of incidence to be swept by the windscreen wiper, from the vehicle interior;

a light energy detector for detecting the directed light energy reflected by said windscreen surface and for producing a signal corresponding to the detected amount of reflected light energy;

a controller for controlling the speed of the windscreen wiper action, or a time delay between a current windscreen wiper action and the next windscreen wiper action, characterised in that the controller is controlled by the detected amount of light energy that corresponds to the magnitude of a wall of water in advance of the wiper as the wiper passes said point of incidence.

Preferably the light is in the infra-red range emitted by a light emitting diode, however an infra-red laser beam may also be used.

Preferably the light source and the detector are located in a rear face of a prismatic lens to be held with its opposite front face substantially flush against the windscreen. The prismatic lens preferably includes respective transmitting and receiving internal reflective surfaces disposed on opposite sides of the prism proximate respectively the source and the detector.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will now be described by way of example only and with reference to the accompanying drawings of which:

Figs. 1(A) and 1(B) schematically show an exemplary embodiment of the invention for detecting the moisture state on the outside of a windscreen;

Figs. 2(A) and 2(B) schematically represent an exemplary embodiment of the invention for detecting the moisture state of the inside of a windscreen; and

Figs. 3(A), 3(B) and 3(C) are sectional views of a preferred design of the layout shown in Fig. 1 and a schematic representation of the light beam pattern that it produces.

BEST MODE CARRYING OUT THE INVENTION

An infra-red (IR) light beam is provided by diode (LED) 4 and directed generally along the path 5 toward windscreen 7. The angle of incidence is selected such that at least a high proportion of the beam 5 travels through the material of windscreen 7 to be internally reflected off the outside surface 1, when the outside surface 1 is dry, to continue along the path 5 to the detector 6.

The presence of water, such as water drops 3, on the outside surface 1 at the point of incidence of beam 5, will result in a substantial portion of diffused light 8 being lost from the beam 5. Thus, with water on the outside of the screen 7, the amount of light detected at detector 6 is diminished thus allowing detector 6 to provide a signal to a logic circuit or other electronic device, which is indicative of the presence of water on the windscreen 7.

It will be clear that the operation of the device depends upon the presence of water altering the refractive index at the screen/air exterior interface. As such operation of the device is not restricted to detecting water droplets, but will also detect for example ice. Thus, throughout this specification, it should be clear that the term "wet" defines the presence of water in any state and the term "dry" defines the absence of water in any state.

A wiper control circuit device, not shown in Fig. 1, is connected to the detector and upon receipt of the signal indicating water on the screen 7, can initiate a first wiping action of the windscreen wiper blades. The moving wiper blade produces a wall of water along its leading edge being characteristically proportional to the amount of water that was on the windscreen 7 at the time of the wiper blade sweep. As this wall of water passes the point of incidence of the laser beam 5, the detector 6 receives a varying amount of reflected light beam 5 and thus produces a signal which is directly related to the amount of moisture that was wiped by the blade from the screen. This signal indicating the amount of moisture on the screen is then processed and used to control the next sweep of the blade. Such control of the blade can be related to the blade speed or lag time between the last and next sweep of the blade.

When the screen 7 becomes dry the reflected beam 5 reaching the detector 6 becomes constant and the wipers are switched off.

In Fig. 2 the infra red beam 15 is directed at the windscreen 7 at an angle of incidence so as to create substantial external reflection from the inside surface 2 of the windscreen 7. Here, the presence of misting, creating moisture condensation 9, on the inside 2 is measured by detector 16, where the amount of light detected is diminished due to light dispersion 19, in a manner similar to that described beforehand with reference to the Fig. 1 embodiment. In this case detector 16 is connected via circuitry to demisting equipment of the vehicle.

Figs. 3A and B show in plan similar integral assemblies 10 and 20 which embody in a particular form the devices shown in Fig. 1 and described above.

The assembly 10 includes a front window 12 which is transparent to infra red light and which is adhered to, and optically matched with, the inside surface 2 of the windscreen 7. In a rear face of the window 12 is an array of three infra-red LEDs 4 to produce beams 5 angled at the screen 7. The light beams 5 strike the outside surface 1 at the desired angle of incidence to be reflected back into the window 12 impinge on a matching set of three diode light receivers 6.

Respective pairs of co-operative LED 4 and detector 6 are housed in their own module 13, three modules 13 being located side by side within a case enclosure 11, creating a pattern of three closely spaced illumination points which ensure correct operation with defective wiper blades. The device is well adaptable to rear windscreens of cars which include wipers.

The assembly 20 comprises six of the modules 13 arranged in two rows of three. The pattern of illumination by assembly 20 is shown in Fig. 3C and allows connected electronics (not shown) to override deleterious effects such as debris, e.g. impacted insects, as well as water streaks caused by faulty wiper blades. The assembly 20 is fixed with the front face of the window 12 flush against the screen surface 2 at any convenient point aligned with a portion of the outside surface 1 wiped by a wiper blade 14. In a typical road vehicle front windscreen this can often be between the screen and the interior rear vision mirror.

INDUSTRIAL APPLICABILITY

The windscreen may be any screen which is to be kept clear of rain or similar by some controllable cleaning mechanism such as, but not necessarily, a pendulous wiper. It does have particular use in road vehicles, boats and aeroplanes.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS: -

1. A method of controlling a vehicle windscreen wiper comprising:

directing radiant energy from the vehicle interior to a point or region of the windscreen, swept by the windscreen wiper, at a preselected angle such that the directed radiant energy will be substantially totally internally reflected by the windscreen only when the exterior surface is dry;

detecting the radiant energy reflected by the windscreen and determining the amount of the reflected radiant energy;

electronically processing the determined amount of reflected radiant energy that is detected during at least one portion of each action of the windscreen wiper including when the wiper passes the said point or region to set a device output; and

controlling the speed of motion of the windscreen wiper, or the time delay from one action of the windscreen wiper to the next action, according to a said device output based on the processing of the amount of reflected radiant energy detected during a previous action of the windscreen wiper.

2. A method as defined in claim 1 wherein the radiant energy is light energy.

3. A method as defined in claim 2 wherein the amount of reflected light is determined substantially only at the time the wiper blade passes the point or region at which the light is directed at the windscreen.

4. The method as defined in claim 2 wherein the light is directed as a plurality of parallel light beams.

5. The method as defined in claim 2 wherein the light is infra-red light.

6. A device for controlling a vehicle windscreen wiper comprising:

a radiant energy source for directing radiant energy on to a surface of the windscreen, at a point or region to be swept by the windscreen wiper, from the vehicle interior,

a radiant energy detector for detecting the directed radiant energy when reflected by a windscreen surface and for producing a signal corresponding to the detected amount of reflected radiant energy;

a processor setting a device output which determines the speed of a windscreen wiper action, or a time delay between a windscreen wiper action and the next windscreen wiper action, substantially based upon the amount of reflected light detected as the wiper passes said point or region during a previous windscreen wiper action.

7. The device of claim 6 wherein the radiant energy is light.

8. A device as defined in claim 7 wherein the light source produces at least one beam of directed light, said light source and light detector are housed in a single unit.

9. A device as defined in claim 8 wherein the light source is a plurality of infra red LEDs producing a plurality of spaced apart parallel beams and the light detector is a corresponding number of infra red detectors.

10. A vehicle windscreen wiper control assembly comprising:

a light source mounted relative to a vehicle windscreen and, in operation, directing light from the vehicle interior at the windscreen swept by the windscreen wiper, at an angle so that said directed light is substantially totally internally reflected by the outside surface of the windscreen only when the windscreen surface is dry;

a light detector mounted relative to the light source and the windscreen so as to detect light from the source reflected by the outside windscreen surface and providing a signal dependant on the amount of detected reflected light; and

an electronic processor device being connected to the light detector and producing a signal setting the speed of a windscreen wiper action or a time delay between a windscreen wiper action and the next windscreen wiper action and being substantially dependant upon the amount of reflected light detected as the wiper passes said point or region during a previous wiping action.

11. An assembly as defined in claim 10 wherein the light source, light detector and processor device are housed in a single rigid unit mounted on the interior of the windscreen, and the light source producing a plurality of parallel beams.

12. A device as in claim 10 further comprising a prismatic lens having mutually opposite front and rear faces, mutually opposite side faces therebetween, a plurality of infra red LEDs in the rear face proximate one side face defining the light source, a corresponding plurality of detecting diodes in the rear face proximate the other side face defining the light detector, and internal reflective surfaces in each side face proximate the front face and lying in the path of the light beam.

13. A device as in claim 7 further comprising a prismatic lens having mutually opposite front and rear faces, mutually opposite side faces therebetween, a plurality of infra red LEDs in the rear face proximate one side face defining the light source, a corresponding plurality of detecting diodes in the rear face proximate the other side face defining the light detector, and internal reflective surfaces in each side face proximate the front face and lying in the path of the light beam.

14. A windscreen wiper control comprising a device determining moisture quantity collected by the wiper blade from the windscreen during each wiper action as the wiper blade passes a device detection point or region on the windscreen and electronic circuitry receiving and processing signals from the device and controlling the speed or frequency of each wiping action dependent upon the signals received during a previous wiper action.

15. A method of controlling a vehicle windscreen wiper comprising:

directing light energy from the vehicle interior to a point of incidence of the windscreen, swept by the windscreen wiper, at a preselected angle such that the directed light energy will be substantially totally internally reflected by the windscreen only when the exterior surface is dry;

detecting the light energy reflected by the windscreen and determining the amount of the reflected light energy;

electronically processing the determined amount of reflected light energy that is detected during at least one portion of each action of the windscreen wiper to produce a signal; and

controlling the speed of motion of the windscreen wiper, or a time delay from one action of the windscreen wiper to the next action, according to said signal; characterised in that said portion at least includes a period when light energy is reflected as a result of a wall of water in advance of the wiper as the wiper passes the point of incidence and wherein said signal is indicative of the magnitude of the wall of water.

16. A method as claimed in claim 15 wherein the amount of reflected light is determined substantially only at the time the wiper blade passes the point of incidence.

17. The method as claimed in any of claims 15 and 16 wherein the light energy is directed as a plurality of parallel light beams.

18. The method as claimed in any of claims 15 to 17 wherein the light energy is infra-red light.

19. A device for controlling a vehicle windscreen wiper comprising:

a light energy source for directing light energy onto a surface of the windscreen, at a point of incidence to be swept by the windscreen wiper, from the vehicle interior,

a light energy detector for detecting the directed light energy reflected by said windscreen surface and for producing a signal corresponding to the detected amount of reflected light energy;

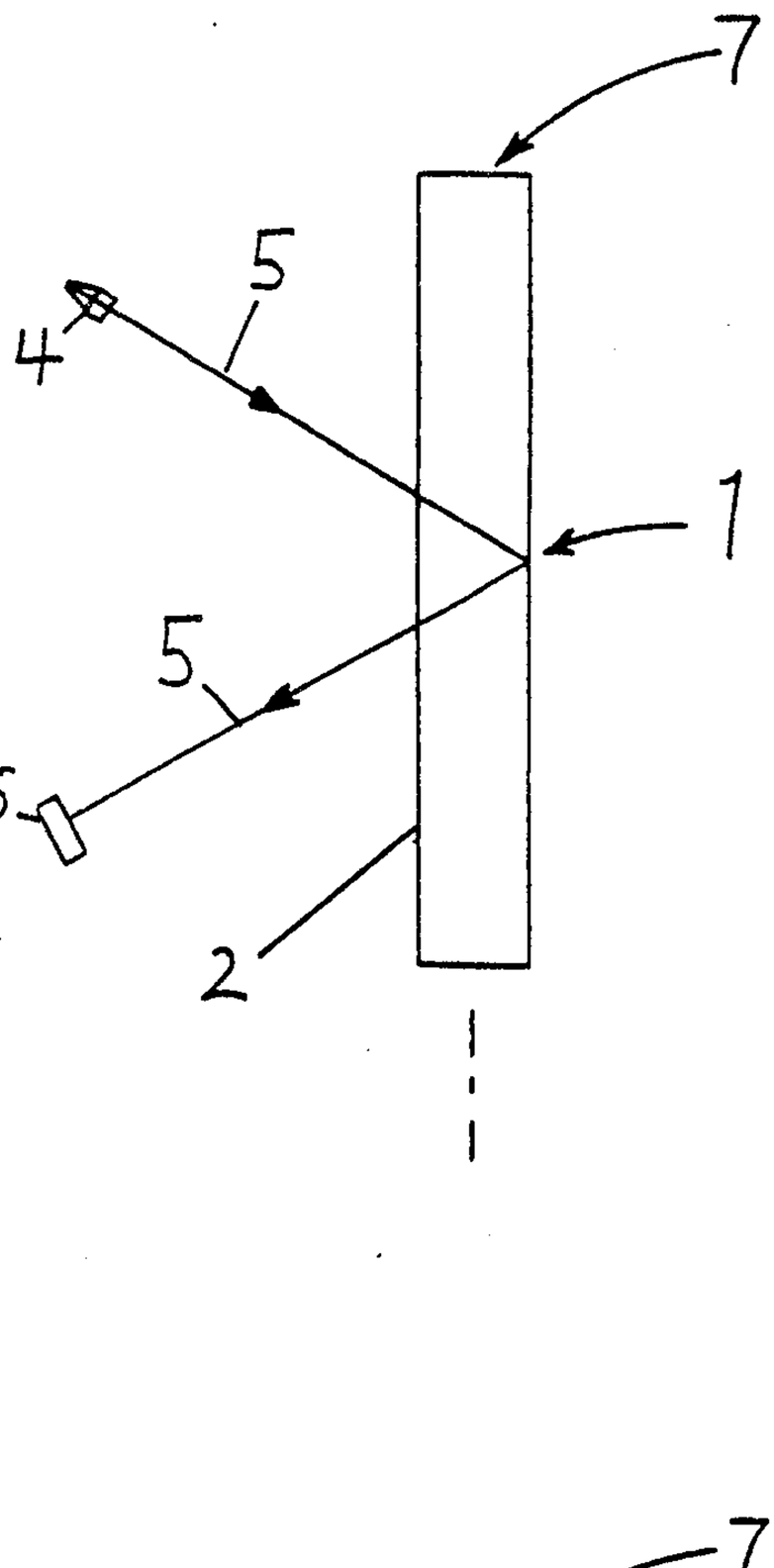
a controller for controlling the speed of the windscreen wiper action, or a time delay between a current windscreen wiper action and the next windscreen wiper action, characterised in that the controller is controlled by the detected amount of light energy that corresponds to the magnitude of a wall of water in advance of the wiper as the wiper passes said point of incidence.

20. A device as claimed in claim 19 wherein the light source produces at least one beam of directed light, and said light source and light detector are housed in a single unit.

21. A device as claimed in any of claims 19 and 20 wherein the light source is a plurality of infra red LEDs producing a plurality of spaced apart parallel beams and the light detector is a corresponding number of infra red detectors.

FIG.1

(A)



(B)

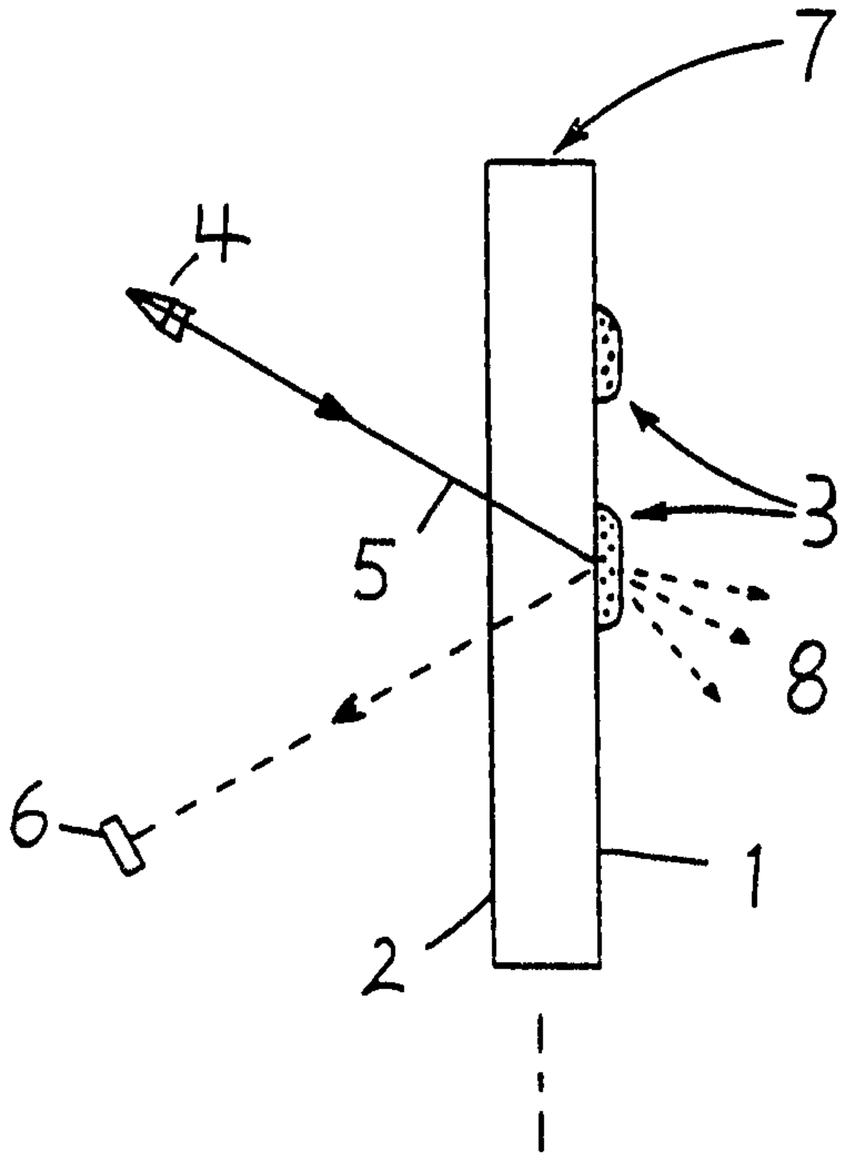
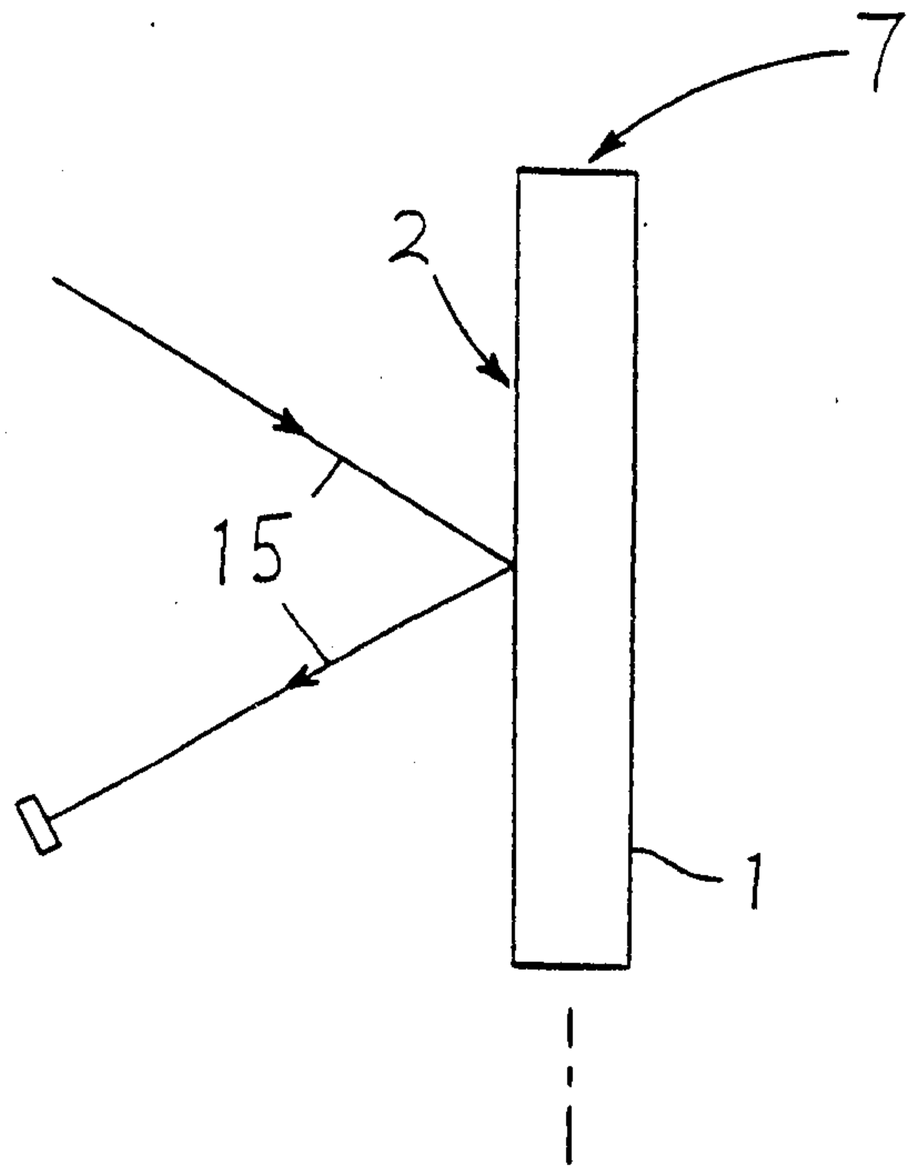


FIG.2

(A)



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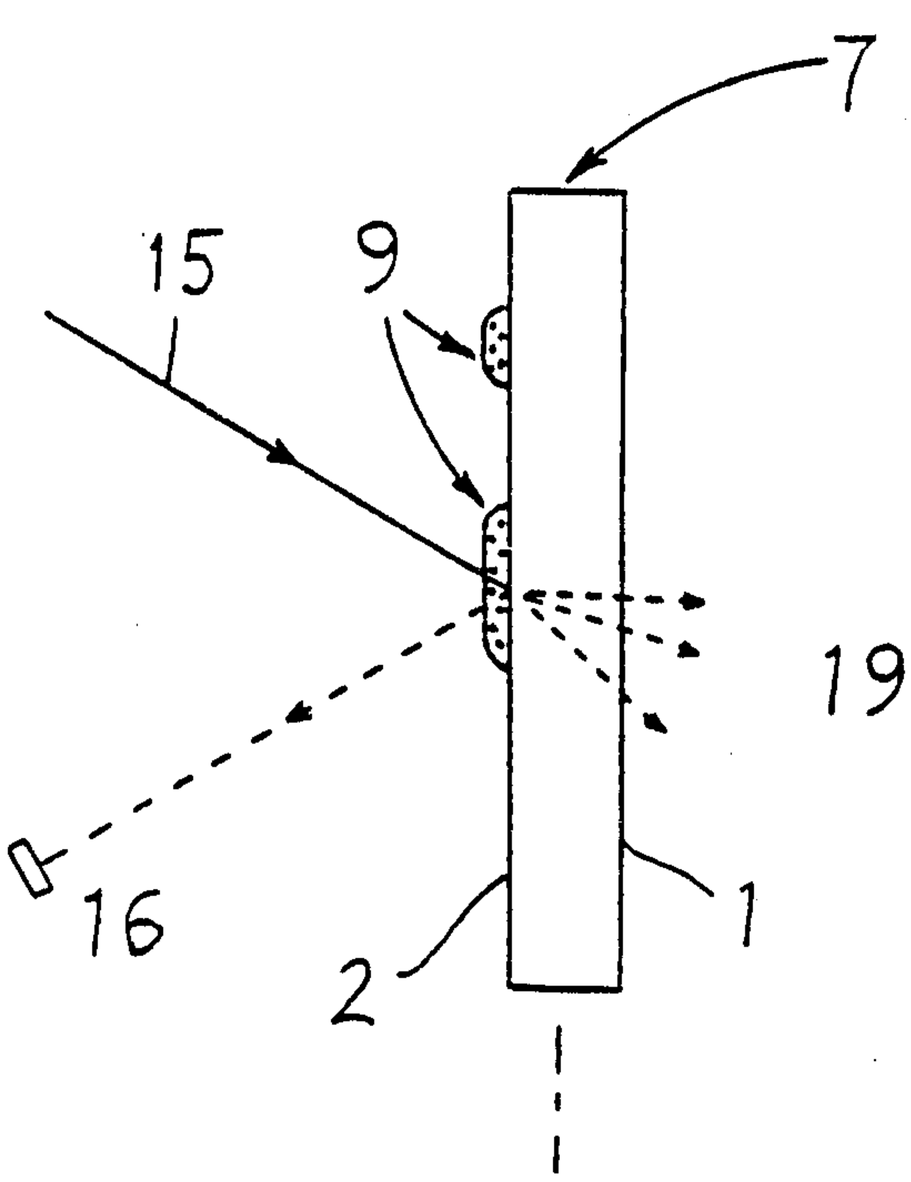
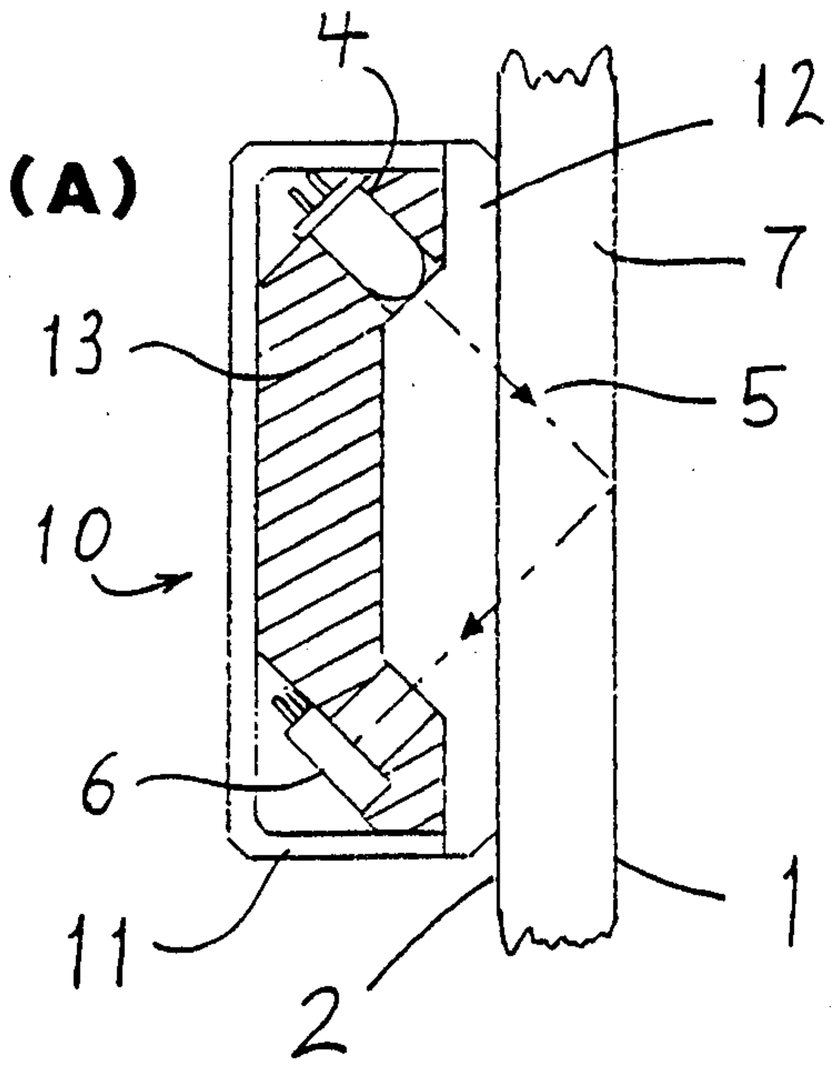
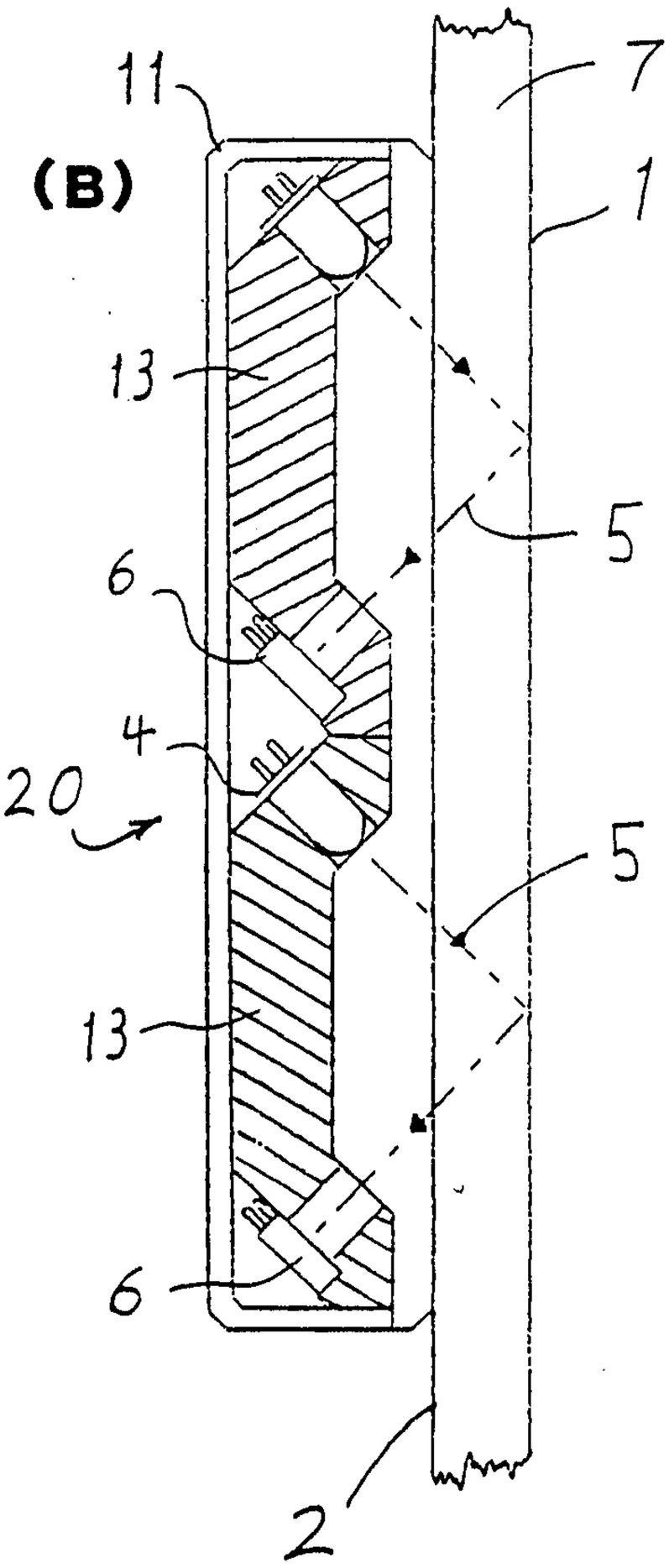
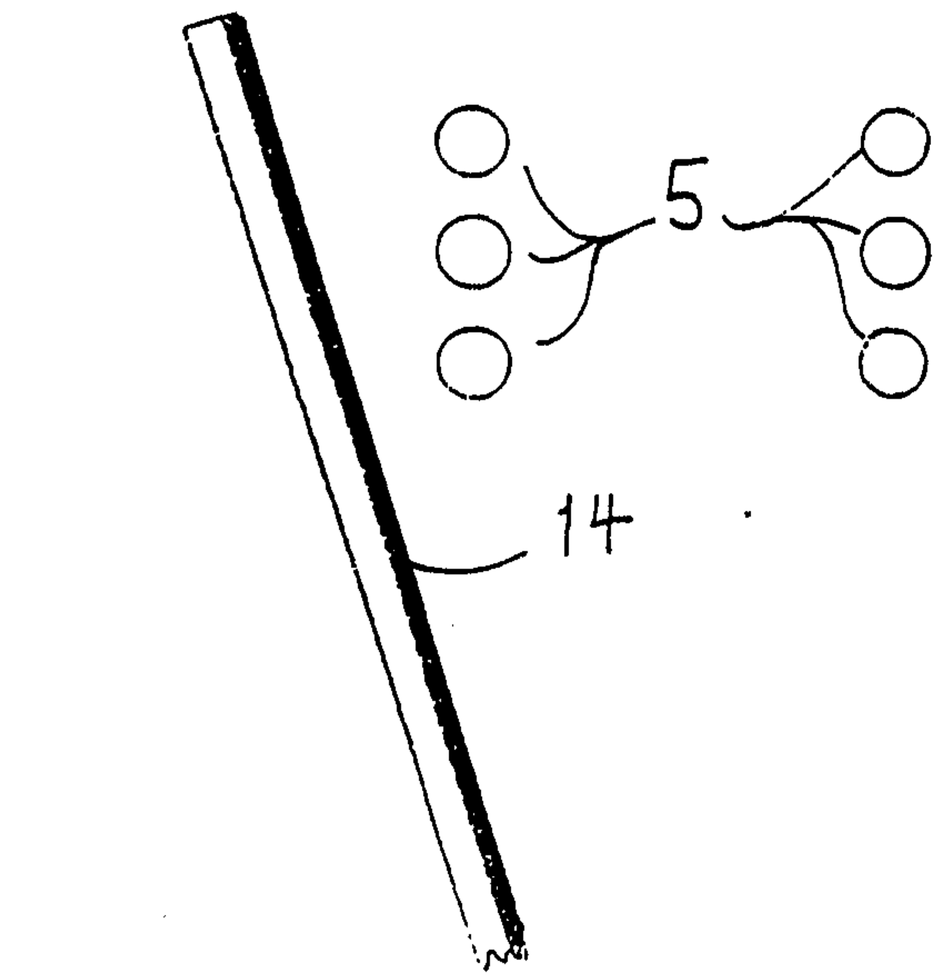
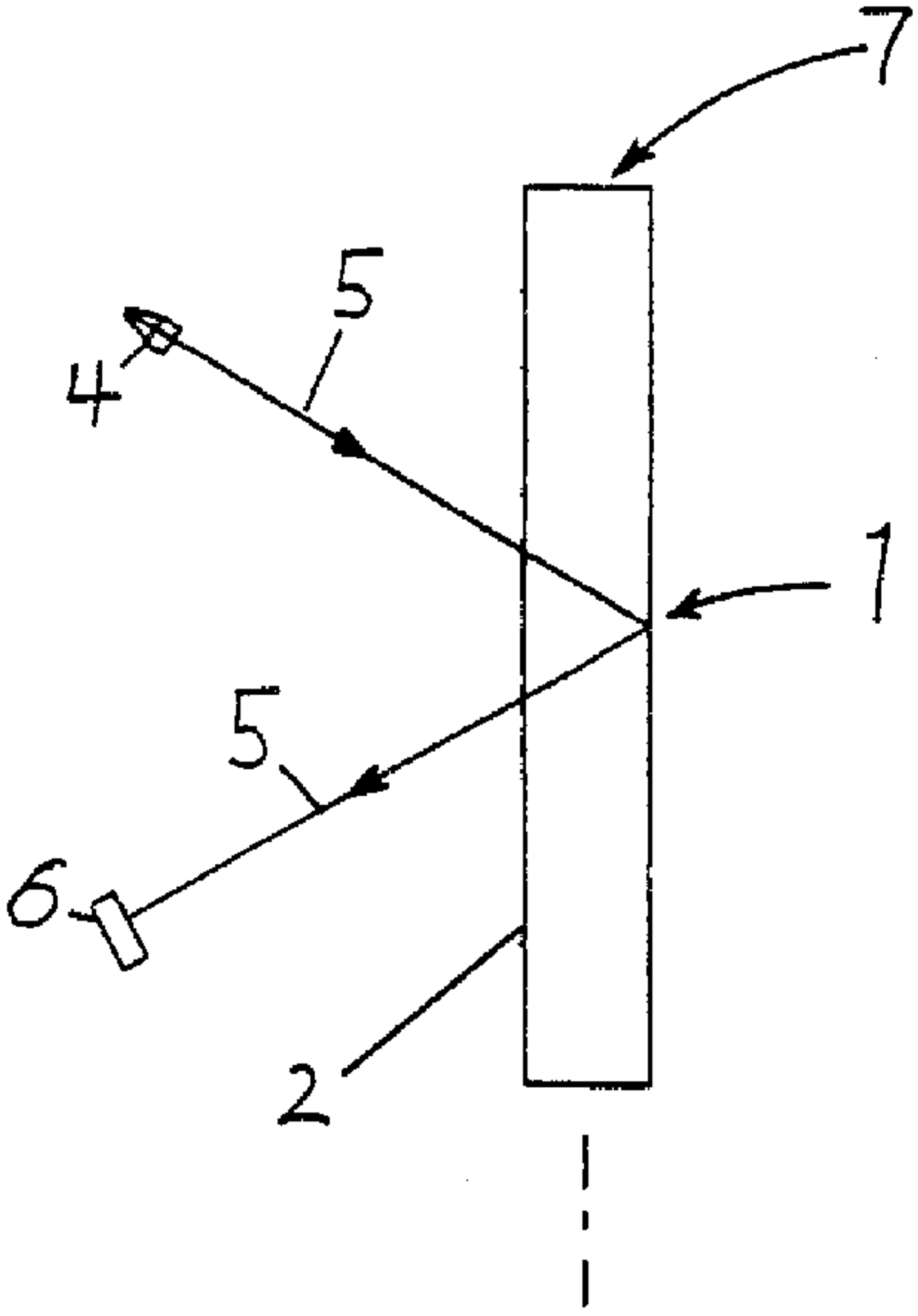


FIG. 3





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