EUROPEAN QUALIFYING EXAMINATION 2005

PAPER A
ELECTRICITY / MECHANICS

This paper comprises:

*	Client's Letter	2005/A(E/M)/e/1-5
*	Client's Drawings	2005/A(E/M)/e/6-9
*	Document D1	2005A(E/M)/e/10
*	Drawings Document D1	2005/A(E/M)/e/11
*	Document D2	2005/A(E/M)/e/12
*	Drawing Document D2	2005/A(E/M)/e/13
*	Document D3	2005/A(E/M)/e/14
*	Drawing Document D3	2005/A(E/M)/e/15

Client's letter

Dear Mr Hal Sangel,

Our company is a supplier of automotive components, in particular of lighting and electric components.

Legislation requires that vehicle lighting includes a low beam and a high beam intended to illuminate the road ahead of the vehicle. The low beam is used when the vehicle meets or follows another vehicle, providing optimum road illumination and protecting other drivers from glare. The low beam is usually produced by providing a screen to cut-off the upper part of the light beam.

For motorcycle lighting, a particular problem exists which will be explained in the following with reference to the Figs. 1 to 4.

In Fig. 1 a motorcycle 1 is travelling on a straight road (in a right-hand drive country), and its headlight illuminates the road ahead with a low beam as shown by the shaded portion. Fig. 2 shows the light distribution pattern of the low beam in the vertical plane A-A of Fig. 1. H-H represents a horizontal plane and V-V a vertical plane. The light distribution pattern of Fig. 2 comprises an upper edge, so defined as to prevent light from shining directly into the eyes of oncoming drivers.

Fig. 3 shows the motorcycle 1 during turning. Turning a motorcycle, in particular at speeds, is accomplished mainly by leaning rather than by steering with the front wheel. The rider leans the motorcycle towards the side to which he wishes to turn. The degree of leaning is proportional to both the speed of the motorcycle and the curvature of the turn. The headlight is fixed to the motorcycle and therefore also inclines, resulting in the light distribution pattern of Fig. 4. Consequently, an inadequate area of the road is illuminated, as illustrated by the shaded portion in Fig. 3. Thus, the motorcyclist may not see obstacles. Visibility becomes even more restricted as the radius of curvature of the road decreases. Moreover, during a turn to the right, as depicted, the beam of the headlight may blind oncoming drivers. This presents a serious safety hazard.

In view of the above problems, our research team has been investigating possible improvements to motorcycle lighting. The following solutions have been developed.

Fig. 5 shows a side view of one of our new headlights. This is based on a known type of headlight, which comprises a housing 10, a lamp 11 providing a light source, a parabolic reflector 12 and a cover-glass or lens 13 disposed at the front aperture of the housing 10. The axis of symmetry of the reflector 12 is the optical axis X-X of the headlight. In order to obtain a high beam and a low beam, a conventional, halogen lamp 11 with two filaments is used as shown in greater detail in Fig. 6. Such a lamp is inserted, without rotation, into a fitting where it is held by a spring clip (both not shown). Projections 21, 22, 23 ensure correct orientation of the lamp. The lamp 11 has a first filament 14 for producing a low beam and a second filament 15 for producing a high beam. As shown in Fig. 5, the first filament 14 is located in front of the reflector's focal point F, so that the light rays emitted upwards from this filament are reflected by the reflector 12 downwards onto the road as shown by the arrows. In order to cut-off the light rays that would otherwise be emitted upwards by the headlight, a screen 17 has to be provided within the lower half of the headlight. The screen 17 shields the first filament 14 from below, and has a shape so as to obtain a light distribution pattern with an upper edge as shown e.g. in Fig. 2.

In order to solve the aforementioned problem, the following modifications have been made. A gear wheel 20 has been provided which comprises an appropriate fitting (not shown) for receiving lamp 11. Lamp 11 is further supported by ball bearing 16. The gear wheel 20 meshes with the drive gear 19 of an electric motor 18. The rotation of the drive gear 19 causes a rotation of gear wheel 20, resulting in a rotation of the lamp 11, and therefore of the light distribution pattern. The axis of rotation of the lamp 11 corresponds to the optical axis X-X.

A different type of headlight is shown in Figs. 7 and 8. This type of headlight provi only a low beam. It comprises a housing portion 110 and an elliptic reflector 112. The axis of symmetry of the reflector 112 is the optical axis X-X of the headlight. A gas-discharge lamp 111 provides a light source positioned at the first focal point F1 of the reflector 112. Alternatively, a halogen lamp with a single filament may be used. Due to this geometrical arrangement, all the rays of light emitted by the lamp 111, and reflected by reflector 112, converge towards a second focal point F2. A screen 117 is arranged in the lower half of the headlight between lamp 111 and the second focal point F2 of the reflector 112. As apparent from Fig. 8, the screen 117 has a first edge 124 which is inclined by an angle of about 15° to a second edge 125. Referring again to Fig. 7, a lens 113 projects an inverted optical image of the screen 117, resulting in a light distribution pattern with an upper edge as shown e.g. in Fig. 2.

In our new headlight, screen 117 is rotatable about the axis X-X. During rotation, the screen 117 is guided by means of two pins 126 connected to the housing portion 110 and running in an arcuate groove of the screen. The screen 117 has a toothed portion 120. This meshes with a gear 119 which is driven by an electric motor 118 such that the screen 117, and therefore the light distribution pattern, is rotated about the axis X-X.

As for the first headlight configuration of Fig. 5, this configuration also allows the use of small-sized, lightweight drive components, all of which are mounted within a normal-sized headlight housing. Consequently our new headlights can replace conventional headlights.

A third configuration would be to combine the lamp 11 and the rotating mechanism 18, 19, 20 of Fig. 5 with an elliptic reflector and a lens of the type shown in Fig. 7.

In all configurations, rotation of the light distribution pattern by an appropriate angle compensates the effect of the inclination of the motorcycle, thus maintaining satisfactory illumination of the road whilst driving in a curve.

In order to determine the appropriate angle of rotation of the light distribution pattern, it is necessary to detect the angle of inclination of the motorcycle. As shown in Fig. 9, an electronic distance sensor 31, 32 is fixed on each side of the motorcycle. A greater number of sensors may be mounted in order to improve precision and to provide redundancy. Each sensor comprises an infrared or ultrasonic transmitter, as well as a receiver for detecting the radiation reflected from the road surface. The sensors output electric signals which are proportional to the magnitude of the detected radiation. From these signals, the angle of inclination of the motorcycle can be calculated.

As shown in Fig. 10, the motorcycle further comprises an electronic control unit (ECU) 30 receiving the output from sensors 31, 32. A vehicle speed sensor 33 is also coupled to the ECU. The ECU 30 calculates the angle of inclination and registers the side to which the motorcycle is inclined. On the basis of this data, the ECU 30 then determines the appropriate angle of rotation of the light distribution pattern, and activates electric motor 18, 118 to compensate for the effect of the inclination of the motorcycle. This system is only activated when the vehicle speed is above a predetermined value such as 30 km/h.

We have performed a search for similar headlight systems and enclose copies of documents D1, D2 and D3 which were published several years ago. We hope that the above description and these documents will prove helpful in drafting a European Patent application which covers all of our configurations.

Yours sincerely
E. C. Rider
R. Lee David & Son Ltd.

Clients drawings

1/4

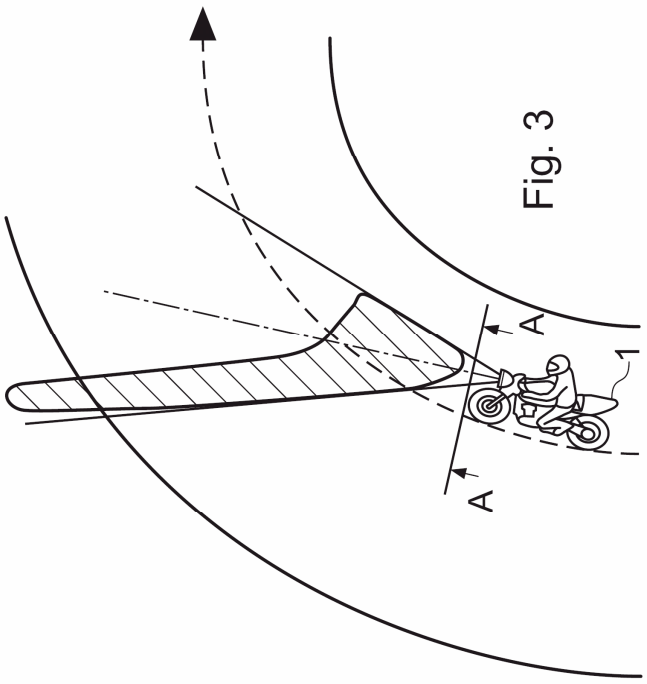


Fig. 3

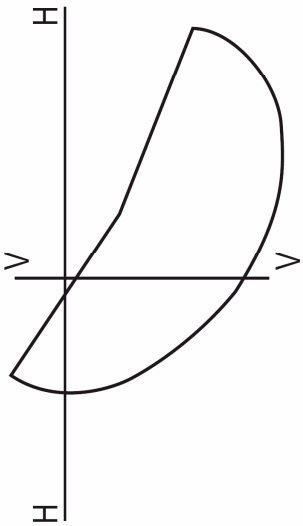


Fig. 4

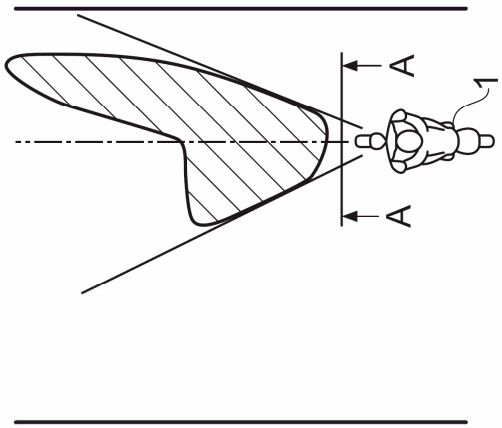


Fig. 1

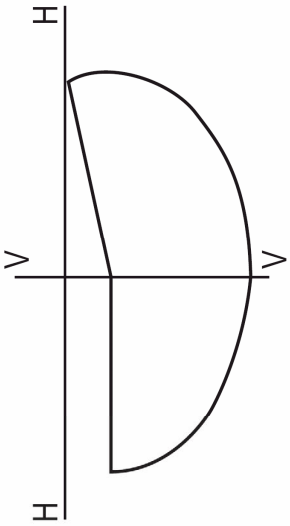


Fig. 2

2/4

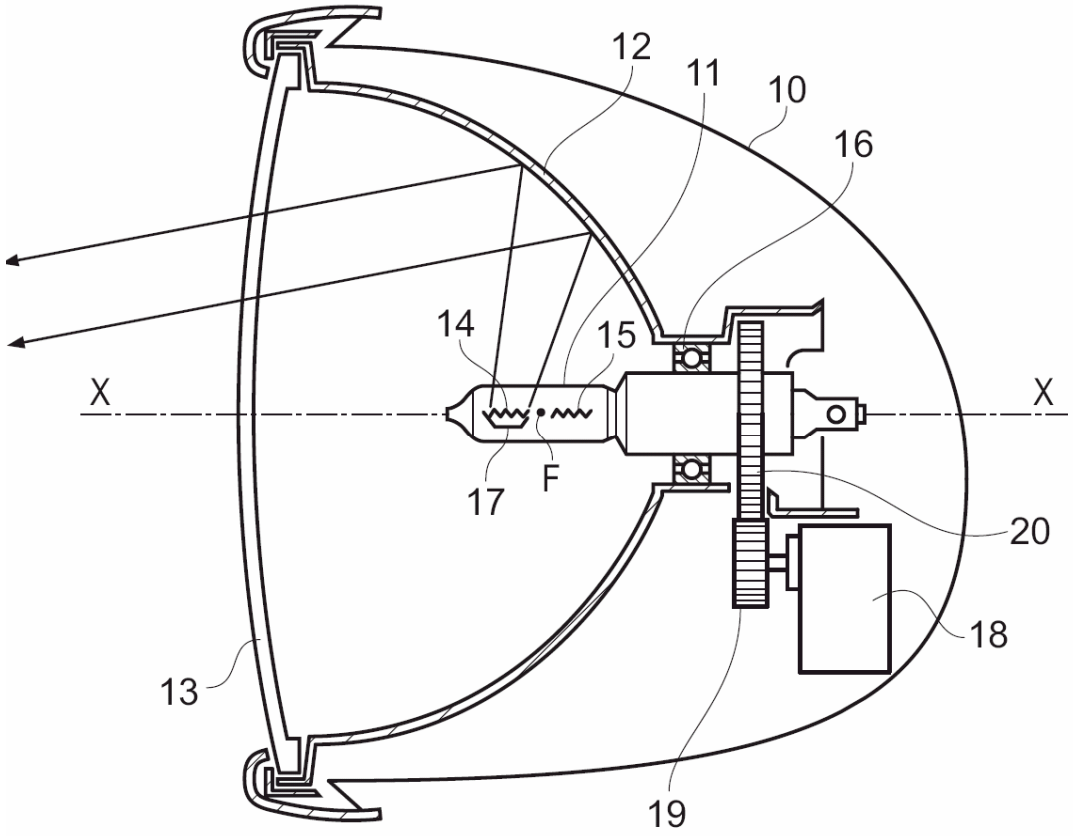


Fig. 5

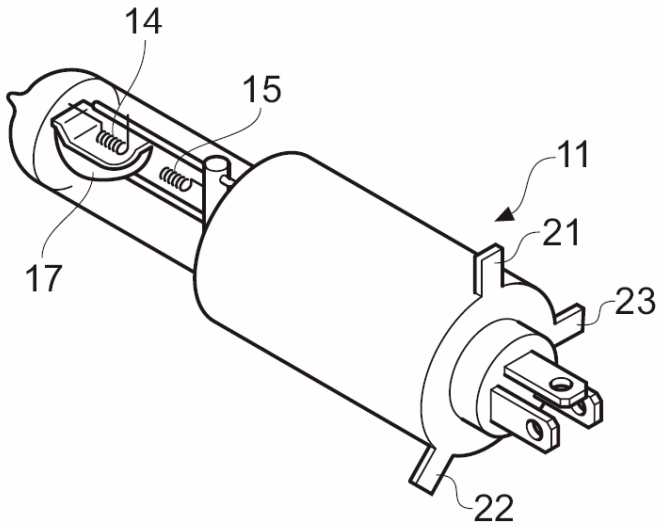


Fig. 6

3/4

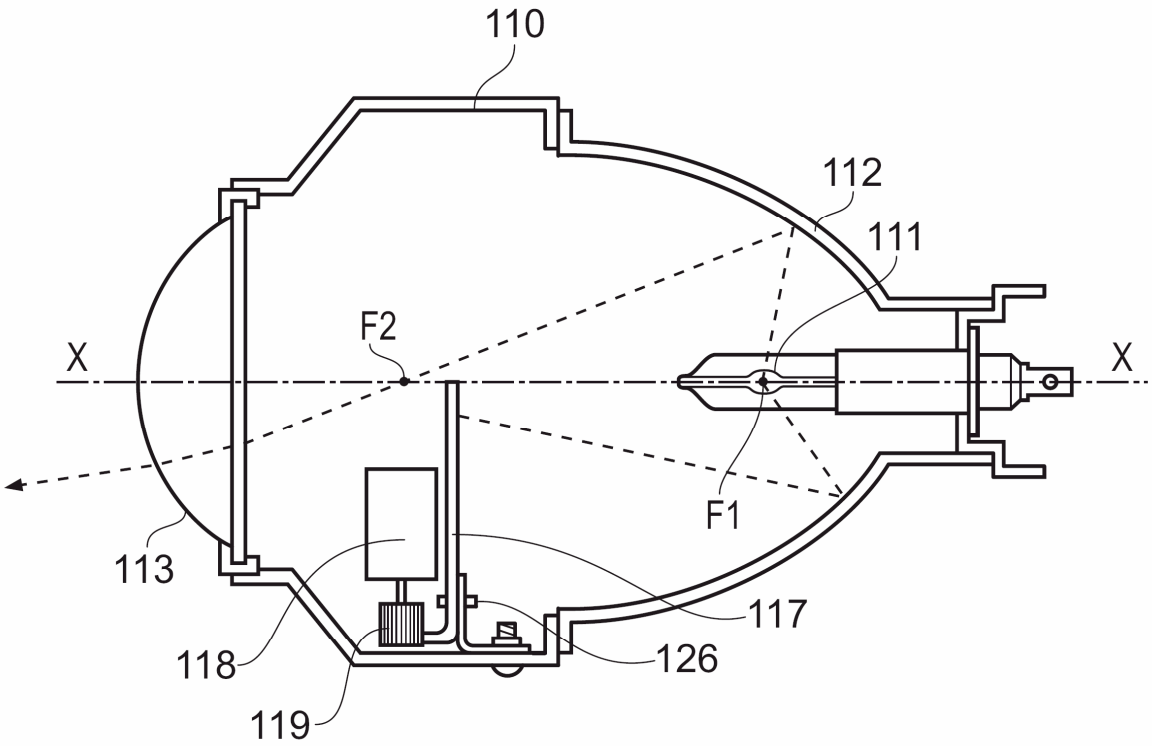


Fig. 7

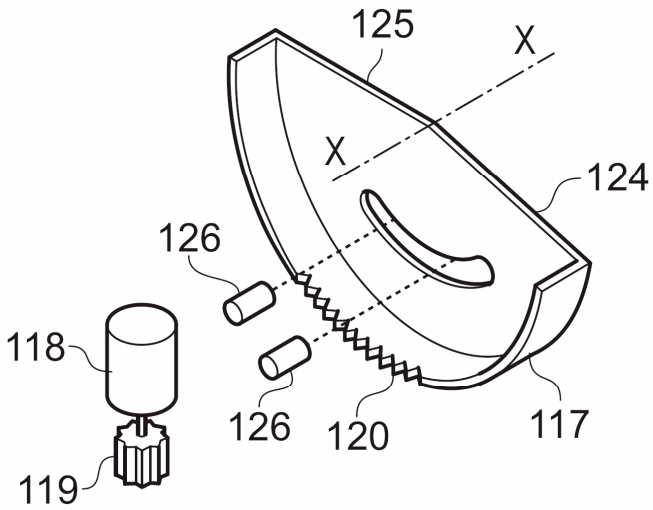


Fig. 8

4/4

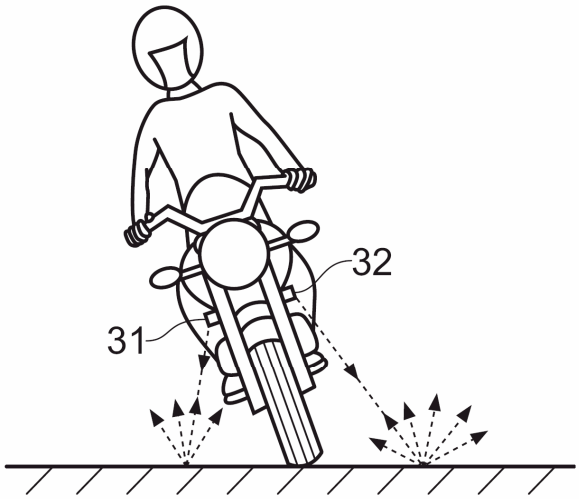


Fig. 9

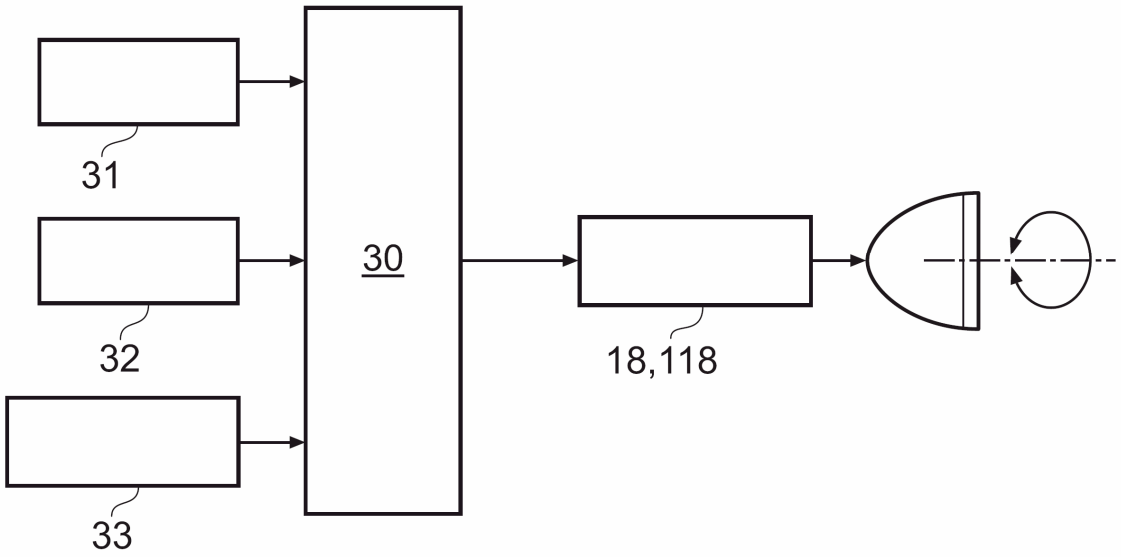


Fig. 10

Document D1 (magazine article)

The auto industry is currently working on new technology to ensure adequate road illumination when turning. Some decades ago the Citroen DS already had pivoting headlights which were mechanically linked to the steering column via a control cable. However, the installation of cables or other mechanical linkage between the steering column and the headlights is complicated. Furthermore, a lot of space is necessary for mounting all of the parts.

Today, these problems can be overcome by replacing the previous mechanical systems by electric motors and sensors. Additionally, electrical components are more accurate and reliable, and allow the use of control algorithms that take into account other parameters such as the speed of the vehicle.

Fig. 1 shows a vehicle turning. The light beam follows the direction of the turn. Fig. 2 is a simplified representation of the system used to produce this effect. For each headlight 43, this system comprises an electric motor 40, a worm gear 41,44 and a rotary shaft 42, which is linked to the headlight 43. The headlight can be rotated about a vertical axis, as indicated by the arrows. The motor is controlled by a microprocessor, such that the headlight is rotated by an adequate angle to provide optimum illumination.

Document D1 1/1

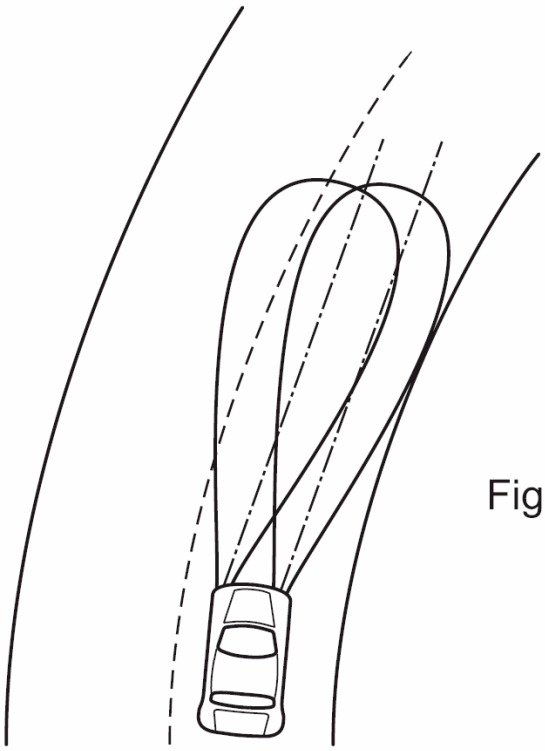


Fig. 1

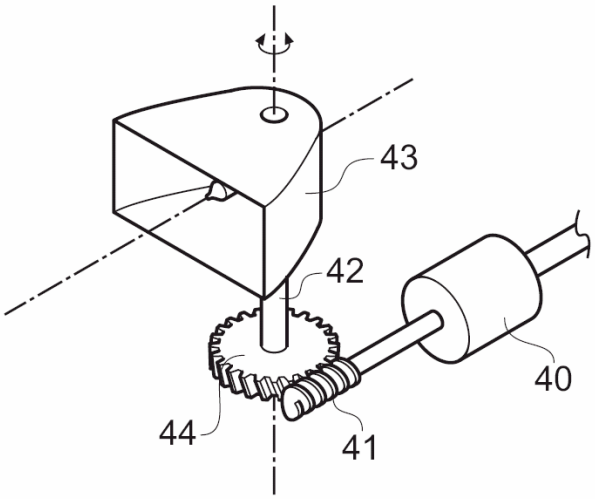


Fig. 2

Document D2 (Patent Specification)

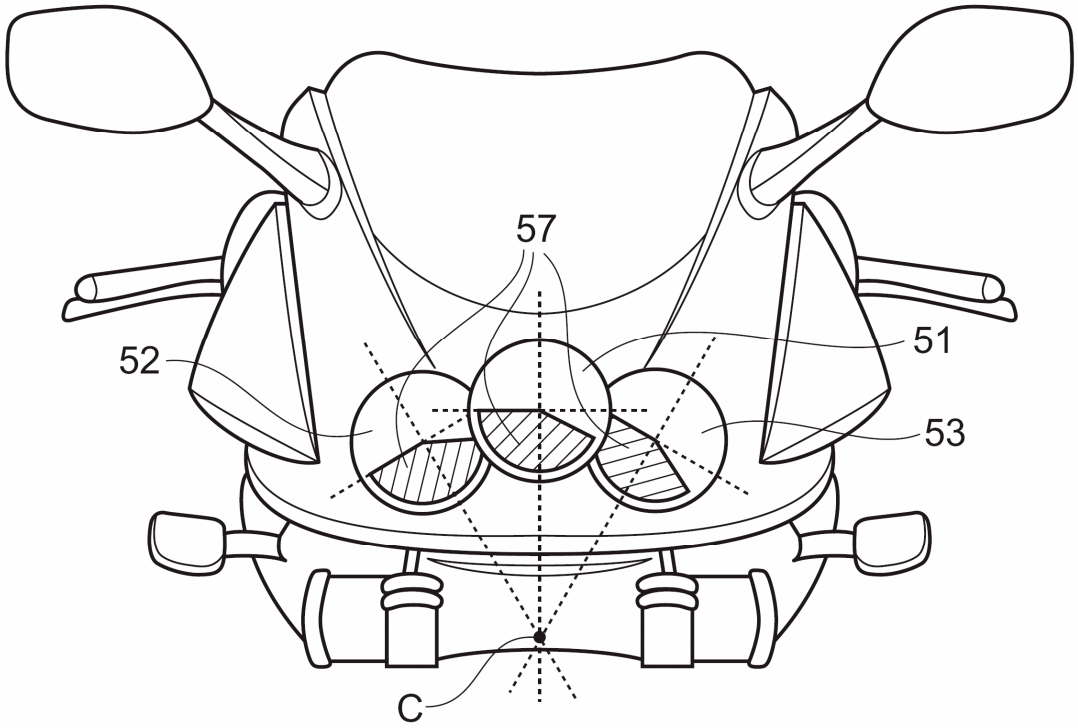
The present invention relates to the field of motorcycle lighting. A known weakness of conventional motorcycle headlights is, that when the motorcycle leans during turning, the light beam does not sufficiently illuminate the road. In the present invention, illumination during turning is improved through the use of a special headlight arrangement.

As shown in the appended drawing, the invention comprises three headlights: a central, main headlight 51 and two auxiliary headlights 52, 53. Each of the headlights 51, 52, 53 has a screen 57 for producing a low beam. The positions of the auxiliary headlights 52, 53 are determined by a theoretical rotation of the main headlight 51 around a common axis C, as shown in the drawing. As a result of this arrangement, when the motorcycle inclines by 25°, one of the auxiliary headlights 52, 53 provides substantially the same illumination as that provided by the central headlight 51 when the motorcycle is not inclined.

When the motorcycle is travelling on a straight road, only main headlight 51 is switched on. During turning, when the angle of inclination of the motorcycle exceeds a certain value, the auxiliary headlight on the opposite side to the direction of the turn is switched on and the main headlight 51 is switched off.

In order to detect the angle of inclination, an inclinometer with a gyroscope is used. However, ultrasonic distance-sensors could also be used. All output signals from these devices are sent to a microprocessor which is programmed to calculate the inclination angle of the motorcycle and control the switching of the headlights.

Document D2 1/1



Document D3 (Patent Specification)

The present invention relates to a lighting system for a two-wheeled vehicle such as a motorcycle. In general, the lighting of such a vehicle deteriorates when the vehicle makes a turn. During turning, the vehicle is inclined. The headlight, and therefore also the projected light beam, follow the inclination of the vehicle.

The object of the invention is to provide means by which the headlight of the vehicle has its orientation corrected to an appropriate extent as the vehicle turns.

As shown in the figure, a headlight comprises a reflector 61, a front lens 66 and a lamp with an integrated screen (not shown), for example a conventional halogen lamp with two filaments. The headlight is mounted in a bearing 62 for rotation about an axis Y-Y. The headlight is connected to first gear wheel 63 that cooperates with a second gear wheel 64. This second gear wheel 64 is freely rotatable about a parallel axis Y'-Y' and is provided at a radially outer portion with a weight 65.

When the vehicle starts to turn, the weight 65 causes rotation of the second gear wheel 64. As indicated by the arrows, this causes rotation of the first gear wheel 63 and thus of the headlight in the required direction.

Due to its size, this arrangement will not fit into a conventional headlight housing. However, a specially–constructed housing may be provided to protect all of the above components from rain and snow.

Document D3 1/1