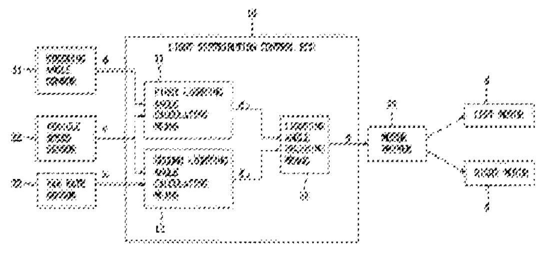
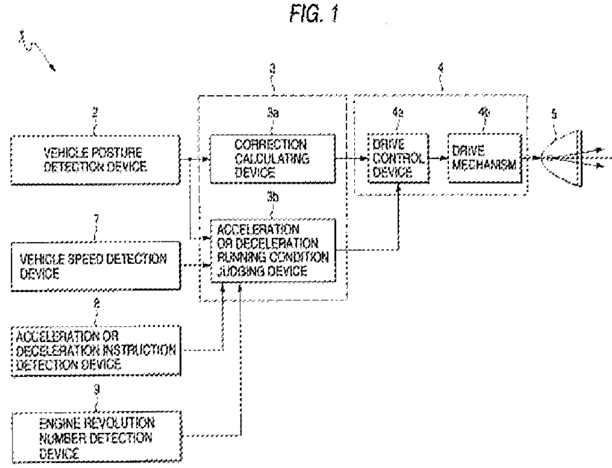
Limitation of '034 Patent Proposed Claim 9	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 773 (Uchida)
		inclination angle in the pitching direction of the vehicle (so-called pitch angle) is detected in accordance with the detect information that is detected by these height detection device, then the running condition of the vehicle can be confirmed to a certain degree."

Limitation of '034 Patent Proposed Claim 10	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 773 (Uchida)
10. The automatic directional control system defined in claim 6,	See claim 6 claim chart, above at page 435.	See claim 6 claim chart, above at page 435.
wherein said first sensor is adapted to generate a signal that is representative of a condition including the pitch of the vehicle and said second sensor is adapted to generate a signal that is representative of a condition including the road speed of the vehicle.		E.g., Page 12 line 27 to page 13, line 15 "The remaining method iv) is a method which can judge the acceleration or deceleration running condition of the vehicle based on the information that is obtained by the vehicle posture detection device 2. Generally, as a device for detecting variations in the vibration of a mechanism for absorbing the vibration that is given to the wheels of the vehicle from the surface of a road or for detecting the height of the axle of the vehicle, there is used height detection device such as a height sensor or the like. In the present method, based on the information that is obtained from the height detection device, the time differential of the detected level or the absolute value thereof is calculated and, after then, by comparing the resultant value with a given reference value, it is possible to judge whether the vehicle is in the

Limitation of '034 Patent Proposed Claim 10	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 773 (Uchida)
		acceleration or deceleration running condition or not. Also, if a plurality of height detection device are arranged at several positions of the vehicle, for example, in the front and rear portions thereof and/or right and left portions thereof and the inclination angle in the pitching direction of the vehicle (so-called pitch angle) is detected in accordance with the detect information that is detected by these height detection device, then the running condition of the vehicle can be confirmed to a certain degree." E.g., Page 9, lines 13 to 23, "At first, the judging method in the acceleration or deceleration running condition judging device 3b will be described by classifying it into the following four methods: i) a method using the vehicle speed detection device; ii) a method using the acceleration or deceleration instruction detection device 8; iii) a method using the engine revolution number detection device 9; and iv) a method using the vehicle posture detection device 2." E.g., Page 9, lines 24 to 28 "Firstly, the method i) is a method which judges whether the vehicle is in the acceleration or deceleration running condition or not by detecting the running speed of the vehicle to calculate the change of the speed with time, that is, by calculating the acceleration of the vehicle."

Limitation of '034 Patent Proposed Claim 11	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 773 (Uchida)
11. The automatic directional control system defined in claim 6,	See claim 6 claim chart, above at page 435.	See claim 6 claim chart, above at page 435.
wherein said first sensor is physically separate from said second sensor.	E.g., col. 4, lines 61 to 67, "Fig. 3 is a rough block diagram showing a control system for changing the lighting region in the present embodiment. The vehicle has a steering angle sensor 21 for detecting a direction of a front wheel with respect to the vehicle body, i.e. a steering angle φ, a vehicle speed sensor 22 for detecting a vehicle speed v and a yaw rate sensor 23 for detecting a yaw angular velocity (yaw rate) ω." E.g., Figure 3  FIG. 3	E.g., page 6, line 30 to page 7, line 3, "In order for the vehicle posture detection device and the acceleration or deceleration running condition judging device to transmit signals to one another, they must be separate: "The outputs of the vehicle posture detection device 2 are transmitted to the correction calculating device 3a and acceleration or deceleration running condition judging device 3b which cooperate together in forming the control device 3, and these outputs are used as control signals to be applied to the drive device 4 and are then used as instructions for correcting the illumination of lamp 5." E.g., Fig. 1: FIG. 1 

Limitation of '034 Patent Proposed Claim 12	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 773 (Uchida)
12. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 426.	See claim 1 claim chart, above at page 426.
wherein said sensed conditions further include one or more of a rate of change of road speed of the vehicle, a rate of change of steering angle of the vehicle, a rate of change of pitch of the vehicle, or a rate of change of suspension height of the vehicle.		E.g., Page 12 line 27 to page 13, line 15 "The remaining method iv) is a method which can judge the acceleration or deceleration running condition of the vehicle based on the information that is obtained by the vehicle posture detection device 2. Generally, as a device for detecting variations in the vibration of a mechanism for absorbing the vibration that is given to the wheels of the vehicle from the surface of a road or for detecting the height of the axle of the vehicle, there is used height detection device such as a height sensor or the like. In the present method, based on the information that is obtained from the height detection device, the time differential of the detected level or the absolute value thereof is calculated and, after then, by comparing the resultant value with a given reference value, it is possible to judge whether the vehicle is in the acceleration or deceleration running condition or not. Also, if a plurality of height detection device are arranged at several positions of the vehicle, for example, in the front and rear portions thereof and/or right and left portions thereof and the inclination angle in the pitching direction of the vehicle (so-called pitch angle) is detected in accordance with the detect information that is detected by these height detection device, then the

Limitation of '034 Patent Proposed Claim 12	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 773 (Uchida)
		running condition of the vehicle can be confirmed to a certain degree."

Limitation of '034 Patent Proposed Claim 13	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 773 (Uchida)
13. The automatic directional control system defined in claim 12,	See claim 12 claim chart, above at page 443.	See claim 12 claim chart, above at page 443.
wherein at least one of said two or more sensors generate a signal that is representative of the rate of change of road speed of the vehicle.	E.g., col. 4, lines 61 to 67, "Fig. 3 is a rough block diagram showing a control system for changing the lighting region in the present embodiment. The vehicle has a steering angle sensor 21 for detecting a direction of a front wheel with respect to the vehicle body, i.e. a steering angle φ, a vehicle speed sensor 22 for detecting a vehicle speed v and a yaw rate sensor 23 for detecting a yaw angular velocity (yaw rate) ω."	E.g., Page 12 line 27 to page 13, line 15 "The remaining method iv) is a method which can judge the acceleration or deceleration running condition of the vehicle based on the information that is obtained by the vehicle posture detection device 2. Generally, as a device for detecting variations in the vibration of a mechanism for absorbing the vibration that is given to the wheels of the vehicle from the surface of a road or for detecting the height of the axle of the vehicle, there is used height detection device such as a height sensor or the like. In the present method, based on the information that is obtained from the height detection device, the time differential of the detected level or the absolute value thereof is calculated and, after then, by comparing the resultant value with a given reference value, it is possible to judge whether the vehicle is in the acceleration or deceleration running condition or not. Also, if a plurality of height detection device are arranged at several positions of the vehicle, for example, in the front and rear portions thereof

Limitation of ’034 Patent Proposed Claim 13	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 773 (Uchida)
		and/or right and left portions thereof and the inclination angle in the pitching direction of the vehicle (so-called pitch angle) is detected in accordance with the detect information that is detected by these height detection device, then the running condition of the vehicle can be confirmed to a certain degree.”

Limitation of ’034 Patent Proposed Claim 20	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 773 (Uchida)
20. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 426.	See claim 1 claim chart, above at page 426.
wherein the at least one actuator includes an electronically controlled mechanical actuator.		E.g., page 19, lines 6 to 22 "For example, when the actuator incorporates therein a DC (direct current) motor, a difference between the control target position (or angle) of the actuator and the current position (or angle) thereof is detected, and a pulse signal having a duty cycle corresponding to the detected position difference is supplied to the DC motor to thereby control the position of the actuator, as shown in Fig. 11, if the characteristic of the duty cycle DT with respect to the position difference δxx is changed from the state of a relatively faster response speed shown by a broken line 10 to the state of a slow response speed shown by a solid line 11, with respect to the same position difference δxx=δxxa, the duty cycle DT in the other running conditions of the vehicle than the acceleration or deceleration running condition

Limitation of '034 Patent Proposed Claim 20	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 773 (Uchida)
		thereof is smaller than the duty cycle in the acceleration or deceleration running condition of the vehicle, so that the drive control on the lamp 5 by the actuator is slowed down."

Limitation of '034 Patent Proposed Claim 22	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 773 (Uchida)
22. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 426.	See claim 1 claim chart, above at page 426.
wherein the at least one actuator includes a servo motor.		E.g., page 19, lines 6 to 22 "For example, when the actuator incorporates therein a DC (direct current) motor, a difference between the control target position (or angle) of the actuator and the current position (or angle) thereof is detected, and a pulse signal having a duty cycle corresponding to the detected position difference is supplied to the DC motor to thereby control the position of the actuator, as shown in Fig. 11, if the characteristic of the duty cycle DT with respect to the position difference δxx is changed from the state of a relatively faster response speed shown by a broken line 10 to the state of a slow response speed shown by a solid line 11, with respect to the same position difference δxx=δxxa, the duty cycle DT in the other running conditions of the vehicle than the acceleration or deceleration running condition thereof is smaller than the duty cycle in the acceleration or deceleration running condition of the vehicle, so that the drive control on the lamp 5

Limitation of '034 Patent Proposed Claim 22	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 773 (Uchida)
		by the actuator is slowed down."

Limitation of '034 Patent Proposed Claim 24	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 773 (Uchida)
24. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 426.	See claim 1 claim chart, above at page 426.
wherein the automatic directional control system is configured such that the headlight is adjustably mounted on the vehicle such that a directional orientation at which a beam of light projects therefrom is capable of being adjusted relative to the vehicle.	E.g., col. 4, lines 32 to 38, "The vehicle 1 of the preferred embodiment has head lights 2 for lighting the space in front of the vehicle installed such that they are swingable in rightward and leftward horizontal directions. FIG. 1 is a view showing the vehicle 1 from above and in this figure, the right and left head lights 2,2 are swung rightward so as to cause the right forward regions to become lighting regions 3, 3."	E.g., page 16, lines 6 to 15 "The simplest method for changing the illumination pattern of the lamp 5 in a vertical plane is a method which changes the illumination angle of the lamp 5 with respect to a horizontal plane by rotating the entire lamp 5 about the rotary shaft thereof. For example, the right and left side surfaces of the lamp 5 are supported in a freely rotatable manner and the rotary shaft of the lamp 5 is rotated directly by a drive source such as a motor or the like, or, there is available a drive mechanism in which a member fixed to the lamp 5 or formed integrally with the lamp 5 is rotated by the drive device 4."

Limitation of '034 Patent Proposed Claim 25	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 773 (Uchida)
25. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 426.	See claim 1 claim chart, above at page 426.
wherein the automatic directional control system is configured such that the headlight is adjustably		E.g., page 16, lines 6 to 15 "The simplest method for changing the illumination pattern of the lamp 5

Limitation of '034 Patent Proposed Claim 25	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 773 (Uchida)
mounted on the vehicle such that a directional orientation at which a beam of light projects therefrom is capable of being adjusted up and down relative to a horizontal reference position.		in a vertical plane is a method which changes the illumination angle of the lamp 5 with respect to a horizontal plane by rotating the entire lamp 5 about the rotary shaft thereof. For example, the right and left side surfaces of the lamp 5 are supported in a freely rotatable manner and the rotary shaft of the lamp 5 is rotated directly by a drive source such as a motor or the like, or, there is available a drive mechanism in which a member fixed to the lamp 5 or formed integrally with the lamp 5 is rotated by the drive device 4."

Limitation of '034 Patent Proposed Claim 26	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 773 (Uchida)
26. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 426.	See claim 1 claim chart, above at page 426.
wherein the automatic directional control system is configured such that the headlight is adjustably mounted on the vehicle such that a directional orientation at which a beam of light projects therefrom is capable of being adjusted left and right relative to a vertical reference position.	E.g., col. 4, lines 32 to 38, "The vehicle 1 of the preferred embodiment has head lights 2 for lighting the space in front of the vehicle installed such that they are swingable in rightward and leftward horizontal directions. FIG. 1 is a view showing the vehicle 1 from above and in this figure, the right and left head lights 2,2 are swung rightward so as to cause the right forward regions to become lighting regions 3, 3."	

Limitation of '034 Patent Proposed Claim 28	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 773 (Uchida)
28. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 426.	See claim 1 claim chart, above at page 426.
wherein the automatic directional control system is configured such that the controller includes a microprocessor.	E.g., col. 4, lines 56 to 60, "Accordingly, the lamp unit 4 is swung together with the rotary shaft 5 through an engagement between the worm gear 7 and the worm wheel 6 under a driving of the motor 8. The motor 8 is controlled for its driving by a light distribution control ECU 10."	

Limitation of '034 Patent Proposed Claim 29	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 773 (Uchida)
29. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 426.	See claim 1 claim chart, above at page 426.
wherein the automatic directional control system is configured such that the controller includes a programmable electronic controller.	E.g., col. 4, lines 56 to 60, "Accordingly, the lamp unit 4 is swung together with the rotary shaft 5 through an engagement between the worm gear 7 and the worm wheel 6 under a driving of the motor 8. The motor 8 is controlled for its driving by a light distribution control ECU 10."	

Limitation of '034 Patent Proposed Claim 37	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 773 (Uchida)
37. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 426.	See claim 1 claim chart, above at page 426.
wherein the automatic directional control system is		E.g., Page 12 line 27 to page 13, line 15 "The

Limitation of '034 Patent Proposed Claim 37	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 773 (Uchida)
configured such that the pitch of the vehicle is capable of being determined by sensing a front and a rear suspension height of the vehicle.		remaining method iv) is a method which can judge the acceleration or deceleration running condition of the vehicle based on the information that is obtained by the vehicle posture detection device 2. Generally, as a device for detecting variations in the vibration of a mechanism for absorbing the vibration that is given to the wheels of the vehicle from the surface of a road or for detecting the height of the axle of the vehicle, there is used height detection device such as a height sensor or the like. In the present method, based on the information that is obtained from the height detection device, the time differential of the detected level or the absolute value thereof is calculated and, after then, by comparing the resultant value with a given reference value, it is possible to judge whether the vehicle is in the acceleration or deceleration running condition or not. Also, if a plurality of height detection device are arranged at several positions of the vehicle, for example, in the front and rear portions thereof and/or right and left portions thereof and the inclination angle in the pitching direction of the vehicle (so-called pitch angle) is detected in accordance with the detect information that is detected by these height detection device, then the running condition of the vehicle can be confirmed to a certain degree."

Limitation of '034 Patent Proposed Claim 38	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 773 (Uchida)
38. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 426.	See claim 1 claim chart, above at page 426.
wherein the automatic directional control system is configured such that the pitch of the vehicle is capable of being determined by a pitch level sensor.		E.g., Page 12 line 27 to page 13, line 15 "The remaining method iv) is a method which can judge the acceleration or deceleration running condition of the vehicle based on the information that is obtained by the vehicle posture detection device 2. Generally, as a device for detecting variations in the vibration of a mechanism for absorbing the vibration that is given to the wheels of the vehicle from the surface of a road or for detecting the height of the axle of the vehicle, there is used height detection device such as a height sensor or the like. In the present method, based on the information that is obtained from the height detection device, the time differential of the detected level or the absolute value thereof is calculated and, after then, by comparing the resultant value with a given reference value, it is possible to judge whether the vehicle is in the acceleration or deceleration running condition or not. Also, if a plurality of height detection device are arranged at several positions of the vehicle, for example, in the front and rear portions thereof and/or right and left portions thereof and the inclination angle in the pitching direction of the vehicle (so-called pitch angle) is detected in accordance with the detect information that is detected by these height detection device, then the running condition of the vehicle can be confirmed to a certain degree."

Limitation of '034 Patent Proposed Claim 41	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 773 (Uchida)
41. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 426.	See claim 1 claim chart, above at page 426.
wherein the automatic directional control system is configured such that the predetermined minimum threshold amount functions as a filter to minimize undesirable operation of the at least one actuator.	E.g., col. 6, line 42 to col. 7, line 2, "Referring to FIG. 8, from changes of the steering angle φ and the yaw angular velocity ω of FIGS. 7A and 7B, the following is understood. When the vehicle goes around the rightward curve, the steering wheel is turned to the right to have a positive steering angle φ at first, and the vehicle body yaws somewhat after the change of steering angle φ so that the yaw angular velocity ω increases following increase of the steering angle. In the meantime, the rear part of the vehicle is swung outside large, and therefore the driver turns the steering wheel to the left or in the opposite direction rapidly for counter-steering to recover direction of the vehicle. Namely, the steering angle φ changes from an upward incline to a downward incline in FIG. 7A. However, the yaw angular velocity ω is maintained due to inertia. Further, when the direction of the vehicle comes to show some recovery, the driver again turns the steering wheel to the right for going around the rightward curve, but he comes to carry out the counter-steering again soon after. Thus, the steering angle φ swings rightward and leftward in large variations.	E.g., page 4, lines 16 to 27, "According to the invention, when it is found that the vehicle is not in the acceleration or deceleration running condition, the control device controls the illumination direction of the lamp by fixing the direction of the illumination light of the lamp in a given direction, or by limiting the direction of the illumination light to a limited range, or by slowing down the response speed of the drive device, thereby being able to prevent the illumination direction of the lamp from being changed excessively and thus prevent the illumination direction of the lamp from being corrected excessively in the bad road running condition of the vehicle."

Limitation of '034 Patent Proposed Claim 41	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 773 (Uchida)
	However, while the steering angle φ is swinging rightward and leftward as described above, the yaw angular velocity ω is maintained at a certain angular velocity stably in general, and at a time somewhat before the vehicle passes through the curve completely, the yaw angular velocity ω comes to coincide with the steering angle φ." E.g., Col. 7, lines 34 to 39, "Since the actual light distribution control is performed on the basis of the above-mentioned final lighting angle θ, even if the steering wheel is operated rapidly for the counter-steering and the like, change of the lighting region is suppressed pertinently and the driver is given no sense of incongruity." E.g., col. 7, lines 34 to 39, "Since the actual light distribution control is performed on the basis of the above-mentioned final lighting angle 9, even 35 if the steering wheel is operated rapidly for the countersteering and the like, change of the lighting region is suppressed pertinently and the driver is given no sense of incongruity."	

Limitation of '034 Patent Proposed Claim 42	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 773 (Uchida)
42. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 426.	See claim 1 claim chart, above at page 426.
wherein said sensed conditions include three or	E.g., col. 4, lines 61 to 67, "Fig. 3 is a rough block	E.g., Page 9, lines 13 to 23, "At first, the judging

Limitation of '034 Patent Proposed Claim 42	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 773 (Uchida)
more of road speed, steering angle, pitch, and suspension height of the vehicle.	diagram showing a control system for changing the lighting region in the present embodiment. The vehicle has a steering angle sensor 21 for detecting a direction of a front wheel with respect to the vehicle body, i.e. a steering angle φ, a vehicle speed sensor 22 for detecting a vehicle speed v and a yaw rate sensor 23 for detecting a yaw angular velocity (yaw rate) ω."	method in the acceleration or deceleration running condition judging device 3b will be described by classifying it into the following four methods: i) a method using the vehicle speed detection device; ii) a method using the acceleration or deceleration instruction detection device 8; iii) a method using the engine revolution number detection device 9; and iv) a method using the vehicle posture detection device 2." E.g., Page 9, lines 24 to 28 "Firstly, the method i) is a method which judges whether the vehicle is in the acceleration or deceleration running condition or not by detecting the running speed of the vehicle to calculate the change of the speed with time, that is, by calculating the acceleration of the vehicle." E.g., Page 12 line 27 to page 13, line 15 "The remaining method iv) is a method which can judge the acceleration or deceleration running condition of the vehicle based on the information that is obtained by the vehicle posture detection device 2. Generally, as a device for detecting variations in the vibration of a mechanism for absorbing the vibration that is given to the wheels of the vehicle from the surface of a road or for detecting the height of the axle of the vehicle, there is used height detection device such as a height sensor or the like. In the present method, based on the information that is obtained from the height detection device, the time differential of the

Limitation of '034 Patent Proposed Claim 42	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 773 (Uchida)
		detected level or the absolute value thereof is calculated and, after then, by comparing the resultant value with a given reference value, it is possible to judge whether the vehicle is in the acceleration or deceleration running condition or not. Also, if a plurality of height detection device are arranged at several positions of the vehicle, for example, in the front and rear portions thereof and/or right and left portions thereof and the inclination angle in the pitching direction of the vehicle (so-called pitch angle) is detected in accordance with the detect information that is detected by these height detection device, then the running condition of the vehicle can be confirmed to a certain degree." E.g., page 15, line 30 to page 16, line 2 "As has been described above, according to the respective methods, it is possible to judge whether the vehicle is running in the acceleration condition or in the deceleration condition. Also, these methods can be applied in various manners, for example, the respective methods can be used individually, or some of them may be combined together for the enhanced accuracy of the judgment."

Limitation of '034 Patent Proposed Claim 43	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 773 (Uchida)
43. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 426.	See claim 1 claim chart, above at page 426.

Limitation of '034 Patent Proposed Claim 43	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 773 (Uchida)
wherein said sensed conditions include all four of road speed, steering angle, pitch, and suspension height of the vehicle.	E.g., col. 4, lines 61 to 67, "Fig. 3 is a rough block diagram showing a control system for changing the lighting region in the present embodiment. The vehicle has a steering angle sensor 21 for detecting a direction of a front wheel with respect to the vehicle body, i.e. a steering angle φ, a vehicle speed sensor 22 for detecting a vehicle speed v and a yaw rate sensor 23 for detecting a yaw angular velocity (yaw rate) ω."	E.g., Page 9, lines 13 to 23, "At first, the judging method in the acceleration or deceleration running condition judging device 3b will be described by classifying it into the following four methods: i) a method using the vehicle speed detection device; ii) a method using the acceleration or deceleration instruction detection device 8; iii) a method using the engine revolution number detection device 9; and iv) a method using the vehicle posture detection device 2." E.g., Page 9, lines 24 to 28 "Firstly, the method i) is a method which judges whether the vehicle is in the acceleration or deceleration running condition or not by detecting the running speed of the vehicle to calculate the change of the speed with time, that is, by calculating the acceleration of the vehicle." E.g., Page 12 line 27 to page 13, line 15 "The remaining method iv) is a method which can judge the acceleration or deceleration running condition of the vehicle based on the information that is obtained by the vehicle posture detection device 2. Generally, as a device for detecting variations in the vibration of a mechanism for absorbing the vibration that is given to the wheels of the vehicle from the surface of a road or for detecting the height of the axle of the vehicle, there is used height detection device such as a height sensor or the like. In the present method, based on the information that is obtained from the height

Limitation of '034 Patent Proposed Claim 43	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 773 (Uchida)
		detection device, the time differential of the detected level or the absolute value thereof is calculated and, after then, by comparing the resultant value with a given reference value, it is possible to judge whether the vehicle is in the acceleration or deceleration running condition or not. Also, if a plurality of height detection device are arranged at several positions of the vehicle, for example, in the front and rear portions thereof and/or right and left portions thereof and the inclination angle in the pitching direction of the vehicle (so-called pitch angle) is detected in accordance with the detect information that is detected by these height detection device, then the running condition of the vehicle can be confirmed to a certain degree." E.g., page 15, line 30 to page, 16, line 2 "As has been described above, according to the respective methods, it is possible to judge whether the vehicle is running in the acceleration condition or in the deceleration condition. Also, these methods can be applied in various manners, for example, the respective methods can be used individually, or some of them may be combined together for the enhanced accuracy of the judgment."

Limitation of '034 Patent Proposed Claim 44	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 773 (Uchida)
44. The automatic directional control system	See claim 1 claim chart, above at page 426.	See claim 1 claim chart, above at page 426.

Limitation of '034 Patent Proposed Claim 44	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 773 (Uchida)
defined in claim 1,		
wherein said controller is configured to be responsive to said two or more sensor signals for generating at least one output signal only when said at least one of the two or more sensor signals changes by more than a predetermined minimum threshold amount to prevent at least one actuator from being operated continuously in response to relatively small variations in the sensed operating conditions.	E.g., col. 6, line 42 to col. 7, line 2, "Referring to FIG. 8, from changes of the steering angle φ and the yaw angular velocity ω of FIGS. 7A and 7B, the following is understood. When the vehicle goes around the rightward curve, the steering wheel is turned to the right to have a positive steering angle φ at first, and the vehicle body yaws somewhat after the change of steering angle φ so that the yaw angular velocity ω increases following increase of the steering angle. In the meantime, the rear part of the vehicle is swung outside large, and therefore the driver turns the steering wheel to the left or in the opposite direction rapidly for counter-steering to recover direction of the vehicle. Namely, the steering angle φ changes from an upward incline to a downward incline in FIG. 7A. However, the yaw angular velocity ω is maintained due to inertia. Further, when the direction of the vehicle comes to show some recovery, the driver again turns the steering wheel to the right for going around the rightward curve, but he comes to carry out the counter-steering again soon after. Thus, the steering angle φ swings rightward and leftward in large variations. However, while the steering angle φ is swinging rightward and leftward as described above, the	E.g., page 4, lines 16 to 27 "According to the invention, when it is found that the vehicle is not in the acceleration or deceleration running condition, the control device controls the illumination direction of the lamp by fixing the direction of the illumination light of the lamp in a given direction, or by limiting the direction of the illumination light to a limited range, or by slowing down the response speed of the drive device, thereby being able to prevent the illumination direction of the lamp from being changed excessively and thus prevent the illumination direction of the lamp from being corrected excessively in the bad road running condition of the vehicle."

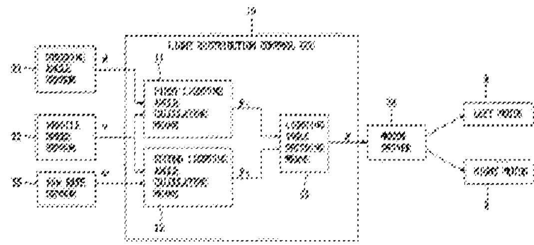
Limitation of '034 Patent Proposed Claim 44	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 773 (Uchida)
	yaw angular velocity ω is maintained at a certain angular velocity stably in general, and at a time somewhat before the vehicle passes through the curve completely, the yaw angular velocity ω comes to coincide with the steering angle φ." E.g., col. 7, lines 34 to 39, "Since the actual light distribution control is performed on the basis of the above-mentioned final lighting angle 9, even if the steering wheel is operated rapidly for the countersteering and the like, change of the lighting region is suppressed pertinently and the driver is given no sense of incongruity."	

Limitation of '034 Patent Proposed Claim 45	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 773 (Uchida)
45. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 426.	See claim 1 claim chart, above at page 426.
wherein controller is configured to be responsive to said two or more sensor signals for generating at least one output signal only when said at least one of the two or more sensor signals changes by more than a predetermined minimum threshold amount to prevent at least one actuator from being operated unduly frequently in response to relatively small variations in the sensed operating conditions.	E.g., col. 6, line 42 to col. 7, line 2, "Referring to FIG. 8, from changes of the steering angle φ and the yaw angular velocity ω of FIGS. 7A and 7B, the following is understood. When the vehicle goes around the rightward curve, the steering wheel is turned to the right to have a positive steering angle φ at first, and the vehicle body yaws somewhat after the change of steering angle φ so that the yaw angular velocity ω increases following increase of the steering angle.	E.g., page 4, lines 16 to 27 "According to the invention, when it is found that the vehicle is not in the acceleration or deceleration running condition, the control device controls the illumination direction of the lamp by fixing the direction of the illumination light of the lamp in a given direction, or by limiting the direction of the illumination light to a limited range, or by slowing down the response speed of the drive device, thereby being able to prevent the illumination direction of the lamp from being changed

Limitation of '034 Patent Proposed Claim 45	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 773 (Uchida)
	In the meantime, the rear part of the vehicle is swung outside large, and therefore the driver turns the steering wheel to the left or in the opposite direction rapidly for counter-steering to recover direction of the vehicle. Namely, the steering angle φ changes from an upward incline to a downward incline in FIG. 7A. However, the yaw angular velocity ω is maintained due to inertia. Further, when the direction of the vehicle comes to show some recovery, the driver again turns the steering wheel to the right for going around the rightward curve, but he comes to carry out the counter-steering again soon after. Thus, the steering angle φ swings rightward and leftward in large variations. However, while the steering angle φ is swinging rightward and leftward as described above, the yaw angular velocity ω is maintained at a certain angular velocity stably in general, and at a time somewhat before the vehicle passes through the curve completely, the yaw angular velocity ω comes to coincide with the steering angle φ." E.g., col. 7, lines 34 to 39, "Since the actual light distribution control is performed on the basis of the above-mentioned final lighting angle 9, even 35 if the steering wheel is operated rapidly for the countersteering and the like, change of the lighting region is suppressed pertinently and the driver is given no sense of incongruity."	excessively and thus prevent the illumination direction of the lamp from being corrected excessively in the bad road running condition of the vehicle."

31. Proposed Claims 1 to 12, 14, 16 to 18, 20 to 22, 24 to 26, 28, 29, 33, 34, 37, 38, and 41 to 45 Are Unpatentable Over the Combination of Gotoh and Takahashi Under 35 U.S.C. § 103(a)

Limitation of '034 Patent Proposed Claim 1	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
1. An automatic directional control system for a vehicle headlight, comprising:	E.g., Abstract, "A head lamp device for a vehicle capable of changing a lighting region in front of the vehicle in right and left directions, in which change of the lighting region is suppressed so as not to give the driver a sense of incongruity when a steering wheel is operated in one direction and then rapidly in the other as in case of counter-steering."	E.g., page 2, lines 6 to 13 "Therefore, there is conventionally known a device which includes a device for detecting the posture of the vehicle by detecting the inclination and height of a vehicle body, and calculates the amount of variations in the inclination of the vehicle based on the information that is obtained by the detect device, thereby being able to adjust automatically the illumination direction of the lamp."
two or more sensors that are each adapted to generate a signal that is representative of a condition of a vehicle, said sensed conditions including two or more of road speed, steering angle, pitch, and suspension height of the vehicle;	E.g., col. 4, lines 61 to 67, "Fig. 3 is a rough block diagram showing a control system for changing the lighting region in the present embodiment. The vehicle has a steering angle sensor 21 for detecting a direction of a front wheel with respect to the vehicle body, i.e. a steering angle φ, a vehicle speed sensor 22 for detecting a vehicle speed v and a yaw rate sensor 23 for detecting a yaw angular velocity (yaw rate) ω." E.g., Figure 3	E.g., page 5, line 30 to page 6, line 9 "The vehicle posture detection device 2 is used to detect the posture of a vehicle (including the vertical inclination of the vehicle in the advancing direction thereof). For example, when there is used height detection device 7 which detects the height of the body of the vehicle, as shown in Fig. 2, there are available a method which measures a distance L between the height detection device 7 and a road surface G by use of detect waves such as ultrasonic waves, laser beams or the like, and a method in which the height detection device 7 detects the expansion and contraction amount x of a suspension S in order to detect the amount of variations in the vertical position of the axle of the vehicle." E.g., page 6, lines 16 to 25 "The vehicle running condition detection device 4 is used to detect the

Limitation of '034 Patent Proposed Claim 1	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
	 FIG. 5	running conditions of the vehicle (including the stopping or stationary condition thereof), while the detect signal of the vehicle running condition detection device 3 is transmitted to the control device 4. As the vehicle running condition detection device 3, for example, there can be used vehicle speed detection device which is one of the existing facilities of the vehicle. Also, every kind of information can be used, provided that it can be used to detect the running conditions of the vehicle." E.g., page 2, lines 6 to 13 "Therefore, there is conventionally known a device which includes a device for detecting the posture of the vehicle by detecting the inclination and height of a vehicle body, and calculates the amount of variations in the inclination of the vehicle based on the information that is obtained by the detect device, thereby being able to adjust automatically the illumination direction of the lamp." E.g., page 5, line 30 to page 6, line 9 "The vehicle posture detection device 2 is used to detect the posture of a vehicle (including the vertical inclination of the vehicle in the advancing direction thereof). For example, when there is used height detection device 7 which detects the height of the body of the vehicle, as shown in Fig. 2, there are available a method which measures a distance L between the height detection device 7 and a road surface G by use of detect waves such

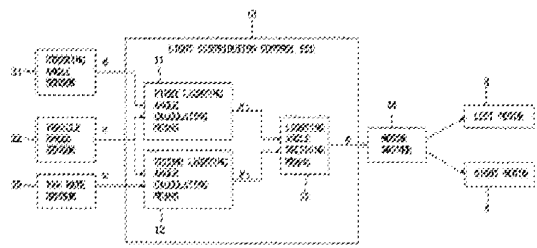
Limitation of '034 Patent Proposed Claim 1	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
		as ultrasonic waves, laser beams or the like, and a method in which the height detection device 7 detects the expansion and contraction amount x of a suspension S in order to detect the amount of variations in the vertical position of the axle of the vehicle."
a controller that is responsive to said two or more sensor signals for generating at least one output signal	E.g., Col. 4, lines 59 to 60, "The motor 8 is controlled for its driving by a light distribution control ECU 10."	E.g., page 8, lines 26 to 32 "Therefore, when the amount of variations with time of the detect signal of the vehicle posture detect signal 2 is equal to or larger than a reference value, it may be judged that the gradient of the road has varied, and the illumination direction of the lamp 6 may be corrected in accordance with the detect signal of the vehicle posture detection device 2." E.g., page 9, lines 16 to 34 "Also, in order to prevent the illumination direction of the lamp 6 from being corrected inadvertently when a sudden change in the posture of the vehicle occurs temporarily or due to the wrong operation of the lamp 6 caused by external disturbances, for example, when the vehicle makes a sudden start or a sudden stop, preferably, a threshold value with respect to time may be set in detection of the road gradient and, only when the amount of variations in the detect signal of the vehicle posture detection device 2 exceeds a given reference value and such excessive state continues for a time equal to or more than the threshold value, the illumination direction of the lamp 6 may be corrected; or, a threshold value with respect to the running

Limitation of '034 Patent Proposed Claim 1	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
		distance of the vehicle may be set and, only when the amount of variations in the detect signal of the vehicle posture detection device 2 exceeds a given reference value and such excessive state continues for a distance equal to or more than the threshold value, the illumination direction of the lamp 6 may be corrected."
only when said at least one of the two or more sensor signals changes by more than a predetermined minimum threshold amount to prevent at least one actuator from being operated continuously or unduly frequently in response to relatively small variations in the sensed operating conditions; and	E.g., col. 6, line 42 to col. 7, line 2, "Referring to FIG. 8, from changes of the steering angle φ and the yaw angular velocity ω of FIGS. 7A and 7B, the following is understood. When the vehicle goes around the rightward curve, the steering wheel is turned to the right to have a positive steering angle φ at first, and the vehicle body yaws somewhat after the change of steering angle φ so that the yaw angular velocity ω increases following increase of the steering angle. In the meantime, the rear part of the vehicle is swung outside large, and therefore the driver turns the steering wheel to the left or in the opposite direction rapidly for counter-steering to recover direction of the vehicle. Namely, the steering angle φ changes from an upward incline to a downward incline in FIG. 7A. However, the yaw angular velocity ω is maintained due to inertia. Further, when the direction of the vehicle comes to show some recovery, the driver again turns the steering wheel to the right for going around the rightward curve, but he comes to carry out the	E.g., page 8, lines 26 to 32 "Therefore, when the amount of variations with time of the detect signal of the vehicle posture detect signal 2 is equal to or larger than a reference value, it may be judged that the gradient of the road has varied, and the illumination direction of the lamp 6 may be corrected in accordance with the detect signal of the vehicle posture detection device 2." E.g., page 9, lines 16 to 34 "Also, in order to prevent the illumination direction of the lamp 6 from being corrected inadvertently when a sudden change in the posture of the vehicle occurs temporarily or due to the wrong operation of the lamp 6 caused by external disturbances, for example, when the vehicle makes a sudden start or a sudden stop, preferably, a threshold value with respect to time may be set in detection of the road gradient and, only when the amount of variations in the detect signal of the vehicle posture detection device 2 exceeds a given reference value and such excessive state continues for a time equal to or more than the threshold value, the illumination direction of the lamp 6 may be corrected; or, a

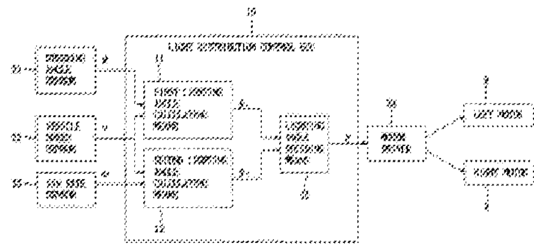
Limitation of '034 Patent Proposed Claim 1	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
	counter-steering again soon after. Thus, the steering angle φ swings rightward and leftward in large variations. However, while the steering angle φ is swinging rightward and leftward as described above, the yaw angular velocity ω is maintained at a certain angular velocity stably in general, and at a time somewhat before the vehicle passes through the curve completely, the yaw angular velocity ω comes to coincide with the steering angle φ." E.g., Col. 7, lines 34 to 39, "Since the actual light distribution control is performed on the basis of the above-mentioned final lighting angle θ, even if the steering wheel is operated rapidly for the counter-steering and the like, change of the lighting region is suppressed pertinently and the driver is given no sense of incongruity."	threshold value with respect to the running distance of the vehicle may be set and, only when the amount of variations in the detect signal of the vehicle posture detection device 2 exceeds a given reference value and such excessive state continues for a distance equal to or more than the threshold value, the illumination direction of the lamp 6 may be corrected."
said at least one actuator being adapted to be connected to the headlight to effect movement thereof in accordance with said at least one output signal.		E.g., page 2, lines 14 to 17 "However, in the above-mentioned automatic adjustment device, since the lamp is driven with high frequency, an actuator used in a drive mechanism for driving the lamp is required to show high response property and high durability." E.g., page 6, lines 26 to 32 "When the control device 4 receives the detect signal of the vehicle running condition detection device 3 and finds from this detect signal that the vehicle is standing still, the control device 4, in accordance with

Limitation of '034 Patent Proposed Claim 1	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
		information on the vehicle posture obtained from the vehicle posture detection device 2, transmits to the drive signal 5 a control signal for correction of the illumination direction of the lamp 6." E.g., page 7, lines 12 to 17 "In view of this, the control device 4 is structured such that, based on the information from the vehicle posture detection device 2, it can detect the amount of variations in the gradient of the road and, therefore, when the road gradient varies suddenly, it can correct the illumination direction of the lamp 6." E.g., page 11, lines 12 to 16, "The correction of the illumination direction of the lamp 6 in Step S5 is carried out by the drive device 5 based on the control signal transmitted from the control device 4 and, as a method for executing such correction, there are available two methods as follows: 1) a method for inclining the entire lamp, and, 2) a method for moving the component (such as a lens, a reflector, a shade or the like) of the optical system of the lamp."

Limitation of '034 Patent Proposed Claim 2	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
2. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 461.	See claim 1 claim chart, above at page 461.
wherein at least one of said two or more sensors generates a signal that is representative of the road	E.g., col. 4, lines 61 to 67, "Fig. 3 is a rough block diagram showing a control system for changing	E.g., page 6, lines 16 to 25 "The vehicle running condition detection device 4 is used to detect the

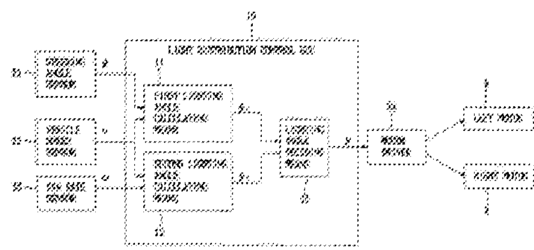
Limitation of '034 Patent Proposed Claim 2	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
speed of the vehicle.	the lighting region in the present embodiment. The vehicle has a steering angle sensor 21 for detecting a direction of a front wheel with respect to the vehicle body, i.e. a steering angle φ, a vehicle speed sensor 22 for detecting a vehicle speed v and a yaw rate sensor 23 for detecting a yaw angular velocity (yaw rate) ω." E.g., Figure 3  FIG. 3	running conditions of the vehicle (including the stopping or stationary condition thereof), while the detect signal of the vehicle running condition detection device 3 is transmitted to the control device 4. As the vehicle running condition detection device 3, for example, there can be used vehicle speed detection device which is one of the existing facilities of the vehicle. Also, every kind of information can be used, provided that it can be used to detect the running conditions of the vehicle."

Limitation of '034 Patent Proposed Claim 3	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
3. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 461.	See claim 1 claim chart, above at page 461.
wherein at least one of said two or more sensors generates a signal that is representative of the steering angle of the vehicle.	E.g., col. 4, lines 61 to 67, "Fig. 3 is a rough block diagram showing a control system for changing the lighting region in the present embodiment. The vehicle has a steering angle sensor 21 for detecting a direction of a front wheel with respect to the vehicle body, i.e. a steering angle φ, a vehicle	

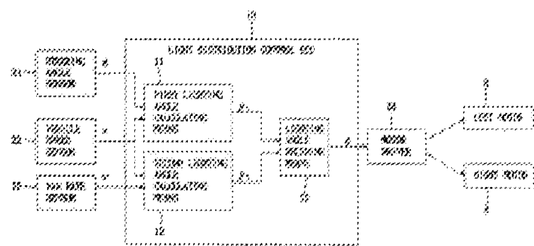
Limitation of '034 Patent Proposed Claim 3	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
	speed sensor 22 for detecting a vehicle speed v and a yaw rate sensor 23 for detecting a yaw angular velocity (yaw rate) ω." E.g., Figure 3  FIG. 3	

Limitation of '034 Patent Proposed Claim 4	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
4. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 461.	See claim 1 claim chart, above at page 461.
wherein at least one of said two or more sensors generates a signal that is representative of the pitch of the vehicle.		E.g., page 2, lines 6 to 13 "Therefore, there is conventionally known a device which includes a device for detecting the posture of the vehicle by detecting the inclination and height of a vehicle body, and calculates the amount of variations in the inclination of the vehicle based on the information that is obtained by the detect device, thereby being able to adjust automatically the illumination direction of the lamp."

Limitation of '034 Patent Proposed Claim 5	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
5. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 461.	See claim 1 claim chart, above at page 461.
wherein at least one of said two or more sensors generates a signal that is representative of the suspension height of the vehicle.		E.g., page 2, lines 6 to 13 "Therefore, there is conventionally known a device which includes a device for detecting the posture of the vehicle by detecting the inclination and height of a vehicle body, and calculates the amount of variations in the inclination of the vehicle based on the information that is obtained by the detect device, thereby being able to adjust automatically the illumination direction of the lamp." E.g., page 5, line 30 to page 6, line 9 "The vehicle posture detection device 2 is used to detect the posture of a vehicle (including the vertical inclination of the vehicle in the advancing direction thereof). For example, when there is used height detection device 7 which detects the height of the body of the vehicle, as shown in Fig. 2, there are available a method which measures a distance L between the height detection device 7 and a road surface G by use of detect waves such as ultrasonic waves, laser beams or the like, and a method in which the height detection device 7 detects the expansion and contraction amount x of a suspension S in order to detect the amount of variations in the vertical position of the axle of the vehicle."

Limitation of '034 Patent Proposed Claim 6	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
6. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 461.	See claim 1 claim chart, above at page 461.
wherein said two or more sensors include a first sensor and a second sensor.	E.g., col. 4, lines 61 to 67, "Fig. 3 is a rough block diagram showing a control system for changing the lighting region in the present embodiment. The vehicle has a steering angle sensor 21 for detecting a direction of a front wheel with respect to the vehicle body, i.e. a steering angle φ, a vehicle speed sensor 22 for detecting a vehicle speed v and a yaw rate sensor 23 for detecting a yaw angular velocity (yaw rate) ω." E.g., Figure 3  FIG. 3	E.g., page 5, line 30 to page 6, line 9 "The vehicle posture detection device 2 is used to detect the posture of a vehicle (including the vertical inclination of the vehicle in the advancing direction thereof). For example, when there is used height detection device 7 which detects the height of the body of the vehicle, as shown in Fig. 2, there are available a method which measures a distance L between the height detection device 7 and a road surface G by use of detect waves such as ultrasonic waves, laser beams or the like, and a method in which the height detection device 7 detects the expansion and contraction amount x of a suspension S in order to detect the amount of variations in the vertical position of the axle of the vehicle." E.g., page 6, lines 16 to 25 "The vehicle running condition detection device 4 is used to detect the running conditions of the vehicle (including the stopping or stationary condition thereof), while the detect signal of the vehicle running condition detection device 3 is transmitted to the control device 4. As the vehicle running condition detection device 3, for example, there can be used vehicle speed detection device which is one of the existing facilities of the vehicle. Also, every kind of information can be used, provided that it can be used to detect the running conditions of the

Limitation of '034 Patent Proposed Claim 6	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
		vehicle."

Limitation of '034 Patent Proposed Claim 7	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
7. The automatic directional control system defined in claim 6,	See claim 6 claim chart, above at page 470.	See claim 6 claim chart, above at page 470.
wherein said first sensor is adapted to generate a signal that is representative of a condition including the road speed of the vehicle and said second sensor is adapted to generate a signal that is representative of a condition including the steering angle of the vehicle.	E.g., col. 4, lines 61 to 67, "Fig. 3 is a rough block diagram showing a control system for changing the lighting region in the present embodiment. The vehicle has a steering angle sensor 21 for detecting a direction of a front wheel with respect to the vehicle body, i.e. a steering angle φ, a vehicle speed sensor 22 for detecting a vehicle speed v and a yaw rate sensor 23 for detecting a yaw angular velocity (yaw rate) ω." E.g., Figure 3  FIG. 3	E.g., page 6, lines 16 to 25 "The vehicle running condition detection device 4 is used to detect the running conditions of the vehicle (including the stopping or stationary condition thereof), while the detect signal of the vehicle running condition detection device 3 is transmitted to the control device 4. As the vehicle running condition detection device 3, for example, there can be used vehicle speed detection device which is one of the existing facilities of the vehicle. Also, every kind of information can be used, provided that it can be used to detect the running conditions of the vehicle."

Limitation of '034 Patent Proposed Claim 8	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
8. The automatic directional control system defined in claim 6,	See claim 6 claim chart, above at page 470.	See claim 6 claim chart, above at page 470.
wherein said first sensor is adapted to generate a signal that is representative of a condition including the steering angle of the vehicle and said second sensor is adapted to generate a signal that is representative of a condition including the pitch of the vehicle.	E.g., col. 4, lines 61 to 67, "Fig. 3 is a rough block diagram showing a control system for changing the lighting region in the present embodiment. The vehicle has a steering angle sensor 21 for detecting a direction of a front wheel with respect to the vehicle body, i.e. a steering angle φ, a vehicle speed sensor 22 for detecting a vehicle speed v and a yaw rate sensor 23 for detecting a yaw angular velocity (yaw rate) ω."	E.g., page 2, lines 6 to 13 "Therefore, there is conventionally known a device which includes a device for detecting the posture of the vehicle by detecting the inclination and height of a vehicle body, and calculates the amount of variations in the inclination of the vehicle based on the information that is obtained by the detect device, thereby being able to adjust automatically the illumination direction of the lamp."

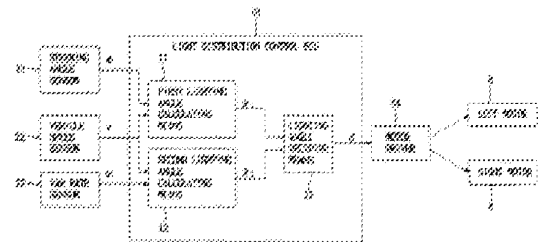
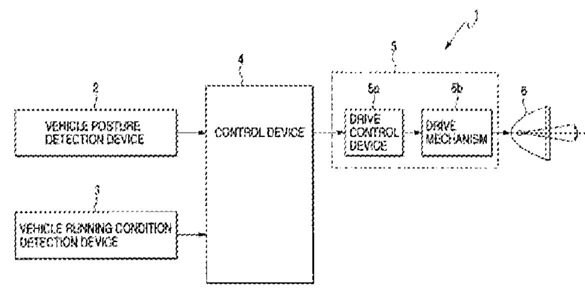
Limitation of '034 Patent Proposed Claim 9	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
9. The automatic directional control system defined in claim 6,	See claim 6 claim chart, above at page 470.	See claim 6 claim chart, above at page 470.
wherein said first sensor is adapted to generate a signal that is representative of a condition including the suspension height of the vehicle and said second sensor is adapted to generate a signal that is representative of a condition including the pitch of the vehicle.		E.g., page 2, lines 6 to 13 "Therefore, there is conventionally known a device which includes a device for detecting the posture of the vehicle by detecting the inclination and height of a vehicle body, and calculates the amount of variations in the inclination of the vehicle based on the information that is obtained by the detect device, thereby being able to adjust automatically the illumination direction of the lamp." E.g., page 5, line 30 to page 6, line 9 "The vehicle posture detection device 2 is used to detect the

Limitation of '034 Patent Proposed Claim 9	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
		posture of a vehicle (including the vertical inclination of the vehicle in the advancing direction thereof). For example, when there is used height detection device 7 which detects the height of the body of the vehicle, as shown in Fig. 2, there are available a method which measures a distance L between the height detection device 7 and a road surface G by use of detect waves such as ultrasonic waves, laser beams or the like, and a method in which the height detection device 7 detects the expansion and contraction amount x of a suspension S in order to detect the amount of variations in the vertical position of the axle of the vehicle." E.g., page 2, lines 6 to 13 "Therefore, there is conventionally known a device which includes a device for detecting the posture of the vehicle by detecting the inclination and height of a vehicle body, and calculates the amount of variations in the inclination of the vehicle based on the information that is obtained by the detect device, thereby being able to adjust automatically the illumination direction of the lamp."

Limitation of '034 Patent Proposed Claim 10	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
10. The automatic directional control system defined in claim 6,	See claim 6 claim chart, above at page 470.	See claim 6 claim chart, above at page 470.

Limitation of '034 Patent Proposed Claim 10	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
wherein said first sensor is adapted to generate a signal that is representative of a condition including the pitch of the vehicle and said second sensor is adapted to generate a signal that is representative of a condition including the road speed of the vehicle.		E.g., page 2, lines 6 to 13 "Therefore, there is conventionally known a device which includes a device for detecting the posture of the vehicle by detecting the inclination and height of a vehicle body, and calculates the amount of variations in the inclination of the vehicle based on the information that is obtained by the detect device, thereby being able to adjust automatically the illumination direction of the lamp." E.g., page 6, lines 16 to 25 "The vehicle running condition detection device 4 is used to detect the running conditions of the vehicle (including the stopping or stationary condition thereof), while the detect signal of the vehicle running condition detection device 3 is transmitted to the control device 4. As the vehicle running condition detection device 3, for example, there can be used vehicle speed detection device which is one of the existing facilities of the vehicle. Also, every kind of information can be used, provided that it can be used to detect the running conditions of the vehicle."

Limitation of '034 Patent Proposed Claim 11	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
11. The automatic directional control system defined in claim 6,	See claim 6 claim chart, above at page 470.	See claim 6 claim chart, above at page 470.
wherein said first sensor is physically separate	E.g., col. 4, lines 61 to 67, "Fig. 3 is a rough	See, e.g., Fig. 1, ref. 2, 3 (Separate detection

Limitation of '034 Patent Proposed Claim 11	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
from said second sensor.	block diagram showing a control system for changing the lighting region in the present embodiment. The vehicle has a steering angle sensor 21 for detecting a direction of a front wheel with respect to the vehicle body, i.e. a steering angle φ, a vehicle speed sensor 22 for detecting a vehicle speed v and a yaw rate sensor 23 for detecting a yaw angular velocity (yaw rate) ω." E.g., Figure 3  FIG. 3	devices). See also 5:25-27 ("an illumination direction control device 1 is composed of vehicle posture detection device 2, vehicle running condition detection device 3, control device 4, drive device 5 . . ., and lamp 6.") FIG. 1 

Limitation of '034 Patent Proposed Claim 12	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
12. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 461.	See claim 1 claim chart, above at page 461.
wherein said sensed conditions further include one or more of a rate of change of road speed of the vehicle, a rate of change of steering angle of the vehicle, a rate of change of pitch of the vehicle, or		E.g., page 7, lines 29 to 34, to page 8, line 21 "In particular, Fig. 3 shows schematically the amount of variations in the output level V when the vehicle runs first along an uphill slope and

Limitation of '034 Patent Proposed Claim 12	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
a rate of change of suspension height of the vehicle.		thereafter runs along a road having a small gradient. In this case, when the vehicle runs over the uphill slope the output level V falls down suddenly." E.g., page 8, lines 19 to 25, "These figures show clearly that the magnitude of the amount of variations in the road gradients is reflected on the amount of variations in the outputs of the height sensor when the vehicle runs from the road having a small gradient to the road having a large gradient or when the vehicle runs from the road having a large gradient to the road having a small gradient."

Limitation of '034 Patent Proposed Claim 14	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
14. The automatic directional control system defined in claim 12,	See claim 12 claim chart, above at page 475.	See claim 12 claim chart, above at page 475.
wherein at least one of said two or more sensors generates a signal that is representative of the rate of change of steering angle of the vehicle.	E.g., col. 4, lines 61 to 67, "Fig. 3 is a rough block diagram showing a control system for changing the lighting region in the present embodiment. The vehicle has a steering angle sensor 21 for detecting a direction of a front wheel with respect to the vehicle body, i.e. a steering angle φ, a vehicle speed sensor 22 for detecting a vehicle speed v and a yaw rate sensor 23 for detecting a yaw angular velocity (yaw rate) ω."	E.g., page 7, lines 29 to 34, to page 8, line 21 "In particular, Fig. 3 shows schematically the amount of variations in the output level V when the vehicle runs first along an uphill slope and thereafter runs along a road having a small gradient. In this case, when the vehicle runs over the uphill slope the output level V falls down suddenly." E.g., page 8, lines 19 to 25, "These figures show clearly that the magnitude of the amount of

Limitation of '034 Patent Proposed Claim 14	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
		variations in the road gradients is reflected on the amount of variations in the outputs of the height sensor when the vehicle runs from the road having a small gradient to the road having a large gradient or when the vehicle runs from the road having a large gradient to the road having a small gradient."

Limitation of '034 Patent Proposed Claim 16	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
16. The automatic directional control system defined in claim 12,	See claim 12 claim chart, above at page 475.	See claim 12 claim chart, above at page 475.
wherein at least one of said two or more sensors generates a signal that is representative of the rate of change of suspension height of the vehicle.		E.g., page 7, lines 29 to 34, to page 8, line 21 "In particular, Fig. 3 shows schematically the amount of variations in the output level V when the vehicle runs first along an uphill slope and thereafter runs along a road having a small gradient. In this case, when the vehicle runs over the uphill slope the output level V falls down suddenly." E.g., page 8, lines 19 to 25, "These figures show clearly that the magnitude of the amount of variations in the road gradients is reflected on the amount of variations in the outputs of the height sensor when the vehicle runs from the road having a small gradient to the road having a large gradient or when the vehicle runs from the road having a large gradient to the road having a small gradient."

Limitation of '034 Patent Proposed Claim 17	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
17. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 461.	See claim 1 claim chart, above at page 461.
wherein the automatic directional control system is configured to include at least two actuators.		E.g., page 16, line 31 to page 17, line 1 "A rudder resistance network 18, which corresponds to the above-mentioned drive control device 5a, is used to convert the output signal of the microcomputer 10 into an analog signal and transmits it to actuators 19 and 19' which are disposed downstream thereof."

Limitation of '034 Patent Proposed Claim 18	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
18. The automatic directional control system defined in claim 17,	See claim 17 claim chart, above at page 478.	See claim 17 claim chart, above at page 478.
wherein the at least two actuators include a first actuator that is adapted to be connected to the headlight to effect movement thereof in a vertical direction.		E.g., page 11, lines 21 to 32 "In particular, the method 1) is the simplest method that can change the illumination pattern of the lamp 6 within a vertical plane, in which the entire lamp is rotated about the rotary shaft thereof to thereby change the illumination angle of the lamp 6 with respect to a horizontal plane including the optical axis of the lamp. For example, in the method 1), there can be used a drive mechanism in which the right and left side surfaces of the lamp 6 are supported rotatably, and the rotary shaft of the lamp 6 is rotated directly by a drive source such as a motor or the like, or a member fixed to or formed integrally with the lamp 6 is rotated by the drive device 5."

Limitation of '034 Patent Proposed Claim 20	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
20. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 461.	See claim 1 claim chart, above at page 461.
wherein the at least one actuator includes an electronically controlled mechanical actuator.		E.g., page 16, line 31 to page 17, line 1 "A rudder resistance network 18, which corresponds to the above-mentioned drive control device 5a, is used to convert the output signal of the microcomputer 10 into an analog signal and transmits it to actuators 19 and 19' which are disposed downstream thereof." E.g., page 11, line 32 to page 12, line 3 "As an example of such lamp, there is available a lamp including a mechanism which can use the rotational force of the motor as the rotational force of the lam through a transmission mechanism using a worm and worm wheel (for example, see Japanese Patent Publication No. Hei. 63-166672)."

Limitation of '034 Patent Proposed Claim 21	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
21. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 461.	See claim 1 claim chart, above at page 461.
wherein the at least one actuator includes a step motor.		E.g., page 18, lines 5 to 8 "Besides this, according to the invention, the lamp or the component thereof can be driven or controlled by use of a stepping motor to thereby correct the illumination

Limitation of '034 Patent Proposed Claim 21	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
		direction of the lamp."

Limitation of '034 Patent Proposed Claim 22	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
22. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 461.	See claim 1 claim chart, above at page 461.
wherein the at least one actuator includes a servo motor.		E.g., page 16, line 31 to page 17, line 1 "A rudder resistance network 18, which corresponds to the above-mentioned drive control device 5a, is used to convert the output signal of the microcomputer 10 into an analog signal and transmits it to actuators 19 and 19' which are disposed downstream thereof." E.g., page 11, line 32 to page 12, line 3 "As an example of such lamp, there is available a lamp including a mechanism which can use the rotational force of the motor as the rotational force of the lam through a transmission mechanism using a worm and worm wheel (for example, see Japanese Patent Publication No. Hei. 63-166672)."

Limitation of '034 Patent Proposed Claim 24	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
24. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 461.	See claim 1 claim chart, above at page 461.

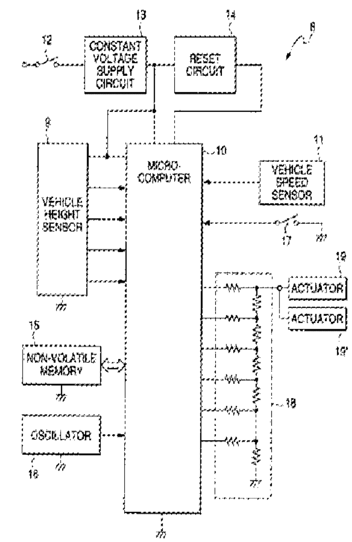
Limitation of ’034 Patent Proposed Claim 24	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
wherein the automatic directional control system is configured such that the headlight is adjustably mounted on the vehicle such that a directional orientation at which a beam of light projects therefrom is capable of being adjusted relative to the vehicle.	E.g., col. 4, lines 32 to 38, “The vehicle 1 of the preferred embodiment has head lights 2 for lighting the space in front of the vehicle installed such that they are swingable in rightward and leftward horizontal directions. FIG. 1 is a view showing the vehicle 1 from above and in this figure, the right and left head lights 2,2 are swung rightward so as to cause the right forward regions to become lighting regions 3, 3.”	E.g., page 11, lines 21 to 32 “In particular, the method 1) is the simplest method that can change the illumination pattern of the lamp 6 within a vertical plane, in which the entire lamp is rotated about the rotary shaft thereof to thereby change the illumination angle of the lamp 6 with respect to a horizontal plane including the optical axis of the lamp. For example, in the method 1), there can be used a drive mechanism in which the right and left side surfaces of the lamp 6 are supported rotatably, and the rotary shaft of the lamp 6 is rotated directly by a drive source such as a motor or the like, or a member fixed to or formed integrally with the lamp 6 is rotated by the drive device 5.”

Limitation of ’034 Patent Proposed Claim 25	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
25. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 461.	See claim 1 claim chart, above at page 461.
wherein the automatic directional control system is configured such that the headlight is adjustably mounted on the vehicle such that a directional orientation at which a beam of light projects therefrom is capable of being adjusted up and down relative to a horizontal reference position.		E.g., page 11, lines 21 to 32 “In particular, the method 1) is the simplest method that can change the illumination pattern of the lamp 6 within a vertical plane, in which the entire lamp is rotated about the rotary shaft thereof to thereby change the illumination angle of the lamp 6 with respect to a horizontal plane including the optical axis of the lamp. For example, in the method 1), there can be used a drive mechanism in which the right and left side surfaces of the lamp 6 are supported rotatably,

Limitation of '034 Patent Proposed Claim 25	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
		and the rotary shaft of the lamp 6 is rotated directly by a drive source such as a motor or the like, or a member fixed to or formed integrally with the lamp 6 is rotated by the drive device 5."

Limitation of '034 Patent Proposed Claim 26	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
26. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 461.	See claim 1 claim chart, above at page 461.
wherein the automatic directional control system is configured such that the headlight is adjustably mounted on the vehicle such that a directional orientation at which a beam of light projects therefrom is capable of being adjusted left and right relative to a vertical reference position.	E.g., col. 4, lines 32 to 38, "The vehicle 1 of the preferred embodiment has head lights 2 for lighting the space in front of the vehicle installed such that they are swingable in rightward and leftward horizontal directions. FIG. 1 is a view showing the vehicle 1 from above and in this figure, the right and left head lights 2,2 are swung rightward so as to cause the right forward regions to become lighting regions 3, 3."	

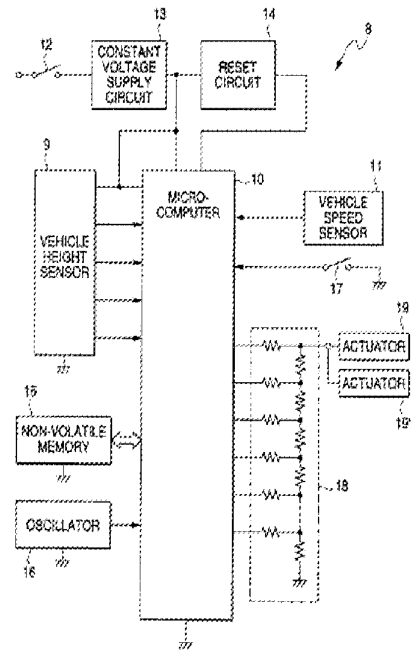
Limitation of '034 Patent Proposed Claim 28	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
28. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 461.	See claim 1 claim chart, above at page 461.
wherein the automatic directional control system is configured such that the controller includes a microprocessor.	E.g., col. 4, lines 56 to 60, "Accordingly, the lamp unit 4 is swung together with the rotary shaft 5 through an engagement between the worm gear 7	E.g., page 16, lines 1 to 4 "When a turn-on switch 12 for the lamp 6 is put into operation, a supply voltage from a constant voltage supply circuit 13

Limitation of '034 Patent Proposed Claim 28	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
	and the worm wheel 6 under a driving of the motor 8. The motor 8 is controlled for its driving by a light distribution control ECU 10."	and a reset signal from a reset circuit 14 are supplied to the microcomputer 10." See also Fig. 9, ref. 10. FIG. 9 

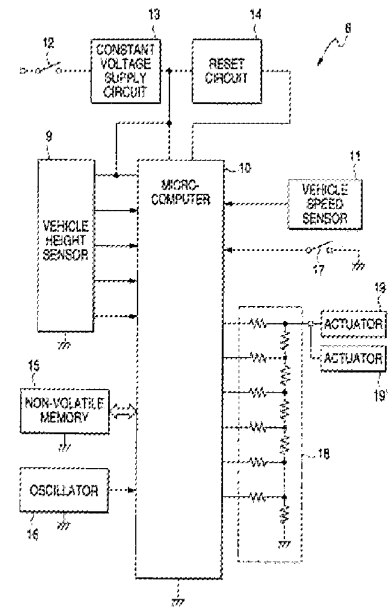
Limitation of '034 Patent Proposed Claim 29	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
29. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 461.	See claim 1 claim chart, above at page 461.
wherein the automatic directional control system is configured such that the controller includes a programmable electronic controller.	E.g., col. 4, lines 56 to 60, "Accordingly, the lamp unit 4 is swung together with the rotary shaft 5 through an engagement between the worm gear 7	

Limitation of '034 Patent Proposed Claim 29	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
	and the worm wheel 6 under a driving of the motor 8. The motor 8 is controlled for its driving by a light distribution control ECU 10."	

Limitation of '034 Patent Proposed Claim 33	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
33. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 461.	See claim 1 claim chart, above at page 461.
wherein the automatic directional control system further includes memory.		E.g., page 16, lines 5 to 9 "Also, a non-volatile memory 15 (such as an electrically erasable EEPROM, or the like) for storing control programs and data values therein) [sic] and an oscillator 16 used to generate a clock signal are additionally attached to the microcomputer 10." See also Fig. 9, ref. 15.

Limitation of '034 Patent Proposed Claim 33	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
		FIG. 9 

Limitation of '034 Patent Proposed Claim 34	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
34. The automatic directional control system defined in claim 33,	See claim 33 claim chart, above at page 484.	See claim 33 claim chart, above at page 484.
wherein the memory includes non-volatile memory.		E.g., page 16, lines 5 to 9 "Also, a non-volatile memory 15 (such as an electrically erasable EEPROM, or the like) for storing control

Limitation of '034 Patent Proposed Claim 34	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
		programs and data values therein) [sic] and an oscillator 16 used to generate a clock signal are additionally attached to the microcomputer 10." See also Fig. 9, ref. 15. FIG. 9 

Limitation of '034 Patent Proposed Claim 37	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
37. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 461.	See claim 1 claim chart, above at page 461.

Limitation of '034 Patent Proposed Claim 37	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
wherein the automatic directional control system is configured such that the pitch of the vehicle is capable of being determined by sensing a front and a rear suspension height of the vehicle.		E.g., page 5, line 30 to page 6, line 9 "The vehicle posture detection device 2 is used to detect the posture of a vehicle (including the vertical inclination of the vehicle in the advancing direction thereof). For example, when there is used height detection device 7 which detects the height of the body of the vehicle, as shown in Fig. 2, there are available a method which measures a distance L between the height detection device 7 and a road surface G by use of detect waves such as ultrasonic waves, laser beams or the like, and a method in which the height detection device 7 detects the expansion and contraction amount x of a suspension S in order to detect the amount of variations in the vertical position of the axle of the vehicle."

Limitation of '034 Patent Proposed Claim 38	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
38. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 461.	See claim 1 claim chart, above at page 461.
wherein the automatic directional control system is configured such that the pitch of the vehicle is capable of being determined by a pitch level sensor.		E.g., page 5, line 30 to page 6, line 9 "The vehicle posture detection device 2 is used to detect the posture of a vehicle (including the vertical inclination of the vehicle in the advancing direction thereof). For example, when there is used height detection device 7 which detects the height of the body of the vehicle, as shown in Fig. 2, there are available a method which measures a

Limitation of '034 Patent Proposed Claim 38	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
		distance L between the height detection device 7 and a road surface G by use of detect waves such as ultrasonic waves, laser beams or the like, and a method in which the height detection device 7 detects the expansion and contraction amount x of a suspension S in order to detect the amount of variations in the vertical position of the axle of the vehicle.":

Limitation of '034 Patent Proposed Claim 41	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
41. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 461.	See claim 1 claim chart, above at page 461.
wherein the automatic directional control system is configured such that the predetermined minimum threshold amount functions as a filter to minimize undesirable operation of the at least one actuator.	E.g., col. 6, line 42 to col. 7, line 2, "Referring to FIG. 8, from changes of the steering angle φ and the yaw angular velocity ω of FIGS. 7A and 7B, the following is understood. When the vehicle goes around the rightward curve, the steering wheel is turned to the right to have a positive steering angle φ at first, and the vehicle body yaws somewhat after the change of steering angle φ so that the yaw angular velocity ω increases following increase of the steering angle. In the meantime, the rear part of the vehicle is swung outside large, and therefore the driver turns the steering wheel to the left or in the opposite direction rapidly for counter-steering to recover direction of the vehicle. Namely, the steering	E.g., page 8, lines 26 to 32 "Therefore, when the amount of variations with time of the detect signal of the vehicle posture detect signal 2 is equal to or larger than a reference value, it may be judged that the gradient of the road has varied, and the illumination direction of the lamp 6 may be corrected in accordance with the detect signal of the vehicle posture detection device 2." E.g., page 9, lines 16 to 34 "Also, in order to prevent the illumination direction of the lamp 6 from being corrected inadvertently when a sudden change in the posture of the vehicle occurs temporarily or due to the wrong operation of the lamp 6 caused by external disturbances, for example, when the vehicle makes a sudden start or

Limitation of '034 Patent Proposed Claim 41	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
	angle φ changes from an upward incline to a downward incline in FIG. 7A. However, the yaw angular velocity ω is maintained due to inertia. Further, when the direction of the vehicle comes to show some recovery, the driver again turns the steering wheel to the right for going around the rightward curve, but he comes to carry out the counter-steering again soon after. Thus, the steering angle φ swings rightward and leftward in large variations. However, while the steering angle φ is swinging rightward and leftward as described above, the yaw angular velocity ω is maintained at a certain angular velocity stably in general, and at a time somewhat before the vehicle passes through the curve completely, the yaw angular velocity ω comes to coincide with the steering angle φ." E.g., col. 7, lines 34 to 39, "Since the actual light distribution control is performed on the basis of the above-mentioned final lighting angle 9, even 35 if the steering wheel is operated rapidly for the countersteering and the like, change of the lighting region is suppressed pertinently and the driver is given no sense of incongruity."	a sudden stop, preferably, a threshold value with respect to time may be set in detection of the road gradient and, only when the amount of variations in the detect signal of the vehicle posture detection device 2 exceeds a given reference value and such excessive state continues for a time equal to or more than the threshold value, the illumination direction of the lamp 6 may be corrected; or, a threshold value with respect to the running distance of the vehicle may be set and, only when the amount of variations in the detect signal of the vehicle posture detection device 2 exceeds a given reference value and such excessive state continues for a distance equal to or more than the threshold value, the illumination direction of the lamp 6 may be corrected."

Limitation of '034 Patent Proposed Claim 42	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
42. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 461.	See claim 1 claim chart, above at page 461.
wherein said sensed conditions include three or more of road speed, steering angle, pitch, and suspension height of the vehicle.	E.g., col. 4, lines 61 to 67, "Fig. 3 is a rough block diagram showing a control system for changing the lighting region in the present embodiment. The vehicle has a steering angle sensor 21 for detecting a direction of a front wheel with respect to the vehicle body, i.e. a steering angle φ, a vehicle speed sensor 22 for detecting a vehicle speed v and a yaw rate sensor 23 for detecting a yaw angular velocity (yaw rate) ω."	E.g., page 6, lines 16 to 25 "The vehicle running condition detection device 4 is used to detect the running conditions of the vehicle (including the stopping or stationary condition thereof), while the detect signal of the vehicle running condition detection device 3 is transmitted to the control device 4. As the vehicle running condition detection device 3, for example, there can be used vehicle speed detection device which is one of the existing facilities of the vehicle. Also, every kind of information can be used, provided that it can be used to detect the running conditions of the vehicle." E.g., page 2, lines 6 to 13 "Therefore, there is conventionally known a device which includes a device for detecting the posture of the vehicle by detecting the inclination and height of a vehicle body, and calculates the amount of variations in the inclination of the vehicle based on the information that is obtained by the detect device, thereby being able to adjust automatically the illumination direction of the lamp." E.g., page 5, line 30 to page 6, line 9 "The vehicle posture detection device 2 is used to detect the posture of a vehicle (including the vertical inclination of the vehicle in the advancing direction thereof). For example, when there is used

Limitation of '034 Patent Proposed Claim 42	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
		height detection device 7 which detects the height of the body of the vehicle, as shown in Fig. 2, there are available a method which measures a distance L between the height detection device 7 and a road surface G by use of detect waves such as ultrasonic waves, laser beams or the like, and a method in which the height detection device 7 detects the expansion and contraction amount x of a suspension S in order to detect the amount of variations in the vertical position of the axle of the vehicle."

Limitation of '034 Patent Proposed Claim 43	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
43. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 461.	See claim 1 claim chart, above at page 461.
wherein said sensed conditions include all four of road speed, steering angle, pitch, and suspension height of the vehicle.	E.g., col. 4, lines 61 to 67, "Fig. 3 is a rough block diagram showing a control system for changing the lighting region in the present embodiment. The vehicle has a steering angle sensor 21 for detecting a direction of a front wheel with respect to the vehicle body, i.e. a steering angle φ, a vehicle speed sensor 22 for detecting a vehicle speed v and a yaw rate sensor 23 for detecting a yaw angular velocity (yaw rate) ω."	E.g., page 6, lines 16 to 25 "The vehicle running condition detection device 4 is used to detect the running conditions of the vehicle (including the stopping or stationary condition thereof), while the detect signal of the vehicle running condition detection device 3 is transmitted to the control device 4. As the vehicle running condition detection device 3, for example, there can be used vehicle speed detection device which is one of the existing facilities of the vehicle. Also, every kind of information can be used, provided that it can be used to detect the running conditions of the vehicle."

Limitation of '034 Patent Proposed Claim 43	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
		E.g., page 2, lines 6 to 13 "Therefore, there is conventionally known a device which includes a device for detecting the posture of the vehicle by detecting the inclination and height of a vehicle body, and calculates the amount of variations in the inclination of the vehicle based on the information that is obtained by the detect device, thereby being able to adjust automatically the illumination direction of the lamp." E.g., page 5, line 30 to page 6, line 9 "The vehicle posture detection device 2 is used to detect the posture of a vehicle (including the vertical inclination of the vehicle in the advancing direction thereof). For example, when there is used height detection device 7 which detects the height of the body of the vehicle, as shown in Fig. 2, there are available a method which measures a distance L between the height detection device 7 and a road surface G by use of detect waves such as ultrasonic waves, laser beams or the like, and a method in which the height detection device 7 detects the expansion and contraction amount x of a suspension S in order to detect the amount of variations in the vertical position of the axle of the vehicle."

Limitation of '034 Patent Proposed Claim 44	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
44. The automatic directional control system	See claim 1 claim chart, above at page 461.	See claim 1 claim chart, above at page 461.

Limitation of '034 Patent Proposed Claim 44	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
defined in claim 1,		
wherein said controller is configured to be responsive to said two or more sensor signals for generating at least one output signal only when said at least one of the two or more sensor signals changes by more than a predetermined minimum threshold amount to prevent at least one actuator from being operated continuously in response to relatively small variations in the sensed operating conditions.	E.g., col. 6, line 42 to col. 7, line 2, "Referring to FIG. 8, from changes of the steering angle φ and the yaw angular velocity ω of FIGS. 7A and 7B, the following is understood. When the vehicle goes around the rightward curve, the steering wheel is turned to the right to have a positive steering angle φ at first, and the vehicle body yaws somewhat after the change of steering angle φ so that the yaw angular velocity ω increases following increase of the steering angle. In the meantime, the rear part of the vehicle is swung outside large, and therefore the driver turns the steering wheel to the left or in the opposite direction rapidly for counter-steering to recover direction of the vehicle. Namely, the steering angle φ changes from an upward incline to a downward incline in FIG. 7A. However, the yaw angular velocity ω is maintained due to inertia. Further, when the direction of the vehicle comes to show some recovery, the driver again turns the steering wheel to the right for going around the rightward curve, but he comes to carry out the counter-steering again soon after. Thus, the steering angle φ swings rightward and leftward in large variations. However, while the steering angle φ is swinging rightward and leftward as described above, the	E.g., page 8, lines 26 to 32 "Therefore, when the amount of variations with time of the detect signal of the vehicle posture detect signal 2 is equal to or larger than a reference value, it may be judged that the gradient of the road has varied, and the illumination direction of the lamp 6 may be corrected in accordance with the detect signal of the vehicle posture detection device 2." E.g., page 9, lines 16 to 34 "Also, in order to prevent the illumination direction of the lamp 6 from being corrected inadvertently when a sudden change in the posture of the vehicle occurs temporarily or due to the wrong operation of the lamp 6 caused by external disturbances, for example, when the vehicle makes a sudden start or a sudden stop, preferably, a threshold value with respect to time may be set in detection of the road gradient and, only when the amount of variations in the detect signal of the vehicle posture detection device 2 exceeds a given reference value and such excessive state continues for a time equal to or more than the threshold value, the illumination direction of the lamp 6 may be corrected; or, a threshold value with respect to the running distance of the vehicle may be set and, only when the amount of variations in the detect signal of the vehicle posture detection device 2 exceeds a given reference value and such excessive state continues for a distance equal to or more than the threshold

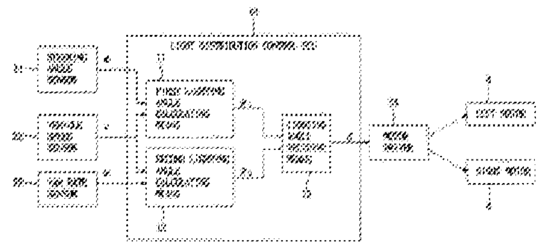
Limitation of '034 Patent Proposed Claim 44	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
	yaw angular velocity ω is maintained at a certain angular velocity stably in general, and at a time somewhat before the vehicle passes through the curve completely, the yaw angular velocity ω comes to coincide with the steering angle φ." E.g., col. 7, lines 34 to 39, "Since the actual light distribution control is performed on the basis of the above-mentioned final lighting angle 9, even if the steering wheel is operated rapidly for the countersteering and the like, change of the lighting region is suppressed pertinently and the driver is given no sense of incongruity."	value, the illumination direction of the lamp 6 may be corrected."

Limitation of '034 Patent Proposed Claim 45	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
45. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 461.	See claim 1 claim chart, above at page 461.
wherein controller is configured to be responsive to said two or more sensor signals for generating at least one output signal only when said at least one of the two or more sensor signals changes by more than a predetermined minimum threshold amount to prevent at least one actuator from being operated unduly frequently in response to relatively small variations in the sensed operating conditions.	E.g., col. 6, line 42 to col. 7, line 2, "Referring to FIG. 8, from changes of the steering angle φ and the yaw angular velocity ω of FIGS. 7A and 7B, the following is understood. When the vehicle goes around the rightward curve, the steering wheel is turned to the right to have a positive steering angle φ at first, and the vehicle body yaws somewhat after the change of steering angle φ so that the yaw angular velocity ω increases following increase of the steering angle.	E.g., page 8, lines 26 to 32 "Therefore, when the amount of variations with time of the detect signal of the vehicle posture detect signal 2 is equal to or larger than a reference value, it may be judged that the gradient of the road has varied, and the illumination direction of the lamp 6 may be corrected in accordance with the detect signal of the vehicle posture detection device 2." E.g., page 9, lines 16 to 34 "Also, in order to prevent the illumination direction of the lamp 6

Limitation of '034 Patent Proposed Claim 45	U.S. Patent No. 5,909,949 (Gotoh)	GB 2 309 774 (Takahashi)
	In the meantime, the rear part of the vehicle is swung outside large, and therefore the driver turns the steering wheel to the left or in the opposite direction rapidly for counter-steering to recover direction of the vehicle. Namely, the steering angle φ changes from an upward incline to a downward incline in FIG. 7A. However, the yaw angular velocity ω is maintained due to inertia. Further, when the direction of the vehicle comes to show some recovery, the driver again turns the steering wheel to the right for going around the rightward curve, but he comes to carry out the counter-steering again soon after. Thus, the steering angle φ swings rightward and leftward in large variations. However, while the steering angle φ is swinging rightward and leftward as described above, the yaw angular velocity ω is maintained at a certain angular velocity stably in general, and at a time somewhat before the vehicle passes through the curve completely, the yaw angular velocity ω comes to coincide with the steering angle φ." E.g., col. 7, lines 34 to 39, "Since the actual light distribution control is performed on the basis of the above-mentioned final lighting angle 9, even if the steering wheel is operated rapidly for the countersteering and the like, change of the lighting region is suppressed pertinently and the driver is given no sense of incongruity."	from being corrected inadvertently when a sudden change in the posture of the vehicle occurs temporarily or due to the wrong operation of the lamp 6 caused by external disturbances, for example, when the vehicle makes a sudden start or a sudden stop, preferably, a threshold value with respect to time may be set in detection of the road gradient and, only when the amount of variations in the detect signal of the vehicle posture detection device 2 exceeds a given reference value and such excessive state continues for a time equal to or more than the threshold value, the illumination direction of the lamp 6 may be corrected; or, a threshold value with respect to the running distance of the vehicle may be set and, only when the amount of variations in the detect signal of the vehicle posture detection device 2 exceeds a given reference value and such excessive state continues for a distance equal to or more than the threshold value, the illumination direction of the lamp 6 may be corrected."

32. Proposed Claims 1 to 13, 24, 26, 28, 29, 37, 38, 41 to 45 Are Unpatentable Over the Combination of Gotoh and Hussman Under 35 U.S.C. § 103(a)

Limitation of '034 Patent Proposed Claim 1	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
1. An automatic directional control system for a vehicle headlight, comprising:	E.g., Abstract, "A head lamp device for a vehicle capable of changing a lighting region in front of the vehicle in right and left directions, in which change of the lighting region is suppressed so as not to give the driver a sense of incongruity when a steering wheel is operated in one direction and then rapidly in the other as in case of counter-steering."	E.g., Abstract, "In a method and apparatus to regulate the illumination range of a motor vehicle in which, at a position on a front axle and at a position on a rear axle, signals are measured which are dependent upon the relative positions of a motor-vehicle body to the front axle and the rear axle, with a difference formation between the signal from the front axle and that of the rear axle being accomplished with a resulting difference signal, as a nominal-value signal, being filtered to a first average-value formation."
two or more sensors that are each adapted to generate a signal that is representative of a condition of a vehicle, said sensed conditions including two or more of road speed, steering angle, pitch, and suspension height of the vehicle;	E.g., col. 4, lines 61 to 67, "Fig. 3 is a rough block diagram showing a control system for changing the lighting region in the present embodiment. The vehicle has a steering angle sensor 21 for detecting a direction of a front wheel with respect to the vehicle body, i.e. a steering angle φ, a vehicle speed sensor 22 for detecting a vehicle speed v and a yaw rate sensor 23 for detecting a yaw angular velocity (yaw rate) ω." E.g., Figure 3	E.g., Abstract, "In a method and apparatus to regulate the illumination range of a motor vehicle in which, at a position on a front axle and at a position on a rear axle, signals are measured which are dependent upon the relative positions of a motor-vehicle body to the front axle and the rear axle, with a difference formation between the signal from the front axle and that of the rear axle being accomplished with a resulting difference signal, as a nominal-value signal, being filtered to a first average-value formation." E.g., col. 2, lines 40 to 48, "A front axle sensor sender (a device including or associated with a sensor for sending a sensed signal) V is here coupled with a nominal-value former over a first

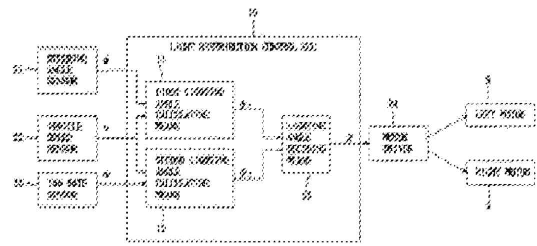
Limitation of '034 Patent Proposed Claim 1	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
	 FIG. 3	analog/digital converter A1. The nominal-value former S is additionally coupled with a rear axle sensor sender H over a second analog/digital converter A2. The front axle sender and the rear axle sender produce signals which are functions of the relative position of a motor vehicle body to the front and rear axles." E.g., col. 3, lines 40 to 45, "The curve-recognition device K is electrically conductively coupled with a speed signal sensor, or sender, G and includes a speed threshold value device which itself affects the switchover such that the third filter F3 is only coupled to the regulator R if a minimum speed of the motor vehicle is exceeded."
a controller that is responsive to said two or more sensor signals for generating at least one output signal	E.g., Col. 4, lines 59 to 60, "The motor 8 is controlled for its driving by a light distribution control ECU 10."	E.g., col. 3, lines 30 to 39, "The curve-recognition device K is electrically conductively coupled with the switchover device SE and thereby couples the third filter F3 electrically conductively with the regulator R if a difference signal other than zero is fed to it from the subtractor SU. When no difference signal from the subtractor SU is present, the curve-recognition device K switches the switchover device SE so that the first filter F1 is coupled to the regulator R." E.g., col. 4, lines 6 to 12, "At the coupling between the switchover device SE and the regulator R, a matching device AE is, here for example, arranged which, upon a switchover by the switchover device SE, adjusts the various

Limitation of '034 Patent Proposed Claim 1	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
		nominal values to one another so that discontinuities or jumps in the adjustment and regulation of the illumination range are avoided." E.g., col. 6, line 10 to 34, "In this connection, it is beneficial that upon the presence of a difference between the second, filtered, nominal-value signal to the third, filtered, nominal-value signal and upon termination of a difference is again switched from the third, filtered, nominal-value signal to the first, filtered, nominal-value signal because in this manner, in an uncomplicated and cost effective manner, upon the presence of an inclination change of the motor vehicle body which is not attributable to a change in loading or to road surface unevenness, the regulation of the illumination range of the motor vehicle, in dependence from the third, long, filter time constant results, whereby the third, filtered, nominal-value signal is independent, or substantially independent, from the disturbing, or distorting, short time inclination changes so that after inclination changes of the motor-vehicle body which, for example, are caused by driving about a curve, false adjustments of the illumination range are not caused which can lead to the blinding of oncoming traffic or to losses in illumination range, which eliminates a danger during operation of a motor vehicle."
only when said at least one of the two or more sensor signals changes by more than a	E.g., col. 6, line 42 to col. 7, line 2, "Referring to FIG. 8, from changes of the steering angle φ and	E.g., col. 4, lines 6 to 12, "At the coupling between the switchover device SE and the

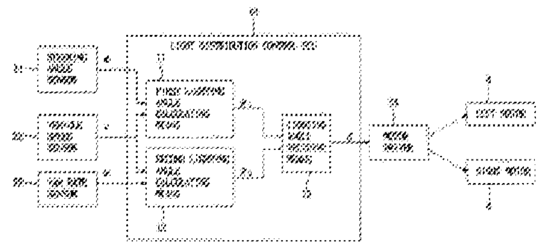
Limitation of '034 Patent Proposed Claim 1	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
predetermined minimum threshold amount to prevent at least one actuator from being operated continuously or unduly frequently in response to relatively small variations in the sensed operating conditions; and	the yaw angular velocity ω of FIGS. 7A and 7B, the following is understood. When the vehicle goes around the rightward curve, the steering wheel is turned to the right to have a positive steering angle φ at first, and the vehicle body yaws somewhat after the change of steering angle φ so that the yaw angular velocity ω increases following increase of the steering angle. In the meantime, the rear part of the vehicle is swung outside large, and therefore the driver turns the steering wheel to the left or in the opposite direction rapidly for counter-steering to recover direction of the vehicle. Namely, the steering angle φ changes from an upward incline to a downward incline in FIG. 7A. However, the yaw angular velocity ω is maintained due to inertia. Further, when the direction of the vehicle comes to show some recovery, the driver again turns the steering wheel to the right for going around the rightward curve, but he comes to carry out the counter-steering again soon after. Thus, the steering angle φ swings rightward and leftward in large variations. However, while the steering angle φ is swinging rightward and leftward as described above, the yaw angular velocity ω is maintained at a certain angular velocity stably in general, and at a time somewhat before the vehicle passes through the curve completely, the yaw angular velocity ω	regulator R, a matching device AE is, here for example, arranged which, upon a switchover by the switchover device SE, adjusts the various nominal values to one another so that discontinuities or jumps in the adjustment and regulation of the illumination range are avoided." E.g., col. 6, line 10 to 34, "In this connection, it is beneficial that upon the presence of a difference between the second, filtered, nominal-value signal to the third, filtered, nominal-value signal and upon termination of a difference is again switched from the third, filtered, nominal-value signal to the first, filtered, nominal-value signal because in this manner, in an uncomplicated and cost effective manner, upon the presence of an inclination change of the motor vehicle body which is not attributable to a change in loading or to road surface unevenness, the regulation of the illumination range of the motor vehicle, in dependence from the third, long, filter time constant results, whereby the third, filtered, nominal-value signal is independent, or substantially independent, from the disturbing, or distorting, short time inclination changes so that after inclination changes of the motor-vehicle body which, for example, are caused by driving about a curve, false adjustments of the illumination range are not caused which can lead to the blinding of oncoming traffic or to losses in illumination range, which eliminates a danger during operation of a motor vehicle."

Limitation of '034 Patent Proposed Claim 1	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
	comes to coincide with the steering angle φ." E.g., Col. 7, lines 34 to 39, "Since the actual light distribution control is performed on the basis of the above-mentioned final lighting angle θ, even if the steering wheel is operated rapidly for the counter-steering and the like, change of the lighting region is suppressed pertinently and the driver is given no sense of incongruity."	
said at least one actuator being adapted to be connected to the headlight to effect movement thereof in accordance with said at least one output signal.		E.g., col. 3, lines 16 to 18, "The regulator R regulates the position of adjusting elements, which are shown here in block form and which change the positions of headlights."

Limitation of '034 Patent Proposed Claim 2	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
2. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 496.	See claim 1 claim chart, above at page 496.
wherein at least one of said two or more sensors generates a signal that is representative of the road speed of the vehicle.	E.g., col. 4, lines 61 to 67, "Fig. 3 is a rough block diagram showing a control system for changing the lighting region in the present embodiment. The vehicle has a steering angle sensor 21 for detecting a direction of a front wheel with respect to the vehicle body, i.e. a steering angle φ, a vehicle speed sensor 22 for detecting a vehicle speed v and a yaw rate sensor 23 for detecting a yaw angular velocity (yaw rate) ω."	E.g., col. 3, lines 40 to 45, "The curve-recognition device K is electrically conductively coupled with a speed signal sensor, or sender, G and includes a speed threshold value device which itself affects the switchover such that the third filter F3 is only coupled to the regulator R if a minimum speed of the motor vehicle is exceeded."

Limitation of '034 Patent Proposed Claim 2	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
	E.g., Figure 3  FIG. 3	

Limitation of '034 Patent Proposed Claim 3	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
3. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 496.	See claim 1 claim chart, above at page 496.
wherein at least one of said two or more sensors generates a signal that is representative of the steering angle of the vehicle.	E.g., col. 4, lines 61 to 67, "Fig. 3 is a rough block diagram showing a control system for changing the lighting region in the present embodiment. The vehicle has a steering angle sensor 21 for detecting a direction of a front wheel with respect to the vehicle body, i.e. a steering angle φ, a vehicle speed sensor 22 for detecting a vehicle speed v and a yaw rate sensor 23 for detecting a yaw angular velocity (yaw rate) ω." E.g., Figure 3	

Limitation of ’034 Patent Proposed Claim 3	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
	 FIG. 3	

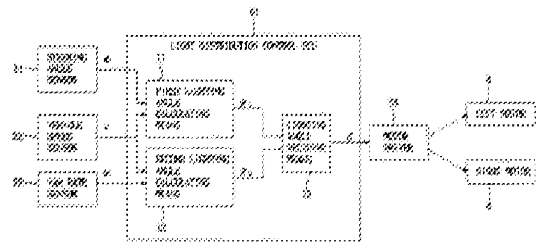
Limitation of ’034 Patent Proposed Claim 4	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
4. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 496.	See claim 1 claim chart, above at page 496.
wherein at least one of said two or more sensors generates a signal that is representative of the pitch of the vehicle.		E.g., Abstract, “In a method and apparatus to regulate the illumination range of a motor vehicle in which, at a position on a front axle and at a position on a rear axle, signals are measured which are dependent upon the relative positions of a motor-vehicle body to the front axle and the rear axle, with a difference formation between the signal from the front axle and that of the rear axle being accomplished with a resulting difference signal, as a nominal-value signal, being filtered to a first average-value formation.” E.g., col. 2, lines 40 to 48, “A front axle sensor sender (a device including or associated with a sensor for sending a sensed signal) V is here

Limitation of '034 Patent Proposed Claim 4	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
		coupled with a nominal-value former over a first analog/digital converter A1. The nominal-value former S is additionally coupled with a rear axle sensor sender H over a second analog/digital converter A2. The front axle sender and the rear axle sender produce signals which are functions of the relative position of a motor vehicle body to the front and rear axles."

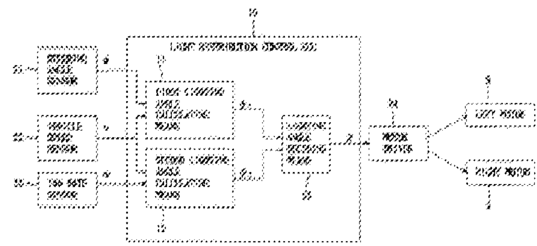
Limitation of '034 Patent Proposed Claim 5	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
5. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 496.	See claim 1 claim chart, above at page 496.
wherein at least one of said two or more sensors generates a signal that is representative of the suspension height of the vehicle.		E.g., Abstract, "In a method and apparatus to regulate the illumination range of a motor vehicle in which, at a position on a front axle and at a position on a rear axle, signals are measured which are dependent upon the relative positions of a motor-vehicle body to the front axle and the rear axle, with a difference formation between the signal from the front axle and that of the rear axle being accomplished with a resulting difference signal, as a nominal-value signal, being filtered to a first average-value formation." E.g., col. 2, lines 40 to 48, "A front axle sensor sender (a device including or associated with a sensor for sending a sensed signal) V is here coupled with a nominal-value former over a first

Limitation of '034 Patent Proposed Claim 5	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
		analog/digital converter A1. The nominal-value former S is additionally coupled with a rear axle sensor sender H over a second analog/digital converter A2. The front axle sender and the rear axle sender produce signals which are functions of the relative position of a motor vehicle body to the front and rear axles."

Limitation of '034 Patent Proposed Claim 6	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
6. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 496.	See claim 1 claim chart, above at page 496.
wherein said two or more sensors include a first sensor and a second sensor.	E.g., col. 4, lines 61 to 67, "Fig. 3 is a rough block diagram showing a control system for changing the lighting region in the present embodiment. The vehicle has a steering angle sensor 21 for detecting a direction of a front wheel with respect to the vehicle body, i.e. a steering angle φ, a vehicle speed sensor 22 for detecting a vehicle speed v and a yaw rate sensor 23 for detecting a yaw angular velocity (yaw rate) ω." E.g., Figure 3	E.g., Abstract, "In a method and apparatus to regulate the illumination range of a motor vehicle in which, at a position on a front axle and at a position on a rear axle, signals are measured which are dependent upon the relative positions of a motor-vehicle body to the front axle and the rear axle, with a difference formation between the signal from the front axle and that of the rear axle being accomplished with a resulting difference signal, as a nominal-value signal, being filtered to a first average-value formation." E.g., col. 2, lines 40 to 48, "A front axle sensor sender (a device including or associated with a sensor for sending a sensed signal) V is here coupled with a nominal-value former over a first analog/digital converter A1. The nominal-value

Limitation of '034 Patent Proposed Claim 6	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
	 FIG. 3	former S is additionally coupled with a rear axle sensor sender H over a second analog/digital converter A2. The front axle sender and the rear axle sender produce signals which are functions of the relative position of a motor vehicle body to the front and rear axles." E.g., col. 3, lines 40 to 45, "The curve-recognition device K is electrically conductively coupled with a speed signal sensor, or sender, G and includes a speed threshold value device which itself affects the switchover such that the third filter F3 is only coupled to the regulator R if a minimum speed of the motor vehicle is exceeded."

Limitation of '034 Patent Proposed Claim 7	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
7. The automatic directional control system defined in claim 6,	See claim 6 claim chart, above at page 504.	See claim 6 claim chart, above at page 504.
wherein said first sensor is adapted to generate a signal that is representative of a condition including the road speed of the vehicle and said second sensor is adapted to generate a signal that is representative of a condition including the steering angle of the vehicle.	E.g., col. 4, lines 61 to 67, "Fig. 3 is a rough block diagram showing a control system for changing the lighting region in the present embodiment. The vehicle has a steering angle sensor 21 for detecting a direction of a front wheel with respect to the vehicle body, i.e. a steering angle φ, a vehicle speed sensor 22 for detecting a vehicle speed v and a yaw rate sensor 23 for detecting a yaw angular velocity (yaw rate) ω."	E.g., col. 3, lines 40 to 45, "The curve-recognition device K is electrically conductively coupled with a speed signal sensor, or sender, G and includes a speed threshold value device which itself affects the switchover such that the third filter F3 is only coupled to the regulator R if a minimum speed of the motor vehicle is exceeded."

Limitation of '034 Patent Proposed Claim 7	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
	E.g., Figure 3  FIG. 3	

Limitation of '034 Patent Proposed Claim 8	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
8. The automatic directional control system defined in claim 6,	See claim 6 claim chart, above at page 504.	See claim 6 claim chart, above at page 504.
wherein said first sensor is adapted to generate a signal that is representative of a condition including the steering angle of the vehicle and said second sensor is adapted to generate a signal that is representative of a condition including the pitch of the vehicle.	E.g., col. 4, lines 61 to 67, "Fig. 3 is a rough block diagram showing a control system for changing the lighting region in the present embodiment. The vehicle has a steering angle sensor 21 for detecting a direction of a front wheel with respect to the vehicle body, i.e. a steering angle φ, a vehicle speed sensor 22 for detecting a vehicle speed v and a yaw rate sensor 23 for detecting a yaw angular velocity (yaw rate) ω."	E.g., Abstract, "In a method and apparatus to regulate the illumination range of a motor vehicle in which, at a position on a front axle and at a position on a rear axle, signals are measured which are dependent upon the relative positions of a motor-vehicle body to the front axle and the rear axle, with a difference formation between the signal from the front axle and that of the rear axle being accomplished with a resulting difference signal, as a nominal-value signal, being filtered to a first average-value formation." E.g., col. 2, lines 40 to 48, "A front axle sensor sender (a device including or associated with a

Limitation of '034 Patent Proposed Claim 8	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
		sensor for sending a sensed signal) V is here coupled with a nominal-value former over a first analog/digital converter A1. The nominal-value former S is additionally coupled with a rear axle sensor sender H over a second analog/digital converter A2. The front axle sender and the rear axle sender produce signals which are functions of the relative position of a motor vehicle body to the front and rear axles."

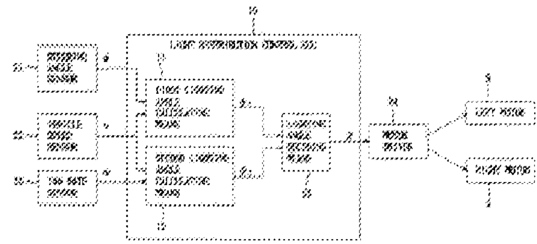
Limitation of '034 Patent Proposed Claim 9	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
9. The automatic directional control system defined in claim 6,	See claim 6 claim chart, above at page 504.	See claim 6 claim chart, above at page 504.
wherein said first sensor is adapted to generate a signal that is representative of a condition including the suspension height of the vehicle and said second sensor is adapted to generate a signal that is representative of a condition including the pitch of the vehicle.		E.g., Abstract, "In a method and apparatus to regulate the illumination range of a motor vehicle in which, at a position on a front axle and at a position on a rear axle, signals are measured which are dependent upon the relative positions of a motor-vehicle body to the front axle and the rear axle, with a difference formation between the signal from the front axle and that of the rear axle being accomplished with a resulting difference signal, as a nominal-value signal, being filtered to a first average-value formation." E.g., col. 2, lines 40 to 48, "A front axle sensor sender (a device including or associated with a sensor for sending a sensed signal) V is here

Limitation of '034 Patent Proposed Claim 9	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
		coupled with a nominal-value former over a first analog/digital converter A1. The nominal-value former S is additionally coupled with a rear axle sensor sender H over a second analog/digital converter A2. The front axle sender and the rear axle sender produce signals which are functions of the relative position of a motor vehicle body to the front and rear axles."

Limitation of '034 Patent Proposed Claim 10	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
10. The automatic directional control system defined in claim 6,	See claim 6 claim chart, above at page 504.	See claim 6 claim chart, above at page 504.
wherein said first sensor is adapted to generate a signal that is representative of a condition including the pitch of the vehicle and said second sensor is adapted to generate a signal that is representative of a condition including the road speed of the vehicle.		E.g., Abstract, "In a method and apparatus to regulate the illumination range of a motor vehicle in which, at a position on a front axle and at a position on a rear axle, signals are measured which are dependent upon the relative positions of a motor-vehicle body to the front axle and the rear axle, with a difference formation between the signal from the front axle and that of the rear axle being accomplished with a resulting difference signal, as a nominal-value signal, being filtered to a first average-value formation." E.g., col. 2, lines 40 to 48, "A front axle sensor sender (a device including or associated with a sensor for sending a sensed signal) V is here coupled with a nominal-value former over a first

Limitation of '034 Patent Proposed Claim 10	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
		analog/digital converter A1. The nominal-value former S is additionally coupled with a rear axle sensor sender H over a second analog/digital converter A2. The front axle sender and the rear axle sender produce signals which are functions of the relative position of a motor vehicle body to the front and rear axles." E.g., col. 3, lines 40 to 45, "The curve-recognition device K is electrically conductively coupled with a speed signal sensor, or sender, G and includes a speed threshold value device which itself affects the switchover such that the third filter F3 is only coupled to the regulator R if a minimum speed of the motor vehicle is exceeded."

Limitation of '034 Patent Proposed Claim 11	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
11. The automatic directional control system defined in claim 6,	See claim 6 claim chart, above at page 504.	See claim 6 claim chart, above at page 504.
wherein said first sensor is physically separate from said second sensor.	E.g., col. 4, lines 61 to 67, "Fig. 3 is a rough block diagram showing a control system for changing the lighting region in the present embodiment. The vehicle has a steering angle sensor 21 for detecting a direction of a front wheel with respect to the vehicle body, i.e. a steering angle φ, a vehicle speed sensor 22 for detecting a vehicle speed v and a yaw rate sensor 23 for detecting a yaw angular velocity (yaw rate) ω."	

Limitation of '034 Patent Proposed Claim 11	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
	E.g., Figure 3  FIG. 3	

Limitation of '034 Patent Proposed Claim 12	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
12. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 496.	See claim 1 claim chart, above at page 496.
wherein said sensed conditions further include one or more of a rate of change of road speed of the vehicle, a rate of change of steering angle of the vehicle, a rate of change of pitch of the vehicle, or a rate of change of suspension height of the vehicle.		E.g., col. 5, lines 34 to 40, "So that also such inclination changes of the motor-vehicle body which are not attributable to acceleration changes will be recognized and false adjustments during regulation of the illumination range because of such inclination changes will be avoided, the third filter F3 is only placed in connection with the regulator when no acceleration of the motor vehicle is present."

Limitation of '034 Patent Proposed Claim 13	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
13. The automatic directional control system defined in claim 12,	See claim 12 claim chart, above at page 510.	See claim 12 claim chart, above at page 510.
wherein at least one of said two or more sensors generate a signal that is representative of the rate of change of road speed of the vehicle.		E.g., col. 5, lines 34 to 40, "So that also such inclination changes of the motor-vehicle body which are not attributable to acceleration changes will be recognized and false adjustments during regulation of the illumination range because of such inclination changes will be avoided, the third filter F3 is only placed in connection with the regulator when no acceleration of the motor vehicle is present."

Limitation of '034 Patent Proposed Claim 24	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
24. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 496.	See claim 1 claim chart, above at page 496.
wherein the automatic directional control system is configured such that the headlight is adjustably mounted on the vehicle such that a directional orientation at which a beam of light projects therefrom is capable of being adjusted relative to the vehicle.	E.g., col. 4, lines 32 to 38, "The vehicle 1 of the preferred embodiment has head lights 2 for lighting the space in front of the vehicle installed such that they are swingable in rightward and leftward horizontal directions. FIG. 1 is a view showing the vehicle 1 from above and in this figure, the right and left head lights 2,2 are swung rightward so as to cause the right forward regions to become lighting regions 3, 3."	

Limitation of '034 Patent Proposed Claim 26	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
26. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 496.	See claim 1 claim chart, above at page 496.
wherein the automatic directional control system is configured such that the headlight is adjustably mounted on the vehicle such that a directional orientation at which a beam of light projects therefrom is capable of being adjusted left and right relative to a vertical reference position.	E.g., col. 4, lines 32 to 38, "The vehicle 1 of the preferred embodiment has head lights 2 for lighting the space in front of the vehicle installed such that they are swingable in rightward and leftward horizontal directions. FIG. 1 is a view showing the vehicle 1 from above and in this figure, the right and left head lights 2,2 are swung rightward so as to cause the right forward regions to become lighting regions 3, 3."	

Limitation of '034 Patent Proposed Claim 28	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
28. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 496.	See claim 1 claim chart, above at page 496.
wherein the automatic directional control system is configured such that the controller includes a microprocessor.	E.g., col. 4, lines 56 to 60, "Accordingly, the lamp unit 4 is swung together with the rotary shaft 5 through an engagement between the worm gear 7 and the worm wheel 6 under a driving of the motor 8. The motor 8 is controlled for its driving by a light distribution control ECU 10."	

Limitation of '034 Patent Proposed Claim 29	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
29. The automatic directional control system	See claim 1 claim chart, above at page 496.	See claim 1 claim chart, above at page 496.

Limitation of '034 Patent Proposed Claim 29	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
defined in claim 1,		
wherein the automatic directional control system is configured such that the controller includes a programmable electronic controller.	E.g., col. 4, lines 56 to 60, "Accordingly, the lamp unit 4 is swung together with the rotary shaft 5 through an engagement between the worm gear 7 and the worm wheel 6 under a driving of the motor 8. The motor 8 is controlled for its driving by a light distribution control ECU 10."	

Limitation of '034 Patent Proposed Claim 37	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
37. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 496.	See claim 1 claim chart, above at page 496.
wherein the automatic directional control system is configured such that the pitch of the vehicle is capable of being determined by sensing a front and a rear suspension height of the vehicle.		E.g., Abstract, "In a method and apparatus to regulate the illumination range of a motor vehicle in which, at a position on a front axle and at a position on a rear axle, signals are measured which are dependent upon the relative positions of a motor-vehicle body to the front axle and the rear axle, with a difference formation between the signal from the front axle and that of the rear axle being accomplished with a resulting difference signal, as a nominal-value signal, being filtered to a first average-value formation." E.g., col. 2, lines 40 to 48, "A front axle sensor sender (a device including or associated with a sensor for sending a sensed signal) V is here coupled with a nominal-value former over a first

Limitation of '034 Patent Proposed Claim 37	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
		analog/digital converter A1. The nominal-value former S is additionally coupled with a rear axle sensor sender H over a second analog/digital converter A2. The front axle sender and the rear axle sender produce signals which are functions of the relative position of a motor vehicle body to the front and rear axles."

Limitation of '034 Patent Proposed Claim 38	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
38. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 496.	See claim 1 claim chart, above at page 496.
wherein the automatic directional control system is configured such that the pitch of the vehicle is capable of being determined by a pitch level sensor.		E.g., Abstract, "In a method and apparatus to regulate the illumination range of a motor vehicle in which, at a position on a front axle and at a position on a rear axle, signals are measured which are dependent upon the relative positions of a motor-vehicle body to the front axle and the rear axle, with a difference formation between the signal from the front axle and that of the rear axle being accomplished with a resulting difference signal, as a nominal-value signal, being filtered to a first average-value formation." E.g., col. 2, lines 40 to 48, "A front axle sensor sender (a device including or associated with a sensor for sending a sensed signal) V is here coupled with a nominal-value former over a first analog/digital converter A1. The nominal-value former S is additionally coupled with a rear axle

Limitation of '034 Patent Proposed Claim 38	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
		sensor sender H over a second analog/digital converter A2. The front axle sender and the rear axle sender produce signals which are functions of the relative position of a motor vehicle body to the front and rear axles."

Limitation of '034 Patent Proposed Claim 41	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
41. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 496.	See claim 1 claim chart, above at page 496.
wherein the automatic directional control system is configured such that the predetermined minimum threshold amount functions as a filter to minimize undesirable operation of the at least one actuator.	E.g., col. 6, line 42 to col. 7, line 2, "Referring to FIG. 8, from changes of the steering angle φ and the yaw angular velocity ω of FIGS. 7A and 7B, the following is understood. When the vehicle goes around the rightward curve, the steering wheel is turned to the right to have a positive steering angle φ at first, and the vehicle body yaws somewhat after the change of steering angle φ so that the yaw angular velocity ω increases following increase of the steering angle. In the meantime, the rear part of the vehicle is swung outside large, and therefore the driver turns the steering wheel to the left or in the opposite direction rapidly for counter-steering to recover direction of the vehicle. Namely, the steering angle φ changes from an upward incline to a downward incline in FIG. 7A. However, the yaw angular velocity ω is maintained due to inertia.	E.g., col. 4, lines 6 to 12, "At the coupling between the switchover device SE and the regulator R, a matching device AE is, here for example, arranged which, upon a switchover by the switchover device SE, adjusts the various nominal values to one another so that discontinuities or jumps in the adjustment and regulation of the illumination range are avoided."

Limitation of '034 Patent Proposed Claim 41	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
	Further, when the direction of the vehicle comes to show some recovery, the driver again turns the steering wheel to the right for going around the rightward curve, but he comes to carry out the counter-steering again soon after. Thus, the steering angle φ swings rightward and leftward in large variations. However, while the steering angle φ is swinging rightward and leftward as described above, the yaw angular velocity ω is maintained at a certain angular velocity stably in general, and at a time somewhat before the vehicle passes through the curve completely, the yaw angular velocity ω comes to coincide with the steering angle φ." E.g., col. 7, lines 34 to 39, "Since the actual light distribution control is performed on the basis of the above-mentioned final lighting angle 9, even 35 if the steering wheel is operated rapidly for the countersteering and the like, change of the lighting region is suppressed pertinently and the driver is given no sense of incongruity."	

Limitation of '034 Patent Proposed Claim 42	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
42. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 496.	See claim 1 claim chart, above at page 496.

Limitation of '034 Patent Proposed Claim 42	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
wherein said sensed conditions include three or more of road speed, steering angle, pitch, and suspension height of the vehicle.	E.g., col. 4, lines 61 to 67, "Fig. 3 is a rough block diagram showing a control system for changing the lighting region in the present embodiment. The vehicle has a steering angle sensor 21 for detecting a direction of a front wheel with respect to the vehicle body, i.e. a steering angle φ, a vehicle speed sensor 22 for detecting a vehicle speed v and a yaw rate sensor 23 for detecting a yaw angular velocity (yaw rate) ω."	E.g., page 6, lines 16 to 25 "The vehicle running condition detection device 4 is used to detect the running conditions of the vehicle (including the stopping or stationary condition thereof), while the detect signal of the vehicle running condition detection device 3 is transmitted to the control device 4. As the vehicle running condition detection device 3, for example, there can be used vehicle speed detection device which is one of the existing facilities of the vehicle. Also, every kind of information can be used, provided that it can be used to detect the running conditions of the vehicle." E.g., page 2, lines 6 to 13 "Therefore, there is conventionally known a device which includes a device for detecting the posture of the vehicle by detecting the inclination and height of a vehicle body, and calculates the amount of variations in the inclination of the vehicle based on the information that is obtained by the detect device, thereby being able to adjust automatically the illumination direction of the lamp." E.g., page 5, line 30 to page 6, line 9 "The vehicle posture detection device 2 is used to detect the posture of a vehicle (including the vertical inclination of the vehicle in the advancing direction thereof). For example, when there is used height detection device 7 which detects the height of the body of the vehicle, as shown in Fig. 2, there are available a method which measures a

Limitation of '034 Patent Proposed Claim 42	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
		distance L between the height detection device 7 and a road surface G by use of detect waves such as ultrasonic waves, laser beams or the like, and a method in which the height detection device 7 detects the expansion and contraction amount x of a suspension S in order to detect the amount of variations in the vertical position of the axle of the vehicle."

Limitation of '034 Patent Proposed Claim 43	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
43. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 496.	See claim 1 claim chart, above at page 496.
wherein said sensed conditions include all four of road speed, steering angle, pitch, and suspension height of the vehicle.	E.g., col. 4, lines 61 to 67, "Fig. 3 is a rough block diagram showing a control system for changing the lighting region in the present embodiment. The vehicle has a steering angle sensor 21 for detecting a direction of a front wheel with respect to the vehicle body, i.e. a steering angle φ, a vehicle speed sensor 22 for detecting a vehicle speed v and a yaw rate sensor 23 for detecting a yaw angular velocity (yaw rate) ω."	E.g., page 6, lines 16 to 25 "The vehicle running condition detection device 4 is used to detect the running conditions of the vehicle (including the stopping or stationary condition thereof), while the detect signal of the vehicle running condition detection device 3 is transmitted to the control device 4. As the vehicle running condition detection device 3, for example, there can be used vehicle speed detection device which is one of the existing facilities of the vehicle. Also, every kind of information can be used, provided that it can be used to detect the running conditions of the vehicle." E.g., page 2, lines 6 to 13 "Therefore, there is conventionally known a device which includes a

Limitation of '034 Patent Proposed Claim 43	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
		device for detecting the posture of the vehicle by detecting the inclination and height of a vehicle body, and calculates the amount of variations in the inclination of the vehicle based on the information that is obtained by the detect device, thereby being able to adjust automatically the illumination direction of the lamp." E.g., page 5, line 30 to page 6, line 9 "The vehicle posture detection device 2 is used to detect the posture of a vehicle (including the vertical inclination of the vehicle in the advancing direction thereof). For example, when there is used height detection device 7 which detects the height of the body of the vehicle, as shown in Fig. 2, there are available a method which measures a distance L between the height detection device 7 and a road surface G by use of detect waves such as ultrasonic waves, laser beams or the like, and a method in which the height detection device 7 detects the expansion and contraction amount x of a suspension S in order to detect the amount of variations in the vertical position of the axle of the vehicle."

Limitation of '034 Patent Proposed Claim 44	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
44. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 496.	See claim 1 claim chart, above at page 496.

Limitation of '034 Patent Proposed Claim 44	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
wherein said controller is configured to be responsive to said two or more sensor signals for generating at least one output signal only when said at least one of the two or more sensor signals changes by more than a predetermined minimum threshold amount to prevent at least one actuator from being operated continuously in response to relatively small variations in the sensed operating conditions.	E.g., col. 6, line 42 to col. 7, line 2, "Referring to FIG. 8, from changes of the steering angle φ and the yaw angular velocity ω of FIGS. 7A and 7B, the following is understood. When the vehicle goes around the rightward curve, the steering wheel is turned to the right to have a positive steering angle φ at first, and the vehicle body yaws somewhat after the change of steering angle φ so that the yaw angular velocity ω increases following increase of the steering angle. In the meantime, the rear part of the vehicle is swung outside large, and therefore the driver turns the steering wheel to the left or in the opposite direction rapidly for counter-steering to recover direction of the vehicle. Namely, the steering angle φ changes from an upward incline to a downward incline in FIG. 7A. However, the yaw angular velocity ω is maintained due to inertia. Further, when the direction of the vehicle comes to show some recovery, the driver again turns the steering wheel to the right for going around the rightward curve, but he comes to carry out the counter-steering again soon after. Thus, the steering angle φ swings rightward and leftward in large variations. However, while the steering angle φ is swinging rightward and leftward as described above, the yaw angular velocity ω is maintained at a certain angular velocity stably in general, and at a time	E.g., col. 4, lines 6 to 12, "At the coupling between the switchover device SE and the regulator R, a matching device AE is, here for example, arranged which, upon a switchover by the switchover device SE, adjusts the various nominal values to one another so that discontinuities or jumps in the adjustment and regulation of the illumination range are avoided."

Limitation of '034 Patent Proposed Claim 44	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
	somewhat before the vehicle passes through the curve completely, the yaw angular velocity ω comes to coincide with the steering angle φ." E.g., col. 7, lines 34 to 39, "Since the actual light distribution control is performed on the basis of the above-mentioned final lighting angle 9, even 35 if the steering wheel is operated rapidly for the countersteering and the like, change of the lighting region is suppressed pertinently and the driver is given no sense of incongruity."	

Limitation of '034 Patent Proposed Claim 45	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
45. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 496.	See claim 1 claim chart, above at page 496.
wherein controller is configured to be responsive to said two or more sensor signals for generating at least one output signal only when said at least one of the two or more sensor signals changes by more than a predetermined minimum threshold amount to prevent at least one actuator from being operated unduly frequently in response to relatively small variations in the sensed operating conditions.	E.g., col. 6, line 42 to col. 7, line 2, "Referring to FIG. 8, from changes of the steering angle φ and the yaw angular velocity ω of FIGS. 7A and 7B, the following is understood. When the vehicle goes around the rightward curve, the steering wheel is turned to the right to have a positive steering angle φ at first, and the vehicle body yaws somewhat after the change of steering angle φ so that the yaw angular velocity ω increases following increase of the steering angle. In the meantime, the rear part of the vehicle is swung outside large, and therefore the driver turns	E.g., col. 4, lines 6 to 12, "At the coupling between the switchover device SE and the regulator R, a matching device AE is, here for example, arranged which, upon a switchover by the switchover device SE, adjusts the various nominal values to one another so that discontinuities or jumps in the adjustment and regulation of the illumination range are avoided."

Limitation of '034 Patent Proposed Claim 45	U.S. Patent No. 5,909,949 (Gotoh)	U.S. Patent No. 5,182,460 (Hussman)
	the steering wheel to the left or in the opposite direction rapidly for counter-steering to recover direction of the vehicle. Namely, the steering angle φ changes from an upward incline to a downward incline in FIG. 7A. However, the yaw angular velocity ω is maintained due to inertia. Further, when the direction of the vehicle comes to show some recovery, the driver again turns the steering wheel to the right for going around the rightward curve, but he comes to carry out the counter-steering again soon after. Thus, the steering angle φ swings rightward and leftward in large variations. However, while the steering angle φ is swinging rightward and leftward as described above, the yaw angular velocity ω is maintained at a certain angular velocity stably in general, and at a time somewhat before the vehicle passes through the curve completely, the yaw angular velocity ω comes to coincide with the steering angle φ." E.g., col. 7, lines 34 to 39, "Since the actual light distribution control is performed on the basis of the above-mentioned final lighting angle 9, even if the steering wheel is operated rapidly for the countersteering and the like, change of the lighting region is suppressed pertinently and the driver is given no sense of incongruity."	

33. Proposed Claims 17 to 19, 21, 23, 26, and 30 to 32 Are Unpatentable in View of the Combination of Uchida and the Admitted Prior Art Described in the '034 Patent Specification Under 35 U.S.C. § 103(a)

Limitation of '034 Patent Proposed Claim 17	GB 2 309 773 (Uchida)	Admitted Prior Art
17. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 156.	
wherein the automatic directional control system is configured to include at least two actuators.		E.g., col. 3, lines 26 to 41, "To effect movement of the illustrated headlight 11 relative to the vehicle, an up/down actuator 12 and a left/right actuator 13 are provided. The actuators 12 and 13 are conventional in the art and may, for example, be embodied as servo motors, step motors, or any other electronically controlled mechanical actuators. It has been found to be desirable to use microstepping motors for the actuators 12 and 13. Such microstepping motors are known in the art and consist of conventional step motors that have appropriate hardware (i.e., driver integrated circuits) and software that allow the step motors to be operated in fractional step increments. The use of such microstepping motors has been found to be desirable because they can effect movements of the headlights in a somewhat faster, smoother, and quieter manner than conventional step motors, and further permit more precise positioning of the headlights 11."

Limitation of '034 Patent Proposed Claim 18	GB 2 309 773 (Uchida)	Admitted Prior Art
18. The automatic directional control system	See claim 17 claim chart, above at page 523.	

Limitation of '034 Patent Proposed Claim 18	GB 2 309 773 (Uchida)	Admitted Prior Art
defined in claim 17,		
wherein the at least two actuators include a first actuator that is adapted to be connected to the headlight to effect movement thereof in a vertical direction.		E.g., col. 3, lines 26 to 41, "To effect movement of the illustrated headlight 11 relative to the vehicle, an up/down actuator 12 and a left/right actuator 13 are provided. The actuators 12 and 13 are conventional in the art and may, for example, be embodied as servo motors, step motors, or any other electronically controlled mechanical actuators. It has been found to be desirable to use microstepping motors for the actuators 12 and 13. Such microstepping motors are known in the art and consist of conventional step motors that have appropriate hardware (i.e., driver integrated circuits) and software that allow the step motors to be operated in fractional step increments. The use of such microstepping motors has been found to be desirable because they can effect movements of the headlights in a somewhat faster, smoother, and quieter manner than conventional step motors, and further permit more precise positioning of the headlights 11."

Limitation of '034 Patent Proposed Claim 19	GB 2 309 773 A (Uchida)	Admitted Prior Art
19. The automatic directional control system defined in claim 18,	See claim 18 claim chart, above at page 523.	
wherein the at least two actuators include a second		E.g., col. 3, lines 26 to 41, "To effect movement of

Limitation of '034 Patent Proposed Claim 19	GB 2 309 773 A (Uchida)	Admitted Prior Art
actuator that is adapted to be connected to the headlight to effect movement thereof in a horizontal direction.		the illustrated headlight 11 relative to the vehicle, an up/down actuator 12 and a left/right actuator 13 are provided. The actuators 12 and 13 are conventional in the art and may, for example, be embodied as servo motors, step motors, or any other electronically controlled mechanical actuators. It has been found to be desirable to use microstepping motors for the actuators 12 and 13. Such microstepping motors are known in the art and consist of conventional step motors that have appropriate hardware (i.e., driver integrated circuits) and software that allow the step motors to be operated in fractional step increments. The use of such microstepping motors has been found to be desirable because they can effect movements of the headlights in a somewhat faster, smoother, and quieter manner than conventional step motors, and further permit more precise positioning of the headlights 11."

Limitation of '034 Patent Proposed Claim 21	GB 2 309 773 (Uchida)	Admitted Prior Art
21. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 156.	
wherein the at least one actuator includes a step motor.		E.g., col. 3, lines 26 to 41, "To effect movement of the illustrated headlight 11 relative to the vehicle, an up/down actuator 12 and a left/right actuator 13 are provided. The actuators 12 and 13 are conventional in the art and may, for example, be

Limitation of '034 Patent Proposed Claim 21	GB 2 309 773 (Uchida)	Admitted Prior Art
		embodied as servo motors, step motors, or any other electronically controlled mechanical actuators. It has been found to be desirable to use microstepping motors for the actuators 12 and 13. Such microstepping motors are known in the art and consist of conventional step motors that have appropriate hardware (i.e., driver integrated circuits) and software that allow the step motors to be operated in fractional step increments. The use of such microstepping motors has been found to be desirable because they can effect movements of the headlights in a somewhat faster, smoother, and quieter manner than conventional step motors, and further permit more precise positioning of the headlights 11."

Limitation of '034 Patent Proposed Claim 23	GB 2 309 773 (Uchida)	Admitted Prior Art
23. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 156.	
wherein the at least one actuator includes a microstepping motor capable of being operated in fractional step increments.		E.g., col. 3, lines 26 to 41, "To effect movement of the illustrated headlight 11 relative to the vehicle, an up/down actuator 12 and a left/right actuator 13 are provided. The actuators 12 and 13 are conventional in the art and may, for example, be embodied as servo motors, step motors, or any other electronically controlled mechanical actuators. It has been found to be desirable to use microstepping motors for the actuators 12 and 13.

Limitation of '034 Patent Proposed Claim 23	GB 2 309 773 (Uchida)	Admitted Prior Art
		Such microstepping motors are known in the art and consist of conventional step motors that have appropriate hardware (i.e., driver integrated circuits) and software that allow the step motors to be operated in fractional step increments. The use of such microstepping motors has been found to be desirable because they can effect movements of the headlights in a somewhat faster, smoother, and quieter manner than conventional step motors, and further permit more precise positioning of the headlights 11."

Limitation of '034 Patent Proposed Claim 26	GB 2 309 773 A (Uchida)	Admitted Prior Art
26. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 156.	
wherein the automatic directional control system is configured such that the headlight is adjustably mounted on the vehicle such that a directional orientation at which a beam of light projects therefrom is capable of being adjusted left and right relative to a vertical reference position.		E.g., col. 1, lines 36 to 61, "In the past, these headlights have been mounted on the vehicle in fixed positions relative thereto such that the beams of light are projected therefrom at predetermined directional aiming angles relative to the vehicle. Although such fixed aiming angle headlight systems have and continue to function adequately, they cannot alter the directional aiming angles of the headlights to account for changes in the operating conditions of the vehicle. For example, if the speed of the vehicle is increased, it would be desirable to adjust the aiming angle of the headlights upwardly such that an area that is

Limitation of '034 Patent Proposed Claim 26	GB 2 309 773 A (Uchida)	Admitted Prior Art
		somewhat farther in front of the vehicle is more brightly illuminated. On the other hand, if the speed of the vehicle is decreased, it would be desirable to adjust the aiming angle of the headlights downwardly such that an area that is somewhat closer in front of the vehicle is more brightly illuminated. Similarly, if the vehicle turns a corner, it would be desirable to adjust the aiming angle of the headlights either toward the left or toward the right (depending on the direction of the turn) such that an area that is somewhat lateral to the front of the vehicle is more brightly illuminated. To accomplish this, it is known to provide a directional control system for vehicle headlights that is capable of automatically altering the directional aiming angles of the headlights to account for changes in the operating conditions of the vehicle. A variety of such automatic directional control systems for vehicle headlights are known in the art. However, such known automatic headlight directional control systems have been found to be deficient for various reasons."

Limitation of '034 Patent Proposed Claim 30	GB 2 309 773 (Uchida)	Admitted Prior Art
30. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 156.	

Limitation of '034 Patent Proposed Claim 30	GB 2 309 773 (Uchida)	Admitted Prior Art
wherein the automatic directional control system further includes at least one position feedback sensor capable of providing a position feedback signal associated with the at least one actuator.		E.g., col. 3, line 49 to col. 4, line 6, "A headlight directional controller 14 is provided for controlling the operations of the up/down actuator 12 and the left/right actuator 13 and, therefore, the angle at which the beam of light projects from the headlight 11 relative to the vehicle. The headlight directional controller 14 can be embodied as any control system, such as a microprocessor or programmable electronic controller, that is responsive to one or more sensed operating conditions of the vehicle for selectively operating the up/down actuator 12 and the left/right actuator 13. To accomplish this, the automatic directional control system 10 can include, for example, a pair of condition sensors 15 and 16 that are connected to the headlight directional controller 14. The condition sensors 15 and 16 are conventional in the art and are responsive to respective sensed operating conditions of the vehicle for generating electrical signals to the headlight directional controller 14. However, if desired, only a single one of the condition sensors 15 and 16 need be provided. Alternatively, additional condition sensors (not shown) may be provided if desired to generate electrical signals that are representative of any other operating conditions of the vehicle. A conventional input/output device 17 is connected to (or can be connected to) the headlight directional controller 14 for facilitating communication therewith in the manner described below."

Limitation of '034 Patent Proposed Claim 31	GB 2 309 773 (Uchida)	Admitted Prior Art
31. The automatic directional control system defined in claim 30,	See claim 30 claim chart, above at page 528.	
wherein the at least one position feedback sensor includes a Hall Effect sensor.		E.g., col. 4, lines 24 to 30, "The position feedback sensors 18 and 19 can be embodied as any conventional sensor structures, such as Hall effect sensors, that are responsive to movements of the headlight 11 (or to the movements of the respective actuators 12 and 13 that are connected to move the headlight 11) for generating such signals."

Limitation of '034 Patent Proposed Claim 32	GB 2 309 773 (Uchida)	Admitted Prior Art
32. The automatic directional control system defined in claim 30,	See claim 30 claim chart, above at page 528.	
wherein the at least one position feedback sensor includes an optical interrupter.		E.g., col. 4, lines 31 to 36, "Alternatively, the position feedback sensors 18 and 19 can be embodied as respective devices that generate electrical signals whenever the headlight 11 has achieved respective predetermined up/down or left/right positions. This can be accomplished, for example, using a conventional optical interrupter (not shown) for each of the actuators 12 and 13."

34. Proposed Claims 19, 23, 26, and 30 to 32 Are Unpatentable in View of the Combination of Takahashi and the Admitted Prior Art Described in the '034 Patent Specification Under 35 U.S.C. § 103(a)

Limitation of '034 Patent Proposed Claim 19	GB 2 309 774 (Takahashi)	Admitted Prior Art
19. The automatic directional control system defined in claim 18,	See claim 18 claim chart, above at page 182.	
wherein the at least two actuators include a second actuator that is adapted to be connected to the headlight to effect movement thereof in a horizontal direction.		E.g., col. 3, lines 26 to 41, "To effect movement of the illustrated headlight 11 relative to the vehicle, an up/down actuator 12 and a left/right actuator 13 are provided. The actuators 12 and 13 are conventional in the art and may, for example, be embodied as servo motors, step motors, or any other electronically controlled mechanical actuators. It has been found to be desirable to use microstepping motors for the actuators 12 and 13. Such microstepping motors are known in the art and consist of conventional step motors that have appropriate hardware (i.e., driver integrated circuits) and software that allow the step motors to be operated in fractional step increments. The use of such microstepping motors has been found to be desirable because they can effect movements of the headlights in a somewhat faster, smoother, and quieter manner than conventional step motors, and further permit more precise positioning of the headlights 11."

Limitation of '034 Patent Proposed Claim 23	GB 2 309 774 (Takahashi)	Admitted Prior Art
23. The automatic directional control system	See claim 1 claim chart, above at page 173.	

Limitation of '034 Patent Proposed Claim 23	GB 2 309 774 (Takahashi)	Admitted Prior Art
defined in claim 1,		
wherein the at least one actuator includes a microstepping motor capable of being operated in fractional step increments.		E.g., col. 3, lines 26 to 41, "To effect movement of the illustrated headlight 11 relative to the vehicle, an up/down actuator 12 and a left/right actuator 13 are provided. The actuators 12 and 13 are conventional in the art and may, for example, be embodied as servo motors, step motors, or any other electronically controlled mechanical actuators. It has been found to be desirable to use microstepping motors for the actuators 12 and 13. Such microstepping motors are known in the art and consist of conventional step motors that have appropriate hardware (i.e., driver integrated circuits) and software that allow the step motors to be operated in fractional step increments. The use of such microstepping motors has been found to be desirable because they can effect movements of the headlights in a somewhat faster, smoother, and quieter manner than conventional step motors, and further permit more precise positioning of the headlights 11."

Limitation of '034 Patent Proposed Claim 26	GB 2 309 774 (Takahashi)	Admitted Prior Art
26. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 173.	
wherein the automatic directional control system is configured such that the headlight is adjustably		E.g., col. 1, lines 36 to 61, "In the past, these headlights have been mounted on the vehicle in

Limitation of '034 Patent Proposed Claim 26	GB 2 309 774 (Takahashi)	Admitted Prior Art
mounted on the vehicle such that a directional orientation at which a beam of light projects therefrom is capable of being adjusted left and right relative to a vertical reference position.		fixed positions relative thereto such that the beams of light are projected therefrom at predetermined directional aiming angles relative to the vehicle. Although such fixed aiming angle headlight systems have and continue to function adequately, they cannot alter the directional aiming angles of the headlights to account for changes in the operating conditions of the vehicle. For example, if the speed of the vehicle is increased, it would be desirable to adjust the aiming angle of the headlights upwardly such that an area that is somewhat farther in front of the vehicle is more brightly illuminated. On the other hand, if the speed of the vehicle is decreased, it would be desirable to adjust the aiming angle of the headlights downwardly such that an area that is somewhat closer in front of the vehicle is more brightly illuminated. Similarly, if the vehicle turns a corner, it would be desirable to adjust the aiming angle of the headlights either toward the left or toward the right (depending on the direction of the turn) such that an area that is somewhat lateral to the front of the vehicle is more brightly illuminated. To accomplish this, it is known to provide a directional control system for vehicle headlights that is capable of automatically altering the directional aiming angles of the headlights to account for changes in the operating conditions of the vehicle. A variety of such automatic directional control systems for vehicle headlights

Limitation of '034 Patent Proposed Claim 26	GB 2 309 774 (Takahashi)	Admitted Prior Art
		are known in the art. However, such known automatic headlight directional control systems have been found to be deficient for various reasons."

Limitation of '034 Patent Proposed Claim 30	GB 2 309 774 (Takahashi)	Admitted Prior Art
30. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 173.	
wherein the automatic directional control system further includes at least one position feedback sensor capable of providing a position feedback signal associated with the at least one actuator.		E.g., col. 3, line 49 to col. 4, line 6, "A headlight directional controller 14 is provided for controlling the operations of the up/down actuator 12 and the left/right actuator 13 and, therefore, the angle at which the beam of light projects from the headlight 11 relative to the vehicle. The headlight directional controller 14 can be embodied as any control system, such as a microprocessor or programmable electronic controller, that is responsive to one or more sensed operating conditions of the vehicle for selectively operating the up/down actuator 12 and the left/right actuator 13. To accomplish this, the automatic directional control system 10 can include, for example, a pair of condition sensors 15 and 16 that are connected to the headlight directional controller 14. The condition sensors 15 and 16 are conventional in the art and are responsive to respective sensed operating conditions of the vehicle for generating electrical signals to the headlight directional

Limitation of '034 Patent Proposed Claim 30	GB 2 309 774 (Takahashi)	Admitted Prior Art
		controller 14. However, if desired, only a single one of the condition sensors 15 and 16 need be provided. Alternatively, additional condition sensors (not shown) may be provided if desired to generate electrical signals that are representative of any other operating conditions of the vehicle. A conventional input/output device 17 is connected to (or can be connected to) the headlight directional controller 14 for facilitating communication therewith in the manner described below."

Limitation of '034 Patent Proposed Claim 31	GB 2 309 774 (Takahashi)	Admitted Prior Art
31. The automatic directional control system defined in claim 30,	See claim 30 claim chart, above at page 534.	See claim 30 claim chart, above at page 534.
wherein the at least one position feedback sensor includes a Hall Effect sensor.		E.g., col. 4, lines 24 to 30, "The position feedback sensors 18 and 19 can be embodied as any conventional sensor structures, such as Hall effect sensors, that are responsive to movements of the headlight 11 (or to the movements of the respective actuators 12 and 13 that are connected to move the headlight 11) for generating such signals."

Limitation of '034 Patent Proposed Claim 32	GB 2 309 774 (Takahashi)	Admitted Prior Art
32. The automatic directional control system defined in claim 30,	See claim 30 claim chart, above at page 534.	See claim 30 claim chart, above at page 534.
wherein the at least one position feedback sensor includes an optical interrupter.		E.g., col. 4, lines 31 to 36, "Alternatively, the position feedback sensors 18 and 19 can be embodied as respective devices that generate electrical signals whenever the headlight 11 has achieved respective predetermined up/down or left/right positions. This can be accomplished, for example, using a conventional optical interrupter (not shown) for each of the actuators 12 and 13."

35. Proposed Claims 17 to 21, 23 to 26, and 30 to 32 Are Unpatentable in View of the Combination of Hussman and the Admitted Prior Art Described in the '034 Patent Specification Under 35 U.S.C. § 103(a)

Limitation of '034 Patent Proposed Claim 17	U.S. Patent No. 5,182,460 (Hussman)	Admitted Prior Art
17. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 193.	
wherein the automatic directional control system is configured to include at least two actuators.		E.g., col. 3, lines 26 to 41, "To effect movement of the illustrated headlight 11 relative to the vehicle, an up/down actuator 12 and a left/right actuator 13 are provided. The actuators 12 and 13 are conventional in the art and may, for example, be embodied as servo motors, step motors, or any other electronically controlled mechanical actuators. It has been found to be desirable to use microstepping motors for the actuators 12 and 13. Such microstepping motors are known in the art and consist of conventional step motors that have appropriate hardware (i.e., driver integrated circuits) and software that allow the step motors to be operated in fractional step increments. The use of such microstepping motors has been found to be desirable because they can effect movements of the headlights in a somewhat faster, smoother, and quieter manner than conventional step motors, and further permit more precise positioning of the headlights 11."

Limitation of '034 Patent Proposed Claim 18	U.S. Patent No. 5,182,460 (Hussman)	Admitted Prior Art
18. The automatic directional control system	See claim 17 claim chart, above at page 537.	See claim 17 claim chart, above at page 537.

Limitation of '034 Patent Proposed Claim 18	U.S. Patent No. 5,182,460 (Hussman)	Admitted Prior Art
defined in claim 17,		
wherein the at least two actuators include a first actuator that is adapted to be connected to the headlight to effect movement thereof in a vertical direction.		E.g., col. 3, lines 26 to 41, "To effect movement of the illustrated headlight 11 relative to the vehicle, an up/down actuator 12 and a left/right actuator 13 are provided. The actuators 12 and 13 are conventional in the art and may, for example, be embodied as servo motors, step motors, or any other electronically controlled mechanical actuators. It has been found to be desirable to use microstepping motors for the actuators 12 and 13. Such microstepping motors are known in the art and consist of conventional step motors that have appropriate hardware (i.e., driver integrated circuits) and software that allow the step motors to be operated in fractional step increments. The use of such microstepping motors has been found to be desirable because they can effect movements of the headlights in a somewhat faster, smoother, and quieter manner than conventional step motors, and further permit more precise positioning of the headlights 11."

Limitation of '034 Patent Proposed Claim 19	U.S. Patent No. 5,182,460 (Hussman)	Admitted Prior Art
19. The automatic directional control system defined in claim 18,	See claim 18 claim chart, above at page 537.	See claim 18 claim chart, above at page 537.
wherein the at least two actuators include a second actuator that is adapted to be connected to the		E.g., col. 3, lines 26 to 41, "To effect movement of the illustrated headlight 11 relative to the vehicle,

Limitation of '034 Patent Proposed Claim 19	U.S. Patent No. 5,182,460 (Hussman)	Admitted Prior Art
headlight to effect movement thereof in a horizontal direction.		an up/down actuator 12 and a left/right actuator 13 are provided. The actuators 12 and 13 are conventional in the art and may, for example, be embodied as servo motors, step motors, or any other electronically controlled mechanical actuators. It has been found to be desirable to use microstepping motors for the actuators 12 and 13. Such microstepping motors are known in the art and consist of conventional step motors that have appropriate hardware (i.e., driver integrated circuits) and software that allow the step motors to be operated in fractional step increments. The use of such microstepping motors has been found to be desirable because they can effect movements of the headlights in a somewhat faster, smoother, and quieter manner than conventional step motors, and further permit more precise positioning of the headlights 11."

Limitation of '034 Patent Proposed Claim 20	U.S. Patent No. 5,182,460 (Hussman)	Admitted Prior Art
20. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 193.	
wherein the at least one actuator includes an electronically controlled mechanical actuator.		E.g., col. 3, lines 26 to 41, "To effect movement of the illustrated headlight 11 relative to the vehicle, an up/down actuator 12 and a left/right actuator 13 are provided. The actuators 12 and 13 are conventional in the art and may, for example, be embodied as servo motors, step motors, or any

Limitation of '034 Patent Proposed Claim 20	U.S. Patent No. 5,182,460 (Hussman)	Admitted Prior Art
		other electronically controlled mechanical actuators. It has been found to be desirable to use microstepping motors for the actuators 12 and 13. Such microstepping motors are known in the art and consist of conventional step motors that have appropriate hardware (i.e., driver integrated circuits) and software that allow the step motors to be operated in fractional step increments. The use of such microstepping motors has been found to be desirable because they can effect movements of the headlights in a somewhat faster, smoother, and quieter manner than conventional step motors, and further permit more precise positioning of the headlights 11."

Limitation of '034 Patent Proposed Claim 21	U.S. Patent No. 5,182,460 (Hussman)	Admitted Prior Art
21. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 193.	
wherein the at least one actuator includes a step motor.		E.g., col. 3, lines 26 to 41, "To effect movement of the illustrated headlight 11 relative to the vehicle, an up/down actuator 12 and a left/right actuator 13 are provided. The actuators 12 and 13 are conventional in the art and may, for example, be embodied as servo motors, step motors, or any other electronically controlled mechanical actuators. It has been found to be desirable to use microstepping motors for the actuators 12 and 13. Such microstepping motors are known in the art

Limitation of '034 Patent Proposed Claim 21	U.S. Patent No. 5,182,460 (Hussman)	Admitted Prior Art
		and consist of conventional step motors that have appropriate hardware (i.e., driver integrated circuits) and software that allow the step motors to be operated in fractional step increments. The use of such microstepping motors has been found to be desirable because they can effect movements of the headlights in a somewhat faster, smoother, and quieter manner than conventional step motors, and further permit more precise positioning of the headlights 11."

Limitation of '034 Patent Proposed Claim 23	U.S. Patent No. 5,182,460 (Hussman)	Admitted Prior Art
23. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 193.	
wherein the at least one actuator includes a microstepping motor capable of being operated in fractional step increments.		E.g., col. 3, lines 26 to 41, "To effect movement of the illustrated headlight 11 relative to the vehicle, an up/down actuator 12 and a left/right actuator 13 are provided. The actuators 12 and 13 are conventional in the art and may, for example, be embodied as servo motors, step motors, or any other electronically controlled mechanical actuators. It has been found to be desirable to use microstepping motors for the actuators 12 and 13. Such microstepping motors are known in the art and consist of conventional step motors that have appropriate hardware (i.e., driver integrated circuits) and software that allow the step motors to be operated in fractional step increments. The use

Limitation of '034 Patent Proposed Claim 23	U.S. Patent No. 5,182,460 (Hussman)	Admitted Prior Art
		of such microstepping motors has been found to be desirable because they can effect movements of the headlights in a somewhat faster, smoother, and quieter manner than conventional step motors, and further permit more precise positioning of the headlights 11."

Limitation of '034 Patent Proposed Claim 24	U.S. Patent No. 5,182,460 (Hussman)	Admitted Prior Art
24. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 193.	
wherein the automatic directional control system is configured such that the headlight is adjustably mounted on the vehicle such that a directional orientation at which a beam of light projects therefrom is capable of being adjusted relative to the vehicle.		E.g., col. 1, lines 36 to 61, "n the past, these headlights have been mounted on the vehicle in fixed positions relative thereto such that the beams of light are projected therefrom at predetermined directional aiming angles relative to the vehicle. Although such fixed aiming angle headlight systems have and continue to function adequately, they cannot alter the directional aiming angles of the headlights to account for changes in the operating conditions of the vehicle. For example, if the speed of the vehicle is increased, it would be desirable to adjust the aiming angle of the headlights upwardly such that an area that is somewhat farther in front of the vehicle is more brightly illuminated. On the other hand, if the speed of the vehicle is decreased, it would be desirable to adjust the aiming angle of the headlights downwardly such that an area that is

Limitation of '034 Patent Proposed Claim 24	U.S. Patent No. 5,182,460 (Hussman)	Admitted Prior Art
		somewhat closer in front of the vehicle is more brightly illuminated. Similarly, if the vehicle turns a corner, it would be desirable to adjust the aiming angle of the headlights either toward the left or toward the right (depending on the direction of the turn) such that an area that is somewhat lateral to the front of the vehicle is more brightly illuminated. To accomplish this, it is known to provide a directional control system for vehicle headlights that is capable of automatically altering the directional aiming angles of the headlights to account for changes in the operating conditions of the vehicle. A variety of such automatic directional control systems for vehicle headlights are known in the art. However, such known automatic headlight directional control systems have been found to be deficient for various reasons."

Limitation of '034 Patent Proposed Claim 25	U.S. Patent No. 5,182,460 (Hussman)	Admitted Prior Art
25. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 193.	
wherein the automatic directional control system is configured such that the headlight is adjustably mounted on the vehicle such that a directional orientation at which a beam of light projects		E.g., col. 1, lines 36 to 61, "In the past, these headlights have been mounted on the vehicle in fixed positions relative thereto such that the beams of light are projected therefrom at predetermined

Limitation of '034 Patent Proposed Claim 25	U.S. Patent No. 5,182,460 (Hussman)	Admitted Prior Art
therefrom is capable of being adjusted up and down relative to a horizontal reference position.		directional aiming angles relative to the vehicle. Although such fixed aiming angle headlight systems have and continue to function adequately, they cannot alter the directional aiming angles of the headlights to account for changes in the operating conditions of the vehicle. For example, if the speed of the vehicle is increased, it would be desirable to adjust the aiming angle of the headlights upwardly such that an area that is somewhat farther in front of the vehicle is more brightly illuminated. On the other hand, if the speed of the vehicle is decreased, it would be desirable to adjust the aiming angle of the headlights downwardly such that an area that is somewhat closer in front of the vehicle is more brightly illuminated. Similarly, if the vehicle turns a corner, it would be desirable to adjust the aiming angle of the headlights either toward the left or toward the right (depending on the direction of the turn) such that an area that is somewhat lateral to the front of the vehicle is more brightly illuminated. To accomplish this, it is known to provide a directional control system for vehicle headlights that is capable of automatically altering the directional aiming angles of the headlights to account for changes in the operating conditions of the vehicle. A variety of such automatic directional control systems for vehicle headlights are known in the art. However, such known automatic headlight directional control systems

Limitation of '034 Patent Proposed Claim 25	U.S. Patent No. 5,182,460 (Hussman)	Admitted Prior Art
		have been found to be deficient for various reasons."

Limitation of '034 Patent Proposed Claim 26	U.S. Patent No. 5,182,460 (Hussman)	Admitted Prior Art
26. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 193.	
wherein the automatic directional control system is configured such that the headlight is adjustably mounted on the vehicle such that a directional orientation at which a beam of light projects therefrom is capable of being adjusted left and right relative to a vertical reference position.		E.g., col. 1, lines 36 to 61, "In the past, these headlights have been mounted on the vehicle in fixed positions relative thereto such that the beams of light are projected therefrom at predetermined directional aiming angles relative to the vehicle. Although such fixed aiming angle headlight systems have and continue to function adequately, they cannot alter the directional aiming angles of the headlights to account for changes in the operating conditions of the vehicle. For example, if the speed of the vehicle is increased, it would be desirable to adjust the aiming angle of the headlights upwardly such that an area that is somewhat farther in front of the vehicle is more brightly illuminated. On the other hand, if the speed of the vehicle is decreased, it would be desirable to adjust the aiming angle of the headlights downwardly such that an area that is somewhat closer in front of the vehicle is more brightly illuminated. Similarly, if the vehicle turns a corner, it would be desirable to adjust the aiming angle of the headlights either toward the left or

Limitation of '034 Patent Proposed Claim 26	U.S. Patent No. 5,182,460 (Hussman)	Admitted Prior Art
		toward the right (depending on the direction of the turn) such that an area that is somewhat lateral to the front of the vehicle is more brightly illuminated. To accomplish this, it is known to provide a directional control system for vehicle headlights that is capable of automatically altering the directional aiming angles of the headlights to account for changes in the operating conditions of the vehicle. A variety of such automatic directional control systems for vehicle headlights are known in the art. However, such known automatic headlight directional control systems have been found to be deficient for various reasons."

Limitation of '034 Patent Proposed Claim 30	U.S. Patent No. 5,182,460 (Hussman)	Admitted Prior Art
30. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 193.	
wherein the automatic directional control system further includes at least one position feedback sensor capable of providing a position feedback signal associated with the at least one actuator.		E.g., col. 3, line 49 to col. 4, line 6, "A headlight directional controller 14 is provided for controlling the operations of the up/down actuator 12 and the left/right actuator 13 and, therefore, the angle at which the beam of light projects from the headlight 11 relative to the vehicle. The headlight directional controller 14 can be embodied as any control system, such as a microprocessor or

Limitation of '034 Patent Proposed Claim 30	U.S. Patent No. 5,182,460 (Hussman)	Admitted Prior Art
		programmable electronic controller, that is responsive to one or more sensed operating conditions of the vehicle for selectively operating the up/down actuator 12 and the left/right actuator 13. To accomplish this, the automatic directional control system 10 can include, for example, a pair of condition sensors 15 and 16 that are connected to the headlight directional controller 14. The condition sensors 15 and 16 are conventional in the art and are responsive to respective sensed operating conditions of the vehicle for generating electrical signals to the headlight directional controller 14. However, if desired, only a single one of the condition sensors 15 and 16 need be provided. Alternatively, additional condition sensors (not shown) may be provided if desired to generate electrical signals that are representative of any other operating conditions of the vehicle. A conventional input/output device 17 is connected to (or can be connected to) the headlight directional controller 14 for facilitating communication therewith in the manner described below."

Limitation of '034 Patent Proposed Claim 31	U.S. Patent No. 5,182,460 (Hussman)	Admitted Prior Art
3l. The automatic directional control system defined in claim 30,	See claim 30 claim chart, above at page 546.	See claim 30 claim chart, above at page 546.
wherein the at least one position feedback sensor		E.g., col. 4, lines 24 to 30, "The position feedback

Limitation of '034 Patent Proposed Claim 31	U.S. Patent No. 5,182,460 (Hussman)	Admitted Prior Art
includes a Hall Effect sensor.		sensors 18 and 19 can be embodied as any conventional sensor structures, such as Hall effect sensors, that are responsive to movements of the headlight 11 (or to the movements of the respective actuators 12 and 13 that are connected to move the headlight 11) for generating such signals."

Limitation of '034 Patent Proposed Claim 32	U.S. Patent No. 5,182,460 (Hussman)	Admitted Prior Art
32. The automatic directional control system defined in claim 30,	See claim 30 claim chart, above at page 546.	See claim 30 claim chart, above at page 546.
wherein the at least one position feedback sensor includes an optical interrupter.		E.g., col. 4, lines 31 to 36, "Alternatively, the position feedback sensors 18 and 19 can be embodied as respective devices that generate electrical signals whenever the headlight 11 has achieved respective predetermined up/down or left/right positions. This can be accomplished, for example, using a conventional optical interrupter (not shown) for each of the actuators 12 and 13."

36. Proposed Claim 27 Is Unpatentable Over the Combination of Uchida and Wassen et al. Under 35 U.S.C. § 103(a)

Limitation of '034 Patent Proposed Claim 27	GB 2 309 773 (Uchida)	U.S. Patent No. 4,954,933 (Wassen et al.)
27. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 156.	
wherein the automatic directional control system is configured such that, while in a calibration mode, a directional orientation at which a beam of light projects therefrom is capable of being adjusted relative to the vehicle by manual operation of the at least one actuator.		E.g., col. 3, lines 17 to 30, "When a driving member such as a small electrical motor M is associated with such an adjustment device, it is placed so as to face the lower bearing point A3 and is functionally connected thereto so as to be capable of achieving, by remote control, possibly in an automated way, the heightwise adjustment of the beam emitted by the headlight. In this case, the directional adjustment of the beam is still done manually because, as pointed out, it would be extremely complicated to provide for means for the mechanical switching-over of the mechanical power and a linkage for making the selective connection of the adjusting point A1 to the motor while, at the same time disengaging the connection with the diagonally opposite point A3."

37. Proposed Claim 27 Is Unpatentable Over the Combination of Takahashi and Wassen et al. Under 35 U.S.C. § 103(a)

Limitation of '034 Patent Proposed Claim 27	GB 2 309 774 (Takahashi)	U.S. Patent No. 4,954,933 (Wassen et al.)
27. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 173.	
wherein the automatic directional control system is configured such that, while in a calibration mode, a directional orientation at which a beam of light projects therefrom is capable of being adjusted relative to the vehicle by manual operation of the at least one actuator.		E.g., col. 3, lines 17 to 30, "When a driving member such as a small electrical motor M is associated with such an adjustment device, it is placed so as to face the lower bearing point A3 and is functionally connected thereto so as to be capable of achieving, by remote control, possibly in an automated way, the heightwise adjustment of the beam emitted by the headlight. In this case, the directional adjustment of the beam is still done manually because, as pointed out, it would be extremely complicated to provide for means for the mechanical switching-over of the mechanical power and a linkage for making the selective connection of the adjusting point A1 to the motor while, at the same time disengaging the connection with the diagonally opposite point A3."

38. Proposed Claim 27 Is Unpatentable Over the Combination of Hussman and Wassen et al. Under 35 U.S.C. § 103(a)

Limitation of '034 Patent Proposed Claim 27	U.S. Patent No. 5,182,460 (Hussman)	U.S. Patent No. 4,954,933 (Wassen et al.)
27. The automatic directional control system defined in claim 1,	See claim 1 claim chart, above at page 193.	
wherein the automatic directional control system is configured such that, while in a calibration mode, a directional orientation at which a beam of light projects therefrom is capable of being adjusted relative to the vehicle by manual operation of the at least one actuator.		E.g., col. 3, lines 17 to 30, "When a driving member such as a small electrical motor M is associated with such an adjustment device, it is placed so as to face the lower bearing point A3 and is functionally connected thereto so as to be capable of achieving, by remote control, possibly in an automated way, the heightwise adjustment of the beam emitted by the headlight. In this case, the directional adjustment of the beam is still done manually because, as pointed out, it would be extremely complicated to provide for means for the mechanical switching-over of the mechanical power and a linkage for making the selective connection of the adjusting point A1 to the motor while, at the same time disengaging the connection with the diagonally opposite point A3."

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	Automatic Directional Control System for Vehicle Headlights
First Named Inventor/Applicant Name:	James E. Smith
Filer:	Clifford A. Ulrich/Helen Tam
Attorney Docket Number:	

Filed as Large Entity

inter partes reexam Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Request for inter reexamination	1813	1	8800	8800
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
		Total in USD ($)		**8800**

Electronic Acknowledgement Receipt

EFS ID:	10100775
Application Number:	95001621
International Application Number:	
Confirmation Number:	1240
Title of Invention:	Automatic Directional Control System for Vehicle Headlights
First Named Inventor/Applicant Name:	James E. Smith
Customer Number:	26646
Filer:	Clifford A. Ulrich
Filer Authorized By:	
Attorney Docket Number:	
Receipt Date:	16-MAY-2011
Filing Date:	
Time Stamp:	19:02:48
Application Type:	inter partes reexam

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$8800
RAM confirmation Number	6368
Deposit Account	110600
Authorized User	ALI,ZEBA

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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Copy of patent for which reexamination is requested	Exhibit-1.pdf	2230858 c7a3e627f160be377c24c737f251c416a62e15c8	no	17
Warnings:					
Information:					
2	Reexam - Affidavit/Decl/Exhibit Filed by 3rd Party	Exhibit-2.pdf	2502387 ebb0e342ef5fc969be99252a9de7029d0fa6ec2b	no	40
Warnings:					
Information:					
3	Reexam - Affidavit/Decl/Exhibit Filed by 3rd Party	Exhibit-3.pdf	105836 cc269293a417533b72b471022426ec496b3df0d6	no	4
Warnings:					
Information:					
4	Reexam - Affidavit/Decl/Exhibit Filed by 3rd Party	Exhibit-4.pdf	49359 c8c55ae0e7b8af4984e47469ce5056b3bc4ae40d	no	2
Warnings:					
Information:					
5	Reexam - Affidavit/Decl/Exhibit Filed by 3rd Party	Exhibit-6.pdf	3190640 4c51f928043e9067057b7ba8096810867bc8aca5	no	39
Warnings:					
Information:					
6	Reexam - Affidavit/Decl/Exhibit Filed by 3rd Party	Exhibit-7.pdf	2588815 cf88543b3c2a4f0515c1c0e65a699eeed5e553a8	no	31
Warnings:					
Information:					
7	Reexam - Affidavit/Decl/Exhibit Filed by 3rd Party	Exhibit-8.pdf	1472739 02a806a62d84a55161fc67b521d728a0d3795a3d	no	9
Warnings:					
Information:					
8	Reexam - Affidavit/Decl/Exhibit Filed by 3rd Party	Exhibit-9.pdf	558013 ef2f09aa5e5cb13b435aa987e38fe47b8dd699d2	no	9

Warnings:					
Information:					
9	Reexam - Affidavit/Decl/Exhibit Filed by 3rd Party	Exhibit-10.pdf	519887 5700f1ba3c331e504bf6b3f1582dfe5cb14b1d38	no	8
Warnings:					
Information:					
10	Reexam - Affidavit/Decl/Exhibit Filed by 3rd Party	Exhibit-11.pdf	1800741 367185e06d877cbb12583f4d321802482e06a57f	no	25
Warnings:					
Information:					
11	Reexam - Affidavit/Decl/Exhibit Filed by 3rd Party	Exhibit-12.pdf	8390138 797c9dd79957838e2987abd680c100a60568440f	no	45
Warnings:					
Information:					
12	Reexam - Affidavit/Decl/Exhibit Filed by 3rd Party	Exhibit-13.pdf	1464677 60bc9f44975c3804ac39f54a12daf50219d054b0	no	12
Warnings:					
Information:					
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New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

EXHIBIT 1

US007241034B2

(12) **United States Patent**
Smith et al.

(10) **Patent No.: US 7,241,034 B2**
(45) **Date of Patent: Jul. 10, 2007**

(54) **AUTOMATIC DIRECTIONAL CONTROL SYSTEM FOR VEHICLE HEADLIGHTS**

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(73) Assignee: **Dana Corporation**, Toledo, OH (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **10/285,312**

(22) Filed: **Oct. 31, 2002**

(65) **Prior Publication Data**

US 2003/0107898 A1 Jun. 12, 2003

Related U.S. Application Data

(60) Provisional application No. 60/369,447, filed on Apr. 2, 2002, provisional application No. 60/356,703, filed on Feb. 13, 2002, provisional application No. 60/335,409, filed on Oct. 31, 2001.

(51) **Int. Cl.**
B60Q 1/00 (2006.01)
B60R 22/00 (2006.01)

(52) **U.S. Cl.** **362/465**; 701/49

(58) **Field of Classification Search** 362/37, 362/465–466; 315/82; 701/49
See application file for complete search history.

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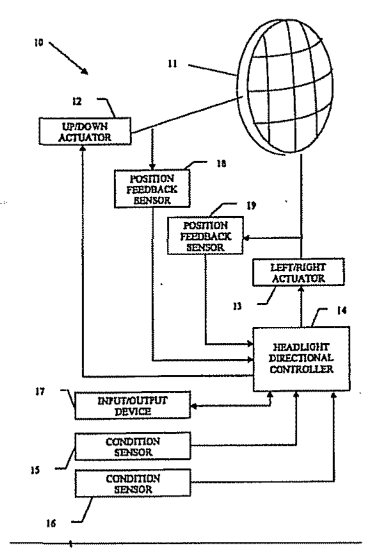
Primary Examiner—Ali Alavi
(74) *Attorney, Agent, or Firm*—MacMillan, Sobanski & Todd, LLC

(57) **ABSTRACT**

A structure and method for operating a directional control system for vehicle headlights that is capable of altering the directional aiming angles of the headlights to account for changes in the operating conditions of the vehicle. One or more operating condition sensors may be provided that generate signals that are representative of a condition of the vehicle, such as road speed, steering angle, pitch, suspension height, rate of change of road speed, rate of change of steering angle, rate of change of pitch, and rate of change of suspension height of the vehicle. A controller is responsive to the sensor signal for generating an output signal. An actuator is adapted to be connected to the headlight to effect movement thereof in accordance with the output signal. The controller can include a table that relates values of sensed operating condition to values of the output signal. The controller is responsive to the sensor signal for looking up the output signal in the table.

5 Claims, 7 Drawing Sheets



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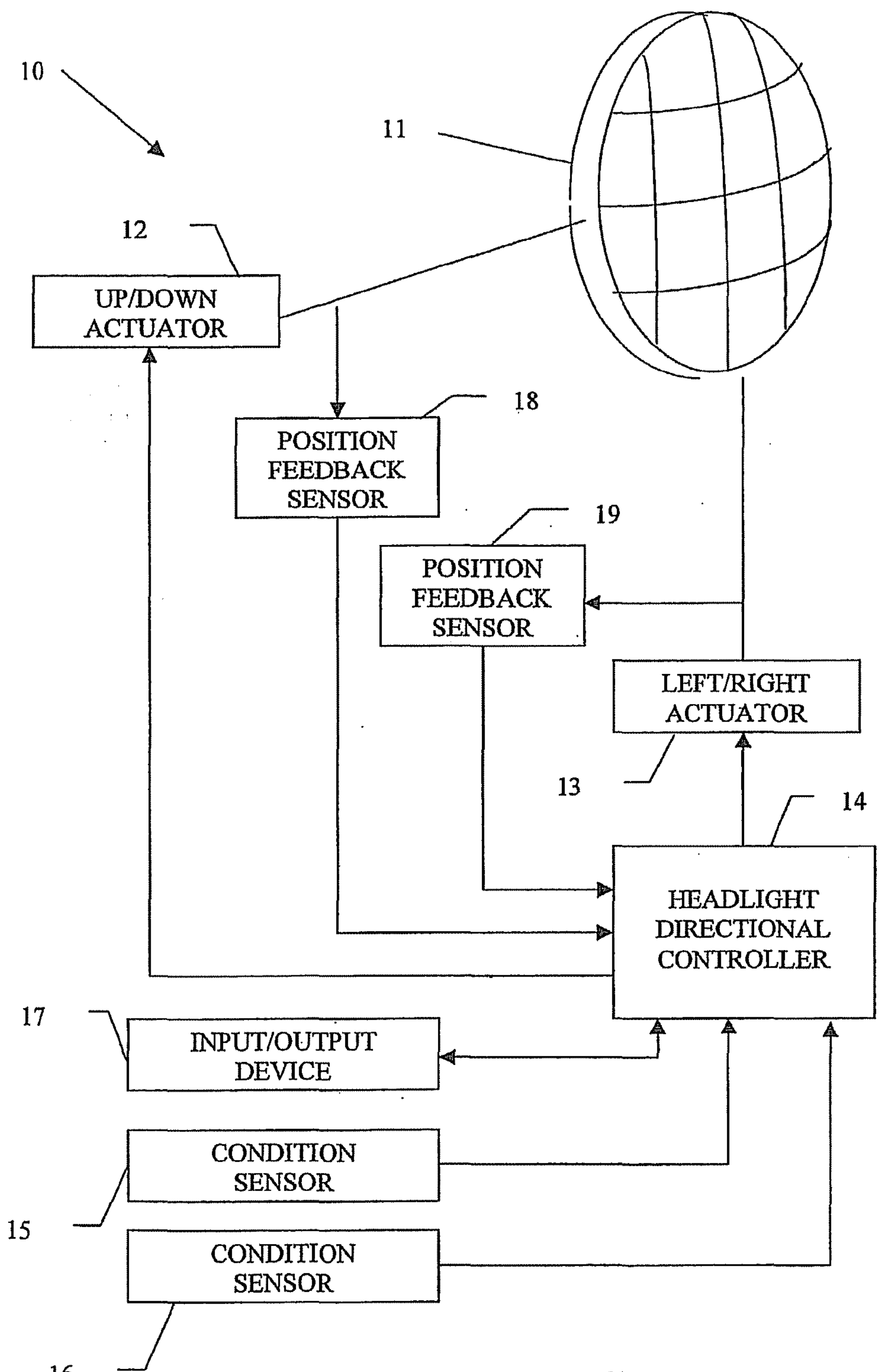
10
11
12
UP/DOWN ACTUATOR
18
POSITION FEEDBACK SENSOR
19
POSITION FEEDBACK SENSOR
LEFT/RIGHT ACTUATOR
13
14
HEADLIGHT DIRECTIONAL CONTROLLER
17
INPUT/OUTPUT DEVICE
CONDITION SENSOR
15
CONDITION SENSOR
16

FIG. 1

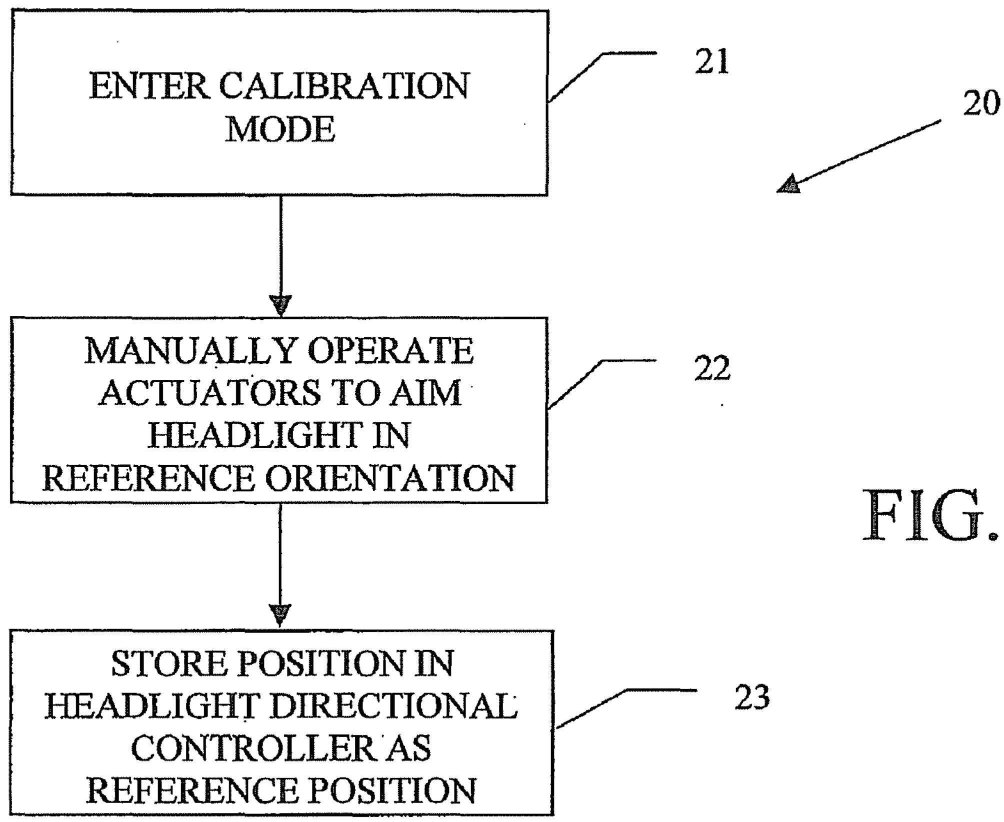
ENTER CALIBRATION MODE
21
20
MANUALLY OPERATE ACTUATORS TO AIM HEADLIGHT IN REFERENCE ORIENTATION
22
STORE POSITION IN HEADLIGHT DIRECTIONAL CONTROLLER AS REFERENCE POSITION
23

FIG. 2

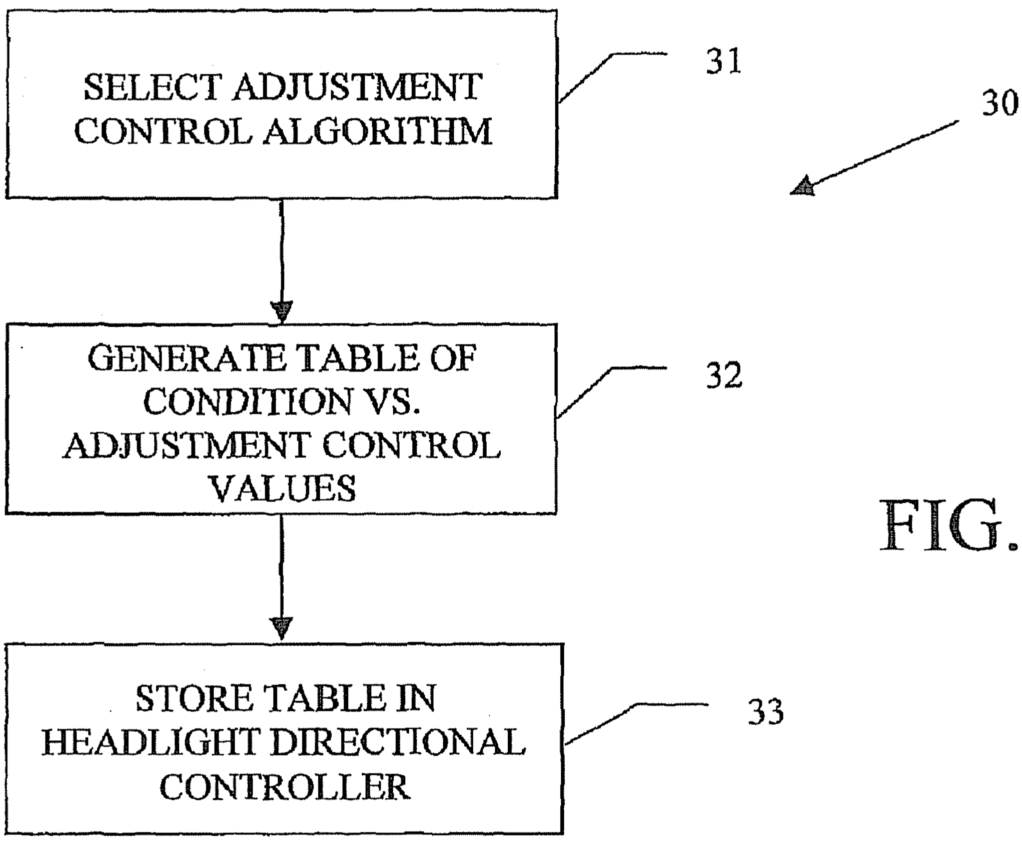
SELECT ADJUSTMENT CONTROL ALGORITHM
31
30
GENERATE TABLE OF CONDITION VS. ADJUSTMENT CONTROL VALUES
32
STORE TABLE IN HEADLIGHT DIRECTIONAL CONTROLLER
33

FIG. 3

40

SENSED CONDITION (STEERING ANGLE) VALUES	UP/DOWN ADJUSTMENT FACTORS	LEFT/RIGHT ADJUSTMENT FACTORS
+6°	-3.00°	+4.50°
+5°	-2.50°	+3.75°
+4°	-2.00°	+3.00°
+3°	-1.50°	+2.25°
+2°	-1.00°	+1.50°
+1°	-0.50°	+0.75°
0°	0.00°	0.00°
-1°	-0.50°	-0.75°
-2°	-1.00°	-1.50°
-3°	-1.50°	-2.25°
-4°	-2.00°	-3.00°
-5°	-2.50°	-3.75°
-6°	-3.00°	-4.50°

FIG. 4

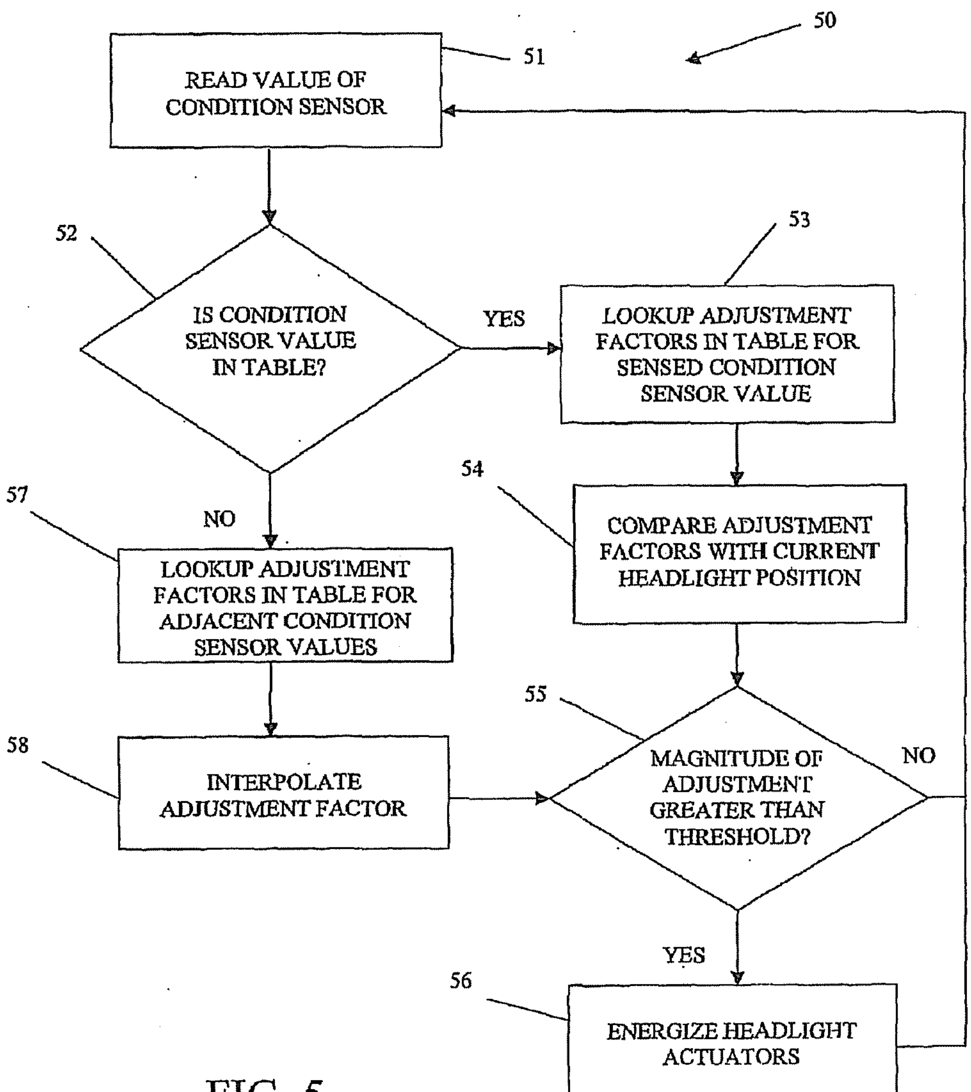
50
51
READ VALUE OF CONDITION SENSOR
52
IS CONDITION SENSOR VALUE IN TABLE?
YES
53
LOOKUP ADJUSTMENT FACTORS IN TABLE FOR SENSED CONDITION SENSOR VALUE
54
COMPARE ADJUSTMENT FACTORS WITH CURRENT HEADLIGHT POSITION
57
NO
LOOKUP ADJUSTMENT FACTORS IN TABLE FOR ADJACENT CONDITION SENSOR VALUES
55
58
INTERPOLATE ADJUSTMENT FACTOR
MAGNITUDE OF ADJUSTMENT GREATER THAN THRESHOLD?
NO
YES
56
ENERGIZE HEADLIGHT ACTUATORS

FIG. 5

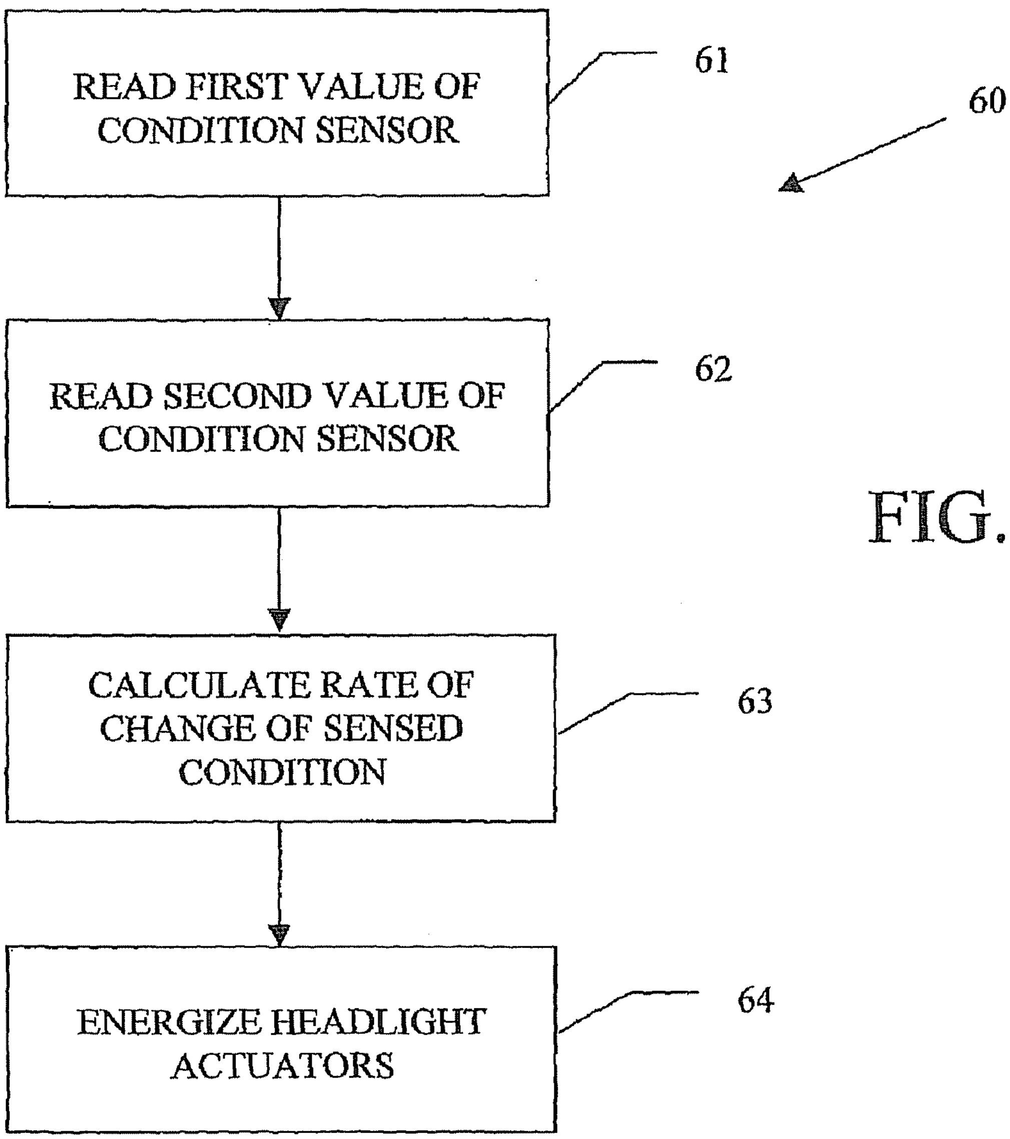
READ FIRST VALUE OF CONDITION SENSOR
61
60
READ SECOND VALUE OF CONDITION SENSOR
62
CALCULATE RATE OF CHANGE OF SENSED CONDITION
63
ENERGIZE HEADLIGHT ACTUATORS
64

FIG. 6

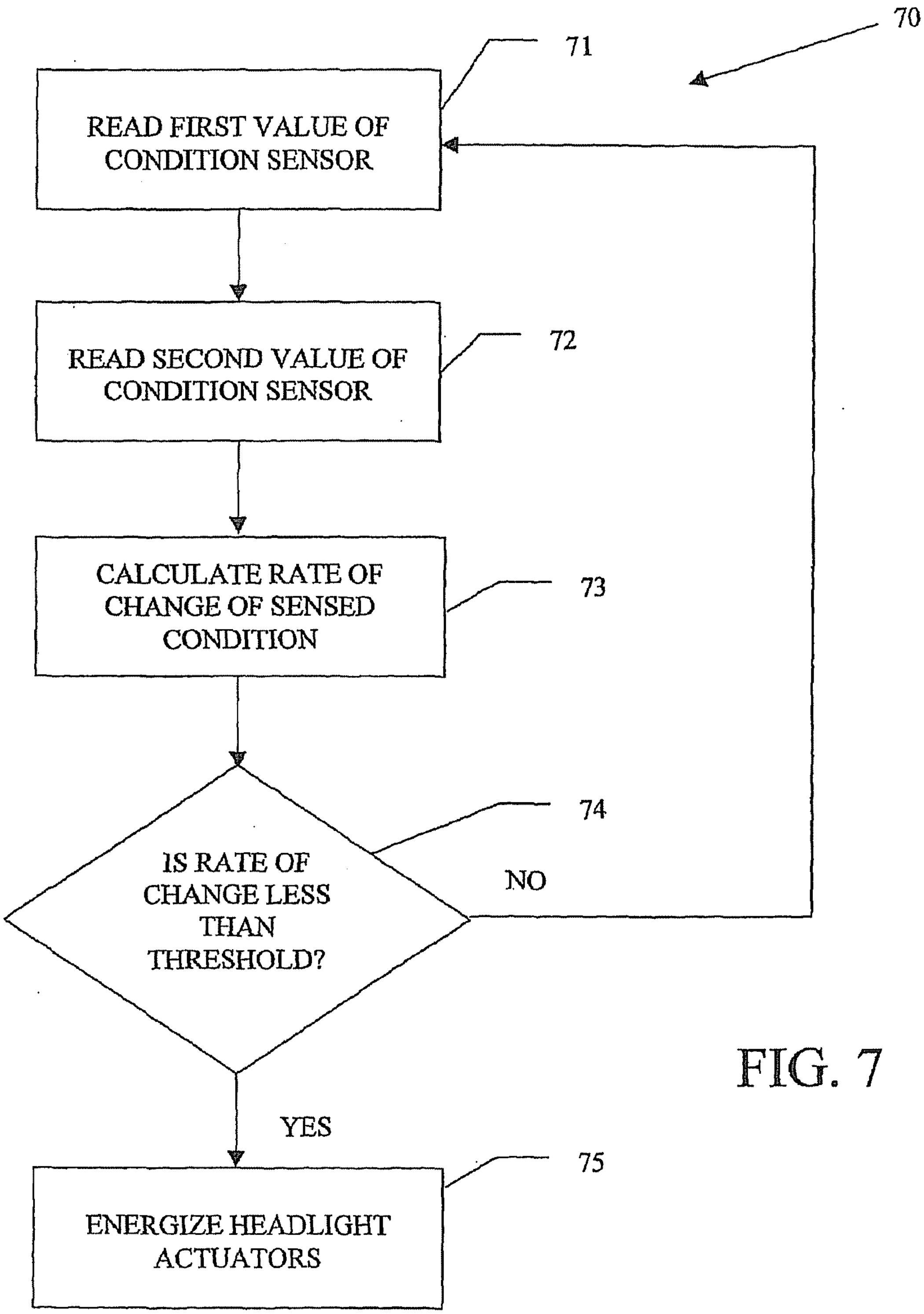
70
71
READ FIRST VALUE OF CONDITION SENSOR
72
READ SECOND VALUE OF CONDITION SENSOR
73
CALCULATE RATE OF CHANGE OF SENSED CONDITION
74
IS RATE OF CHANGE LESS THAN THRESHOLD?
NO
YES
75
ENERGIZE HEADLIGHT ACTUATORS

FIG. 7

AUTOMATIC DIRECTIONAL CONTROL SYSTEM FOR VEHICLE HEADLIGHTS

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Application Nos. 60/335,409, filed Oct. 31, 2001; 60/356,703, filed Feb. 13, 2002; and 60/369,447, filed Apr. 2, 2002, the disclosures of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

This invention relates in general to headlights that are provided on vehicles for illuminating dark road surfaces or other areas in the path of movement. In particular, this invention relates to an automatic directional control system for such vehicle headlights.

Virtually all land vehicles, and many other types of vehicles (such as boats and airplanes, for example), are provided with one or more headlights that are adapted to illuminate a portion of a dark road surface or other area in the path of movement of the vehicle to facilitate safe travel thereon. Typically, each headlight is mounted on or near the front end of the vehicle and is oriented in such a manner that a beam of light is projected forwardly therefrom. The angle at which the beam of light projects from the headlight can, for example, be characterized in a variety of ways, including (1) up and down relative to a horizontal reference position or plane and (2) left and right relative to a vertical reference position or plane. Such directional aiming angles are usually set at the time of assembly of the headlight into the vehicle so as to illuminate a predetermined portion of the road surface or other area in the path of movement of the vehicle.

In the past, these headlights have been mounted on the vehicle in fixed positions relative thereto such that the beams of light are projected therefrom at predetermined directional aiming angles relative to the vehicle. Although such fixed aiming angle headlight systems have and continue to function adequately, they cannot alter the directional aiming angles of the headlights to account for changes in the operating conditions of the vehicle. For example, if the speed of the vehicle is increased, it would be desirable to adjust the aiming angle of the headlights upwardly such that an area that is somewhat farther in front of the vehicle is more brightly illuminated. On the other hand, if the speed of the vehicle is decreased, it would be desirable to adjust the aiming angle of the headlights downwardly such that an area that is somewhat closer in front of the vehicle is more brightly illuminated. Similarly, if the vehicle turns a corner, it would be desirable to adjust the aiming angle of the headlights either toward the left or toward the right (depending on the direction of the turn) such that an area that is somewhat lateral to the front of the vehicle is more brightly illuminated.

To accomplish this, it is known to provide a directional control system for vehicle headlights that is capable of automatically altering the directional aiming angles of the headlights to account for changes in the operating conditions of the vehicle. A variety of such automatic directional control systems for vehicle headlights are known in the art. However, such known automatic headlight directional control systems have been found to be deficient for various reasons. Thus, it would be desirable to provide an improved structure for an automatic headlight directional control system that addresses such deficiencies.

SUMMARY OF THE INVENTION

This invention relates to an improved structure and method for operating a directional control system for vehicle headlights that is capable of automatically altering the directional aiming angles of the headlights to account for changes in the operating conditions of the vehicle. One or more operating condition sensors may be provided that generate signals that are representative of an operating condition of the vehicle, such as road speed, steering angle, pitch, suspension height, rate of change of road speed, rate of change of steering angle, rate of change of pitch, and rate of change of suspension height of the vehicle. A controller is responsive to the sensor signal for generating an output signal. An actuator is adapted to be connected to the headlight to effect movement thereof in accordance with the output signal. The controller can include a table that relates values of sensed operating condition to values of the output signal. The controller is responsive to the sensor signal for looking up the output signal in the table.

Various objects and advantages of this invention will become apparent to those skilled in the art from the following detailed description of the preferred embodiments, when read in light of the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram of an automatic directional control system for a vehicle headlight in accordance with this invention.

FIG. **2** is a flow chart of an algorithm for calibrating the automatic directional control system illustrated in FIG. **1** so as to define an initial reference position for the headlight from which the headlight directional controller can implement directional angle adjustments.

FIG. **3** is a flow chart of an algorithm for generating a table that relates one or more sensed vehicle operating condition values to one or more headlight directional angle adjustment factors and for storing such table in the headlight directional controller illustrated in FIG. **1**.

FIG. **4** is an example of a table that can be generated and stored in the headlight directional controller in accordance with the table generating algorithm illustrated in FIG. **3**.

FIG. **5** is a flow chart of an algorithm for operating the headlight directional controller illustrated in FIG. **1** to automatically implement directional angle adjustments in accordance with sensed condition values.

FIG. **6** is a flow chart of an algorithm for operating the headlight directional controller illustrated in FIG. **1** to automatically implement directional angle adjustments in accordance with the rate of change of one or more of the sensed condition values.

FIG. **7** is a flow chart of an algorithm for operating the headlight directional controller illustrated in FIG. **1** to automatically implement directional angle adjustments, but only when the rate of change of one or more of the sensed condition values is less than (or greater than) a predetermined value.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, there is illustrated in FIG. **1** an automatic directional control system, indicated generally at **10**, for a vehicle headlight **11** in accordance with this invention. The illustrated headlight **11** is, of itself, conventional in the art and is intended to be representative of any device that can be supported on any type of vehicle for the purpose of illuminating any area, such as an area in the path of movement of the vehicle. The headlight **11** is typically mounted on or near the front end of a vehicle (not shown) and is oriented in such a manner that a beam of light is projected therefrom. In a manner that is well known in the art, the headlight **11** is adapted to illuminate a portion of a dark road surface or other area in the path of movement of the vehicle to facilitate safe travel thereon.

The headlight **11** is adjustably mounted on the vehicle such that the directional orientation at which the beam of light projects therefrom can be adjusted relative to the vehicle. Any desired mounting structure can be provided to accomplish this. Typically, the headlight **11** is mounted on the vehicle such that the angle at which the beam of light projects therefrom can be adjusted both (1) up and down relative to a horizontal reference position or plane and (2) left and right relative to a vertical reference position or plane. Although this invention will be described and illustrated in the context of a headlight that is adjustable in both the up/down direction and the left/right direction, it will be appreciated that this invention may be practiced with any headlight **11** that is adjustable in any single direction or multiple directions of movement, whether up/down, left/right, or any other direction.

To effect movement of the illustrated headlight **11** relative to the vehicle, an up/down actuator **12** and a left/right actuator **13** are provided. The actuators **12** and **13** are conventional in the art and may, for example, be embodied as servo motors, step motors, or any other electronically controlled mechanical actuators. It has been found to be desirable to use microstepping motors for the actuators **12** and **13**. Such microstepping motors are known in the art and consist of conventional step motors that have appropriate hardware (i.e., driver integrated circuits) and software that allow the step motors to be operated in fractional step increments. The use of such microstepping motors has been found to be desirable because they can effect movements of the headlights in a somewhat faster, smoother, and quieter manner than conventional step motors, and further permit more precise positioning of the headlights **11**. In the illustrated embodiment, the up/down actuator **12** is mechanically connected to the headlight **11** such that the headlight **11** can be selectively adjusted up and down relative to a horizontal reference position or plane. Similarly, the illustrated left/right actuator **13** is mechanically connected to the headlight **11** such that the headlight **11** can be selectively adjusted left and right relative to a vertical reference position or plane.

A headlight directional controller **14** is provided for controlling the operations of the up/down actuator **12** and the left/right actuator **13** and, therefore, the angle at which the beam of light projects from the headlight **11** relative to the vehicle. The headlight directional controller **14** can be embodied as any control system, such as a microprocessor or programmable electronic controller, that is responsive to one or more sensed operating conditions of the vehicle for selectively operating the up/down actuator **12** and the left/right actuator **13**. To accomplish this, the automatic directional control system **10** can include, for example, a pair of condition sensors **15** and **16** that are connected to the headlight directional controller **14**. The condition sensors **15** and **16** are conventional in the art and are responsive to respective sensed operating conditions of the vehicle for generating electrical signals to the headlight directional controller **14**. However, if desired, only a single one of the condition sensors **15** and **16** need be provided. Alternatively, additional condition sensors (not shown) may be provided if desired to generate electrical signals that are representative of any other operating conditions of the vehicle. A conventional input/output device **17** is connected to (or can be connected to) the headlight directional controller **14** for facilitating communication therewith in the manner described below.

If desired, a first position feedback sensor **18** may be provided for the up/down actuator **12**, and a second position feedback sensor **19** may be provided for the left/right actuator **13**. The position feedback sensors **18** and **19** are conventional in the art and are adapted to generate respective electrical signals that are representative of the actual up/down and left/right positions of the headlight **11**. Thus, the first position feedback sensor **18** is responsive to the actual up/down position of the headlight **11** (as determined by a portion of the up/down actuator **12**, for example) for generating an electrical signal to the headlight directional controller **14** that is representative thereof. Similarly, the second position feedback sensor **19** is responsive to the actual left/right position of the headlight **11** (as determined by a portion of the left/right actuator **13**, for example) for generating an electrical signal to the headlight directional controller **14** that is representative thereof. The position feedback sensors **18** and **19** can be embodied as any conventional sensor structures, such as Hall effect sensors, that are responsive to movements of the headlight **11** (or to the movements of the respective actuators **12** and **13** that are connected to move the headlight **11**) for generating such signals.

Alternatively, the position feedback sensors **18** and **19** can be embodied as respective devices that generate electrical signals whenever the headlight **11** has achieved respective predetermined up/down or left/right positions. This can be accomplished, for example, using a conventional optical interrupter (not shown) for each of the actuators **12** and **13**. Each of the optical interrupters includes a flag or other component that is mounted on or connected to the headlight **11** for movement therewith. Each of the optical interrupters further includes an optical source and sensor assembly. As the headlight **11** is moved by the actuators **12** and **13**, the flag moves therewith relative to the optical source and sensor assembly between a first position, wherein the flag permits light emitted from the source from reaching the sensor, and a second position, wherein the flag prevents light emitted from the source from reaching the sensor. When the flag is in the first position relative to the optical source and sensor assembly, the sensor is permitted to receive light emitted from the source. As a result, a first signal is generated from the optical source and sensor assembly to the headlight directional controller **14**. Conversely, when the flag is in the second position relative to the optical source and sensor assembly, the sensor is not permitted to receive light emitted from the source. As a result, a second signal is generated from the optical source and sensor assembly to the headlight directional controller **14**. Thus, the edge of the flag defines a transition between the first and second positions of the flag relative to the optical source and sensor assembly and, therefore, defines a predetermined up/down or left/right position of the headlight **11**. The nature of the signal generated from the optical source and sensor assembly to the headlight directional controller **14** (i.e., the first signal or the second signal) can also be used to determine on which side of the predetermined position (the left side or the right side, for example) that the headlight **11** is positioned. The purpose for such position feedback sensors **18** and **19** will be discussed below.

FIG. 2 is a flow chart of an algorithm, indicated generally at 20, for calibrating the automatic directional control system illustrated in FIG. 1 so as to define an initial reference position or positions for the headlight 11 from which the headlight directional controller 14 can implement directional angle adjustments. As mentioned above, the headlight 11 is mounted on the vehicle such that the angle at which the beam of light projects therefrom can be adjusted both up and down relative to a horizontal reference position or plane and left and right relative to a vertical reference position or plane. To insure accurate positioning of the headlight 11, it is desirable that a reference position or positions be initially established by the headlight directional controller 14. Subsequent directional angle adjustments can be made by the headlight directional controller 14 from the pre-established reference position or positions established by this calibration algorithm 20.

To accomplish this, the calibration algorithm 20 has a first step 21 wherein the headlight directional controller 14 is caused to enter a calibration mode of operation. In the calibration mode of operation, the headlight directional controller 14 is responsive to input signals from the input/output device 17 (or from another source, if desired) for causing manual operation of the up/down actuator 12 and the left/right actuator 13. Thus, while the headlight directional controller 14 is in the calibration mode of operation, an operator of the input/output device 17 can manually effect either up/down movement of the headlight 11, left/right movement of the headlight 11, or both, as desired.

In a second step 22 of the calibration algorithm 20, the up/down actuator 12 and the left/right actuator 13 are manually operated to aim the headlight 11 in a predetermined reference orientation. This can be accomplished by use of the input/output device 17 that, as mentioned above, is connected to (or can be connected to) the headlight directional controller 14. Traditionally, the aiming of a headlight 11 has been accomplished by parking the vehicle on a surface near a wall or other vertical structure, providing a reference target at a predetermined location on the wall or other structure, and mechanically adjusting the mounting structure of the headlight 11 such that the center of the beam therefrom is projected at the reference target. In this invention, the vehicle is parked on a surface near a wall or other vertical structure, and a reference target is provided at a predetermined location on the wall or other structure, as described above. Next, in accordance with the second step 22 of this calibration algorithm 20, the input/output device 17 is operated to generate electrical signals to the headlight directional controller 14. In response to such electrical signals, the headlight directional controller 14 operates the up/down actuator 12 and the left/right actuator 13 to move the headlight 11 such that center of the beam projecting therefrom is aimed at the reference target. When the beam from the headlight 11 is so aimed, then the headlight 11 is determined to be oriented in the initial reference position from which the headlight directional controller 14 can subsequently implement directional angle adjustments.

In a third step 23 of the calibration algorithm 20, once this initial reference position for the headlight 11 has been achieved, such position is stored in the headlight directional controller 14 as the predetermined initial reference position. This can be accomplished by means of the position feedback sensors 18 and 19. As discussed above, the position feedback sensors 18 and 19 are adapted to generate respective electrical signals that are representative of the actual up/down and left/right positions of the headlight 11 or of the predetermined positions for the headlight. Thus, the first position feedback sensor 18 is responsive to the actual up/down position of the headlight 11 (as determined by the up/down actuator 12, for example) for generating an electrical signal to the headlight directional controller 14 that is representative thereof. Similarly, the second position feedback sensor 19 is responsive to the actual left/right position of the headlight 11 (as determined by the left/right actuator 13, for example) for generating an electrical signal to the headlight directional controller 14 that is representative thereof. Accordingly, the third step 23 of the calibration algorithm 20 can be performed by causing the headlight directional controller 14 to read the signals from the position feedback sensors 18 and 19 and store the current up/down and left/right positions of the headlight 11 as the initial reference positions from which the headlight directional controller 14 can subsequently implement directional angle adjustments.

The current position of the headlight 11 is preferably stored in the non-volatile memory of the headlight directional controller 14 for reference during normal operation of the automatic directional control system 10 described below. Thus, when the automatic directional control system 10 is initially activated (such as when the electrical system of the vehicle is initially turned on), the headlight directional controller 14 can position the headlight 11 at or near the calibrated position utilizing the signals comparing the current position of the headlight 11 (as determined by the signals generated by the position feedback sensors 18 and 19) with the predetermined reference position determined by the calibration algorithm 20.

FIG. 3 is a flow chart of an algorithm, indicated generally at 30, for generating a table that relates the sensed condition values from the condition sensors 15 and 16 to the headlight directional angle adjustment factors that will be implemented by the headlight directional controller 14, and further for storing such table in the headlight directional controller 14 illustrated in FIG. 1. As used herein, the term "table" is intended to be representative of any collection or association of data that relates one or more of the sensed condition values to one or more of the headlight directional angle adjustment factors. The table of data can be generated, stored, and expressed in any desired format. For example, this table of data can be generated, stored, and expressed in a conventional spreadsheet format, such as shown in FIG. 4, which will be discussed in detail below.

In a first step 31 of the table generating algorithm 30, an adjustment control algorithm is selected. The adjustment control algorithm can be, generally speaking, any desired relationship that relates one or more operating conditions of the vehicle to one or more angular orientations of the headlight 11. A variety of such relationships are known in the art, and this invention is not intended to be limited to any particular relationship. Typically, such relationships will be expressed in terms of a mathematical equation or similar relationship that can be readily processed using a microprocessor or similar electronic computing apparatus, such as the above-described headlight directional controller 14. The particular adjustment control algorithm that is selected may, if desired, vary from vehicle to vehicle in accordance with a variety of factors, including relative size and performance characteristics of the vehicle or any other desired condition.

As mentioned above, a plurality of operating conditions may be sensed by the condition sensors 15 and 16 and provided to the headlight directional controller 14 for use with the adjustment control mechanism. For example, the condition sensors 15 and 16 may generate electrical signals to the headlight directional controller 14 that are representative of the road speed, the steering angle, and the pitch of the vehicle (which can, for example, be determined by sensing the front and rear suspension heights of the vehicle or by a pitch or level sensor). Additionally, the time derivative of these operating conditions (i.e., the rate of change of the road speed, steering angle, and pitch of the vehicle) can be sensed or calculated. However, any other operating condition or conditions of the vehicle may be sensed and provided to the headlight directional controller **14**.

In a second step **32** of the table generating algorithm **30**, the table is generated using the adjustment control algorithm selected in the first step **31**. The table can be generated in any desired manner. For example, let it be assumed that the selected adjustment control algorithm relates a single sensed operating condition to each of the angular adjustment control values for adjusting both the up/down orientation and the left/right orientation of the headlight **11**. The table can be generated by initially selecting a first discrete sensed operating condition value that might be encountered during operation of the vehicle. Then, the selected adjustment control algorithm is solved using such first discrete sensed operating condition value to obtain the corresponding adjustment control values for the up/down and left/right orientation of the headlight **11**. Then, the first discrete sensed operating condition value and the corresponding adjustment control values are stored in the table. This process can be repeated for any desired number of other discrete sensed operating condition values that might be encountered during operation of the vehicle.

As mentioned above, FIG. **4** is a representative example of a table, indicated generally at **40**, that can be generated in accordance with the second step **32** of the table generating algorithm **30** illustrated in FIG. **3**. As shown therein, a series of discrete sensed operating condition values (degrees of steering angles, for example) is related to the angular adjustment control values (degrees of movement from the associated up/down and left/right reference positions or planes, for example) for adjusting both the up/down orientation and the left/right orientation of the headlight **11**. For the purposes of illustration only, let it be assumed that (1) a positive steering angle value represents steering toward left, while a negative steering angle value represents steering toward the right, (2) a positive up/down adjustment factor represents aiming the headlight **11** upwardly, while a negative up/down adjustment factor represents aiming the headlight **11** downwardly, and (3) a positive left/right adjustment factor represents aiming the headlight **11** toward the left, while a negative left/right adjustment factor represents aiming the headlight **11** toward the right.

Thus, in accordance with the selected adjustment control algorithm, a sensed steering angle of +6° results in an up/down adjustment factor of −3.00° and a left/right adjustment factor of +4.50°. Similarly, a sensed steering angle of +5° results in an up/down adjustment factor of −2.50° and a left/right adjustment factor of +3.75°, and so on as shown in the table **40**. The illustrated table **40** relates thirteen different sensed steering angle values to their corresponding adjustment control values for both the up/down and left/right orientation of the headlight **11**. However, the table **40** can include a greater or lesser number of such sensed operating condition values, together with their corresponding adjustment control values. Furthermore, although the illustrated table **40** relates only a single sensed operating condition value (steering angle) to the corresponding adjustment control values for both the up/down and left/right orientation of the headlight **11**, the selected adjustment control algorithm may, as mentioned above, be responsive to a plurality of sensed operating condition values for determining the corresponding adjustment control values. Alternatively, as will be discussed further below, a plurality of tables **40** can be generated, one for each of the plurality of sensed operating condition values. The size and extent of the table **40** or tables can be varied to accommodate any desired number of such sensed operating conditions.

Referring back to FIG. **3**, in a third step **33** of the table generating algorithm **30**, the table **40** generated in the second step **32** is stored in the memory of the headlight directional controller **14** illustrated in FIG. **1**. The contents of the table **40** can be communicated serially to the headlight directional controller **14** by means of the input/output device **17** illustrated in FIG. **1** or in any other desired manner. Regardless of how it is communicated, the table **40** is preferably stored in a non-volatile memory of the headlight directional controller **14** for subsequent use in the manner described further below when the vehicle is operated.

As mentioned above, it may be desirable to vary the algorithm that is selected for use in implementing the headlight directional angle adjustment factors. The generation of the table **40** and the storage of such table **40** in the memory of the headlight directional controller **14** allow a designer of the automatic directional control system **10** to quickly and easily alter the response characteristics of the system **10** as desired, without the need for direct access to the computer code or software that is used to operate the headlight directional controller **14**. Rather, to effect such alterations, a designer can simply change some or all of the data points that are contained within the table **40**. As will be described in detail below, the headlight directional controller **14** will use whatever data points that are contained within the table **40** in determining the need for adjustments in the angular orientation of the headlight **11**. This structure also reduces the amount of processing power that is necessary for the headlight directional controller **14** because it can operate on a relatively simple look-up basis using the table **40**, rather than having to calculate relatively high order equations that may be used to determine the data points contained within the table **40**.

FIG. **5** is a flow chart of an algorithm, indicated generally at **50**, for operating the headlight directional controller illustrated in FIG. **1** to automatically implement directional angle adjustments in accordance with one or more of the sensed condition values from the condition sensors **15** and **16**. In a first step **51** of the operating algorithm **50**, the values of one or more of the condition sensors **15** and **16** are read by the headlight directional controller **14**. Then, the operating algorithm **50** enters a decision point **52**, wherein it is determined whether the value or values of the condition sensors **15** and **16** that have been read by the headlight directional controller **14** are specifically contained in the table **40**. For example, using the table **40** illustrated in FIG. **4**, if the headlight directional controller **14** has read a steering angle value of −2°, then it is determined that the value of the condition sensor **15** is specifically contained within the table **40**. In this instance, the operating algorithm **50** branches from the decision point **52** to an instruction **53**, wherein the adjustment factors contained in the table **40** that correspond to the sensed condition value are looked up and stored in the headlight directional controller **14**.

The operating algorithm **50** next enters an instruction **54** wherein the value of the magnitude of the adjustment factor (i.e., the desired position for the headlight **11**) is compared with the current position of the headlight **11**. This step **54** of the operating algorithm **50** is optional and can be performed if one or more of the position feedback sensors **18** and **19** are provided in the automatic directional control system **10** to generate respective electrical signals that are representative of the actual up/down and left/right positions of the headlight **11**, as described above. This step **54** of the operating algorithm **50** can be performed to determine how much of an adjustment is necessary to move the headlight **11** from its current position, as determined by the position feedback sensors **18** and **19**, to the desired position, as defined by the adjustment factor obtained from the table **40**. To accomplish this, the value of the adjustment factor may, for example, be subtracted from the current position of the headlight **11** to determine the magnitude of the difference therebetween and, therefore, the magnitude of the adjustment that is necessary to move the headlight **11** from its current position to the desired position. However, this step **54** of the operating algorithm **50** can be accomplished in any other desired manner.

Next, the operating algorithm **50** enters a decision point **55**, wherein it is determined whether the magnitude of the adjustment that is necessary to move the headlight **11** from its current position to the desired position is greater than a predetermined minimum threshold. This step in the operating algorithm **50** is also optional, but may be desirable to prevent the actuators **12** and **13** from being operated continuously or unduly frequently in response to relatively small variations in the sensed operating condition or conditions, such as relatively small bumps in the road. For example, if the current position of the headlight **11** is relatively close to the desired position, then it may be undesirable to effect any movement thereof. This step **55** will prevent the actuators **12** and **13** from being operated unless the current position of the headlight **11** is relatively far from the desired position. As another example, if the condition sensors **15** and **16** are respectively responsive to the front and rear suspension heights of the vehicle for the purpose of determining the pitch thereof, then the headlight directional controller **14** may be programmed to be responsive only to changes in the suspension heights that occur at frequencies that are lower than the suspension rebound frequency of the vehicle (thereby ignoring relatively high frequency changes in suspension height that are likely the result of bumps in the road). However, relatively high frequency changes in the suspension heights could also be monitored to assist in deciphering relatively rough suspension changes from other suspension changes.

In any event, the provision of the predetermined minimum threshold functions as a filter or dead band that minimizes or eliminates undesirable "hunting" of the actuators **12** and **13** for relatively small magnitudes of movement of the headlight **11**. If the magnitude of the adjustment factor is not greater than the predetermined minimum threshold, then the operation of the actuators **12** and **13** is considered to be undesirable. Thus, the operating algorithm **50** branches from the decision point **55** back to the instruction **51**, wherein the above-described steps of the operating algorithm **50** are repeated.

If, on the other hand, the magnitude of the adjustment factor is greater than the predetermined minimum threshold, then the operation of the actuators **12** and **13** is considered to be desirable. Thus, the operating algorithm **50** branches from the decision point **55** to an instruction **56**, wherein either or both of the actuators **12** and **13** are actuated to effect movement of the headlight **11**. For example, using the table **40** illustrated in FIG. **4**, if the headlight directional controller **14** has read a steering angle value of −2°, then the headlight directional controller **14** will look up an up/down adjustment factor of −1.00° and a left/right adjustment factor of −1.50° from the table **40**. The headlight directional controller **14** operates the actuators **12** and **13** to adjust the angular orientation of the headlight **11** to achieve the noted adjustment factors.

In some instances, the amounts of movement that are to be implemented by the two actuators **12** and **13** will be the same (i.e., the amount of up/down movement of the headlight **11** will be the same as the amount of left/right movement). More frequently, however, the amounts of movement that are to be implemented by the two actuators **12** and **13** will be different from one another. In the latter instances, it may be desirable to operate the two actuators **12** and **13** at two different speeds such that the overall movement of the headlight **11** is relatively uniform. For example, if the amount of movement that is to be implemented by the up/down actuator **12** is twice as large as the amount of movement that is to be implemented by the left/right actuator **13**, then it may be desirable to operate the up/down actuator **12** at one-half of the speed of the left/right actuator **13** so that the movements of both actuators **12** and **13** (and, therefore, the overall movement of the headlight **11**) will start and stop at approximately the same time. Similarly, if the vehicle is provided with two different headlights **11**, as is commonly found, then it may be desirable to control the respective movements of such different headlights **11** in such a manner that they both start and stop at approximately the same time. This can be accomplished, for example, by providing a single headlight directional controller **14** for not only controlling, but also coordinating the movements of both of the headlights **11** in response to the sensed operating conditions.

Such operations can be performed in an open loop manner if desired, wherein the actuators **12** and **13** are operated to achieve predetermined amounts of movement. For example, the actuators **12** and **13** can be embodied as step motors that are operated a predetermined number of steps to achieve predetermined amounts of movement. Alternatively, the actuators **12** and **13** can be operated for predetermined periods of time to achieve the predetermined amounts of movement. However, more desirably, the operations of the actuators **12** and **13** are performed in a closed loop manner. To accomplish this, the actuators **12** and **13** are operated until either or both of the position feedback sensors **18** and **19** generate signals indicate that the headlight **11** has actually achieved the predetermined amounts of movement or desired position. In either event, the operating algorithm **50** then branches back to the instruction **51**, wherein the above-described steps of the algorithm **50** are repeated.

Referring back to the decision point **52**, if the value or values of the condition sensors **15** and **16** that have been read by the headlight directional controller **14** are not specifically contained in the table **40**, then the operating algorithm **50** branches from the decision point **52** to an instruction **57**, wherein the adjustment factors that are specifically contained in the table **40** that correspond to the adjacent sensed condition values are looked up and stored in the headlight directional controller **14**. For example, using the table **40** illustrated in FIG. **4**, if the headlight directional controller **14** has read a steering angle value of −1.5°, then it is determined that the value of the condition sensor **15** is not specifically contained within the table **40**. Rather than simply default to the closest value that is contained within the table **40**, the two adjustment factors specifically contained in the table **40** that are adjacent to the sensed condition value (namely, the adjustment factors for the steering angle values of −1° and −2°) are looked up and stored in the headlight directional controller **14**.

The operating algorithm **50** next enters an instruction **58**, wherein the actual adjustment factors to be implemented by the headlight directional controller **14** are interpolated or otherwise calculated from the stored adjustment factors that are adjacent to the sensed condition value. For example, as mentioned above, if the actual sensed steering angle value is −1.5°, then the headlight directional controller **14** looks up the adjustment factors for the steering angle values of −1° and −2°. The up/down adjustment factor for a steering angle value of −1° is −0.50 while the up/down adjustment factor for a steering angle value of −2° is −1.00°. If the calculation that is performed by the headlight directional controller **14** is a simple arithmetic mean, then the interpolated up/down adjustment factor would be −0.75°. Similarly, the left/right adjustment factor for a steering angle value of −1° is −0.75°, while the left/right adjustment factor for a steering angle value of −2° is −1.50°. If the calculation that is performed by the headlight directional controller **14** is a simple arithmetic mean, then the interpolated left/right adjustment factor would be −1.13°. Thereafter, the operating algorithm **50** branches to the decision point **55**, and the remainder of the operating algorithm **50** is performed as described above.

The interpolation that is performed by the headlight directional controller **14** can be accomplished in any desired manner. The performance of the simple arithmetic mean described above is intended to be representative of any mathematical or other function that can be performed to calculate, derive, or otherwise obtain adjustment factors that are not present in the table **40**. Furthermore, although this interpolation has been described in the context of using only the two condition values that are directly adjacent to the actual sensed condition value, it will be appreciated that the adjustment values for any single condition value or combination of sensed condition values may be selected for the interpolation. For example, several of the condition values both above and below the sensed condition value can be read from the table **40** to derive a trend line or other good estimate of the adjustment factors that are not present in the table **40**. Performance of this interpolation does not require any significant increase in the amount of processing power that is necessary for the headlight directional controller **14**.

The above discussion has assumed the use of a single table **40** that provides adjustment values based upon a single sensed operating condition (steering angle of the vehicle, in the illustrated embodiment). However, as discussed above, this invention may be practiced by sensing a plurality of operating conditions of the vehicle. For example, let it be assumed that both steering angle and vehicle road speed are sensed by the condition sensors **15** and **16**. As previously discussed, the adjustment control algorithm that is selected in the first step **31** of the table generating algorithm **30** can be designed to accommodate multiple sensed conditions. Alternatively, however, a first table (such as the table **40** illustrated in FIG. **4**) may be generated that relates the steering angle of the vehicle to the angular adjustment control values for adjusting both the up/down orientation and the left/right orientation of the headlight **11**. A second, similar table (not shown) may also be generated that relates the road speed of the vehicle to the angular adjustment control values for adjusting both the up/down orientation and the left/right orientation of the headlight **11**. Thus, for a given steering angle and road speed of the vehicle, the first and second tables may provide differing angular adjustment control values. To address this, the interpolation step **57** of the operating algorithm **50** can be performed to interpolate a single composite adjustment value that is based upon the two different values provided in the first and second tables for the pair of sensed operating conditions. This interpolation can be performed in the same manner as described above for each of the actuators **12** and **13**.

A variety of control strategies can be implemented using the automatic directional control system **10** described above. For example, the pitch of the vehicle can change as a result of a variety of factors, including acceleration, deceleration, and weight distribution of the vehicle. These pitch variations can alter the angle at which the beam of light projects from the headlight **11** in the up and down direction relative to a horizontal reference position or plane. The automatic directional control system **10** can be responsive to such pitch variations for operating the up/down actuator **12** to maintain the angle at which the beam of light projects from the headlight **11** in the up and down direction relatively constant to the horizontal reference position or plane.

As discussed above, the angle at which the beam of light projects from the headlight **11** in the left and right direction relative to a vertical reference position or plane can be adjusted in accordance with the sensed steering angle. However, the angle at which the beam of light projects from the headlight **11** in the up and down direction relative to a horizontal reference position or plane can also be adjusted in accordance with the sensed steering angle. This can be done to lower the headlight beams as the vehicle is turning a corner. The advantages of this are not only to better illuminate the road surface in the path of movement of the vehicle, but also to reduce headlight glare to other vehicles as the turn is negotiated.

Lastly, many vehicles on the road today have halogen lamps or other lights that are aimed to illuminate the sides of the roads in front of the vehicle during the turn. These other lights are activated by the manual operation of the turn signals of the vehicle. The automatic directional control system **10** of this invention can be responsive to one or more operating conditions of the vehicle to automatically activate these other lights on the vehicle. For example, the automatic directional control system **10** of this invention can be responsive to a steering angle in excess of a predetermined magnitude for automatically activating these other lights on the vehicle. This can be effective to extend the angular range of illumination of the road surface.

FIG. **6** is a flow chart of an algorithm, indicated generally at **60**, for operating the headlight directional controller illustrated in FIG. **1** to automatically implement directional angle adjustments in accordance with the rate of change of one or more of the sensed condition values. As mentioned above, the headlight directional controller **14** can be operated to automatically implement directional angle adjustments in accordance with one or more of the sensed condition values or in accordance with the rate of change of one or more of the sensed condition values.

To accomplish this, the algorithm **60** has a first step **61** wherein the values of one or more of the condition sensors **15** and **16** are initially read by the headlight directional controller **14**. Then, the algorithm **60** enters a second step **62** wherein the values of one or more of the condition sensors **15** and **16** are subsequently read a second time by the headlight directional controller **14**. The second reading of the condition sensors **15** and **16** occurs a predetermined amount of time after the first reading thereof. Next, the algorithm enters a third step **63** wherein a rate of change of the sensed condition or conditions is calculated. The rate of change of the sensed condition can be calculated as the difference between the first and second readings divided by the amount of time therebetween or by any other desired means. For example, if the sensed condition is vehicle speed, then the difference between the first sensed vehicle speed and the second sensed vehicle speed, divided by the amount of time therebetween, would yield a number that is representative of the acceleration of the vehicle. In a final step **64** of the algorithm **60**, either or both of the actuators **12** and **13** are actuated to effect movement of the headlight **11** in accordance with the calculated rate of change of the sensed condition. Such movement of the headlight **11** can be effected in a manner that is similar to that described above.

FIG. **7** is a flow chart of an algorithm, indicated generally at **70**, for operating the headlight directional controller illustrated in FIG. **1** to automatically implement directional angle adjustments, but only when the rate of change of one or more of the sensed condition values is less than (or greater than) a predetermined value. As mentioned above, the headlight directional controller **14** can be operated to automatically implement directional angle adjustments in accordance with one or more of the sensed condition values. In this variation of the invention, the headlight directional controller **14** automatically implements directional angle adjustments in response to the sensed condition values (or in response to the rate of change of the sensed condition values), but only when the rate of change of one or more of the sensed condition values is less than (or greater than) a predetermined value.

To accomplish this, the algorithm **70** has a first step **71** wherein the values of one or more of the condition sensors **15** and **16** are initially read by the headlight directional controller **14**. Then, the algorithm **70** enters a second step **72** wherein the values of one or more of the condition sensors **15** and **16** are subsequently read a second time by the headlight directional controller **14**. The second reading of the condition sensors **15** and **16** occurs a predetermined amount of time after the first reading thereof. Next, the algorithm enters a third step **73** wherein a rate of change of the sensed condition or conditions is calculated. The rate of change of the sensed condition can be calculated as the difference between the first and second readings divided by the amount of time therebetween or by any other desired means. For example, if the sensed condition is suspension height, then the difference between the first sensed suspension height and the second sensed suspension height, divided by the amount of time therebetween, would yield a number that is representative of the rate of change of the suspension height of the vehicle.

In a fourth step **74** of the algorithm **70**, a determination is made as to whether the rate of change of the sensed condition value is less than a predetermined threshold value. If the rate of change of the sensed condition value is less than this predetermined threshold value, then the algorithm **70** branches from the decision point **74** to a final step **75** of the algorithm **70**, wherein either or both of the actuators **12** and **13** are actuated to effect movement of the headlight **11** in accordance with the calculated rate of change of the sensed condition. Such movement of the headlight **11** can be effected in a manner that is similar to that described above. If, however, the rate of change of the sensed condition value is not less than this predetermined threshold value, then the algorithm **70** branches from the decision point **74** back to the first step **71**, wherein the algorithm **70** is repeated. This threshold sensing algorithm **70** can function to prevent the headlight directional controller **14** from being operated to automatically implement directional angle adjustments when the rate of change of the suspension height of the vehicle changes more rapidly than the system can effect corrective changes. For example, if the vehicle is operated on a bumpy road, the algorithm **70** will prevent the headlight directional controller **14** from attempting to correct for every single bump that is encountered. However, for relatively low frequency or rates of change in the suspension height of the vehicle, such as can occur when accelerating, decelerating, and weight changes, the headlight directional controller **14** will be operated in the normal manner to effect corrective actions, as described above.

As mentioned above, the input/output device **17** is connected to (or can be connected to) the headlight directional controller **14** for facilitating communication therewith, and the input/output device **17** can be used for calibrating the automatic directional control system illustrated in FIG. **1** so as to define an initial reference position or positions for the headlight **11** from which the headlight directional controller **14** can implement directional angle adjustments. Additionally, however, the input/output device **17** can be employed as a diagnostic tool. To accomplish this, the input/output device **17** can be embodied as a conventional microprocessor or similar electronically programmable device that can be connected to the headlight directional controller **14** to read fault codes that may be generated during the operation thereof. The headlight directional controller **14** can be programmed to generate fault codes whenever a fault condition or other anomaly occurs or is detected. Such fault codes can be stored in the headlight directional controller **14** until the input/output device **17** is subsequently connected thereto. When so connected, the input/output device **17** can read such codes and display them for an operator. As a result, the operator can take whatever corrective actions are necessary to address the fault condition or anomaly. The input/output device **17** can also be programmed to clear the fault codes from the headlight directional controller **14** after they are read.

In accordance with the provisions of the patent statutes, the principle and mode of operation of this invention have been explained and illustrated in its preferred embodiments. However, it must be understood that this invention may be practiced otherwise than as specifically explained and illustrated without departing from its spirit or scope.

What is claimed is:

1. An automatic directional control system for a vehicle headlight comprising:

a sensor that is adapted to generate a signal that is representative of a condition of the vehicle, said sensed condition includes one or more of road speed, steering angle, pitch, and suspension height of the vehicle;

a controller that is responsive to said sensor signal for generating an output signal only when said sensor signal changes by more than a predetermined minimum threshold amount to prevent said actuator from being operated continuously or unduly frequently in response to relatively small variations in the sensed operating condition; and

an actuator that is adapted to be connected to the headlight to effect movement thereof in accordance with said output signal.

2. The automatic directional control system defined in claim **1** wherein said sensor generates a signal that is representative of the road speed of the vehicle.

3. The automatic directional control system defined in claim **1** wherein said sensor generates a signal that is representative of the steering angle of the vehicle.

4. The automatic directional control system defined in claim **1** wherein said sensor generates a signal that is representative of the pitch of the vehicle.

5. The automatic directional control system defined in claim **1** wherein said sensor generates a signal that is representative of the suspension height of the vehicle.

* * * * *

EXHIBIT 2

IN THE UNITED STATES DISTRICT COURT

FOR THE EASTERN DISTRICT OF TEXAS

TYLER DIVISION

BALTHER TECHNOLOGIES, LLC, **Plaintiff,** **v.** **AMERICAN HONDA MOTOR CO. INC., HONDA MOTOR COMPANY, LTD., BMW OF NORTH AMERICA, LLC, BMW AG, CHRYSLER GROUP LLC, FERRARI NORTH AMERICA, INC., FERRARI S.P.A., GENERAL MOTORS, LLC, HYUNDAI MOTOR AMERICA, HYUNDAI MOTOR COMPANY, JAGUAR LAND ROVER NORTH AMERICA, LLC, JAGUAR CARS LIMITED, MASERATI NORTH AMERICA, INC., MASERATI S.P.A., MERCEDES-BENZ USA, LLC, DAIMLER NORTH AMERICA CORP., DAIMLER AG, MAZDA MOTOR OF NORTH AMERICA, INC., MAZDA MOTOR CORP., MITSUBISHI MOTORS NORTH AMERICA, INC., MITSUBISHI MOTORS CORP., NISSAN NORTH AMERICA, INC., NISSAN MOTOR CO., LTD., PORSCHE CARS NORTH AMERICA, INC., DR. ING. HC. F. PORSCHE AG, SAAB CARS NORTH AMERICA, INC., TOYOTA MOTOR NORTH AMERICA, INC., TOYOTA MOTOR SALES, U.S.A., INC., TOYOTA MOTOR CORP., VOLKSWAGEN GROUP OF AMERICA, INC., AUTOMOBILI LAMBORGHINI S.P.A., AUDI AG, VOLKSWAGEN AG, FORD MOTOR COMPANY, VOLVO CARS OF NORTH AMERICA, LLC, and VOLVO CAR CORP.,** **Defendants.**	§ §	**Civil Action No. 6:10-CV-78** **JURY TRIAL DEMANDED**

ORIGINAL COMPLAINT FOR PATENT INFRINGEMENT

This is an action for patent infringement in which Plaintiff Balther Technologies, LLC ("Balther") complains against Defendants American Honda Motor Co. Inc. and Honda Motor Company, Ltd. (collectively "Honda"); BMW of North America, LLC and BMW AG (collectively "BMW"); Chrysler Group LLC ("Chrysler"); Ferrari North America, Inc. and Ferrari S.p.A. (collectively "Ferrari"); General Motors, LLC (formerly known as General Motors Company) ("GM"); Hyundai Motor America and Hyundai Motor Company (collectively "Hyundai"); Jaguar Land Rover North America, LLC and Jaguar Cars Limited (collectively "Jaguar"); Maserati North America, Inc. and Maserati S.p.A. (collectively "Maserati"); Mercedes-Benz USA, LLC, Daimler North America Corporation, and Daimler AG (collectively "Mercedes-Benz"); Mazda Motor of America, Inc. (also known as Mazda North American Operations) and Mazda Motor Corporation (collectively "Mazda"); Mitsubishi Motors North America, Inc. and Mitsubishi Motors Corporation (collectively "Mitsubishi"); Nissan North America, Inc. and Nissan Motor Co., Ltd. (collectively "Nissan"); Porsche Cars North America, Inc. and Dr. Ing. hc. F. Porsche AG (collectively "Porsche"); SAAB Cars North America, Inc. ("SAAB"); Toyota Motor North America, Inc., Toyota Motor Sales, U.S.A., Inc., and Toyota Motor Corporation (collectively "Toyota"); Volkswagen Group of America, Inc. (also known as Audi of America, Inc.) ("VW-Audi US"); Automobili Lamborghini S.p.A. ("Lamborghini"); Audi AG; Volkswagen AG ("VW AG"); Ford Motor Company ("Ford"); and Volvo Cars of North America, LLC and Volvo Car Corporation (collectively "Volvo"), as follows:

PARTIES

1. Plaintiff Balther Technologies, LLC is a Texas limited liability company having its principal place of business in Longview, Texas.

2. On information and belief, Defendant American Honda Motor Co. Inc. is a California corporation having its principal place of business in Torrance, California.

3. On information and belief, Defendant Honda Motor Company, Ltd. is a Japanese corporation having its principal place of business in Tokyo, Japan.

4. On information and belief, Defendant American Honda Motor Co. Inc. is a subsidiary of Defendant Honda Motor Company, Ltd.

5. On information and belief, Defendant BMW of North America, LLC is a Delaware limited liability company having its principal place of business in Woodcliff Lake, New Jersey.

6. On information and belief, Defendant BMW AG is a German corporation having its principal place of business in Munich, Germany.

7. On information and belief, Defendant BMW of North America, LLC is a wholly owned subsidiary of BMW (US) Holding Corp., which is a wholly owned subsidiary of Defendant BMW AG.

8. On information and belief, Defendant Chrysler is a Delaware limited liability company having its principal place of business in Auburn Hills, Michigan.

9. On information and belief, Defendant Ferrari North America, Inc. is a Delaware corporation having its principal place of business in Englewood Cliffs, New Jersey.

10. On information and belief, Defendant Ferrari S.p.A. is an Italian corporation having its principal place of business in Maranello, Italy.

11. On information and belief, Defendant Ferrari North America, Inc. is a wholly-owned subsidiary of Defendant Ferrari S.p.A.

12. On information and belief, Defendant GM is a Delaware limited liability company having its principal place of business in Detroit, Michigan.

13. On information and belief, Defendant Hyundai Motor America is a California corporation having its principal place of business in Fountain Valley, California.

14. On information and belief, Defendant Hyundai Motor Company is a Korean corporation having its principal place of business in Seoul, South Korea.

15. On information and belief, Defendant Hyundai Motor America is a wholly owned subsidiary of Defendant Hyundai Motor Company.

16. On information and belief, Defendant Jaguar Land Rover North America, LLC is a Delaware limited liability company having its principal place of business in Mahwah, New Jersey.

17. On information and belief, Defendant Jaguar Cars Limited is a UK corporation having its principal place of business in Whitley, England.

18. On information and belief, Defendant Jaguar Land Rover North America LLC is a wholly owned subsidiary of Defendant Jaguar Cars Limited.

19. On information and belief, Defendant Maserati North America, Inc. is a Delaware corporation having its principal place of business in Englewood Cliffs, New Jersey.

20. On information and belief, Defendant Maserati S.p.A. is an Italian corporation having its principal place of business in Modena, Italy.

21. On information and belief, Defendant Maserati North America, Inc. is a wholly owned subsidiary of Defendant Maserati S.p.A.

22. On information and belief, Defendant Mercedes-Benz USA, LLC is a Delaware limited liability company having its principal place of business in Montvale, New Jersey.

23. On information and belief, Defendant Daimler North America Corp. is a Delaware corporation having its principal place of business in Bingham Farms, Michigan.

24. On information and belief, Defendant Daimler AG is a German corporation having its principal place of business in Stuttgart, Germany.

25. On information and belief, Defendant Mercedes-Benz USA LLC is a wholly owned subsidiary of Defendant Daimler North America Corp., which is a wholly owned subsidiary of Defendant Daimler AG.

26. On information and belief, Defendant Mazda Motor of America, Inc. is a California corporation having its principal place of business in Irvine, California.

27. On information and belief, Defendant Mazda Motor Corporation is a Japanese corporation having its principal place of business in Hiroshima, Japan.

28. On information and belief, Defendant Mazda Motor of America, Inc. is a subsidiary of Defendant Mazda Motor Corporation.

29. On information and belief, Defendant Mitsubishi Motors North America, Inc. is a California corporation having its principal place of business in Cypress, California.

30. On information and belief, Defendant Mitsubishi Motors Corporation is a Japanese corporation having its principal place of business in Tokyo, Japan.

31. On information and belief, Defendant Mitsubishi Motors North America, Inc. is a wholly owned subsidiary of Defendant Mitsubishi Motors Corporation.

32. On information and belief, Defendant Nissan North America, Inc. is a California corporation having its principal place of business in Franklin, Tennessee.

33. On information and belief, Defendant Nissan Motor Co., Ltd. is a Japanese corporation having its principal place of business in Kanagawa, Japan.

34. On information and belief, Defendant Nissan North America, Inc. is a subsidiary of Defendant Nissan Motor Co., Ltd.

35. On information and belief, Defendant Porsche Cars North America, Inc. is a Delaware corporation having its principal place of business in Atlanta, Georgia.

36. On information and belief, Defendant Dr. Ing. hc. F. Porsche AG is a German corporation having its principal place of business in Stuttgart, Germany.

37. On information and belief, Defendant Dr. Ing. hc. F. Porsche AG indirectly owns the stock of Defendant Porsche Cars North America, Inc.

38. On information and belief, Defendant SAAB is a Delaware corporation having its principal place of business in Detroit, Michigan.

39. On information and belief, Defendant Toyota Motor North America, Inc. is a California corporation having its principal place of business in New York, New York.

40. On information and belief, Defendant Toyota Motor Sales, U.S.A., Inc. is a California corporation having its principal place of business in Torrance, California.

41. On information and belief, Defendant Toyota Motor Corporation is a Japanese corporation having its principal place of business in Toyota City, Japan.

42. On information and belief, Defendant Toyota Motor North America, Inc. and Defendant Toyota Motor Sales, U.S.A., Inc. are each wholly owned subsidiaries of Defendant Toyota Motor Corporation.

43. On information and belief, Defendant VW-Audi US is a New Jersey corporation having its principal place of business in Herndon, Virginia.

44. On information and belief, Defendant Lamborghini is an Italian corporation having its principal place of business in Sant' Agata Bolognese, Italy.

45. On information and belief, Defendant VW AG is a German corporation having its principal place of business in Wolfsburg, Germany.

46. On information and belief, Defendant VW-Audi US and Defendant Lamborghini are each wholly owned subsidiaries of Defendant VW AG.

47. On information and belief, Defendant Audi AG is a German corporation having its principal place of business in Ingolstadt, Germany.

48. On information and belief, Defendant Audi AG is a 99.55% owned subsidiary of Defendant VW AG.

49. On information and belief, Defendant Ford Motor Company is a Delaware corporation having its principal place of business in Dearborn, Michigan.

50. On information and belief, Defendant Volvo Cars of North America, LLC is a Delaware limited liability company having its principal place of business in Rockleigh, New Jersey.

51. On information and belief, Defendant Volvo Car Corporation is a Swedish corporation having its principal place of business in Göteborg, Sweden.

52. On information and belief, Defendant Volvo Cars of North America, LLC is a subsidiary of Defendant Volvo Car Corporation.

JURISDICTION AND VENUE

53. This action arises under the patent laws of the United States, Title 35 of the United States Code. This Court has subject matter jurisdiction pursuant to 28 U.S.C. §§ 1331 and 1338(a).

54. Venue is proper in this district under 28 U.S.C. §§ 1391(c) and 1400(b). On information and belief, each Defendant has transacted business in this district and has committed and/or induced and/or contributed to acts of patent infringement in this district.

55. On information and belief, Defendants are subject to this Court's specific and general personal jurisdiction pursuant to due process and/or the Texas Long Arm Statute, due at least to their substantial business in this forum, directly or through intermediaries, including: (i) at least a portion of the infringements alleged herein; and (ii) regularly doing or soliciting business, engaging in other persistent courses of conduct, and/or deriving substantial revenue from goods and services provided to individuals in Texas and in this Judicial District.

PATENT INFRINGEMENT

56. Balther is the owner by assignment of United States Patent No. 7,241,034 ("the '034 patent") entitled "Automatic Directional Control System for Vehicle Headlights." The '034 patent was duly and legally issued on July 10, 2007. A true and correct copy of the '034 patent is attached as Exhibit A.

57. On information and belief, Defendant Honda has been and now is directly infringing, and/or inducing infringement by others, and/or contributing to the infringement by others of the '034 patent in the State of Texas, in this judicial district, and elsewhere in the United States. Honda's infringements include, without limitation, making, using, offering for sale, and/or selling within the United States, and/or importing into the United States, at least the Acura RL product that includes automatic directional and/or leveling control system(s) for vehicle lights or similar features, and any other product made, used, offered for sale, and/or sold by Honda that includes automatic directional and/or leveling control system(s) for vehicle lights

or similar features that infringe one or more claims of the '034 patent. Honda is thus liable for infringement of the '034 patent pursuant to 35 U.S.C. § 271.

58. On information and belief, Defendant BMW has been and now is directly infringing, and/or inducing infringement by others, and/or contributing to the infringement by others of the '034 patent in the State of Texas, in this judicial district, and elsewhere in the United States. BMW's infringements include, without limitation, making, using, offering for sale, and/or selling within the United States, and/or importing into the United States, at least the BMW 5 Series and Mini Cooper S products that include automatic directional and/or leveling control system(s) for vehicle lights or similar features, and any other product made, used, offered for sale, and/or sold by BMW that includes automatic directional and/or leveling control system(s) for vehicle lights or similar features that infringe one or more claims of the '034 patent. BMW is thus liable for infringement of the '034 patent pursuant to 35 U.S.C. § 271.

59. On information and belief, Defendant Chrysler has been and now is directly infringing, and/or inducing infringement by others, and/or contributing to the infringement by others of the '034 patent in the State of Texas, in this judicial district, and elsewhere in the United States. Chrysler's infringements include, without limitation, making, using, offering for sale, and/or selling within the United States at least the Jeep Grand Cherokee product that includes automatic directional and/or leveling control system(s) for vehicle lights or similar features, and any other product made, used, offered for sale, and/or sold by Chrysler that includes automatic directional and/or leveling control system(s) for vehicle lights or similar features that infringe one or more claims of the '034 patent. Chrysler is thus liable for infringement of the '034 patent pursuant to 35 U.S.C. § 271.

60. On information and belief, Defendant Ferrari has been and now is directly infringing, and/or inducing infringement by others, and/or contributing to the infringement by others of the '034 patent in the State of Texas, in this judicial district, and elsewhere in the United States. Ferrari's infringements include, without limitation, making, using, offering for sale, and/or selling within the United States, and/or importing into the United States, at least the Ferrari California product that includes automatic directional and/or leveling control system(s) for vehicle lights or similar features, and any other product made, used, offered for sale, and/or sold by Ferrari that includes automatic directional and/or leveling control system(s) for vehicle lights or similar features that infringe one or more claims of the '034 patent. Ferrari is thus liable for infringement of the '034 patent pursuant to 35 U.S.C. § 271.

61. On information and belief, Defendant GM has been and now is directly infringing, and/or inducing infringement by others, and/or contributing to the infringement by others of the '034 patent in the State of Texas, in this judicial district, and elsewhere in the United States. GM's infringements include, without limitation, making, using, offering for sale, and/or selling within the United States at least the Cadillac CTS and Buick Enclave products that include automatic directional and/or leveling control system(s) for vehicle lights or similar features, and any other product made, used, offered for sale, and/or sold by GM that includes automatic directional and/or leveling control system(s) for vehicle lights or similar features that infringe one or more claims of the '034 patent. GM is thus liable for infringement of the '034 patent pursuant to 35 U.S.C. § 271.

62. On information and belief, Defendant Hyundai has been and now is directly infringing, and/or inducing infringement by others, and/or contributing to the infringement by others of the '034 patent in the State of Texas, in this judicial district, and elsewhere in the

United States. Hyundai's infringements include, without limitation, making, using, offering for sale, and/or selling within the United States, and/or importing into the United States, at least the Hyundai Genesis product that includes automatic directional and/or leveling control system(s) for vehicle lights or similar features, and any other product made, used, offered for sale, and/or sold by Hyundai that includes automatic directional and/or leveling control system(s) for vehicle lights or similar features that infringe one or more claims of the '034 patent. Hyundai is thus liable for infringement of the '034 patent pursuant to 35 U.S.C. § 271.

63. On information and belief, Defendant Jaguar has been and now is directly infringing, and/or inducing infringement by others, and/or contributing to the infringement by others of the '034 patent in the State of Texas, in this judicial district, and elsewhere in the United States. Jaguar's infringements include, without limitation, making, using, offering for sale, and/or selling within the United States, and/or importing into the United States, at least the Jaguar XKR and Land Rover Range Rover Sport products that include automatic directional and/or leveling control system(s) for vehicle lights or similar features, and any other product made, used, offered for sale, and/or sold by Jaguar that includes automatic directional and/or leveling control system(s) for vehicle lights or similar features that infringe one or more claims of the '034 patent. Jaguar is thus liable for infringement of the '034 patent pursuant to 35 U.S.C. § 271.

64. On information and belief, Defendant Maserati has been and now is directly infringing, and/or inducing infringement by others, and/or contributing to the infringement by others of the '034 patent in the State of Texas, in this judicial district, and elsewhere in the United States. Maserati's infringements include, without limitation, making, using, offering for sale, and/or selling within the United States, and/or importing into the United States, at least the

Maserati GranTurismo product that includes automatic directional and/or leveling control system(s) for vehicle lights or similar features, and any other product made, used, offered for sale, and/or sold by Maserati that includes automatic directional and/or leveling control system(s) for vehicle lights or similar features that infringe one or more claims of the '034 patent. Maserati is thus liable for infringement of the '034 patent pursuant to 35 U.S.C. § 271.

65. On information and belief, Defendant Mercedes-Benz has been and now is directly infringing, and/or inducing infringement by others, and/or contributing to the infringement by others of the '034 patent in the State of Texas, in this judicial district, and elsewhere in the United States. Mercedes-Benz's infringements include, without limitation, making, using, offering for sale, and/or selling within the United States, and/or importing into the United States, at least the Mercedes-Benz GL550 and Maybach 57 products that include automatic directional and/or leveling control system(s) for vehicle lights or similar features, and any other product made, used, offered for sale, and/or sold by Mercedes-Benz that includes automatic directional and/or leveling control system(s) for vehicle lights or similar features that infringe one or more claims of the '034 patent. Mercedes-Benz is thus liable for infringement of the '034 patent pursuant to 35 U.S.C. § 271.

66. On information and belief, Defendant Mazda has been and now is directly infringing, and/or inducing infringement by others, and/or contributing to the infringement by others of the '034 patent in the State of Texas, in this judicial district, and elsewhere in the United States. Mazda's infringements include, without limitation, making, using, offering for sale, and/or selling within the United States, and/or importing into the United States, at least the Mazda RX-8 product that includes automatic directional and/or leveling control system(s) for vehicle lights or similar features, and any other product made, used, offered for sale, and/or sold

by Mazda that includes automatic directional and/or leveling control system(s) for vehicle lights or similar features that infringe one or more claims of the '034 patent. Mazda is thus liable for infringement of the '034 patent pursuant to 35 U.S.C. § 271.

67. On information and belief, Defendant Mitsubishi has been and now is directly infringing, and/or inducing infringement by others, and/or contributing to the infringement by others of the '034 patent in the State of Texas, in this judicial district, and elsewhere in the United States. Mitsubishi's infringements include, without limitation, making, using, offering for sale, and/or selling within the United States, and/or importing into the United States, at least the Mitsubishi Outlander XLS product that includes automatic directional and/or leveling control system(s) for vehicle lights or similar features, and any other product made, used, offered for sale, and/or sold by Mitsubishi that includes automatic directional and/or leveling control system(s) for vehicle lights or similar features that infringe one or more claims of the '034 patent. Mitsubishi is thus liable for infringement of the '034 patent pursuant to 35 U.S.C. § 271.

68. On information and belief, Defendant Nissan has been and now is directly infringing, and/or inducing infringement by others, and/or contributing to the infringement by others of the '034 patent in the State of Texas, in this judicial district, and elsewhere in the United States. Nissan's infringements include, without limitation, making, using, offering for sale, and/or selling within the United States, and/or importing into the United States, at least the Infiniti G37 Sport product that includes automatic directional and/or leveling control system(s) for vehicle lights or similar features, and any other product made, used, offered for sale, and/or sold by Nissan that includes automatic directional and/or leveling control system(s) for vehicle lights or similar features that infringe one or more claims of the '034 patent. Nissan is thus liable for infringement of the '034 patent pursuant to 35 U.S.C. § 271.

69. On information and belief, Defendant Porsche has been and now is directly infringing, and/or inducing infringement by others, and/or contributing to the infringement by others of the '034 patent in the State of Texas, in this judicial district, and elsewhere in the United States. Porsche's infringements include, without limitation, making, using, offering for sale, and/or selling within the United States, and/or importing into the United States, at least the Porsche 911 GT3 product that includes automatic directional and/or leveling control system(s) for vehicle lights or similar features, and any other product made, used, offered for sale, and/or sold by Porsche that includes automatic directional and/or leveling control system(s) for vehicle lights or similar features that infringe one or more claims of the '034 patent. Porsche is thus liable for infringement of the '034 patent pursuant to 35 U.S.C. § 271.

70. On information and belief, Defendant SAAB has been and now is directly infringing, and/or inducing infringement by others, and/or contributing to the infringement by others of the '034 patent in the State of Texas, in this judicial district, and elsewhere in the United States. SAAB's infringements include, without limitation, making, using, offering for sale, and/or selling within the United States, and/or importing into the United States, at least the Saab 9-3 2.0T product that includes automatic directional and/or leveling control system(s) for vehicle lights or similar features, and any other product made, used, offered for sale, and/or sold by SAAB that includes automatic directional and/or leveling control system(s) for vehicle lights or similar features that infringe one or more claims of the '034 patent. SAAB is thus liable for infringement of the '034 patent pursuant to 35 U.S.C. § 271.

71. On information and belief, Defendant Toyota has been and now is directly infringing, and/or inducing infringement by others, and/or contributing to the infringement by others of the '034 patent in the State of Texas, in this judicial district, and elsewhere in the

United States. Toyota's infringements include, without limitation, making, using, offering for sale, and/or selling within the United States, and/or importing into the United States, at least the Toyota Avalon product that includes automatic directional and/or leveling control system(s) for vehicle lights or similar features, and any other product made, used, offered for sale, and/or sold by Toyota that includes automatic directional and/or leveling control system(s) for vehicle lights or similar features that infringe one or more claims of the '034 patent. Toyota is thus liable for infringement of the '034 patent pursuant to 35 U.S.C. § 271.

72. On information and belief, Defendants Toyota Motor Sales, U.S.A., Inc. and Toyota Motor Corporation have been and now are further directly infringing, and/or inducing infringement by others, and/or contributing to the infringement by others of the '034 patent in the State of Texas, in this judicial district, and elsewhere in the United States. Toyota Motor Sales, U.S.A., Inc. and Toyota Motor Corporation's further infringements include, without limitation, making, using, offering for sale, and/or selling within the United States, and/or importing into the United States, at least the Lexus IS 250 product that includes automatic directional and/or leveling control system(s) for vehicle lights or similar features, and any other product made, used, offered for sale, and/or sold by Toyota Motor Sales, U.S.A., Inc. and Toyota Motor Corporation that includes automatic directional and/or leveling control system(s) for vehicle lights or similar features that infringe one or more claims of the '034 patent. Toyota Motor Sales, U.S.A., Inc. and Toyota Motor Corporation are thus liable for further infringement of the '034 patent pursuant to 35 U.S.C. § 271.

73. On information and belief, Defendants VW-Audi US, Audi AG, and VW AG have been and now are directly infringing, and/or inducing infringement by others, and/or contributing to the infringement by others of the '034 patent in the State of Texas, in this judicial

district, and elsewhere in the United States. VW-Audi US, Audi AG, and VW AG's infringements include, without limitation, making, using, offering for sale, and/or selling within the United States, and/or importing into the United States, at least the Audi S4 Avant product that includes automatic directional and/or leveling control system(s) for vehicle lights or similar features, and any other product made, used, offered for sale, and/or sold by VW-Audi US, Audi AG, and VW AG that includes automatic directional and/or leveling control system(s) for vehicle lights or similar features that infringe one or more claims of the '034 patent. VW-Audi US, Audi AG, and VW AG are thus liable for infringement of the '034 patent pursuant to 35 U.S.C. § 271.

74. On information and belief, Defendants VW-Audi US and VW AG have been and now are further directly infringing, and/or inducing infringement by others, and/or contributing to the infringement by others of the '034 patent in the State of Texas, in this judicial district, and elsewhere in the United States. VW-Audi US and VW AG's further infringements include, without limitation, making, using, offering for sale, and/or selling within the United States, and/or importing into the United States, at least the Volkswagen Passat Lux product that includes automatic directional and/or leveling control system(s) for vehicle lights or similar features, and any other product made, used, offered for sale, and/or sold by VW-Audi US and VW AG that includes automatic directional and/or leveling control system(s) for vehicle lights or similar features that infringe one or more claims of the '034 patent. VW-Audi US and VW AG are thus liable for further infringement of the '034 patent pursuant to 35 U.S.C. § 271.

75. On information and belief, Defendants Lamborghini and VW AG have been and now are directly infringing, and/or inducing infringement by others, and/or contributing to the infringement by others of the '034 patent in the State of Texas, in this judicial district, and

elsewhere in the United States. Lamborghini and VW AG's infringements include, without limitation, making, using, offering for sale, and/or selling within the United States, and/or importing into the United States, at least the Lamborghini Gallardo product that includes automatic directional and/or leveling control system(s) for vehicle lights or similar features, and any other product made, used, offered for sale, and/or sold by Lamborghini and VW AG that includes automatic directional and/or leveling control system(s) for vehicle lights or similar features that infringe one or more claims of the '034 patent. Lamborghini and VW AG are thus liable for infringement of the '034 patent pursuant to 35 U.S.C. § 271.

76. On information and belief, Defendant Ford has been and now is directly infringing, and/or inducing infringement by others, and/or contributing to the infringement by others of the '034 patent in the State of Texas, in this judicial district, and elsewhere in the United States. Ford's infringements include, without limitation, making, using, offering for sale, and/or selling within the United States at least the Lincoln MKX product that includes automatic directional and/or leveling control system(s) for vehicle lights or similar features, and any other product made, used, offered for sale, and/or sold by Ford that includes automatic directional and/or leveling control system(s) for vehicle lights or similar features that infringe one or more claims of the '034 patent. Ford is thus liable for infringement of the '034 patent pursuant to 35 U.S.C. § 271.

77. On information and belief, Defendant Volvo has been and now is directly infringing, and/or inducing infringement by others, and/or contributing to the infringement by others of the '034 patent in the State of Texas, in this judicial district, and elsewhere in the United States. Volvo's infringements include, without limitation, making, using, offering for sale, and/or selling within the United States, and/or importing into the United States, at least the

Volvo S80 product that includes automatic directional and/or leveling control system(s) for vehicle lights or similar features, and any other product made, used, offered for sale, and/or sold by Volvo that includes automatic directional and/or leveling control system(s) for vehicle lights or similar features that infringe one or more claims of the '034 patent. Volvo is thus liable for infringement of the '034 patent pursuant to 35 U.S.C. § 271.

78. As a result of Defendants' infringement of the '034 patent, Balther has suffered monetary damages that are adequate to compensate it for the infringement under 35 U.S.C. § 284, but in no event less than a reasonable royalty.

PRAYER FOR RELIEF

WHEREFORE, Balther requests that this Court enter:

A. A judgment in favor of Balther that Defendants have directly infringed, induced others to infringe, and/or contributed to others' infringement of the '034 patent;

B. A judgment and order requiring Defendants to pay Balther its damages, costs, expenses, and prejudgment and post-judgment interest for Defendants' infringement of the '034 patent as provided under 35 U.S.C. § 284; and

C. Any and all other relief to which the Court may deem Balther entitled.

DEMAND FOR JURY TRIAL

Balther, under Rule 38 of the Federal Rules of Civil Procedure, requests a trial by jury of any issues so triable by right.

Respectfully submitted,

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CERTIFICATE OF SERVICE

The undersigned certifies that the foregoing document was filed electronically in compliance with Local Rule CV-5(a). As such, this motion was served on all counsel who are deemed to have consented to electronic service. Local Rule CV-5(a)(3)(A). Pursuant to Fed. R. Civ. P. 5(d) and Local Rule CV-5(d) and (e), all other counsel of record not deemed to have consented to electronic service were served with a true and correct copy of the foregoing by email and/or fax, on this the 8th day of March 2010.

Eric M. Albritton

IN THE UNITED STATES DISTRICT COURT

FOR THE EASTERN DISTRICT OF TEXAS

TYLER DIVISION

BALTHER TECHNOLOGIES, LLC,	§	
	§	
Plaintiff,	§	**Civil Action No. 6:10-CV-78**
	§	
v.	§	
	§	
AMERICAN HONDA MOTOR CO. INC., *et al.*,	§	**JURY TRIAL DEMANDED**
	§	
	§	
Defendants.	§	

ORIGINAL COMPLAINT FOR PATENT INFRINGEMENT

EXHIBIT A

US007241034B2

(12) **United States Patent**
Smith et al.

(10) **Patent No.: US 7,241,034 B2**
(45) **Date of Patent: Jul. 10, 2007**

(54) **AUTOMATIC DIRECTIONAL CONTROL SYSTEM FOR VEHICLE HEADLIGHTS**

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(73) Assignee: **Dana Corporation**, Toledo, OH (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **10/285,312**

(22) Filed: **Oct. 31, 2002**

(65) **Prior Publication Data**

US 2003/0107898 A1 Jun. 12, 2003

Related U.S. Application Data

(60) Provisional application No. 60/369,447, filed on Apr. 2, 2002, provisional application No. 60/356,703, filed on Feb. 13, 2002, provisional application No. 60/335,409, filed on Oct. 31, 2001.

(51) **Int. Cl.**
B60Q 1/00 (2006.01)
B60R 22/00 (2006.01)

(52) **U.S. Cl.** **362/465**; 701/49

(58) **Field of Classification Search** 362/37, 362/465–466; 315/82; 701/49
See application file for complete search history.

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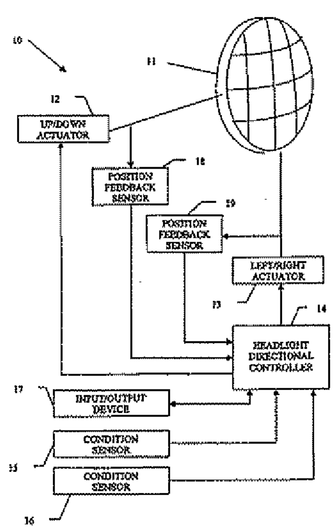
(74) *Attorney, Agent, or Firm*—MacMillan, Sobanski & Todd, LLC

(57) **ABSTRACT**

A structure and method for operating a directional control system for vehicle headlights that is capable of altering the directional aiming angles of the headlights to account for changes in the operating conditions of the vehicle. One or more operating condition sensors may be provided that generate signals that are representative of a condition of the vehicle, such as road speed, steering angle, pitch, suspension height, rate of change of road speed, rate of change of steering angle, rate of change of pitch, and rate of change of suspension height of the vehicle. A controller is responsive to the sensor signal for generating an output signal. An actuator is adapted to be connected to the headlight to effect movement thereof in accordance with the output signal. The controller can include a table that relates values of sensed operating condition to values of the output signal. The controller is responsive to the sensor signal for looking up the output signal in the table.

5 Claims, 7 Drawing Sheets



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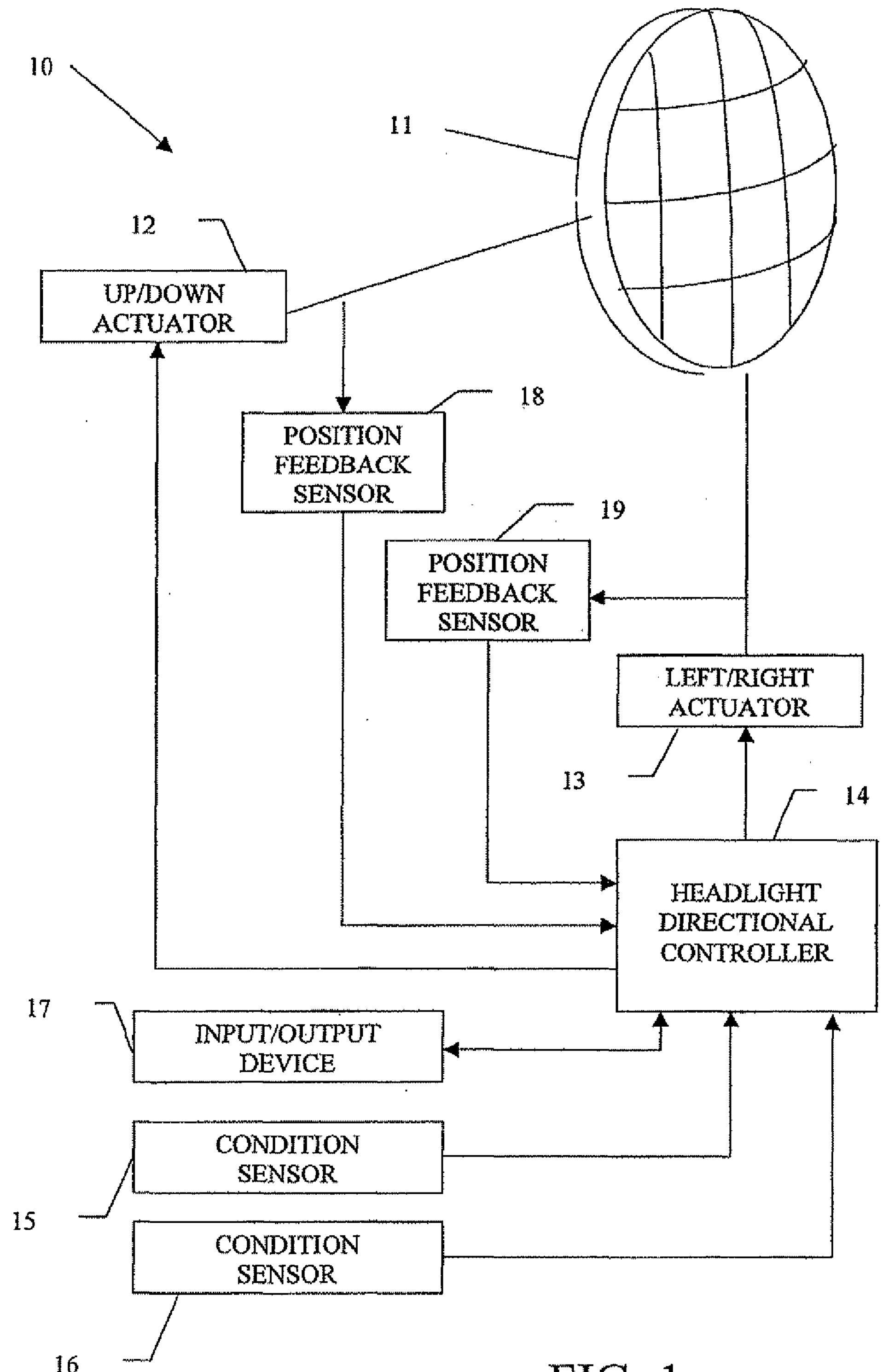
10
11
12
UP/DOWN ACTUATOR
18
POSITION FEEDBACK SENSOR
19
POSITION FEEDBACK SENSOR
LEFT/RIGHT ACTUATOR
13
14
HEADLIGHT DIRECTIONAL CONTROLLER
17
INPUT/OUTPUT DEVICE
CONDITION SENSOR
15
CONDITION SENSOR
16

FIG. 1

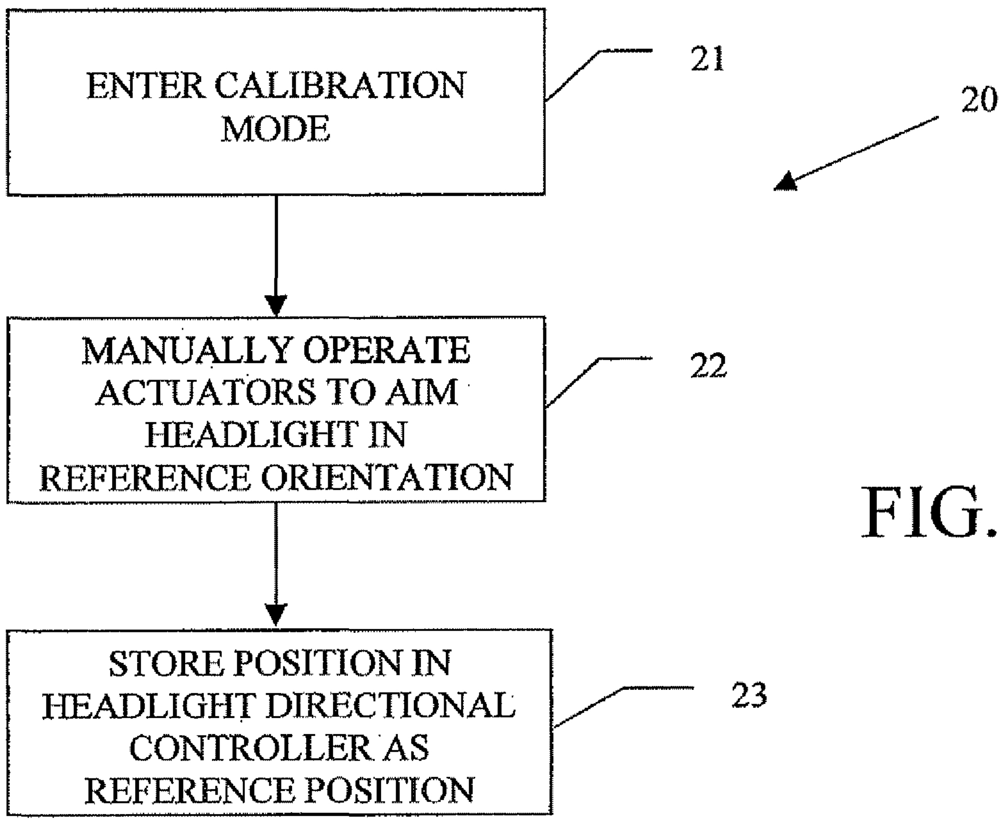
ENTER CALIBRATION MODE
21
20
MANUALLY OPERATE ACTUATORS TO AIM HEADLIGHT IN REFERENCE ORIENTATION
22
STORE POSITION IN HEADLIGHT DIRECTIONAL CONTROLLER AS REFERENCE POSITION
23

FIG. 2

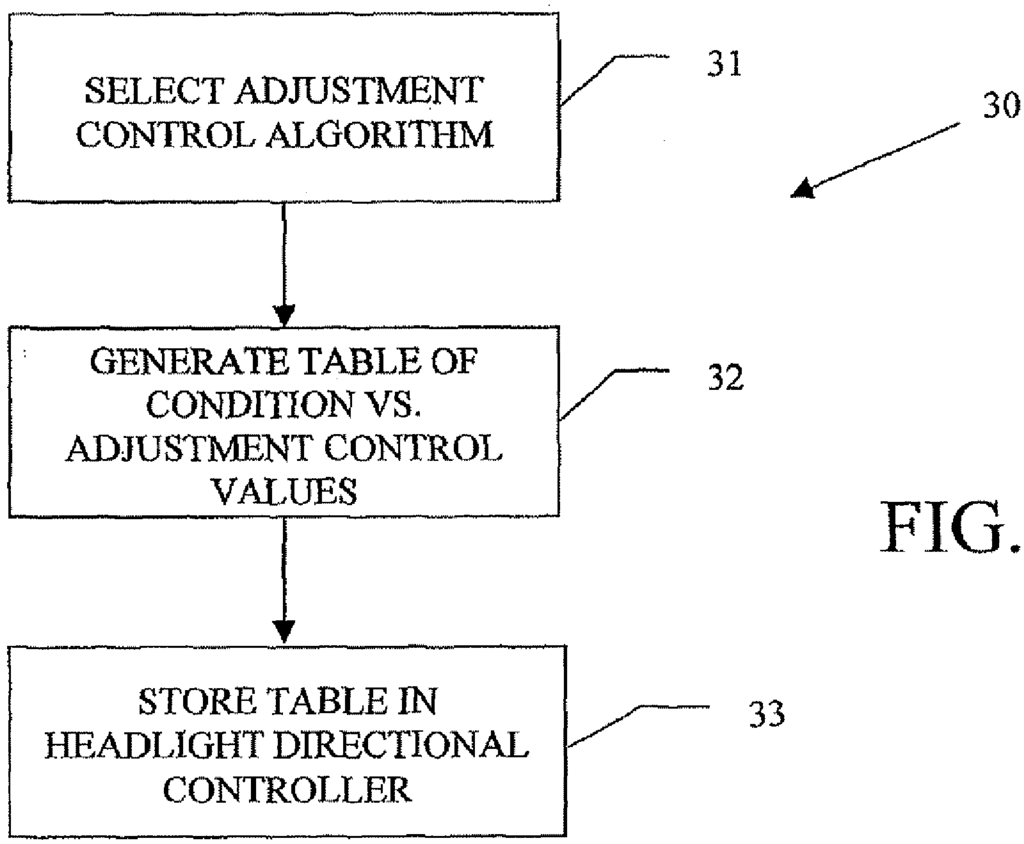
SELECT ADJUSTMENT CONTROL ALGORITHM
31
30
GENERATE TABLE OF CONDITION VS. ADJUSTMENT CONTROL VALUES
32
STORE TABLE IN HEADLIGHT DIRECTIONAL CONTROLLER
33

FIG. 3

40

SENSED CONDITION (STEERING ANGLE) VALUES	UP/DOWN ADJUSTMENT FACTORS	LEFT/RIGHT ADJUSTMENT FACTORS
+6°	-3.00°	+4.50°
+5°	-2.50°	+3.75°
+4°	-2.00°	+3.00°
+3°	-1.50°	+2.25°
+2°	-1.00°	+1.50°
+1°	-0.50°	+0.75°
0°	0.00°	0.00°
-1°	-0.50°	-0.75°
-2°	-1.00°	-1.50°
-3°	-1.50°	-2.25°
-4°	-2.00°	-3.00°
-5°	-2.50°	-3.75°
-6°	-3.00°	-4.50°

FIG. 4

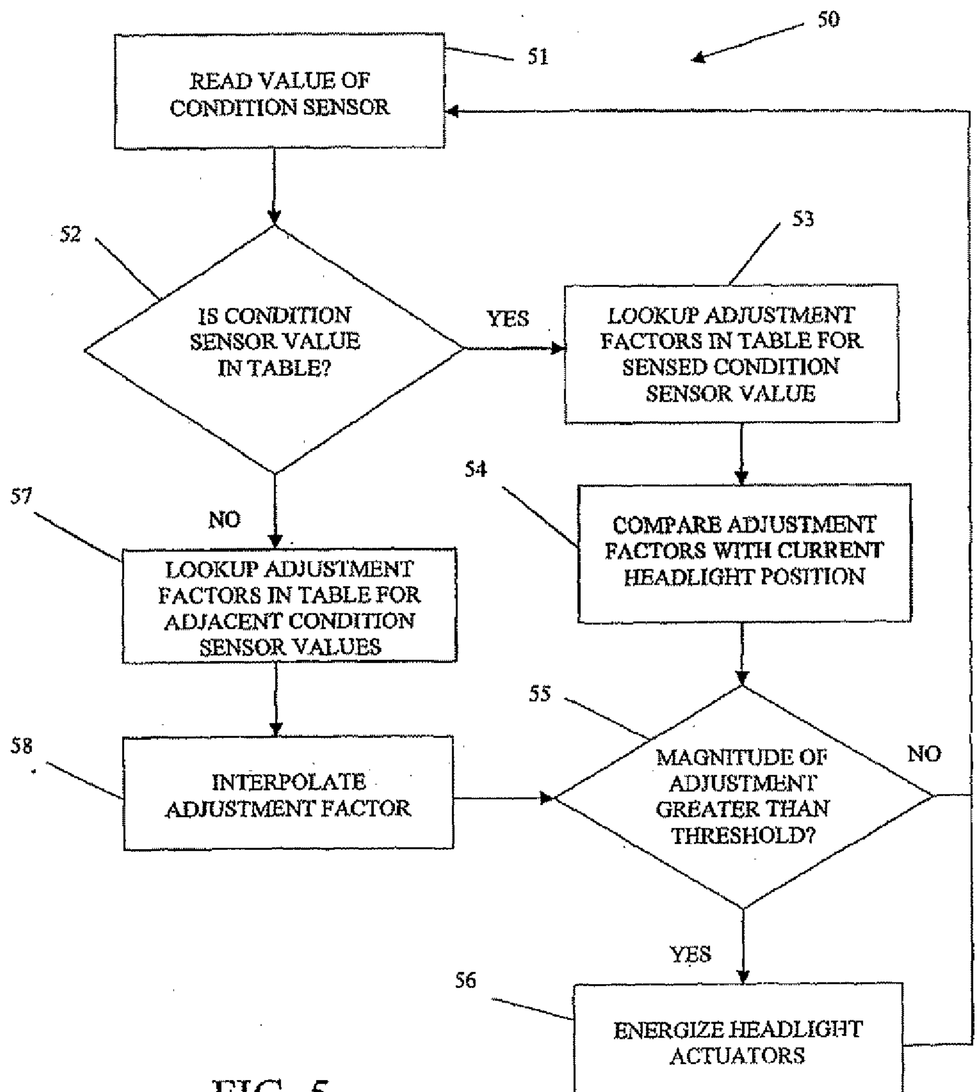
50
51
READ VALUE OF CONDITION SENSOR
52
IS CONDITION SENSOR VALUE IN TABLE?
YES
53
LOOKUP ADJUSTMENT FACTORS IN TABLE FOR SENSED CONDITION SENSOR VALUE
54
COMPARE ADJUSTMENT FACTORS WITH CURRENT HEADLIGHT POSITION
57
NO
LOOKUP ADJUSTMENT FACTORS IN TABLE FOR ADJACENT CONDITION SENSOR VALUES
55
58
INTERPOLATE ADJUSTMENT FACTOR
MAGNITUDE OF ADJUSTMENT GREATER THAN THRESHOLD?
NO
YES
56
ENERGIZE HEADLIGHT ACTUATORS

FIG. 5

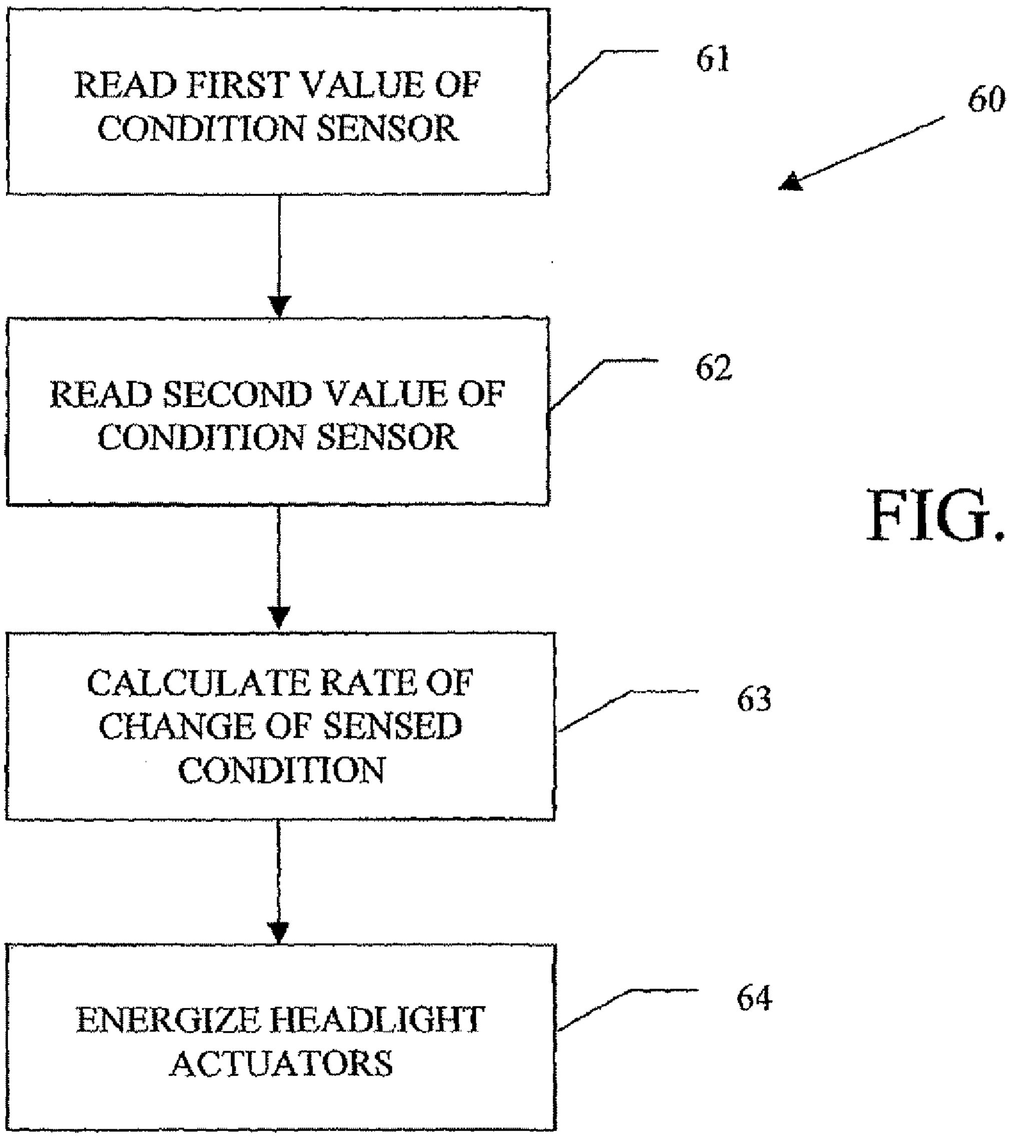
READ FIRST VALUE OF CONDITION SENSOR
61
60
READ SECOND VALUE OF CONDITION SENSOR
62
CALCULATE RATE OF CHANGE OF SENSED CONDITION
63
ENERGIZE HEADLIGHT ACTUATORS
64

FIG. 6

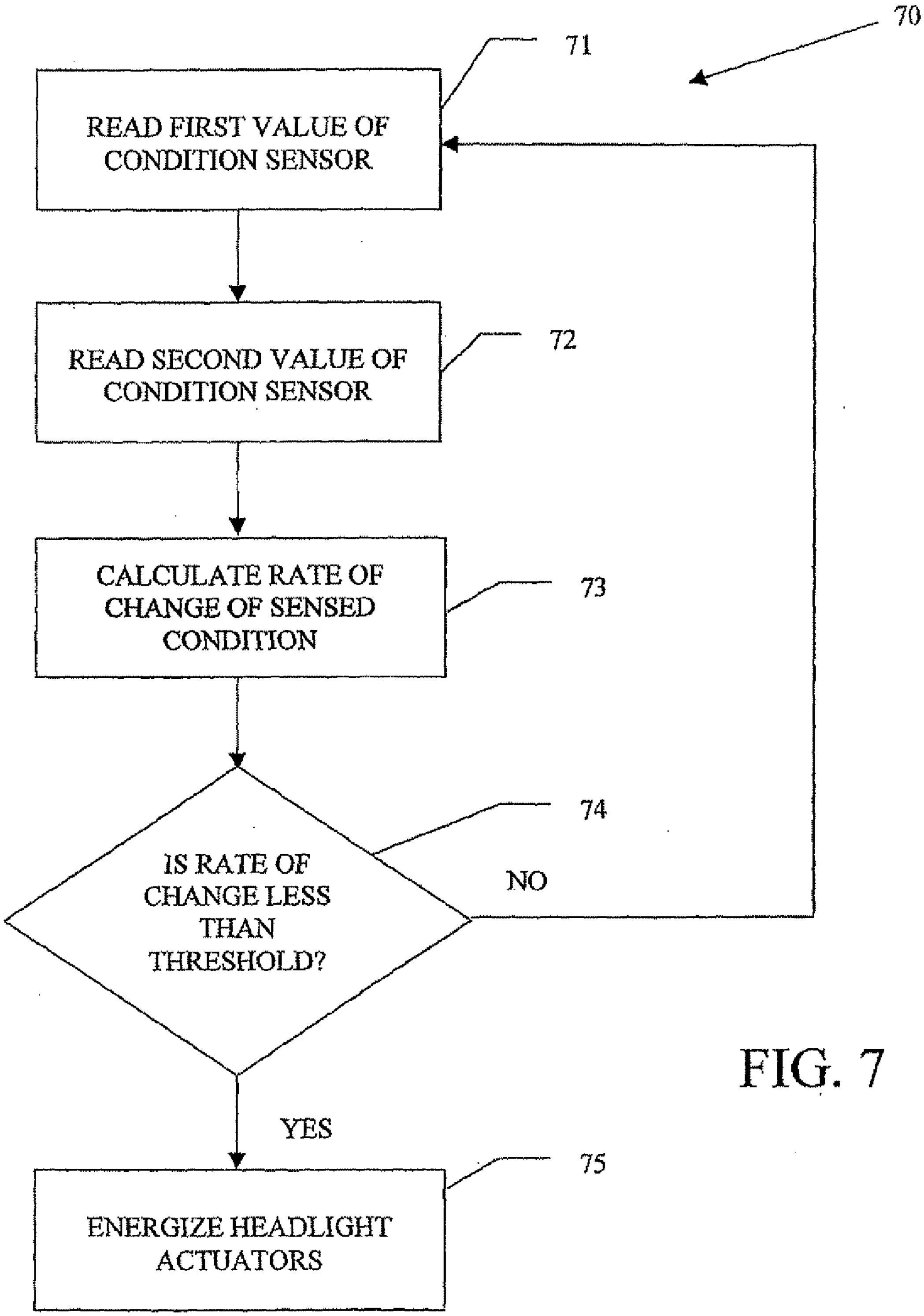
70
71
READ FIRST VALUE OF CONDITION SENSOR
72
READ SECOND VALUE OF CONDITION SENSOR
73
CALCULATE RATE OF CHANGE OF SENSED CONDITION
74
IS RATE OF CHANGE LESS THAN THRESHOLD?
NO
YES
75
ENERGIZE HEADLIGHT ACTUATORS

FIG. 7

AUTOMATIC DIRECTIONAL CONTROL SYSTEM FOR VEHICLE HEADLIGHTS

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Application Nos. 60/335,409, filed Oct. 31, 2001; 60/356,703, filed Feb. 13, 2002; and 60/369,447, filed Apr. 2, 2002, the disclosures of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

This invention relates in general to headlights that are provided on vehicles for illuminating dark road surfaces or other areas in the path of movement. In particular, this invention relates to an automatic directional control system for such vehicle headlights.

Virtually all land vehicles, and many other types of vehicles (such as boats and airplanes, for example), are provided with one or more headlights that are adapted to illuminate a portion of a dark road surface or other area in the path of movement of the vehicle to facilitate safe travel thereon. Typically, each headlight is mounted on or near the front end of the vehicle and is oriented in such a manner that a beam of light is projected forwardly therefrom. The angle at which the beam of light projects from the headlight can, for example, be characterized in a variety of ways, including (1) up and down relative to a horizontal reference position or plane and (2) left and right relative to a vertical reference position or plane. Such directional aiming angles are usually set at the time of assembly of the headlight into the vehicle so as to illuminate a predetermined portion of the road surface or other area in the path of movement of the vehicle.

In the past, these headlights have been mounted on the vehicle in fixed positions relative thereto such that the beams of light are projected therefrom at predetermined directional aiming angles relative to the vehicle. Although such fixed aiming angle headlight systems have and continue to function adequately, they cannot alter the directional aiming angles of the headlights to account for changes in the operating conditions of the vehicle. For example, if the speed of the vehicle is increased, it would be desirable to adjust the aiming angle of the headlights upwardly such that an area that is somewhat farther in front of the vehicle is more brightly illuminated. On the other hand, if the speed of the vehicle is decreased, it would be desirable to adjust the aiming angle of the headlights downwardly such that an area that is somewhat closer in front of the vehicle is more brightly illuminated. Similarly, if the vehicle turns a corner, it would be desirable to adjust the aiming angle of the headlights either toward the left or toward the right (depending on the direction of the turn) such that an area that is somewhat lateral to the front of the vehicle is more brightly illuminated.

To accomplish this, it is known to provide a directional control system for vehicle headlights that is capable of automatically altering the directional aiming angles of the headlights to account for changes in the operating conditions of the vehicle. A variety of such automatic directional control systems for vehicle headlights are known in the art. However, such known automatic headlight directional control systems have been found to be deficient for various reasons. Thus, it would be desirable to provide an improved structure for an automatic headlight directional control system that addresses such deficiencies.

SUMMARY OF THE INVENTION

This invention relates to an improved structure and method for operating a directional control system for vehicle headlights that is capable of automatically altering the directional aiming angles of the headlights to account for changes in the operating conditions of the vehicle. One or more operating condition sensors may be provided that generate signals that are representative of an operating condition of the vehicle, such as road speed, steering angle, pitch, suspension height, rate of change of road speed, rate of change of steering angle, rate of change of pitch, and rate of change of suspension height of the vehicle. A controller is responsive to the sensor signal for generating an output signal. An actuator is adapted to be connected to the headlight to effect movement thereof in accordance with the output signal. The controller can include a table that relates values of sensed operating condition to values of the output signal. The controller is responsive to the sensor signal for looking up the output signal in the table.

Various objects and advantages of this invention will become apparent to those skilled in the art from the following detailed description of the preferred embodiments, when read in light of the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram of an automatic directional control system for a vehicle headlight in accordance with this invention.

FIG. **2** is a flow chart of an algorithm for calibrating the automatic directional control system illustrated in FIG. **1** so as to define an initial reference position for the headlight from which the headlight directional controller can implement directional angle adjustments.

FIG. **3** is a flow chart of an algorithm for generating a table that relates one or more sensed vehicle operating condition values to one or more headlight directional angle adjustment factors and for storing such table in the headlight directional controller illustrated in FIG. **1**.

FIG. **4** is an example of a table that can be generated and stored in the headlight directional controller in accordance with the table generating algorithm illustrated in FIG. **3**.

FIG. **5** is a flow chart of an algorithm for operating the headlight directional controller illustrated in FIG. **1** to automatically implement directional angle adjustments in accordance with sensed condition values.

FIG. **6** is a flow chart of an algorithm for operating the headlight directional controller illustrated in FIG. **1** to automatically implement directional angle adjustments in accordance with the rate of change of one or more of the sensed condition values.

FIG. **7** is a flow chart of an algorithm for operating the headlight directional controller illustrated in FIG. **1** to automatically implement directional angle adjustments, but only when the rate of change of one or more of the sensed condition values is less than (or greater than) a predetermined value.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, there is illustrated in FIG. **1** an automatic directional control system, indicated generally at **10**, for a vehicle headlight **11** in accordance with this invention. The illustrated headlight **11** is, of itself, conventional in the art and is intended to be representative of any device that can be supported on any type of vehicle for the purpose of illuminating any area, such as an area in the path of movement of the vehicle. The headlight **11** is typically mounted on or near the front end of a vehicle (not shown) and is oriented in such a manner that a beam of light is projected therefrom. In a manner that is well known in the art, the headlight **11** is adapted to illuminate a portion of a dark road surface or other area in the path of movement of the vehicle to facilitate safe travel thereon.

The headlight **11** is adjustably mounted on the vehicle such that the directional orientation at which the beam of light projects therefrom can be adjusted relative to the vehicle. Any desired mounting structure can be provided to accomplish this. Typically, the headlight **11** is mounted on the vehicle such that the angle at which the beam of light projects therefrom can be adjusted both (1) up and down relative to a horizontal reference position or plane and (2) left and right relative to a vertical reference position or plane. Although this invention will be described and illustrated in the context of a headlight that is adjustable in both the up/down direction and the left/right direction, it will be appreciated that this invention may be practiced with any headlight **11** that is adjustable in any single direction or multiple directions of movement, whether up/down, left/right, or any other direction.

To effect movement of the illustrated headlight **11** relative to the vehicle, an up/down actuator **12** and a left/right actuator **13** are provided. The actuators **12** and **13** are conventional in the art and may, for example, be embodied as servo motors, step motors, or any other electronically controlled mechanical actuators. It has been found to be desirable to use microstepping motors for the actuators **12** and **13**. Such microstepping motors are known in the art and consist of conventional step motors that have appropriate hardware (i.e., driver integrated circuits) and software that allow the step motors to be operated in fractional step increments. The use of such microstepping motors has been found to be desirable because they can effect movements of the headlights in a somewhat faster, smoother, and quieter manner than conventional step motors, and further permit more precise positioning of the headlights **11**. In the illustrated embodiment, the up/down actuator **12** is mechanically connected to the headlight **11** such that the headlight **11** can be selectively adjusted up and down relative to a horizontal reference position or plane. Similarly, the illustrated left/right actuator **13** is mechanically connected to the headlight **11** such that the headlight **11** can be selectively adjusted left and right relative to a vertical reference position or plane.

A headlight directional controller **14** is provided for controlling the operations of the up/down actuator **12** and the left/right actuator **13** and, therefore, the angle at which the beam of light projects from the headlight **11** relative to the vehicle. The headlight directional controller **14** can be embodied as any control system, such as a microprocessor or programmable electronic controller, that is responsive to one or more sensed operating conditions of the vehicle for selectively operating the up/down actuator **12** and the left/right actuator **13**. To accomplish this, the automatic directional control system **10** can include, for example, a pair of condition sensors **15** and **16** that are connected to the headlight directional controller **14**. The condition sensors **15** and **16** are conventional in the art and are responsive to respective sensed operating conditions of the vehicle for generating electrical signals to the headlight directional controller **14**. However, if desired, only a single one of the condition sensors **15** and **16** need be provided. Alternatively, additional condition sensors (not shown) may be provided if desired to generate electrical signals that are representative of any other operating conditions of the vehicle. A conventional input/output device **17** is connected to (or can be connected to) the headlight directional controller **14** for facilitating communication therewith in the manner described below.

If desired, a first position feedback sensor **18** may be provided for the up/down actuator **12**, and a second position feedback sensor **19** may be provided for the left/right actuator **13**. The position feedback sensors **18** and **19** are conventional in the art and are adapted to generate respective electrical signals that are representative of the actual up/down and left/right positions of the headlight **11**. Thus, the first position feedback sensor **18** is responsive to the actual up/down position of the headlight **11** (as determined by a portion of the up/down actuator **12**, for example) for generating an electrical signal to the headlight directional controller **14** that is representative thereof. Similarly, the second position feedback sensor **19** is responsive to the actual left/right position of the headlight **11** (as determined by a portion of the left/right actuator **13**, for example) for generating an electrical signal to the headlight directional controller **14** that is representative thereof. The position feedback sensors **18** and **19** can be embodied as any conventional sensor structures, such as Hall effect sensors, that are responsive to movements of the headlight **11** (or to the movements of the respective actuators **12** and **13** that are connected to move the headlight **11**) for generating such signals.

Alternatively, the position feedback sensors **18** and **19** can be embodied as respective devices that generate electrical signals whenever the headlight **11** has achieved respective predetermined up/down or left/right positions. This can be accomplished, for example, using a conventional optical interrupter (not shown) for each of the actuators **12** and **13**. Each of the optical interrupters includes a flag or other component that is mounted on or connected to the headlight **11** for movement therewith. Each of the optical interrupters further includes an optical source and sensor assembly. As the headlight **11** is moved by the actuators **12** and **13**, the flag moves therewith relative to the optical source and sensor assembly between a first position, wherein the flag permits light emitted from the source from reaching the sensor, and a second position, wherein the flag prevents light emitted from the source from reaching the sensor. When the flag is in the first position relative to the optical source and sensor assembly, the sensor is permitted to receive light emitted from the source. As a result, a first signal is generated from the optical source and sensor assembly to the headlight directional controller **14**. Conversely, when the flag is in the second position relative to the optical source and sensor assembly, the sensor is not permitted to receive light emitted from the source. As a result, a second signal is generated from the optical source and sensor assembly to the headlight directional controller **14**. Thus, the edge of the flag defines a transition between the first and second positions of the flag relative to the optical source and sensor assembly and, therefore, defines a predetermined up/down or left/right position of the headlight **11**. The nature of the signal generated from the optical source and sensor assembly to the headlight directional controller **14** (i.e., the first signal or the second signal) can also be used to determine on which side of the predetermined position (the left side or the right side, for example) that the headlight **11** is positioned. The purpose for such position feedback sensors **18** and **19** will be discussed below.

FIG. 2 is a flow chart of an algorithm, indicated generally at 20, for calibrating the automatic directional control system illustrated in FIG. 1 so as to define an initial reference position or positions for the headlight 11 from which the headlight directional controller 14 can implement directional angle adjustments. As mentioned above, the headlight 11 is mounted on the vehicle such that the angle at which the beam of light projects therefrom can be adjusted both up and down relative to a horizontal reference position or plane and left and right relative to a vertical reference position or plane. To insure accurate positioning of the headlight 11, it is desirable that a reference position or positions be initially established by the headlight directional controller 14. Subsequent directional angle adjustments can be made by the headlight directional controller 14 from the pre-established reference position or positions established by this calibration algorithm 20.

To accomplish this, the calibration algorithm 20 has a first step 21 wherein the headlight directional controller 14 is caused to enter a calibration mode of operation. In the calibration mode of operation, the headlight directional controller 14 is responsive to input signals from the input/output device 17 (or from another source, if desired) for causing manual operation of the up/down actuator 12 and the left/right actuator 13. Thus, while the headlight directional controller 14 is in the calibration mode of operation, an operator of the input/output device 17 can manually effect either up/down movement of the headlight 11, left/right movement of the headlight 11, or both, as desired.

In a second step 22 of the calibration algorithm 20, the up/down actuator 12 and the left/right actuator 13 are manually operated to aim the headlight 11 in a predetermined reference orientation. This can be accomplished by use of the input/output device 17 that, as mentioned above, is connected to (or can be connected to) the headlight directional controller 14. Traditionally, the aiming of a headlight 11 has been accomplished by parking the vehicle on a surface near a wall or other vertical structure, providing a reference target at a predetermined location on the wall or other structure, and mechanically adjusting the mounting structure of the headlight 11 such that the center of the beam therefrom is projected at the reference target. In this invention, the vehicle is parked on a surface near a wall or other vertical structure, and a reference target is provided at a predetermined location on the wall or other structure, as described above. Next, in accordance with the second step 22 of this calibration algorithm 20, the input/output device 17 is operated to generate electrical signals to the headlight directional controller 14. In response to such electrical signals, the headlight directional controller 14 operates the up/down actuator 12 and the left/right actuator 13 to move the headlight 11 such that center of the beam projecting therefrom is aimed at the reference target. When the beam from the headlight 11 is so aimed, then the headlight 11 is determined to be oriented in the initial reference position from which the headlight directional controller 14 can subsequently implement directional angle adjustments.

In a third step 23 of the calibration algorithm 20, once this initial reference position for the headlight 11 has been achieved, such position is stored in the headlight directional controller 14 as the predetermined initial reference position. This can be accomplished by means of the position feedback sensors 18 and 19. As discussed above, the position feedback sensors 18 and 19 are adapted to generate respective electrical signals that are representative of the actual up/down and left/right positions of the headlight 11 or of the predetermined positions for the headlight. Thus, the first

position feedback sensor 18 is responsive to the actual up/down position of the headlight 11 (as determined by the up/down actuator 12, for example) for generating an electrical signal to the headlight directional controller 14 that is representative thereof. Similarly, the second position feedback sensor 19 is responsive to the actual left/right position of the headlight 11 (as determined by the left/right actuator 13, for example) for generating an electrical signal to the headlight directional controller 14 that is representative thereof. Accordingly, the third step 23 of the calibration algorithm 20 can be performed by causing the headlight directional controller 14 to read the signals from the position feedback sensors 18 and 19 and store the current up/down and left/right positions of the headlight 11 as the initial reference positions from which the headlight directional controller 14 can subsequently implement directional angle adjustments.

The current position of the headlight 11 is preferably stored in the non-volatile memory of the headlight directional controller 14 for reference during normal operation of the automatic directional control system 10 described below. Thus, when the automatic directional control system 10 is initially activated (such as when the electrical system of the vehicle is initially turned on), the headlight directional controller 14 can position the headlight 11 at or near the calibrated position utilizing the signals comparing the current position of the headlight 11 (as determined by the signals generated by the position feedback sensors 18 and 19) with the predetermined reference position determined by the calibration algorithm 20.

FIG. 3 is a flow chart of an algorithm, indicated generally at 30, for generating a table that relates the sensed condition values from the condition sensors 15 and 16 to the headlight directional angle adjustment factors that will be implemented by the headlight directional controller 14, and further for storing such table in the headlight directional controller 14 illustrated in FIG. 1. As used herein, the term "table" is intended to be representative of any collection or association of data that relates one or more of the sensed condition values to one or more of the headlight directional angle adjustment factors. The table of data can be generated, stored, and expressed in any desired format. For example, this table of data can be generated, stored, and expressed in a conventional spreadsheet format, such as shown in FIG. 4, which will be discussed in detail below.

In a first step 31 of the table generating algorithm 30, an adjustment control algorithm is selected. The adjustment control algorithm can be, generally speaking, any desired relationship that relates one or more operating conditions of the vehicle to one or more angular orientations of the headlight 11. A variety of such relationships are known in the art, and this invention is not intended to be limited to any particular relationship. Typically, such relationships will be expressed in terms of a mathematical equation or similar relationship that can be readily processed using a microprocessor or similar electronic computing apparatus, such as the above-described headlight directional controller 14. The particular adjustment control algorithm that is selected may, if desired, vary from vehicle to vehicle in accordance with a variety of factors, including relative size and performance characteristics of the vehicle or any other desired condition.

As mentioned above, a plurality of operating conditions may be sensed by the condition sensors 15 and 16 and provided to the headlight directional controller 14 for use with the adjustment control mechanism. For example, the condition sensors 15 and 16 may generate electrical signals to the headlight directional controller 14 that are representative of the road speed, the steering angle, and the pitch of the vehicle (which can, for example, be determined by sensing the front and rear suspension heights of the vehicle or by a pitch or level sensor). Additionally, the time derivative of these operating conditions (i.e., the rate of change of the road speed, steering angle, and pitch of the vehicle) can be sensed or calculated. However, any other operating condition or conditions of the vehicle may be sensed and provided to the headlight directional controller **14**.

In a second step **32** of the table generating algorithm **30**, the table is generated using the adjustment control algorithm selected in the first step **31**. The table can be generated in any desired manner. For example, let it be assumed that the selected adjustment control algorithm relates a single sensed operating condition to each of the angular adjustment control values for adjusting both the up/down orientation and the left/right orientation of the headlight **11**. The table can be generated by initially selecting a first discrete sensed operating condition value that might be encountered during operation of the vehicle. Then, the selected adjustment control algorithm is solved using such first discrete sensed operating condition value to obtain the corresponding adjustment control values for the up/down and left/right orientation of the headlight **11**. Then, the first discrete sensed operating condition value and the corresponding adjustment control values are stored in the table. This process can be repeated for any desired number of other discrete sensed operating condition values that might be encountered during operation of the vehicle.

As mentioned above, FIG. **4** is a representative example of a table, indicated generally at **40**, that can be generated in accordance with the second step **32** of the table generating algorithm **30** illustrated in FIG. **3**. As shown therein, a series of discrete sensed operating condition values (degrees of steering angles, for example) is related to the angular adjustment control values (degrees of movement from the associated up/down and left/right reference positions or planes, for example) for adjusting both the up/down orientation and the left/right orientation of the headlight **11**. For the purposes of illustration only, let it be assumed that (1) a positive steering angle value represents steering toward left, while a negative steering angle value represents steering toward the right, (2) a positive up/down adjustment factor represents aiming the headlight **11** upwardly, while a negative up/down adjustment factor represents aiming the headlight **11** downwardly, and (3) a positive left/right adjustment factor represents aiming the headlight **11** toward the left, while a negative left/right adjustment factor represents aiming the headlight **11** toward the right.

Thus, in accordance with the selected adjustment control algorithm, a sensed steering angle of +6° results in an up/down adjustment factor of −3.00° and a left/right adjustment factor of +4.50°. Similarly, a sensed steering angle of +5° results in an up/down adjustment factor of −2.50° and a left/right adjustment factor of +3.75°, and so on as shown in the table **40**. The illustrated table **40** relates thirteen different sensed steering angle values to their corresponding adjustment control values for both the up/down and left/right orientation of the headlight **11**. However, the table **40** can include a greater or lesser number of such sensed operating condition values, together with their corresponding adjustment control values. Furthermore, although the illustrated table **40** relates only a single sensed operating condition value (steering angle) to the corresponding adjustment control values for both the up/down and left/right orientation of the headlight **11**, the selected adjustment control algorithm may, as mentioned above, be responsive to a plurality of sensed operating condition values for determining the corresponding adjustment control values. Alternatively, as will be discussed further below, a plurality of tables **40** can be generated, one for each of the plurality of sensed operating condition values. The size and extent of the table **40** or tables can be varied to accommodate any desired number of such sensed operating conditions.

Referring back to FIG. **3**, in a third step **33** of the table generating algorithm **30**, the table **40** generated in the second step **32** is stored in the memory of the headlight directional controller **14** illustrated in FIG. **1**. The contents of the table **40** can be communicated serially to the headlight directional controller **14** by means of the input/output device **17** illustrated in FIG. **1** or in any other desired manner. Regardless of how it is communicated, the table **40** is preferably stored in a non-volatile memory of the headlight directional controller **14** for subsequent use in the manner described further below when the vehicle is operated.

As mentioned above, it may be desirable to vary the algorithm that is selected for use in implementing the headlight directional angle adjustment factors. The generation of the table **40** and the storage of such table **40** in the memory of the headlight directional controller **14** allow a designer of the automatic directional control system **10** to quickly and easily alter the response characteristics of the system **10** as desired, without the need for direct access to the computer code or software that is used to operate the headlight directional controller **14**. Rather, to effect such alterations, a designer can simply change some or all of the data points that are contained within the table **40**. As will be described in detail below, the headlight directional controller **14** will use whatever data points that are contained within the table **40** in determining the need for adjustments in the angular orientation of the headlight **11**. This structure also reduces the amount of processing power that is necessary for the headlight directional controller **14** because it can operate on a relatively simple look-up basis using the table **40**, rather than having to calculate relatively high order equations that may be used to determine the data points contained within the table **40**.

FIG. **5** is a flow chart of an algorithm, indicated generally at **50**, for operating the headlight directional controller illustrated in FIG. **1** to automatically implement directional angle adjustments in accordance with one or more of the sensed condition values from the condition sensors **15** and **16**. In a first step **51** of the operating algorithm **50**, the values of one or more of the condition sensors **15** and **16** are read by the headlight directional controller **14**. Then, the operating algorithm **50** enters a decision point **52**, wherein it is determined whether the value or values of the condition sensors **15** and **16** that have been read by the headlight directional controller **14** are specifically contained in the table **40**. For example, using the table **40** illustrated in FIG. **4**, if the headlight directional controller **14** has read a steering angle value of −2°, then it is determined that the value of the condition sensor **15** is specifically contained within the table **40**. In this instance, the operating algorithm **50** branches from the decision point **52** to an instruction **53**, wherein the adjustment factors contained in the table **40** that correspond to the sensed condition value are looked up and stored in the headlight directional controller **14**.

The operating algorithm **50** next enters an instruction **54** wherein the value of the magnitude of the adjustment factor (i.e., the desired position for the headlight **11**) is compared with the current position of the headlight **11**. This step **54** of the operating algorithm **50** is optional and can be performed if one or more of the position feedback sensors **18** and **19** are provided in the automatic directional control system **10** to generate respective electrical signals that are representative of the actual up/down and left/right positions of the headlight **11**, as described above. This step **54** of the operating algorithm **50** can be performed to determine how much of an adjustment is necessary to move the headlight **11** from its current position, as determined by the position feedback sensors **18** and **19**, to the desired position, as defined by the adjustment factor obtained from the table **40**. To accomplish this, the value of the adjustment factor may, for example, be subtracted from the current position of the headlight **11** to determine the magnitude of the difference therebetween and, therefore, the magnitude of the adjustment that is necessary to move the headlight **11** from its current position to the desired position. However, this step **54** of the operating algorithm **50** can be accomplished in any other desired manner.

Next, the operating algorithm **50** enters a decision point **55**, wherein it is determined whether the magnitude of the adjustment that is necessary to move the headlight **11** from its current position to the desired position is greater than a predetermined minimum threshold. This step in the operating algorithm **50** is also optional, but may be desirable to prevent the actuators **12** and **13** from being operated continuously or unduly frequently in response to relatively small variations in the sensed operating condition or conditions, such as relatively small bumps in the road. For example, if the current position of the headlight **11** is relatively close to the desired position, then it may be undesirable to effect any movement thereof. This step **55** will prevent the actuators **12** and **13** from being operated unless the current position of the headlight **11** is relatively far from the desired position. As another example, if the condition sensors **15** and **16** are respectively responsive to the front and rear suspension heights of the vehicle for the purpose of determining the pitch thereof, then the headlight directional controller **14** may be programmed to be responsive only to changes in the suspension heights that occur at frequencies that are lower than the suspension rebound frequency of the vehicle (thereby ignoring relatively high frequency changes in suspension height that are likely the result of bumps in the road). However, relatively high frequency changes in the suspension heights could also be monitored to assist in deciphering relatively rough suspension changes from other suspension changes.

In any event, the provision of the predetermined minimum threshold functions as a filter or dead band that minimizes or eliminates undesirable "hunting" of the actuators **12** and **13** for relatively small magnitudes of movement of the headlight **11**. If the magnitude of the adjustment factor is not greater than the predetermined minimum threshold, then the operation of the actuators **12** and **13** is considered to be undesirable. Thus, the operating algorithm **50** branches from the decision point **55** back to the instruction **51**, wherein the above-described steps of the operating algorithm **50** are repeated.

If, on the other hand, the magnitude of the adjustment factor is greater than the predetermined minimum threshold, then the operation of the actuators **12** and **13** is considered to be desirable. Thus, the operating algorithm **50** branches from the decision point **55** to an instruction **56**, wherein either or both of the actuators **12** and **13** are actuated to effect movement of the headlight **11**. For example, using the table **40** illustrated in FIG. **4**, if the headlight directional controller **14** has read a steering angle value of −2°, then the headlight directional controller **14** will look up an up/down adjustment factor of −1.00° and a left/right adjustment factor of −1.50° from the table **40**. The headlight directional controller **14** operates the actuators **12** and **13** to adjust the angular orientation of the headlight **11** to achieve the noted adjustment factors.

In some instances, the amounts of movement that are to be implemented by the two actuators **12** and **13** will be the same (i.e., the amount of up/down movement of the headlight **11** will be the same as the amount of left/right movement). More frequently, however, the amounts of movement that are to be implemented by the two actuators **12** and **13** will be different from one another. In the latter instances, it may be desirable to operate the two actuators **12** and **13** at two different speeds such that the overall movement of the headlight **11** is relatively uniform. For example, if the amount of movement that is to be implemented by the up/down actuator **12** is twice as large as the amount of movement that is to be implemented by the left/right actuator **13**, then it may be desirable to operate the up/down actuator **12** at one-half of the speed of the left/right actuator **13** so that the movements of both actuators **12** and **13** (and, therefore, the overall movement of the headlight **11**) will start and stop at approximately the same time. Similarly, if the vehicle is provided with two different headlights **11**, as is commonly found, then it may be desirable to control the respective movements of such different headlights **11** in such a manner that they both start and stop at approximately the same time. This can be accomplished, for example, by providing a single headlight directional controller **14** for not only controlling, but also coordinating the movements of both of the headlights **11** in response to the sensed operating conditions.

Such operations can be performed in an open loop manner if desired, wherein the actuators **12** and **13** are operated to achieve predetermined amounts of movement. For example, the actuators **12** and **13** can be embodied as step motors that are operated a predetermined number of steps to achieve predetermined amounts of movement. Alternatively, the actuators **12** and **13** can be operated for predetermined periods of time to achieve the predetermined amounts of movement. However, more desirably, the operations of the actuators **12** and **13** are performed in a closed loop manner. To accomplish this, the actuators **12** and **13** are operated until either or both of the position feedback sensors **18** and **19** generate signals indicate that the headlight **11** has actually achieved the predetermined amounts of movement or desired position. In either event, the operating algorithm **50** then branches back to the instruction **51**, wherein the above-described steps of the algorithm **50** are repeated.

Referring back to the decision point **52**, if the value or values of the condition sensors **15** and **16** that have been read by the headlight directional controller **14** are not specifically contained in the table **40**, then the operating algorithm **50** branches from the decision point **52** to an instruction **57**, wherein the adjustment factors that are specifically contained in the table **40** that correspond to the adjacent sensed condition values are looked up and stored in the headlight directional controller **14**. For example, using the table **40** illustrated in FIG. **4**, if the headlight directional controller **14** has read a steering angle value of −1.5°, then it is determined that the value of the condition sensor **15** is not specifically contained within the table **40**. Rather than simply default to the closest value that is contained within the table **40**, the two adjustment factors specifically contained in the table **40** that are adjacent to the sensed condition value (namely, the adjustment factors for the steering angle values of −1° and −2°) are looked up and stored in the headlight directional controller **14**.

The operating algorithm **50** next enters an instruction **58**, wherein the actual adjustment factors to be implemented by the headlight directional controller **14** are interpolated or otherwise calculated from the stored adjustment factors that are adjacent to the sensed condition value. For example, as mentioned above, if the actual sensed steering angle value is −1.5°, then the headlight directional controller **14** looks up the adjustment factors for the steering angle values of −1° and −2°. The up/down adjustment factor for a steering angle value of −1° is −0.50 while the up/down adjustment factor for a steering angle value of −2° is −1.00°. If the calculation that is performed by the headlight directional controller **14** is a simple arithmetic mean, then the interpolated up/down adjustment factor would be −0.75°. Similarly, the left/right adjustment factor for a steering angle value of −1° is −0.75°, while the left/right adjustment factor for a steering angle value of −2° is −1.50°. If the calculation that is performed by the headlight directional controller **14** is a simple arithmetic mean, then the interpolated left/right adjustment factor would be −1.13°. Thereafter, the operating algorithm **50** branches to the decision point **55**, and the remainder of the operating algorithm **50** is performed as described above.

The interpolation that is performed by the headlight directional controller **14** can be accomplished in any desired manner. The performance of the simple arithmetic mean described above is intended to be representative of any mathematical or other function that can be performed to calculate, derive, or otherwise obtain adjustment factors that are not present in the table **40**. Furthermore, although this interpolation has been described in the context of using only the two condition values that are directly adjacent to the actual sensed condition value, it will be appreciated that the adjustment values for any single condition value or combination of sensed condition values may be selected for the interpolation. For example, several of the condition values both above and below the sensed condition value can be read from the table **40** to derive a trend line or other good estimate of the adjustment factors that are not present in the table **40**. Performance of this interpolation does not require any significant increase in the amount of processing power that is necessary for the headlight directional controller **14**.

The above discussion has assumed the use of a single table **40** that provides adjustment values based upon a single sensed operating condition (steering angle of the vehicle, in the illustrated embodiment). However, as discussed above, this invention may be practiced by sensing a plurality of operating conditions of the vehicle. For example, let it be assumed that both steering angle and vehicle road speed are sensed by the condition sensors **15** and **16**. As previously discussed, the adjustment control algorithm that is selected in the first step **31** of the table generating algorithm **30** can be designed to accommodate multiple sensed conditions. Alternatively, however, a first table (such as the table **40** illustrated in FIG. **4**) may be generated that relates the steering angle of the vehicle to the angular adjustment control values for adjusting both the up/down orientation and the left/right orientation of the headlight **11**. A second, similar table (not shown) may also be generated that relates the road speed of the vehicle to the angular adjustment control values for adjusting both the up/down orientation and the left/right orientation of the headlight **11**. Thus, for a given steering angle and road speed of the vehicle, the first and second tables may provide differing angular adjustment control values. To address this, the interpolation step **57** of the operating algorithm **50** can be performed to interpolate a single composite adjustment value that is based upon the two different values provided in the first and second tables for the pair of sensed operating conditions. This interpolation can be performed in the same manner as described above for each of the actuators **12** and **13**.

A variety of control strategies can be implemented using the automatic directional control system **10** described above. For example, the pitch of the vehicle can change as a result of a variety of factors, including acceleration, deceleration, and weight distribution of the vehicle. These pitch variations can alter the angle at which the beam of light projects from the headlight **11** in the up and down direction relative to a horizontal reference position or plane. The automatic directional control system **10** can be responsive to such pitch variations for operating the up/down actuator **12** to maintain the angle at which the beam of light projects from the headlight **11** in the up and down direction relatively constant to the horizontal reference position or plane.

As discussed above, the angle at which the beam of light projects from the headlight **11** in the left and right direction relative to a vertical reference position or plane can be adjusted in accordance with the sensed steering angle. However, the angle at which the beam of light projects from the headlight **11** in the up and down direction relative to a horizontal reference position or plane can also be adjusted in accordance with the sensed steering angle. This can be done to lower the headlight beams as the vehicle is turning a corner. The advantages of this are not only to better illuminate the road surface in the path of movement of the vehicle, but also to reduce headlight glare to other vehicles as the turn is negotiated.

Lastly, many vehicles on the road today have halogen lamps or other lights that are aimed to illuminate the sides of the roads in front of the vehicle during the turn. These other lights are activated by the manual operation of the turn signals of the vehicle. The automatic directional control system **10** of this invention can be responsive to one or more operating conditions of the vehicle to automatically activate these other lights on the vehicle. For example, the automatic directional control system **10** of this invention can be responsive to a steering angle in excess of a predetermined magnitude for automatically activating these other lights on the vehicle. This can be effective to extend the angular range of illumination of the road surface.

FIG. **6** is a flow chart of an algorithm, indicated generally at **60**, for operating the headlight directional controller illustrated in FIG. **1** to automatically implement directional angle adjustments in accordance with the rate of change of one or more of the sensed condition values. As mentioned above, the headlight directional controller **14** can be operated to automatically implement directional angle adjustments in accordance with one or more of the sensed condition values or in accordance with the rate of change of one or more of the sensed condition values.

To accomplish this, the algorithm **60** has a first step **61** wherein the values of one or more of the condition sensors **15** and **16** are initially read by the headlight directional controller **14**. Then, the algorithm **60** enters a second step **62** wherein the values of one or more of the condition sensors **15** and **16** are subsequently read a second time by the headlight directional controller **14**. The second reading of the condition sensors **15** and **16** occurs a predetermined amount of time after the first reading thereof. Next, the algorithm enters a third step **63** wherein a rate of change of the sensed condition or conditions is calculated. The rate of change of the sensed condition can be calculated as the difference between the first and second readings divided by the amount of time therebetween or by any other desired means. For example, if the sensed condition is vehicle speed, then the difference between the first sensed vehicle speed and the second sensed vehicle speed, divided by the amount of time therebetween, would yield a number that is representative of the acceleration of the vehicle. In a final step **64** of the algorithm **60**, either or both of the actuators **12** and **13** are actuated to effect movement of the headlight **11** in accordance with the calculated rate of change of the sensed condition. Such movement of the headlight **11** can be effected in a manner that is similar to that described above.

FIG. **7** is a flow chart of an algorithm, indicated generally at **70**, for operating the headlight directional controller illustrated in FIG. **1** to automatically implement directional angle adjustments, but only when the rate of change of one or more of the sensed condition values is less than (or greater than) a predetermined value. As mentioned above, the headlight directional controller **14** can be operated to automatically implement directional angle adjustments in accordance with one or more of the sensed condition values. In this variation of the invention, the headlight directional controller **14** automatically implements directional angle adjustments in response to the sensed condition values (or in response to the rate of change of the sensed condition values), but only when the rate of change of one or more of the sensed condition values is less than (or greater than) a predetermined value.

To accomplish this, the algorithm **70** has a first step **71** wherein the values of one or more of the condition sensors **15** and **16** are initially read by the headlight directional controller **14**. Then, the algorithm **70** enters a second step **72** wherein the values of one or more of the condition sensors **15** and **16** are subsequently read a second time by the headlight directional controller **14**. The second reading of the condition sensors **15** and **16** occurs a predetermined amount of time after the first reading thereof. Next, the algorithm enters a third step **73** wherein a rate of change of the sensed condition or conditions is calculated. The rate of change of the sensed condition can be calculated as the difference between the first and second readings divided by the amount of time therebetween or by any other desired means. For example, if the sensed condition is suspension height, then the difference between the first sensed suspension height and the second sensed suspension height, divided by the amount of time therebetween, would yield a number that is representative of the rate of change of the suspension height of the vehicle.

In a fourth step **74** of the algorithm **70**, a determination is made as to whether the rate of change of the sensed condition value is less than a predetermined threshold value. If the rate of change of the sensed condition value is less than this predetermined threshold value, then the algorithm **70** branches from the decision point **74** to a final step **75** of the algorithm **70**, wherein either or both of the actuators **12** and **13** are actuated to effect movement of the headlight **11** in accordance with the calculated rate of change of the sensed condition. Such movement of the headlight **11** can be effected in a manner that is similar to that described above. If, however, the rate of change of the sensed condition value is not less than this predetermined threshold value, then the algorithm **70** branches from the decision point **74** back to the first step **71**, wherein the algorithm **70** is repeated. This threshold sensing algorithm **70** can function to prevent the headlight directional controller **14** from being operated to automatically implement directional angle adjustments when the rate of change of the suspension height of the vehicle changes more rapidly than the system can effect corrective changes. For example, if the vehicle is operated on a bumpy road, the algorithm **70** will prevent the headlight directional controller **14** from attempting to correct for every single bump that is encountered. However, for relatively low frequency or rates of change in the suspension height of the vehicle, such as can occur when accelerating, decelerating, and weight changes, the headlight directional controller **14** will be operated in the normal manner to effect corrective actions, as described above.

As mentioned above, the input/output device **17** is connected to (or can be connected to) the headlight directional controller **14** for facilitating communication therewith, and the input/output device **17** can be used for calibrating the automatic directional control system illustrated in FIG. **1** so as to define an initial reference position or positions for the headlight **11** from which the headlight directional controller **14** can implement directional angle adjustments. Additionally, however, the input/output device **17** can be employed as a diagnostic tool. To accomplish this, the input/output device **17** can be embodied as a conventional microprocessor or similar electronically programmable device that can be connected to the headlight directional controller **14** to read fault codes that may be generated during the operation thereof. The headlight directional controller **14** can be programmed to generate fault codes whenever a fault condition or other anomaly occurs or is detected. Such fault codes can be stored in the headlight directional controller **14** until the input/output device **17** is subsequently connected thereto. When so connected, the input/output device **17** can read such codes and display them for an operator. As a result, the operator can take whatever corrective actions are necessary to address the fault condition or anomaly. The input/output device **17** can also be programmed to clear the fault codes from the headlight directional controller **14** after they are read.

In accordance with the provisions of the patent statutes, the principle and mode of operation of this invention have been explained and illustrated in its preferred embodiments. However, it must be understood that this invention may be practiced otherwise than as specifically explained and illustrated without departing from its spirit or scope.

What is claimed is:

1. An automatic directional control system for a vehicle headlight comprising:

a sensor that is adapted to generate a signal that is representative of a condition of the vehicle, said sensed condition includes one or more of road speed, steering angle, pitch, and suspension height of the vehicle;

a controller that is responsive to said sensor signal for generating an output signal only when said sensor signal changes by more than a predetermined minimum threshold amount to prevent said actuator from being operated continuously or unduly frequently in response to relatively small variations in the sensed operating condition; and

an actuator that is adapted to be connected to the headlight to effect movement thereof in accordance with said output signal.

2. The automatic directional control system defined in claim **1** wherein said sensor generates a signal that is representative of the road speed of the vehicle.

3. The automatic directional control system defined in claim **1** wherein said sensor generates a signal that is representative of the steering angle of the vehicle.

4. The automatic directional control system defined in claim **1** wherein said sensor generates a signal that is representative of the pitch of the vehicle.

5. The automatic directional control system defined in claim **1** wherein said sensor generates a signal that is representative of the suspension height of the vehicle.

* * * * *

JS 44 (Rev 12/07)

CIVIL COVER SHEET

The JS 44 civil cover sheet and the information contained herein neither replace nor supplement the filing and service of pleadings or other papers as required by law, except as provided by local rules of court. This form, approved by the Judicial Conference of the United States in September 1974, is required for the use of the Clerk of Court for the purpose of initiating the civil docket sheet. (SEE INSTRUCTIONS ON THE REVERSE OF THE FORM.)

I. (a) PLAINTIFFS

BALTHER TECHNOLOGIES, LLC

(b) County of Residence of First Listed Plaintiff GREGG, TX
(EXCEPT IN U.S. PLAINTIFF CASES)

(c) Attorney's (Firm Name, Address, and Telephone Number)
(see attachment)

DEFENDANTS

AMERICAN HONDA MOTOR CO. INC., ET AL

County of Residence of First Listed Defendant
(IN U.S. PLAINTIFF CASES ONLY)
NOTE: IN LAND CONDEMNATION CASES, USE THE LOCATION OF THE LAND INVOLVED.

Attorneys (If Known)

II. BASIS OF JURISDICTION (Place an "X" in One Box Only)

- ☐ 1 U.S. Government Plaintiff
- ☒ 3 Federal Question (U.S. Government Not a Party)
- ☐ 2 U.S. Government Defendant
- ☐ 4 Diversity (Indicate Citizenship of Parties in Item III)

III. CITIZENSHIP OF PRINCIPAL PARTIES (Place an "X" in One Box for Plaintiff and One Box for Defendant) (For Diversity Cases Only)

	PTF	DEF		PTF	DEF
Citizen of This State	☐ 1	☐ 1	Incorporated *or* Principal Place of Business In This State	☐ 4	☐ 4
Citizen of Another State	☐ 2	☐ 2	Incorporated *and* Principal Place of Business In Another State	☐ 5	☐ 5
Citizen or Subject of a Foreign Country	☐ 3	☐ 3	Foreign Nation	☐ 6	☐ 6

IV. NATURE OF SUIT (Place an "X" in One Box Only)

CONTRACT
☐ 110 Insurance
☐ 120 Marine
☐ 130 Miller Act
☐ 140 Negotiable Instrument
☐ 150 Recovery of Overpayment & Enforcement of Judgment
☐ 151 Medicare Act
☐ 152 Recovery of Defaulted Student Loans (Excl. Veterans)
☐ 153 Recovery of Overpayment of Veteran's Benefits
☐ 160 Stockholders' Suits
☐ 190 Other Contract
☐ 195 Contract Product Liability
☐ 196 Franchise

REAL PROPERTY
☐ 210 Land Condemnation
☐ 220 Foreclosure
☐ 230 Rent Lease & Ejectment
☐ 240 Torts to Land
☐ 245 Tort Product Liability
☐ 290 All Other Real Property

TORTS

PERSONAL INJURY
☐ 310 Airplane
☐ 315 Airplane Product Liability
☐ 320 Assault, Libel & Slander
☐ 330 Federal Employers' Liability
☐ 340 Marine
☐ 345 Marine Product Liability
☐ 350 Motor Vehicle
☐ 355 Motor Vehicle Product Liability
☐ 360 Other Personal Injury

PERSONAL INJURY
☐ 362 Personal Injury - Med. Malpractice
☐ 365 Personal Injury - Product Liability
☐ 368 Asbestos Personal Injury Product Liability

PERSONAL PROPERTY
☐ 370 Other Fraud
☐ 371 Truth in Lending
☐ 380 Other Personal Property Damage
☐ 385 Property Damage Product Liability

CIVIL RIGHTS
☐ 441 Voting
☐ 442 Employment
☐ 443 Housing/ Accommodations
☐ 444 Welfare
☐ 445 Amer. w/Disabilities - Employment
☐ 446 Amer. w/Disabilities - Other
☐ 440 Other Civil Rights

PRISONER PETITIONS
☐ 510 Motions to Vacate Sentence
Habeas Corpus:
☐ 530 General
☐ 535 Death Penalty
☐ 540 Mandamus & Other
☐ 550 Civil Rights
☐ 555 Prison Condition

FORFEITURE/PENALTY
☐ 610 Agriculture
☐ 620 Other Food & Drug
☐ 625 Drug Related Seizure of Property 21 USC 881
☐ 630 Liquor Laws
☐ 640 R.R. & Truck
☐ 650 Airline Regs.
☐ 660 Occupational Safety/Health
☐ 690 Other

LABOR
☐ 710 Fair Labor Standards Act
☐ 720 Labor/Mgmt. Relations
☐ 730 Labor/Mgmt.Reporting & Disclosure Act
☐ 740 Railway Labor Act
☐ 790 Other Labor Litigation
☐ 791 Empl. Ret. Inc. Security Act

IMMIGRATION
☐ 462 Naturalization Application
☐ 463 Habeas Corpus - Alien Detainee
☐ 465 Other Immigration Actions

BANKRUPTCY
☐ 422 Appeal 28 USC 158
☐ 423 Withdrawal 28 USC 157

PROPERTY RIGHTS
☐ 820 Copyrights
☒ 830 Patent
☐ 840 Trademark

SOCIAL SECURITY
☐ 861 HIA (1395ff)
☐ 862 Black Lung (923)
☐ 863 DIWC/DIWW (405(g))
☐ 864 SSID Title XVI
☐ 865 RSI (405(g))

FEDERAL TAX SUITS
☐ 870 Taxes (U.S. Plaintiff or Defendant)
☐ 871 IRS—Third Party 26 USC 7609

OTHER STATUTES
☐ 400 State Reapportionment
☐ 410 Antitrust
☐ 430 Banks and Banking
☐ 450 Commerce
☐ 460 Deportation
☐ 470 Racketeer Influenced and Corrupt Organizations
☐ 480 Consumer Credit
☐ 490 Cable/Sat TV
☐ 810 Selective Service
☐ 850 Securities/Commodities/ Exchange
☐ 875 Customer Challenge 12 USC 3410
☐ 890 Other Statutory Actions
☐ 891 Agricultural Acts
☐ 892 Economic Stabilization Act
☐ 893 Environmental Matters
☐ 894 Energy Allocation Act
☐ 895 Freedom of Information Act
☐ 900Appeal of Fee Determination Under Equal Access to Justice
☐ 950 Constitutionality of State Statutes

V. ORIGIN (Place an "X" in One Box Only)

☒ 1 Original Proceeding ☐ 2 Removed from State Court ☐ 3 Remanded from Appellate Court ☐ 4 Reinstated or Reopened ☐ 5 Transferred from another district (specify) ☐ 6 Multidistrict Litigation ☐ 7 Appeal to District Judge from Magistrate Judgment

VI. CAUSE OF ACTION
Cite the U.S. Civil Statute under which you are filing (**Do not cite jurisdictional statutes unless diversity**):
35 U.S.C. §§ 271, 284
Brief description of cause:
Patent Infringement

VII. REQUESTED IN COMPLAINT: ☐ CHECK IF THIS IS A CLASS ACTION UNDER F.R.C.P. 23 **DEMAND $**
CHECK YES only if demanded in complaint:
JURY DEMAND: ☒ Yes ☐ No

VIII. RELATED CASE(S) IF ANY (See instructions): JUDGE ______ DOCKET NUMBER ______

DATE
03/08/2010

SIGNATURE OF ATTORNEY OF RECORD

FOR OFFICE USE ONLY

RECEIPT # ______ AMOUNT ______ APPLYING IFP ______ JUDGE ______ MAG. JUDGE ______

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EXHIBIT 3

IN THE UNITED STATES DISTRICT COURT

FOR THE EASTERN DISTRICT OF TEXAS

TYLER DIVISION

BALTHER TECHNOLOGIES, LLC,	§	
	§	
Plaintiff,	§	**Civil Action No. 6:10-CV-78-LED**
	§	
v.	§	
	§	
AMERICAN HONDA MOTOR CO. INC., *et al.*,	§	**JURY TRIAL DEMANDED**
	§	
	§	
Defendants.	§	

PLAINTIFF'S NOTICE OF VOLUNTARY DISMISSAL

Balther Technologies, LLC, plaintiff in the above-entitled and numbered civil action, files this notice of voluntary dismissal of this civil action without prejudice pursuant to Fed. R. Civ. P. 41(a)(1)(A)(i). To date, none of the defendants have filed an answer to Plaintiff's Original Complaint for Patent Infringement or a motion for summary judgment.

Plaintiff and Defendants shall bear their own costs, expenses and legal fees.

Respectfully submitted,

[signature]

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Attorneys for Balther Technologies, LLC

CERTIFICATE OF SERVICE

The undersigned hereby certifies that all counsel of record who are deemed to have consented to electronic service are being served with a copy of this document via the Court's CM/ECF system per Local Rule CV-5(a)(3). Any other counsel of record will be served by e-mail, facsimile transmission and/or first class mail on May 17, 2010.

Eric M. Albritton

IN THE UNITED STATES DISTRICT COURT

FOR THE EASTERN DISTRICT OF TEXAS

TYLER DIVISION

BALTHER TECHNOLOGIES, LLC,	§	
	§	
Plaintiff,	§	**Civil Action No. 6:10-CV-78-LED**
	§	
v.	§	
	§	
AMERICAN HONDA MOTOR CO. INC., ***et al.*****,**	§	**JURY TRIAL DEMANDED**
	§	
	§	
Defendants.	§	

ORDER

Pursuant to the Plaintiff's Notice of Voluntary Dismissal this civil action, shall be, and is hereby, DISMISSED WITHOUT PREJUDICE.

Plaintiff and Defendants shall bear their own costs, expenses and legal fees.

EXHIBIT 4

IN THE UNITED STATES DISTRICT COURT

FOR THE EASTERN DISTRICT OF TEXAS

TYLER DIVISION

BALTHER TECHNOLOGIES, LLC,	§	
	§	
Plaintiff,	§	**Civil Action No. 6:10-CV-78-LED**
	§	
v.	§	
	§	
AMERICAN HONDA MOTOR CO. INC., *et al.*,	§	**JURY TRIAL DEMANDED**
	§	
	§	
Defendants.	§	

ORDER

Pursuant to the Plaintiff's Notice of Voluntary Dismissal this civil action, shall be, and is hereby, DISMISSED WITHOUT PREJUDICE.

Plaintiff and Defendants shall bear their own costs, expenses and legal fees.

So ORDERED and SIGNED this 18th day of May, 2010.

LEONARD DAVIS
UNITED STATES DISTRICT JUDGE

EXHIBIT 6

(12) UK Patent Application (19) GB (11) 2 309 773 (13) A

(43) Date of A Publication 06.08.1997

(21) Application No 9701821.2

(22) Date of Filing 29.01.1997

(30) Priority Data
(31) 08037109 (32) 01.02.1996 (33) JP

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(51) INT CL^6
B60Q 1/115

(52) UK CL (Edition O)
F4R RMC R364 R41Y R765 R78X R789
U1S S1934

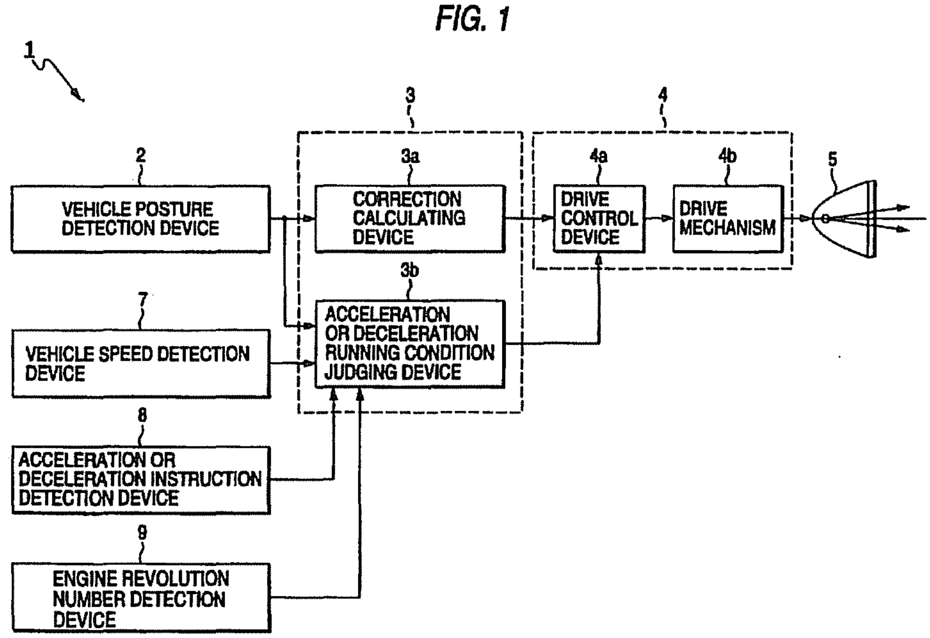
(56) Documents Cited
GB2053439 A EP 0709240 A2 EP 0699559 A1
EP 0652134 A1 WO 96/18524 A1

(58) Field of Search
UK CL (Edition O) F4R RMC
INT CL^6 B60Q 1/08 1/10 1/105 1/11 1/115
Online : WPI, CLAIMS, JAPIO

(54) **Controlling direction of vehicle lights**

(57) The illumination direction of lights in a vehicle is controlled by detecting (1) vehicle posture (stationary and/or moving) and (2) whether the vehicle is accelerating/ decelerating and directing the illumination of the lights to a predetermined direction in accordance with signals received from the posture detection device. The signals to the drive means are over-ridden when acceleration/deceleration is detected in order to fix the lights in a predetermined direction and/or limit the permitted range of light movement and/or slow the speed of direction change. Reference values may be used to determine whether and what direction change occurs. The system may include means to distinguish true acceleration/deceleration from vehicle movements caused by rough roads.

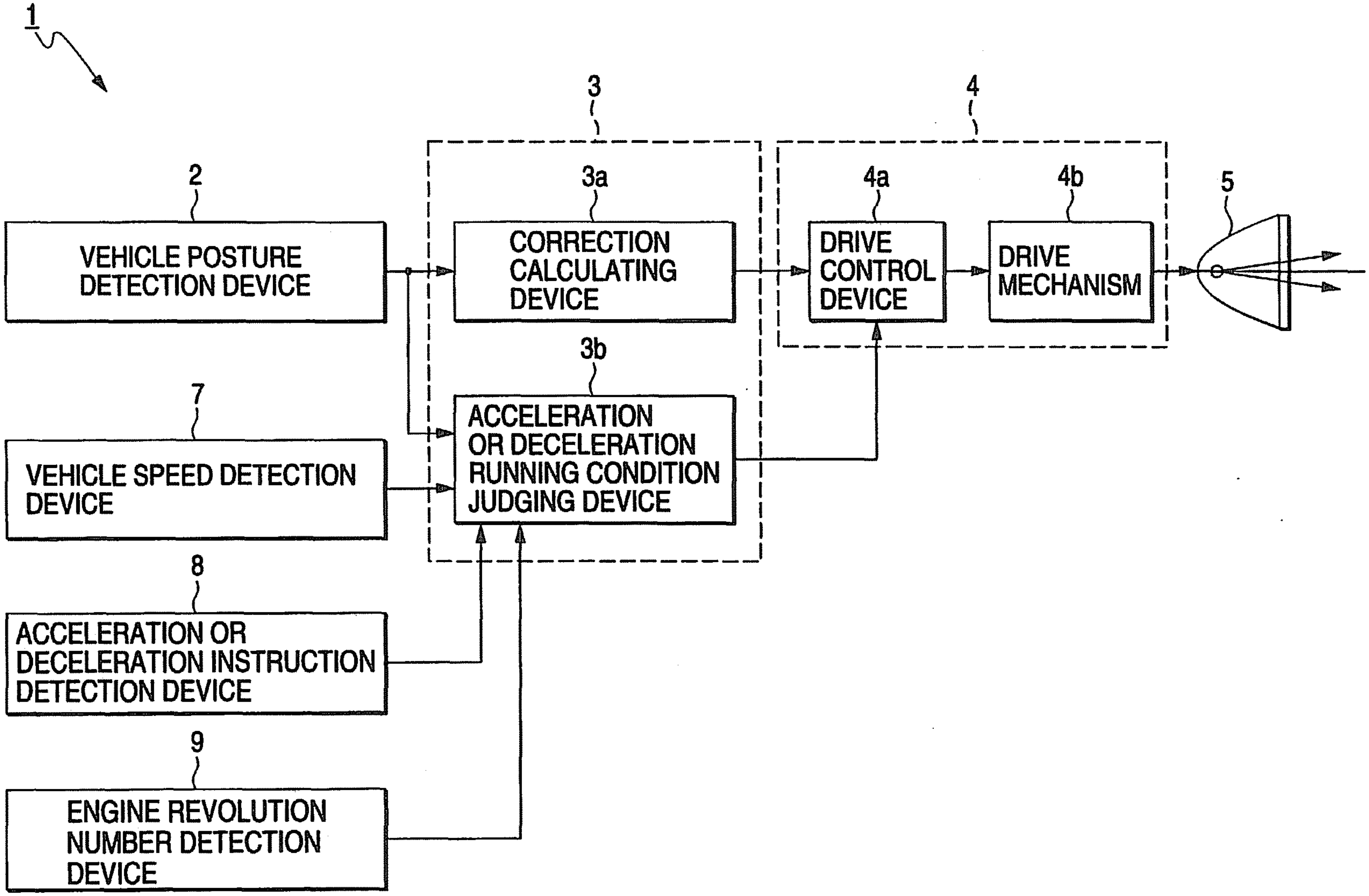
FIG. 1



At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

GB 2 309 773 A

FIG. 1


1
2
VEHICLE POSTURE DETECTION DEVICE
3
3a
CORRECTION CALCULATING DEVICE
3b
ACCELERATION OR DECELERATION RUNNING CONDITION JUDGING DEVICE
4
4a
DRIVE CONTROL DEVICE
4b
DRIVE MECHANISM
5
7
VEHICLE SPEED DETECTION DEVICE
8
ACCELERATION OR DECELERATION INSTRUCTION DETECTION DEVICE
9
ENGINE REVOLUTION NUMBER DETECTION DEVICE

1/11

FIG. 2

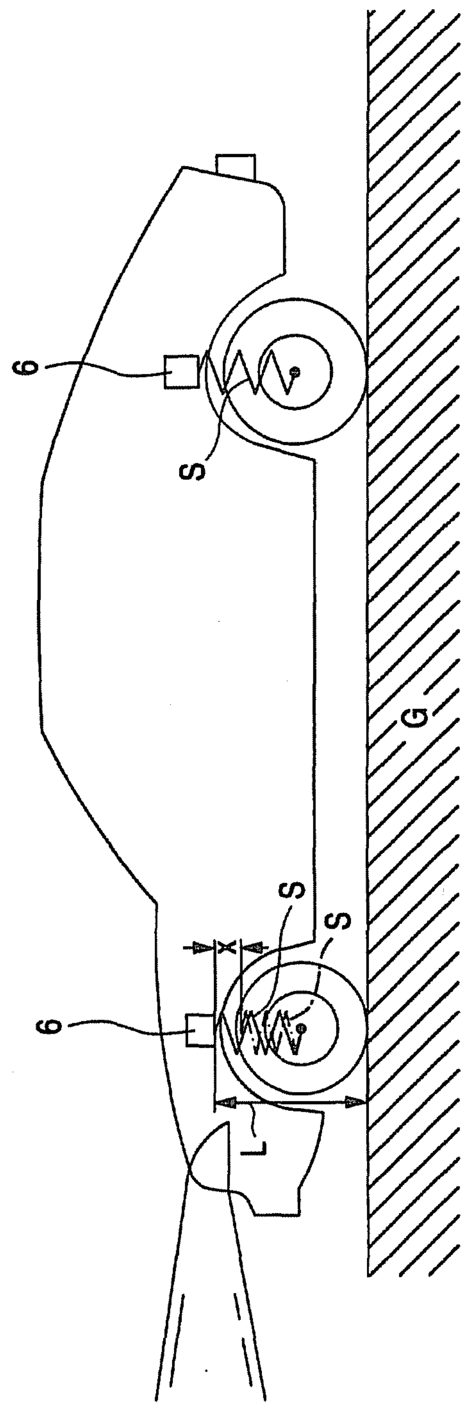


FIG. 3

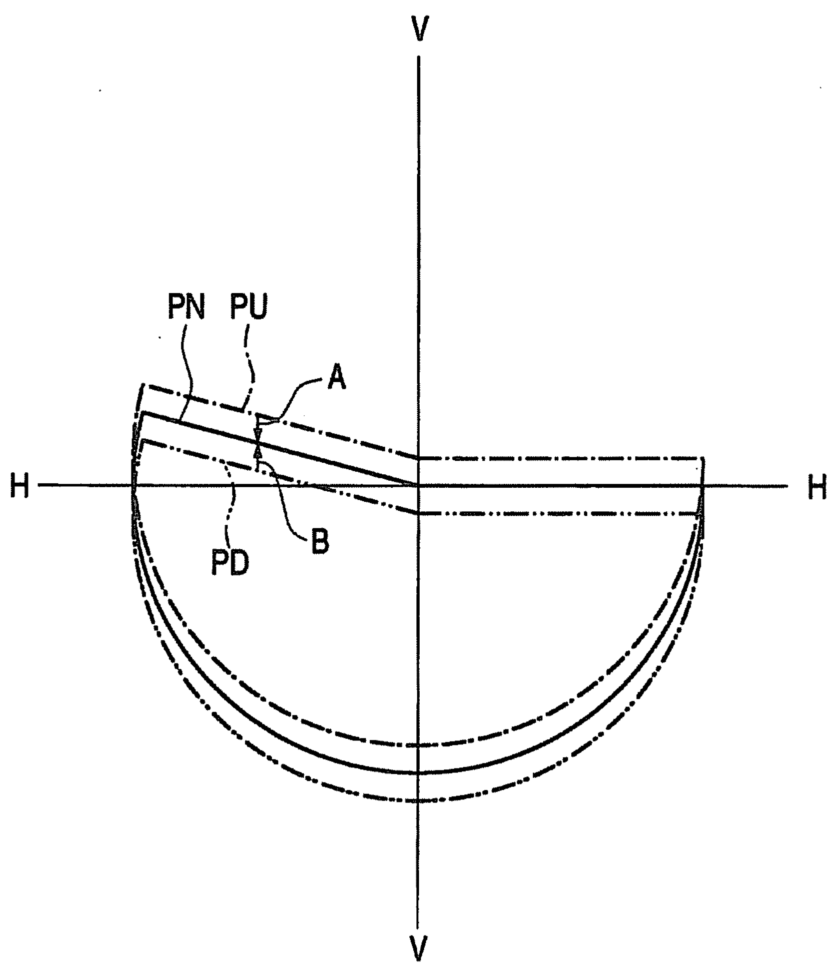


FIG. 4

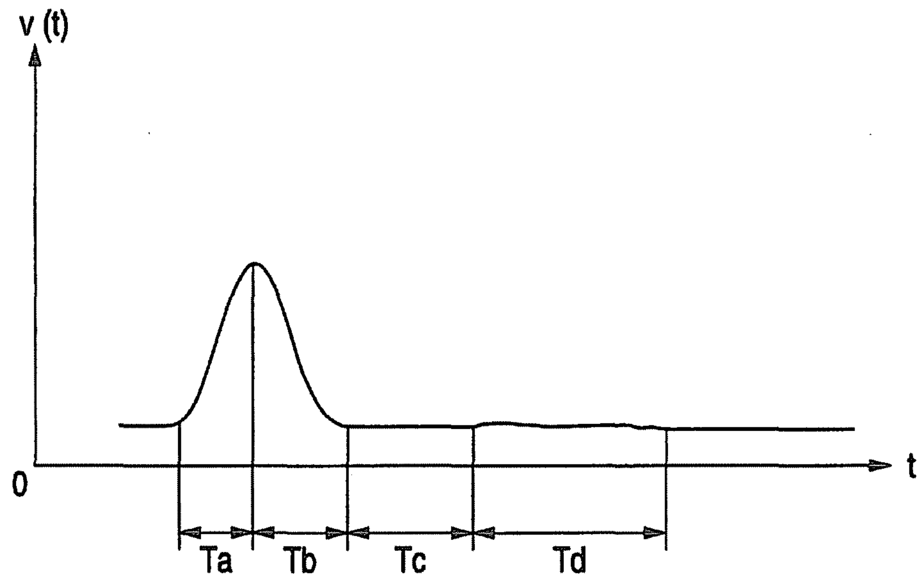


FIG. 5

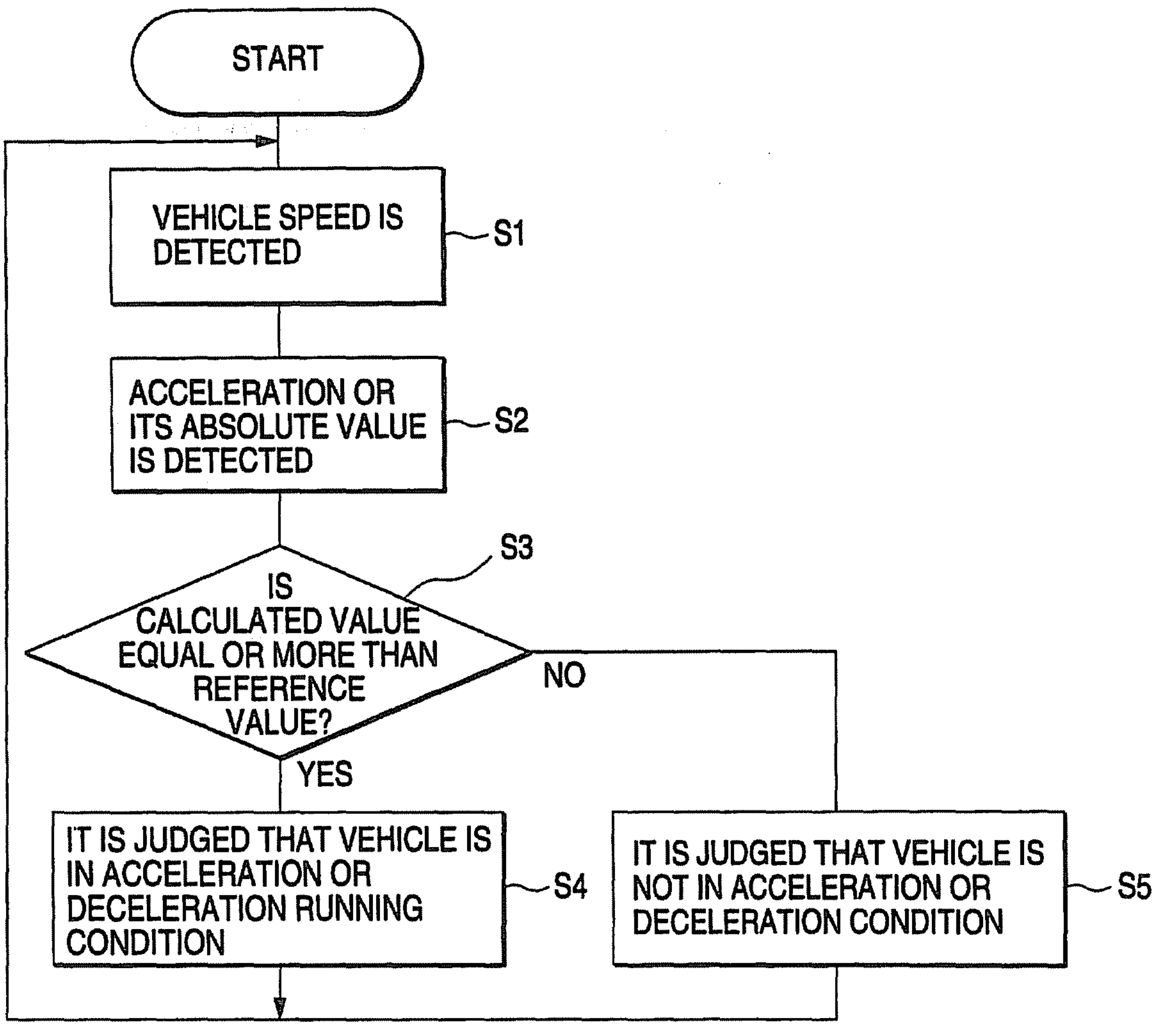

START
VEHICLE SPEED IS DETECTED
S1
ACCELERATION OR ITS ABSOLUTE VALUE IS DETECTED
S2
S3
IS CALCULATED VALUE EQUAL OR MORE THAN REFERENCE VALUE?
NO
YES
IT IS JUDGED THAT VEHICLE IS IN ACCELERATION OR DECELERATION RUNNING CONDITION
S4
IT IS JUDGED THAT VEHICLE IS NOT IN ACCELERATION OR DECELERATION CONDITION
S5

FIG. 6

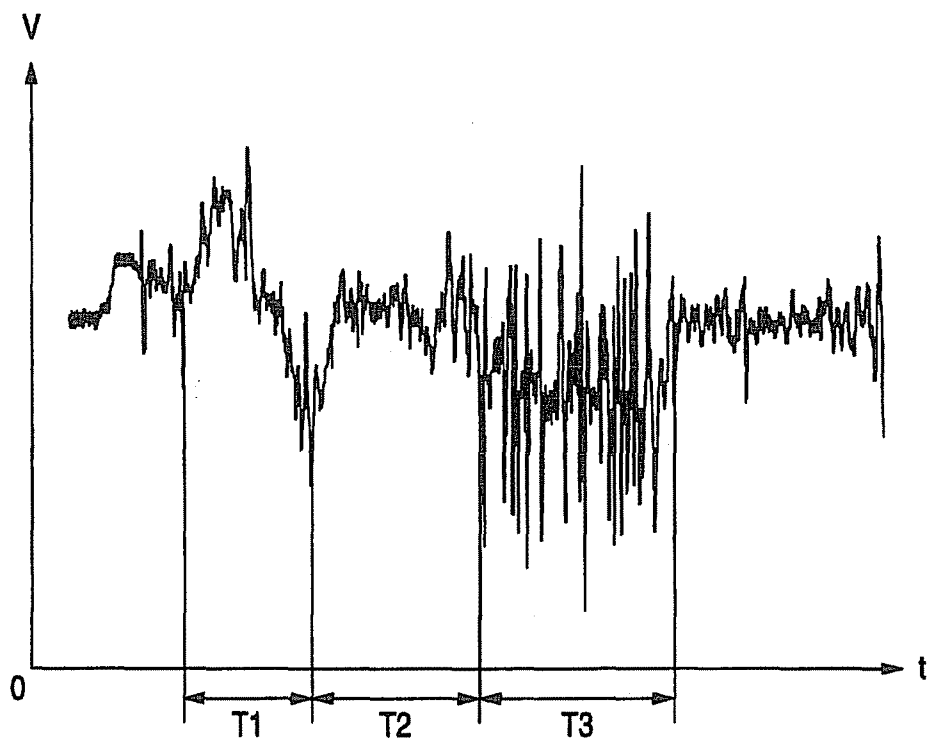


FIG. 7

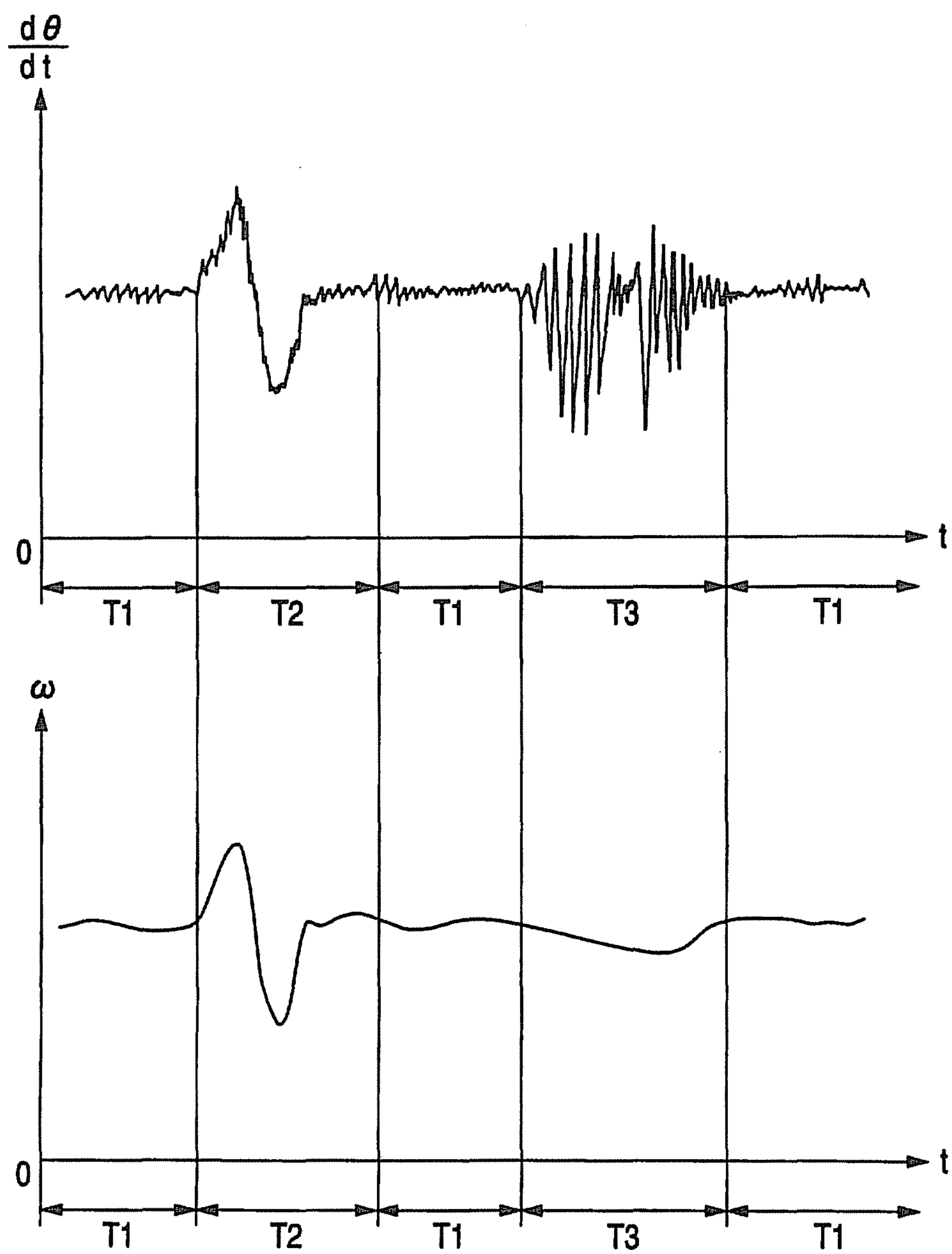


FIG. 8

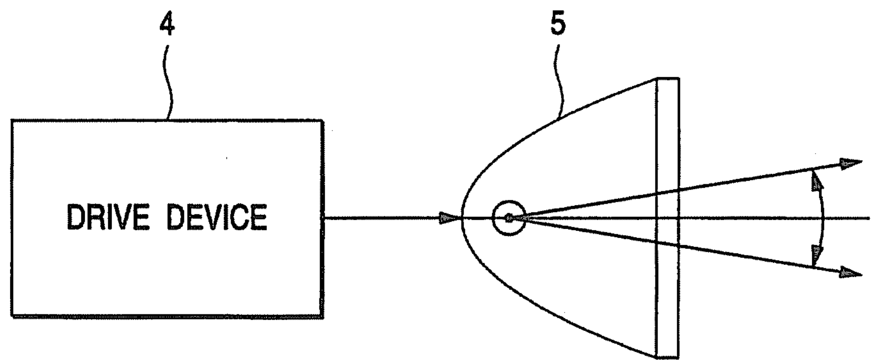


FIG. 9

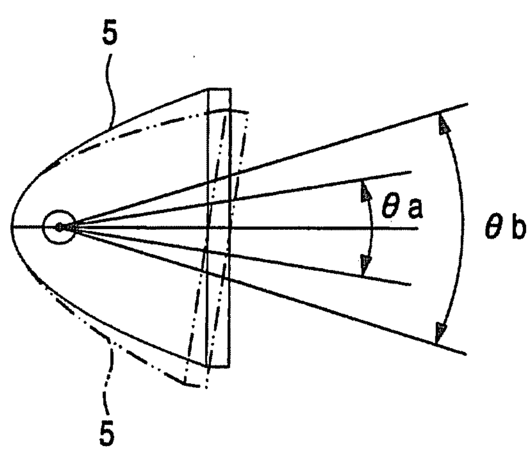


FIG. 10

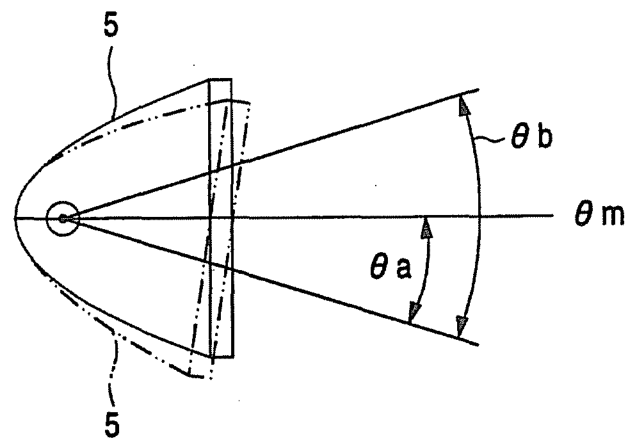


FIG. 11

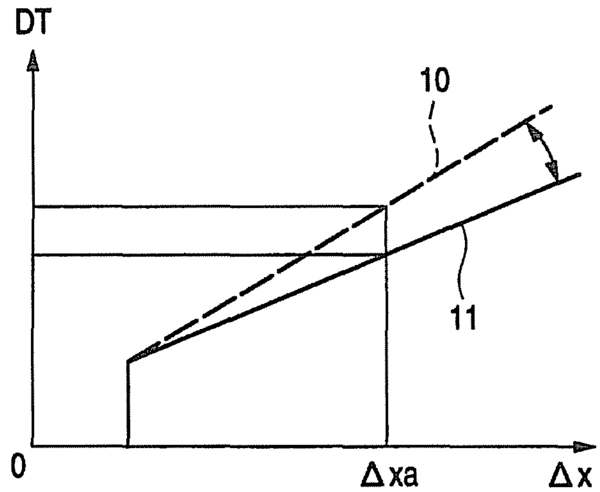


FIG. 12

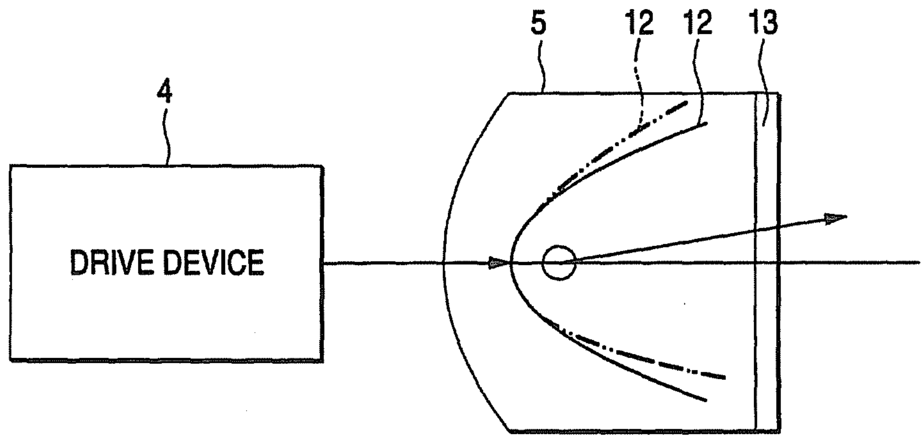


FIG. 13

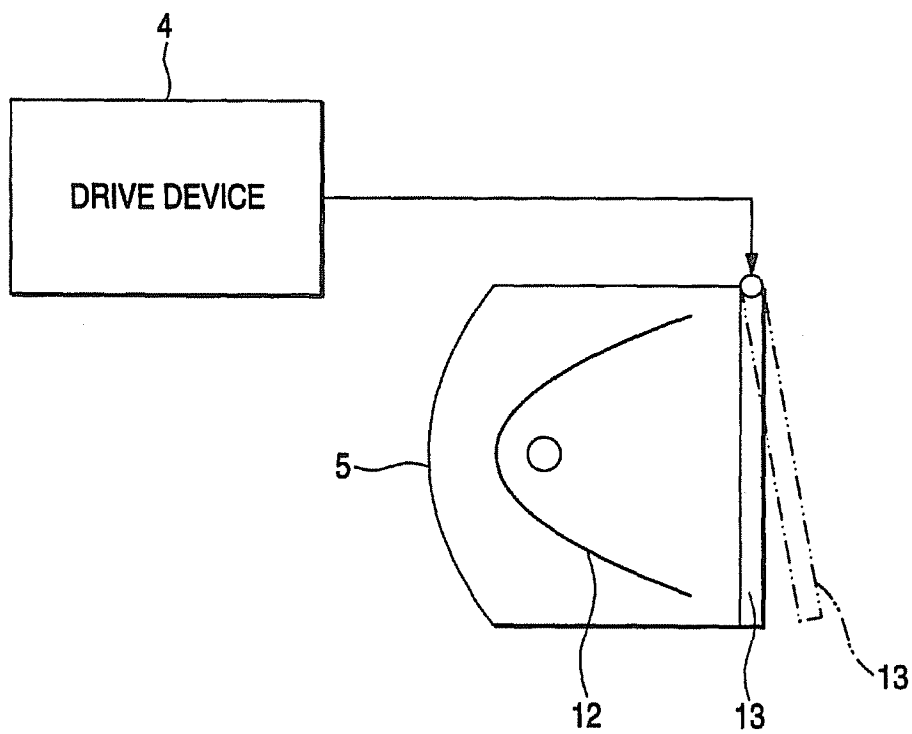
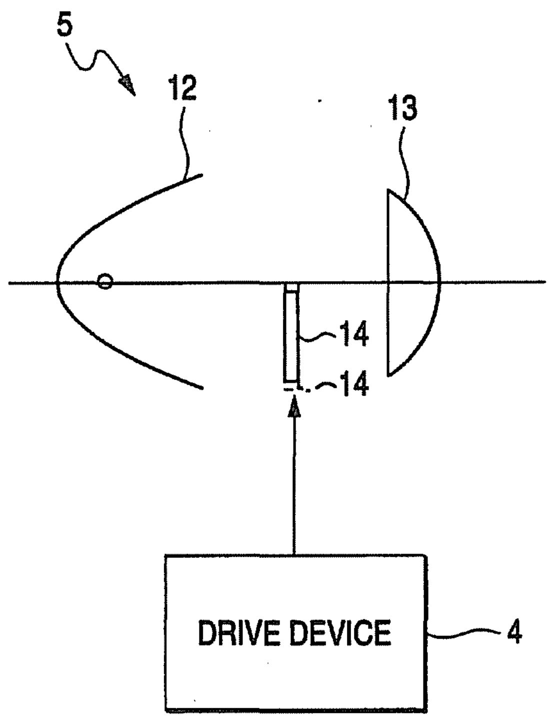


FIG. 14



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A VEHICLE LAMP ILLUMINATION DIRECTION CONTROL DEVICE

The present invention relates to a vehicle lamp illumination direction control device which detects the posture of a vehicle and correctly adjusts the illumination direction of a vehicle lamp so that the illumination direction can be always kept in a predetermined direction.

Conventionally, there has been known a device (a so called automatic leveling device) which, even when the inclination of a vehicle body varies, is capable of automatically adjusting the illumination direction of the vehicle lamp so that the illumination direction of the vehicle lamp can be kept at a predetermined direction. The conventional device of this type includes a detection device which detects the inclination and height of the vehicle body variable according to the conditions of occupants (such as the number of occupants, the position arrangement of the occupants and the like), the loaded conditions of loads on board the vehicle, the running conditions of the vehicle, and the like, calculates the amount of variations in the inclination of the vehicle based on the information that is obtained by the detection device, and adjusts the illumination angle of the vehicle lamp with respect to the initially adjusted value of the vehicle lamp so that the illumination state of the vehicle lamp can be always kept in a desired state, thereby to control the illumination direction of the vehicle lamp for desired light distribution.

For example, when a load is applied to the rear portion of the vehicle, the device finds the then inclination angle of the vehicle body in the longitudinal direction thereof, and inclines the vehicle lamp downward because the illumination direction of which would be displaced upwardly of the reference direction if the posture of the vehicle lamp is left as it is, thereby adjusting the illumination direction of the vehicle lamp (a so called leveling adjustment) so that the vehicle lamp illumination direction can be always kept in the reference direction.

However, in the above-mentioned conventional device, while the vehicle is running along a rough road including an uneven and rough surface, when the device makes the above-mentioned automatic adjustment of the illumination direction of the vehicle lamp, there is a possibility that the detection device can respond excessively to the illumination direction of the vehicle lamp and thus the illumination direction of the vehicle lamp can be controlled or adjusted excessively, which causes the light distribution of the vehicle lamp and the field of view to vary. Such variations in the light distribution and visibility in turn can give a driver a strange feeling, or can dazzle the driver of an oncoming vehicle, a pedestrian, and the like.

For example, when the vehicle runs into a rough road at a rather high speed, vibrations and the like applied to the vehicle wheels from the surface of the rough road are relieved by the expansion and contraction of the suspension of the vehicle and, therefore, there is a possibility that variations in the inclination of the vehicle body are not as large as variations in the output of the detection device due to the vehicle height and the like. That is, if the leveling adjustment is made faithfully according to the output of the detection device, then there is a possibility that the illumination direction of the vehicle lamp can be corrected excessively when compared with the actual inclination of the vehicle body.

The present invention was made in view of the foregoing problems accompanying the conventional device as discussed above. Therefore, it is an object of the present invention to provide a vehicle lamp illumination direction control device capable of controlling and properly adjusting the vehicle lamp illumination direction without correcting the same excessively while the vehicle is running along a rough road, whereby the visibility of the driver of the vehicle can be enhanced while the controlled vehicle lamp illumination direction can never dazzle the driver of an oncoming vehicle, so that the safety of the vehicle driving can be assured.

In attaining the above object, according to the invention, in view of the fact that the posture change of the vehicle in the constant speed running condition of the vehicle or in the bad road running condition thereof is relatively smaller than the posture change of the vehicle in the acceleration or deceleration running condition of thereof, there is provided a vehicle lamp illumination direction control device for changing the direction of the illumination light of a lamp according to the vertical inclination of a vehicle in the advancing direction thereof, the control device comprising:

a vehicle posture detection device for detecting the posture of the vehicle during the stationary and/or moving condition thereof;

an acceleration or deceleration running condition judging device for judging whether the vehicle is in the acceleration running condition or in the deceleration running condition or not;

a drive device for directing the illumination light of the lamp in a predetermined direction; and

a correction calculating device for transmitting to the drive device a correction signal for holding the illumination light of the lamp in a given direction, in accordance with a signal received from the vehicle posture detection device, wherein, when it is judged by the acceleration or deceleration running condition judging device that the vehicle is in the acceleration running condition or in the deceleration running condition, the direction of the lamp can be controlled by the signal transmitted from the correction calculating device to the drive device, and, when it is judged by the acceleration or deceleration running condition judging device that the vehicle is not in the acceleration running condition or in the deceleration running condition, the drive device can fix the direction of the illumination light of the lamp in a given direction or can limit the allowable range of the direction of the illumination light, or the response speed of the drive device can be slowed down.

According to the invention, when it is found that the vehicle is not in the acceleration or deceleration running condition, the control device controls the illumination direction of the lamp by fixing the direction of the illumination light of the lamp in a given direction, or by limiting the direction of the illumination light to a limited range, or by slowing down the response speed of the drive device, thereby being able to prevent the illumination direction of the lamp from being changed excessively and thus prevent the illumination direction of the lamp from being corrected excessively in the bad road running condition of the vehicle.

In the accompanying drawings:

Fig. 1 is a block diagram of the structure of a vehicle lamp illumination direction control device according to the invention;

Fig. 2 is a schematic view of a vehicle for explanation of height detection device;

Fig. 3 is an explanatory view of a correction control on the illumination direction of a vehicle lamp;

Fig. 4 is a graphical representation of an example of the change with time of a detect level detected by vehicle speed detection device;

Fig. 5 is a flow chart of a judging processing on the acceleration or deceleration running condition of the vehicle;

Fig. 6 is a graphical representation of an example of a detect level detected by a height sensor;

Fig. 7 is an explanatory view of a method for judging the bad road running condition of the vehicle by combined use of a height sensor and an angular velocity sensor;

Fig. 8 is a schematic view of an example of a method for changing the illumination direction of the lamp by driving and controlling the entire lamp;

Fig. 9 is an explanatory view of a method for limiting the allowable range of the illumination angle of the lamp when it is judged that the vehicle is in the acceleration or deceleration running condition;

Fig. 10 is an explanatory view of a method for limiting the allowable range of the illumination angle of the lamp to thereby prohibit the occurrence of an upwardly directed light when it is judged that the vehicle is in the acceleration or deceleration running condition;

Fig. 11 is an explanatory view of a method for slowing down the response speed of drive device when it is judged that the vehicle is in the acceleration or deceleration running condition;

Fig. 12 is an explanatory view of a method for changing the illumination direction of a reflector by driving or controlling the reflector;

Fig. 13 is an explanatory view of a method for changing the illumination direction of a lens by driving or controlling the lens; and,

Fig. 14 is an explanatory view of a method for changing the illumination direction of a shade by driving or controlling the shade.

Now, description will be given below of an embodiment of a vehicle lamp illumination direction control device according to the invention with reference to the accompanying drawings.

Fig. 1 shows the basic structure of the present invention, in which an illumination direction control device 1 includes a vehicle posture detection device 2, a control device 3 (which is composed of correction calculating device 3a and acceleration or deceleration running condition judging device 3b), a drive device 4 (which is composed of a drive control device 4a and a drive mechanism 4b), and a lamp 5.

The vehicle posture detection device 2 is used to detect the posture of a vehicle while it is standing still and/or moving (including the vertical inclination of the vehicle while it is running). For example, when there is used a vehicle height detection device 6 which detects the height of the vehicle body according to the uneven surface of the road, as shown in Fig. 2, there are available a method for measuring a distance L between the vehicle height detection device 6 and the road surface G by use of detect waves such as ultrasonic waves, laser beams or the like, and a method in which the vehicle height detection device 6 detects the amount x of the expansion and contraction of a suspension S. These two methods are both advantageous in that the existing facilities in the vehicle can be used.

The outputs of the vehicle posture detection device 2 are transmitted to the correction calculating device 3a and acceleration or deceleration running condition judging device 3b which cooperate together in forming the control device 3, and these outputs are used as control signals to be applied to the drive device 4 and are then used as instructions for correcting the illumination condition of the lamp 5.

In particular, the correction calculating device 3a is structured in the following manner: that is, in accordance with a detect signal from the vehicle posture detection device 2, it transmits a control signal to the drive device 4 so that the illumination direction of the lamp 5 can be always kept in a given direction. For example, as shown in Fig. 3, when the vehicle body rises in the front portion thereof with respect to a light distribution pattern PN (shown by a solid line in Fig. 3) which is set using a horizontal line H-H or a vertical line V-V as a reference line, the illumination direction of the lamp 5 varies upward with respect to the horizontal line H-H and thus the light distribution pattern varies upward like a pattern PU (shown by a one-dot chained line in Fig. 3). In this case, the correction calculating device 3a transmits to the drive control device 4a a signal which causes the illumination direction of the lamp 5 to vary downward as well as the light distribution pattern thereof to vary downward and coincide with the light distribution patter PN as shown by an arrow A in Fig. 3. Also, contrary to this, when the vehicle body falls down in the front portion thereof, the illumination direction of the lamp 5 varies downward with respect to the horizontal line H-H and thus the light distribution pattern also varies downward like a pattern PD (shown by a two-dot chained line in Fig. 3). In this case, the correction calculating device 3a transmits to the drive control device 4a a signal which causes the illumination direction of the lamp 5 to vary upward as well as the light distribution pattern thereof to vary upward and coincide with the light distribution pattern PN as shown by an arrow B in Fig. 3.

Now, the acceleration or deceleration running condition judging device 3b is used to judge whether the vehicle is increasing its speed or decreasing its speed. When the judging device 3b judges that the vehicle is in an acceleration or deceleration running condition, in accordance with a control signal transmitted from the correction calculating device 3a to the drive control device 4a, the acceleration or deceleration running condition judging device 3b transmits to the drive control device 4a a signal which allows the illumination direction of the lamp 5 to be corrected in a predetermined direction. Also, when the acceleration or deceleration running condition judging device 3b judges that the vehicle is not in the acceleration or deceleration running condition (that is, it is judged that the vehicle is in a constant speed running condition or in a bad road running condition, or the like), it transmits a control signal to the drive device 4, so that the illumination direction of the lamp 5 can be fixed in a predetermined direction or limited to a given range, or the response speed of the drive mechanism 4b for varying the illumination direction of the lamp 5 is slowed down to thereby be able to control the illumination direction of the lamp 5 in such a manner that it varies slowly. Here, as basic information used to judge whether the vehicle is in the acceleration or deceleration running condition or not, besides the information that is given by the vehicle posture detection device 2, as shown in Fig. 1, there is also available information which can be obtained by providing acceleration or deceleration instruction detection device 8 used to detect an acceleration or deceleration instruction or information relating to the present instruction according to the amount of pressing-down of a gas pedal, variations in the opening angle of a throttle valve or the like, or information which can be obtained by providing an engine revolution number detection device 9 used to detect the number of revolutions of an engine: that is, the information obtained by these detection devices may be transmitted to the acceleration or deceleration running condition judging device 3b. A judging method for judging whether the vehicle is in the acceleration or deceleration running condition or not will be described later below.

The drive control device 4a is used to receive signals from the correction calculating device 3a and acceleration or deceleration running condition judging device 3b and allow the drive mechanism 4b to control or change the illumination direction of the lamp 5. The control or change of the illumination direction of the lamp 5 can be achieved by inclining the entire lamp 5 or by moving part of the components of the lamp 5 such as a shade or the like, while the details of these controlling or changing methods will be given later.

At first, the judging method in the acceleration or deceleration running condition judging device 3b will be described by classifying it into the following four methods:

i) a method using the vehicle speed detection device;

ii) a method using the acceleration or deceleration instruction detection device 8;

iii) a method using the engine revolution number detection device 9; and,

iv) a method using the vehicle posture detection device 2.

Firstly, the method i) is a method which judges whether the vehicle is in the acceleration or deceleration running condition or not by detecting the running speed of the vehicle to calculate the change of the speed with time, that is, by calculating the acceleration of the vehicle. The present method i) is advantageous in that the vehicle speed detection device 7 is one of the existing facilities in the vehicle and use of the detect signal of the vehicle speed detection device 7 facilitates the judgment on the acceleration or deceleration running condition of the vehicle.

Fig. 4 shows an example of the change of the speed with time, in which the axis of abscissa expresses the time t and the axis of ordinate expresses the speed v (t) of the vehicle. In Fig. 4, a period designated by Ta expresses the acceleration period of the vehicle, a period designated by Tb expresses the deceleration period of the vehicle, a period designated by Tc expresses the constant speed period of the vehicle, and a period designated by Td expresses the bad road running period of the vehicle.

Based on the speed v obtained from the vehicle speed detection device 7, if the time differential of the speed v or an acceleration dv (t)/dt is calculated, the acceleration is given as a positive value in the acceleration period Ta, the acceleration is given as a negative value in the deceleration period Tb, and the acceleration is given as zero in the constant speed period or a small value in the bad road running period Td. Therefore, by comparing the acceleration or the absolute value thereof with a given reference value, it is possible to judge whether the vehicle is in the acceleration or deceleration running condition or not.

Now, Fig. 5 is a flow chart which shows the flow of the acceleration or deceleration running condition judging process, that is, Fig. 5 shows the procedure of the processing to be performed by the above-mentioned acceleration or deceleration running condition judging device 3b.

At first, in Step S1, the vehicle speed v (t) is detected and, after then, in Step S2, the acceleration dv (t)/dt or the absolute value thereof is calculated. Next, in Step S3, it is checked whether the acceleration dv (t)/dt or the absolute value thereof is equal to or more than a reference value or not. If it is found that the acceleration dv (t)/dt or the absolute value thereof is less than the reference value, then the processing advances to Step S5.

In Step S4, it is judged that the vehicle is in the acceleration or deceleration running condition and, after then, the processing goes back to Step S2. Also, in Step S5, it is judged that the vehicle is not in the acceleration or deceleration running condition and, after then, the processing returns back to the first step S1.

As described above, the method i) is a method which monitors the variations in the speed of the vehicle and, therefore, when an instruction for acceleration or deceleration of the vehicle given by a driver cannot be reflected instantaneously on the speed of the vehicle, there is a fear that a time delay can occur in the judgment of the acceleration or deceleration. In this case, as shown in the method ii), as the information relating to the acceleration or deceleration instruction of the vehicle, there can be used the detect information relating to the variations in the amount of pressing-down of the accelerator pedal or relating to the variations in the amount of opening of the throttle valve.

In particular, the variations in the accelerator pedal pressing-down amount or the variations in the throttle valve opening amount is large when the vehicle is in the acceleration or deceleration running condition (which is hereinafter referred to as acceleration or deceleration time), while it is small when the vehicle is running at a constant speed or along a bad road. Therefore, by detecting a difference between the variations, it is possible to judge whether the vehicle is in the acceleration or deceleration running condition or not. In other words, in Fig. 5, Step S1 may be replaced by the detection of the accelerator pedal pressing-down amount or the throttle valve opening amount, the variations in these amounts may be calculated in Step S2 and, after then, the thus calculated value may be compared with the given reference value in Step S3, whereby the following processing (that is, the processing to be performed after then) can be decided.

In another method, attention is paid to variations in the state of the drive source of the vehicle, that is, as shown in above-mentioned method iii), by detecting variations in the number of revolutions of the engine, the judgment on the acceleration or deceleration running condition can be achieved.

That is, due to the fact that the variations in the number of revolutions of the engine are large in the acceleration or deceleration running condition of the vehicle, whereas the variations are small in the constant speed running condition or in the bad road running condition, by detecting a difference between the variations, it is possible to judge whether the vehicle is in the acceleration or deceleration running condition or not. In this case, in Fig. 5, the number of revolutions of the engine may be detected in Step S1, a variation in the number of revolutions of the engine may be calculated in Step S2 and, after then, the thus calculated value may be compared with the given reference value in Step S3, whereby the following processing can be decided.

As described above, based on the respective pieces of information that are obtained by calculating the amounts of variations with time of the vehicle speed, the speed instruction given by the driver, and the state of the drive source of the vehicle, or based on the information that is obtained by combining them with each other, the variations in the acceleration or deceleration condition of the vehicle can be detected.

The remaining method iv) is a method which can judge the acceleration or deceleration running condition of the vehicle based on the information that is obtained by the vehicle posture detection device 2. Generally, as a device for detecting variations in the vibration of a mechanism for absorbing the vibration that is given to the wheels of the vehicle from the surface of a road or for detecting the height of the axle of the vehicle, there is used height detection device such as a height sensor or the like. In the present method, based on the information that is obtained from the height detection device, the time differential of the detected level or the absolute value thereof is calculated and, after then, by comparing the resultant value with a given reference value, it is possible to judge whether the vehicle is in the acceleration or deceleration running condition or not. Also, if a plurality of height detection device are arranged at several positions of the vehicle, for example, in the front and rear portions thereof and/or right and left portions thereof and the inclination angle in the pitching direction of the vehicle (so called pitch angle) is detected in accordance with the detect information that is detected by these height detection device, then the running condition of the vehicle can be confirmed to a certain degree. However, actually, there exists a state in which it is difficult to tell the acceleration or deceleration running condition of the vehicle from the bad road running condition only by means of such height detection device.

Now, Fig. 6 shows an example of the level variations in the detect signal that is output from a height sensor attached to the vehicle. In Fig. 6, the axis of abscissa expresses the time t and the axis of ordinate expresses the level V of the detect signal.

In Fig. 6, a period designated by T1 expresses a period in which the vehicle is in an acceleration or deceleration running condition, a period designated by T2 expresses a period in which the vehicle is in a constant speed running condition, and a period designated by T3 expresses a period in which the vehicle is in a bad road running condition. Fig. 6 tells that the width of the amplitude variations in the output signal of the height sensor is large in the periods T1 and T3.

That is, in order to judge whether the vehicle is in the acceleration or deceleration running condition or in the bad road running condition, it is necessary to recognize a difference between the detected level variations in the period T1 and T3. For example, attention is paid to a difference between the degrees of the variations in the detected levels and the judgment is made in accordance with the fact that the amplitude variations in the detected levels in the period T3 are heavier. However, as a method which can enhance the accuracy of the judgment, there can be pointed out a method which detects the variations in the detected levels by using the vehicle height detection device and angular velocity detection device in combination.

Now, Fig. 7 shows a method which carries out a judgment on the acceleration or deceleration running condition of the vehicle by using a height sensor and an angular velocity sensor in combination. In Fig. 7, a graphical representation shown in the upper stage thereof represents variations with time in the time difference amount (which is expressed as $d\theta/dt$) of the pitch angle of the vehicle calculated from the detect level V of the height sensor, whereas a graphical representation in the lower stage thereof represents variations with time in the output level (which is expressed as ω) of the angular velocity sensor which is installed at a position above the suspension of the vehicle to detect the pitch angle. Here, in Fig. 7, a period T1 expresses a period in which the vehicle is running at a constant speed along a comparatively even road, a period T2 expresses a period in which the vehicle is running in an acceleration or deceleration condition, and a period T3 expresses a period in which the vehicle is running on a bad road, respectively.

As can be seen from Fig. 7, in the period T2, variations in $d\theta/dt$ and ω are found when the vehicle is running in the acceleration or deceleration condition, whereas variations in $d\theta/dt$ and ω are small in the period T1; in the period T3, the vibration component of $d\theta/dt$ is large, whereas large variations are not found in ω; and, therefore, it can be found that $d\theta/dt$ and have no correlation between them or the relation between them is low. The reason for this is as follows: since the vibration of the suspension is detected by the height sensor in the bad road running condition of the vehicle, $d\theta/dt$ calculated from the output of the height sensor is also affected by the influence of the thus detected vibration, whereas, because the influence of the vibration on the load portion of the suspension situated above the spring is absorbed by the expansion and contraction of the suspension, the present load portion is not inclined so greatly in the pitching direction and, therefore, the vibration component relating to the load portion of the suspension situated below the spring is not reflected greatly on the output of the angular velocity sensor for detection of the pitch angle.

In this manner, when there is found a correlative variation between $d\theta/dt$ and ω , it can be judged that the vehicle is in the acceleration or deceleration running condition. In the other cases, that is, when $d\theta/dt$ and ω are small in variations, or when no correlation or only a small correlation is found, it can be judged that the vehicle is running at a constant speed or along a bad road.

Here, the number of the angular velocity sensor (in Fig. 1, included in the vehicle posture detection device 2) is not limited to one but, of course, a plurality of angular velocity sensors may be used, that is, it is also possible to obtain the information that is necessary for the angular velocity calculation based on the information from these angular velocity sensors.

As has been described above, according to the respective methods, it is possible to judge whether the vehicle is running in the acceleration condition or in the deceleration condition. Also, these methods can be applied in various manners, for example, the respective methods can be used individually, or some of them may be combined together for the enhanced accuracy of the judgment.

Next, description will be given below of the control of the direction of the illumination light of the lamp 5 to be made by the drive device 4.

The simplest method for changing the illumination pattern of the lamp 5 in a vertical plane is a method which changes the illumination angle of the lamp 5 with respect to a horizontal plane by rotating the entire lamp 5 about the rotary shaft thereof. For example, the right and left side surfaces of the lamp 5 are supported in a freely rotatable manner and the rotary shaft of the lamp 5 is rotated directly by a drive source such as a motor or the like, or, there is available a drive mechanism in which a member fixed to the lamp 5 or formed integrally with the lamp 5 is rotated by the drive device 4. As an example of such lamp, there is pointed out a lamp of a type that it employs a mechanism in which the rotational force of the motor is used as the rotational force of the lamp by a transmission mechanism using a worm and a worm wheel (for example, see Japanese Patent Publication No. Sho. 63-166672).

If it is judged by the acceleration or deceleration running condition judging device 3b that the vehicle is in the acceleration running condition or in the deceleration running condition, then the drive control device 4a rotates the entire lamp 5 within a vertical plane so that the lamp 5 can provide an illumination angle as specified by the correction calculating device 3a.

Also, if it is judged by the acceleration or deceleration running condition judging device 3b that the vehicle is not in the acceleration or deceleration running condition, then the illumination angle of the lamp 5 can be controlled by one of the following methods when the drive control device 4a receives an instruction from the acceleration or deceleration running condition judging device 3b:

1) a method for fixing the illumination angle;

2) a method for limiting the range of the illumination angle or forbidding part of the range of the illumination angle; and,

3) a method for changing the response speed or control speed of an actuator.

At first, the method 1), which is the simplest in the above-mentioned three methods, is a method which always holds the illumination angle of the lamp 5 at a constant angle when judging whether the vehicle is in the acceleration or deceleration running condition or not. That is, when the vehicle is not in the acceleration or deceleration running condition, in order to prevent the illumination light of the lamp 5 from being directed too upwardly, the lamp 5 may be held in such a condition that the illumination direction of the lamp 5 can be directed a little downwardly.

The then downwardly directed angle of illumination may be set for a value irrelevant to an illumination angle before it is judged that the vehicle is not in the acceleration or deceleration running condition, or may be set at an illumination angle just prior to the present judgment or an angle obtained by correcting the present illumination angle (for example, adjusting the present illumination angle a little downwardly), or, may be set at an average illumination angle prior to the present judgment or an angle obtained by correcting the present average illumination angle.

The method 2), which limits the range of the illumination angle, is a method which narrows the range of the illumination angle so that the allowable range of the illumination angle of the lamp 5 when it is judged that the vehicle is not in the acceleration or deceleration running condition is smaller than the allowable range of the illumination angle when it is judged that the vehicle is in the acceleration or deceleration running condition.

For example, as shown in Fig. 9, where the allowable range of the illumination angle of the lamp 5 in the other running conditions than the acceleration or deceleration running condition is expressed as θa and the allowable range of the illumination angle in the acceleration or deceleration running condition is expressed as θb, if a ratio n $(0<(1/n)<1)$ is introduced and the angle range is narrowed so that $\theta a = \theta b/n$ can be obtained, then it is possible to reduce the frequency that the illumination light of the lamp 5 provides an upward light in the other running conditions of the vehicle than the acceleration or deceleration running condition thereof.

Also, as shown in Fig. 10, by setting an upper limit on the illumination angle of the lamp 5 in the other running conditions of the vehicle than the acceleration or deceleration running condition thereof, the illumination angle of the lamp 5 can be restricted in such a manner that it is prevented from exceeding the upper limit. For example, if an upper limit θm is set on the allowable range θb of the illumination angle of the lamp in the acceleration or deceleration running condition of the vehicle so that the allowable range θa of the illumination angle of the lamp 5 is prevented from exceeding the upper limit θm, then the illumination light of the lamp 5, in the other running conditions of the vehicle than the acceleration or deceleration running condition, can be controlled such that it cannot provide an upward light.

Now, the remaining method 3) is a method which, while the previously described two methods respectively control the illumination angle itself, controls the response speed of the drive device 4 to thereby prevent the illumination angle of the lamp 5 from being changed excessively in the other running conditions of the vehicle than the acceleration or deceleration running condition.

That is, while the control on the response speed of the drive device 4 varies infinitely according to the structures of the drive device 4, by changing a voltage, a current, a control signal and the like to be supplied to an actuator forming the drive device, it is possible to slow down the posture control of the lamp 5 in the other running conditions of the vehicle than the acceleration or deceleration running condition.

For example, when the actuator incorporates therein a DC (direct current) motor, a difference between the control target position (or angle) of the actuator and the current position (or angle) thereof is detected, and a pulse signal having a duty cycle corresponding to the detected position difference is supplied to the DC motor to thereby control the position of the actuator, as shown in Fig. 11, if the characteristic of the duty cycle DT with respect to the position difference δxx is changed from the state of a relatively faster response speed shown by a broken line 10 to the state of a slow response speed shown by a solid line 11, with respect to the same position difference δxx = δxxa, the duty cycle DT in the other running conditions of the vehicle than the acceleration or deceleration running condition thereof is smaller than the duty cycle in the acceleration or deceleration running condition of the vehicle, so that the drive control on the lamp 5 by the actuator is slowed down.

Here, according to the method 3), various kinds of embodiments are possible. For example, the response speed of the drive device 4 can be changed according to the running speed of the vehicle, or can be changed according as the vehicle is in the constant running condition or in the bad road running condition. Also, of course, it is possible to use the methods 1) to 3) in combination according to the states of the vehicle (such as the running conditions thereof, variations in the posture thereof, and the like).

In the above description, by rotating the entire lamp by use of the drive device 4, the illumination direction of the lamp is changed. However, alternatively, the components of the lamp 5 may be in part controlled in position.

For example, as shown in Fig. 12, it is possible to employ a structure in which a reflector 12 is rotated within a vertical plane by the drive device 4 to thereby change the direction of the reflected light of the reflector 12. In particular, in order that the reflector can be in part supported rotatably on the body of the lamp and a screw member mounted on the other portions than the lamp body for adjusting the inclining angle of the reflector can be rotated by a motor, there can be used a transmission mechanism which includes a worm and a worm wheel (for example, see Japanese Patent Publication No. 59-195441). Or, as shown in Fig. 13, it is also possible to employ a structure in which a lens 13 is inclined by the drive device 4 to thereby change the direction of the illumination light that has passed through the lens 13 (for example, see Japanese Patent Publication No. Hei. 7-37405). Here, instead of inclining the whole of the reflector and lens, the main portions of the illumination light may also be changed to a predetermined direction by controlling the position of part of the reflector and lens.

Further, as shown in Fig. 14, a shade 14 interposed between the reflector 12 and the lens 13 in the lamp 5 may be moved by the drive device 4 so that a light and shade boundary (so called cut line) in the light distribution pattern of the lamp 5 can be changed vertically (for example, see Japanese Patent Publication No. Hei. 7-29401).

In addition, according to the method 3), other various kinds of embodiments are also possible according to the combinations of the optical components of the lamp 5. For example, if the reflector and light source, or the lens and reflector, or the lens and shade are moved together by the drive device 4, then the direction of the illumination light of the lamp 5 can be changed in the vertical direction.

As can be understood clearly from the foregoing description, according to the invention as set force in Claim 1, when it is found that the vehicle is not in the acceleration or deceleration running condition, the control device controls the illumination direction of the lamp by fixing the direction of the illumination light of the lamp in a predetermined direction, or by limiting the direction of the illumination light to a limited range, or by slowing down the response speed of the drive device, thereby being able to prevent the illumination direction of the lamp from being changed excessively and thus prevent the illumination direction of the lamp from being corrected excessively in the bad road running condition of the vehicle. This makes it possible to restrict not only a strange feeling given to the driver of the vehicle due to the sudden change of the lamp light distribution and visibility but also a dazzling feeling given to the driver of an oncoming vehicle, a pedestrian, and the like.

Also, according to the invention as set forth in Claim 2, by detecting the acceleration instruction or deceleration instruction given to the drive source of the vehicle, or by detecting the drive condition of the drive source of the vehicle, it is possible to judge whether the vehicle is in the acceleration or deceleration running condition or not, without waiting for a time delay necessary for the change of the speed of the vehicle.

Further, according to the invention as set forth in Claim 3, the detect signal relating to the vehicle posture from the vehicle posture detection device can also be used as basic information to judge whether the vehicle is in the acceleration or deceleration running condition or not.

Still further, according to the invention as set forth in Claim 4, the change with time of the inclination angle of the vehicle based on the detect signal from the height detection device is compared with the change with time of the angular velocity of the inclination angle detected by the angular velocity detection device to find a correlation in terms of time between them, and, in accordance with the high or low correlation between them, it is possible to distinguish the acceleration or deceleration running condition of the vehicle from the bad road running condition of the vehicle.

CLAIMS

1. A vehicle lamp illumination direction control device for changing the direction of the illumination light of a lamp according to the vertical inclination of a vehicle in the advancing direction thereof, the control device comprising:

a vehicle posture detection device for detecting the posture of said vehicle during the stationary and/or moving condition thereof;

an acceleration or deceleration running condition judging device for judging whether said vehicle is in the acceleration running condition or in the deceleration running condition or not;

a drive device for directing the illumination light of said lamp in a predetermined direction; and,

a correction calculating device for transmitting to said drive device a correction signal for holding said illumination light of said lamp in a predetermined direction, in accordance with a signal received from said vehicle posture detection device,

wherein, when it is judged by said acceleration or deceleration running condition judging device that said vehicle is in the acceleration running condition or in the deceleration running condition, the direction of said lamp can be controlled by said signal transmitted from said correction calculating device to said drive device, and, when it is judged by said acceleration or deceleration running condition judging device that said vehicle is not in the acceleration running condition or in the deceleration running condition, said drive device can fix the direction of said illumination light of said lamp in a predetermined direction or can limit the allowable range of the direction of said illumination light, or the response speed of said drive device can be slowed down.

2. A vehicle lamp illumination direction control device as set forth in Claim 1, wherein said acceleration or deceleration running condition judging device detects an acceleration instruction or a deceleration instruction to the drive source of said vehicle or detects the drive state of said drive source of said vehicle, thereby being able to judge whether said vehicle is in the acceleration running condition or in the deceleration running condition or not.

3. A vehicle lamp illumination direction control device as set forth in Claim 1, wherein said acceleration or deceleration running condition judging device detects the change with time of a detect signal relating to the vehicle posture from said vehicle posture detection device, thereby being able to judge whether said vehicle is in the acceleration running condition or in the deceleration running condition or not.

4. A vehicle lamp illumination direction control device as set forth in Claim 3, further including:

a height detection device for detecting variations in the vibrations of a mechanism for absorbing the vibrations that are applied to the wheels of said vehicle from the surface of a road, or detecting the height of the axle of said vehicle; and,

an angular velocity detection device for detecting an angular velocity relating to the inclination angle of said vehicle in the advancing direction thereof,

wherein said acceleration or deceleration running condition judging device detects the change with time of said inclination angle of said vehicle in the advancing direction thereof in accordance with a detect signal from said height detection device, and compares said change with time of said vehicle inclination angle with the change with time of a detect signal from said angular velocity detection device, thereby being able to judge in accordance with high or low correlation between them whether said vehicle is in the acceleration running condition or in the deceleration running condition or not.

The Patent Office

2

Application No:	GB 9701821.2	**Examiner:**	R E Hardy
Claims searched:	ALL	**Date of search:**	18 April 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): F4R (RMC)

Int Cl (Ed.6): B60Q (1/08, 1/10, 1/105, 1/11, 1/115)

Other: Online : WPI, CLAIMS, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	GB2053439 A	CIBIE : Whole document	1
A	EP0709240 A2	MERCEDES-BENZ : Whole document	1
A	EP0699559 A1	JOSIC : Whole document	1
A	EP0652134 A1	CARELLO : Whole document	1
A	WO96/18524 A1	ARAYA : Whole document	1

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
		E	Patent document published on or after, but with priority date earlier than, the filing date of this application.
&	Member of the same patent family		

EXHIBIT 7

(12) UK Patent Application (19) GB (11) 2 309 774 (13) A

(43) Date of A Publication 06.08.1997

(21) Application No 9701822.0

(22) Date of Filing 29.01.1997

(30) Priority Data
(31) 08037108 (32) 01.02.1996 (33) JP

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(51) INT CL^6
B60Q 1/115

(52) UK CL (Edition O)
F4R RMC R364 R41Y R765 R78X R789
U1S S1934

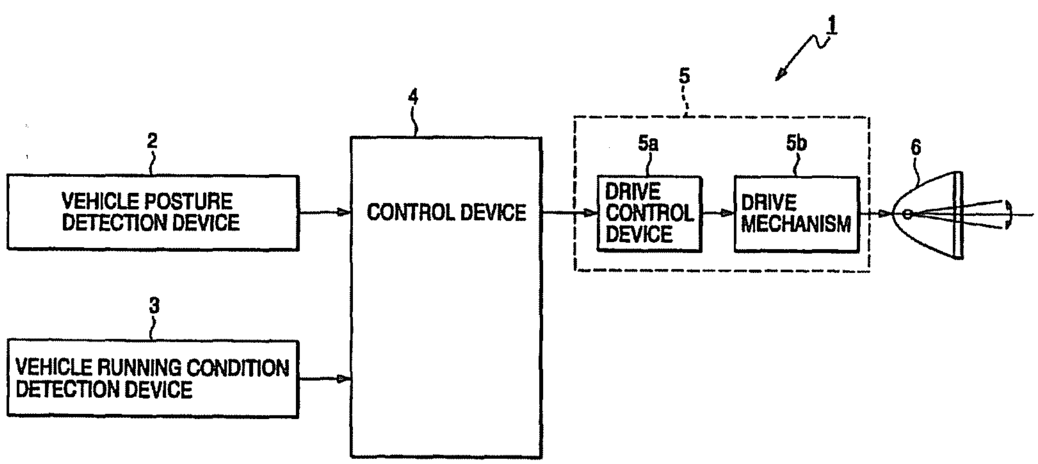
(56) Documents Cited
GB 2115929 A EP 0699559 A1 EP 0554663 A2
US 5195816 A US 4204270 A

(58) Field of Search
UK CL (Edition O) F4R RMC
INT CL^6 B60Q 1/08 1/10 1/105 1/11 1/115
Online : WPI, CLAIMS, JAPIO

(54) Controlling direction of vehicle lights

(57) The illumination direction of lights in a vehicle is controlled by detecting vehicle posture (eg height and/or inclination) and whether the vehicle is stationary and/or has passed through a change of road gradient, and directing the illumination of the lights to a desired direction in accordance with signals received from the posture detection device. Control means effect the direction change only when the vehicle is stationary and/or has passed through a change of gradient. Reference values related to time may be used to prevent unwanted light movements due to rough road surfaces and sudden stops or starts.

FIG. 1



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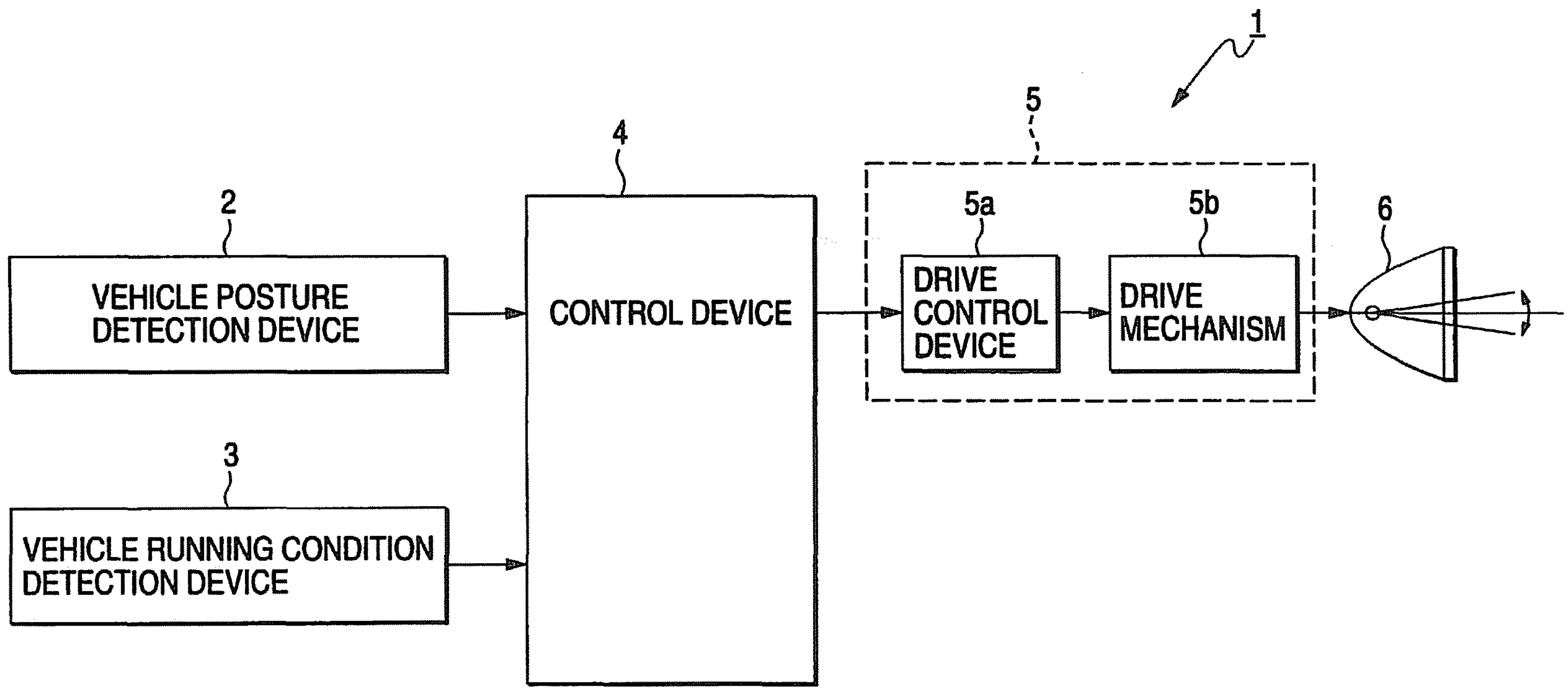
At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

FIG. 1



1
2
VEHICLE POSTURE DETECTION DEVICE
3
VEHICLE RUNNING CONDITION DETECTION DEVICE
4
CONTROL DEVICE
5
5a
DRIVE CONTROL DEVICE
5b
DRIVE MECHANISM
6

1/7

FIG. 2

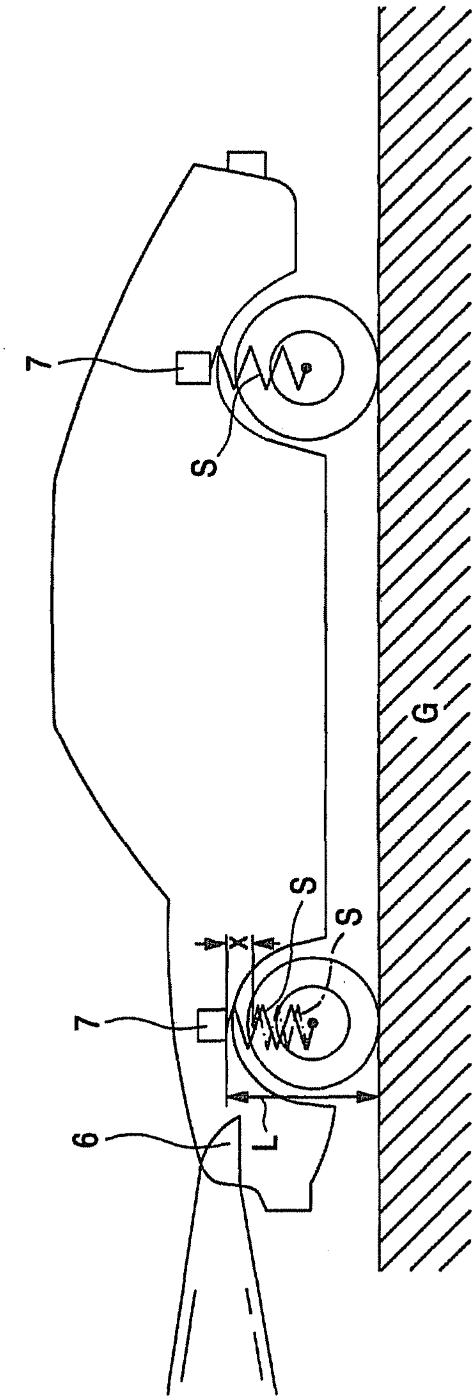


FIG. 3

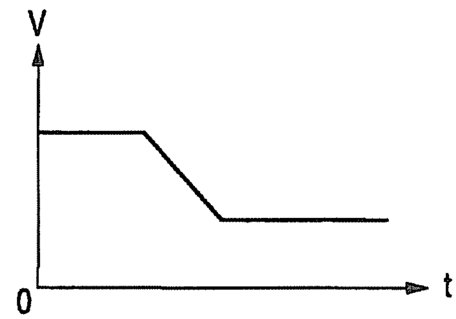


FIG. 4

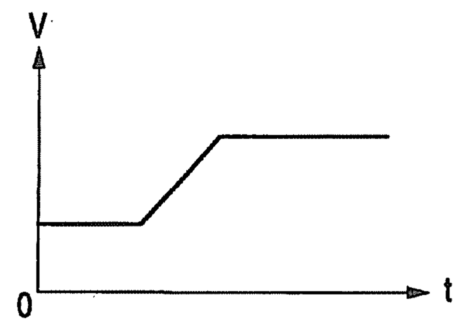


FIG. 5

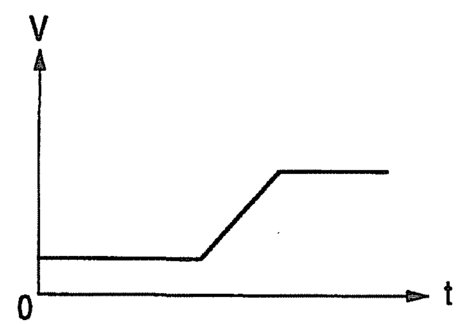


FIG. 6

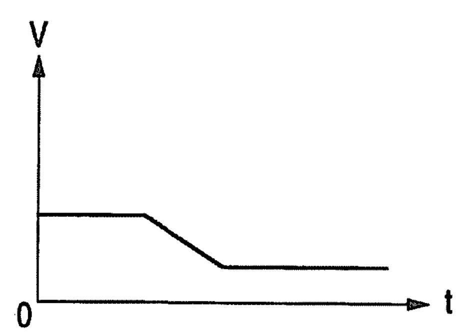


FIG. 7

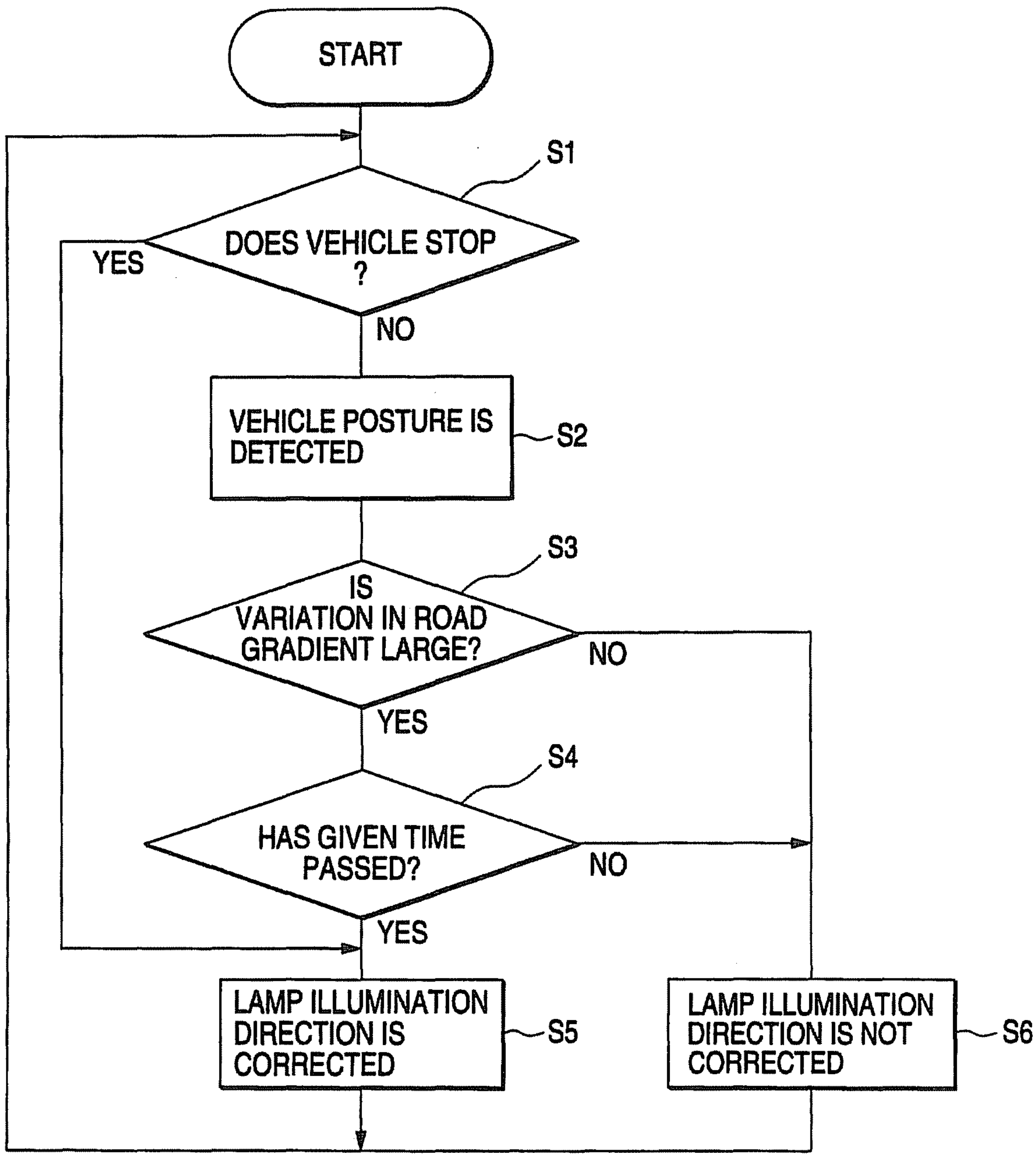

START
S1
DOES VEHICLE STOP ?
YES
NO
VEHICLE POSTURE IS DETECTED
S2
S3
IS VARIATION IN ROAD GRADIENT LARGE?
NO
YES
S4
HAS GIVEN TIME PASSED?
NO
YES
LAMP ILLUMINATION DIRECTION IS CORRECTED
S5
LAMP ILLUMINATION DIRECTION IS NOT CORRECTED
S6

FIG. 8

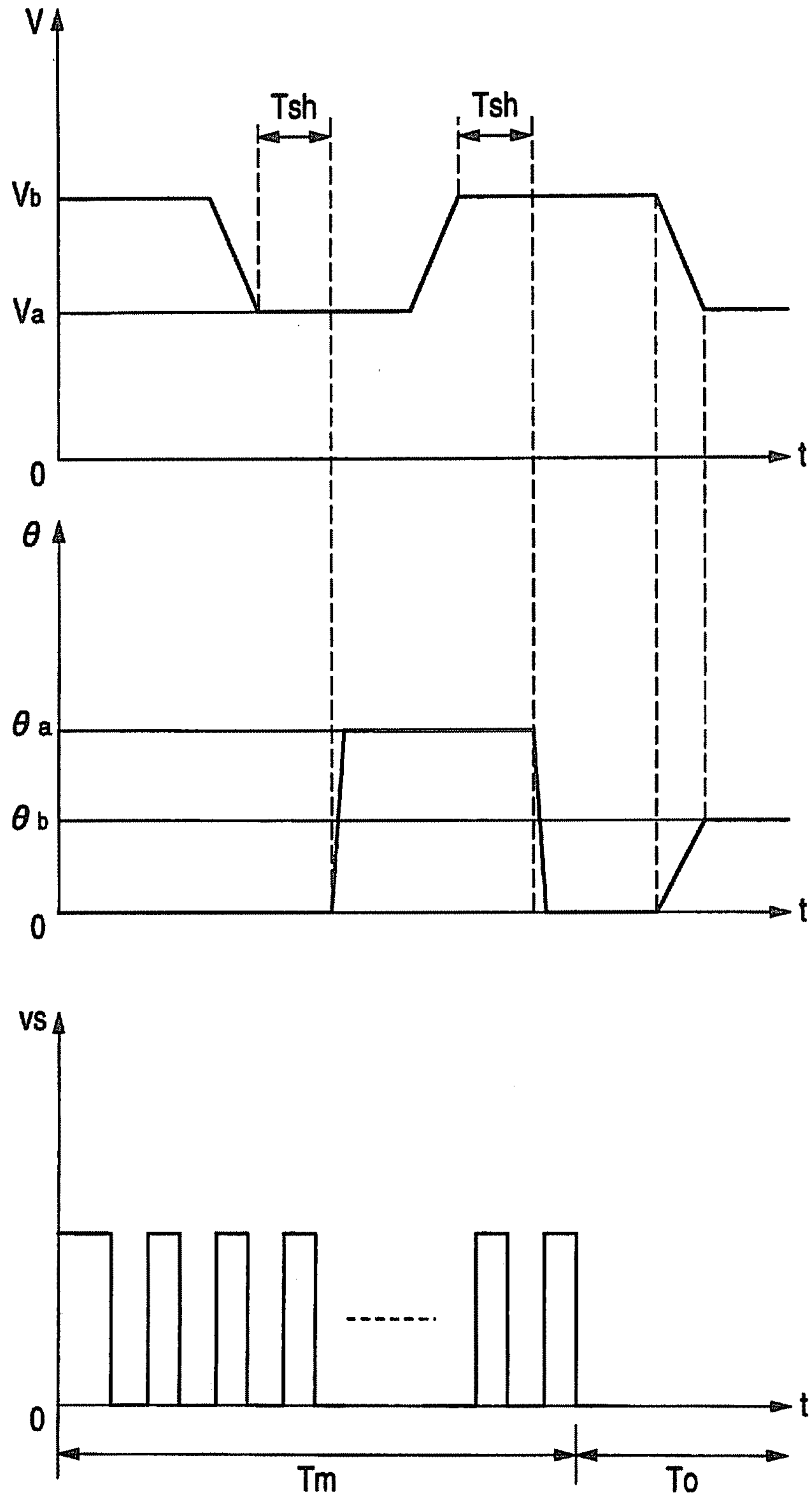


FIG. 9

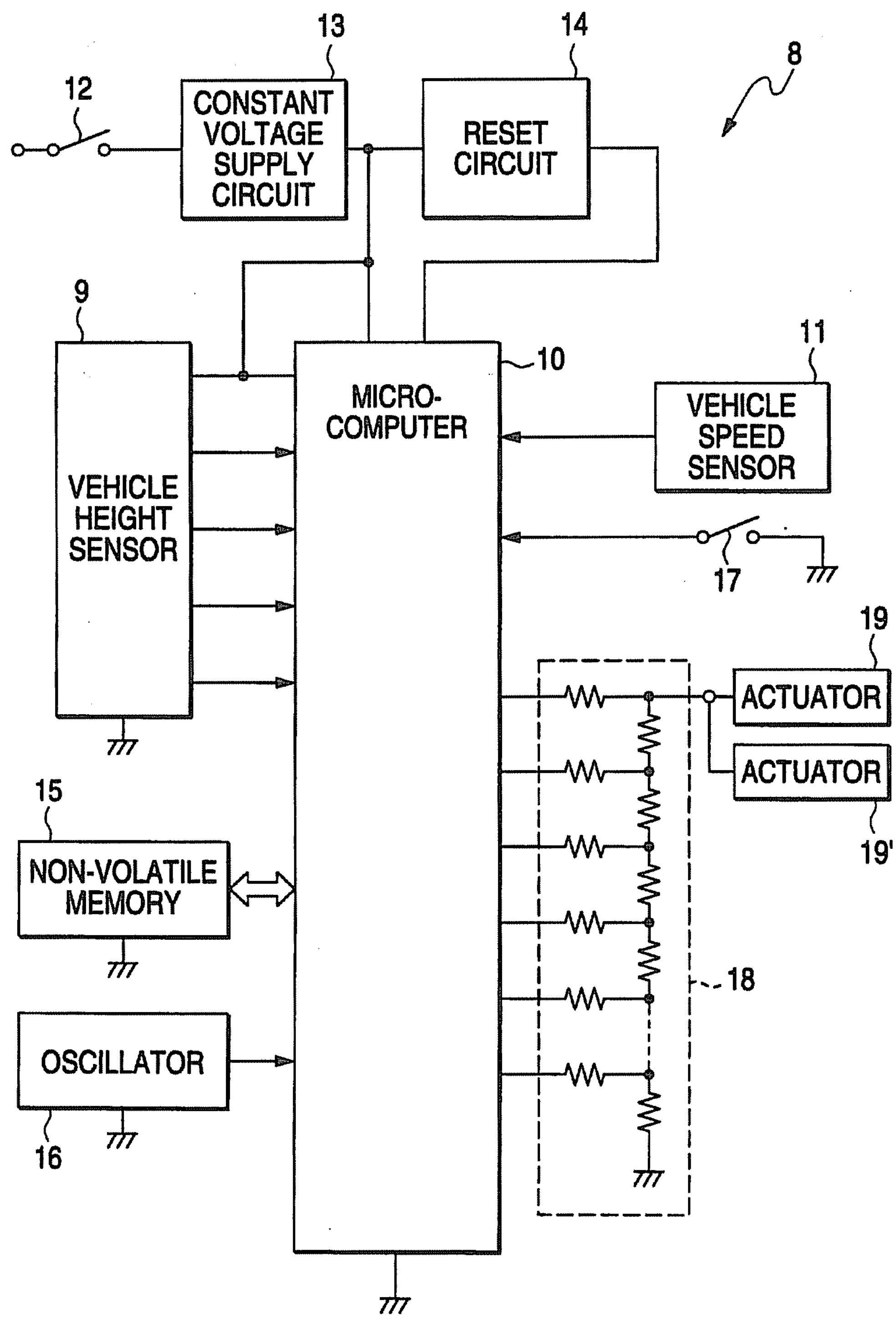
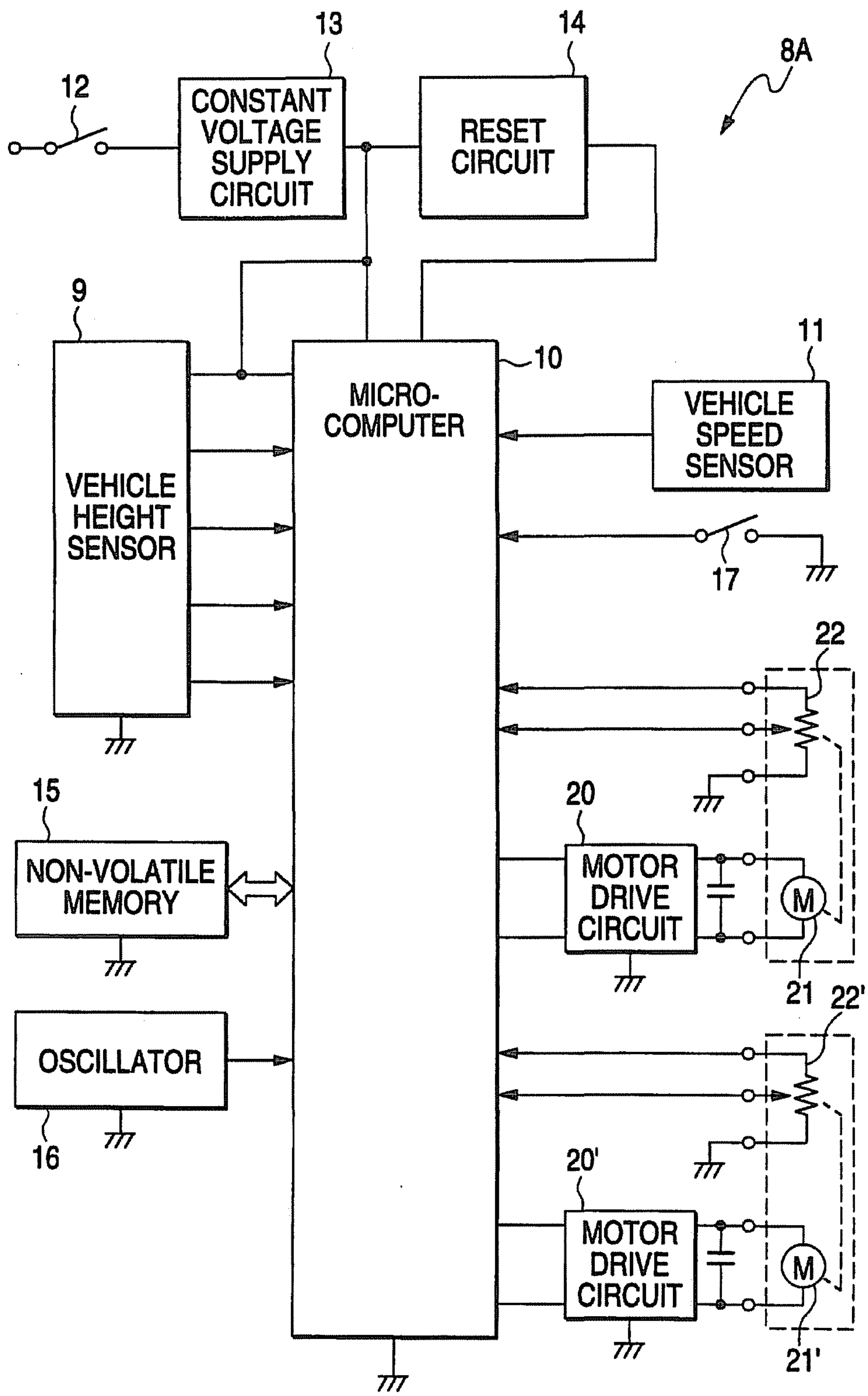

13
14
8
12
CONSTANT VOLTAGE SUPPLY CIRCUIT
RESET CIRCUIT
9
11
10
MICRO-COMPUTER
VEHICLE SPEED SENSOR
VEHICLE HEIGHT SENSOR
17
19
ACTUATOR
ACTUATOR
19'
15
NON-VOLATILE MEMORY
18
OSCILLATOR
16

FIG. 10


8A
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CONSTANT VOLTAGE SUPPLY CIRCUIT
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NON-VOLATILE MEMORY
20
MOTOR DRIVE CIRCUIT
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21
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OSCILLATOR
16
20'
MOTOR DRIVE CIRCUIT
M
21'

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A VEHICLE LAMP ILLUMINATION DIRECTION CONTROL DEVICE

The present invention relates to a vehicle lamp illumination direction control device which detects the posture of a vehicle and correctly adjust the illumination direction of a vehicle lamp so that it can be always kept in a predetermined direction.

Conventionally, there has been known a device (a so called automatic leveling device) which, even when the inclination of a vehicle body varies, is capable of automatically adjusting the illumination direction of the vehicle lamp so that the illumination direction of the vehicle lamp can be kept at a predetermined direction. The device of this type, with the conditions of occupants (such as the number of occupants, the position arrangement of the occupants, and the like) as well as the loaded conditions of loads on board the vehicle taken into consideration, corrects manually the illumination angle of the vehicle lamp with respect to the initially adjusted value of the vehicle lamp so that the illumination state of the vehicle lamp can be always kept in a desired state, thereby to control the illumination direction of the vehicle lamp to provide desired light distribution.

For example, when a load is applied to the rear portion of the vehicle, the device finds the then inclination angle of the vehicle body in the longitudinal direction thereof, and inclines the vehicle lamp downward because the illumination direction of which would be displaced upwardly of the reference direction if the posture of the vehicle lamp is left as it is, thereby adjusting the illumination direction of the vehicle lamp so that the vehicle lamp illumination direction can be always kept in the reference direction.

However, in the above-mentioned manual adjustment, there is no guarantee that the illumination direction of the lamp can be always held in the optimum condition with respect to the posture of the vehicle. Therefore, there is conventionally known a device which includes a device for detecting the posture of the vehicle by detecting the inclination and height of a vehicle body, and calculates the amount of variations in the inclination of the vehicle based on the information that is obtained by the detect device, thereby being able to adjust automatically the illumination direction of the lamp.

However, in the above-mentioned automatic adjustment device, since the lamp is driven with high frequency, an actuator used in a drive mechanism for driving the lamp is required to show high response property and high durability. Due to this, the adjustment device is expensive and consumes a large amount of electric power.

Therefore, in order to avoid the above inconveniences, there can be expected a device which corrects the illumination direction of the lamp only when the vehicle is standing still. However, in such device, when the vehicle stops once on a road having a gradient, the illumination of the lamp cannot be corrected until the vehicle stops again on a road having a small gradient, which raises another inconvenience. For example, when the vehicle stops on a downhill road, because the vehicle posture detect device detects that the front portion of the vehicle is lower in position, the illumination direction of the lamp is corrected to a position which is set a little upwardly of a reference position. After then, when the driver starts the vehicle while the illumination direction of the lamp remains as it is corrected upwardly, and the vehicle passes through the downhill slope and then runs into a flat road, that is, even when the vehicle runs along the flat road, the illumination direction of the lamp is still left in the upwardly corrected condition until the vehicle stops again, which can cause an increase in the glare onto an oncoming vehicle or can worsen the visibility of the driver of the present vehicle.

Accordingly, it is an object of the invention to provide a vehicle lamp illumination direction control device capable of not only reducing the cost thereof but also correctly adjusting the illumination direction of a lamp according to the stationary condition of the vehicle and the amount of variations in the gradient of the road to thereby improve the visibility thereof and guarantee the safety of the running of the vehicle.

In attaining the above object, according to the invention, there is provided a vehicle lamp illumination direction control device so structured as to change the illumination direction of a vehicle lamp according to the vertical inclination of a vehicle in the advancing direction thereof, the vehicle lamp illumination direction control device comprising:

a vehicle posture detection device for detecting the posture of the vehicle;

a vehicle running condition detection device for detecting the running conditions of the vehicle including the stationary condition thereof;

a drive device for directing the illumination light of the lamp to a desired direction; and,

control device, when it is judged in accordance with a signal from the vehicle running condition detection device that the vehicle is in the stationary condition thereof and when it is judged that the vehicle has run from a road having a small gradient into a road having a large gradient or the vehicle has run from a road having a large gradient into a road having a small gradient, for transmitting to the drive device a signal for correcting the illumination direction of the lamp in a predetermined direction in accordance with a signal from the vehicle posture detection device.

Therefore, according to the invention, only when the vehicle is found stationary and when it is found that the vehicle has run from a road having a small gradient into a road having a large gradient or the vehicle has run from a road having a large gradient into a road having a small gradient, the illumination direction of the lamp can be corrected.

In the accompanying drawings:

Fig. 1 is a block diagram of the structure of a vehicle lamp illumination direction control device according to the invention;

Fig. 2 is a schematic view of a vehicle, explaining height detection device provided in the vehicle;

Fig. 3, together with Figs. 4 to 6, is a schematic graphical representation of the amount of variations with time in the output signal of the height sensor when the vehicle runs along a road having a large gradient; and, in particular, Fig. 3 shows the variations in the output of the height sensor when the vehicle firstly runs along an uphill slope and then runs along a road having a small gradient;

Fig. 4 shows the amount of variations in the output of the height sensor when the vehicle firstly runs along a road having a small gradient and then runs along an uphill slope;

Fig. 5 shows the amount of variations in the output of the height sensor when the vehicle firstly runs along a downhill slope and then runs along a road having a small gradient;

Fig. 6 shows the amount of variations in the output of the height sensor when the vehicle firstly runs along a road having a small gradient and then runs along a downhill slope;

Fig. 7 is a flow chart of a processing for correction of the illumination direction of the lamp;

Fig. 8 is a graphical representation in which variations in the output signal levels of the height sensor, the illumination angles of the lamp, and the vehicle speeds are shown in combination;

Fig. 9 is a circuit block diagram of a first embodiment of a vehicle lamp illumination direction control device according to the invention; and,

Fig. 10 is a circuit block diagram of a second embodiment of a vehicle lamp illumination direction control device according to the invention.

Now, description will be given below of the embodiments of a vehicle lamp illumination direction control device according to the invention with reference to the accompanying drawings.

At first, Fig. 1 shows the basic structure of the present invention, in which an illumination direction control device 1 is composed of vehicle posture detection device 2, vehicle running condition detection device 3, control device 4, drive device 5 (which is composed of drive control device 5a and a drive mechanism 5b), and a lamp 6.

The vehicle posture detection device 2 is used to detect the posture of a vehicle (including the vertical inclination of the vehicle in the advancing direction thereof). For example, when there is used height detection device 7 which detects the height of the body of the vehicle, as shown in Fig. 2, there are available a method which measures a distance L between the height detection device 7 and a road surface G by use of detect waves such as ultrasonic waves, laser beams or the like, and a method in which the height detection device 7 detects the expansion and contraction amount x of a suspension S in order to detect the amount of variations in the vertical position of the axle of the vehicle. The two methods are both advantageous in that the existing facilities of the vehicle can be used for detection of the posture of the vehicle.

The output of the vehicle posture detection device 2 is sent to the control device 4 and is used as basic information for correction calculation of the illumination direction of the lamp 6.

The vehicle running condition detection device 3 is used to detect the running conditions of the vehicle (including the stopping or stationary condition thereof), while the detect signal of the vehicle running condition detection device 3 is transmitted to the control device 4. As the vehicle running condition detection device 3, for example, there can be used vehicle speed detection device which is one of the existing facilities of the vehicle. Also, every kind of information can be used, provided that it can be used to detect the running conditions of the vehicle.

When the control device 4 receives the detect signal of the vehicle running condition detection device 3 and finds from this detect signal that the vehicle is standing still, the control device 4, in accordance with information on the vehicle posture obtained from the vehicle posture detection device 2, transmits to the drive signal 5 a control signal for correction of the illumination direction of the lamp 6. For example, in the stationary condition of the vehicle, when the front portion of the vehicle is situated lower (or higher) than the rear portion thereof, the illumination direction of the lamp 6 is adjusted in the upward (or downward) direction so that the illumination direction can be always held substantially in the horizontal direction.

By the way, the vehicle does not always stop on a road having no gradient but, as described above, the vehicle is sometimes caused to stop on the slanting road. In this case, with use of the above-mentioned method for adjusting the illumination direction of the lamp only when the vehicle is caused to stop, the thus adjusted illumination direction of the lamp cannot be corrected until the vehicle stops next.

In view of this, the control device 4 is structured such that, based on the information from the vehicle posture detection device 2, it can detect the amount of variations in the gradient of the road and, therefore, when the road gradient varies suddenly, it can correct the illumination direction of the lamp 6.

Now, Figs. 3 to 6 are respectively explanatory views of a method for detecting the amount of variations in the road gradient when a height sensor is used as the vehicle posture detection device 2 and, in these figures, an axis of abscissa expresses the time t and an axis of ordinate expresses the output level V of the height sensor; that is, in these figures, there is shown an example of the amount of variations in the output level V with the passage of time (by the way, for the purpose of simplified expression, the term "with the passage of time" is sometimes expressed as "with time" in this specification).

In particular, Fig. 3 shows schematically the amount of variations in the output level V when the vehicle runs first along an uphill slope and thereafter runs along a road having a small gradient. In this case, when the vehicle runs over the uphill slope, the output level V falls down suddenly.

Also, Fig. 4 shows schematically the amount of variations in the output level V when the vehicle runs first along a road having a small gradient and thereafter runs along an uphill slope. In this case, when the vehicle starts to run the uphill slope, the output level V rises up suddenly.

Fig. 5 shows schematically the amount of variations in the output level V when the vehicle runs first along a downhill slope and thereafter runs along a road having a small gradient. In this case, when the vehicle has run through the downhill road, the output level V rises up suddenly.

Fig. 6 shows schematically the amount of variations in the output level V when the vehicle runs first along a road having a small gradient and thereafter runs along a downhill slope. In this case, when the vehicle starts to run along the downhill slope, the output level V falls down suddenly.

These figures show clearly that the magnitude of the amount of variations in the road gradients is reflected on the amount of variations in the outputs of the height sensor when the vehicle runs from the road having a small gradient to the road having a large gradient or when the vehicle runs from the road having a large gradient to the road having a small gradient.

Therefore, when the amount of variations with time of the detect signal of the vehicle posture detect signal 2 is equal to or larger than a reference value, it may be judged that the gradient of the road has varied, and the illumination direction of the lamp 6 may be corrected in accordance with the detect signal of the vehicle posture detection device 2. That is, according to this way of correction, when the vehicle moves from the uphill or downhill slope to the road having a small gradient, or vice versa, the illumination direction of the lamp 6 can be adjusted in a proper direction.

By the way, in the present method, the control device 4 is structured such that it can judge the amount of variations in the road gradients according to the detect information provided by the vehicle posture detection device 2, which can in turn simplify the structure of the illumination direction control device. However, the invention is not limited to this but, for example, a device for detecting the road gradients or the amounts of variations therein may be provided separately from the vehicle posture detection device 2 and the control device 4 may judge the amounts of variations in the road gradients according to the information that is detected by the separately provided detection device.

Also, in order to prevent the illumination direction of the lamp 6 from being corrected inadvertently when a sudden change in the posture of the vehicle occurs temporarily or due to the wrong operation of the lamp 6 caused by external disturbances, for example, when the vehicle makes a sudden start or a sudden stop, preferably, a threshold value with respect to time may be set in detection of the road gradient and, only when the amount of variations in the detect signal of the vehicle posture detection device 2 exceeds a given reference value and such excessive state continues for a time equal to or more than the threshold value, the illumination direction of the lamp 6 may be corrected; or, a threshold value with respect to the running distance of the vehicle may be set and, only when the amount of variations in the detect signal of the vehicle posture detection device 2 exceeds a given reference value and such excessive state continues for a distance equal to or more than the threshold value, the illumination direction of the lamp 6 may be corrected. Also, these threshold values may be set in various manners, for example, they may be set as a constant value, or may be set as a variable which varies according to the speeds of the vehicle.

Now, Fig. 7 is a flow chart of a processing to be performed by the control device 4. At first, in Step S1, it is checked in accordance with the information from the vehicle running condition detection device 3 whether the vehicle is stopped or not. If it is found that the vehicle is stopped, then the processing advances to Step S5 and, if the vehicle is found running, then the processing advances to Step S2.

After the posture of the vehicle is detected by the vehicle posture detection device 2 in Step S2, in Step S3, it is checked from the amount of variations with time in the detect signal whether the amount of variations in the gradient of the road is large or not. If it is found that the amount of variations in the road gradients is large, then the processing advances to Step S4 and, if not, then the processing advances to Step S6.

In Step S4, it is checked whether a state in which the amount of variations of the detect signal supplied by the vehicle posture detection device 2 is equal to or more than a given reference value continues for a given period of time or longer or not. If it is found that such state continues, then the processing advances to Step S5 and, if not, then the processing goes to Step S6. Here, when a threshold value relating to the running distance of the vehicle is set instead of setting a threshold value relating to the above-mentioned continuing time, in Step S4, it may be checked whether a state in which the amount of variations in the detect signal supplied by the vehicle posture detection device 2 is equal to or more than a given reference value continues over a given running distance or not.

In Step S5, in accordance with the information from the vehicle posture detection device 2, the control device 4 transmits to the drive control device 5a a control signal which causes the illumination direction of the lamp 6 to be kept in a predetermined direction, and the illumination direction of the lamp 6 is corrected through the drive mechanism 5. After then, the processing goes back to the first step S1.

Also, in Step 6, the correction of the illumination direction of the lamp 6 is not carried out but the processing returns to the first step S1.

The correction of the illumination direction of the lamp 6 in Step S5 is carried out by the drive device 5 based on the control signal transmitted from the control device 4 and, as a method for executing such correction, there are available two methods as follows:

1) a method for inclining the entire lamp, and,
2) a method for moving the component (such as a lens, a reflector, a shade or the like) of the optical system of the lamp.

In particular, the method 1) is the simplest method that can change the illumination pattern of the lamp 6 within a vertical plane, in which the entire lamp is rotated about the rotary shaft thereof to thereby change the illumination angle of the lamp 6 with respect to a horizontal plane including the optical axis of the lamp. For example, in the method 1), there can be used a drive mechanism in which the right and left side surfaces of the lamp 6 are supported rotatably, and the rotary shaft of the lamp 6 is rotated directly by a drive source such as a motor or the like, or a member fixed to or formed integrally with the lamp 6 is rotated by the drive device 5. As an example of such lamp, there is available a lamp including a mechanism which can use the rotational force of the motor as the rotational force of the lamp through a transmission mechanism using a worm and a worm wheel (for example, see Japanese Patent Publication No. Sho. 63-166672).

Also, in the method 2), there is employed a structure in which the reflector of the lamp 6 is rotated by the drive device 5 within a vertical plane including the optical axis of the lamp to thereby change the direction of the reflected light of the reflector. For example, there is available a structure in which part of the reflector is rotatably supported on the lamp and, in order that a screw member mounted on the other part than the lamp for adjusting the inclining angle of the remaining portions of the reflector can be rotated by a motor, there is employed a transmission mechanism including a worm and a worm wheel (for example, see Japanese Patent Publication No. Sho. 59-195441); or, there is also available a structure in which the lens is inclined by the drive device 5 to thereby change the direction of the illumination light of the lamp that has passed through the present lens (for example, see Japanese Patent Publication No. Hei. 7-37405). Here, instead of inclining the whole of the reflector and lens, part of them may be controlled in position to thereby change the main portions of the illumination light in a desired direction.

Also, when a shade is interposed between the reflector and lens, the shade may be moved by the drive device 5 to thereby change a light and shade boundary in the light distribution pattern of the lamp 6 in the vertical direction (for example, see Japanese Patent Publication No. Hei. 7-29401).

Further, there are also possible other various embodiments according to the combinations of the optical components of the lamp 6; for example, the reflector and light source, the lens and reflector, or the lens and shade may be moved together by the drive device 5 to thereby change the direction of the illumination light of the lamp in the vertical direction.

In addition, in either of the method 1) or 2), of course, the illumination direction of the lamp 6 can be controlled in stages or continuously.

Now, Fig. 8 is a graphical representation in which, when the vehicle runs down along a downhill slope from a road having a small gradient and runs again for a short time along a road having a small gradient and, after then, it stops, there are shown the respective amounts of variations with time in the output level V of the height sensor, in the illumination angle θ of the lamp 6, and in the output signal vs of the vehicle speed sensor. Here, in the graph shown in the upper stage of Fig. 8 and showing the amount of variations in the output level V, reference character 「Va」 represents a detect level detected on the downhill slope and Vb represents a detect level detected on the road having a small gradient, while Tsh stands for a judgment time relating to the detection of the variations in the road gradients. Also, in the graph shown in the middle stage of Fig. 8 and showing the amount of variations in the illumination angle θ, θa expresses an illumination angle when the vehicle is running on the slanting slope, while θb expresses an illumination angle when the vehicle is standing still. Further, in the graph shown in the lower stage of Fig. 8 and showing the variations in the output signal vs, a period Tm, during which pulse trains continue, stands for a period during which the vehicle is running, whereas a period To, during which no pulse train exists, represents a period during which the vehicle is standing still.

In this example, when the vehicle runs from a road having a small gradient into a downhill slope, the amount of variations in the output level V of the height sensor is equal to or more than a reference value and such high variation amount state continues for a time equal to a judging time Ts or longer. Therefore, the illumination angle of the lamp 6 is corrected from zero to θa after the passage of a time Tsh. And, when the vehicle runs into a road having a small gradient after the vehicle has run through the downhill slope, the variation amount of the output level V of the height sensor is equal to or more than a reference value and such high variation amount state continues for a time equal to a judging time Ts or longer. Therefore, the illumination angle of the lamp 6 is corrected from θa to zero after the passage of the time Tsh. After then, if the vehicle is caused to stop in a period To, then the illumination angle of the lamp 6 is corrected according to the then posture of the vehicle. For example, when the loading condition of the vehicle is varied by unloading the cargo, the illumination angle of the lamp 6 is corrected to an angle of θb.

As described above, a threshold value (which is expressed as Ls) of the running distance can be substituted for the judging time Tsh, the illumination angle θ can be corrected when the vehicle runs continuously for a distance equal to or larger than the threshold value Ls with the detect level of the height sensor remaining higher than the reference value, or the threshold value can be caused to vary with respect to a vehicle speed vs in accordance with an equation $Ts = Ls/vs$ ($\neq 0$).

Also, in the above description, for the convenience of explanation, the number of height sensors to be provided on the vehicle is set as one. However, this is not limitative but other various embodiments are also possible, for example, some of a plurality of sensors provided in the front and rear portions and/or right and left portions of the vehicle can be selected and the detect signals of the selected sensors can be used. In particular, out of sensors respectively provided in the front and rear portions of the vehicle as well as in the right and left portions thereof, the sensors provided in the right and left direction can be selected and the average value of the selected sensors can be used; or, out of four sensors which are respectively provided in the front, rear, right and left portions of the vehicle, there can be selected a pair of sensors positioned diagonally with respect to each other in a quadrangle having four vertices respectively consisting of the positions of the four sensors (for example, a pair of a left and front sensor and a right and rear sensor, or a pair of a right and front sensor and a left and rear sensor), and only the detect signals of the thus selected pair of sensors can be used; or, there can be used only the detect signals of two sensors which are respectively positioned in the front and rear portions of the vehicle and are also positioned on the same straight line extending in the longitudinal direction of the vehicle (for example, sensors which are positioned in the front and rear portions of the vehicle on the right or left side of the vehicle).

Now, in Figs. 9 and 10, there are shown the first and second embodiments of a vehicle lamp illumination direction control device according to the invention.

In particular, Fig. 9 shows a block diagram of a vehicle lamp illumination direction control device according to the first embodiment of the invention. In the present embodiment, the vehicle posture detect member 2 is composed of four height sensors 9 which are respectively provided in the neighborhood of the front and rear as well as right and left wheels of the vehicle.

Also, the control device 4 includes a microcomputer 10 into which there are input the detect voltages of the four height sensors 9, and the output signals of a vehicle speed sensor 11 corresponding to the previously described vehicle running condition detection device 3. When a turn-on switch 12 for the lamp 6 is put into operation, a supply voltage from a constant voltage supply circuit 13 and a reset signal from a reset circuit 14 are supplied to the microcomputer 10. Also, a non-volatile memory 15 (such as an electrically erasable EEPROM, or the like) for storing control programs and data values therein) and an oscillator 16 used to generate a clock signal are additionally attached to the microcomputer 10.

And, into the microcomputer 10, there is input by switch device 17 a select signal which is used to instruct whether the above-mentioned control on the illumination direction of the lamp is to be carried out or not. The reason for such input of the select signal is as follows: that is, when a lamp is mounted on a vehicle and the illumination direction of the lamp is initially adjusted, or when the lamp is inspected, if the above-mentioned correction control on the illumination direction of the lamp is carried out, then the adjusting operation and inspection are difficult to perform. In this case, by operating the switch device 17, the illumination direction of the lamp may be set in a non-control state in which no correction control is carried out (for example, in a state in which the illumination angle of the lamp is fixed at a given angle). Here, if the detect data of the height sensors 9 in the initial adjustment time are stored in the above-mentioned memory 15, then the illumination direction of the lamp in and after the initial adjustment time can be controlled with the vehicle posture in the initial adjustment time as a reference.

A rudder resistance network 18, which corresponds to the above-mentioned drive control device 5a, is used to convert the output signal of the microcomputer 10 into an analog signal and transmits it to actuators 19 and 19' which are disposed downstream thereof. In this case, there is employed an actuator of a current input type and the lamp or the components thereof are driven by these actuators 19 and 19′ to thereby correct the illumination direction of the lamp. Here, one actuator 19 is used to control the illumination direction of the lamp provided on the right side of the front portion of the vehicle, while the other actuator 19′ is used to the illumination direction of the lamp provided on the left side of the front portion of the vehicle.

Now, Fig. 10 shows a vehicle lamp illumination direction control device 8A according to the second embodiment of the invention, in which there are used a potentiometer and a direct current motor as the actuators thereof. Since most of the second embodiment is similar to the first embodiment, the similar portions thereof are given the same designations as the corresponding portions of the first embodiment and thus the description thereof is omitted here.

In the present embodiment, there are provided two motor drive circuits 20 and 20′ which correspond to the above-mentioned drive control device 5a and are respectively used to control the rotational movements of two motors 21 and 21′ in accordance with a control signal output from the microcomputer 10.

In this case, the drive mechanism 5 is composed of the motors 21 (21′) and potentiometers 22 (22′). For example, when a reflector disposed within the lamp is inclined in a vertical plane including the optical axis thereof to thereby change the illumination direction of the lamp, the reflector is inclined by the motors 21 and 21′ and then the inclining angle of the reflector is detected by the potentiometers 22 and 22′ (including A/D conversion and the like) and is input to the microcomputer 10. That is, the microcomputer 10 continues to transmit the control signal to the motor drive circuits 20 and 20′ until the inclining angle of the reflector detected by the potentiometers 22 and 22′ becomes a target angle.

Besides this, according to the invention, the lamp or the components thereof can be driven or controlled by use of a stepping motor to thereby correct the illumination direction of the lamp. In other words, the concrete structure of the drive device 5 can vary greatly according to the structure of the lamp.

As can be clearly understood from the foregoing description, according to the invention as set forth in Claim 1, since the illumination direction of the lamp can be corrected only when the vehicle is found standing still as well as only when it is found that the vehicle runs from a road having a small gradient into a road having a large gradient or that it runs from a road having a large gradient into a road having a small gradient, it is not necessary that the drive device have high response property and high durability, so that the cost of the vehicle lamp illumination direction control device or the consumption of power thereof cannot be increased excessively. Also, even when the vehicle is caused to stop on a road having a gradient, the amount of variations in the gradient of the road can be detected and thus, without waiting for the next stop of the vehicle, the illumination direction of the lamp can be corrected.

Also, according to the invention as set forth in Claim 2, since the control device judges the magnitude of the road gradients in accordance with the amount of variations with time in the output signal levels of the vehicle posture detection device, it is not necessary to provide exclusive device for detecting the road gradients.

Further, according to the invention as set forth in Claim 3, when a state in which the output signal level of the vehicle posture detection device is equal to or higher than a given reference value continues for a given time or running distance, it is judged that the vehicle has run from a road having a small gradient into a road having a large gradient or the vehicle has run from a road having a large gradient into a road having a small gradient. This eliminates the possibility that the illumination direction of the lamp can be corrected inadvertently when the vehicle starts or stops suddenly, thereby being able to prevent the generation of the wrong correction of the illumination direction of the lamp.

CLAIMS

1. A vehicle lamp illumination direction control device for changing the illumination direction of a vehicle lamp according to the vertical inclination of a vehicle in the advancing direction thereof, said vehicle lamp illumination direction control device comprising:

vehicle posture detection device for detecting the posture of said vehicle;

vehicle running condition detection device for detecting the running conditions of said vehicle including the stationary condition thereof;

drive device for directing the illumination light of said lamp to a desired direction; and,

control device, when it is judged in accordance with a signal from said vehicle running condition detection device that said vehicle is in the stationary condition thereof and when it is judged that said vehicle has run from a road having a small gradient into a road having a large gradient or said vehicle has run from a road having a large gradient into a road having a small gradient, for transmitting to said drive device a signal for correcting the illumination direction of said lamp in a predetermined direction in accordance with a signal from said vehicle posture detection device.

2. A vehicle lamp illumination direction control device as set forth in Claim 1, wherein said control device can judge the magnitude of the gradients of roads in accordance with the amount of variations with time in the output signal of said vehicle posture detection device.

3. A vehicle lamp illumination direction control device as set forth in Claim 2, wherein, if a state in which the output signal of said vehicle posture detection device is

equal to or larger than a given reference value continues for a given time or running distance, then said control device judges that said vehicle has run from a road having a small gradient into a road having a large gradient or said vehicle has run from a road having a large gradient into a road having a small gradient.

The Patent Office

22

Application No: GB 9701822.0
Claims searched: ALL

Examiner: R E Hardy
Date of search: 21 April 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): F4R (RMC)

Int Cl (Ed.6): B60Q (1/08, 1/10, 1/105, 1/11, 1/115)

Other: Online : WPI, CLAIMS, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	GB2115929 A	STC : Whole document	1
A	EP0699559 A1	JOSIC : Whole document	1
A	EP0554663 A2	HELLA : Whole document	1
A	US5195816 A	MOSS : Whole document	1
A	US4204270 A	D'ORSAY : Whole document	1

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
		E	Patent document published on or after, but with priority date earlier than, the filing date of this application.
&	Member of the same patent family		

EXHIBIT 9

(19) BUNDESREPUBLIK DEUTSCHLAND

DEUTSCHES PATENTAMT

(12) **Offenlegungsschrift**

(11) **DE 31 10 094 A1**

(51) Int. Cl. 3: B 60 Q 1/10

(21) Aktenzeichen: P 31 10 094.5
(22) Anmeldetag: 16. 3. 81
(43) Offenlegungstag: 30. 9. 82

DE 31 10094 A1

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(56) Recherchenergebnis gem. § 43 Abs. 1 Satz 1 PatG:

DE-OS	27 42 271
US	42 04 270 =
DE-OS	27 16 476
DE-OS	22 20 586
FR	24 58 426

(54) **»Einrichtung zur automatischen Scheinwerfereinstellung bei Kraftfahrzeugen«**

Eine Einrichtung zur automatischen Scheinwerfereinstellung bei Kraftfahrzeugen besteht aus vier Sensoren, die paarweise hintereinander in Fahrtrichtung an solchen Teilen des Kraftfahrzeuges angeordnet sind, die auf Belastung ansprechen. Die Sensoren senden dann Signale aus, die über einen Analog-Multiplexer und einen Analog/Digital-Wandler in einen Mikroprozessor gelangen, der die Signale auswertet, d.h. Differenzwerte ermittelt, ferner Mittelwerte aus einer Reihe von Messungen errechnet und mit einem vorgegebenen Wert vergleicht. Beim Abweichen von diesem Wert und Überschreiten eines bestimmten Schwellwertes sendet der Mikroprozessor Signale aus, die über Digital/Analog-Wandler mit nachgeschalteten Operationsverstärkern zu Scheinwerfereinstellvorrichtungen gelangen und dort über entsprechende herkömmliche Mittel, wie z.B. Servomotoren, eine Korrektur des jeweiligen zugehörigen Scheinwerfers bewirken.
(31 10 094)

DE 31 10094 A1

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Dr.Rl/bk
13. März 1981

Patentansprüche

1. Einrichtung zur automatischen Korrektur der Scheinwerfereinstellung bei Kraftfahrzeugen, gekennzeichnet durch folgende Merkmale:
   - die Ausgangssignale von vier Sensoren (S1,...S4) sind einem Analog-Multiplexer (2) zugeführt, dessen Ausgang über einen Analog/Digital-Wandler (3) mit einem Mikroprozessor (4) verbunden ist,
   - vom Mikroprozessor (4) führen zwei Ausgänge (8, 8') über je einen Digital/Analog-Wandler (6,6') zu zwei Operationsverstärkern (7, 7'), an die jeweils eine Scheinwerfereinstellvorrichtung (9, 9') angeschlossen ist.

2. Einrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die vier Sensoren (S1,...S4) jeweils an vier verschiedenen, auf Belastung ansprechenden Punkten des Kraftfahrzeuges angeordnet sind.

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13. März 1981

Einrichtung zur automatischen Scheinwerfereinstellung bei Kraftfahrzeugen

Die Erfindung betrifft eine Einrichtung nach dem Oberbegriff des Anspruchs 1.

Die Einstellung der Scheinwerfer eines Kraftfahrzeuges erfolgt üblicherweise in einer Kfz-Werkstatt unter Zuhilfenahme hierfür konstruierte Geräte, wobei die eigentliche Ausrichtung von Hand vorgenommen wird. Das bedeutet, daß normalerweise eine korrekte Lage der Scheinwerfer praktisch nur beim nicht belasteten Fahrzeug gegeben ist.

Wird dieses belastet, z.B. beim PKW durch Beladung des Kofferraumes, so tritt eine Verschiebung des Lichtkegels nach oben ein. Dadurch kommt es zur häufig beobachteten Blendwirkung, trotz eingeschaltetem Fahrlicht. Eine Korrektur der Scheinwerferlage durch den Fahrer wäre erforderlich, ist jedoch nur in Ausnahmefällen ohne großen Aufwand möglich und wird selbst dann noch durch das Fehlen eines festgelegten Bezugspunktes erschwert, d.h. ohne Hilfsgeräte wird das Nachregulieren ungenau.

Der Erfindung liegt deshalb die Aufgabe zugrunde, eine Einrichtung anzugeben, die eine automatische Korrektur der Scheinwerfereinstellung auf eine festgelegte Höhe ermöglicht. Die Aufgabe wird durch die im Anspruchs 1 angegebene Erfindung gelöst. Eine zweckmäßige Ausgestaltung ist dem Anspruch 2 gekennzeichnet.

Die Einrichtung nach der Erfindung ermöglicht die korrekte Ausleuchtung der Fahrbahn unabhängig von der Belastung des Kraftfahrzeuges, die seine Lage gegenüber dem unbeladenen Zustand ändert. Die Blendung entgegenkommender Fahrzeuge wird vermieden, der von den Lampen kommende Lichtstrahl bleibt scharf abgegrenzt.

Die Erfindung wird nun anhand der beigefügten Zeichnung, die das Blockschaltbild eines Ausführungsbeispiels zeigt, näher erläutert.

Die Bezugszeichen S1...S4 in der Figur bedeuten vier Sensoren, die über einen Analog-Multiplexer 2 an den Eingang eines Analog/Digital-Wandlers 3 angeschlossen sind, dessen Ausgang zu einem Mikroprozessor 4 führt. Dieser besitzt zwei Ausgänge 8, 8', die über zwei Digital/Analog-Wandler 6,6' mit jeweils einem nachgeschalteten Operationsverstärker 7, 7' mit zwei Scheinwerfereinstellvorrichtungen 9, 9' verbunden sind.

Die vier Sensoren sind paarweise hintereinander S1,S2/S3,S4 in Fahrtrichtung an solchen Teilen des Kraftfahrzeuges angeordnet, die bei Belastung eine Lageveränderung erfahren, also z.B. an Radaufhängungen oder an Stoßdämpfern. Die vier Senseren können z.B. Dehnmeßstreifen sein.

Voraussetzung für den Betrieb der erfindungsgemäßen Einrichtung ist die Festlegung der Ideal- oder Soll-Lage der Scheinwerfer. Dazu werden sie mittels der üblichen Hilfsmittel genau eingestellt und die sich dabei für die einzelnen Sensoren S1...S4 ergebenden Werte im Mikroprozessor 4 gespeichert. Die Einrichtung arbeitet dann wie folgt: werden die Sensoren S1...S4 durch Belastung beeinflußt, so senden sie elektrische Signale aus, die über den Analog-

Multiplexer 2 zum Analog/Digital-Wandler 3 gelangen und von dort als Digitalsignale dem Microprozessor 4 eingegeben werden.

Die Aufnahme der elektrischen Signale, die bestimmten Meßwerten bezüglich der Scheinwerferlage entsprechen, erfolgt in festgelegten Zeitabständen von z.B. einer Minute. Zur Erfassung der jeweiligen Scheinwerferlage benötigt man n Meßwerte, wobei n eine ganze Zahl zwischen eins und unendlich sein kann. Zweckmäßigerweise wird man n so groß wählen, daß sich bei einer sinnvollen Zahl von Meßwerten ein optimaler Mittelwert ergibt. Nach jeder Messung wird ein Mittelwert $\bar{V}$ der letzten n Meßwerte nach der folgenden Formel errechnet:

$$\bar{V}_K = \frac{1}{N} \cdot \sum_{n=1}^{N} \cdot V \quad (S_K^n)$$

wobei mit K die Anzahl der Räder 1 bis 4,
N die Anzahl der in die obige Berechnung einbezogenen Meßwerte (wird experimentell ermittelt)
S das von den Sensoren kommende Signal bezeichnet ist.

Aus den Werten $\bar{V}_K$ werden Differenzen für die Sensorenpaare S1/S2 und S3/S4 ermittelt, die die Lage des Kraftfahrzeuges beschreiben. Diese Differenzwerte ergeben zwei Scheinwerfereinstellwerte. In Abhängigkeit von deren Vorzeichen werden gleichzeitig z.B. Servomotoren vor- bzw. zurückgestellt und die Scheinwerferlageregister im Mikroprozessor 4 hoch- und heruntergezählt.

Beruhen die zu den Meßwerten führenden Signale auf geringen Belastungen, wie sie z.B. durch Fahrbahnstöße entstehen, so ergibt sich im Mittel ein Differenzwert, der nur eine geringe Abweichung vom Wert der Ideallage der Scheinwerfer aufweisen, ein vorgegebener Schwellwert wird somit nicht überschritten, die Verstellung der Scheinwerfer wird nicht ausgelöst. Bei stärkerer Belastung wird der Schwellwert überschritten, der Mikroprozessor 4 sendet Signale über die Digital/Analog-Wandler 6, 6' und die Operationsverstärker 7, 7' zu den jeweiligen Scheinwerfereinstellvorrichtungen, die dann die Lage der Scheinwerfer unter Verwendung herkömmlicher Einrichtungen, wie z.B. von Schraubspindeln, die die Drehbewegung des Motors in eine Linearbewegung der Scheinwerfer umsetzen, entsprechend verändern.

6
Leerseite

Nummer: 31 10 094
Int. Cl.3: B 60 Q 1/10
Anmeldetag: 16. März 1981
Offenlegungstag: 30. September 1982

NACHGEREICHT

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P 31 10 094.5

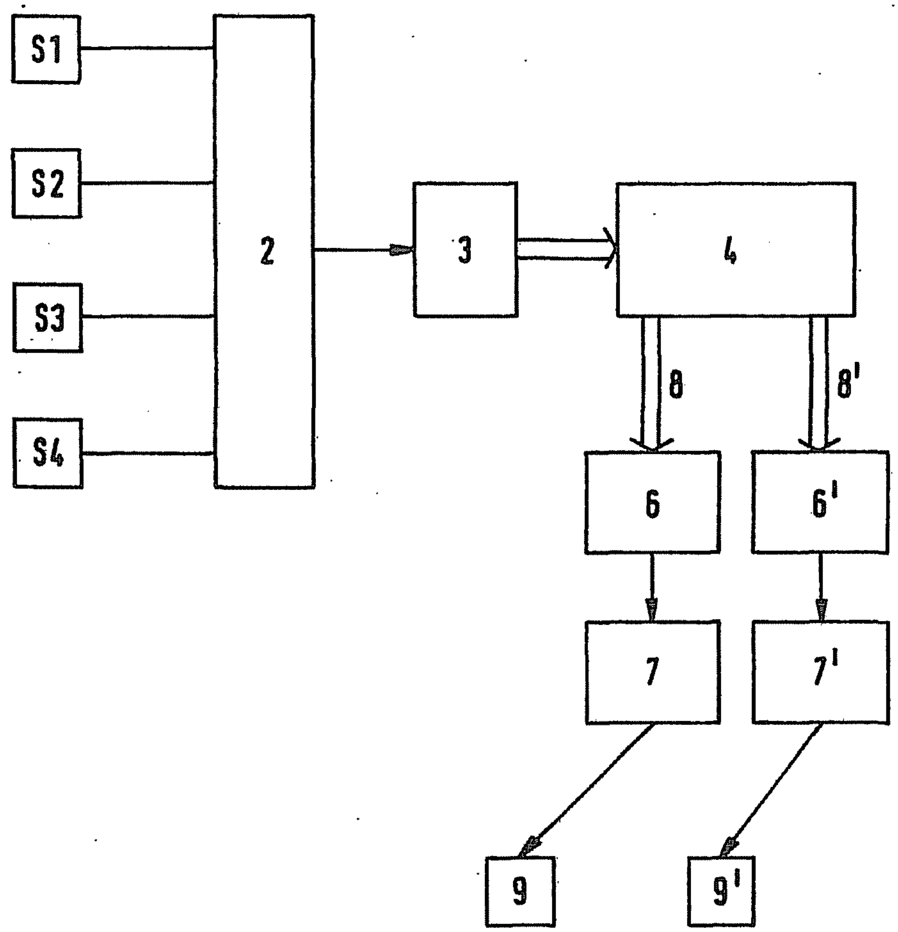

EXHIBIT 10

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I, Kevin Kelley, hereby certify that the following is, to the best of my knowledge and belief, a true and accurate translation of the following document, "DE 311 00 94 A1" from German into English.

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DE 31 10 094 A1

Device for automatic headlight adjustment in motor vehicles

A device for automatic headlight adjustment in motor vehicles, which consists of four sensors that are arranged in pairs one behind the other in the direction of travel on those components of the motor vehicle that respond to loading. The sensors then transmit signals, which pass via an analog multiplexer and an analog-to-digital converter into a microprocessor that evaluates the signals, i.e. determines differential values and additionally calculates the mean values from a series of measurements and compares them with a predetermined value. In the event of deviations from this value and when a specific threshold value is exceeded, the microprocessor transmits signals, which are fed via digital-to-analog converters with operational amplifiers connected downstream to headlight adjustment equipment and bring about there a correction of the respective associated headlight using corresponding conventional means, such as, for example, servo motors.

Patent claims

1. Device for automatic headlight adjustment in motor vehicles, <u>characterized by the following properties:</u>

- the output signals of the four sensors (S1,…S4) are fed to an analog-multiplexer (2) and its output is connected with a microprocessor (4) via an analog-digital converter (3),

- from the microprocessor (4) two outputs (8, 8 ') pass through a respective digital/analog converter (6, 6') to two operational amplifiers (7, 7'), that are each coupled to a respective headlight adjustment device (9, 9').

2. The device according to claim 1, wherein 4 sensors (S1,…S4) are arranged in each case at four different vehicle points responding to the load.

Device for automatic headlight adjustment in motor vehicles

The invention relates to a device according to the preamble of claim 1.

The installation of the headlights of a motor vehicle usually takes place in a garage with the help of the appropriate instruments, wherein the actual alignment is done manually. This means that normally the position of the headlights is correct, practically, only when vehicle is not loaded.

When the vehicle is loaded, for example, by filling up the baggage compartment of the car, a light beam is shifted upwards. This leads to the frequently observed blinding, despite the switched-on driving lights. It would require a correction of the headlight position by the driver but in only exceptional cases is it possible without much effort and is even more complicated by the lack of a fixed reference point, i.e. without auxiliary devices the readjustment is inaccurate.

The object of the invention is, therefore, to provide a device that allows automatic adjustment of the headlights to a specified level. The object of the invention is achieved by the technical teaching of patent claim 1. The advantageous embodiment is characterized by the claim 2.

The device according to the invention allows the correct illumination of the road regardless of the load of the vehicle that changes its position compared to its unloaded state. The blinding of oncoming vehicles is avoided and the light beam coming from the lights is sharply delimited.

The invention will be described in more detail with reference to the attached drawing which illustrates the block diagram of an embodiment.

In the figure, reference characters S1...S4 stand for four sensors that are connected via an analog multiplexer 2 to the input of an analog/digital converter 3, whose output leads to a microprocessor 4. The microprocessor has two outputs 8, 8' that are connected in each case with a downstream operational amplifier 7,7′ with two headlight adjustment devices 9, 9' through the two digital-analog converters 6, 6'.

The four sensors are arranged in pairs one behind the other S1, S2/S3, S4, following the driving direction on those components of the motor vehicle that experience position change by loading, e.g. on wheel suspensions or shock absorbers. The four sensors can be, for example, strain gauges.

Determination of the ideal or nominal position of the headlights is required for the operation of the device according to the invention. For this purpose, the nominal position is precisely set using the conventional instruments and the values produced by each sensor S1...S4 are saved in the microprocessor 4. The device operates then as follows: when the sensors S1...S4 are affected by loading, they transmit electrical signals that pass through the analog multiplexer 2 to the analog-digital converter 3 and from there are entered to the microprocessor 4 as digital signals.

The recording of the electrical signals that correspond to specific measured data regarding the headlight position is carried out at fixed intervals of e.g. one minute. To capture the respective headlight position n measurements are required, where n can be an integer between one and infinity. Advantageously, n can be chosen to be so large that, when there are a reasonable number of measurements, an optimal mean value appears. After each measuring, a mean value $\bar{V}$ of the last n values is calculated using the following formula:

$$\bar{V}_K = \frac{1}{N} \cdot \sum_{n=1}^{N} \cdot V \ (S_K^n)$$

wherein K is the number of wheels 1 to 4,

N is the number of measured data included in the calculation above (to be determined experimentally)

S is the signal coming from the sensors

The differences for the sensors pairs S1/S2 and S3/S4 that describe the position of the vehicle are determined from the values of $\bar{\bar{V}}_K$. These differential values provide two headlight position values. Depending on the sign of these values, the servo motor, for example, will be put forward or reset and, simultaneously, the headlight position register in the microprocessor 4 will be counted up and down.

If the signals that lead to measured data are based on light loads such as those caused by road bumps, then it will result on average in a differential value that provides only a small deviation from the ideal headlight position value, thus the predetermined threshold value is not exceeded and the adjustment of the headlights does not occur. For heavier loads, the threshold value is exceeded, the microprocessor 4 transmits signals via the digital/analog converter 6, 6' and the operational amplifier 7, 7' to the respective headlight adjustment devices, which then change the position of the headlights accordingly using conventional tools, such as, for example, spindles, which convert the rotary motion of the motor into linear movement of the headlights.

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EXHIBIT 11

(19) BUNDESREPUBLIK DEUTSCHLAND

DEUTSCHES PATENTAMT

(12) **Offenlegungsschrift**

(11) **DE 31 29 891 A1**

(51) Int. Cl. 3: B 60 Q 1/08

(21) Aktenzeichen: P 31 29 891.5
(22) Anmeldetag: 29. 7. 81
(43) Offenlegungstag: 9. 6. 82

Behördeneigentum

DE 31 29 891 A1

(30) Unionspriorität: (32) (33) (31)
31.07.80 FR 8016959 13.05.81 FR 8109537

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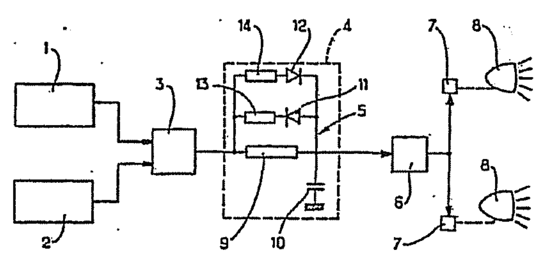
(54) **»Vorrichtung zur dynamischen Einstellung der Stellung von Scheinwerfern eines Fahrzeuges«**

Gezeigt und beschrieben wird eine Vorrichtung zur dynamischen Einstellung der Stellung von Scheinwerfern (8) eines Fahrzeuges in Abhängigkeit von der relativen Position der Räder in bezug auf die Karosserie mit zwei Fühlern (1, 2) zur Lieferung von der relativen Position entsprechenden Signalen und mit in Verbindung mit den Scheinwerfern (8) stehenden Betätigungsorganen (7), wobei die Betätigungsorgane (7) durch eine Steuervorrichtung (6) steuerbar sind und wobei die Steuervorrichtung (6) durch das Positionssignal über ein Tiefpaßfilter (4) unerwünschte Frequenzen des Positionssignales ableitbar sind. Um bei Fahrzeugen eine angenehme Nachtfahrt unter allen Fahrbedingungen und unabhängig vom Straßenzustand zu ermöglichen, weist das Filter (4) Filterelemente (11 bis 14) auf, über die eine variable Charakteristik der Frequenzabtrennung in Abhängigkeit von der Amplitude der Positionssignale der Fühler (1, 2) gewährleistet ist.
(31 29 891)



DE 31 29 891 A1

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28. Juli 1981
Sg-vR-fz

Patentansprüche:

1. Vorrichtung zur dynamischen Einstellung der Stellung von Scheinwerfern eines Fahrzeuges in Abhängigkeit von der relativen Position der Räder in Bezug auf die Karosserie, mit mindestens einem Fühler zur Lieferung eines der relativen Position entsprechenden Signales und mit in Verbindung mit den Scheinwerfern stehenden Betätigungsorganen, wobei die Betätigungsorgane durch eine Steuervorrichtung steuerbar sind und die Steuervorrichtung durch das Positionssignal über ein Tiefpaßfilter schaltbar ist und wobei über das Tiefpaßfilter unerwünschte Frequenzen des Positionssignales ableitbar sind, dadurch gekennzeichnet, daß das Filter (4;104) Filterelemente (11 bis 14; 111 bis 114) aufweist und daß über die Filterelemente (11 bis 14; 111 bis 114) eine variable Charakteristik der Frequenzabtrennung in Abhängigkeit von der Amplitude der Positionssignale der Fühler (1,2;101,102) gewährleistet ist.

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2. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß das Filter (4;104) Schwellwertelemente (11,12; 111,112) aufweist, über die mindestens eine Amplitudenschwelle (s_1, s_2) definierbar ist, für die das Filter (4;104) eine Grenzfrequenz vorbestimmt.

3. Vorrichtung nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Grenzfrequenz des Filters (4;104) für eine Amplitude über den Amplitudenschwellen (s_1,s_2) etwa 2 Hz und für eine Amplitude unter den Amplitudenschwellen (s_1,s_2) etwa 0,3 Hz beträgt.

4. Vorrichtung nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß das Filter (4;104) elektrisch ist und ein L-förmiges RC-Glied (5;105) aufweist, daß das RC-Glied (5;105) aus einem Serienwiderstand (9;109) und einem Parallelkondensator (10;110) besteht, daß dem Serienwiderstand (9;109) eine Antiparallelschaltung zweier Gleichrichter (11,12;111,112) parallel geschaltet ist und daß über die Innenwiderstände in Durchgangsrichtung die Amplitudenschwellen (s_1,s_2) festlegbar sind.

5. Vorrichtung nach einem der Ansprüche 1 bis 4, wobei über Filterelemente zwei Amplitudenschwellen festlegbar sind, die mit den Bewegungen der Karosserie in Bezug auf die Räder in Beziehung stehen, dadurch gekennzeichnet, daß die Absolutwerte der Amplitudenschwellen (s_1,s_2) unterschiedlich sind, daß nämlich

der Absolutwert der Amplitudenschwelle (s_2) für die durch Beschleunigungen erzeugten Bewegungen unter dem Absolutwert der Amplitudenschwelle (s_1) für die durch Verzögerungen erzeugten Bewegungen liegt.

6. Vorrichtung nach einem der Ansprüche 1 bis 5, dadurch gekennzeichnet, daß die Grenzfrequenz des Filters (4;104) 1 bis 2 Hz für Schwankungen des Positionssignales (S_E) beträgt, die die Amplitudenschwelle (s_2) für die Beschleunigung oder die Amplitudenschwelle (s_1) für die Verzögerung überschreiten und daß die Grenzfrequenz im übrigen, d.h. wenn die Schwankungen weder die eine noch die andere Amplitudenschwelle (s_1, s_2) überschreiten, 0,15 Hz beträgt.

7. Vorrichtung nach Anspruch 5 oder 6, dadurch gekennzeichnet, daß das Filter (104) elektrisch ist und ein L-förmiges RC-Glied (105) aufweist, daß das RC-Glied (105) aus einem Serienwiderstand (109) und einem Parallelkondensator (110) besteht, daß dem Serienwiderstand (109) eine Antiparallelschaltung zweier Gleichrichtereinheiten (111,112) parallel geschaltet ist und daß die Gleichrichtereinheiten (111,112) verschiedene Innenwiderstände in Durchgangsrichtung aufweisen, so daß die Amplitudenschwellen (s_1,s_2) festgelegt sind.

8. Vorrichtung nach Anspruch 7, dadurch gekennzeichnet, daß die Gleichrichtereinheiten (111, 112) jeweils mehrere voneinander verschiedene Einheitsgleichrichter aufweisen.

9. Vorrichtung nach einem der Ansprüche 1 bis 8, dadurch gekennzeichnet, daß als Gleichrichter (11,12;111,112) Dioden vorgesehen sind.

10. Vorrichtung nach einem der Ansprüche 1 bis 9, dadurch gekennzeichnet, daß die Gleichrichter (11,12;111,112) jeweils in Serie mit einem Einstellwiderstand (13,14;113,114) geschaltet sind.

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Vorrichtung zur dynamischen Einstellung der Stellung von Scheinwerfern eines Fahrzeuges

Die Erfindung betrifft eine Vorrichtung zur dynamischen Einstellung der Stellung von Scheinwerfern eines Fahrzeuges in Abhängigkeit von der relativen Position der Räder in Bezug auf die Karosserie, mit mindestens einem Fühler zur Lieferung eines der relativen Position entsprechenden Signales und mit in Verbindung mit den Scheinwerfern stehenden Betätigungsorganen, wobei die Betätigungsorgane durch eine Steuervorrichtung steuerbar sind und die Steuervorrichtung durch das Positionssignal über ein Tiefpaßfilter schaltbar ist und wobei über das Tiefpaßfilter unerwünschte Frequenzen des Positionssignales ableitbar sind, insbesondere für ein Auto.

Man hat bereits Vorrichtungen für die Korrektur der Scheinwerferstellung eines Fahrzeuges gebaut, wobei einige statisch, einige dynamisch waren.

Die statischen Korrekturvorrichtungen haben eine relativ lange Ansprechzeit und verstellen die Scheinwerfer des Fahrzeuges abhängig von der Last und deren Verteilung zwischen Vorder- und Hinterachse. Eine solche Vorrichtung kann nicht tätig werden, wenn das Fahrzeug sich bewegt.

Es sind auch schon Vorrichtungen mit dynamischer Einstellung konstruiert worden, um eine adäquate Position der Scheinwerfer bei allen Fahrbedingungen des Fahrzeuges zu gewährleisten. Eine Vorrichtung hat Korrekturorgane in Verbindung mit den Scheinwerfern und funktioniert durch Schwerkraft (z.B. Pendel). Diese Vorrichtung hat den Nachteil, daß sie die Scheinwerfer nicht passend einstellen kann, wenn das Fahrzeug auf einem Abhang rollt.

Andere dynamische Einstellvorrichtungen haben Fühler über die die relative Position beim Schwanken oder Schaukeln von vorn nach hinten bei der Karosserie in Bezug auf die Räder feststellbar ist. Diese Fühler wirken über ein Korrekturfilter auf Betätigungsorgane, die die Position der Scheinwerfer abhängig von dem durch die Fühler gelieferten Signal ändern sollen. Einige Vorrichtungen sind hydraulisch und in diesem Fall wird die Filterung der unerwünschten Signale mit erhöhter Frequenz (insbesondere derjenigen aufgrund von Bewegungen des Fahrzeuges auf Pflaster) an den Leitungen des hydraulischen Systems vorgenommen. Wenn die Einrichtung zur Verstellung elektrisch ist, bewirkt man die Filterung durch ein elektrisches Tiefpaßfilter.

Die Störerscheinungen aufgrund des Wegezustandes und der Fahrzeugbedingungen, die eine Korrektur der Stellung der Scheinwerfer verlangen, sind zahlreich:

- Pflaster verursacht Störungen mit relativ hoher Frequenz von 5 bis 15 Hz;

- Löcher und Schwellen können Stampfschwingungen von 5 bis 10 Hz verursachen, aber diese Störungen sind relativ selten und für die Fahrweise relativ wenig hinderlich;

- plötzliche Beschleunigungen und Bremsungen bringen Schwankungen in der Grössenordnung von 1 bis 2 Hz mit sich.

Jenseits von 15 Hz sind die Schwingungen des Fahrzeuges wegen der Ansprechzeit des Auges, das diese schnellen Änderungen der Scheinwerferposition automatisch integriert, nicht hinderlich. Die weniger hohen Frequenzen zwischen 2 und 15 Hz werden in einem gewissen Umfang durch die Federung des Fahrzeuges gefiltert und gelangen daher in abgeschwächter Form an die Scheinwerfer. Jedoch bleiben diese Frequenzen auch in abgeschwächter Form lästig.

Die bisher entwickelten Einstellvorrichtungen haben den ernsten Nachteil einer Phasenverschiebung zwischen der Zeit des Schaukelns des Fahrzeuges und der Reaktion der Korrekturvorrichtung bei Erscheinungen, deren Frequenz gleich oder höher ist als die Grenzfrequenz des die Filterung bewirkenden Systems. Wenn z.B. die Grenzfrequenz 2 Hz ist, gelangen schnellere Phänomene als diejenigen aufgrund von Pflaster, obwohl sie durch die

Filterung abgeschwächt sind, trotzdem zu den Betätigungsorganen der Scheinwerfer und können so durch die Phasenverschiebung bestimmte physiologische Unbehaglichkeiten mit sich bringen. Bei Bewegungen des Fahrzeuges auf Pflaster kann die Korrektur gerade gegenphasig in Bezug auf Stampfschwingungen des Fahrzeuges eingreifen. Die Scheinwerfer sind z.B. gerade in dem Augenblick nach oben orientiert, in dem das Vorderteil der Karosserie des Fahrzeuges auch eine Bewegung nach oben ausführt.

Eine andere Unannehmlichkeit der vorhandenen Einstellvorrichtungen besteht darin, daß bei schnellen Phänomenen ihre Korrekturorgane ständig gefordert werden und so die Lebensdauer relativ gering ist.

Gemäß der Erfindung soll eine Vorrichtung zur dynamischen Einstellung der Scheinwerfer eines Fahrzeuges geschaffen werden, die die oben erwähnten Nachteile nicht besitzt und eine angenehme Nachtfahrt unter allen Fahrbedingungen und unabhängig vom Straßenzustand zulässt.

Die erfindungsgemäße Vorrichtung ist dadurch gekennzeichnet, daß das Filter Filterelemente aufweist und daß über die Filterelemente eine variable Charakteristik der Frequenzabtrennung in Abhängigkeit von der Amplitude der Positionssignale der Fühler gewährleistet ist.

Dank dieser Merkmale ist die erfindungsgemäße Vorrichtung in der Lage, eine Unterscheidung vorzunehmen zwischen den Erscheinungen, die eine Korrektur verlangen und denjenigen, bei denen eine Korrektur aufgrund der unvermeidlichen Phasenverschiebung, die es zwischen dem Störphänomen und der Korrektur der Scheinwerfer geben würde, unerwünscht ist.

Eine erste Ausführungsform der Vorrichtung ist dadurch gekennzeichnet, daß das Filter Schwellwertelemente aufweist, über die mindestens eine Amplitudenschwelle definierbar ist, für die das Filter eine Grenzfrequenz vorbestimmt. Auf diese Weise können die Merkmale des Filters mit Genauigkeit den verschiedenen Störerscheinungen angepaßt werden, die eine Verstellung der Scheinwerferposition verlangen.

Eine weitere vorteilhafte Ausführungsform ist dadurch gekennzeichnet, daß die Grenzfrequenz des Filters für eine Amplitude über den Amplitudenschwellen etwa 2 Hz und für eine Amplitude unter den Amplitudenschwellen etwa 0,3 Hz beträgt. So werden die Hochfrequenzsignale zwischen 2 und 5 Hz und mit schwacher Amplitude aufgrund einer Bewegung auf Pflaster z.B. nicht berücksichtigt und können daher auch nicht der Fahrannehmlichkeit schaden.

Eine bevorzugte Ausführungsform der Erfindung ist dadurch gekennzeichnet, daß das Filter elektrisch ist und ein L-förmiges RC-Glied aufweist, daß das RC-Glied aus einem Serienwiderstand und einem Parallelkondensator besteht, daß dem Serienwiderstand eine Antiparallelschaltung zweier Gleichrichter parallel geschaltet ist und daß über die Innenwiderstände in Durchgangsrichtung die Amplitudenschwellen festlegbar sind.

Gemäß einem anderen Merkmal sind die Gleichrichter Dioden. Vorteilhafterweise sind die Dioden in Serie mit einem Widerstand für die Einstellung der Abschaltschwelle geschaltet.

Die Ausführungsform, die beschrieben wird, hat den Vorteil, daß sie leicht an eine statische Einstellvorrichtung für die Position von Scheinwerfern eines Fahrzeuges mittels Benutzung von zwei einfachen Dioden und von zwei Widerständen angepaßt werden kann, deren Kosten nicht sehr hoch sind.

Man konnte aber beobachten, daß der absolute Wert der genannten Schwellen ausreichend hoch sein muß, um die Schwankungen mit geringer Amplitude auszuschalten, die sich z.B. ergeben, wenn das Fahrzeug auf Pflaster fährt, insbesondere bei mittleren Geschwindigkeiten. Daraus ergibt sich, daß in bestimmten Fällen Bewegungen mittlerer Amplitude aufgrund von Beschleunigungen oder Verzögerungen des Fahrzeuges nicht mehr berücksichtigt werden, und daß die Einrichtung in diesen Fällen nicht eingreift, um die Position der Scheinwerfer zu regeln. Dieser Ein-stellungsmangel bei solchen Bewegungen wird umso lästiger, je bedeutsamer Reichweite und Genauigkeit der Scheinwerfer werden.

In einer zweiten Ausführungsform beabsichtigt die Erfindung daher, eine Vorrichtung zur dynamischen Einstellung der Scheinwerfer eines Fahrzeuges abhängig von der relativen Position der Räder in Bezug auf die Karosserie zu liefern, wobei die Reaktion der Vorrichtung bei Bewegungen mit geringer Amplitude wirksam unterdrückt wird, wie z.B. Bewegungen, die mit der Fahrt über Pflaster oder Schwellen in Verbindung stehen. Die Vorrichtung soll dabei eine wirksame dynamische Einstellung bei anderen Bewegungen mit geringer oder mittlerer Amplitude gewährleisten, zumindest in den Fällen, die für das Fahren und die Sicherheit auf der Straße wichtig sind.

Die Erfindung bezieht sich daher auch auf eine zweite Ausführungsform einer Vorrichtung des obigen Typs, bei der Bestandteile zwei Amplitudenschwellen definieren, welche mit den Bewegungen der Karosserie in Bezug auf die Räder in Verbindung stehen, für deren jede das Filter eine Grenzfrequenz bestimmt. Diese Vorrichtung ist dadurch gekennzeichnet, daß die Absolutwerte der Amplitudenschwellen unterschiedlich sind, daß nämlich der Absolutwert der Amplitudenschwelle für die durch Beschleunigungen erzeugten Bewegungen unter dem Absolutwert der Amplitudenschwelle für die durch Verzögerungen erzeugten Bewegungen liegt. So wird die Schwelle in Bezug auf Signale in Verbindung mit einer Beschleunigung festgelegt auf einen ausreichend schwachen Wert, um auf geringfügige Beschleunigungen anzusprechen, die für Fahrer entgegenkommender Fahrzeuge lästig sind, während die Schwelle für Signale in Verbindung mit einer Bremsung oder Geschwindigkeitsabnahme eine sehr große Amplitude hat. Überraschenderweise hat man festgestellt, daß bei einer solchen Regelung der Werte der Schwellen ein komplettes Verschwinden der unerwünschten Reaktionen erzielt wird, die ein Schwanken hervorrufen, z.B. bei einer Fahrt über Straßenpflaster, wobei eine wirksame Einstellung der Scheinwerfer auf die durch eine noch so geringe Beschleunigung hervorgerufenen Bewegungen gewährleistet wird, was insbesondere die Sicherheit auf der Straße wesentlich erhöht.

Andererseits stellt man fest, daß die Vorrichtung bei geringen Verzögerungen keine Korrektur der Scheinwerferstellung bewirkt. Dies ist nicht lästig, weil sich in diesem Fall das Lichtbündel senkt, was keinen Nachteil für die Sicherheit auf der Straße nach sich zieht.

Gemäß einer vorteilhaften Gestaltung der zweiten Ausführungsform der Erfindung beträgt die Grenzfrequenz des Filters 1 bis 2 Hz bei einem Signal, das die Schwelle für die Beschleunigung überschreitet, oder einem Signal (mit entgegengesetztem Vorzeichen das die andere Schwelle für die Verzögerung überschreitet, während die Abschaltfrequenz 0,15 Hz beträgt, wenn das

Signal nicht gemäß seinem Vorzeichen die eine oder andere Schwelle überschreitet.

So werden die Signale zwischen 0,15 und 2 Hz mit schwachter Amplitude, die sich aus der Bewegung auf Pflaster ergeben, nicht berücksichtigt. Dagegen wird ein Beschleunigungssignal mit einer Frequenz in der Rangordnung von 1 Hz und einer Amplitude, die kaum höher ist als diejenige der Signale, die sich durch Bewegung auf dem Pflaster ergeben, berücksichtigt und es erfolgt ein Eingreifen der Stellvorrichtung für die Korrektur der Scheinwerferposition. Vorteilhafterweise ist dabei die Vorrichtung so konstruiert, daß das Filter elektrisch ist und ein L-förmiges RC-Glied aufweist, daß das RC-Glied aus einem Serienwiderstand und einem Parallelkondensator besteht, daß dem Serienwiderstand eine Antiparallelschaltung zweier Gleichrichtereinheiten parallel geschaltet ist und daß die Gleichrichtereinheiten verschiedene Innenwiderstände in Durchgangsrichtung aufweisen, so daß die Amplitudenschwellen festgelegt sind.

Der Unterschied zwischen den Innenschwellen kann z.B. erzielt werden, indem man in der einen Gleichrichtereinheit, nämlich derjenigen, die das elektrische Signal durchläßt, das mit den relativen Positionen verbunden ist, welche der Bremsung oder der Verzögerung entsprechen, eine Anzahl von Einheitsgleichrichtern anbringt, die größer ist als die der anderen Gleichrichtereinheit. Als Variante kann man Einheitsgleichrichter verwenden, z.B. Dioden, die verschiedene Innenschwellen haben. Die Gleichrichter jeder Einheit sind vorzugsweise in Serie geschaltet mit einem Einstellwiderstand.

Zum besseren Verständnis der Erfindung werden nachstehend zwei Ausführungsformen anhand der beigefügten Zeichnung beschrieben; es zeigt:

Fig. 1 ein Grundschaltbild einer Vorrichtung gemäß einer ersten Ausführungsform der Erfindung,

Fig. 2 ein Diagramm, das den Betrieb der Vorrichtung gem. Fig. 1 durch den Vergleich von zwei Kurven zeigt,

Fig. 3 ein Grundschaltbild einer Vorrichtung gemäß einer zweiten Ausführungsform der Erfindung und

Fig. 4 ein Diagramm analog demjenigen der Fig. 2 zur Darstellung des Betriebs der Vorrichtung gemäß Fig. 3.

Die in Fig. 1 dargestellte Vorrichtung hat einen ersten Fühler 1 zwischen der Vorderachse und der Karosserie des Fahrzeuges, um eine relative Bewegung zu entdecken. Ein entsprechender Fühler 2 befindet sich an der Hinterachse.

Die von den Fühlern 1,2 erzeugten Signale werden in einer Mischstufe 3 behandelt, in der ein Signal erzeugt wird, das die Schwingung oder Schaukelbewegung des Fahrzeuges im Verlauf seiner Bewegung darstellt.

Der Ausgang der Mischstufe 3 ist mit einem Tiefpaßfilter 4 verbunden, das in diesem Beispiel durch ein RC-Glied 5, das in L-Form montiert ist, gebildet wird.

Der Ausgang des Filters 4 ist mit einer Steuer- und Verstärkervorrichtung 6 verbunden, die ein Leistungssignal an Betätigungsorgane 7 abgibt, welche Bewegungen der Scheinwerfer 8 hervorrufen.

Das Filter 4 hat einen Serienwiderstand 9 und einen Parallelkondensator 10. Dem Serienwiderstand 9 sind zwei antiparallel geschaltete Dioden 11 und 12, die jeweils in Serie mit einem Einstellwiderstand 13 und 14 liegen, parallel geschaltet.

Wenn die Amplitude des Eingangssignals des Filters 4 die Amplitudenschwellen s_1, s_2 der Dioden 11 und 12 überschreitet, werden diese für entsprechende Signale durchgängig, so daß der Wert des Serienwiderstandes des RC-Gliedes 5 sinkt.Die Zeitkonstante RC sinkt ebenfalls und die Grenzfrequenz wird höher. Das Filter 4 bewirkt also eine Abstufung seiner Grenzfrequenz in Abhängigkeit von der Amplitude des Signals, das ihm geliefert wird.

In dem dargestellten Fall, in dem man handelsübliche Dioden 11,12 verwendet, ist deren Innenwiderstand nicht ausreichend, um eine Grenzfrequenz von 2 Hz zu erzielen. Deshalb sind die Einstellwiderstände 13 und

14 in Serie vorgesehen.

Der Betrieb der Vorrichtung geht aus Fig. 2 hervor:

fe sei die Frequenz des Eingangssignals S_E des Filters 4 und fc diejenige des Ausgangssignals S_s. Man sieht, daß während der Zeit A die Frequenz fe des Eingangssignals unter der Grenzfrequenz fc des Filters 4 liegt. So ist das Signal am Ausgang uneingeschränkt wiederhergestellt. Dieser Fall findet bei einer statischen Korrektur Anwendung, z.B. wenn die Belastung des Fahrzeuges geändert wird.

Während der Zeit B ist die Frequenz fe höher als die Grenzfrequenz des Filters, aber die Amplitude des Eingangssignals liegt unter den Amplitudenschwellen s_1, s_2, die von den Dioden 11 und 12 gegeben werden, so daß das Signal uneingeschränkt durch den Filter 4 gelangt. Am Ausgang wird der Mittelwert des Eingangssignals wiederhergestellt, wogegen das Hochfrequenzsignal durch das Filter 4 gelöscht wird. Dieser Fall entspricht dem Rollen auf Pflaster.

Während der Zeit C ist die Frequenz fe auch höher als die Grenzfrequenz fc, aber die Amplitude des Signals übersteigt die Amplitudenschwellen s_1, s_2, die von den Dioden 11,12 gegeben werden. Das Hochfrequenzsignal erfährt keine Phasenverschiebung, sondern es wird in der Amplitude um den Wert der Amplitudenschwellen s_1, s_2 verringert. Dieser Fall entspricht dem Rollen auf einem Weg, der in sehr schlechtem Zustand ist.

Bei D handelt es sich um brutales Bremsen auf schlechtem Weg. Sobald das Eingangssignal den Wert der Amplitudenschwellen s_1, s_2 überschreitet, findet man es am Ausgang, vermindert um den Wert der Amplitudenschwellen s_1, s_2 wieder. Wenn das Phänomen sich hinzieht, kann man mit dem Filter 4 am Ausgang einen Wert erhalten, der mit dem Eingangssignal identisch ist.

Die Grenzfrequenzen des Filters 4 können gewählt werden, z.B. für starke Amplituden mit 2 Hz, bei geringen Amplituden mit 0,3 Hz. Im letztgenannten Fall ist also die Dämpfung des Signals wichtig. Die bei höheren Frequenzen gegebene Phasenverschiebung hat keine Wirkung auf die Einstellung der Scheinwerfer.

In Fig. 3 sieht man, daß die Vorrichtung einen ersten Fühler 101 besitzt, welcher zwischen der Vorderachse und der Karosserie des Fahrzeuges montiert ist, um die relativen Bewegungen festzustellen. Ein weiterer Fühler 102 ist der Hinterachse zugeordnet. Die durch die Fühler 101,102 erzeugten Signale werden in einer Mischstufe 103 behandelt, in der ein Signal erzeugt wird, welches das Schaukeln oder Schwingen des Fahrzeuges bei seiner Bewegung darstellt. Der Ausgang der Mischstufe 103 ist mit einem Tiefpaßfilter 104 verbunden, das durch ein RC-Glied 105 in L-Form gebildet wird. Der Ausgang des Filters 104 ist mit einer Steuer- und Verstärkungseinrichtung 106 verbunden, die ein Leistungssignal an Betätigungsorgane 107 abgibt, welche die Bewegungen der Scheinwerfer 108 des Fahrzeuges hervorrufen. Das Filter 104 hat einen Serienwiderstand 109 und einen Parallelkondensator 110. Dem Serienwiderstand 109 ist eine Antiparallelschaltung zweier Diodeneinheiten 111,112 parallel geschaltet. Die eine Einheit hat zwei Dioden 111 und die andere drei Dioden 112. Jede Einheit ist in Serie mit einem Einstellwiderstand 113 bzw. 114 geschaltet.

Der Betrieb der Vorrichtung geht aus Fig. 4 hervor:

fe sei die Frequenz des Eingangssignals SE des Filters 104 und fc diejenige des Ausgangssignals SS. Man sieht, daß in der Zeit A die Frequenz des Eingangssignals fe unter der Grenzfrequenz fc des Filters 104 liegt. Daher wird das Signal uneingeschränkt am Ausgang wiederhergestellt, was die Korrektur bewirkt. Dieser Fall liegt z.B. einer einer statischen Korrektur vor, wenn die Last des Fahrzeuges geändert wird.

In der Zeit B ist die Frequenz fe höher als die Grenzfrequenz fc des Filters, aber die Hochfrequenzamplitude des Eingangssignals ist nicht nur geringer als der absolute Wert der Amplitudenschwelle s_1 entsprechend der

Verzögerung, sondern auch als der Wert der Amplitudenschwelle s_2 entsprechend der Beschleunigung, so daß das Signal uneingeschränkt den Filter 104 passiert. Am Ausgang wird nur der mittlere Wert des Eingangssignals wiederhergestellt, wogegen das Hochfrequenzsignal durch das Filter 104 eliminiert wird. Dieser Fall entspricht dem Weg auf Pflaster.

In der Zeit C, die einer leichten Beschleunigung entspricht, sieht man, daß die Amplitude des Signals S_E die Amplitudenschwelle s_2 der Beschleunigung überschreitet. Dies übersetzt sich in eine Veränderung des Signals S_S am Ausgang und infolgedessen in eine Korrektur der Scheinwerfer, die leicht gesenkt werden.

In der Zeit D, die einer leichten Verzögerung entspricht, welche eine Änderung mit fast derselben Amplitude wie bei der Beschleunigung C bewirkt, erfolgt keine Änderung des Signals S_S, weil die Amplitude unter der Amplitudenschwelle s_1 bleibt.

Erst wenn die Bremsung stärker ist, wie in der Zeit E, wobei die Amplitudenschwelle s_1 diesmal überschritten wird, geschieht auf der Kurve S_S eine Änderung des Signals, als Antwort auf die Bremsung. Die Grenzfrequenzen des Filters 104 können gewählt werden, z.B. für starke Amplituden 1 bis 2 Hz und für schwache Amplituden 0,15 Hz.

Man kann im übrigen in vorteilhafter Weise die antiparallel geschalteten Dioden durch in Serie geschaltete Zenerdioden ersetzen.

Leerseite

3129891

Nummer:	3129891
Int. Cl.³:	B 60 Q 1/08
Anmeldetag:	29. Juli 1981
Offenlegungstag:	9. Juni 1982

23.

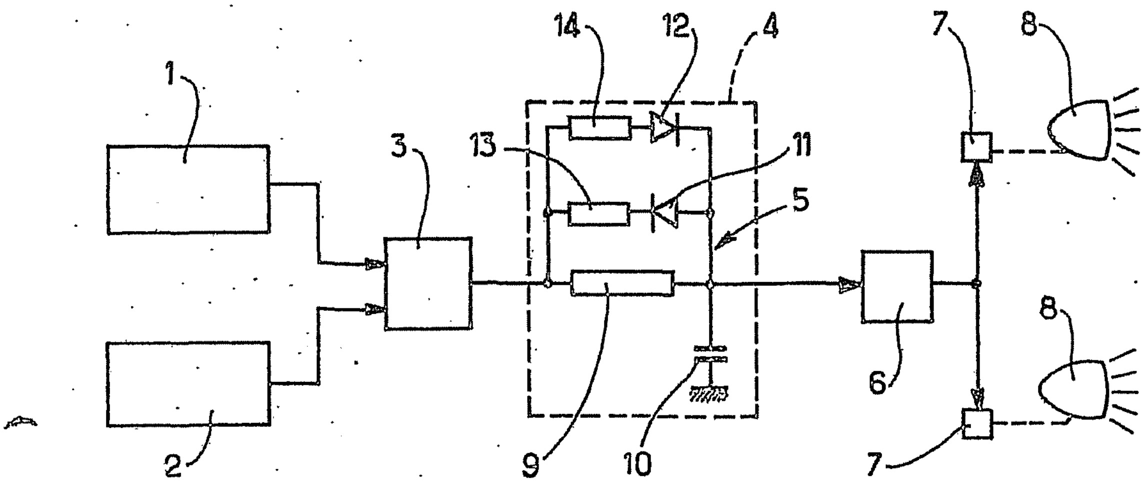

FIG. 1

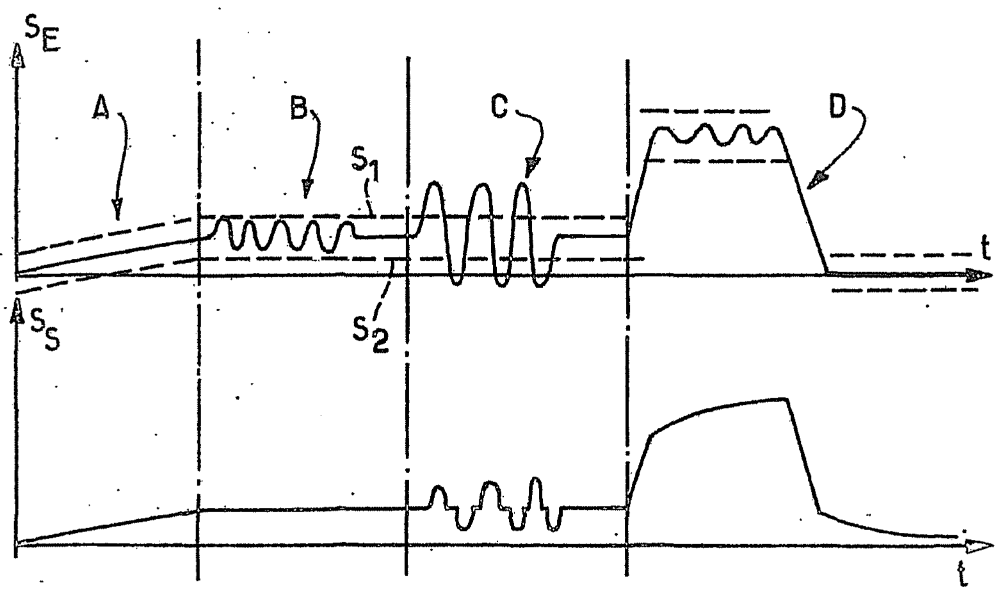

FIG. 2

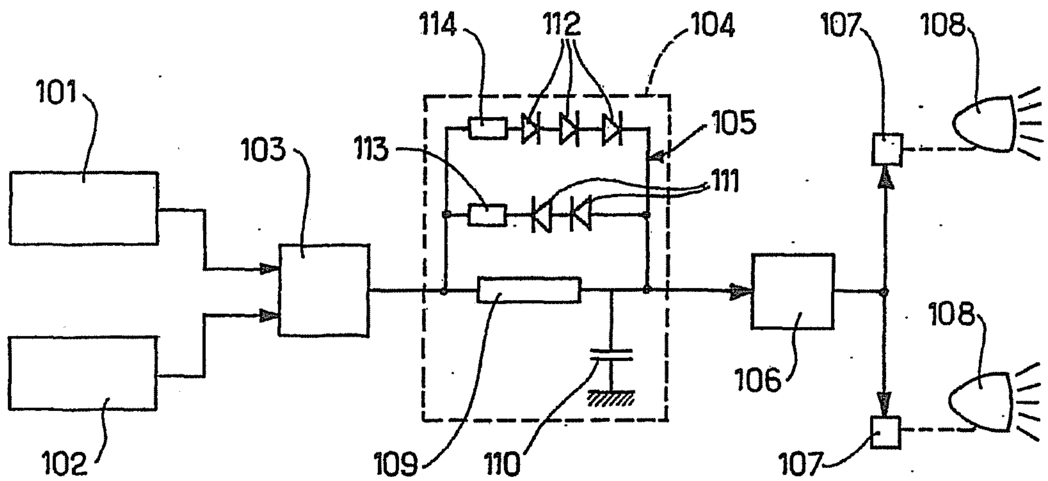
101
102
103
104
105
106
107
108
109
110
111
112
113
114

FIG. 3

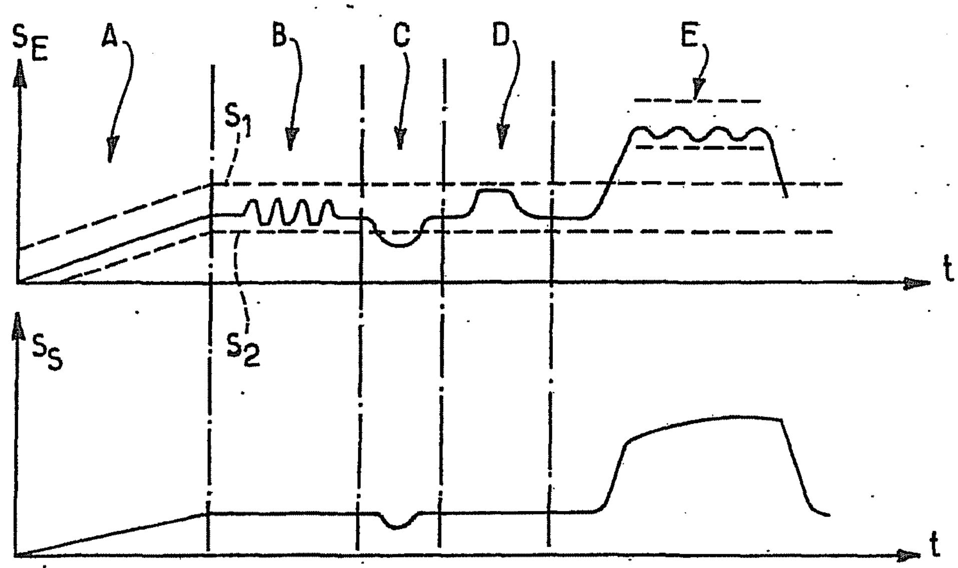
S_E
A
B
C
D
E
S_1
S_2
t
S_S
t

FIG. 4

EXHIBIT 12

DECLARATION

I, Judith E. Taddeo, declare that I am well qualified as a translator of German to English and that I have carefully prepared the attached English language translation from the original document:

> Offenbarungsschrift DE 31 29 891 A1 "Vorrichtung zur dynamischen Einstellung der Stellung von Scheinwerfern eines Fahrzeuges"
>
> [Laid-Open Document DE 31 29 891 A1 "Device for Dynamically Adjusting the Position of Headlights of a Vehicle"]

filed at the German Patent Office on July 29, 1981 written in German and that the attached translation is an accurate English version of such original to the best of my knowledge and belief.

I certify under penalty of perjury that the foregoing is true and correct.

Date April 29, 2011 Signature Judith E. Taddeo

Name Judith E. Taddeo

(19) FEDERAL REPUBLIC OF GERMANY

GERMAN PATENT OFFICE

(12) **Published Application**

(11) **DE 31 29 891 A1**

(51) Int. Cl.3: **B 60 Q 1/08**

(21) File Number: P 31 29 891.5
(22) Filing Date: 29. 7. 81
(43) Publication Date: 9. 6. 82

DE 31 29 891 A1

(30) Union Priority: (32) (33) (31)
31.07.80 FR 8016959 13.05.81 FR 8109537

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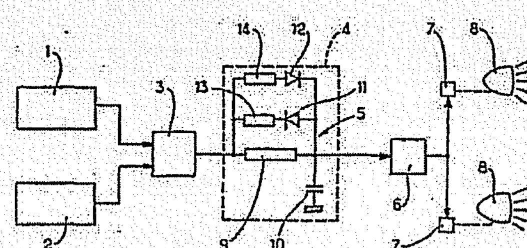
(54) **"Device for Dynamically Adjusting the Position of Headlights of a Vehicle"**

Shown and described is a device for dynamically adjusting the position of headlights (8) of a vehicle as a function of the relative position of the wheels in relation to the car body, having two sensors (1, 2) for supplying signals that correspond to the relative position, and actuating organs (7) connected to the headlights (8), the actuating organs (7) being controllable by a control device (6) and the control device (6) by the position signal via a deep-pass filter (4) undesired frequencies of the position signal removable [sic]. In order to provide pleasant night-time driving for vehicles under all driving conditions and regardless of the state of the road, the filter (4) has filter elements (11 through 14) via which a variable characteristic of the frequency separation is ensured as a function of the amplitude of the position signals from the sensors (1, 2).
(31 29 891)



DE 31 29 891 A1

FEDERAL PRINTING OFFICE 04.82 230 023/710 12/60

DE 31 29 891 A1

Device for Dynamically Adjusting the Position of Headlights of a Vehicle

Shown and described is a device for dynamically adjusting the position of headlights (8) of a vehicle as a function of the relative position of the wheels in relation to the car body, having two sensors (1, 2) for supplying signals that correspond to the relative position, and actuating organs (7) connected to the headlights (8), the actuating organs (7) being controllable by a control device (6) and the control device (6) by the position signal via a deep-pass filter (4) undesired frequencies of the position signal removable [sic]. In order to provide pleasant night-time driving for vehicles under all driving conditions and regardless of the state of the road, the filter (4) has filter elements (11 through 14) via which a variable characteristic of the frequency separation is ensured as a function of the amplitude of the position signals from the sensors (1, 2).

(31 29 891)

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Patent Claims:

1. A device for dynamically adjusting the position of headlights of a vehicle as a function of the relative position of the wheels in relation to the body, comprising at least one sensor for supplying a signal that corresponds to the relative position, and actuating organs, which are connected to the headlights, the actuating organs being controllable by a control device, and the control device being switchable by the position signal via a low-pass filter, and undesired frequencies of the position signal are able to be removed via the low-pass filter, wherein the filter (4;104) includes filter elements (11 through 14; 111 through 114), and a variable characteristic of the frequency separation as a function of the amplitude of the position signals of the sensors (1,2;101,102) is ensured via the filter elements (11 through 14; 111 through 114).

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2. The device as recited in Claim 1, wherein the filter (4;104) has threshold value elements (11;12; 111,112), via which at least one amplitude threshold (s_1, s_2) is definable, for which the filter (4;104) predefines a limit frequency.

3. The device as recited in Claim 1 or 2, wherein the limit frequency of the filter (4;104) amounts to approximately 2 Hz for an amplitude above the amplitude thresholds (s_1, s_2), and to approximately 0.3 Hz for an amplitude below the amplitude thresholds (s_1, s_2).

4. The device as recited in one of the Claims 1 through 3, wherein the filter (4;104) is electric and has an L-shaped RC element (5;105), the RC element (5;105) is made up of a series resistor (9;109) and a parallel capacitor (10;110), an antiparallel circuit of two rectifiers (11,12;111,112) is switched in parallel to the series resistor (9;109), and the amplitude thresholds (s_1, s_2) are definable via the internal resistances in the throughput direction.

5. The device as recited in one of the Claims 1 through 4, two amplitude thresholds, which are related to the movements of the body in relation to the wheels, being definable via filter elements, wherein the absolute values of the amplitude thresholds (s_1, s_2) differ in that the absolute value of the amplitude threshold (s_2) for the movements produced by accelerations lies below the absolute value of the amplitude threshold (s_1) for the movements produced by decelerations.

6. The device as recited in one of the Claims 1 through 5, wherein the limit frequency of the filter (4;104) amounts to 1 to 2 Hz for fluctuations of the position signal (S_E) that exceed the amplitude threshold (s_2) for the

acceleration or the amplitude threshold (s_1) for the deceleration, and in all other cases, i.e., when the fluctuations exceed neither the one nor the other amplitude threshold (s_1, s_2), the limit frequency amounts to 0.15 Hz.

7. The device as recited in Claim 5 or 6, wherein the filter (104) is electric and has an L-shaped RC element (105), the RC element (105) is made up of a series resistor (109) and a parallel capacitor (110), an antiparallel circuit of two rectifier units (111,112) is switched in parallel to the series resistor (109), and the rectifier units (111,112) have different internal resistances in the throughput direction, so that the amplitude thresholds (s_1, s_2) are defined.

8. The device as recited in Claim 7, wherein the rectifier units (111, 112) each have a plurality of standard rectifiers that differ from each other.

9. The device as recited in one of the Claims 1 through 8, wherein diodes are provided as rectifiers (11,12;111,112).

10. The device as recited in one of the Claims 1 through 9, wherein the rectifiers (11,12;111,112) are each switched in series with an adjustable resistor (13,14;113,114).

Equipements Automobiles Marchal

Device for Dynamically Adjusting the Position of Headlights of a Vehicle

The invention relates to a device for dynamically adjusting the position of headlights of a vehicle as a function of the relative position of the wheels in relation to the body, having at least one sensor for supplying a signal which corresponds to the relative position, and actuating organs, which are connected to the headlights, the actuating organs being controllable by a control device and the control device being switchable by the position signal via a low-pass filter, undesired frequencies of the position signal being able to be removed via the low-pass filter, especially for an automobile.

Devices for correcting the headlight position of a vehicle have already been built, some of them having had a static and others a dynamic design.

The static correction devices have a relatively long response time and adjust the headlights of the vehicle as a function of the load and its distribution between front and rear axles. Such a device is unable to act when the vehicle is moving.

Devices featuring a dynamic adjustment have also been built already, so as to ensure a proper position of the headlights under all driving conditions of the vehicle. A device includes correction organs connected to the headlights, and functions by gravity (e.g., pendulum). This device has the disadvantage of being unable to properly adjust the headlights when the vehicle is moving on a downhill slope.

Other dynamic adjustment devices are equipped with sensors, via which the relative position is able to be determined during forward or rearward rocking or swinging of the body in relation to the wheels. Via a correction filter, these sensors are acting on actuating organs which are meant to adjust the position of the headlights as a function of the signal supplied by the sensors. Some devices are hydraulic, and in this case the filtering of the undesired signals is implemented at an increased frequency (in particular the frequency caused by movements of the vehicles on block pavement), at the lines of the hydraulic system. If the adjustment device is an electrical device, then the filtering is implemented by an electric low-pass filter.

The interference phenomena due to the state of the road, and the vehicle conditions requiring a correction of the headlight position are numerous:

- block pavement causes interference of a relatively high frequency of 5 to 15 Hz;
- holes and thresholds may cause pitch vibrations of 5 to 10 Hz, but this type of interference is relatively rare and does not interfere significantly with the driving style;
- sudden accelerations and braking cause fluctuations on the order of magnitude of 1 to 2 Hz.

Beyond 15 Hz, the vibrations of the vehicle are not a problem due to the response time of the eye, which automatically integrates these rapid changes in the headlight position. The less pronounced frequencies between 2 and 15 Hz are filtered to a certain extent by the suspension of the vehicle and thus reach the headlights in attenuated form. However, these frequencies are a nuisance even in attenuated form.

The adjustment devices developed so far have the serious disadvantage of causing a phase shift between the rocking instant of the vehicle and the response of the correction device when phenomena arise that have a frequency that is equal to or higher than the limit frequency of the system carrying out the filtering. For example, if the limit frequency is 2 Hz, more rapid phenomena than those resulting from block pavement reach the actuating organs of the headlights despite being attenuated by the filtering and thus may cause certain uncomfortable physiological conditions due to the phase shift. In movements of the vehicle on block pavement, the correction may intervene precisely in phase opposition in relation to the pitch vibrations of the vehicle. For example, the headlights happen to be directed upward at the same moment that the front part of the vehicle body is executing an upward movement as well.

Another unpleasant effect of the existing adjustment devices is that their correction organs are constantly stressed in the presence of rapid phenomena, so that the service life is relatively short.

According to the invention, a device for the dynamic adjustment of the headlights of a vehicle is to be provided, which no longer has the aforementioned disadvantages and allows pleasant night-time driving under all driving conditions and regardless of the state of the road.

The device according to the invention is characterized by the fact that the filter includes filter elements and that a variable characteristic of the frequency separation as a function of the amplitude of the position signals of the sensors is ensured via the filter elements.

Due to these features, the device according to the invention is able to differentiate between phenomena that require correction, and those for which a correction is undesired on account of the unavoidable phase shift that would arise between the interference phenomenon and the headlight correction.

One first specific embodiment of the invention is characterized by the fact that the filter includes threshold value elements, via which at least one amplitude threshold is able to be defined, for which the filter predefines a limit frequency. This allows a precise adaptation of the features of the filter to the different interference phenomena requiring an adjustment of the headlight position.

One further advantageous specific embodiment is characterized by the fact that the limit frequency of the filter amounts to approximately 2 Hz for an amplitude above the amplitude thresholds, and to approximately 0.3 Hz for an amplitude below the amplitude thresholds. Thus, the high frequency signals between 2 and 5 Hz having a weak amplitude due to movement on block pavement, for example, are not taken into account and thus are also unable to have an adverse effect on driving comfort.

One preferred specific embodiment of the invention is characterized in that the filter is electric and includes an L-shaped RC element, the RC element is made up of a series resistor and a parallel capacitor, an antiparallel circuit of two rectifiers is switched in parallel with the series resistor, and the amplitude thresholds are specifiable via the internal resistances in the throughput direction.

According to another feature, the rectifiers are diodes. The diodes are advantageously switched in series with a resistor for adjusting the switch-off threshold.

The specific embodiment described has the advantage of being easily adaptable to a static adjustment device for the position of headlights of a vehicle, utilizing two simple diodes and two resistors, the cost of which is relatively low.

However, it became obvious that the absolute value of the mentioned thresholds must be high enough to eliminate the fluctuations having a low amplitude, which, for example, arise when the vehicle is driving on block pavement, especially at medium speeds. This has the result that movements having a medium amplitude due to accelerations or decelerations of the vehicle are no longer taken into account in certain cases, and the device no longer intervenes to regulate the position of the headlights in such instances. This lack of adjustment in the presence of such movements becomes more bothersome the more important the range and precision of the headlights become.

Therefore, in a second specific embodiment, the invention intends to provide a device for dynamically adjusting the headlights of a vehicle as a function of the relative position of the wheels in relation to the body, the response of the device in movements having a low amplitude such as movements related to driving over block pavement or thresholds, for example, being effectively suppressed. In so doing, the device is to ensure an effective dynamic adjustment at other movements having a low or medium amplitude, at least in cases where this is important for driving and for safety on the road.

The invention thus also relates to a second specific embodiment of a device of the above type, in which components define two amplitude thresholds which are related to the movements of the body in relation to the wheels, for which the filter defines a limit frequency in each case. This device is characterized by different absolute values of the amplitude thresholds; that is to say, the absolute value of the amplitude threshold for the movements caused by accelerations lies below the absolute value of the amplitude threshold for the movements caused by decelerations. For instance, the threshold with regard to signals in connection with an acceleration is specified as a low value sufficient to respond to slight accelerations which are a nuisance to drivers of oncoming vehicles, while the threshold for signals in connection with a braking operation or a decrease in speed has a very high amplitude. It came as a surprise to discover that such a control of the values of the thresholds achieves complete vanishing of the undesired reactions that provoke rocking; when driving over block pavement, for example, an effective adjustment of the headlights in response to the movements caused by even the slightest acceleration is ensured, which considerably increases road safety, in particular.

On the other hand, it is obvious that the device does not bring about a correction of the headlight position when slight decelerations take place. However, this is not a problem because the light beam is lowered in this case, which has no adverse effect on road safety.

According to one advantageous development of the second specific embodiment of the invention, the limit frequency of the filter amounts to 1 to 2 Hz for a signal that exceeds the threshold for the acceleration, or a signal (having the opposite algebraic sign that exceeds the other threshold for the deceleration, while the switch-off frequency amounts to 0.15 Hz when the signal does not exceed the one or the other threshold according to its algebraic sign.

For instance, the signals between 0.15 and 2 Hz having a weak amplitude resulting from movement on block pavement are not taken into account. On the other hand, an acceleration signal having a frequency on the order of magnitude of 1 Hz and an amplitude that is barely higher than that of the signals resulting from movement on the block pavement is taken into account, and the actuating device intervenes to correct the headlight position. The device is advantageously constructed in such a way that the filter is electric and has an L-shaped RC element, the RC element is made up of a series resistor and a parallel capacitor, an antiparallel circuit of two rectifier units is switched in parallel to the series resistor, and the rectifier units have different internal resistances in the throughput direction, so that the amplitude thresholds are specified.

For example, the difference between the internal thresholds is achievable by installing a number of standard rectifiers greater than that of the other rectifier unit in the one rectifier unit, i.e., the unit that lets through the electrical signal related to the relative positions that correspond to the braking or the deceleration. As a variant, standard rectifiers may be used, e.g., diodes having different internal thresholds. The rectifiers of each unit are preferably switched in series with an adjustable resistor.

For a better understanding of the invention, two specific embodiments are described in the following text with the aid of the appended drawing; the figures show:

Fig. 1 a basic circuit diagram of a device according to a first specific embodiment of the invention,

Fig. 2 a diagram showing the operation of the device according to Fig. 1 by comparing two curves,

Fig. 3 a basic circuit diagram of a device according to a second specific embodiment of the invention, and

Fig. 4 a diagram analogous to the diagram from Fig. 2, to illustrate the operation of the device according to Fig. 3.

The device shown in Fig. 1 has a first sensor 1 between the front axle and the body of the vehicle in order to detect a relative movement. A corresponding sensor 2 is situated on the rear axle.

The signals generated by sensors 1,2 are processed in a mixer stage 3, where a signal is generated that represents the vibration or rocking motion of the vehicle in the course of its movement.

The output of mixer stage 3 is connected to a low-pass filter 4, which in this case is formed by an RC element 5 mounted in an L-shape.

The output of filter 4 is connected to a control and amplifier device 6, which outputs a power signal to actuating organs 7, which causes headlights 8 to move.

Filter 4 has a series resistor 9 and a parallel capacitor 10. Two diodes 11 and 12 switched in antiparallel manner are switched in parallel with series resistor 9, the diodes each being connected in series with an adjustable resistor 13 and 14.

If the amplitude of the input signal of filter 4 exceeds amplitude thresholds s_1, s_2 of diodes 11 and 12, they become transmissive to corresponding signals, so that the value of the series resistor of RC element 5 drops. Time constant RC drops as well, and the limit frequency becomes higher. That is to say, filter 4 causes a gradation of its limit frequency as a function of the amplitude of the signal supplied to it.

In the case illustrated, in which commercially available diodes 11,12 are used, their internal resistance is insufficient to achieve a limit frequency of 2 Hz. This is why the series connection of adjustable resistors 13 and 14 is provided.

The operation of the device can be gathered from Fig. 2:

fe is the frequency of input signal S_E of filter 4, and fc is the frequency of output signal S_S. It is apparent that frequency fe of the input signal lies below limit frequency fc of filter 4 during time A. In this way the signal at the output is completely restored again. This case is used in a static correction, e.g., when the loading of the vehicle is varied.

During time B, frequency fe is higher than the limit frequency of the filter, but the amplitude of the input signal lies below amplitude thresholds s_1, s_2, which are specified by diodes 11 and 12, so that the signal passes through filter 4 without restriction. At the output, the average value of the input signal is restored again, whereas the high frequency signal is deleted by filter 4. This corresponds to rolling on block pavement.

During time C, frequency fe is also higher than limit frequency fc, but the amplitude of the signal exceeds amplitude thresholds s_1, s_2 defined by diodes 11,12. The high-frequency signal undergoes no phase shift, but it is reduced in its amplitude by the value of amplitude thresholds s_1, s_2. This case corresponds to rolling on a road that is in very poor condition.

D relates to brutal braking on a poor road. As soon as the input signal exceeds the value of amplitude thresholds s_1,s_2, it can be found again at the output, reduced by the value of amplitude thresholds s_1, s_2. If the phenomenon drags on, a value that is identical to the input signal may be obtained at the output with the aid of filter 4.

The limit frequencies of filter 4 are selectable, e.g., 2 Hz for strong amplitudes, 0.3 Hz for low amplitudes. In the latter case, damping of the signal is therefore important. The phase shift experienced at higher frequencies has no effect on the setting of the headlights.

As can be gathered from Fig. 3, the device includes a first sensor 101, which is mounted between the front axle and the vehicle body for the purpose of detecting the relative movements. Another sensor 102 is assigned to the rear axle. The signals generated by sensors 101,102 are processed in a mixer stage 103, where a signal is generated that represents the rocking or vibration of the vehicle in the course of its movement. The output of mixer stage 103 is connected to a low-pass filter 104, which is formed by an RC element 105 in L-shape. The output of filter 104 is connected to a control and amplifier device 106, which outputs a power signal to actuating organs 107 bringing about the movements of headlights 108 of the vehicle. Filter 104 has a series resistor 109 and a parallel capacitor 110. An antiparallel circuit of two diode units 111,112 is switched in parallel to series resistor 109. One unit has two diodes 111, and the other has three diodes 112. Each unit is switched in series with an adjustable resistor 113 and 114 respectively.

The operation of the device can be gathered from Fig. 4:

fe is the frequency of input signal SE of filter 1, and fc the frequency of output signal SS. It is apparent that the frequency of input signal fe lies below limit frequency fc of filter 104 during time A. Thus, the signal is completely restored at the output, which brings about the correction.

This case exists in a static correction, for example, when the load of the vehicle is varied.

During time B, frequency fe is higher than limit frequency fc of the filter, but the high-frequency amplitude of the input signal is not only lower than the absolute value of amplitude threshold s_1 according to the deceleration, but also lower than the value of amplitude threshold s_2 according to the acceleration, so that the signal passes filter 104 without restriction. Only the average value of the input signal is restored again at the output, whereas the high-frequency signal is eliminated by filter 104. This case corresponds to rolling on block pavement.

During time C, which corresponds to a slight acceleration, it can be seen that the amplitude of signal S_E exceeds amplitude threshold s_2 of the acceleration. This translates into a modification of signal S_S at the output and thus into a correction of the headlights, which are lowered slightly.

During time D, which corresponds to a slight deceleration which causes a change having virtually the same amplitude as in acceleration C, no change takes place in signal S_S because the amplitude remains below amplitude threshold s_1.

Only when the braking is stronger, as during time E, where amplitude threshold s_1 has now been exceeded, does a change in the signal occur on curve S_S in response to the braking operation. The limit frequencies of filter 104 are selectable, e.g., 1 to 2 Hz for strong amplitudes, and 0.15 Hz for weak amplitudes.

It should be noted that the diodes switched in antiparallel manner may advantageously be replaced by Zener diodes switched in series.

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Number:	3129891
Int. Cl.^{3}:	B 60 Q 1/08
Filing date:	July 29, 1981
Publication date:	June 9, 1982

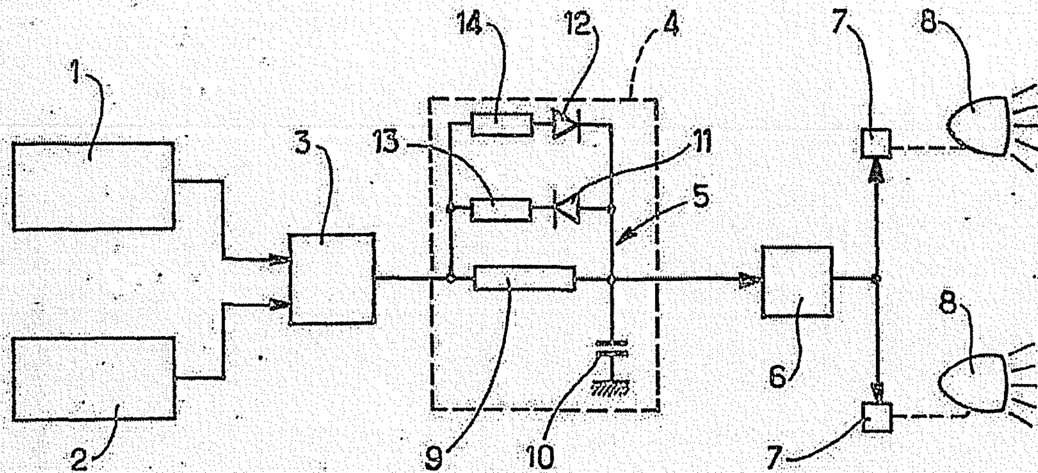

FIG. 1

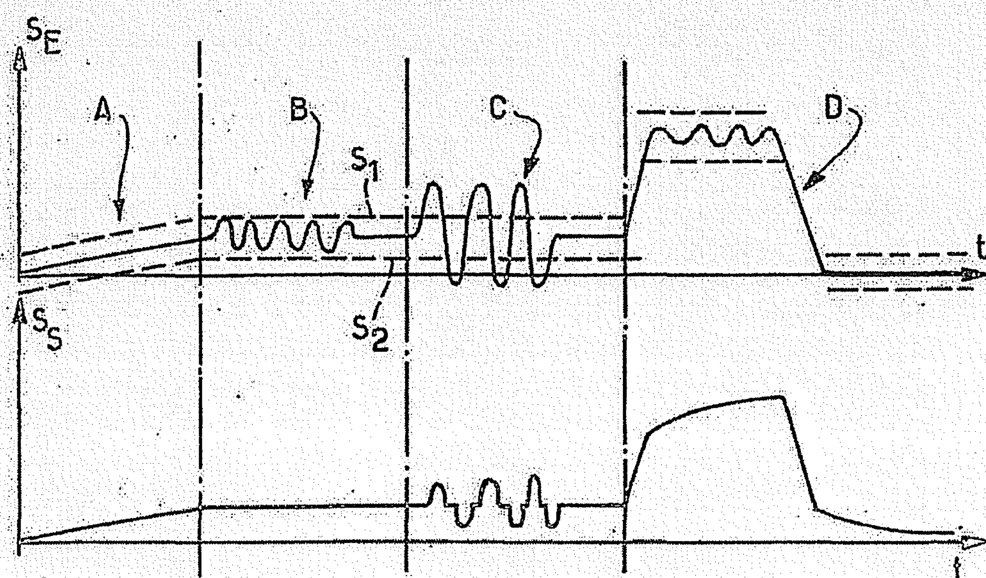

FIG. 2

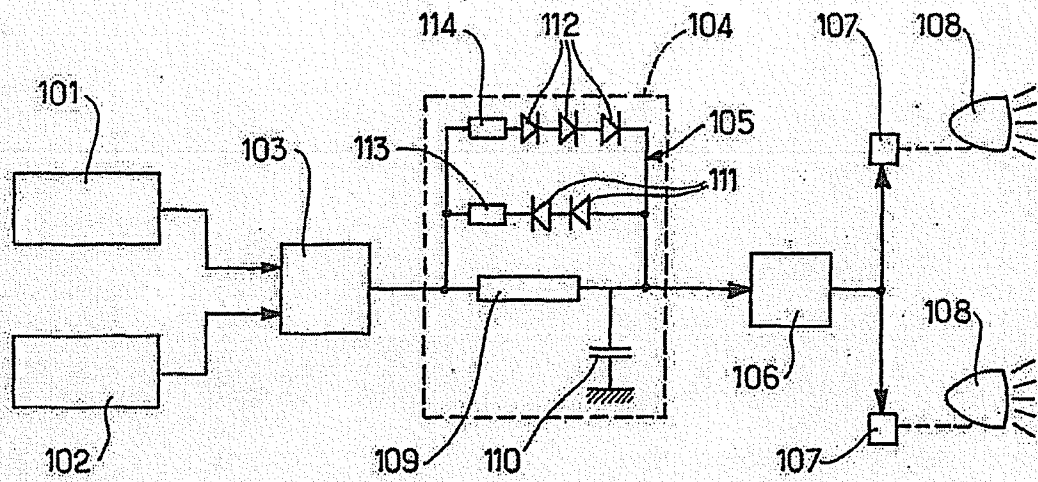
101
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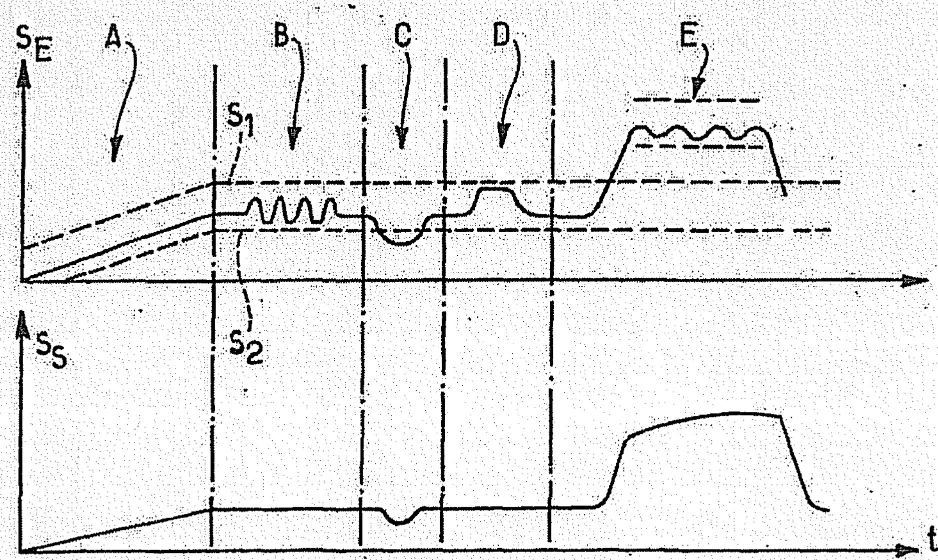
FIG. 3


S_E
A
B
C
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E
S_1
S_2
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S_S
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FIG. 4

(19) BUNDESREPUBLIK DEUTSCHLAND

DEUTSCHES PATENTAMT

(12) **Offenlegungsschrift**

(11) **DE 31 29 891 A1**

(51) Int. Cl. 3: B 60 Q 1/08

(21) Aktenzeichen: P 31 29 891.5
(22) Anmeldetag: 29. 7. 81
(43) Offenlegungstag: 9. 6. 82

Behördeneigentum

DE 31 29 891 A1

(30) Unionspriorität: (32) (33) (31)
31.07.80 FR 8016959 13.05.81 FR 8109537

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(54) **»Vorrichtung zur dynamischen Einstellung der Stellung von Scheinwerfern eines Fahrzeuges«**

Gezeigt und beschrieben wird eine Vorrichtung zur dynamischen Einstellung der Stellung von Scheinwerfern (8) eines Fahrzeuges in Abhängigkeit von der relativen Position der Räder in bezug auf die Karosserie mit zwei Fühlern (1, 2) zur Lieferung von der relativen Position entsprechenden Signalen und mit in Verbindung mit den Scheinwerfern (8) stehenden Betätigungsorganen (7), wobei die Betätigungsorgane (7) durch eine Steuervorrichtung (6) steuerbar sind und wobei die Steuervorrichtung (6) durch das Positionssignal über ein Tiefpaßfilter (4) unerwünschte Frequenzen des Positionssignales ableitbar sind. Um bei Fahrzeugen eine angenehme Nachtfahrt unter allen Fahrbedingungen und unabhängig vom Straßenzustand zu ermöglichen, weist das Filter (4) Filterelemente (11 bis 14) auf, über die eine variable Charakteristik der Frequenzabtrennung in Abhängigkeit von der Amplitude der Positionssignale der Fühler (1, 2) gewährleistet ist.
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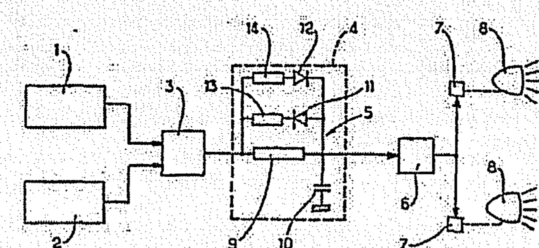

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Patentansprüche:

1. Vorrichtung zur dynamischen Einstellung der Stellung von Scheinwerfern eines Fahrzeuges in Abhängigkeit von der relativen Position der Räder in Bezug auf die Karosserie, mit mindestens einem Fühler zur Lieferung eines der relativen Position entsprechenden Signales und mit in Verbindung mit den Scheinwerfern stehenden Betätigungsorganen, wobei die Betätigungsorgane durch eine Steuervorrichtung steuerbar sind und die Steuervorrichtung durch das Positionssignal über ein Tiefpaßfilter schaltbar ist und wobei über das Tiefpaßfilter unerwünschte Frequenzen des Positionssignales ableitbar sind, d a d u r c h g e k e n n z e i c h n e t , daß das Filter (4;104) Filterelemente (11 bis 14; 111 bis 114) aufweist und daß über die Filterelemente (11 bis 14; 111 bis 114) eine variable Charakteristik der Frequenzabtrennung in Abhängigkeit von der Amplitude der Positionssignale der Fühler (1,2;101,102) gewährleistet ist.

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2. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß das Filter (4;104) Schwellwertelemente (11,12; 111,112) aufweist, über die mindestens eine Amplitudenschwelle (s_1, s_2) definierbar ist, für die das Filter (4;104) eine Grenzfrequenz vorbestimmt.

3. Vorrichtung nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Grenzfrequenz des Filters (4;104) für eine Amplitude über den Amplitudenschwellen (s_1,s_2) etwa 2 Hz und für eine Amplitude unter den Amplitudenschwellen (s_1,s_2) etwa 0,3 Hz beträgt.

4. Vorrichtung nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß das Filter (4;104) elektrisch ist und ein L-förmiges RC-Glied (5;105) aufweist, daß das RC-Glied (5;105) aus einem Serienwiderstand (9;109) und einem Parallelkondensator (10;110) besteht, daß dem Serienwiderstand (9;109) eine Antiparallelschaltung zweier Gleichrichter (11,12;111,112) parallel geschaltet ist und daß über die Innenwiderstände in Durchgangsrichtung die Amplitudenschwellen (s_1,s_2) festlegbar sind.

5. Vorrichtung nach einem der Ansprüche 1 bis 4, wobei über Filterelemente zwei Amplitudenschwellen festlegbar sind, die mit den Bewegungen der Karosserie in Bezug auf die Räder in Beziehung stehen, dadurch gekennzeichnet, daß die Absolutwerte der Amplitudenschwellen (s_1,s_2) unterschiedlich sind, daß nämlich

der Absolutwert der Amplitudenschwelle (s_2) für die durch Beschleunigungen erzeugten Bewegungen unter dem Absolutwert der Amplitudenschwelle (s_1) für die durch Verzögerungen erzeugten Bewegungen liegt.

6. Vorrichtung nach einem der Ansprüche 1 bis 5, dadurch gekennzeichnet, daß die Grenzfrequenz des Filters (4;104) 1 bis 2 Hz für Schwankungen des Positionssignales (S_E) beträgt, die die Amplitudenschwelle (s_2) für die Beschleunigung oder die Amplitudenschwelle (s_1) für die Verzögerung überschreiten und daß die Grenzfrequenz im übrigen, d.h. wenn die Schwankungen weder die eine noch die andere Amplitudenschwelle (s_1, s_2) überschreiten, 0,15 Hz beträgt.

7. Vorrichtung nach Anspruch 5 oder 6, dadurch gekennzeichnet, daß das Filter (104) elektrisch ist und ein L-förmiges RC-Glied (105) aufweist, daß das RC-Glied (105) aus einem Serienwiderstand (109) und einem Parallelkondensator (110) besteht, daß dem Serienwiderstand (109) eine Antiparallelschaltung zweier Gleichrichtereinheiten (111,112) parallel geschaltet ist und daß die Gleichrichtereinheiten (111,112) verschiedene Innenwiderstände in Durchgangsrichtung aufweisen, so daß die Amplitudenschwellen (s_1,s_2) festgelegt sind.

8. Vorrichtung nach Anspruch 7, dadurch gekennzeichnet, daß die Gleichrichtereinheiten (111, 112) jeweils mehrere voneinander verschiedene Einheitsgleichrichter aufweisen.

9. Vorrichtung nach einem der Ansprüche 1 bis 8, dadurch gekennzeichnet, daß als Gleichrichter (11,12;111,112) Dioden vorgesehen sind.

10. Vorrichtung nach einem der Ansprüche 1 bis 9, dadurch gekennzeichnet, daß die Gleichrichter (11,12;111,112) jeweils in Serie mit einem Einstellwiderstand (13,14;113,114) geschaltet sind.

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Vorrichtung zur dynamischen Einstellung der Stellung von Scheinwerfern eines Fahrzeuges

Die Erfindung betrifft eine Vorrichtung zur dynamischen Einstellung der Stellung von Scheinwerfern eines Fahrzeuges in Abhängigkeit von der relativen Position der Räder in Bezug auf die Karosserie, mit mindestens einem Fühler zur Lieferung eines der relativen Position entsprechenden Signales und mit in Verbindung mit den Scheinwerfern stehenden Betätigungsorganen, wobei die Betätigungsorgane durch eine Steuervorrichtung steuerbar sind und die Steuervorrichtung durch das Positionssignal über ein Tiefpaßfilter schaltbar ist und wobei über das Tiefpaßfilter unerwünschte Frequenzen des Positionssignales ableitbar sind, insbesondere für ein Auto.

Man hat bereits Vorrichtungen für die Korrektur der Scheinwerferstellung eines Fahrzeuges gebaut, wobei einige statisch, einige dynamisch waren.

Die statischen Korrekturvorrichtungen haben eine relativ lange Ansprechzeit und verstellen die Scheinwerfer des Fahrzeuges abhängig von der Last und deren Verteilung zwischen Vorder- und Hinterachse. Eine solche Vorrichtung kann nicht tätig werden, wenn das Fahrzeug sich bewegt.

Es sind auch schon Vorrichtungen mit dynamischer Einstellung konstruiert worden, um eine adäquate Position der Scheinwerfer bei allen Fahrbedingungen des Fahrzeuges zu gewährleisten. Eine Vorrichtung hat Korrekturorgane in Verbindung mit den Scheinwerfern und funktioniert durch Schwerkraft (z.B. Pendel). Diese Vorrichtung hat den Nachteil, daß sie die Scheinwerfer nicht passend einstellen kann, wenn das Fahrzeug auf einem Abhang rollt.

Andere dynamische Einstellvorrichtungen haben Fühler über die die relative Position beim Schwanken oder Schaukeln von vorn nach hinten bei der Karosserie in Bezug auf die Räder feststellbar ist. Diese Fühler wirken über ein Korrekturfilter auf Betätigungsorgane, die die Position der Scheinwerfer abhängig von dem durch die Fühler gelieferten Signal ändern sollen. Einige Vorrichtungen sind hydraulisch und in diesem Fall wird die Filterung der unerwünschten Signale mit erhöhter Frequenz (insbesondere derjenigen aufgrund von Bewegungen des Fahrzeuges auf Pflaster) an den Leitungen des hydraulischen Systems vorgenommen. Wenn die Einrichtung zur Verstellung elektrisch ist, bewirkt man die Filterung durch ein elektrisches Tiefpaßfilter.

Die Störerscheinungen aufgrund des Wegezustandes und der Fahrzeugbedingungen, die eine Korrektur der Stellung der Scheinwerfer verlangen, sind zahlreich:

- Pflaster verursacht Störungen mit relativ hoher Frequenz von 5 bis 15 Hz;

- Löcher und Schwellen können Stampfschwingungen von 5 bis 10 Hz verursachen, aber diese Störungen sind relativ selten und für die Fahrweise relativ wenig hinderlich;

- plötzliche Beschleunigungen und Bremsungen bringen Schwankungen in der Grössenordnung von 1 bis 2 Hz mit sich.

Jenseits von 15 Hz sind die Schwingungen des Fahrzeuges wegen der Ansprechzeit des Auges, das diese schnellen Änderungen der Scheinwerferposition automatisch integriert, nicht hinderlich. Die weniger hohen Frequenzen zwischen 2 und 15 Hz werden in einem gewissen Umfang durch die Federung des Fahrzeuges gefiltert und gelangen daher in abgeschwächter Form an die Scheinwerfer. Jedoch bleiben diese Frequenzen auch in abgeschwächter Form lästig.

Die bisher entwickelten Einstellvorrichtungen haben den ernsten Nachteil einer Phasenverschiebung zwischen der Zeit des Schaukelns des Fahrzeuges und der Reaktion der Korrekturvorrichtung bei Erscheinungen, deren Frequenz gleich oder höher ist als die Grenzfrequenz des die Filterung bewirkenden Systems. Wenn z.B. die Grenzfrequenz 2 Hz ist, gelangen schnellere Phänomene als diejenigen aufgrund von Pflaster, obwohl sie durch die

Filterung abgeschwächt sind, trotzdem zu den Betätigungsorganen der Scheinwerfer und können so durch die Phasenverschiebung bestimmte physiologische Unbehaglichkeiten mit sich bringen. Bei Bewegungen des Fahrzeuges auf Pflaster kann die Korrektur gerade gegenphasig in Bezug auf Stampfschwingungen des Fahrzeuges eingreifen. Die Scheinwerfer sind z.B. gerade in dem Augenblick nach oben orientiert, in dem das Vorderteil der Karosserie des Fahrzeuges auch eine Bewegung nach oben ausführt.

Eine andere Unannehmlichkeit der vorhandenen Einstellvorrichtungen besteht darin, daß bei schnellen Phänomenen ihre Korrekturorgane ständig gefördert werden und so die Lebensdauer relativ gering ist.

Gemäß der Erfindung soll eine Vorrichtung zur dynamischen Einstellung der Scheinwerfer eines Fahrzeuges geschaffen werden, die die oben erwähnten Nachteile nicht besitzt und eine angenehme Nachtfahrt unter allen Fahrbedingungen und unabhängig vom Straßenzustand zulässt.

Die erfindungsgemäße Vorrichtung ist dadurch gekennzeichnet, daß das Filter Filterelemente aufweist und daß über die Filterelemente eine variable Charakteristik der Frequenzabtrennung in Abhängigkeit von der Amplitude der Positionssignale der Fühler gewährleistet ist.

Dank dieser Merkmale ist die erfindungsgemäße Vorrichtung in der Lage, eine Unterscheidung vorzunehmen zwischen den Erscheinungen, die eine Korrektur verlangen und denjenigen, bei denen eine Korrektur aufgrund der unvermeidlichen Phasenverschiebung, die es zwischen dem Störphänomen und der Korrektur der Scheinwerfer geben würde, unerwünscht ist.

Eine erste Ausführungsform der Vorrichtung ist dadurch gekennzeichnet, daß das Filter Schwellwertelemente aufweist, über die mindestens eine Amplitudenschwelle definierbar ist, für die das Filter eine Grenzfrequenz vorbestimmt. Auf diese Weise können die Merkmale des Filters mit Genauigkeit den verschiedenen Störerscheinungen angepaßt werden, die eine Verstellung der Scheinwerferposition verlangen.

Eine weitere vorteilhafte Ausführungsform ist dadurch gekennzeichnet, daß die Grenzfrequenz des Filters für eine Amplitude über den Amplitudenschwellen etwa 2 Hz und für eine Amplitude unter den Amplitudenschwellen etwa 0,3 Hz beträgt. So werden die Hochfrequenzsignale zwischen 2 und 5 Hz und mit schwacher Amplitude aufgrund einer Bewegung auf Pflaster z.B. nicht berücksichtigt und können daher auch nicht der Fahrannehmlichkeit schaden.

Eine bevorzugte Ausführungsform der Erfindung ist dadurch gekennzeichnet, daß das Filter elektrisch ist und ein L-förmiges RC-Glied aufweist, daß das RC-Glied aus einem Serienwiderstand und einem Parallelkondensator besteht, daß dem Serienwiderstand eine Antiparallelschaltung zweier Gleichrichter parallel geschaltet ist und daß über die Innenwiderstände in Durchgangsrichtung die Amplitudenschwellen festlegbar sind.

Gemäß einem anderen Merkmal sind die Gleichrichter Dioden. Vorteilhafterweise sind die Dioden in Serie mit einem Widerstand für die Einstellung der Abschaltschwelle geschaltet.

Die Ausführungsform, die beschrieben wird, hat den Vorteil, daß sie leicht an eine statische Einstellvorrichtung für die Position von Scheinwerfern eines Fahrzeuges mittels Benutzung von zwei einfachen Dioden und von zwei Widerständen angepaßt werden kann, deren Kosten nicht sehr hoch sind.

Man konnte aber beobachten, daß der absolute Wert der genannten Schwellen ausreichend hoch sein muß, um die Schwankungen mit geringer Amplitude auszuschalten, die sich z.B. ergeben, wenn das Fahrzeug auf Pflaster fährt, insbesondere bei mittleren Geschwindigkeiten. Daraus ergibt sich, daß in bestimmten Fällen Bewegungen mittlerer Amplitude aufgrund von Beschleunigungen oder Verzögerungen des Fahrzeuges nicht mehr berücksichtigt werden, und daß die Einrichtung in diesen Fällen nicht eingreift, um die Position der Scheinwerfer zu regeln. Dieser Ein-stellungsmangel bei solchen Bewegungen wird umso lästiger, je bedeutsamer Reichweite und Genauigkeit der Scheinwerfer werden.

In einer zweiten Ausführungsform beabsichtigt die Erfindung daher, eine Vorrichtung zur dynamischen Einstellung der Scheinwerfer eines Fahrzeuges abhängig von der relativen Position der Räder in Bezug auf die Karosserie zu liefern, wobei die Reaktion der Vorrichtung bei Bewegungen mit geringer Amplitude wirksam unterdrückt wird, wie z.B. Bewegungen, die mit der Fahrt über Pflaster oder Schwellen in Verbindung stehen. Die Vorrichtung soll dabei eine wirksame dynamische Einstellung bei anderen Bewegungen mit geringer oder mittlerer Amplitude gewährleisten, zumindest in den Fällen, die für das Fahren und die Sicherheit auf der Straße wichtig sind.

Die Erfindung bezieht sich daher auch auf eine zweite Ausführungsform einer Vorrichtung des obigen Typs, bei der Bestandteile zwei Amplitudenschwellen definieren, welche mit den Bewegungen der Karosserie in Bezug auf die Räder in Verbindung stehen, für deren jede das Filter eine Grenzfrequenz bestimmt. Diese Vorrichtung ist dadurch gekennzeichnet, daß die Absolutwerte der Amplitudenschwellen unterschiedlich sind, daß nämlich der Absolutwert der Amplitudenschwelle für die durch Beschleunigungen erzeugten Bewegungen unter dem Absolutwert der Amplitudenschwelle für die durch Verzögerungen erzeugten Bewegungen liegt. So wird die Schwelle in Bezug auf Signale in Verbindung mit einer Beschleunigung festgelegt auf einen ausreichend schwachen Wert, um auf geringfügige Beschleunigungen anzusprechen, die für Fahrer entgegenkommender Fahrzeuge lästig sind, während die Schwelle für Signale in Verbindung mit einer Bremsung oder Geschwindigkeitsabnahme eine sehr große Amplitude hat. Überraschenderweise hat man festgestellt, daß bei einer solchen Regelung der Werte der Schwellen ein komplettes Verschwinden der unerwünschten Reaktionen erzielt wird, die ein Schwanken hervorrufen, z.B. bei einer Fahrt über Straßenpflaster, wobei eine wirksame Einstellung der Scheinwerfer auf die durch eine noch so geringe Beschleunigung hervorgerufenen Bewegungen gewährleistet wird, was insbesondere die Sicherheit auf der Straße wesentlich erhöht.

Andererseits stellt man fest, daß die Vorrichtung bei geringen Verzögerungen keine Korrektur der Scheinwerferstellung bewirkt. Dies ist nicht lästig, weil sich in diesem Fall das Lichtbündel senkt, was keinen Nachteil für die Sicherheit auf der Straße nach sich zieht.

Gemäß einer vorteilhaften Gestaltung der zweiten Ausführungsform der Erfindung beträgt die Grenzfrequenz des Filters 1 bis 2 Hz bei einem Signal, das die Schwelle für die Beschleunigung überschreitet, oder einem Signal (mit entgegengesetztem Vorzeichen das die andere Schwelle für die Verzögerung überschreitet, während die Abschaltfrequenz 0,15 Hz beträgt, wenn das

Signal nicht gemäß seinem Vorzeichen die eine oder andere Schwelle überschreitet.

So werden die Signale zwischen 0,15 und 2 Hz mit schwachter Amplitude, die sich aus der Bewegung auf Pflaster ergeben, nicht berücksichtigt. Dagegen wird ein Beschleunigungssignal mit einer Frequenz in der Rangordnung von 1 Hz und einer Amplitude, die kaum höher ist als diejenige der Signale, die sich durch Bewegung auf dem Pflaster ergeben, berücksichtigt und es erfolgt ein Eingreifen der Stellvorrichtung für die Korrektur der Scheinwerferposition. Vorteilhafterweise ist dabei die Vorrichtung so konstruiert, daß das Filter elektrisch ist und ein L-förmiges RC-Glied aufweist, daß das RC-Glied aus einem Serienwiderstand und einem Parallelkondensator besteht, daß dem Serienwiderstand eine Antiparallelschaltung zweier Gleichrichtereinheiten parallel geschaltet ist und daß die Gleichrichtereinheiten verschiedene Innenwiderstände in Durchgangsrichtung aufweisen, so daß die Amplitudenschwellen festgelegt sind.

Der Unterschied zwischen den Innenschwellen kann z.B. erzielt werden, indem man in der einen Gleichrichtereinheit, nämlich derjenigen, die das elektrische Signal durchläßt, das mit den relativen Positionen verbunden ist, welche der Bremsung oder der Verzögerung entsprechen, eine Anzahl von Einheitsgleichrichtern anbringt, die größer ist als die der anderen Gleichrichtereinheit. Als Variante kann man Einheitsgleichrichter verwenden, z.B. Dioden, die verschiedene Innenschwellen haben. Die Gleichrichter jeder Einheit sind vorzugsweise in Serie geschaltet mit einem Einstellwiderstand.

Zum besseren Verständnis der Erfindung werden nachstehend zwei Ausführungsformen anhand der beigefügten Zeichnung beschrieben; es zeigt:

Fig. 1 ein Grundschaltbild einer Vorrichtung gemäß einer ersten Ausführungsform der Erfindung,

Fig. 2 ein Diagramm, das den Betrieb der Vorrichtung gem. Fig. 1 durch den Vergleich von zwei Kurven zeigt,

Fig. 3 ein Grundschaltbild einer Vorrichtung gemäß einer zweiten Ausführungsform der Erfindung und

Fig. 4 ein Diagramm analog demjenigen der Fig. 2 zur Darstellung des Betriebs der Vorrichtung gemäß Fig. 3.

Die in Fig. 1 dargestellte Vorrichtung hat einen ersten Fühler 1 zwischen der Vorderachse und der Karosserie des Fahrzeuges, um eine relative Bewegung zu entdecken. Ein entsprechender Fühler 2 befindet sich an der Hinterachse.

Die von den Fühlern 1,2 erzeugten Signale werden in einer Mischstufe 3 behandelt, in der ein Signal erzeugt wird, das die Schwingung oder Schaukelbewegung des Fahrzeuges im Verlauf seiner Bewegung darstellt.

Der Ausgang der Mischstufe 3 ist mit einem Tiefpaßfilter 4 verbunden, das in diesem Beispiel durch ein RC-Glied 5, das in L-Form montiert ist, gebildet wird.

Der Ausgang des Filters 4 ist mit einer Steuer- und Verstärkervorrichtung 6 verbunden, die ein Leistungssignal an Betätigungsorgane 7 abgibt, welche Bewegungen der Scheinwerfer 8 hervorrufen.

Das Filter 4 hat einen Serienwiderstand 9 und einen Parallelkondensator 10. Dem Serienwiderstand 9 sind zwei antiparallel geschaltete Dioden 11 und 12, die jeweils in Serie mit einem Einstellwiderstand 13 und 14 liegen, parallel geschaltet.

Wenn die Amplitude des Eingangssignals des Filters 4 die Amplitudenschwellen s_1, s_2 der Dioden 11 und 12 überschreitet, werden diese für entsprechende Signale durchgängig, so daß der Wert des Serienwiderstandes des RC-Gliedes 5 sinkt.Die Zeitkonstante RC sinkt ebenfalls und die Grenzfrequenz wird höher. Das Filter 4 bewirkt also eine Abstufung seiner Grenzfrequenz in Abhängigkeit von der Amplitude des Signals, das ihm geliefert wird.

In dem dargestellten Fall, in dem man handelsübliche Dioden 11,12 verwendet, ist deren Innenwiderstand nicht ausreichend, um eine Grenzfrequenz von 2 Hz zu erzielen. Deshalb sind die Einstellwiderstände 13 und

14 in Serie vorgesehen.

Der Betrieb der Vorrichtung geht aus Fig. 2 hervor:

fe sei die Frequenz des Eingangssignals S_E des Filters 4 und fc diejenige des Ausgangssignals S_S. Man sieht, daß während der Zeit A die Frequenz fe des Eingangssignals unter der Grenzfrequenz fc des Filters 4 liegt. So ist das Signal am Ausgang uneingeschränkt wiederhergestellt. Dieser Fall findet bei einer statischen Korrektur Anwendung, z.B. wenn die Belastung des Fahrzeuges geändert wird.

Während der Zeit B ist die Frequenz fe höher als die Grenzfrequenz des Filters, aber die Amplitude des Eingangssignals liegt unter den Amplitudenschwellen s_1, s_2, die von den Dioden 11 und 12 gegeben werden, so daß das Signal uneingeschränkt durch den Filter 4 gelangt. Am Ausgang wird der Mittelwert des Eingangssignals wiederhergestellt, wogegen das Hochfrequenzsignal durch das Filter 4 gelöscht wird. Dieser Fall entspricht dem Rollen auf Pflaster.

Während der Zeit C ist die Frequenz fe auch höher als die Grenzfrequenz fc, aber die Amplitude des Signals übersteigt die Amplitudenschwellen s_1, s_2, die von den Dioden 11,12 gegeben werden. Das Hochfrequenzsignal erfährt keine Phasenverschiebung, sondern es wird in der Amplitude um den Wert der Amplitudenschwellen s_1,s_2 verringert. Dieser Fall entspricht dem Rollen auf einem Weg, der in sehr schlechtem Zustand ist.

Bei D handelt es sich um brutales Bremsen auf schlechtem Weg. Sobald das Eingangssignal den Wert der Amplitudenschwellen s_1,s_2 überschreitet, findet man es am Ausgang, vermindert um den Wert der Amplitudenschwellen s_1,s_2 wieder. Wenn das Phänomen sich hinzieht, kann man mit dem Filter 4 am Ausgang einen Wert erhalten, der mit dem Eingangssignal identisch ist.

Die Grenzfrequenzen des Filters 4 können gewählt werden, z.B. für starke Amplituden mit 2 Hz, bei geringen Amplituden mit 0,3 Hz. Im letztgenannten Fall ist also die Dämpfung des Signals wichtig. Die bei höheren Frequenzen gegebene Phasenverschiebung hat keine Wirkung auf die Einstellung der Scheinwerfer.

In Fig. 3 sieht man, daß die Vorrichtung einen ersten Fühler 101 besitzt, welcher zwischen der Vorderachse und der Karosserie des Fahrzeuges montiert ist, um die relativen Bewegungen festzustellen. Ein weiterer Fühler 102 ist der Hinterachse zugeordnet. Die durch die Fühler 101,102 erzeugten Signale werden in einer Mischstufe 103 behandelt, in der ein Signal erzeugt wird, welches das Schaukeln oder Schwingen des Fahrzeuges bei seiner Bewegung darstellt. Der Ausgang der Mischstufe 103 ist mit einem Tiefpaßfilter 104 verbunden, das durch ein RC-Glied 105 in L-Form gebildet wird. Der Ausgang des Filters 104 ist mit einer Steuer- und Verstärkungseinrichtung 106 verbunden, die ein Leistungssignal an Betätigungsorgane 107 abgibt, welche die Bewegungen der Scheinwerfer 108 des Fahrzeuges hervorrufen. Das Filter 104 hat einen Serienwiderstand 109 und einen Parallelkondensator 110. Dem Serienwiderstand 109 ist eine Antiparallelschaltung zweier Diodeneinheiten 111,112 parallel geschaltet. Die eine Einheit hat zwei Dioden 111 und die andere drei Dioden 112. Jede Einheit ist in Serie mit einem Einstellwiderstand 113 bzw. 114 geschaltet.

Der Betrieb der Vorrichtung geht aus Fig. 4 hervor:

fe sei die Frequenz des Eingangssignals SE des Filters 104 und fc diejenige des Ausgangssignals SS. Man sieht, daß in der Zeit A die Frequenz des Eingangssignals fe unter der Grenzfrequenz fc des Filters 104 liegt. Daher wird das Signal uneingeschränkt am Ausgang wiederhergestellt, was die Korrektur bewirkt. Dieser Fall liegt z.B. einer einer statischen Korrektur vor, wenn die Last des Fahrzeuges geändert wird.

In der Zeit B ist die Frequenz fe höher als die Grenzfrequenz fc des Filters, aber die Hochfrequenzamplitude des Eingangssignals ist nicht nur geringer als der absolute Wert der Amplitudenschwelle s_1 entsprechend der

Verzögerung, sondern auch als der Wert der Amplitudenschwelle s_2 entsprechend der Beschleunigung, so daß das Signal uneingeschränkt den Filter 104 passiert. Am Ausgang wird nur der mittlere Wert des Eingangssignals wiederhergestellt, wogegen das Hochfrequenzsignal durch das Filter 104 eliminiert wird. Dieser Fall entspricht dem Weg auf Pflaster.

In der Zeit C, die einer leichten Beschleunigung entspricht, sieht man, daß die Amplitude des Signals S_E die Amplitudenschwelle s_2 der Beschleunigung überschreitet. Dies übersetzt sich in eine Veränderung des Signals S_S am Ausgang und infolgedessen in eine Korrektur der Scheinwerfer, die leicht gesenkt werden.

In der Zeit D, die einer leichten Verzögerung entspricht, welche eine Änderung mit fast derselben Amplitude wie bei der Beschleunigung C bewirkt, erfolgt keine Änderung des Signals S_S, weil die Amplitude unter der Amplitudenschwelle s_1 bleibt.

Erst wenn die Bremsung stärker ist, wie in der Zeit E, wobei die Amplitudenschwelle s_1 diesmal überschritten wird, geschieht auf der Kurve S_S eine Änderung des Signals, als Antwort auf die Bremsung. Die Grenzfrequenzen des Filters 104 können gewählt werden, z.B. für starke Amplituden 1 bis 2 Hz und für schwache Amplituden 0,15 Hz.

Man kann im übrigen in vorteilhafter Weise die antiparallel geschalteten Dioden durch in Serie geschaltete Zenerdioden ersetzen.

- 24 -

Leerseite

NACH[illegible]
3129891

Nummer: 3129891
Int. Cl.³: B 60 Q 1/08
Anmeldetag: 29. Juli 1981
Offenlegungstag: 9. Juni 1982

23.

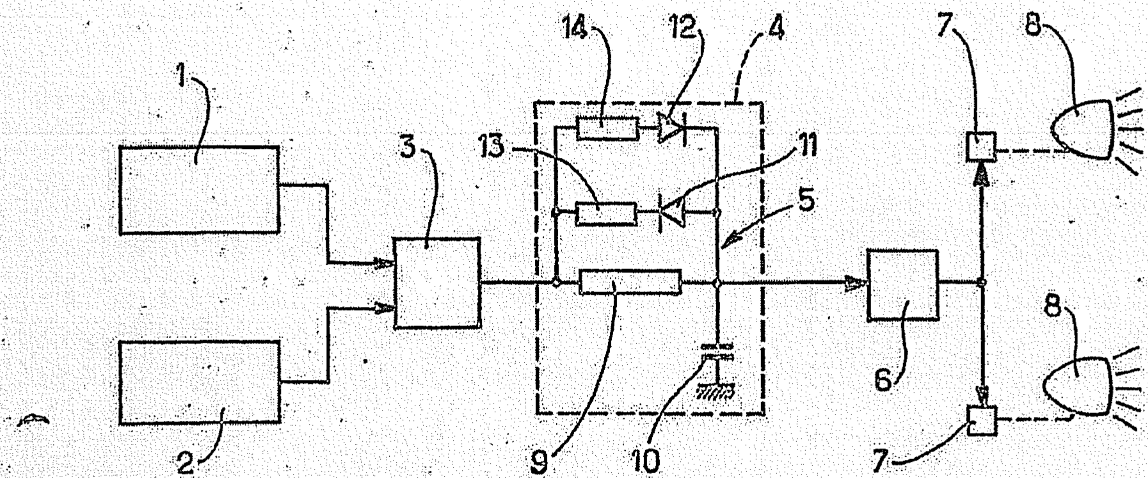


FIG. 1

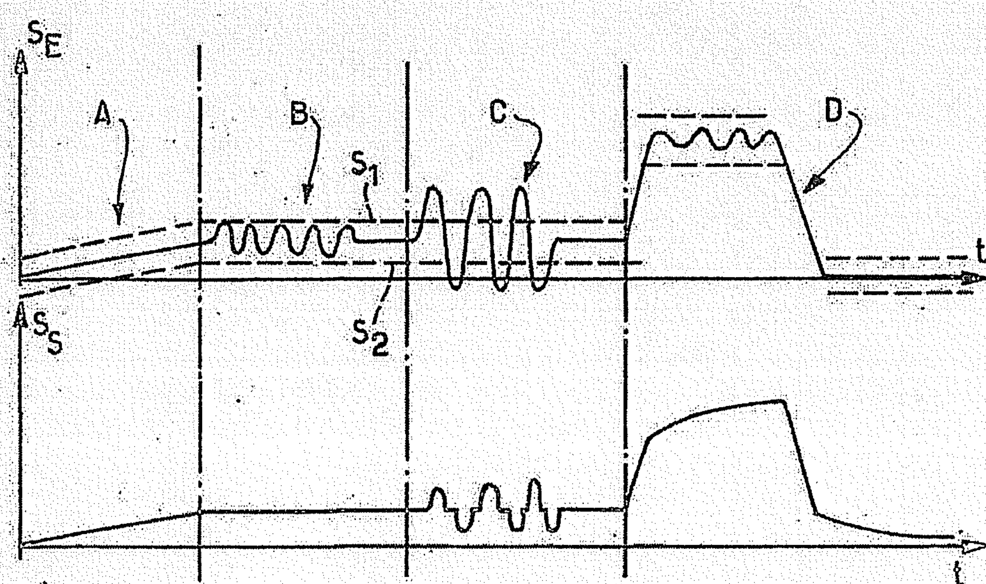
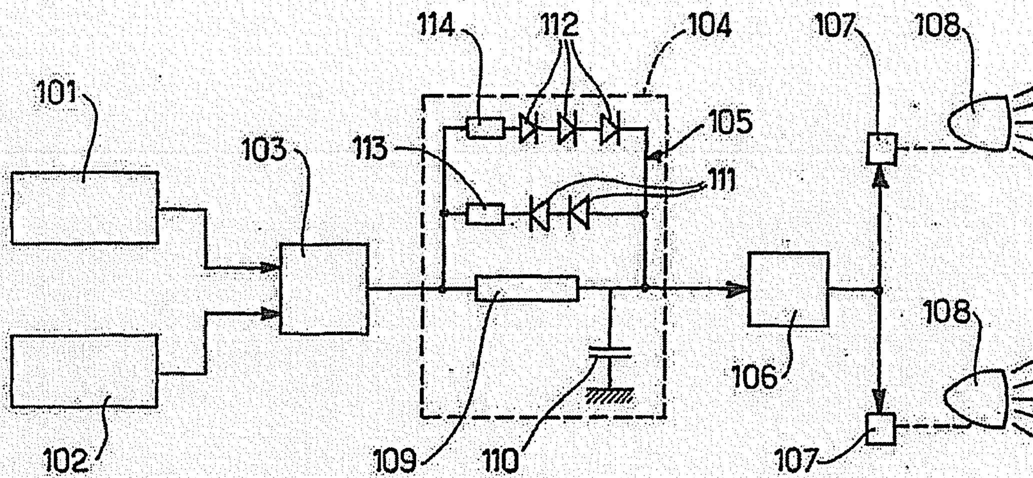


FIG. 2


101
102
103
104
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110
111
112
113
114

FIG. 3

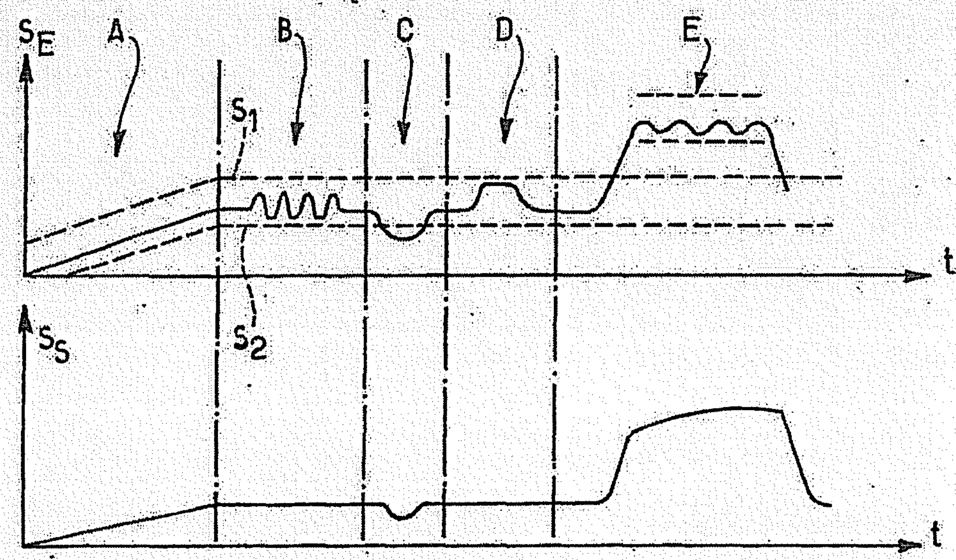
S_E
A
B
C
D
E
S_1
S_2
t
S_S
t

FIG. 4

EXHIBIT 5

LIST OF DOCUMENTS CITED BY THIRD PARTY REQUESTER IN *INTER PARTES* REEXAMINATION	PATENT NO. 7,241,034	PATENTEE James E. SMITH et al.
	PATENT DATE July 10, 2007	

U. S. PATENT DOCUMENTS

EXAM. INITIAL	PATENT/ PUBLICATION NUMBER	NAME	PATENT/ PUBLICATION DATE	CLASS	SUBCLASS	FILING DATE
	4,954,933	Wassen et al.	September 4, 1990			
	5,182,460	Hussman	January 26, 1993			
	5,909,949	Gotoh	June 8, 1999			
	6,193,398	Okuchi et al.	February 27, 2001			
	6,305,823	Toda et al.	October 23, 2001			

FOREIGN PATENT DOCUMENTS

EXAMINER INITIAL	DOCUMENT NUMBER	COUNTRY	DATE	NAME	SUBCLASS	TRANSLATION	
						YES	NO
	31 29 891	DE	June 9, 1982			X	
	31 10 094	DE	September 30, 1982			X	
	2 309 773	GB	August 6, 1997				X
	2 309 774	GB	August 6, 1997				X

OTHER DOCUMENTS

EXAMINER INITIAL	Name
	"Original Complaint for Patent Infringement," filed on March 8, 2010, *BALTHER TECHNOLOGIES, LLC, v. AM. HONDA MOTOR CO. INC., et al.*, Case No. 6:10-CR-78-LED (E.D. Tex.).
	"Plaintiff's Notice of Voluntary Dismissal," filed on May 17, 2010, *BALTHER TECHNOLOGIES, LLC, v. AM. HONDA MOTOR CO. INC., et al.*, Case No. 6:10-CR-78-LED (E.D. Tex.).
	"Order," dated May 18, 2010, *BALTHER TECHNOLOGIES, LLC, v. AM. HONDA MOTOR CO. INC., et al.*, Case No. 6:10-CR-78-LED (E.D. Tex.).
	Certified English-language translation of German Patent Application Publication No. 31 10 094 to Miskin et al.
	Certified English-language translation of German Patent Application Publication No. 31 29 891 to Leleve.

EXAMINER	DATE CONSIDERED
EXAMINER: Initial if citation considered, whether or not citation is in conformance with M.P.E.P. 609; draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.	

EXHIBIT 17

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re Patent of	:	James E. SMITH et al.
Patent No.	:	7,241,034
Issued	:	July 10, 2007
Title	:	AUTOMATIC DIRECTIONAL CONTROL SYSTEM FOR VEHICLE HEADLIGHTS
Application Serial No.	:	10/285,312
Filed	:	October 31, 2002
Requester	:	Volkswagen Group of America, Inc.

CERTIFICATE OF SERVICE

I hereby certify that a copy of the attached "**REQUEST FOR *INTER PARTES* REEXAMINATION OF U.S. PATENT NO. 7,241,034 PURSUANT TO 37 C.F.R. § 1.915**" has been served in its entirety by first class mail on the patent owner at the following address as provided for in 37 C.F.R. § 1.33 (c):

The Caldwell Firm, LLC
PO Box 59655
Dept. SVIPGP
Dallas, TX 75229

on this 16th day of May 2011.

/Clifford A. Ulrich/
Clifford A. Ulrich
Reg. No. 42,194

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One Broadway
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Attorney for Requester,
Volkswagen Group of America, Inc.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

Bib Data Sheet

CONFIRMATION NO. 1240

SERIAL NUMBER	FILING OR 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
95/001,621	05/16/2011 RULE	362	3992	

APPLICANTS

7,241,034, Residence Not Provided;
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KENYON & KENYON LLP, NEW YORK, NY

** **CONTINUING DATA** *************************

This application is a REX of 10/285,312 10/31/2002 PAT 7,241,034
which claims benefit of 60/335,409 10/31/2001
and claims benefit of 60/356,703 02/13/2002
and claims benefit of 60/369,447 04/02/2002

** **FOREIGN APPLICATIONS** ********************

	STATE OR COUNTRY	SHEETS DRAWING	TOTAL CLAIMS	INDEPENDENT CLAIMS
Foreign Priority claimed ☐ yes ☐ no 35 USC 119 (a-d) conditions met ☐ yes ☐ no ☐ Met after Allowance Verified and Acknowledged ________ Examiner's Signature Initials				

ADDRESS
92045

TITLE

Automatic Directional Control System for Vehicle Headlights

FILING FEE RECEIVED	FEES: Authority has been given in Paper No. _________ to charge/credit DEPOSIT ACCOUNT No. _________ for following:	☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other ____________ ☐ Credit

Patent Assignment Abstract of Title

Total Assignments: 4

Application #: 10285312 **Filing Dt:** 10/31/2002 **Patent #:** 7241034 **Issue Dt:** 07/10/2007

PCT #: NONE **Publication #:** US20030107898 **Pub Dt:** 06/12/2003

Inventors: James E. Smith, Anthony B. McDonald

Title: AUTOMATIC DIRECTIONAL CONTROL SYSTEM FOR VEHICLE HEADLIGHTS

Assignment: 1

Reel/Frame: 013729 / 0559 **Received:** 02/10/2003 **Recorded:** 02/06/2003 **Mailed:** 06/13/2003 **Pages:** 3

Conveyance: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Assignors: SMITH, JAMES E. **Exec Dt:** 01/31/2003

MCDONALD, ANTHONY B. **Exec Dt:** 01/31/2003

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Assignment: 2

Reel/Frame: 020540 / 0476 **Received:** 02/22/2008 **Recorded:** 02/22/2008 **Mailed:** 02/22/2008 **Pages:** 30

Conveyance: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Assignor: DANA CORPORATION **Exec Dt:** 01/31/2008

Assignee: DANA AUTOMOTIVE SYSTEMS GROUP, LLC
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Correspondent: DANA HOLDING CORPORATION
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KRISTENE M RAGAN
TOLEDO, OH 43615

Assignment: 3

Reel/Frame: 022813 / 0432 **Received:** 06/12/2009 **Recorded:** 06/12/2009 **Mailed:** 06/12/2009 **Pages:** 2

Conveyance: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Assignor: DANA AUTOMOTIVE SYSTEMS GROUP, LLC **Exec Dt:** 05/26/2009

Assignee: STRAGENT, LLC
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LONGVIEW, TX 75601

Assignment: 4

Reel/Frame: 024045 / 0235 **Received:** 03/08/2010 **Recorded:** 03/08/2010 **Mailed:** 03/09/2010 **Pages:** 2

Conveyance: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Assignor: STRAGENT, LLC **Exec Dt:** 12/16/2009

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Search Results as of: 05/20/2011 11:36 AM

Web interface last modified: Apr. 20, 2009

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United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
www.uspto.gov

REEXAM CONTROL NUMBER	FILING OR 371 (c) DATE	PATENT NUMBER
95/001,621	05/16/2011	7241034

CONFIRMATION NO. 1240
ASSIGNMENT NOTICE

92045
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PO Box 59655
Dept. SVIPGP
Dallas, TX 75229

OC000000047807534

Date Mailed: 05/23/2011

NOTICE OF ASSIGNMENT OF *INTER PARTES* REEXAMINATION REQUEST

The above-identified request for *inter partes* reexamination has been assigned to Art Unit 3992. All future correspondence in this proceeding should be identified by the control number listed above and directed to: Mail Stop Inter Partes Reexam, Commissioner for Patents, P.O. Box 1450, Alexandria VA 22313-1450.

A copy of this Notice is being sent to the latest attorney or agent of record in the patent file or, if none is of record, to all owners of record. (See 37 CFR 1.33(c).) If the addressee is not, or does not represent, the current owner, he or she is required to forward all communications regarding this proceeding to the current owner(s)

(MPEP 2222). An attorney or agent receiving this communication who does not represent the current owner(s) may wish to seek to withdraw pursuant to 37 CFR 1.36 in order to avoid receiving future communications. If the address of the current owner(s) is unknown, this communication should be returned with the request to withdraw pursuant to Section 1.36.

cc: Third Party Requester
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Legal Instruments Examiner
Central Reexamination Unit 571-272-7705; FAX No. 571-273-9900

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REEXAM CONTROL NUMBER	FILING OR 371 (c) DATE	PATENT NUMBER
95/001,621	05/16/2011	7241034

CONFIRMATION NO. 1240

REEXAM ASSIGNMENT NOTICE

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OC000000047807533

Date Mailed: 05/23/2011

NOTICE OF *INTER PARTES* REEXAMINATION REQUEST FILING DATE

Requester is hereby notified that the filing date of the request for *inter partes* reexamination is 05/16/2011, the date that the filing requirements of 37 CFR § 1.915 were received.

A decision on the request for *inter partes* reexamination will be mailed within three months from the filing date of the request for *inter partes* reexamination. (See 37 CFR 1.923.)

A copy of this Notice is being sent to the person identified by the requestor as the patent owner. Further patent owner correspondence will be with the latest attorney or agent of record in the patent file. (See 37 CFR 1.33.) Any paper filed should include a reference to the present request for *inter partes* reexamination (by Reexamination Control Number) and should be addressed to: Mail Stop Inter Partes Reexam, Commissioner for Patents, P.O. Box 1450, Alexandria VA 22313-1450.

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Central Reexamination Unit 571-272-7705; FAX No. 571-273-9900

Litigation Search Report CRU 3999

Reexam Control No. 95/001,621

TO: Mark Reinhart Location: CRU Art Unit: 3992 Date: 5/23/2011	From: Patricia Volpe Location: CRU 3999 MDW 7C69 Phone: (571) 272-6825 Patricia.volpe@uspto.gov

Search Notes

Litigation Search for U.S. Patent Number: **7,241,034**

Status (**CLOSED**) 6:10cv78 *Balther Technologies, Llc v. American Honda Motor Co Inc et A*

1) I performed a KeyCite Search in Westlaw, which retrieves all history on the patent including any litigation.

2) I performed a search on the patent in Lexis CourtLink for any open dockets or closed cases.

3) I performed a search in Lexis in the Federal Courts and Administrative Materials databases for any cases found.

4) I performed a search in Lexis in the IP Journal and Periodicals database for any articles on the patent.

5) I performed a search in Lexis in the news databases for any articles about the patent or any articles about litigation on this patent.

Date of Printing: May 23, 2011

KEYCITE

C US PAT 7241034 AUTOMATIC DIRECTIONAL CONTROL SYSTEM FOR VEHICLE HEADLIGHTS, Assignee: Dana Corporation (Jul 10, 2007)

History

Direct History

=> 1 **AUTOMATIC DIRECTIONAL CONTROL SYSTEM FOR VEHICLE HEADLIGHTS,** US PAT 7241034, 2007 WL 1978614 (U.S. PTO Utility Jul 10, 2007) (NO. 10/285312)

Patent Family

2 AUTOMATIC DIRECTIONAL CONTROL SYSTEM FOR A VEHICLE HEADLIGHT USES SENSOR TO GENERATE SIGNAL REPRESENTATIVE OF CONDITION OF VEHICLE, CONTROLLER RESPONSIVE TO SENSOR SIGNAL TO GENERATE OUTPUT SIGNAL AND ACTUATOR TO EFFECT, Derwent World Patents Legal 2003-543647

Assignments

3 Action: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS). Number of Pages: 002, (DATE RECORDED: Mar 08, 2010)

4 Action: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS). Number of Pages: 002, (DATE RECORDED: Jun 12, 2009)

5 Action: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS). Number of Pages: 030, (DATE RECORDED: Feb 22, 2008)

6 Action: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS). Number of Pages: 003, (DATE RECORDED: Feb 06, 2003)

Patent Status Files

.. Request for Re-Examination, (OG DATE: Sep 07, 2010)

.. Patent Suit(See LitAlert Entries),

Docket Summaries

9 BALTHER TECHNOLOGIES, LLC v. AMERICAN HONDA MOTOR CO. INC. ET AL, (E.D.TEX. Mar 08, 2010) (NO. 6:10CV00078), (35 USC 271 PATENT INFRINGEMENT)

Litigation Alert

10 Derwent LitAlert P2010-11-45 (Mar 08, 2010) Action Taken: complaint

Prior Art (Coverage Begins 1976)

C 11 ADJUSTABLE HEADLIGHTS, HEADLIGHT ADJUSTING AND DIRECTION SENSING CONTROL SYSTEM AND METHOD OF ADJUSTING HEADLIGHTS, US PAT 5868488 (U.S. PTO Utility 1999)

C 12 APPARATUS AND METHOD FOR CONTROLLING LIGHT DISTRIBUTION OF HEAD-LAMP, US PAT 5660454Assignee: Toyota Jidosha Kabushiki Kaisha, (U.S. PTO Utility 1997)

C 13 APPARATUS AND METHOD FOR CONTROLLING THE LIGHT-RANGE OF MOTOR VEHICLE HEADLIGHTS, US PAT 5193894Assignee: Robert Bosch GmbH, (U.S. PTO Utility 1993)

C 14 APPARATUS FOR AUTOMATICALLY ADJUSTING AIMING OF HEADLIGHTS OF AN AUTOMOTIVE VEHICLE, US PAT 5877680Assignee: Denso Corporation, (U.S. PTO Utility 1999)

C 15 APPARATUS FOR CONTROLLING A HEADLIGHT OF A VEHICLE, US PAT 4891559Assignee: Nippondenso Soken, Inc., (U.S. PTO Utility 1990)

C 16 APPARATUS FOR REGULATING THE ILLUMINATION FIELD OF A VEHICLE HEAD-LIGHT, US PAT 6144159Assignee: Robert Bosch GmbH, (U.S. PTO Utility 2000)

C 17 ARRANGEMENT FOR AUTOMATIC HEADLIGHT ADJUSTMENT, US PAT 6231216Assignee: Dr. Ing. h.c.F. Porsche AG, (U.S. PTO Utility 2001)

C 18 AUTOMATIC LEVELING APPARATUS FOR USE WITH AUTOMOBILE HEADLAMPS, US PAT 6183118Assignee: Koito Manufacturing Co., Ltd., (U.S. PTO Utility 2001)

C 19 AUTOMATIC LEVELING DEVICE FOR AUTOMOTIVE VEHICLE HEADLAMPS, US PAT 6305823Assignee: Koito Manufacturing Co., Ltd., (U.S. PTO Utility 2001)

C 20 AUTOMOTIVE ILLUMINATION SYSTEM, US PAT 4943893Assignee: Koito Manufacturing Co., Ltd., (U.S. PTO Utility 1990)

C 21 CONTINUOUSLY VARIABLE HEADLAMP CONTROL, US PAT 6281632Assignee: Gentex Corporation, (U.S. PTO Utility 2001)

C 22 CORNERING LIGHT SYSTEM FOR TWO-WHEELED VEHICLES, US PAT 4024388Assignee: Marvin H. Kleinberg, Inc., (U.S. PTO Utility 1977)

C 23 DEVICE FOR ADJUSTING THE INCLINATION OF AUTOMOBILE HEADLIGHTS, US PAT 4186428Assignee: Cibie Projecteurs, (U.S. PTO Utility 1980)

C 24 DEVICE FOR ADJUSTING THE LEVEL OF A VEHICLE HEADLIGHT, US PAT 5779342Assignee: Bayerische Motoren Werke Aktiengellschaft, (U.S. PTO Utility 1998)

C 25 DEVICE FOR ADJUSTING AN OBJECT TO ASSUME A PREDETERMINED ANGLE TO A CERTAIN PLANE, US PAT 4217631 (U.S. PTO Utility 1980)

C 26 DEVICE FOR ADJUSTING A PRESETTABLE LIGHTING LEVEL OF A HEADLIGHT IN MOTOR VEHICLES, US PAT 5785405Assignee: Bayerische Motoren Werke, (U.S. PTO Utility 1998)

C 27 DEVICE FOR CONTROLLING THE LIGHT WIDTH OF HEADLIGHTS FOR VEHICLES, US PAT 5896011Assignee: Robert Bosch GmbH, (U.S. PTO Utility 1999)

C 28 DEVICE FOR REGULATING LIGHT WIDTH OF HEADLIGHTS FOR VEHICLES, AND VEHICLE PROVIDED THEREWITH, US PAT 6142655Assignee: Robert Bosch GmbH, (U.S.