

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Mercedes-Benz USA, LLC,
Petitioner,

v.

Yechezkal Evan Spero.
Patent Owner.

IPR2023-01034
Patent 11,208,029

**SECOND DECLARATION OF DR. NIKOLAOS PAPANIKOLOPOULOS
IN SUPPORT OF MERCEDES' PETITION FOR *INTER PARTES* REVIEW
OF CLAIMS 1-33 OF U.S. PATENT NO. 11,208,029**

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I, Dr. Nikolaos Papanikolopoulos, declare:

I. INTRODUCTION

1. I have been retained on behalf of Mercedes-Benz USA, LLC (“Mercedes”) to offer technical opinions relating to U.S. Patent No. 11,208,029 (EX1001) (the “’029 Patent”) and certain prior art references relating to its subject matter in the present case (IPR2023-01034). My qualifications and background are provided in my first Declaration in this IPR. (EX1003.) I submit this Second Declaration to address certain issues raised in Yechezkal Evan Spero’s Patent Owner’s Response (“POR”; Paper 23), Dr. Matthew A. Turk’s declaration (EX2040), and the transcript of Dr. Turk’s deposition (EX1011, EX1012).

2. I have no financial interest in either party or in the outcome of this proceeding. I am being compensated for my work as an expert on an hourly basis. My compensation is not dependent on the outcome of these proceedings or the content of my opinions.

3. In writing this declaration, I have considered the following: the list of materials attached as Appendix A hereto, my own knowledge and expertise, including my work experience in the fields of intelligent vehicle systems, automotive control systems, and lighting control systems.

4. My opinions, as explained below, are based on my education, experience, and expertise in the fields relating to the ’029 Patent. Unless otherwise

stated, my testimony below refers to the knowledge of one of ordinary skill in the fields as of the priority date of the '029 Patent, or before. For the purposes of this Declaration, I have been asked to assume that the '029 Patent has a priority date of July 12, 2002.

II. Independent Claims 1, 12, and 23

1[D]: *determine a light change, the change adapting a light pattern of the headlamps in at least one of color, intensity or spatial distribution to increase light in a direction of the road curvature ahead of the motor vehicle and shaping light based at least in part on the road curvature; and*

1[E]: [1] *control at least a first plurality of the LED light sources to provide light based at least in part on the determined light change and [2] prior to the motor vehicle reaching the road curvature.*

5. I understand that Patent Owner argues that Alden does not provide an enabling disclosure of detecting road curves by sensing roadside reflectors, particularly because Alden's system cannot distinguish between reflectors and other light sources such as an oncoming vehicle. (POR, 23-25.) I disagree. Rather, Alden provides an enabling disclosure of a segmented headlight system with all the functionality described therein.

6. As explained in my first declaration and at my deposition, Alden teaches its system detects different objects by checking for light above a certain "threshold" intensity or distance at each location of the sensor array. (Alden, Fig. 4, [0028]; EX1003, ¶60.) The logic of Figure 4 would apply to detecting roadside reflectors, with Paragraph [0036] of Alden now indicating that instead of dimming

where objects (*i.e.*, reflectors) indicating the curve are detected, the system will now “direct light into the corner” by switching LEDs directed towards the reflectors to high beam and switching certain LEDs not directed at the curve to low beam or even off. (EX1003, ¶¶59-65; EX2066, 114:20-115:14; Alden, [0027]-[0028], Fig. 4.) To distinguish between different objects, such as roadside reflectors or oncoming vehicles, a POSITA would have understood from Alden that the threshold intensity or distance of the process described in Figures 3 and 4 may, for example, simply be adjusted based on the type of an object. (*Id.*; *see also* EX2066, 114:20-115:14.) Additionally, Alden’s system also evaluates the location/distance of detected lights in determining the headlight distribution pattern, which could also be used to differentiate between different objects. (*Id.*) A POSITA would understand that by looking at the spatial-temporal data representing light received from a reflector, Alden’s system could distinguish the reflector from other objects. (*Id.*)

7. For example, unlike an oncoming vehicle which is continuously moving, a roadside reflector is usually fixed at a certain location and is often at the opposite side from the oncoming vehicle. Further, just like how Alden’s system looks for “two dots” from the headlights of a vehicle to identify an oncoming vehicle, the system could instead look for a pattern consisting of smaller dots representing the light from roadside reflectors along a road curve. (Alden, [0028], [0036], Fig. 4.) Additionally, Alden’s system also evaluates the location/distance of detected lights

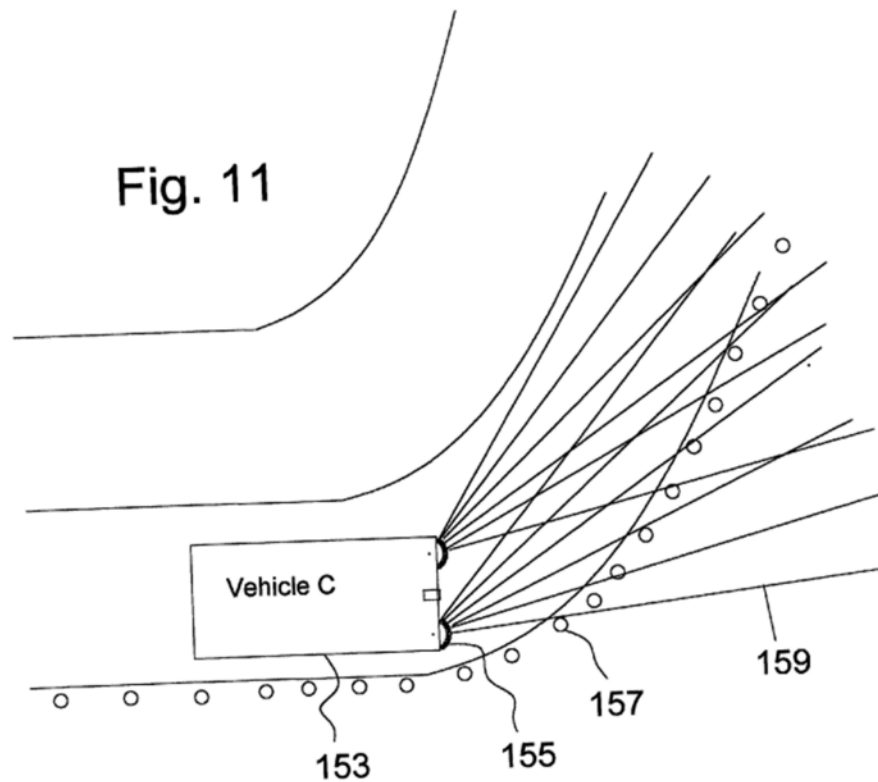
in determining the headlight distribution pattern, which could also be used to differentiate between a headlight and a series of roadside reflectors. (Alden, [0028].) Thus, a POSITA would understand that Alden's system can identify different objects not only based on the light intensities but also based on their locations.

8. Moreover, Patent Owner mischaracterizes my testimony at my deposition explaining Alden's functionality to concentrate light in the direction of an upcoming curve. (POR, 23-25.) At my deposition, I did not read anything into Alden or suggest that Alden's system could not distinguish roadside reflectors from vehicle headlights. Rather, in response to Patent Owner's questions, I explained that light from roadside reflectors could be sensed by Alden's light sensors in the same matter that vehicle headlights are sensed. The system could then adjust the headlight illumination pattern in response to the detected road curve by applying the logic the system applies to adjust the headlight illumination pattern in response to an oncoming vehicle. That is, when the system detects a road curve by sensing light from reflectors, the system could use the same logic and "the segmented sensing elements and segmented light distribution elements" described in relation to Figures 3-4, but instead of dimming light the system would "direct light into" the road curve to maximize the driver's ability to see there." (Alden, [0028], [0036], Fig. 4; EX2066, 114:20-115:14.)

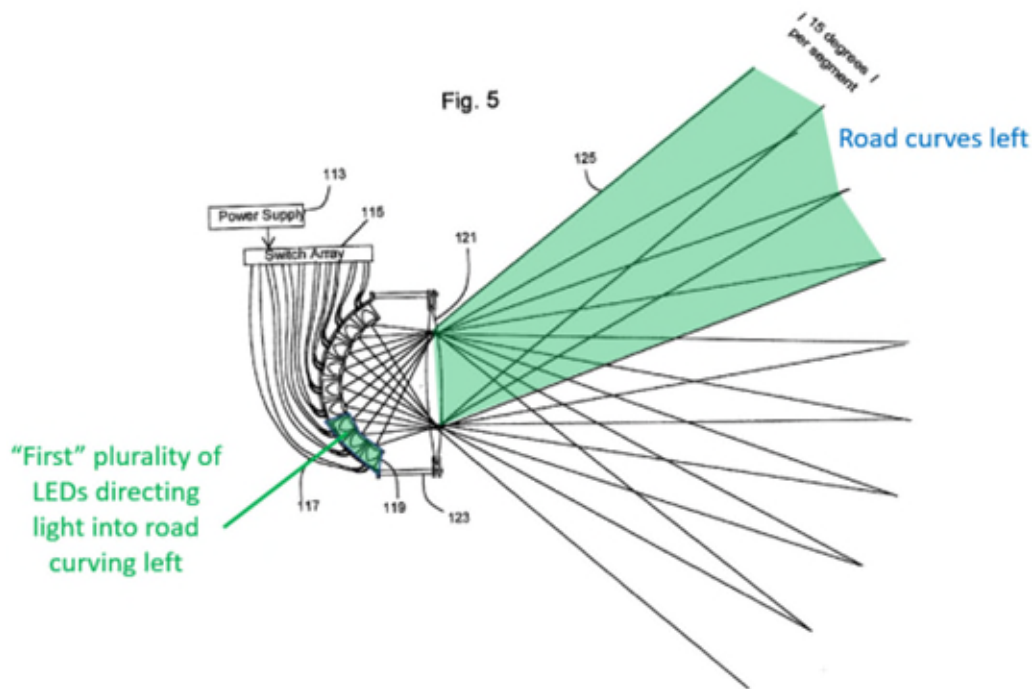
9. I understand that Patent Owner further argues that Alden does not increase illumination in the direction of a curve, because its headlamp beam is wide enough to encompass curves and its LEDs are always in high beam. (POR, 25-31.) That is not how a POSITA would have understood the reference.

10. As a preliminary matter, even if maximizing light and selectively dimming only the sectors required to minimize glare for oncoming drivers was considered Alden’s primary purpose, nothing in Alden suggests that its system must *always* operate to achieve this purpose, especially when performing other functionality expressly disclosed in Alden.

11. For example, as described above, Alden discloses the functionality to “concentrate light to look around corners in response to road conditions.” (Alden, [0036].) Alden illustrates its system performing this functionality in Figure 11 depicting an equipped vehicle approaching a left-hand curve:



(*Id.*, Fig. 11.) As shown above, when performing this functionality Alden’s system does not simply operate all LEDs at high beam, only dimming sectors required to minimize glare. Rather, Alden discloses its LEDs are “operable within a range of intensities” and shows its system could control its LEDs to produce an illumination pattern like the one shown in the annotated Figure 5 included in my first declaration:



(*Id.*, Fig. 5 (annotated), [0027]-[0029], [0036], [0061]; EX1003, ¶75.) That is, when the equipped vehicle approaches a left-hand curve, the LEDs aimed towards the left side of the headlight distribution area can be controlled to direct light to illuminate the curve while those aimed elsewhere could be terminated or dimmed.

12. As a further example, Alden discloses its system can be used “to concentrate light to look up a hill” and “to concentrate light to look down a hill.” (*Id.*, [0055]-[0056].) Figures 12 and 13 highlight this, showing light distribution patterns that would be output from different LEDs depending on the situation. (Alden, Figs. 12-13.) For example, looking at Figure 12 with light being directed uphill, it is clear that LEDs in the bottom rows would be activated to achieve the illumination towards the top of the hill. But, when traveling on a straight road, there

would be no need to provide illumination that high up. As such, the bottom row of LEDs could be off in such situations (*i.e.*, not defaulted to high beam) and only activated when needed to look up a hill. (*Id.*, Figs. 12-13, [0037]-[0038] (indicating the functionalities of directing light uphill and downhill can be “achieved with the segmented sensing elements and segmented light distribution elements described herein,” which would include Figure 5).) Thus, a POSITA would have understood that Alden’s system does not simply always maximize light and selectively dim only the sectors required to minimize glare for oncoming drivers. Rather, Alden discloses a segmented distribution headlight with individually controlled segments with broad functionality.

13. I understand that Patent Owner argues that Kobayashi’s map data cannot be used with Alden because using Kobayashi’s map data would be incompatible with Alden’s steering wheel sensor. (POR, 35-36.) This is incorrect. As I explained in my previous declaration, it would have been obvious to a POSITA to apply Kobayashi’s teachings of detecting road curves and adapting the headlight pattern based on map data to Alden’s system. (EX1003, ¶69.) Kobayashi’s map data and Alden’s steering wheel rotation sensor data are both a means by which the system can determine that the vehicle is approaching a road curve. (Alden, [0039]-[0040]; Petition, 21-25 29-30; EX1003, ¶¶66-77.) A POSITA would have understood that using Kobayashi’s map data to determine when the road curves and

adjust the lights accordingly would be preferred in certain situations. (Petition, 25.) For example, map data may be preferable for considering and accounting for upcoming curves farther away from the vehicle, while steering wheel rotation sensor data may be preferable for accounting for curves more immediate or slight turning of the vehicle as it travels along a road. And, in areas where map data is less reliable, such as where GPS signals cannot be acquired, steering wheel rotation sensor data may be preferred. (EX1003, ¶¶69-70.) It would have been obvious to a POSITA to incorporate different types of data and to prioritize certain data based on the vehicle's particular circumstances.

14. I understand that Patent Owner additionally argues that neither Alden nor Kobayashi teach controlling the light of the headlight *prior to* the equipped vehicle entering the curve. (POR, 37-42.) I disagree. Both references disclose adapting its system's illumination pattern before the vehicle enters the road curve.

15. As explained in my first declaration, Alden discloses that its system concentrates light in the direction of the road curvature when said road curvature is detected. (EX1003, ¶76; Alden, Fig. 11, [0036]-[0040].) Drivers need the road curve illuminated before reaching the curve so that they can adjust their speed and steering accordingly. Alden's system discloses that a road curve can be detected by sensing the light from roadside reflectors. (Alden, [0036].) Because the sensors are positioned to detect light ahead of the equipped vehicle, Alden's system would

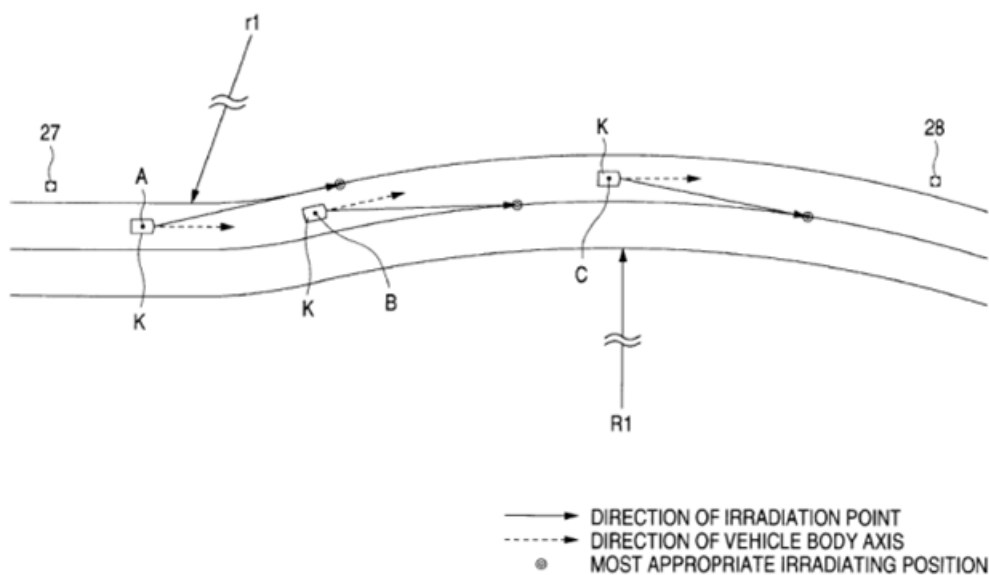
detect a curve by sensing roadside reflectors when the reflectors, and thus the road curve, is ahead of the vehicle. When the curve is detected, Alden's system will control its LEDs to adapt the headlight illumination pattern accordingly. Thus, the light from the headlight is controlled when the curve is ahead of the equipped vehicle, prior to the vehicle entering the curve.

16. Moreover, Alden discloses that a steering wheel rotation sensor can be used to detect an upcoming road curve. (*Id.*, [0039]-[0040].) Using the steering wheel rotation sensor can be an alternative means for detecting an upcoming road curve, or "may be used in combination" with the method of detecting road curves by sensing reflectors or other methods. (*Id.*, [0061].) Alden explains that when the steering wheel rotation sensor detects that the steering wheel has been rotated "x" degrees, Alden's system "changes the direction of the headlight output a corresponding 'f(x)' degrees." (*Id.*, [0040].) In other words, when a driver turns the steering wheel, the system will control the LEDs accordingly.

17. A driver begins to turn the steering wheel prior to entering the curve in order to align the vehicle with the direction of the beginning of the curve. The driver then continues to keep the steering wheel turned in order to follow the curvature of the road as the vehicle advances along the road. Thus, because a driver of a vehicle begins to turn the steering wheel prior to the vehicle entering the road curve, the system would control the LEDs prior to the vehicle entering the curve.

18. In addition, as I explained in my first declaration, Kobayashi also discloses “reshaping” the light emitted from a headlight before the equipped vehicle enters the road curve. (EX1003, ¶77.) Doing so is shown in Kobayashi’s Figure 10:

FIG. 10



(Kobayashi, Fig. 10.) As seen above, Kobayashi’s system reshapes the light of its headlight to provide illumination in the direction curve prior to the vehicle entering the curve. For example, at Point A in Figure 10, the solid line representing the direction of irradiation shows the reshaped headlight pattern illuminating to the vehicle’s left in the direction of the upcoming leftward curve. At this point, the vehicle has not yet reached the road curve and is still travelling straight (to the right of the figure) as shown by the dotted line representing the direction of vehicle body axis. Likewise, at Point C, Figure 10 shows the light reshaped to illuminate to the

vehicle's right. At Point C, the vehicle has not yet entered the rightward curve and is still travelling straight (to the right of the figure) as represented by the dotted line.

III. Dependent Claims 5, 16, and 27

5/16: *The [system of claim 1 / storage medium of claim 12] wherein the increase of light in the direction of the road curvature includes at least an increase of light emitted at a level below high-beam light and directed in the direction of the road curvature.*

27: *The method of claim 23, wherein the increase of light in the direction associated with the shape change includes at least light output that increases light emitted at a level below high-beam light and directed in the direction associated with shape change.*

19. I understand that Patent Owner argues that Alden does not teach the increase of light emitted at a level below high-beam directed in the direction of a road curve because the default operating state of Alden's LEDs is to emit high-beam intensity, so there would never be light below high beam that is increased. (POR, 47-50.) That is not how a POSITA would have understood Alden's system. As I explained above, a POSITA would have understood Alden's system has broad functionality and does not simply provide maximum light unless otherwise dimmed as Patent Owner suggests. *See supra* ¶¶5-18. Moreover, as I explained, a POSITA would have understood this increase of light in the direction of the curve would be a level less than high beam. (EX1003, ¶¶98-100.)

IV. Dependent Claims 7, 18, and 29

7[A]/18[A]: *wherein the determination of the light change includes determination of light changes to individual LEDs of the first plurality of LED light sources,*

7[B]/18[B]: at least one of the changes including at least one of: [1] a variation to at least one of intensity or color of individual LEDs of the first plurality of LED light sources, or [2] providing light directed in the direction of the road curvature from an LED not providing light directed in the direction of the road curvature prior to the change.

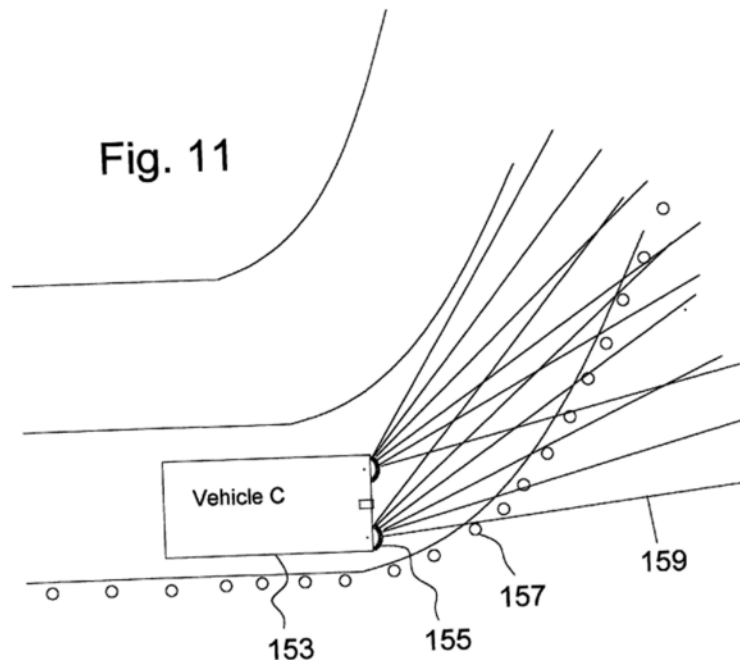
29[A]: wherein the determining the light output includes determining output for individual LEDs of the first plurality of LED light sources,

29[B]: the output including providing light directed in the direction associated with the shape change from an LED not providing light directed in the direction associated with the shape change prior to the change.

20. I understand that Patent Owner argues that Alden cannot change an LED from not providing light in the direction of the curve to providing light in the direction of the curve because all of Alden's LEDs allegedly always produce high intensity light unless otherwise dimmed, and Alden cannot change the LED from a direction aimed away from the curve to a direction aimed at the curve. (POR, 55.) Patent Owner again fails to understand how a POSITA would have understood Alden's disclosure.

21. First, as I explained above, a POSITA would have understood that Alden's system does not default all LEDs to emit light at high-beam intensity unless otherwise dimmed. *See supra* ¶¶5-18. Second, as explained in the Petition, Alden's system will "concentrate light to look around corners" when a curve is detected by "direct[ing] light into the corner to maximize the driver's ability to see there." (Petition 51-52; Alden, [0036].) It does this by emitting light from LEDs directed towards the curve which may not have previously been illuminated (as they do not

direct light generally ahead), and thus it changes shape of the overall illumination by emitting light from LEDs not providing light directed towards the curve prior to the change. (EX1003, ¶¶107, 112.) Consider, for example, Alden’s Figure 11:

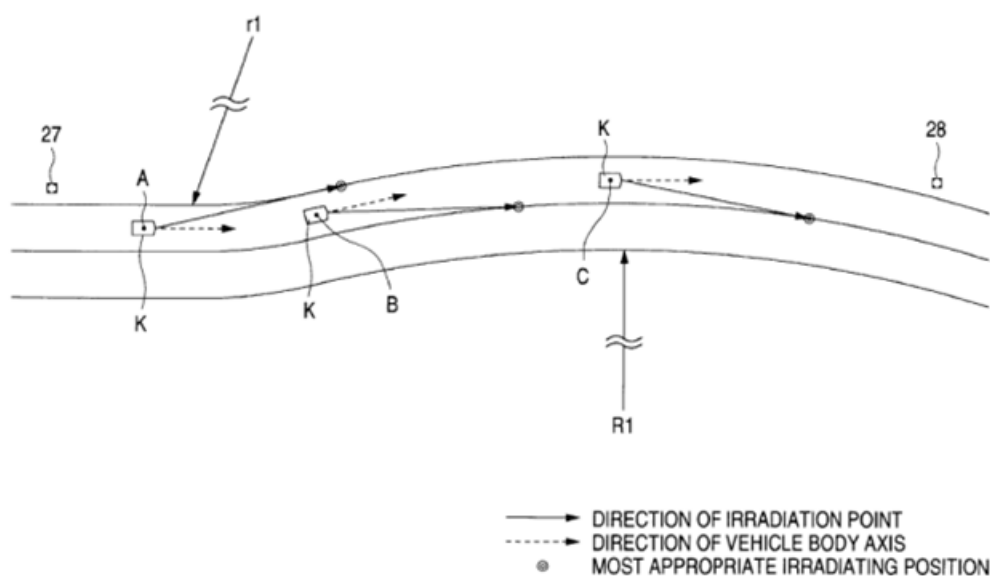


(Alden, Fig. 11.) Figure 11 illustrates the system’s ability to “direct light into the corner[.]” (*Id.*, [0054].) When the vehicle was traveling straight, prior to detecting the road curve, the headlight illumination pattern would have been directing light forward from the vehicle. Figure 11 shows that once the system detects a left-hand curve, LEDs positioned to provide illumination to sectors on the left side of the system’s light distribution area are increased their illumination to direct light into the curve. As I explained at my deposition, the curved surface could be a spherical surface (EX2041, 119:9-17), and a POSITA would understand that when the

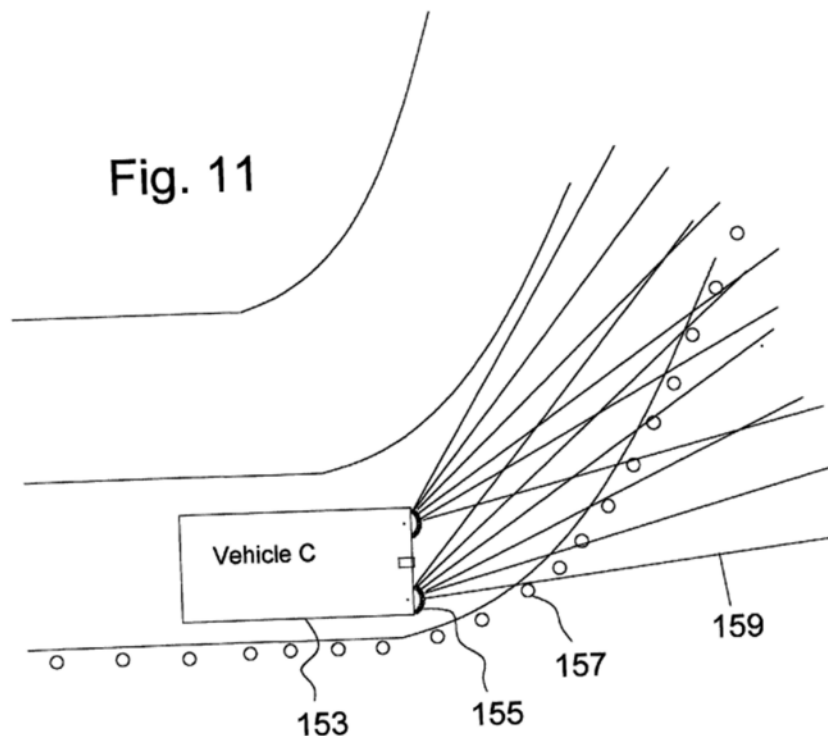
headlight needs to concentrate light to the left, the right columns of LEDs will be switched on. Similarly, when the headlight needs to concentrate light to the right, the left columns of LEDs will be switched on.

22. Moreover, Kobayashi teaches continuously “reshaping” the light output of the headlight as the equipped vehicles continue along a road with multiple road curves. As I explained in my first declaration, if the road had a left-hand curve followed by a right-hand curve, the combined system would select a second set of LEDs to direct light into the right-hand curve that were not previously focusing light into the curve as the vehicle approaches the right-hand curve. An example of such a road is shown in Kobayashi’s Figure 10:

FIG. 10



(Kobayashi, Fig. 10.) When the vehicle detects the left-hand road curve, Alden teaches to concentrate light in the direction of the road curve. LEDs are controlled to concentrate light in the direction of the road curve. (Alden, Fig. 11, [0054].) The resulting illumination pattern will be similar to that of Alden's Figure 11 shown below:



(Alden, Fig. 11.) As shown above in Figure 11, when accommodating such a left-hand curve, LEDs aimed at the sectors on the right end of the light distribution area are not providing illumination. If the vehicle detects a right-hand curve that follows the left-hand curve, the system would select a group of LEDs that included some of the LEDs aimed at the sectors on the right end of the light distribution area to

concentrate light in the direction of the right-hand curve. Thus, LEDs that *were not* providing light in the direction of the curve would be changed to LEDs that *are* providing light in the direction of the curve.

V. Dependent Claims 8, 19, and 30

8[B]/19[B]/30[B]: [1] *[control / controlling], based at least in part on the position, a second plurality of LED light sources providing light directed towards an area including at least a portion of the other vehicle to diminish glare to a driver of the other vehicle by a decrease to intensity of light directed towards and illuminating the area, [2] the light [that is] directed towards and illuminating the area having lower intensity compared to light directed towards points laterally adjacent the area to either side.*

23. I understand that Patent Owner argues Alden's Figure 5 is limited to a single row of LEDs and Petitioner's proofs relying on multiple rows of LEDs require modifying Alden. (POR, 56-59.) I disagree. Alden never calls the LEDs a "row" nor indicates that they are "one dimensional." Rather, Alden discloses that "the segmented headlight" as illustrated in Figure 5 is comprised of an "array" of lighting elements. (Alden, [0029], Fig. 5.) Figure 5 is simply a sectional view that depicts one row of LEDs in this array.

24. Reading Alden as a whole, a POSITA would readily understand that the segmented headlight as illustrated in Fig. 5 includes multiple rows of LEDs. For example, Figures 6-7 both show (a) a "sectional" view of one row of lighting elements and (b) a "front-on" view depicting the full two-dimensional array of elements within the headlight. (Alden, Figures 6-7.) Similarly, Figure 5 shows a

sectional view of a row of LEDs to illustrate the segmented lighting, and a POSITA would understand that the full array in the front-on view (such as similarly shown in Figures 6-7) would be two-dimensional. Alden also explains that “[a]ll embodiments maximize the areas receiving high beams for the benefit of the equipped vehicle driver while concurrently all areas with other drivers present receive low beams so as to minimize the glare for to betterment of other driver,” which include the embodiment in Figure 5 and the embodiment in Figures 6 and 7. (Alden, Abstract.) Alden also explains that these embodiments could be used “in combination to vary illumination in a segmented system.” (*Id.*, [0061].) Alden even discloses that a switch array similar to 115 as shown in Figure 5 is used in the embodiment of Figures 6 and 7. Therefore, a POSITA would have understood that because these embodiments use a similar switch array, share the same objective, and can be combined together, the segmented headlight in Figure 5 similarly has two-dimensional lighting element array as shown in Figures 6 and 7.

25. Additionally, Alden explains the “array” of LEDs in Figure 5 is controlled by corresponding switches from a switch array using the “CPU and logic previously described” in Figures 3 and 4. Thus, a POSITA would understand Alden’s Figure 5 must be read in connection with the descriptions of Figures 3 and 4. Because Figures 3-4 disclose the CPU and logic selectively providing high beam and dimmed low beam light in different sectors across a two-dimensional plane, a

POSITA would understand Figure 5 to likewise use multiple rows of LEDs. (Alden, Figs. 3-4, [0027]-[0028].)

26. As a further example, Figure 4 discloses the CPU logic compiling two-dimensional (XY) sensor maps of the detected light and determining dimmed and high beam zones within this XY space. (*Id.*, Fig. 4, [0028].) Particularly, Alden discloses the system checks each sector of the left sensor 89, from A1L, A2L through XYL, and similarly checks each sector of the right sensor, from A1R, A2R through XYR. (*Id.*) This is a clear indication that the sensor sectors are distributed in two dimensions, X and Y. For this logic to apply to Figure 5, as Alden expressly says it does, a POSITA would understand that a two-dimensional array of LEDs would be used corresponding to the two-dimensional sensor sectors. In particular, where Alden discloses that the LEDs “are on a curve along the focal point of a headlight lens 121 such that the light from each lighting element goes into a specified portion (or portions) of the headlight distribution area,” Alden is describing directing light into different sectors of a two-dimensional plane in front of the vehicle, which correspond to different sensor sectors. As such, it is again clear that Alden discloses multiple rows of LEDs along the focal point of a curved surface behind the lens to accomplish this. (Alden, [0029].) As I explained at my deposition, the curved surface could be a spherical surface. (EX2041, 119:9-17.) If the LED array were one-dimensional as Patent Owner alleges, then it could only correspond to X locations,

and not the plurality of XY locations that Figure 4 and Paragraph [0028] of Alden indicate are accounted for. (Alden, Fig. 4, [0028].)

27. As a final example, Alden discloses additional functionalities its “segmented light distribution elements” can perform, including “directing light to look around corners,” “concentrat[ing] light to look uphill,” and “concentrat[ing] light to look downhill.” (Alden, Figs. 11-13, [0036]-[0038].) In these paragraphs, Alden discloses that it is the “segmented light distribution elements described herein” (which would include those of Figure 5) that can perform these functions, not just the lighting elements of any particular embodiment. (*Id.*) For the segmented headlight of Figure 5 to direct light uphill and downhill, for example, there must be multiple rows of LEDs with some positioned on the curved surface to direct light upwards and others angled and positioned to direct light downwards. And a POSITA would understand that when the headlight needs to be concentrated to look up, it is likely that the bottom row of LEDs will be switched on, and when the headlight needs to be concentrated to look down, the top row of the LEDs will be switched on. (EX2067, 58:11-59:16.)

28. A POSITA would understand Figure 5 of Alden to illustrate one row of a two-dimensional LED array, with, as Alden explains, each LED used in the array having a corresponding switch in the control switch array. Overall, Alden’s figures are conceptual figures, and not technical schematics intended to represent the precise

number of switches and LEDs to be used in a particular real-world system. And, looking at Figures and description, it is clear that Alden is not limiting the sensors or switches to a particular number of rows or columns, or to a specific total number of sensors or switches. Instead, Alden uses notations like “A1L,” “A2L” and then “... XYZ” sensor positions to indicate there is a first left sensor (A1L), a second left sensor (A2L), and then some “XY” sensor that will depend on the number of sensors actually used. (Alden, Figures 3-4.) Therefore, Figure 3 does not disclose Alden’s system requiring 576 switches, and Figure 5 does not limit Alden’s system to 9 LEDs.

29. I understand Patent Owner further claims Petitioner is “modifying” Alden because I “admitted” that Alden does not expressly describe certain details of its system and read things into Alden at my deposition. (POR, 58-59.) This mischaracterizes my testimony. I have consistently testified that a POSITA would understand Alden’s Figure 5 to illustrate one row of a two-dimensional LED array, with each LED used in the array having a corresponding switch in the control switch array. At deposition, I did not read anything into Alden or suggest that a POSITA would not understand its concepts. Rather, in response to Patent Owner’s questions, I explained how Alden’s figures are conceptual figures (not precise schematics) and gave examples as to what these figures and corresponding descriptions disclose to a

POSITA regarding Alden. (See e.g., EX2041, 57:12-58:8, 111:9-23, 115:7-116:14; EX2066, 32:20-34:3, 44:12-22, 47:1-19, 99:21-100:11.)

VI. Dependent Claims 9, 20, and 31

9[B]/20[B]/31[B]: *the control of the second plurality of LED light source[s] is based at least in part on third data received from a non-camera sensor of the motor vehicle;*

30. I understand that Patent Owner argues that no control of a second plurality of LEDs to diminish glare can be in part based on data from Alden's steering wheel rotation sensor or Kobayashi's GPS sensor. (POR. 63-65). I disagree. As mentioned in my first declaration control of a second plurality of LEDs to reduce glare can be based in part on Alden's steering wheel rotation sensor data or Kobayashi's GPS sensor data. (EX1003; ¶¶138-143.)

31. Alden discloses that "[o]ne or more" of these "method employed herein may be used in combination to vary illumination in a segmented system." (Alden, [0061].) Thus, a POSITA would have understood that the method of controlling the headlight output based on the steering wheel rotation sensor could be used in combination with the method of dimming sectors in which an oncoming vehicle is detected. As I have previously described, Alden explains that its system "changes the direction of the headlight output a corresponding $f(x)$ degrees" when the steering wheel rotation sensor detects that the driver has rotated the steering wheel " x " degrees. (Alden, [0039]-[0040].) See *supra* ¶¶13-17. Accordingly, when the system

is dimming LEDs aimed at sectors containing an oncoming vehicle to diminish glare and the steering wheel rotation sensor is then turned “x” degrees, the headlight output, including the output of the dimmed LEDs, will have its direction changed a corresponding “f(x)” degrees.

32. For example, the equipped vehicle may be traveling along a road that is initially straight with an oncoming vehicle ahead of the equipped vehicle. When the system detects the oncoming vehicle by sensing the vehicles headlights, the system will dim a group of LEDs aimed at the vehicle to diminish glare. (Alden, [0026]-[0028].) If equipped vehicle then approaches a right-hand curve, the driver of the equipped vehicle will begin to turn the steering wheel to the right. The steering wheel rotation sensor will detect that the steering wheel has been rotated “x” degrees. (*Id.*, [0058].) In response, the system will change the headlight output direction a corresponding “f(x)” degrees to maximize visibility. This change of the headlight output direction will include further controlling the plurality of LEDs aimed at the oncoming vehicle to diminish glare. By doing so, the area dimmed to diminish glare will be maintained around the oncoming vehicle.

33. This control could similarly be achieved using data from Kobayashi’s GPS sensor. Like before, Alden’s light sensors could detect an oncoming vehicle and dim a plurality of LEDs aimed at the oncoming vehicle to diminish glare. Only now, rather than the headlight output direction being changed based on the steering

wheel rotation sensor data indicating that the equipped vehicle is turning to follow a road curve, the headlight output direction would be changed based on Kobayashi's GPS sensor data indicating that the equipped vehicle is following a road curve. Thus, control of the plurality of LEDs dimmed to diminish glare could be based at least in part on data from a non-camera sensor.

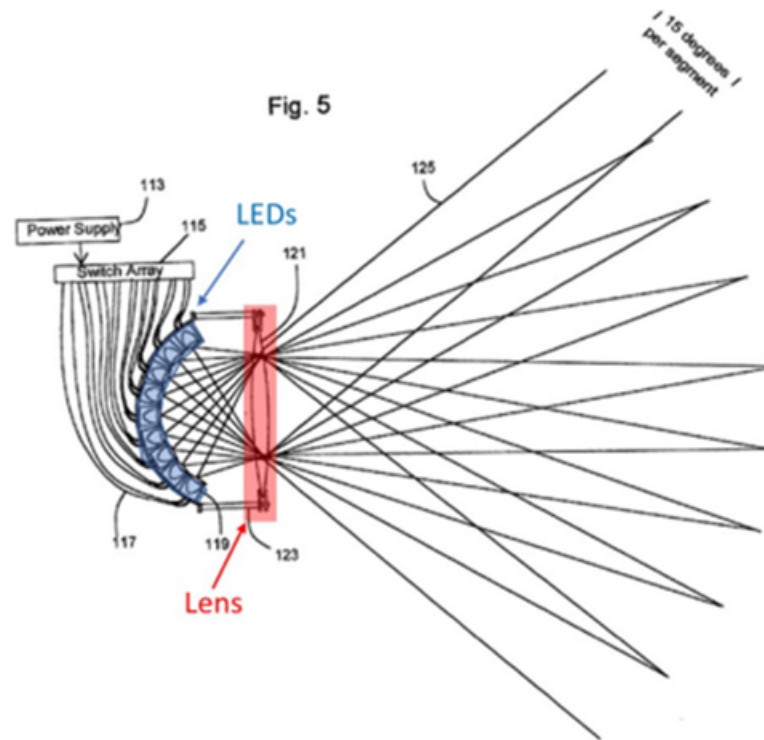
VII. Dependent Claims 21 and 32

21: The storage medium of claim 19, wherein the instructions include instructions that, when executed by the one or more processors, enable the one or more processors to utilize one or more optical control elements included in the motor vehicle to control light from at least the first plurality or second plurality of the LED light sources.

32: The method of claim 30, further comprising utilizing one or more optical control elements included in the motor vehicle to control light from at least the first plurality or second plurality of the LED light sources.

34. Regarding claims 21 and 32, I understand that Patent Owner argues that Alden's lens cannot be "used" or "utilized" by the processor. (POR, 67-68.) I disagree. As explained in my first declaration, Alden discloses that its LEDs "are on a curve along the focal point of a headlight lens 121 such that the light from each lighting element goes into a specified portion (or portions) of the headlight distribution area." (Alden, [0029]; EX2066, 34:18-35, 46:21-25; EX2067, 61:5-9.) In other words, the area a particular LED illuminates is dependent on how the LED is positioned relative to the focal point of the lens. As shown in Alden's annotated

Figure 5 below, as the light from an LED passes through the lens, the direction of the light is changed:



(*Id.*, Fig. 5 (annotated).) The processor is aware of how the lens affects the direction of light emitted from each LED, and it makes use of the change in direction to provide the desired illumination in a specified portion or portions of the entire light distribution area. In other words, the processor utilizes the lens to produce the desired headlight distribution pattern.

CERTIFICATION

I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true and, further, that these statements were made with the knowledge that willful false statements and the like are punishable by fine, imprisonment, or both, under Section 1001 of Title 18 of the U.S. Code.



Dr. Nikolaos Papanikolopoulos

Dated: July 8, 2024

APPENDIX A

Materials Considered

Exhibit No.	Description
1001	U.S. Patent No. 11,208,029 (“ ’029 ”)
1002	Original File History for the ’029 Patent
1003	Declaration of Dr. Nikolaos Papanikolopoulos
1004	Curriculum Vitae of Dr. Nikolaos Papanikolopoulos
1005	U.S. Patent Publication No. 2003/0,137,849 (“ Alden ”)
1006	U.S. Patent No. 6,049,749 (“ Kobayashi ”)
1007	U.S. Patent No. 6,144,158 (“ Beam ”)
1010	Second Declaration of Dr. Nikolaos Papanikolopoulos
1011	First Deposition Transcript of Dr. Matthew Turk
1012	Second Deposition Transcript of Dr. Matthew Turk
Paper 23	Patent Owner’s Response
2001	Declaration of Mathew A. Turk (POPR)
2040	Declaration of Mathew A. Turk (PO Response)
2041	Deposition Transcript of Dr. Nikolaos Papanikolopoulos
2066	Second Deposition Transcript of Dr. Nikolaos Papanikolopoulos
2067	Third Deposition Transcript of Dr. Nikolaos Papanikolopoulos