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(54) Title: BICYCLE LIGHTING SYSTEMS AND METHODS

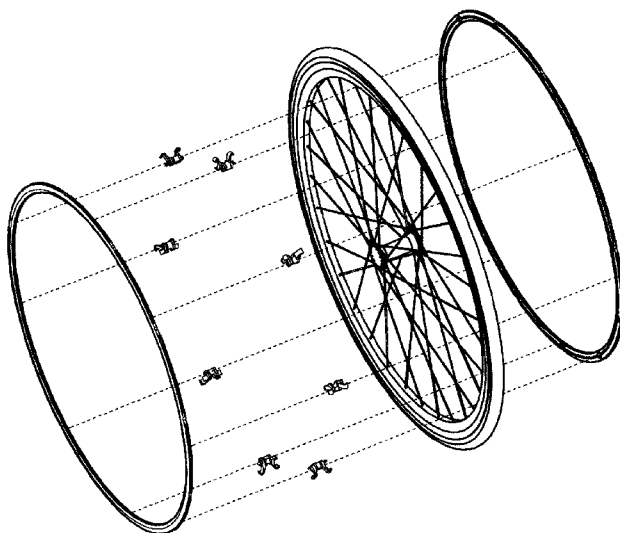


FIG. 43

(57) Abstract: Systems and methods for providing adequate lighting and sighting for a bicycle are disclosed. A lighting system that includes an illumination ring configured to be coupled to a wheel is also disclosed. The illumination ring is configured to simultaneously project light forward and to the side of a front wheel and to project light rearward of and to the side of a rear wheel. The illumination ring may be mounted to or integrated with the bicycle wheel. Methods of controlling light sources on the illumination ring are also disclosed.



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AMENDED CLAIMS

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We claim:

1. A lighting system for a wheel having a center plane encompassing the wheel circumference and the midpoint of the wheel width, the lighting system comprising:

- a support configured to be coupled to the wheel offset from the center plane; and
- a plurality of lights positioned on the support to direct radially in front of or behind the wheel from an arcuate area during wheel rotation, the arcuate area comprising an arc angle of less than 360 degrees defined from a reference position, each of the plurality of lights switching between:
 - a high state while the light is within the arcuate area, wherein the light emits light at substantially full power; and
 - a low state while the light is outside the arcuate area, wherein the light emits light at less than full power.

2. The lighting system of claim 1, wherein the support is a ring.

3. The lighting system of claim 1, wherein the support is integrated with the rim of the wheel.

4. The lighting system of claim 1, wherein the support is rigid.

5. The lighting system of claim 1, wherein the plurality of lights provide the

continuous arc of light by illuminating at least two neighboring lights of the plurality of lights at any given time.

6. The lighting system of claim 1, wherein the lights are light emitting diodes.

7. The lighting system of claim 1, wherein the lights are equally spaced along a circumference of the support.

8. The lighting system of claim 1, further comprising: a controller mounted to the ring and coupled to the plurality of lights to control the state of each of the plurality of lights.

9. The lighting system of claim 8, wherein the wheel is configured to be coupled to a vehicle frame, wherein the reference position is defined from a point on the vehicle frame, the lighting system further comprising an index sensor to sense a rotation of the wheel, and wherein the controller receives data from the index sensor and calculates a period of rotation or determines the reference position.

10. The lighting system of claim 9, wherein the index sensor comprises a hall effect sensor coupled to the support and a magnet coupled to the frame.

11. The lighting system of claim 9, further comprising an accelerometer, and wherein the controller receives data from the accelerometer to determine a velocity of the wheel.

12. The lighting system of claim 11, wherein the controller determines whether to turn each of the plurality of lights on or off based on the position of each light relative to the reference position and the velocity.

13. The lighting system of claim 8, further comprising an accelerometer, and wherein the controller receives data from the accelerometer to determine a velocity of the wheel and determines whether to turn each of the plurality of lights on or off based on the position of each light relative to the reference position and the velocity.

14. The lighting system of claim 8, wherein the reference position is a gravity vector, the lighting system further comprising an accelerometer that estimates the reference position from gravity, and wherein the controller receives data from the accelerometer to determine a velocity of the wheel and the reference position and determines whether to turn each of the plurality of lights of the illumination ring on or off based on the position of each light relative to the reference position and the velocity.

15. The lighting system of claim 1, wherein at most half of the plurality of lights are on during rotation of the wheel.

16. The lighting system of claim 1, wherein the wheel is a bicycle wheel, and wherein the support is mounted to the bicycle wheel between the bicycle wheel and a fork of the bicycle frame.

17. The lighting system of claim 1, further comprising: a plurality of mounts to mount the support to the wheel.

18. The lighting system of claim 17, wherein the plurality of mounts each comprise a first portion securable to a spoke of the wheel and a second portion to securable to the support.

19. The lighting system of claim 1, wherein the plurality of lights are mounted to the support.

20. The lighting system of claim 1, further comprising a power source on the illumination ring.

21. The lighting system of claim 19, wherein the power source comprises a plurality of induction coils.

22. lighting system of claim 21, wherein the plurality of induction coils are embedded in the ring.

23. The lighting system of claim 21, wherein the wheel is a bicycle wheel coupled to a frame, and further comprising a magnet coupled to the frame.

24. The lighting system of claim 1, wherein the wheel comprises a rim, and wherein

the plurality of lights are positioned in the rim of the wheel.

25. A lighting system for a wheel, the wheel comprising a tire, the tire having a width, the wheel having a central plane extending through the wheel circumference and a midpoint of the wheel width, the lighting system comprising:

a plurality of lights positioned on the wheel from the central plane by a distance at least equal to half the width of the tire and positioned to project light radially outward of the wheel in a vector substantially parallel to the central plane.

26. The lighting system of claim 25, wherein the distance is greater than half the width.

27. The lighting system of claim 25, further comprising a support, the plurality of lights positioned on the support, and wherein the support is mounted to the wheel so that the plurality of lights are offset from the central plane.

28. The lighting system of claim 25, further comprising a ring, the plurality of lights positioned on the ring, and wherein the ring is mounted to the wheel so that a plane through a circumference of the ring is offset from the central plane.

29. The lighting system of claim 1, wherein the arc angle of the arcuate area is between 20 degrees and 180 degrees.

30. The lighting system of claim 1, wherein each of the plurality of lights project

light radially outward of the wheel in a direction substantially parallel to the center plane when in the high state.

31. The lighting system of claim 30, wherein the arc angle of the arcuate area is substantially 120 degrees.

32. The lighting system of claim 30, wherein each of the plurality of lights project light through the center plane outside of the wheel circumference when in the high state.

33. A lighting system for a wheel of a bicycle, the wheel having a rim and a center plane that encompasses the midpoint of the rim width and extends normal to the axis of wheel rotation, the lighting system comprising:

a plurality of light emitting elements, configured to be fastened to the rim offset from the center plane and directed to project light through the center plane outside of the rim circumference, each of the plurality of light emitting elements configured to alternate during the rotation of the wheel between a lit state when the light emitting element is within an arcuate area and a dim state when the light emitting element is outside of the arcuate area, wherein the arcuate area is defined relative to a gravity vector, has an arc angle of less than 360 degrees, and encompasses at least two of the plurality of light emitting elements.

34. The lighting system of claim 33, further comprising a second plurality of light emitting elements for a second wheel of the bicycle, the second wheel having a

second rim and a second center plane that encompasses the midpoint of the second rim and extends normal to the axis of second wheel rotation, wherein the second plurality of light emitting elements is configured to be fastened to the second rim offset from the second center plane and directed to project light through the second center plane outside of the second rim circumference, each of the second plurality of light emitting elements configured to alternate during the rotation of the second wheel between a lit state when the light emitting element is within a second arcuate area and a dim state when the light emitting element is outside of the second arcuate area, wherein the second arcuate area is defined relative to a second gravity vector, has an arc angle of less than 360 degrees, and encompasses at least two of the second plurality of light emitting elements.

35. The lighting system of claim 34, wherein the first plurality of light emitting elements emit substantially white light when in the lit state, and the second plurality of light emitting elements emit substantially red light when in the lit state.

36. The lighting system of claim 34, wherein the first plurality of light emitting elements are configured to project light in front of the first wheel and the second plurality of light emitting elements are configured to project light behind the second wheel.

37. A lighting system for a vehicle having a frame, the lighting system comprising:

- a wheel that couples to the frame, the wheel including a center plane that encompasses the midpoint of the wheel width and extends normal to the axis

of wheel rotation; and

- a plurality of light emitting elements, fastened to the wheel offset from the center plane and directed to project light radially outward of the wheel in a vector substantially parallel to the center plane, the plurality of light emitting elements configured to alternate during the rotation of the wheel between a lit state when the light emitting element is within a arcuate area and a dim state when the light emitting element is outside of the arcuate area, wherein the arcuate area is defined from a point on the frame, has a arc angle of less than 360 degrees, and encompasses at least two of the plurality of light emitting elements.

38. The lighting system of claim 37, further comprising:

- a second wheel that couples to the frame, the second wheel including a second center plane that encompasses the midpoint of the second wheel width and extends normal to the axis of second wheel rotation;
- a second plurality of light emitting elements, fastened to the second wheel offset from the second center plane and directed to project light radially outward of the wheel in a vector substantially parallel to the center plane, the second plurality of light emitting elements configured to alternate during the rotation of the second wheel between a lit state when the light emitting element is within a second arcuate area and a dim state when the light emitting element is outside of the second arcuate area, wherein the second arcuate area is defined from a second point on the frame, has a second arc angle of less than 360 degrees and encompasses at least two of the second

plurality of light emitting elements.

39. The system of claim 38, wherein the first plurality of light emitting elements emit substantially white light in the lit state, and wherein the second plurality of light emitting elements emit substantially red light in the lit state.

40. The system of claim 38, wherein the first plurality of light emitting elements are configured to project light in front of the first wheel and the second plurality of light emitting elements are configured to project light behind the second wheel.

41. The lighting system of claim 25, wherein the plurality of lights are positioned to project light through the center plane outside of the tire circumference.

42. A hub for a bicycle wheel, the bicycle wheel including a plurality of light emitting elements that rotate with the bicycle wheel, the hub comprising:

- a controller mounted to the hub that controls each of the light emitting elements to operate between:
 - a lit mode wherein the light emitting element projects light radially outward of the wheel when the light emitting element is within an arcuate area defined from a reference point, the arcuate area having an arc length of less than 360 degrees; and
 - a dim mode when the light emitting element is outside the arcuate area; and

- an electrical connector that connects the controller to the light emitting elements.

43. The hub of claim 42, wherein the wheel has a central plane extending through the wheel circumference and a midpoint of the wheel width, wherein each light emitting element projects light in a vector substantially parallel to the central plane when in the lit mode.

44. The hub of claim 43, wherein each light emitting element projects light in a vector that intersects the central plane when in the lit mode.

45. The hub of claim 42, wherein the electrical connector comprises a power wire.

46. The hub of claim 45, wherein the power wire extends along a spoke of the wheel.

47. The hub of claim 45, wherein the controller is individually wired to each light emitting element.

48. The hub of claim 47, wherein the controller is individually wired to each light emitting element by a wire pair comprising the power wire and a ground wire.

49. The hub of claim 42, wherein the controller comprises an index sensor that indexes the reference point.

50. The hub of claim 49, wherein the index sensor comprises a contact switch.

51. The hub of claim 49, wherein the reference point is defined by an emitter statically coupled to a vehicle frame, wherein the hub rotatably couples to the vehicle frame.

52. The hub of claim 51, wherein the controller switches a light emitting element to the lit mode in response to the index sensor passing the emitter.

53. The hub of claim 52, wherein the controller applies a voltage across a light emitting element to place the light emitting element in the lit mode.

54. The hub of claim 53, wherein the controller electrically connects a power source with the light emitting element in the lit mode.

55. The hub of claim 52, wherein the controller switches off a light emitting element in the dim mode.

56. The hub of claim 55, wherein the controller disconnects the power source from the light emitting element in the dim mode.

57. The hub of claim 42, wherein the controller is mounted to an arcuate surface of the hub.

58. The hub of claim 57, wherein the controller is mounted within the hub.

59. The hub of claim 42, wherein the controller is integrated with a disk that is coaxially mounted an end of the hub.

60. A wheel comprising a hub and a plurality of light emitting elements, the wheel comprising:

- an emitter configured to statically mount to a vehicle frame, thereby defining a reference position;
- a controller mounted to the hub and electrically connected to the light emitting elements by a wire extending along a spoke of the wheel, the controller comprising an index sensor, the controller configured to switch each light emitting element between:
 - a lit mode wherein the light emitting element projects light radially outward of the wheel when the light emitting element is within an arcuate area defined from a reference point, the arcuate area having an arc length of less than 360 degrees; and
 - a dim mode when the light emitting element is outside the arcuate area;

wherein the controller switches the light emitting element to the lit mode in response to the index sensor passing the emitter.

61. A hub for a wheel, the hub including a hub shell and an axle extending coaxially through an interior of the hub shell, the wheel including a plurality of lights mounted to rotate with the wheel, the hub comprising:

- a controller mounted to the hub shell interior that controls each of the light emitting elements to operate between:
 - a lit mode, wherein the light emitting element projects light radially outward of the wheel when the light emitting element is within an arcuate area defined from a reference point, the arcuate area having an arc length of less than 360 degrees; and
 - a dim mode when the light emitting element is outside the arcuate area;
- an emitter configured to statically mount to a vehicle frame in rotatable relation to the controller and define the reference position; and
- an electrical connector configured to transmit signals from the controller to the light emitting elements.