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(54) **Title:** LIGHT CONTROL SYSTEMS AND METHODS

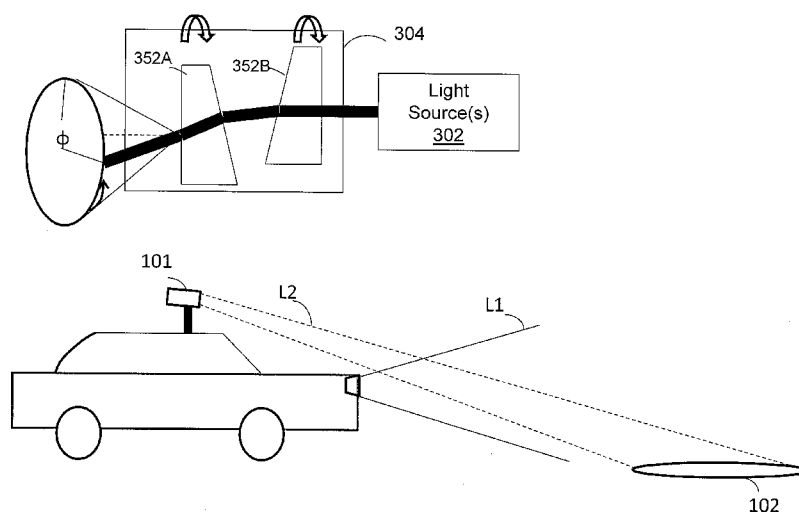


Figure 1

(57) **Abstract:** Provided is a beam-steering mechanism, comprising a lens and a light source positioned in a focal plane of the lens. One of the light source and the lens moves relative to the other of the light source and the lens. The light source outputs a light beam at the lens which forms an illumination spot on a surface from the light beam. The illumination spot moves in a direction in response to a movement of one of the light source and the lens.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US15/28163

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - F21V 14/02, 14/06, 14/00 (2015.01)

CPC - F21V 14/02, 14/06, 14/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC(8): F21V 14/02, 14/06, 14/00 (2015.01)

CPC: F21V 14/02, 14/06, 14/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PatSeer (US, EP, WO, JP, DE, GB, CN, FR, KR, ES, AU, IN, CA, INPADOC Data); Google Patent, Google Scholar, IEEE, ProQuest
 Search terms used: beam, steering, light, source, lamp, illuminator, lens, fresnel, spot, x-axis, y-axis, rails, guide, perpendicular, orthogonal, optic, stationary, fixed, relative, led, laser

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ---	US 2005/0228366 A1 (KESSLER, R et al.) October 13, 2005; abstract, figures 2, 3A, paragraphs [0020], [0025]	1, 4 ---
Y		2, 3, 5-7
Y	US 4,843,522 A (ROSENBERG, B) June 27, 1989; figure 2, column 4, lines 3-11	2, 3
Y	US 4,985,651 A (CHITAYAT, A) January 15, 1991; figure 1, column 5, lines 13-26, 62-67	3, 5
Y	US 2013/0208481 A1 (SOOFERIAN, D) August 15, 2013; paragraph [0039]	6
Y	US 2011/0103063 A1 (JURIK, P) May 5, 2011; paragraphs [0017], [0018]	7
A	US 2009/0040299 A1 (HARRISON, M et al.) February 12, 2009, entire document	1-7

☐

Further documents are listed in the continuation of Box C.

☐

See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T"

later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X"

document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y"

document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&"

document member of the same patent family

Date of the actual completion of the international search

31 August 2015 (31.08.2015)

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US15/28163

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See extra sheet.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-7

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

-Continued from Box III -

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fee must be paid.

Group I: Claims 1-7 are directed towards a beam steering mechanism.

Group II: Claims 8-21 are directed towards a guided rail system.

Group III: Claim 22 is directed towards a track light system.

Group IV: Claim 23 is directed towards a light-emitting device control system.

Group V: Claim 24 is directed towards a pair of Fresnel prisms.

Group VI: Claims 25 & 26 are directed towards illuminating different regions of a target surface with no need for movement.

Group VII: Claim 27 is directed towards a fog penetrating sensor.

The inventions listed as Groups I-VII do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features.

Group I has at least one of the at least one light source and the lens moves relative to the other of the at least one light source and the lens, wherein the illumination spot moves in a direction in response to a movement of one of the at least one light source and the lens which Groups II-VII do not have. Group II has at least a guided rail system, comprising a vertical rail, at least one inner rail, and at least one outer rail, wherein one of the lens and the light source module is mounted to the guided rail system which Groups I & III-VII do not have. Group III has at least a track light system, a non-motorized track light array, a plurality of light sources positioned on a plurality of rails, at least one motorized track rail adjacent the non-motorized track light array, a steering car that moves along the at least one motorized track rail for steering individual light sources of the track light array that Groups I, II, & IV-VII do not have. Group IV has at least a light-emitting device control system for vehicle light beam steering, an input device controller that receives external inputs for beam steering control, a potentiometer for adjusting a light level, a processor that performs a calculation to determine the amount of beam steering is needed and sends a signal to the beam steering mechanism to perform a beam steering motion according to the calculation that Groups I-III & VI-VII do not have. Group V has at least a pair of Fresnel prisms constructed and arranged to counter rotate relative to each other, a light beam received by the prisms is directed in an azimuth direction according to the counter-rotation and co-rotation of the two prisms that Groups I-IV, VI, & VII do not have. Group VI has at least an array of light sources above the lens; a plate on which the light sources are mounted, wherein a light source distribution from the light sources allows for an illumination of different regions at a target surface, or from different positions of a focal plane with respect to the lens with no need for movement, and wherein activating the light sources one at a time, one region can be illuminated in the target surface at a time, which Groups I-V & VII do not have. Group VII has at least a fog penetrating sensor, a pyramid mirror, a shortwave infrared (SWIR) LED light source, a SWIR focal plane array (FPA), a focus and defocus wheel to eliminate background, an uncooled thermal FPA, an aperture lens that is shared by the light source, the SWIR channel, and the uncooled thermal channel at a foci of the lens, the share aperture lens allowing illuminating and imaging of the same target area simultaneously permitting more efficient use of illumination light, the longer wavelength SWIR light is scattered less by aerosols such as fog, therefore, sees further permitting active imaging of the target by the SWIR channel and passive imaging of the target by the thermal channel, a beam steering mechanism that steer the illumination light to the target and imaging light from the target allowing scanning of the target scene, which Groups I-VI do not have.

The common technical features of Groups I-VII are at least a beam steering mechanism, a light source that emits a light beam, a rail, a lens with a focal plane, and illuminating a target region. These common technical features are previously disclosed by US 2009/0040299 A1 to Harrison, M et al. (hereinafter 'Harrison'). Harrison discloses a beam steering mechanism (a beam steering device 54; paragraph [0062]), a light source that emits a light beam (a laser beam source 56 emitting beam 76; paragraph [0062]), a rail (rack or rail system, paragraph [0087]), a lens with a focal plane (a focusing lens 48 will have a focal plane about focal point 74; paragraph [0062]), and illuminating a target region (a target 72 for receiving beam 76; paragraph [0062]).

Since the common technical feature is previously disclosed by Harrison, these common features are not special and so Groups I-VII lack unity.