



(43) International Publication Date
4 June 2015 (04.06.2015)

(51) International Patent Classification:
F41G 1/00 (2006.01)

(21) International Application Number:
PCT/US2014/050984

(22) International Filing Date:
14 August 2014 (14.08.2014)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/909,624 27 November 2013 (27.11.2013) US

(71) Applicant: BAE SYSTEMS INFORMATION AND
ELECTRONIC SYSTEMS INTEGRATION INC.
[US/US]; PO Box 868, NHQ1-719, Nashua, NH 03061-
0868 (US).

(72) Inventor: CHOINIERE, Michael, J.; 4 Bates Road, Mer-
rimack, NH 03054 (US).

(74) Agent: LONG, Daniel, J.; Bae Systems Information And
Electronic, Systems Integration Inc., PO Box 868, NHQ1-
719, Nashua, NH 03061-0868 (US).

(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY,
BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM,
DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,
HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR,
KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME,
MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ,
OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA,
SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM,
TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM,
ZW.

(84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ,
UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ,
TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK,
EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,
MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
KM, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: SYSTEM AND METHOD FOR REMOVING AND REINSTALLING WEAPON SIGHT WITHOUT CHANGING
BORESIGHT

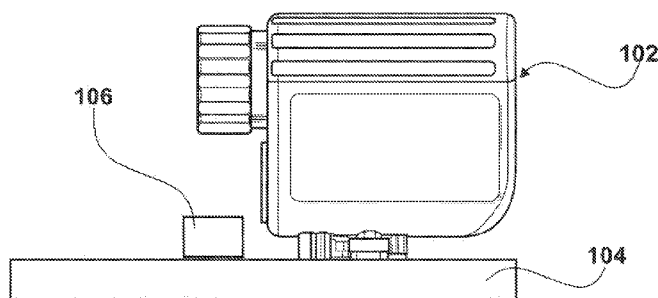


FIG. 1

(57) Abstract: A system and method for removing and reinstating a sight of a weapon without changing a boresight is disclosed. A reference optical device is installed on a rail of the weapon and then the sight is installed on the rail. An attitude determination unit determines a change in attitude of the sight with respect to the boresight. The aim point of the weapon in the sight is compensated accordingly based on the change in attitude without changing the boresight by utilizing a compensation module. This allows retaining the boresight even when the weapon sight is removed and reinstalled. Thus weapon sight can be mounted anywhere on a weapon without the need to boresight the weapon.



WO 2015/080774 A1

**SYSTEM AND METHOD FOR REMOVING AND REINSTALLING WEAPON
SIGHT WITHOUT CHANGING BORESIGHT**

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This Application claims rights under 35 USC §119(e) from U.S. Application Serial No. 61/909,624 filed 27 Nov 2013, the contents of which are incorporated herein by reference.

TECHNICAL FIELD

[0002] The present disclosure relates generally to a weapon sights. Embodiments of the disclosure are related to systems and methods for removing and reinstalling weapon sights without changing boresight of a weapon.

BACKGROUND

[0003] In close quarter combat, soldiers are required to rapidly acquire, identify, and accurately fire on enemy targets. Soldiers may use weapon-mounted sights with visible and infrared light sources to assist in the aiming process during daytime and nighttime missions. These sights may be mounted on handheld weapons and other small arms and are used to provide better target observation, illumination, and marking.

[0004] Boresight is the adjustments made to an optical firearm sight or iron sights, to align the firearm barrel and sights. A device called a bore sighter or collimator is used to accomplish this. A holographic weapon sight or holographic diffraction sight is a non-magnifying gun sight that allows the user to look through a glass optical window and see a reticle image superimposed at a distance on the field of view. The hologram of the reticle is built into the window and is illuminated by a laser diode.

[0005] Every time when the weapon sight is removed/installed, the boresight should be changed accordingly to the aim point. For example, when the sight is removed from the weapon for transport and it should be reinstalled without loss of the aim point to the weapon. For this reason, the weapon sights should be clipped on at a particular position, in front of the weapon to use the aim point of the weapon. This increases the cost and manufacturing tolerance. This makes the sight not exchangeable between weapons and needs boresight adjustment.

[0006] A need, therefore, exists for an improved way to retain boresight even when the weapon sight is removed and reinstalled. There is also a need to a way to mount a sight anywhere on a weapon without the need to boresight the weapon.

SUMMARY

[0007] The following summary is provided to facilitate an understanding of some of the innovative features unique to the disclosed embodiment and is not intended to be a full description. A full appreciation of the various aspects of the embodiments disclosed herein can be gained by taking into consideration the entire specification, claims, drawings, and abstract as a whole.

[0008] It is, therefore, one aim of the disclosed embodiments is to provide for a method for removing and reinstalling a sight of a weapon without changing a boresight of a weapon. A reference optical device is installed on a rail of the weapon. The sight installed on the rail can be removed and reinstalled along the rail. The reference optical device is utilized for determining a change in attitude of the weapon sight with respect to the boresight. Then, the aim point of the weapon in the sight is compensated based on the change in attitude without changing the boresight

[0009] It is, therefore, one aim of the disclosed embodiments is to provide for a method for removing and reinstalling a sight of a weapon without changing a boresight in which the change in attitude of the sight from a first position on the rail to a second position on the rail is accounted.

[0010] It is, therefore, one aim of the disclosed embodiments is to provide for a method for automatic alignment of a sight of a weapon with the boresight without changing a boresight. The method comprises installing a reference optical device on a rail of the weapon, installing the sight on the rail, allowing a light to reflect from a reference optical device and from an optical device in the sight, obtaining a resultant light reflected from the reference optical device and from the optical device in the sight, processing the resultant light, determining a change in attitude of the sight relative the boresight and adjusting the sight based on the change in attitude.

[0011] It is, therefore, one aim of the disclosed embodiments is to provide for a method for automatic alignment of a sight of a weapon with the boresight without changing a boresight in which processing the resultant light comprises, adjusting the brightness of the resultant light, performing dual centroid operation, determining the azimuth and elevation offsets, and obtaining a change in attitude of the sight relative the boresight by subtracting the error obtained based on the offsets.

[0012] It is, therefore, one aim of the disclosed embodiments is to provide for a method for automatic alignment of a sight of a weapon with the boresight without changing a boresight in which the brightness of the resultant light is adjusted by increasing the brightness of the maximum pixels of resultant light to a first predetermined value and decreasing the brightness of all the pixels that are below a second predetermined of a saturation point.

[0013] It is, therefore, one aim of the disclosed embodiments is to provide for

a method for automatic alignment of a sight of a weapon with the boresight without changing a boresight in which, the reference rail is maintained in the rail irrespective of removal and reinstallation of the sight of the weapon.

[0014] It is, therefore, one aim of the disclosed embodiments is to provide for a system for removing and reinstalling a sight of a weapon without changing a boresight comprising a reference optical device installed on a rail of the weapon, the sight installed on the rail, an attitude determination unit for determining a change in attitude of the sight with respect to the boresight and a compensation module for compensating the aim point of the weapon in the sight based on the change in attitude without changing the boresight.

[0015] It is, therefore, one aim of the disclosed embodiments is to provide for a system for removing and reinstalling a sight of a weapon without changing a boresight in which the attitude determination unit accounts the change in attitude of the sight from a first position on the rail to a second position on the rail.

[0016] It is, therefore, one aim of the disclosed embodiments is to provide for a system for removing and reinstalling a sight of a weapon without changing a boresight further comprising an automatic alignment unit for aligning the sight of the weapon with the boresight without changing a boresight.

[0017] It is, therefore, one aim of the disclosed embodiments is to provide for a system for removing and reinstalling a sight of a weapon without changing a boresight in which the automatic alignment unit is configured to allow a light to reflect from the reference optical device and from an optical device in the sight obtain a resultant light reflected from the reference optical device and from the optical device in the sight process the resultant light, determine a change in attitude of the sight relative the boresight and adjust the sight based on the change in attitude.

[0018] It is, therefore, one aim of the disclosed embodiments is to provide for a system for removing and reinstalling a sight of a weapon without changing a boresight in which, the resultant light is processed to adjust the brightness of the resultant light, perform dual centroid operation, determine the azimuth and elevation offsets and obtain a change in attitude of the sight relative the boresight by subtracting the error obtained based on the offsets.

[0019] It is, therefore, one aim of the disclosed embodiments is to provide for a system for removing and reinstalling a sight of a weapon without changing a boresight in which the brightness of the resultant light is adjusted by increasing the brightness of the maximum pixels of resultant light to a first predetermined value and decreasing the brightness of all the pixels that are below a second predetermined of a saturation point.

[0020] It is, therefore, one aim of the disclosed embodiments is to provide for a system for removing and reinstalling a sight of a weapon without changing a boresight in which the reference rail is maintained in the rail irrespective of removal and reinstallation of the sight of the weapon.

[0021] It is, therefore, one aim of the disclosed embodiments is to provide for a system and method for removing and reinstalling a sight of a weapon without changing a boresight in which the sight can be removed from the weapon for transport and reinstall without loss of the aim point to the weapon.

[0022] It is, therefore, one aim of the disclosed embodiments is to provide for a system and method for removing and reinstalling a sight of a weapon without changing a boresight in which the sight can be mounted anywhere on the weapon and no longer only in front of the Advanced Combat Optical Gunsight (ACOG). This reduces cost and manufacturing tolerance since it does not need to be a "clip-on" style weapon sight.

[0023] It is, therefore, one aim of the disclosed embodiments is to provide for a system and method for removing and reinstalling a sight of a weapon without changing a boresight in which the reference optical is mounted at a position on the rail where the weapon sight is exactly aligned with the boresight.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] The summary above, as well as the following detailed description of illustrative embodiments, is better understood when read in conjunction with the appended drawings. For the purpose of illustrating the present disclosure, exemplary constructions of the disclosure are shown in the drawings. However, the disclosure is not limited to specific methods and instrumentalities disclosed herein. Moreover, those in the art will understand that the drawings are not to scale. Wherever possible, like elements have been indicated by identical numbers.

[0025] FIG. 1 is an illustration of a schematic diagram of weapon sight installed on a rail with a reference mirror, in accordance with the disclosed embodiments;

[0026] FIG. 2 is an illustration of a side view of weapon sight installed on a weapon, in accordance with the disclosed embodiments;

[0027] FIG. 3 is an illustration of a schematic diagram of an automatic alignment system showing a weapon sight aligned via a reference mirror, in accordance with the disclosed embodiments;

[0028] FIG. 4 is an illustration of a flow chart pertaining a boresight alignment process, in accordance with the disclosed embodiments;

[0029] FIG. 5 is an illustration of a schematic diagram of images obtained during boresight alignment process as depicted in FIG. 4, in accordance with the disclosed embodiments; and

[0030] FIG. 6 is an illustration of a schematic diagram of images showing error visualization via differential measurement, in accordance with the disclosed embodiments.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

[0031] The particular configurations discussed in the following description are non-limiting examples that can be varied and are cited merely to illustrate at least one embodiment and are not intended to limit the scope thereof.

[0032] The present invention allows the aim point of the weapon in the sight can be compensated accordingly based on the change in attitude of the sight without changing the boresight. This allows retaining the boresight even when the weapon sight is removed and reinstalled. Thus, weapon sight can be mounted anywhere on a weapon without the need to boresight the weapon.

[0033] Referring to FIG. 1, a schematic diagram of a weapon sight 102 in accordance with the disclosed embodiments is disclosed. The weapon sight 102 can be installed at any position on a rail 104 of a weapon with respect to a reference optical device 106. The reference optical device 106 is permanently installed on the rail 104 irrespective of the weapon sight 102 installation. A change in attitude of the weapon sight 102 with respect to the boresight of the weapon is determined and accordingly the aim point of the weapon sight 102 is changed without changing the boresight.

[0034] It should be noted that the optical reference may be at a fixed position at which the weapon sight is perfectly aligned with the boresight. The weapon sight can be positioned at any position on the rail and by determining the change in the attitude of the weapon sight with respect to the optical reference so that the weapon sight is adjusted without changing the boresight. The attitude data between the optical reference and the weapon is coded into a reference module and sent to the weapon sight when installed.

[0035] As shown in FIG. 2 the weapon sight 102 depicted in FIG. 1 is in installed state on a weapon 200. The weapon sight 102 can be removed from the weapon 200 and reinstalled without changing the boresight. The position of the weapon sight 102 on the rail 104 can be varied at any time and the aim point of the weapon sight 102 is compensated accordingly. This avoids need for changing the boresight each time when the weapon sight 102 is reinstalled.

[0036] FIG. 3 is an illustration of a schematic diagram of an automatic alignment unit 300 showing a weapon sight 102 aligned via a reference optical device 106 for correcting the weapon sight 102 of the weapon 200 depicted in FIG. 2. The LED source 306 emits LED light 311 towards the beam splitter cube 308. A collimating optics 312 positioned between the beam splitter cube 308 and the LED source 306 focus the LED light 311 on to the beam splitter cube 308 and avoids diverging. The LED light 311 from the single LED light source 306 is spitted into two beams 309 and 307 in the beam splitter cube 308. The beam splitter cube 308 is a part of the weapon sight 102. The light 307 from the beam splitter cube 308 passes towards the reference optical device 106 where it gets reflected back and pass through the beam splitter cube 308 and reach another collimating optics 310. Similarly a part of the light 309 spitted from the beam splitter cube 308 also reaches the collimating optics 310. The collimating optics 310 focuses the lights 309 and 307 from the beam splitter cube 308 onto an imaging device for example, camera 304.

[0037] The resultant image 316 depicts the resultant lights 307 and 309 on the collimating optics 310. The enlarged view of the resultant image 316 is depicted as image 314. From the image 314 it is very apparent that there is a change in the attitude of weapon sight 102 and the reference optical device 106. By processing the image 314, the change in the aim point of the weapon sight 102 with respect to boresight can be determined. The weapon sight 102 can be changed based on the determined change in aim point of weapon sight 102 without changing the boresight.

[0038] It should be noted that as shown in FIG. 2, it will be seen that the weapon sight allows for a simplified one step alignment. Azimuth and elevation offsets can be measured by calculating dx and dy distances from the "reference" spot for a differential measurement. Alignment is insensitive over time to shifts due to shock, vibration and temperature so that differential measurement provides temperature and vibration hardening.

[0039] The camera 314 and its associated processing unit may be configured as a determination unit to determine a change in attitude of the sight with respect to the boresight. A compensation unit is utilized for compensating the aim point of the weapon in the sight based on the change in attitude without changing the boresight. The compensation unit is installed in the sight to vary weapon sight without varying the boresight when the weapon sight is reinstalled or removed. It should be noted that the determination and compensation units has one or more algorithms for performing its tasks.

[0040] FIG. 4 is an illustration of a flow chart 400 pertaining to a boresight alignment process, in accordance with the disclosed embodiments. As shown at the block 402, the weapon sight is set for factory calibrations. The factory calibrations can include but not limited to placing the optical components inside the weapon sight, adjusting the optical components for precise results

and finally checking its results. The weapon sight detects whether it has been attached or reinstalled on the rail of the weapon as said at the block 404. The sensing of weapon sight on the rail also includes positioning the weapon sight from one position of the rail to other position on the rail, removing the weapon sight, reinstalling the weapon sight, without limitation.

[0041] After detecting the presence of the weapon sight on the rail, as said at block 406, the LED source is enabled to obtain the image 314 depicted in FIG. 3. The image 314 is brightness adjusted by adjusting the maximum brightness pixel to a first predetermined higher value say 70%, as illustrated at block 408. The brightness of the image 314 that are of zero pixel are adjusted to a second predetermined lower value say 20%, as illustrated at block 416. Then as said at block 412, the visible area of the image is split into two fields. The azimuth and elevation offsets are determined by performing the dual centroid operations as said at blocks 418 and 414. As shown in the FIG. 4, the blocks 406, 408, 412, 416, 418 and 414 are together represented as automatic alignment process 410. The azimuth and elevation offsets are subtracted from the original image and then transformed to the weapon sight as illustrated at blocks 422 and 420 respectively.

[0042] FIG. 5 is an illustration of a schematic diagram of images obtained during boresight alignment process as depicted in FIG. 4, in accordance with the disclosed embodiments. Image 502 represent the process of enabling the LED source as depicted at block 406 of FIG. 4. Image 504 represents the process of adjusting the brightness of the image as depicted at block 408 of FIG. 4. Image 506 represents the process of adjusting the brightness of the image as depicted at block 416 of FIG. 4. Image 508 represents the process of splitting the visible area into two fields as depicted at block 412 of FIG. 4.

[0043] It will be understood that a feature provided by the auto-alignment subsystem provides the ability to remove and reattach the weapon sight at will. Auto-alignment will automatically determine attitude of the sight relative to the rail. Corrections will be made digitally for the Laser Range Finder (LRF) and Aim Point. The reference mirror remains on the weapon. The system is a small component lesser than 0.05 lbs and has a low profile, lesser than 0.3 in³. There is no visible signature.

[0044] FIG. 6 is an illustration of a schematic diagram of images showing error visualization via differential measurement, in accordance with the disclosed embodiments. Images 602 and 606 represents the azimuth error of the weapon sight at first rail position and second rail position having a 20 pixel difference at a small (δ) movement with respect to the first. Images 604 and 608 represent the elevation error of the weapon sight at first rail position and second rail position having a 20 pixel difference at a small (δ) movement with respect to the first.

[0045] Those skilled in the art will appreciate that this invention allows for the removal of the sight from the weapon for transport and reinstall without loss of the aim point to the weapon. The sight doesn't need to be "clip-on" to use the aim point of the Advanced Combat Optical Gunsight (ACOG). The weapon sight can be mounted anywhere on the weapon and no longer only in front of the ACOG, this reduces cost and manufacturing tolerance, as it does not need to be a "clip-on" style weapon sight. The sight could also be exchangeable between weapons without the need for a boresight. Attitude data between the optical reference and the weapon could be coded into the reference module and sent to the weapon sight when installed. This invention allows for a weapon sight which is highly modular, exchangeable and boresighted and the reference is programmed.

[0046] It will be appreciated that variations of the above disclosed and other features and functions, or alternatives thereof, may be desirably combined into many other different systems or applications. Also, various presently unforeseen or unanticipated alternatives, modifications, variations or improvements therein may be subsequently made by those skilled in the art which are also intended to be encompassed by the following claims.

[0047] Although embodiments of the current disclosure have been described comprehensively in considerable detail to cover the possible aspects, those skilled in the art would recognize that other versions of the disclosure are also possible.

CLAIMS

What is claimed is:

1. A method for removing and reinstalling a sight of a weapon without changing a boresight comprising:
 - installing a reference optical device on a rail of the weapon;
 - installing the sight on the rail;
 - determining a change in attitude of the sight with respect to the boresight; and
 - compensating the aim point of the weapon in the sight based on the change in attitude without changing the boresight.
2. The method of claim 1 further comprising accounting a change in attitude of the sight from a first position on the rail to a second position on the rail.
3. The method of claim 1 further comprising configuring the optical reference device at a fixed position on the rail at which the weapon sight is perfectly aligned with the boresight, whereby the weapon sight can be positioned at any position on the rail and by determining the change in the attitude of the weapon sight with respect to the optical reference, so that the weapon sight is adjusted without changing the boresight.
4. The method of claim 3 wherein the attitude data between the optical reference and the weapon could be is coded into a reference module and sent to the weapon sight when installed.

5. A method for automatic alignment of a sight of a weapon with a boresight without changing the boresight comprising:
 - installing a reference optical device on a rail of the weapon;
 - installing the sight on the rail;
 - allowing a light to reflect from the reference optical device and from an optical device in the sight;
 - obtaining a resultant light reflected from the reference optical device and from the optical device in the sight;
 - processing the resultant light;
 - determining a change in attitude of the sight relative the boresight; and
 - automatically adjusting the sight based on the change in attitude, whereby alignment is insensitive over time to shifts due to shock, vibration and temperature so that differential measurement provides temperature and vibration hardening..
6. The method of claim 5, wherein the processing the resultant light comprising:
 - adjusting the brightness of the resultant light;
 - performing dual centroid operation;
 - determining the azimuth and elevation offsets;
 - obtaining a change in attitude of the sight relative the boresight by subtracting the error obtained based on the offsets.
7. The method of claim 6, wherein adjusting the brightness of the resultant light comprising:
 - increasing the brightness of the maximum pixels of the resultant light to a first predetermined value; and
 - decreasing the brightness of all the pixels that are below a second predetermined of a saturation point.

8. The method claim 5 further comprising configuring the reference optical device at a fixed position on the rail at which the weapon sight is perfectly aligned with the boresight.

9. The method of claim 5, wherein the reference optical device is maintained in the rail irrespective of removal and reinstallation of the sight of the weapon.

10. A system for removing and reinstalling a sight of a weapon without changing a boresight comprising:

- a reference optical device installed on a rail of the weapon;
- the sight installed on the rail;
- an attitude determination unit for determining a change in attitude of the sight with respect to the boresight; and
- a compensation module for compensating an aim point of the weapon in the sight based on the change in attitude without changing the boresight.

11. The system of claim 10 wherein the attitude determination unit accounts the change in attitude of the sight from a first position on the rail to a second position on the rail.

12. The system of claim 10 further comprising an automatic alignment unit for aligning the sight of the weapon with the boresight without changing a boresight.

13. The system of claim 12 wherein the automatic alignment unit is configured to:

- allow a light to reflect from the reference optical device and from an optical device in the sight;

obtain a resultant light reflected from the reference optical device and from the optical device in the sight;
process the resultant light;
determine a change in attitude of the sight relative the boresight;
and
adjust the sight based on the change in attitude.

14. The system of claim 13 wherein the resultant light is processed to:

adjust the brightness of the resultant light;
perform dual centroid operation;
determine the azimuth and elevation offsets;
obtain a change in attitude of the sight relative the boresight by subtracting the error obtained based on the offsets.

15. The system of claim 14 wherein the brightness of the resultant light is adjusted by:

increasing the brightness of the maximum pixels of resultant light to a first predetermined value; and
decreasing the brightness of all the pixels that are below a second predetermined of a saturation point.

16. The system of claim 14, wherein the reference optical device is maintained in the rail irrespective of removal and reinstallation of the sight of the weapon.

17. The system of claim 14, wherein the reference optical device is fixed at a position on the rail at which the weapon sight is perfectly aligned with the boresight.

1/6

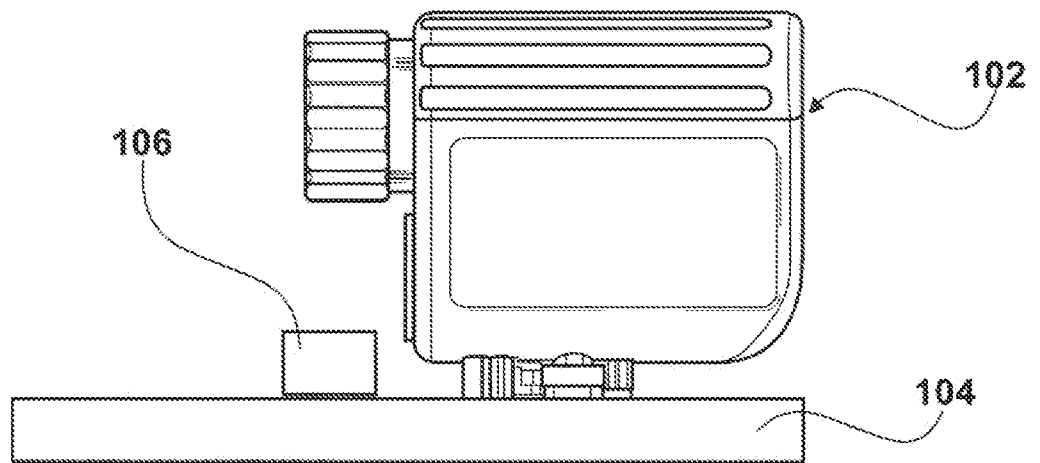
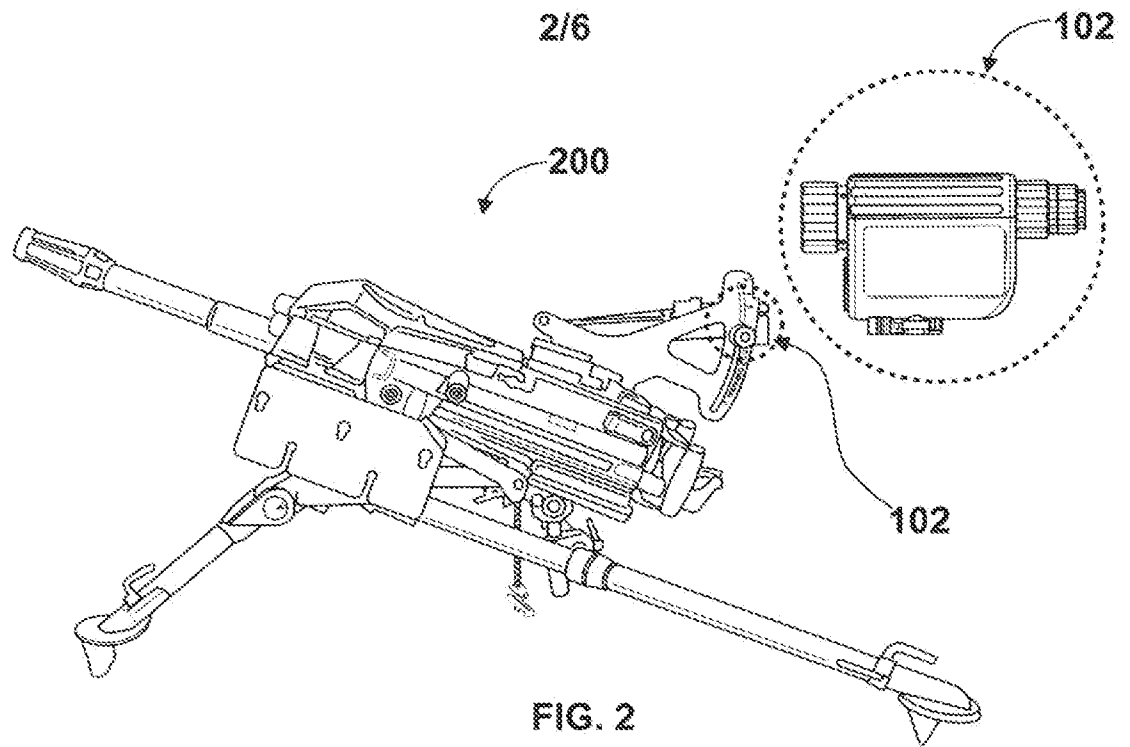
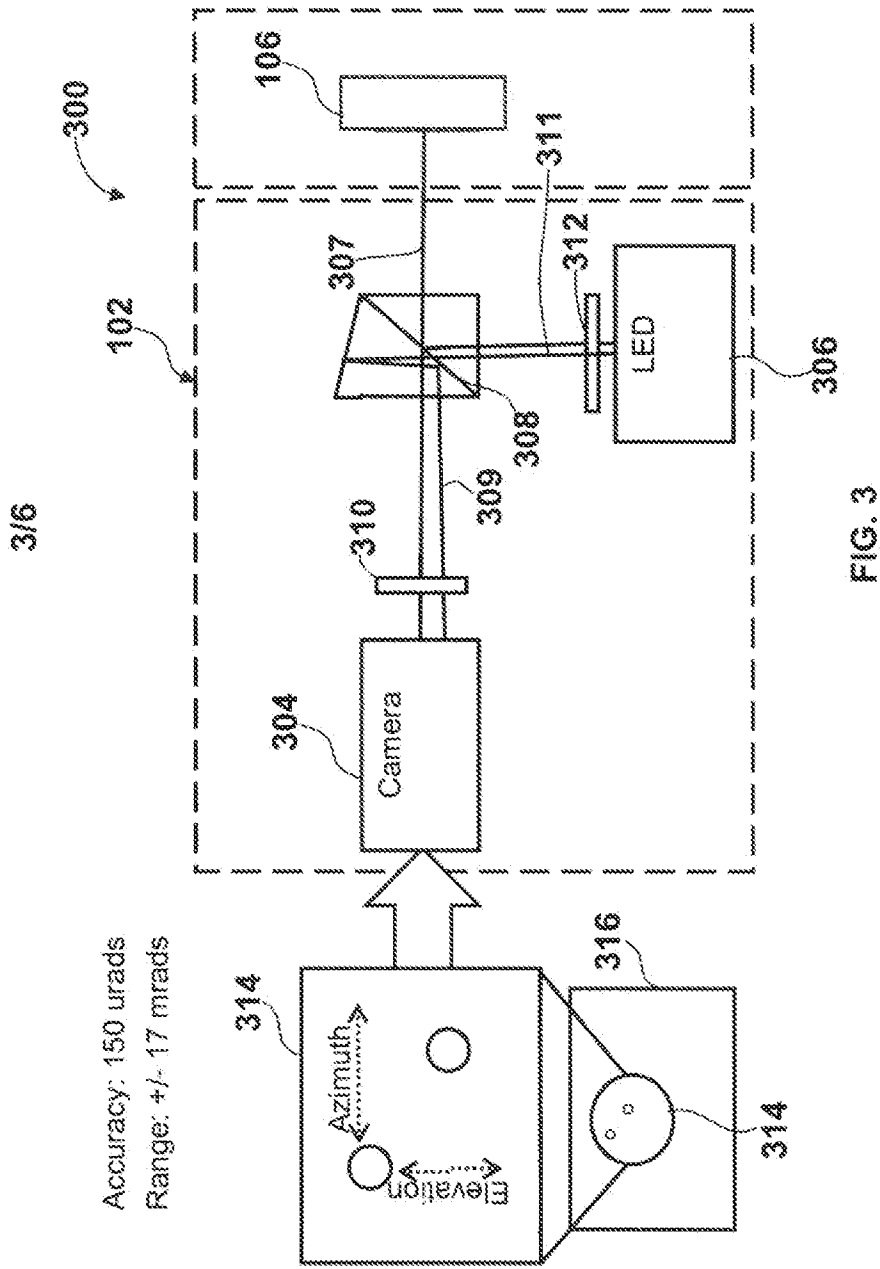


FIG. 1





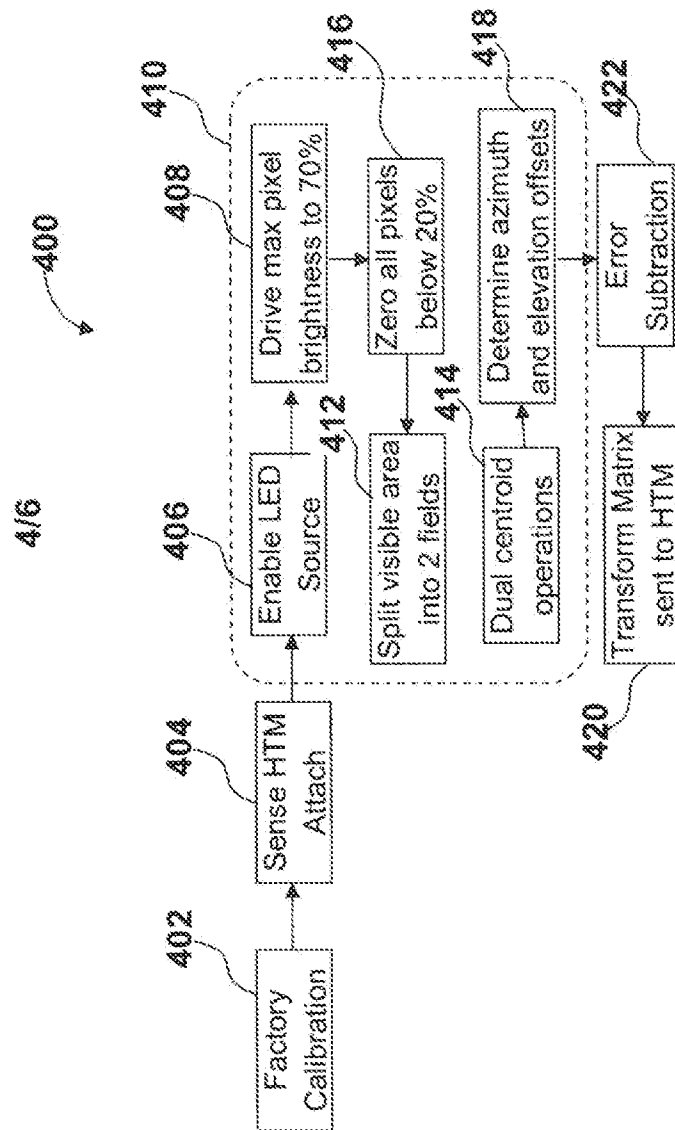
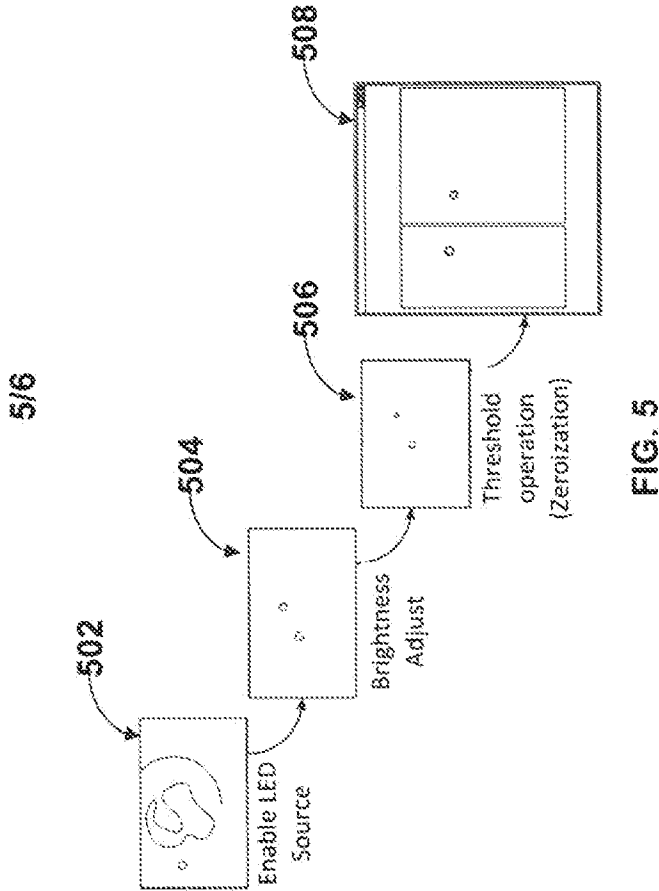


FIG. 4



6/6

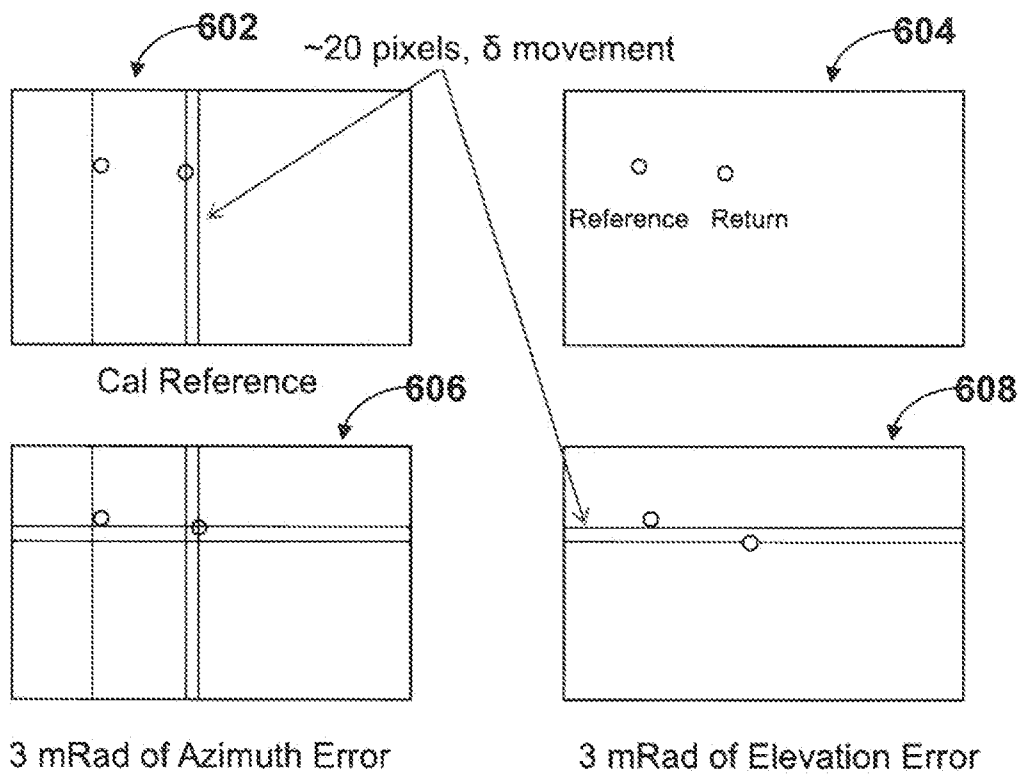


FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 14/50984

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - F41G 1/00, 1/44 (2014.01)

CPC - F41G 1/00, 1/387

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) - F41G 1/00, 1/44 (2014.01)

CPC - F41G 1/00, 1/387

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

CPC - F41G 1/033, 1/16, 1/44, 1/54, 1/545, 3/326

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

Patbase; Google Patents; Google Scholar; Google Web; Espacenet; Search Terms: account*, affix*, aim*, angle*, anywhere*, attach*, attitude*, auto*, barrel*, bore, boresight*, brightness*, calibrat*, centroid*, chang*, compensat*, correct*, determin*, device, differ*, firearm*, fixed, height*, install*, mount*, mov*, object*, point*, position*, rail

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y --- A	US 2012/0126001 A1 (Justice et al.) 24 May 2012 (24.05.2012), entire document, especially Figs. 1-2, para [0042], [0056], [0060]	1-5 and 8-13 ----- 6-7 and 14-17
Y --- A	US 2011/0179689 A1 (Blevins et al.) 28 July 2011 (28.07.2011), entire document, especially para [0043]-[0045]	1-5 and 8-13 ----- 6-7 and 14-17
A	US 2012/0182417 A1 (Everett) 19 July 2012 (19.07.2012), para [0040]	6-7 and 14-17
A	WO 2012/137195 A1 (Ben-Ami) 11 October 2012 (11.10.2012), Fig. 1A, pg. 7, ln. 30 - pg. 8, ln. 21	1-17
A	WO 2013/114066 A1 (Williams) 08 August 2013 (08.08.2013), pg. 2, ln. 7-19	1-17
A	US 2012/0167439 A1 (Jock et al.) 05 July 2012 (05.07.2012), para [0012], [0027]-[0031]	1-17

☐ Further documents are listed in the continuation of Box C.

* 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

04 November 2014 (04.11.2014)

Date of mailing of the international search report

20 NOV 2014

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents
P.O. Box 1450, Alexandria, Virginia 22313-1450

Facsimile No. 571-273-3201

Authorized officer:

Lee W. Young

PCT Helpdesk: 571-272-4300
PCT OSP: 571-272-7774