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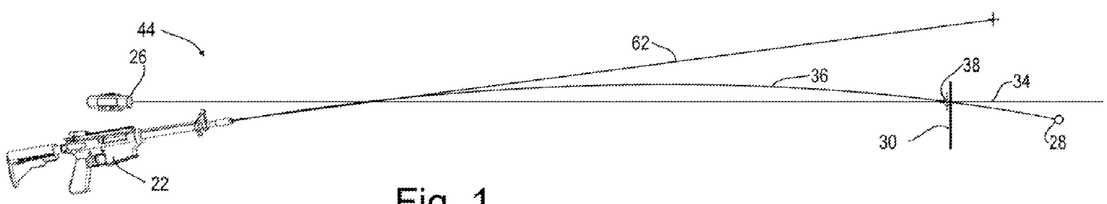

Fig. 1

(57) Abstract: A sighting system for a firearm having sights is disclosed herein. The sighting system utilized with a firearm having a line of sight, a barrel with a bore forming line of bore, a muzzle. The sighting system comprising: a first sensor removably affixed to the barrel of the firearm; the first sensor configured to sense the line of bore of the firearm; a data receiver; the first sensor comprising a transmitter configured to transmit data including the line of bore position to the data receiver; a second sensor separate from the first sensor; the second sensor fixed to the sight of the firearm; the second sensor configured to sense the line of sight of the firearm. In one example the second sensor comprising a transmitter configured to transmit data including the line of sight position relative to the line of bore of the firearm to the data receiver; and the data receiver coupled to a personal computing device configured to receive data from the data receiver, compare the line of bore to the line of sight, and display to a marksman an offset from the line of sight to a point of impact.

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FIREARM SIGHTING SYSTEM WITH REMOTE SENSORS

RELATED APPLICATIONS

[0001] This application claims priority benefit of U.S. Serial Number 62/946,849 filed December 11, 2019 incorporated by reference.

BACKGROUND OF THE DISCLOSURE

Field of the Disclosure

[0002] This disclosure relates to the field of firearm sighting systems configured to zero, align, or re-align the sights of a firearm without the discharge (firing) of a projectile.

BRIEF SUMMARY OF THE DISCLOSURE

[0003] Disclosed herein is a sighting system with remote sensors for a firearm having sights, a barrel, a chamber, a muzzle, and a trigger mechanism. The barrel with comprising a bore with a center axis along the innermost surface thereof forming line of bore. The sighting system in one example comprising: a first sensor removably affixed to the barrel of the firearm; the first sensor configured to sense the line of bore of the firearm; the first sensor comprising a transmitter configured to transmit data including the line of bore position to the data receiver; a second sensor separate from the first sensor; the second sensor fixed to the sight of the firearm; the second sensor configured to sense the line of sight of the firearm. In one example the second sensor comprising a transmitter configured to transmit data including the line of sight position relative to the line of bore of the firearm to the data receiver; and the data receiver coupled to a personal computing device configured to receive data from the data receiver, compare the line of bore to the line of sight, and display to a marksman an offset from the line of sight to a point of impact.

[0004] The sighting system may be arranged where the second sensor comprises a video sensor. In one example the first sensor is configured to send data to the data receiver including direction, distance, and angle of the first sensor relative to the second sensor.

[0005] In one example the second sensor is configured to send data to the data receiver including direction, distance, and angle of the second sensor relative to the first sensor.

[0006] The sighting system may be arranged wherein the data receiver is a mobile phone comprising an app (software application) utilized to analyze the data on the display device as raw data, calculated offset, or graphic representation.

[0007] The sighting system may be arranged wherein the second sensor is a scope cap configured to protect a lens of the sights from damage.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0008] Fig. 1 is an environmental side view of a firearm in use with a correct sight alignment.

[0009] Fig. 2 is a perspective partially exploded view of one example of the disclosed apparatus.

[0010] Fig. 3 is an environmental side view of a firearm in use with an incorrect sight alignment.

[0011] Fig. 4 is a perspective view of one example of the disclosed apparatus.

[0012] Fig. 5 is a highly schematic (symbolic and simplified) perspective view of a plurality of sensors positioned within a locator.

[0013] Fig. 6 is a perspective view of the sensors shown in Fig. 1 and Fig. 5.

DETAILED DESCRIPTION OF THE DISCLOSURE

[0014] The Firearm Sighting System 20 as disclosed herein utilizes existing technology modified for a specific purpose and allows for future improvements to sensor, display, alignment, and to other technologies. Currently, the US armed services police departments, security agencies, and other organizations are deploying training simulations systems and devices that instruct personnel on vehicle driving, weapons marksmanship, combat tactics techniques and procedures (TTPs) from small unit to large fighting formations. Such systems are designed for use with and by the armed services. These systems may be modular or may stand alone and may have the capability to be connected to and interact with a larger network of training and/or tactical components.

[0015] Before beginning a detailed description of the novel examples disclosed herein, an axes system 10 is disclosed relative to the firearm 22 for ease in understanding of the examples presented. The axes system 10 as shown in Fig. 1 comprises a transverse axis 12, a lateral axis 14, and a longitudinal axis 16. The longitudinal axis 16 in some examples is aligned with the bore 24 of the firearm 22. The transverse axis is perpendicular to the longitudinal axis and passes through the line of sight. The transverse axis 12 and lateral axis 14 are orthogonal to each other and the longitudinal axis. These axes are not intended to limit the firearm 22 or firearm sighting system 20 to an orientation relative to Earth or any other outside element as the firearm 22 can be rotated and positioned as needed during operation.

[0016] The term “zero” is used herein as a method to adjust (an instrument or apparatus) to a zero-error point or to an arbitrary reading from which all other readings are to be measured. In particular, the term is used to denote a condition wherein a marksman (user) has aligned the sights 26 of a firearm 22 with an impact point (live fire or calculated) of a projectile 28 fired from the firearm 22 under specific conditions. Subsequent alignment of the sights 26 of the firearm 22 will result in a projectile 28 fired from that firearm 22 impacting a target 30 at a desired location under real-life conditions. Such conditions may include distance 32 from the firearm 22 to the target 30, elevation differential from shooter to target, elevation of range above sea level, temperature, etc.

[0017] Sighting in or zeroing a firearm 22 is the process, goal, and result of adjusting the sights 26 of a firearm 22 such that the projectile 28 (e.g. bullet) will impact a predictable position (target 30) within the sight picture. The principle of zeroing a firearm is to adjust the relative position of the sight 26 to the bore 24 so as to shift the line of sight 34. When properly zeroed, the line of sight 34 intersects the parabolic projectile trajectory 36 at a designated point 38 or target 30. This sighing in, when properly completed, achieves a near perfect alignment of the line of sight 34 with the trajectory 36 at the distance 32. When the firearm is zeroed in this manner, the firearm will repeatably hit where the user aligns the sights at the distance 32 of that zero or sight setting.

[0018] This iterative procedure of zeroing previously involved firing projectiles 28 from a firearm 22 at a target or targets 30, adjusting the sights 26 to move the point of impact 40 to the point of aim 42 at a prescribed distance 32, and repeating the process until a group of projectile impacts is centered on the point of aim 42 on the target 30.

[0019] When firing a non-zeroed firearm 22 at a target 30, a marksman fires the firearm 22 and the projectile 28 strikes a random location downrange. When the firearm is not zeroed, the point of aim 42 (where the marksman has aligned the sights 26) and the point of impact 40 (where the projectile 28 strikes the target 30) do not coincide. To align these points the conditions or variables that result in the discrepancy between the point of aim and the point of impact will be accounted for by the marksman by adjusting the sights 26 of the firearm 22, to offset the discrepancy. The marksman will adjust the sights 26 (point of aim 42) laterally and transversely until the discrepancy (if any) is within an acceptable standard of accuracy in relationship to the point of impact of the projectile on the target 30 (this process when complete zeroing the firearm 22 to that distance). If the marksman can virtually isolate a variable(s) resulting in the discrepancy and extract the variable(s) from the whole, and if a new variable(s) are accounted for without firing of a projectile 28, then a new sight alignment can be achieved in a virtual scenario representative of real-life conditions and target 30. Using the disclosed firearm sighting system 20, the need to fire many expensive and dangerous rounds of ammunition through the firearm 22 to establish a correct sight alignment 44 (zero) may be avoided. This partially virtual system reduces wear on the firearm 22 and cost of ammunition.

[0020] The disclosed firearm sighting system 20 in one form includes a calculation and display application (Display App) written, programed, or wired for firearm marksmanship. The Display App works in conjunction with the system/hardware disclosed herein to improve accuracy and reduce live fire needs during and after zeroing. In use, a marksman can also provide data to the display App from a portable weather station, a Global Positioning System (GPS), a muzzle velocity measuring device, keyboard, touch pad, database, remote weather sensors and stations, or other sensors and systems. The Display App in one form may comprise firearm and bullet (projectile and cartridge) ballistics firing data which is commonly found in ballistic tables. The inputs from chronographs, Global Positioning System (GPS) trackers, portable weather station(s), and other sources can be incorporated. This firearm sighting system 20 in one example will incorporate several interoperating components in a small easy to carry case.

[0021] The hardware portions of the firearm sighting system 20 may comprise a first/bore sensor 46, which may be designed to fit and optionally frictionally engage the outer or inner surface of a barrel 48 of the firearm 22. Such a bore sensor 46 may center on the bore 24 of the firearm 22, such as at the muzzle end, within the chamber, or otherwise index to the bore 24 such that the relative position and orientation of the bore 24 relative to the sight 26 can be determined. In one example, the bore sensor is positioned within the barrel, or chamber of the firearm in a manner to be defined. The bore sensor 46 engaging the inner and/or outer surface of the barrel 48, chamber, or other component to thus provide an index to and position/orientation of the bore 24 to the sights 26. The bore sensor may physically engage the barrel, muzzle, chamber, or bore in such a way as to align with the line of bore and determine this line, or may visually detect the line of bore, such as visually detecting the inner surface of the bore as a pattern recognition or phase detection.

[0022] The bore sensor 46 may include a circuit or system that communicates position and orientation data via wired or wireless communication with a receiver 50. The receiver 50 of one example providing the position and orientation data of the bore sensor 46 relative to the position and orientation of the sight 26 such as the scope as shown to a display device 52. This communication may be established via a combination of accelerometer, gyroscope, magnetometer, proximity sensor, GPS, microphone, barometer, etc. The bore sensor 46 in one example indexes to the bore 26 of the firearm 22 when it is used properly. One such barrel mounted sensor / bore sensor 46 is shown in Fig. 4. A highly schematic example is shown in Fig. 5 and Fig. 6

[0023] The hardware portions of the firearm sighting system 20 may comprise a second 56 (sight sensor), which may be designed to fit and optionally frictionally engage the outer or inner surface of a sight 26. Such a sight sensor 56 may center on the sight 26 of the firearm 22 and be aligned with the line of sight, or otherwise index to the line of sight such that the relative position and orientation of the sight 26 relative to the bore 24 can be determined when the data of the bore sensor 46 is compared to the data of the sight sensor 56. In one example, the sight sensor 56 (temporarily) replaces a sight cap. The sight cap known in the art and used to protect the lens of the sight from damage. The sight sensor may physically engage the sight in such a way as to align with the line of sight and determine this line, or may visually detect the sights, such as crosshairs through a scope as a pattern recognition or phase detection.

[0024] With sights, such as scope sights using an erector assembly 54 as disclosed in US patent 3297389A (incorporated herein by reference) the sight sensor 56 may be configured to determine the relative position of an erector assembly 54 movable within the outer components of the sight 26 relative to the bore sensor 46. Where the windage and elevation of the erector assembly 54 is adjusted during the sighting or zeroing process, not only the position of the outer components of the sight 26 relative to the firearm 22, the position of the erector assembly 54 may be critical in some applications, and easily adjustable relative to the scope tube and other outer components of the sight 26.

[0025] The position and orientation of the sight sensor 56 may be established via position sensors including in different examples an accelerometer, gyroscope, magnetometer, proximity sensor, GPS, microphone, barometer, etc. and combinations thereof within the sight sensor 56. The bore sensor 46 in one example is formed to index to the sight 26 of the firearm 22 when it is used properly. One such sight sensor 56 is shown in Fig. 4. A highly schematic view is shown in Fig. 5 and Fig. 6.

[0026] In one example, the bore sensor 46 and sight sensor 56 benefit from indexing to each other prior to indexing relative to the firearm 22. Thus, a locator

58 may be provided. The locator 58 establishing a starting point from which the bore sensor 46 and sight sensor 56 are indexed. Thus, as the bore sensor 46 and sight sensor 56 are indexed, and any movement from this position at the locator can be determined by the position sensor(s), recorded, and the relative distance, position, and orientation of the bore sensor 46 to the sight sensor 56 can be determined. Movement/position may be established via a combination of accelerometer, gyroscope, magnetometer, proximity sensor, GPS, microphone, etc. The relative position (distance and/or orientation) of the bore sensor 46 and the sight sensor 56 allowing the sighting system 20 to determine a transverse offset 60 between the line of sight 34 and a line of bore 62. In some examples, the position of the sights (crosshairs) may also need to be determined. The distance 32 to target 30 can then be taken into account, the firearm sighting system 20 calculating a transverse and/or lateral sight offset for the condition variables including the distance 32, and the user shown on the display device 52 what elevation (transverse offset) and windage (lateral offset) corrections need to be made to the sight 26 for the offset 60 (transverse and lateral) to be zero for the conditions present for a later live-fire. The display device of one example, coupled to a display app 64, may utilize other shooting factors (condition variables) including ballistics data of the firearm, ballistics data of the cartridge to be fired, elevation (above sea level) of the shooting location, weather factors including temperature, barometric pressure, precipitation, wind, entered manually or through sensors or external data sources to more accurately establish a correct zero for the firearm for a live round to be fired.

[0027] In one example, the sight sensor 56 comprises a camera 66 which captures an image along the line of sight 34 and determines the line of sight 34 relative to the sight sensor 56 visually sense the position of crosshairs, or other component of the erector assembly 54 relative to the scope tube, firearm 22, or line of bore 62. Thus, in examples where the adjustable components of the sight

26 are not physically available (erector assembly) the camera 66 or other sensor is able to provide data to the sighting system 20 of the position of the line of sight 34. In one example, the camera views the crosshairs of the erector assembly and uses their relative position to accurately determine the line of sight 34.

[0028] In one example communication between the bore sensor 56, sight sensor 46, and display app is via wireless communication. In one example this is accomplished via radio frequency (RF), WiFi, Bluetooth, infrared technology, and combinations thereon. In one example wireless technology is used for exchanging data between fixed and mobile devices over short distances using short-wavelength UHF radio waves in the industrial, scientific and medical radio bands, from 2.400 to 2.485 GHz, and building personal area networks (PANs).

[0029] In the example shown in Fig. 5 the locator 58 comprises a box with a base 68 and a lid 70 connected to the base via a hinge. Within the locater of this example are shown a plurality of sensor locations 72/74. The bore sensor 56 and sight sensor 46 are placed onto or into sensor locations 72/74. Once in place, the sighting system 20 is reset to an indexed position and orientation, and the relative position of the sensors 46 and 56 to each other is indexed. Any movement from this position can be recorded, and as the sensors 72/74 are placed on the firearm 22 their relative position/distance/orientation (PDO) can be accurately determined. This PDO data is used by the display app to establish the sight 26 position and line of bore 62 of the firearm 22. The sight sensor 56 of one example also providing data (e.g., visual images from the camera 66) enabling the display app and to determine the line of sight 34 and thus any offset 60.

[0030] Indexing can be established manually by a user actuating the indexing system through a switch on the locator 58, switches on the sensors 72/74, through wireless actuation via RF or IR, magnetic switches, contact switches, proximity switches etc. For example, when the locator box of the example shown is opened; the locator 58 may actuate the indexing system. This may also turn on the sensors 72/74 while placing them in the locator 58 or closing the locator 58 may turn the sensors 72/74 off to save battery and sensor life. Other switches and systems may also be used for turning the sensors 72/74 on or off.

[0031] In another example, the locator 58 comprises a charging system for powering power cells (batteries) within the sensors 72/74. Such technology is used for example in wireless earbud charging such as shown in US Patent 9,906,851 incorporated herein by reference. A cooperating power supply may be wired or otherwise provided power to the locator 58.

[0032] In one example batteries are easily removed from the sensors 72/74 for long term storage.

[0033] In one method of operation, the user turns on the sensors 46/56 and thus engages the indexing system while the sensors and the sensors 46/56 are at the locator 58. Thus, the sensors 46/56 are indexed to a starting position. The user then removes the sensors 46/56 from the locator 58 and places them in position on the firearm 22 such as on the barrel 48 and sights 26. In one example the bore sensor 46 is attached to the barrel 48, bore 24, or within the chamber 76 portion of the barrel 48. In one example the sight sensor 56 is mounted to the rear portion of the sight 26. The sight sensor 56 may be positioned such that the camera 66 captures a sight picture including the crosshairs of the erector assembly 54.

[0034] In one example position sensors within the bore sensor 46 and sight sensor 56 then relay movement data from the indexing position to the use position (Fig. 5) to the use position (Fig. 4) The position receiver 50 then receives this position data and in one example shows to the user any offset 60 from the projected (simulated) point of impact 40 to the line of sight 34. Thus, the user can adjust the windage (lateral) and elevation (transverse) alignment of the sight 26 until the projected (simulated) point of impact 40 aligns with the line of sight 34. In one example, a perfect or near perfect alignment results in a visual and/or audible notification to the user. For example, the crosshairs may change color (red to green), an audio beep may sound, or an icon may be displayed, such as at the center of the cross hairs. The firearm is thus virtually zeroed and ready for a live fire without firing any live rounds.

[0035] As mentioned, the display app 64 may utilize other shooting factors in determining the desired offset, including the firing distance 32, ballistics data of the firearm, ballistics data of the cartridge to be fired, elevation (above sea level) of the shooting location, weather factors including temperature, barometric pressure, precipitation, wind, entered manually or through sensors or external data sources to more accurately and virtually establish a correct zero for the firearm for a later live round to be fired.

[0036] In another example, the sensors 46/56 comprises beacons. Beacons are small, wireless transmitters that use low-energy Bluetooth technology to send signals to other devices nearby. Beacons connect and transmit data to smart devices making location-based searching and interaction easier and more accurate than many other technologies. Such beacons are discussed in US Patent US8629773B2 incorporated herein by reference.

[0037] In one example the sensors 46/56 when comprised of beacons emit a constant, intermittent or responsive data stream to the position receiver 50 of the display device 52. The location receiver is configured to receive this data from the sensors 46/56 and calculate the relative PDO of the line of bore 62 to the line of sight 26. The zero or desired offset is then calculated by the position receiver 50 and/or display device 52 and displayed on the display device 52.

[0038] In one example, the following steps may be followed to use the firearm sighting system 20:

STEP 1. CREATE PROFILE AND BORESIGHT:
Create a profile with your specific firearm/sighting system and input range to zero in yards. With the gun unloaded install the first sensor 46, second sensor 56 and boresight the firearm. Follow directions on the display device 52, moving sight alignment as indicated on the display device 52.

STEP 2. ZERO FIREARM AT RANGE:
After bore sighting the firearm, remove sensor components 46/56 and zero the firearm on paper at designated yardage. Ensure proper calibration by determining rounds impact at the location of scope reticle.

STEP 3. SAVE ZERO:
After you have zeroed, unload the gun and reinstall sensor components.
Launch ‘Save Zero’ from a menu on the display device 52 and move the app crosshair or dot (point of aim 42) to the scope reticle on the display device. This stores the zero and calibration setting from step two by recording the deviation (offset) between the line of sight or reticle point and point of impact.
A new adjusted line of sight is recorded. The user can now recall this zero for later use.

STEP 4. VERIFY ZERO: With the gun unloaded install sensor components 46/56. The display device 52 will display the point of aim relative to the point of impact and determine if the firearm is properly zeroed or if sight 6 needs windage and/or elevation adjustment.

[0039] During ‘Boresight’ the app uses geometry to triangulate distance between sensors and determine scope height. During ‘Save Zero’ the app allows users to pair calibration data determined during zeroing alongside ballistic data in one easy step. Any number of variables can impact bullet trajectory. This includes make and model of firearm and scope, manufacturing tolerances for ammunition, and even location and weather. This information may be stored to a calibration profile within the display device or elsewhere.

[0040] In one example, before any adjustments are made the line of sight 34 and line of bore 62 are parallel. After a firearm is properly boresighted and zeroed, the new adjusted line of sight 34 and total deviation 60 that may occur is calculated by the sensors and app. Notice, when the gun is fired the line of bore fired the line of bore and trajectory path shift upward. The trajectory path then crosses the adjusted line of sight as shown in Fig. 1.

[0041] In use, the sight alignment should be verified when a sighting system has been compromised or knocked out of alignment or when the firearm is used in a new location, or where weather or elevation have changed.

[0042] While the present invention is illustrated by description of several embodiments and while the illustrative embodiments are described in detail, it is not the intention of the applicants to restrict or in any way limit the scope of the appended claims to such detail. Additional advantages and modifications within the scope of the appended claims will readily appear to those sufficed in the art. The invention in its broader aspects is therefore not limited to the specific details, representative apparatus and methods, and illustrative examples shown and described. Accordingly, departures may be made from such details without departing from the spirit or scope of applicants' general concept. The invention illustratively disclosed herein suitably may be practiced in the absence of any element which is not specifically disclosed herein.

CLAIMS

1. A sighting system (20) for a firearm having sights (26), with a line of sight (34), a barrel (48) with a bore forming line of bore (62), a muzzle; the sighting system (20) comprising:

   a first sensor (46) removably affixed to the firearm (22);

   the first sensor (62) configured to sense the line of bore (62) of the firearm (22);

   a data receiver (50) in data communication with the first sensor (46);

   the first sensor (46) comprising a transmitter configured to transmit data including the line of bore position to the data receiver (50);

   a second sensor (56) separate and remote from the first sensor (46);

   the second sensor (56) fixed to the sight (26) of the firearm;

   the second sensor (56) configured to sense the line of sight (34) of the sights (26) of the firearm (22);

   the second sensor (56) comprising a transmitter configured to transmit data including the line of sight;

   the sighting system (20) configured to determine the line of sight (34) relative to the line of bore (62) of the firearm (22) to the data receiver (50) and

   the data receiver (50) coupled to a personal computing device including a display device (52) configured to receive data from the data receiver (50), compare the line of bore position and orientation relative to the line of sight orientation and position, and display to a marksman an offset (60) from the line of sight (34) to a point of impact (40).

2. The sighting system (20) as recited in claim 1 wherein the second sensor (56) comprises a video sensor.

3. The sighting system as recited in claim 1 wherein the first sensor (46) is configured to send data to the data receiver (50) including direction, distance, and angle of the first sensor (46) relative to the second sensor (56) and or data receiver (50).

4. The sighting system (20) as recited in claim 1 wherein the second sensor (56) is configured to send data to the data receiver (50) including direction, distance, and angle of the second sensor relative to the first sensor (46) and or data receiver (50).

5. The sighting system (20) as recited in claim 1 wherein the data receiver (50) is a mobile phone.

6. The sighting system (20) as recited in claim 1 wherein the second sensor (56) comprises a scope cap configured to protect a lens of the sights (26) from damage.

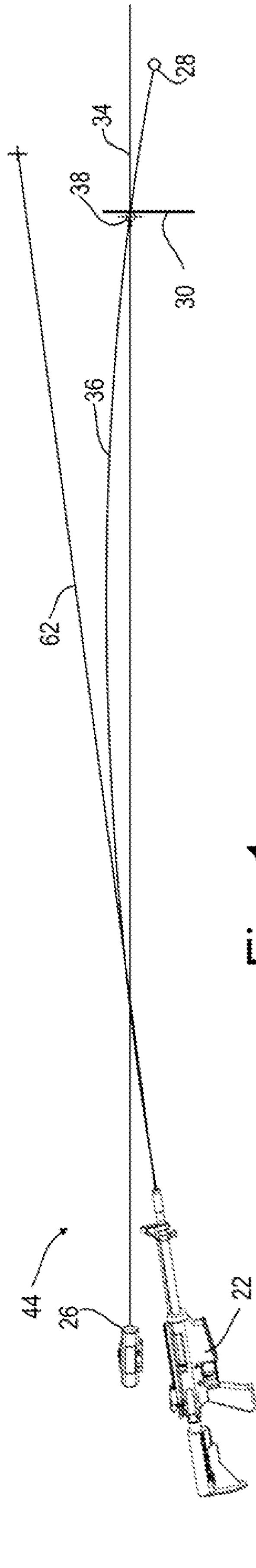
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Fig. 1

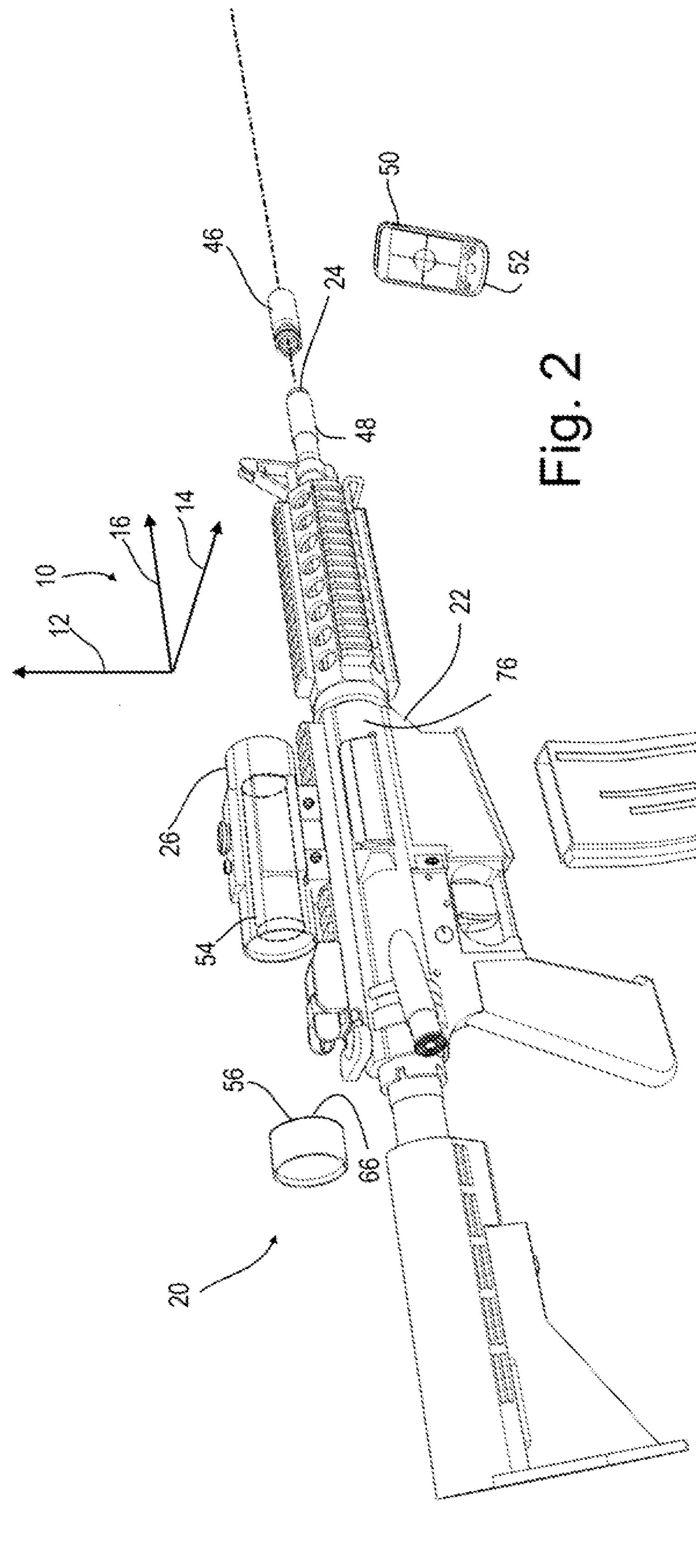
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Fig. 2

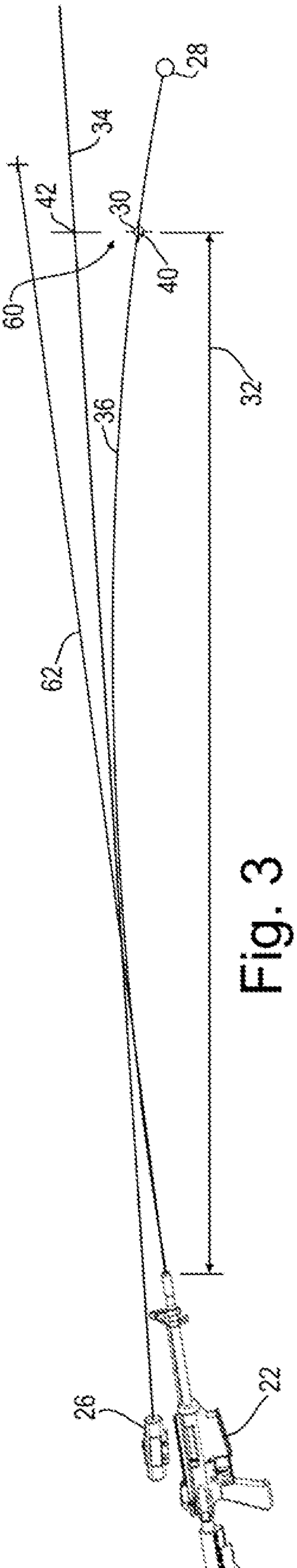

Fig. 3

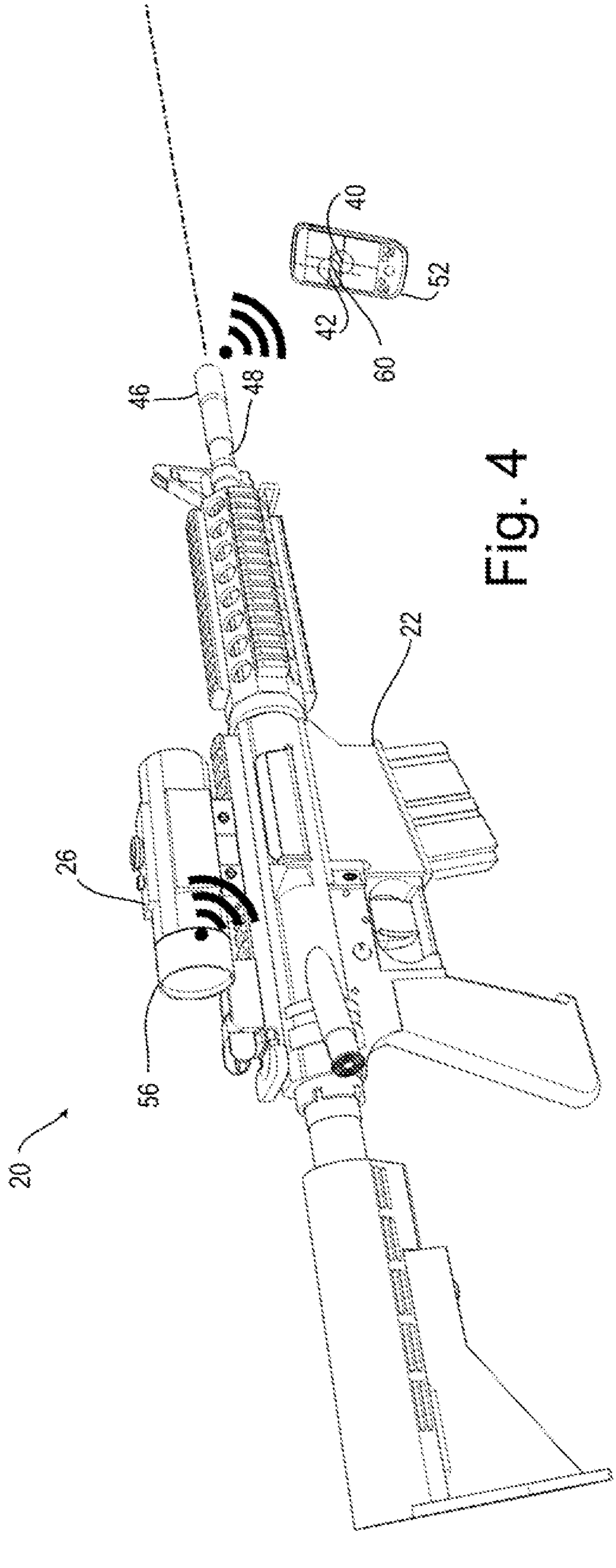

Fig. 4

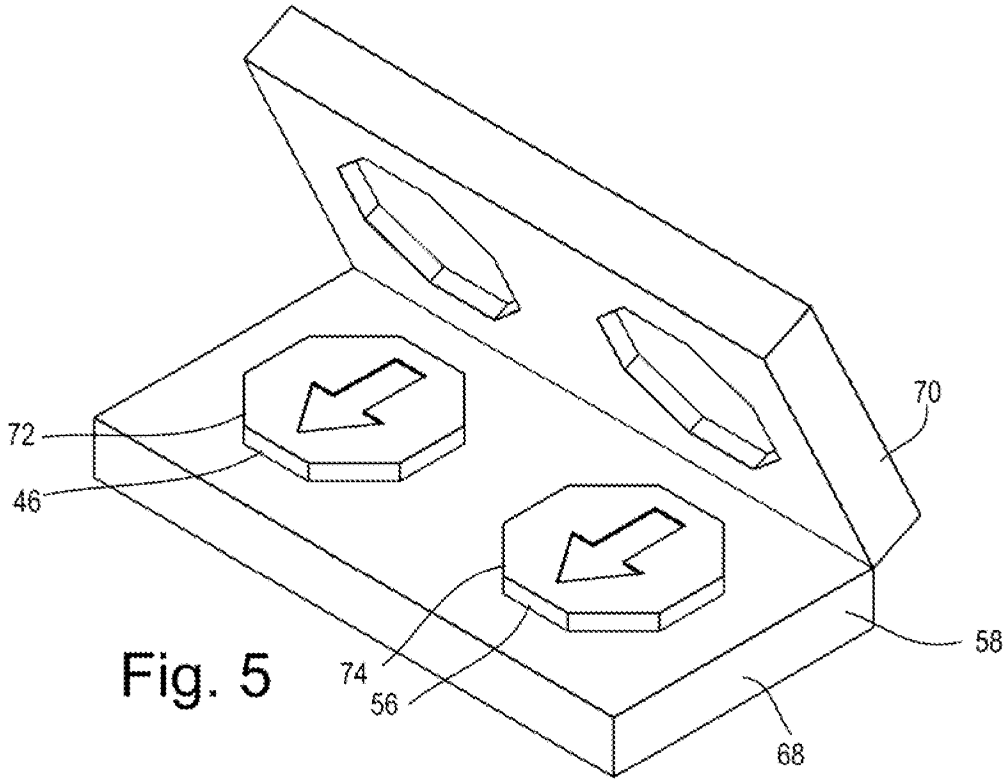

Fig. 5

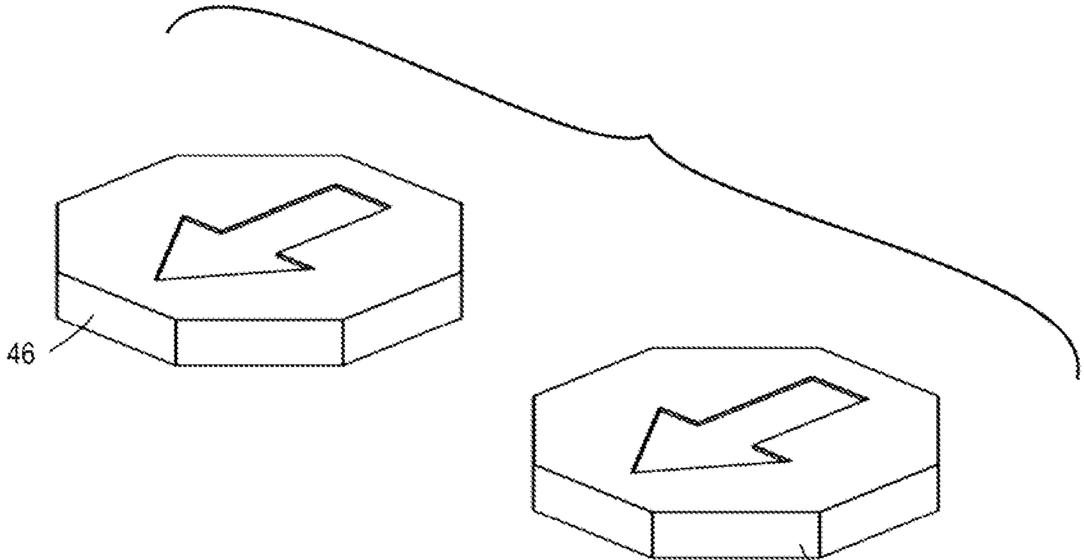

Fig. 6