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(54) **FIREARM ILLUMINATION SYSTEM AND METHOD**

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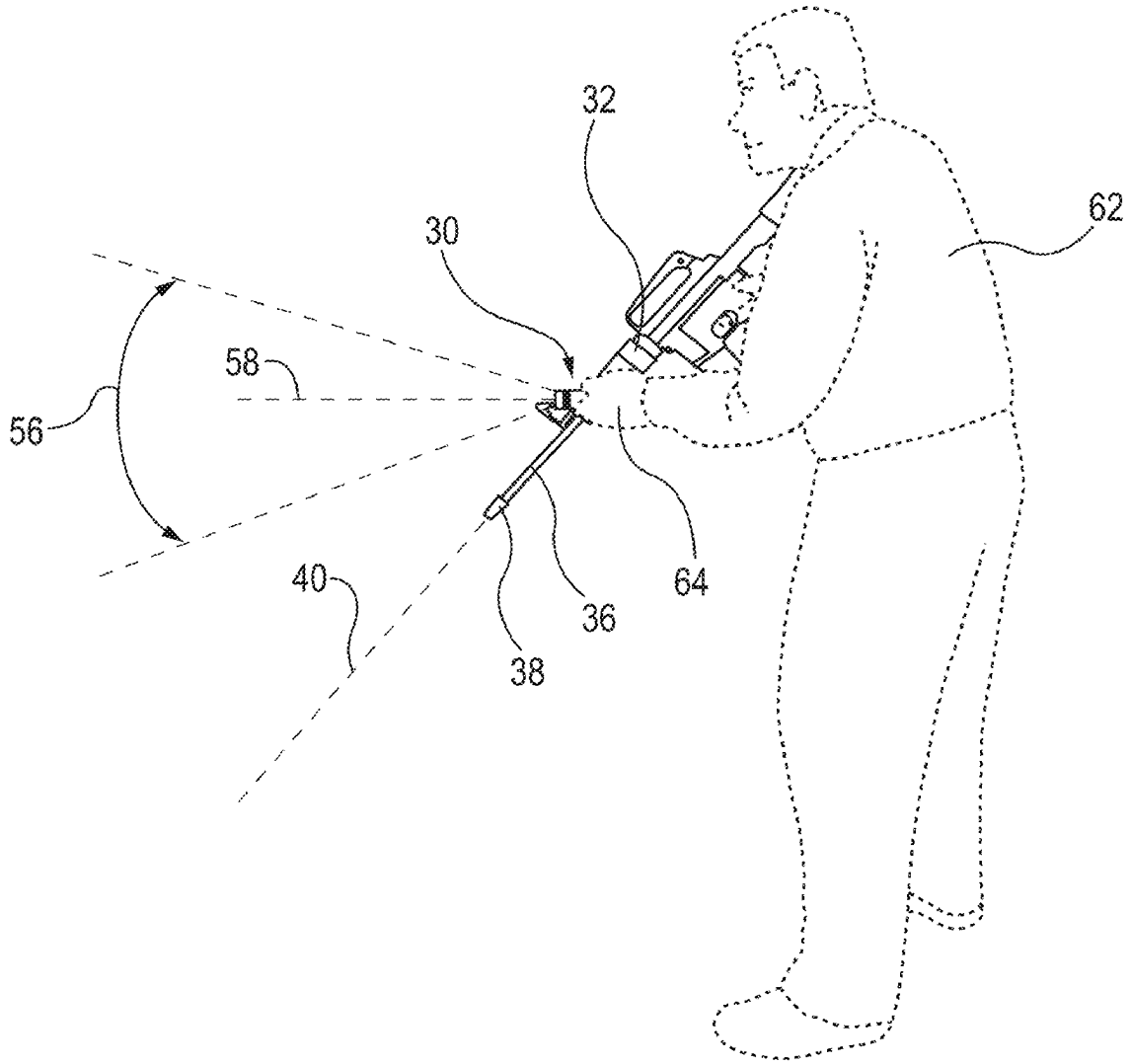
CPC ***F41G 1/35*** (2013.01); ***F41G 11/007*** (2013.01)

(57) **ABSTRACT**

A firearm illumination system that is selectively mounted to a firearm, includes an illumination device for emitting an illumination field. A mount housing incorporates a firearm coupling mechanism that is adapted for selectively coupling of the illumination device to a firearm. A swivel mechanism is coupled to the mount housing between the illumination device and the firearm coupling mechanism. The swivel mechanism defines an axis of rotation normal to the bore axis of the mounted firearm, for facilitating selective pivotal movement of an illumination axis of the illumination device above or parallel with, or below the bore axis of the firearm. In use, the illumination field is oriented within a search area by pivoting the illumination axis while orienting the firearm bore axis outside the search field. Upon threat identification, the firearm is brought to bear on it and the illumination axis is oriented parallel with the bore axis.



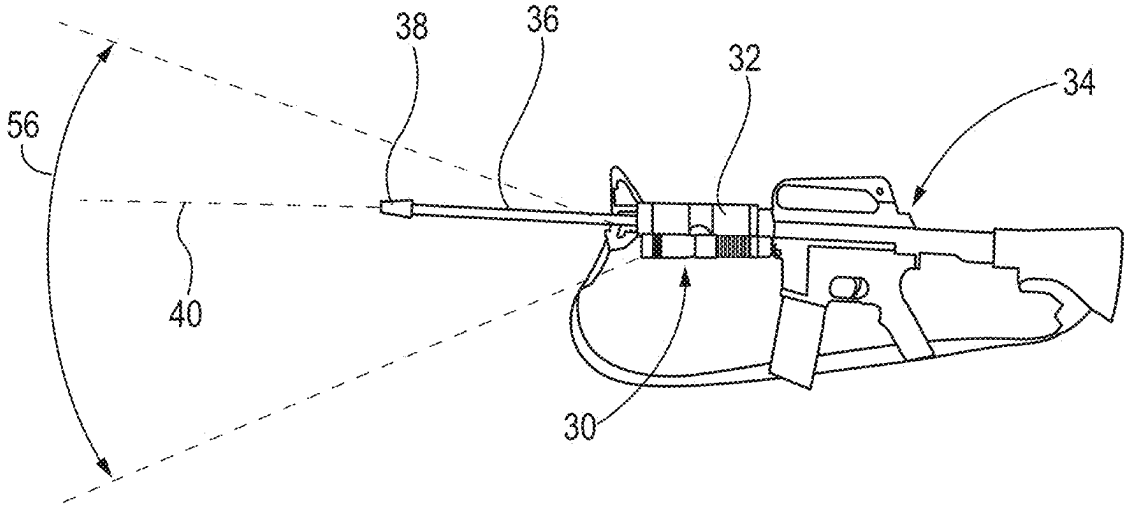


FIG. 1

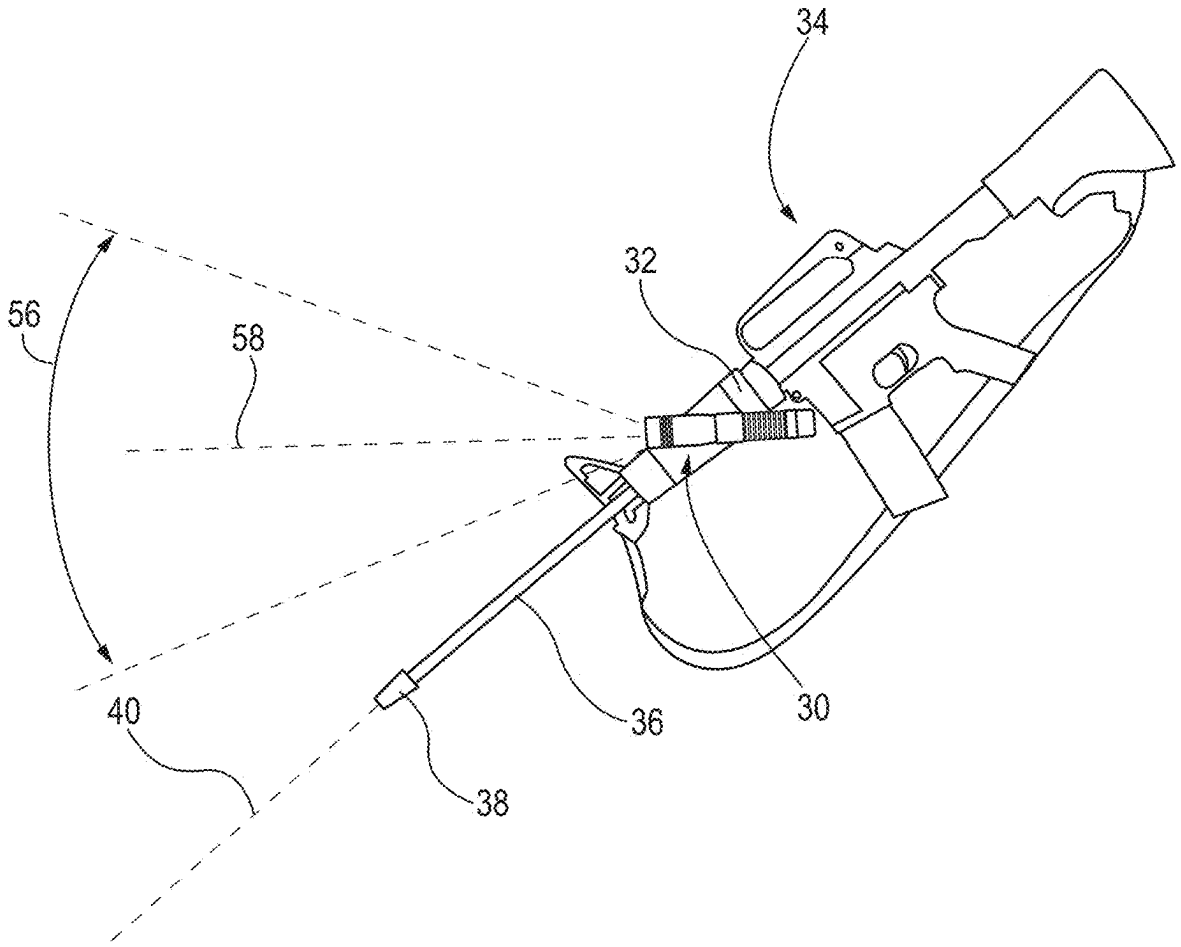


FIG. 2

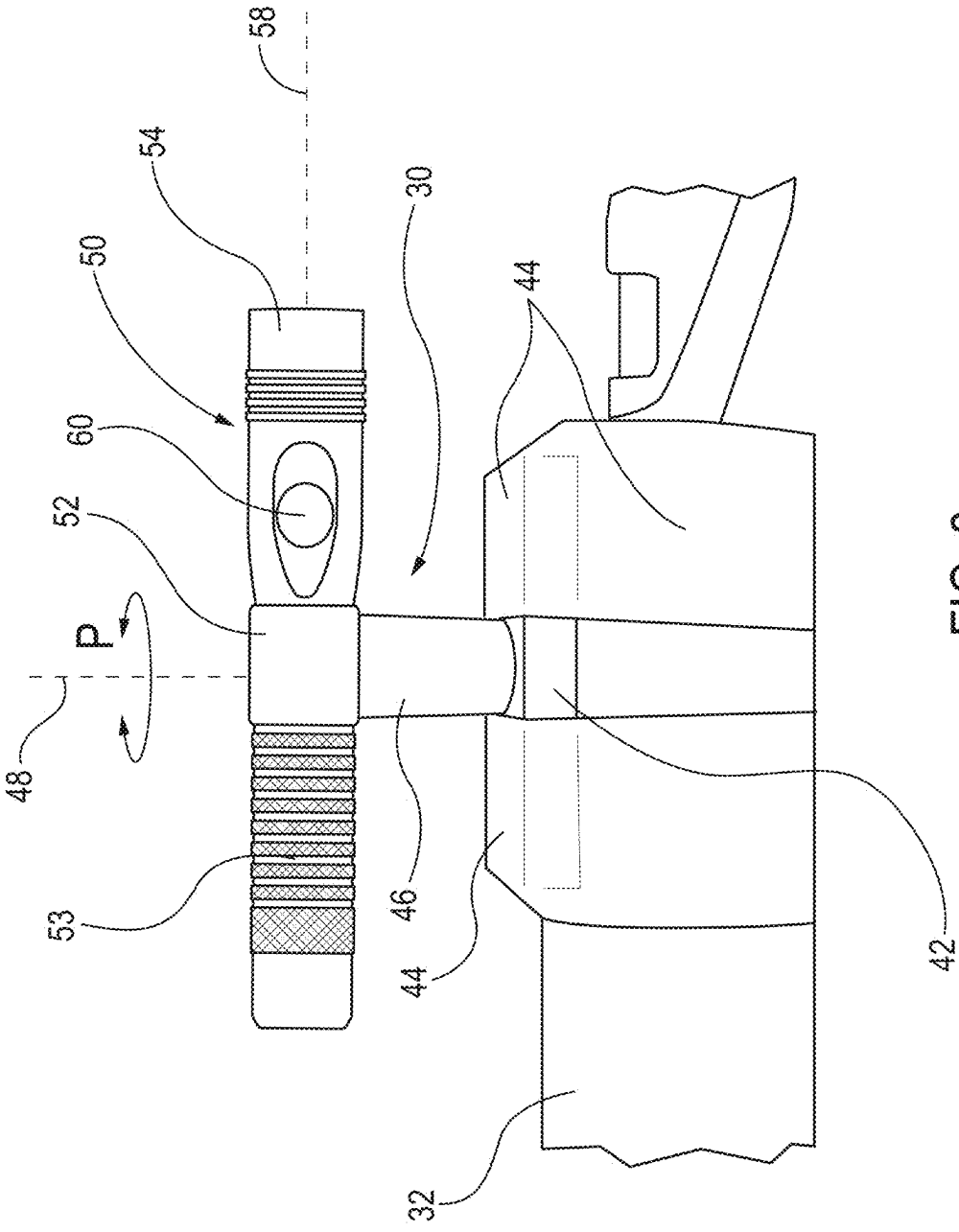


FIG. 3

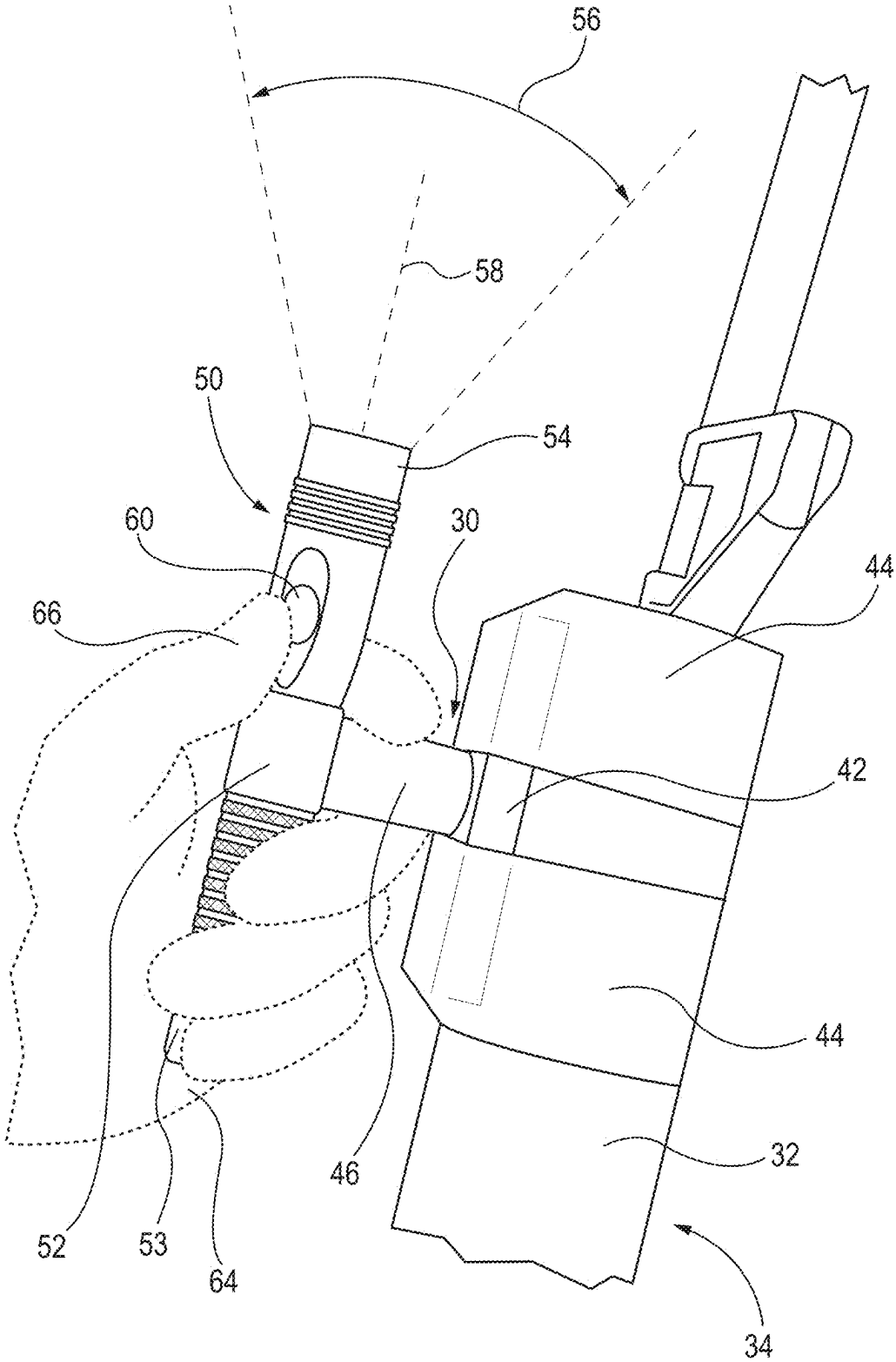


FIG. 4

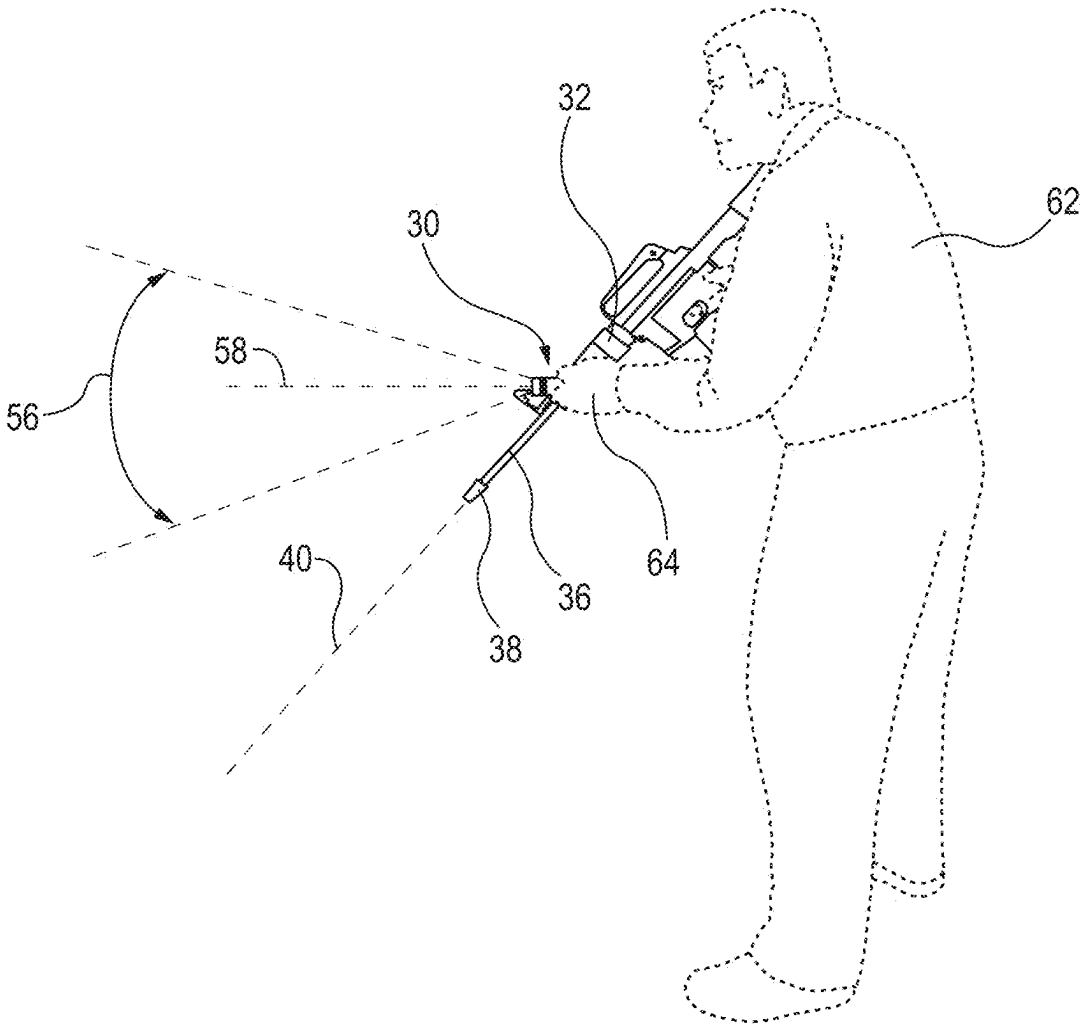


FIG. 5

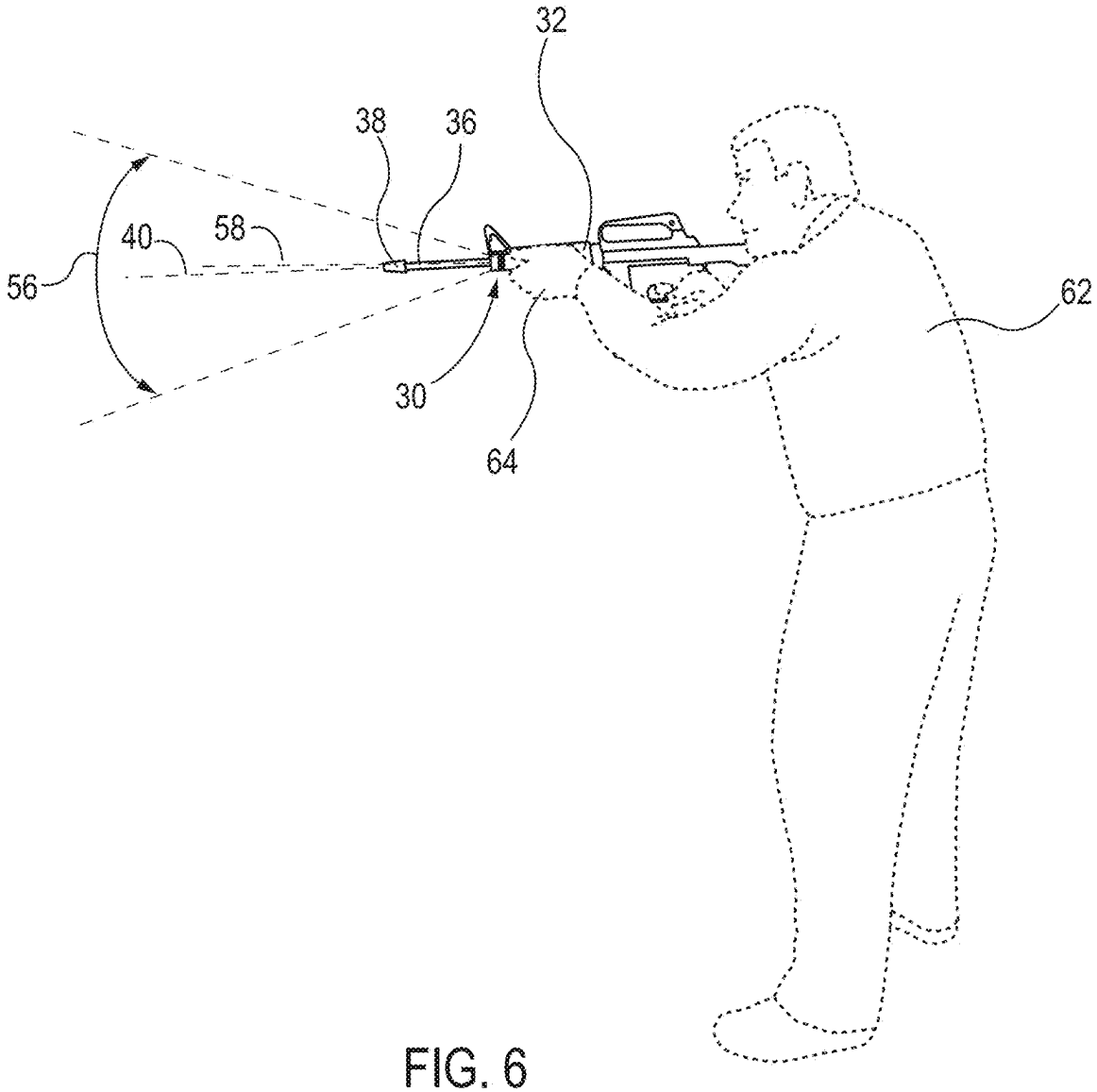


FIG. 6

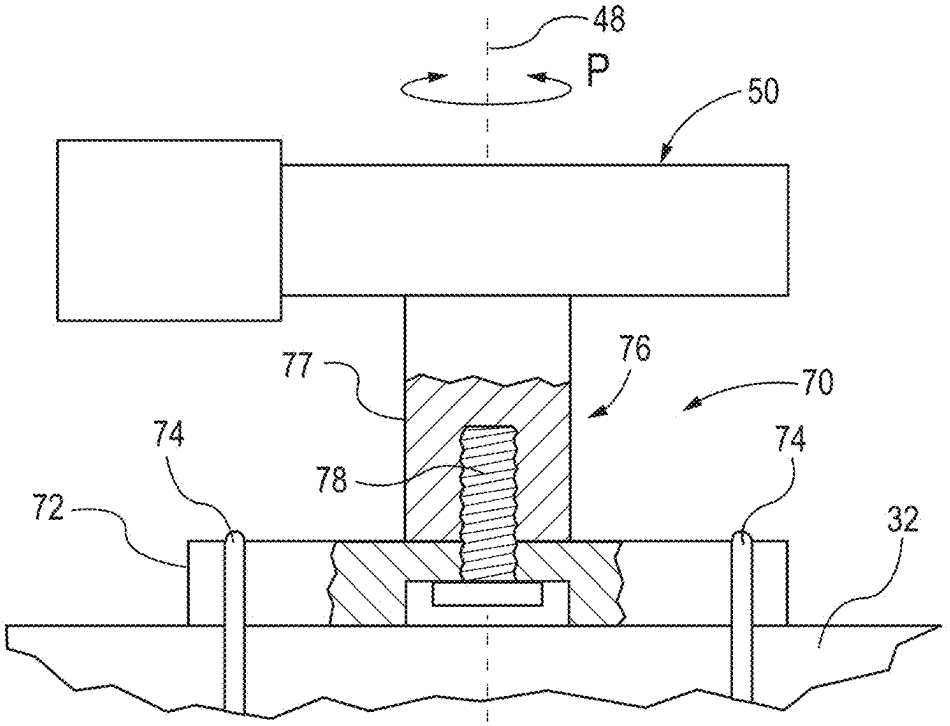

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FIG. 7

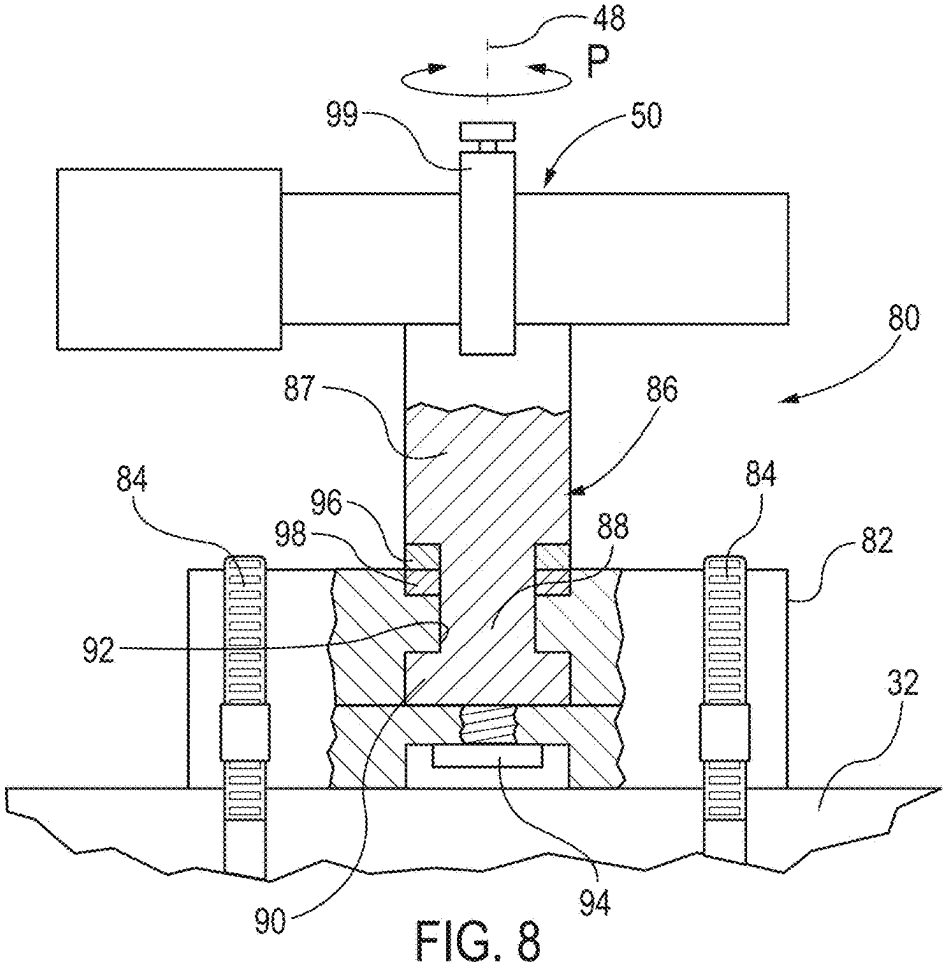
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FIG. 8

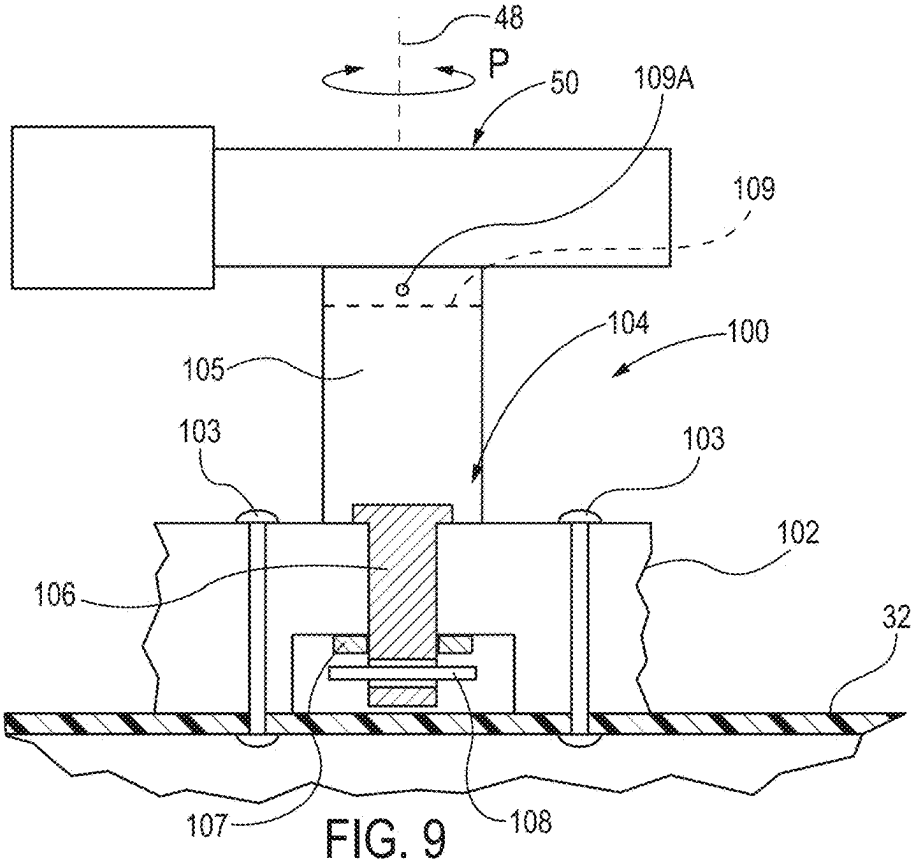
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FIG. 9

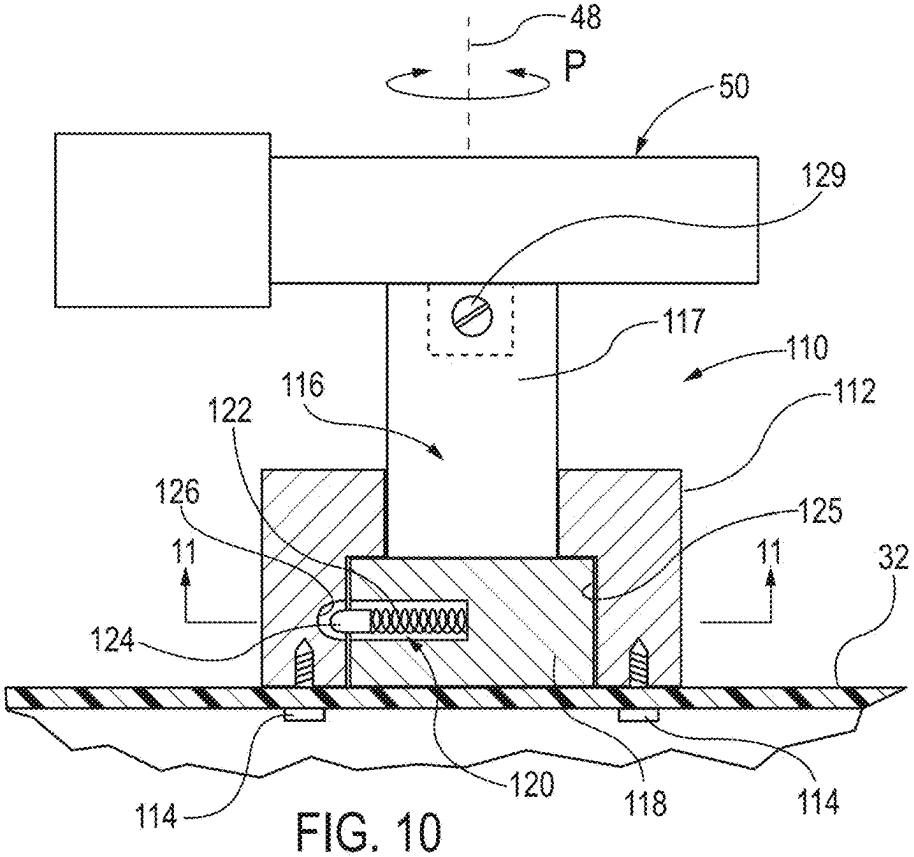
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FIG. 10

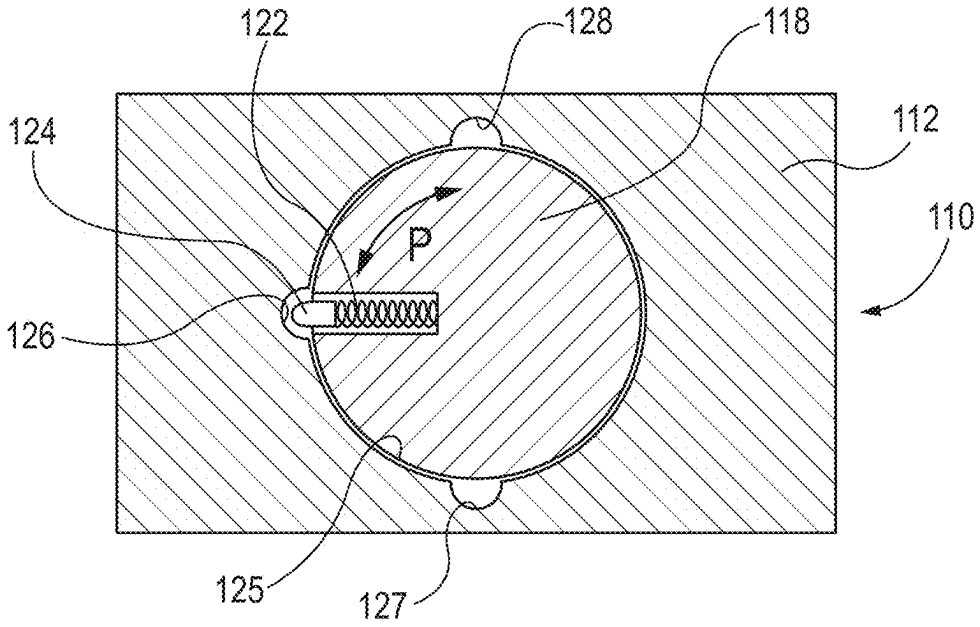
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FIG. 11

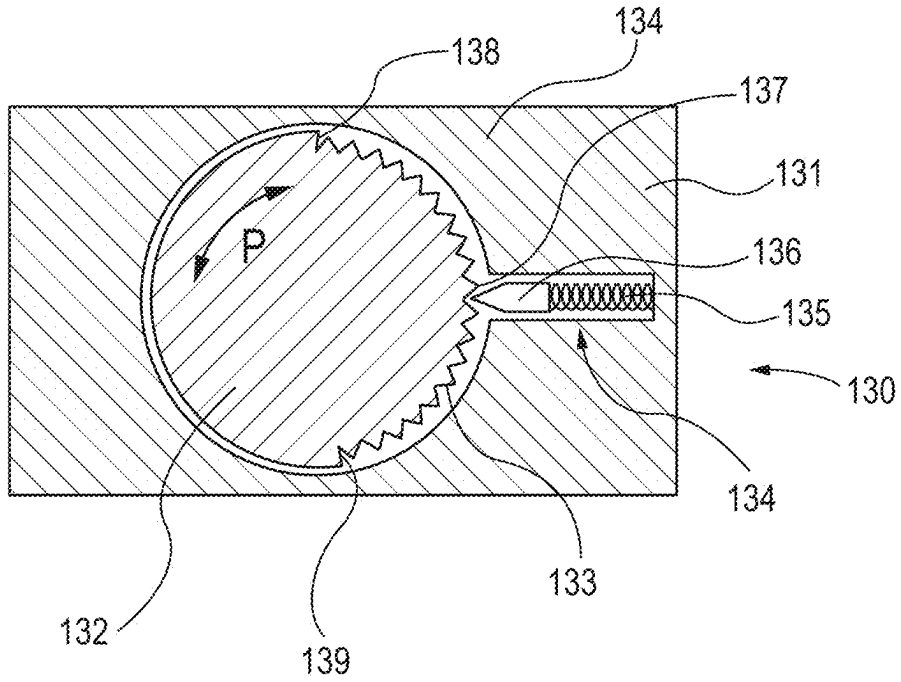
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FIG. 12

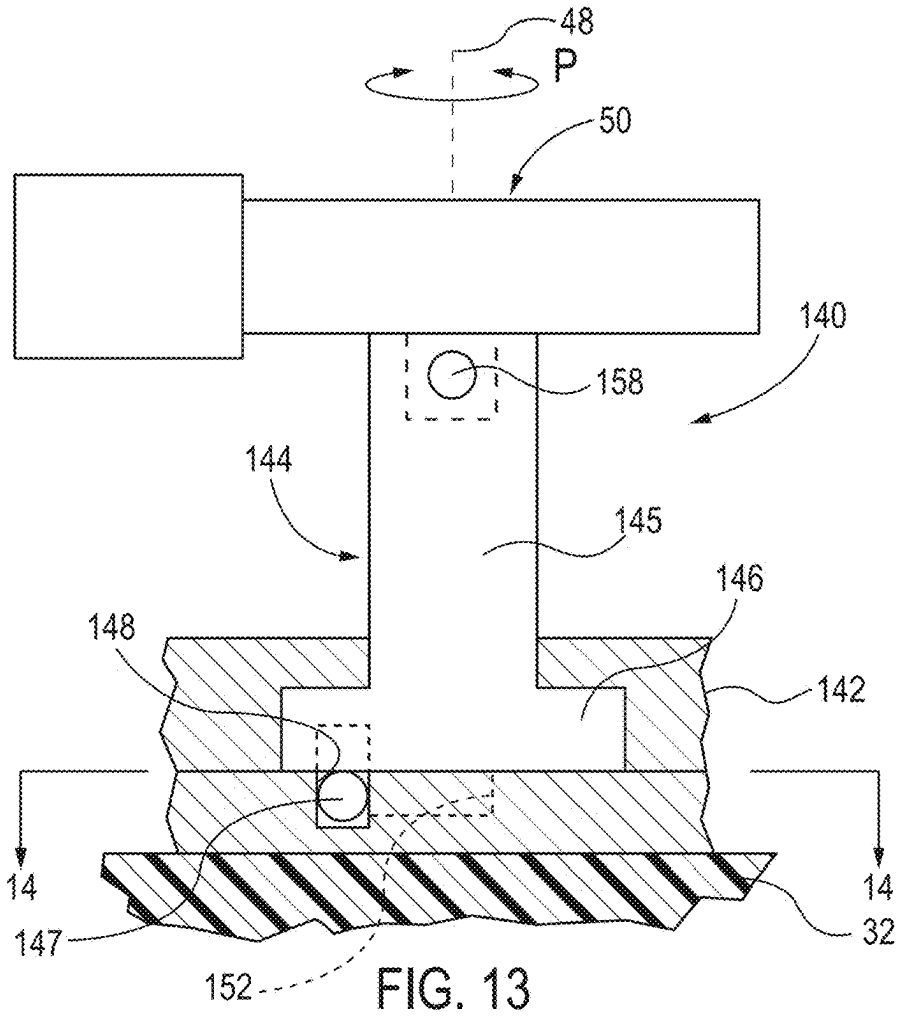
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FIG. 13

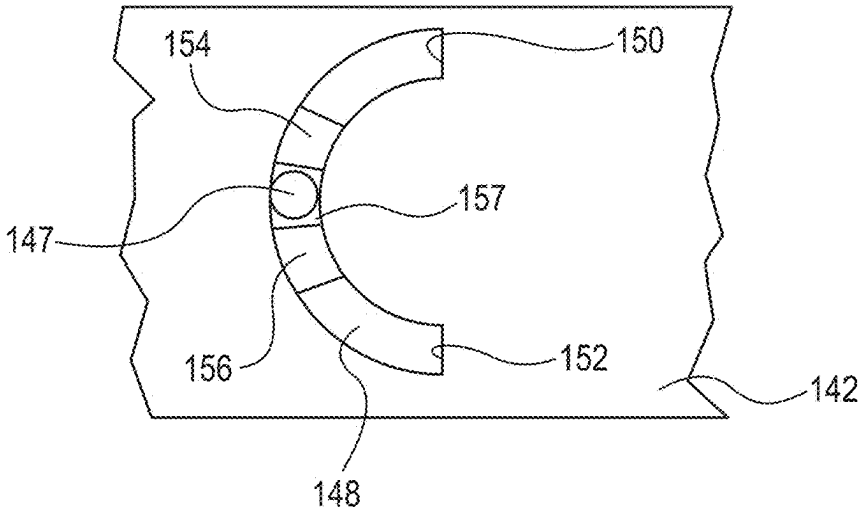
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FIG. 14

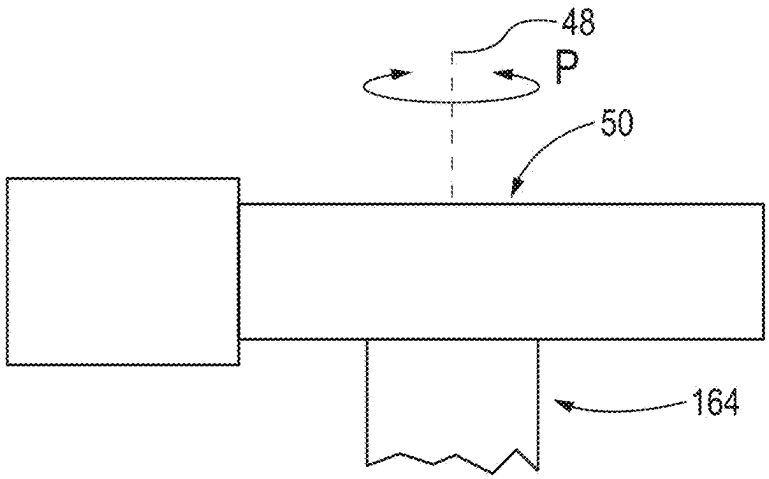
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FIG. 15

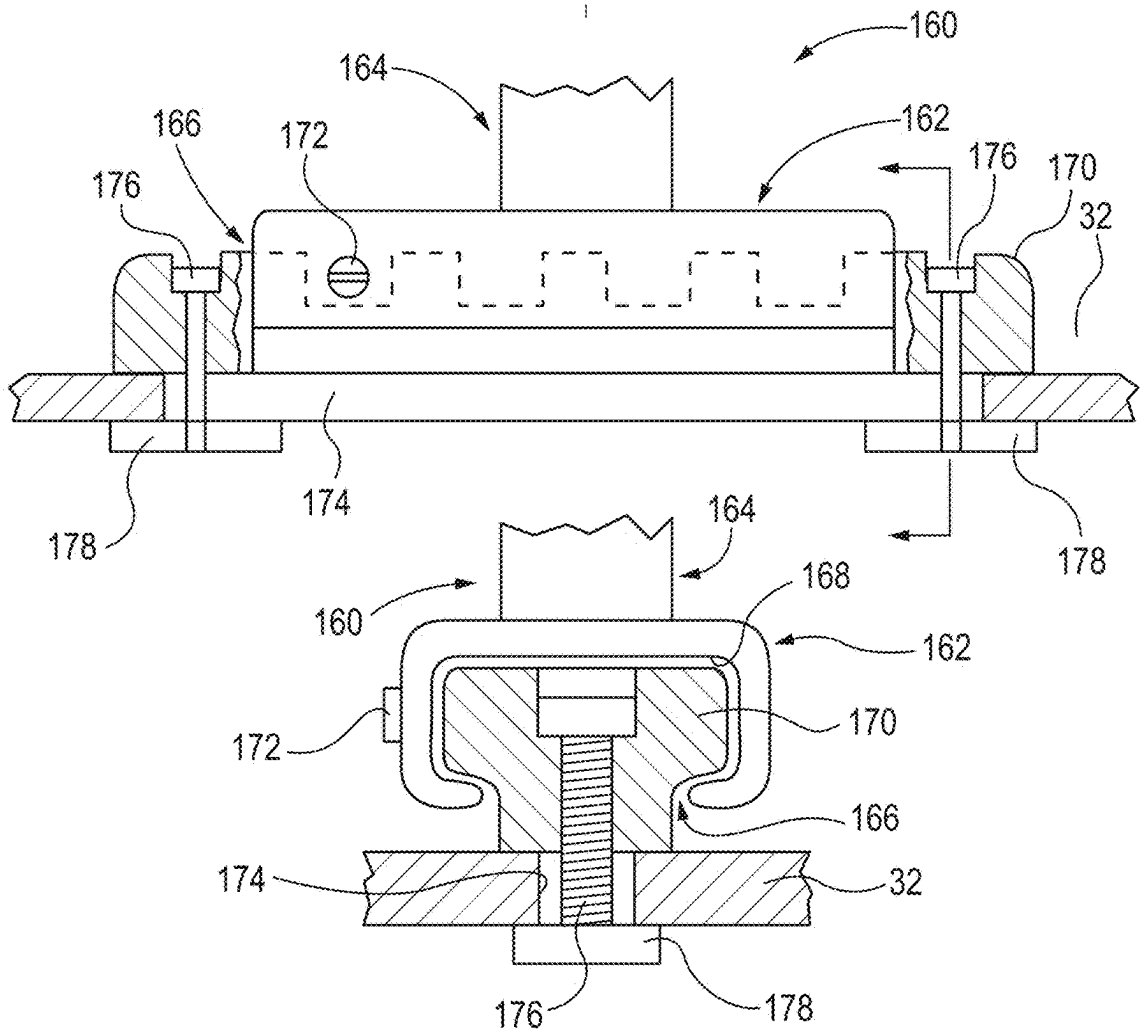
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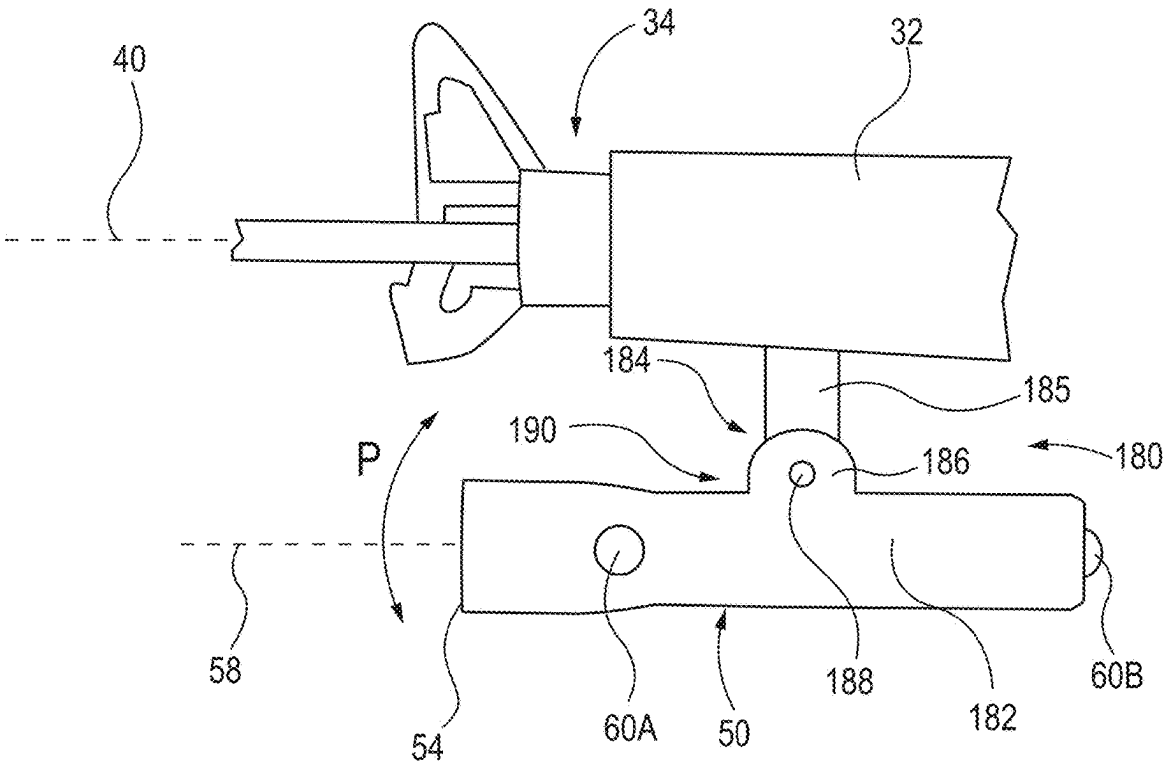
FIG. 16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60B
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FIG. 17

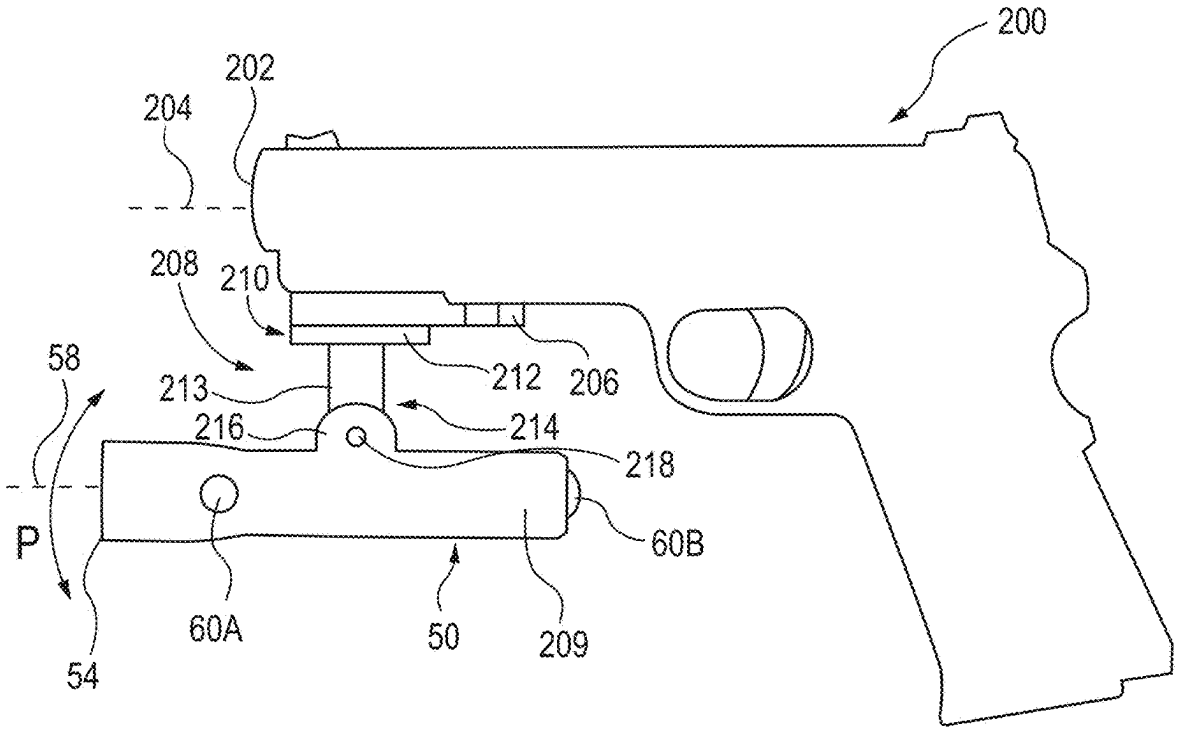
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FIG. 18

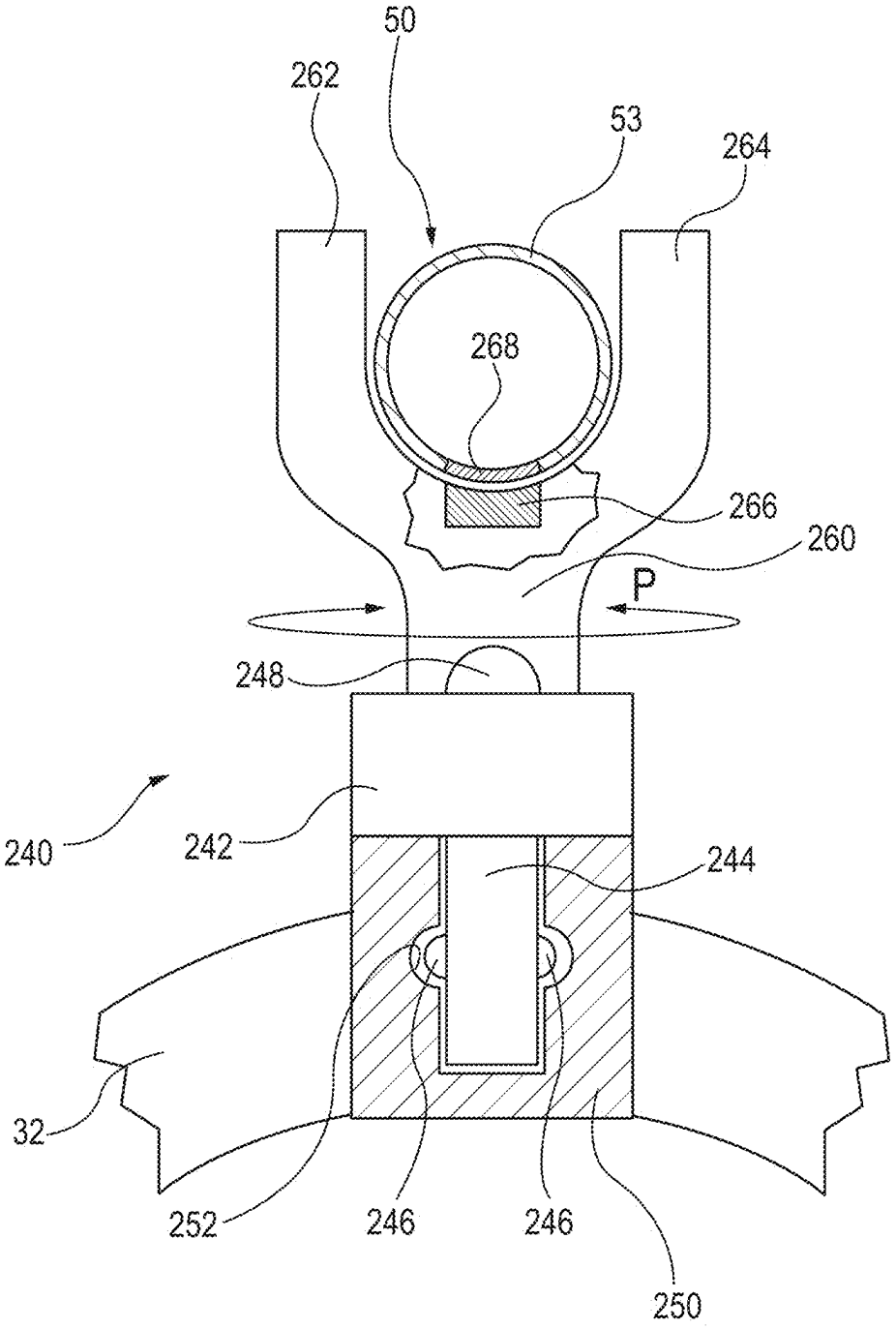

FIG. 19

FIREARM ILLUMINATION SYSTEM AND METHOD

PRIORITY CLAIM

[0001] This application claims the benefit of priority of U.S. Provisional Application No. 63/555,386, filed Feb. 19, 2024, and entitled "FIREARM ILLUMINATION SYSTEM AND METHOD" which is incorporated by reference herein.

TECHNICAL FIELD

[0002] This disclosure relates to illumination systems for firearms. More particularly, this disclosure relates to illumination systems that are mountable on firearms. This disclosure also relates to methods for using such illumination systems selectively, to avoid directing the firearm muzzle at an innocent bystander or into a search field unless the user intends immediately to discharge the firearm at that individual or in that direction.

BACKGROUND

[0003] Law enforcement and security officers, military personnel, and armed private

[0004] individuals sometimes have to search or move through darkened areas, whether at night or in poorly illuminated interior areas at any time of day. They commonly use hand-held flashlights as illumination devices to illuminate these areas for several purposes, including finding their way ("navigating") through the area or terrain safely, locating potential threats, assessing the threat level presented (i.e., deadly threat, non-deadly threat, unknown threat level, or no threat), and as an aid to marksmanship if shots must be fired. In recent years, the use of weapon-mounted lights ("WMLs") has become common on handguns, rifles, shotguns, and submachine guns used for law enforcement, military, and other defensive purposes.

[0005] Many police departments now issue WMLs to officers on their service pistols, rifles, and other firearms. The mounting systems currently employed for WMLs hold the light positioned so that the light illuminates the area at which the firearm is pointed, that is, with the axis of the light field parallel to (approximately coaxial with) the axis of the firearm's bore or barrel. This is good for using the light as an aid to marksmanship when firing the weapon, or perhaps for verbally challenging and covering a threatening suspect at gunpoint. It is not good for navigating, locating subjects, and in some cases for determining the threat level posed by the subjects, as the fact that the firearm is pointed at the area illuminated by the light results in the firearm being pointed at innocent bystanders, individuals who do not pose a sufficient threat to justify pointed a firearm at them, and unsafe areas, where the potential discharge of a firearm, whether intentional or accidental, would endanger the public, other individuals, or critical items of property.

[0006] When searching or moving through a dark area with a handgun, these problems can, and often are, solved, by the use of a separate hand-held flashlight, not attached to the handgun, and most law enforcement and security officers and military personnel are equipped with hand-held flashlights which can be used in this manner. This tactical method is feasible because the handgun can either be carried in the holster, or held in one hand, when moving through or searching an area. However, when the firearm being used is not a handgun, but is a shoulder weapon such as a patrol rifle, carbine, shotgun, or submachine gun, the use of a separate hand-held flashlight is problematic, as these shoulder weapons are best carried in ready positions, and are best fired, with both of the user's hands on the weapon. While there are techniques for using a separate hand-held flashlight, rather than a WML, when holding, aiming, or firing a shoulder weapon, these techniques are difficult to teach, awkward to employ, and for many users do not provide the speed and accuracy of fire available through use of a WML.

[0007] On the other hand, use of the shoulder weapon's WML for navigating, locating subjects, and assessing the threat level posed by the subjects is unacceptable in situations where using the WML in this way will result in pointing a loaded firearm, in a stressful situation, at an innocent bystander, or into an unsafe area, such as down a hallway in a public building, or into an auditorium, movie theater or restaurant full of people. Many law enforcement agencies have written policies that can be construed to prohibit their officers from pointing their firearms at individuals unless they have reason to believe the use of deadly force may be imminently necessary. This would be hard to justify, for instance, if an officer using the WML on his patrol rifle used the light when searching an apartment to illuminate a mother in her bathrobe, who came around a corner with an infant in her arms, and by doing so pointed his rifle at the mother and infant. In many states, simply pointing a gun at someone without proper justification constitutes a criminal offense, typically simple assault, aggravated assault, reckless endangerment, or brandishing. In many law enforcement agencies and some entire states, such as California, a law enforcement officer's pointing a gun at someone is a reportable use of force.

[0008] There have been court cases holding that a police officer's pointing a gun at a person without adequate justification may be a Fourth Amendment violation under the Constitution of the United States of America. See, e.g., *Baird v. Renbarger,* 576 F.3d 340 (7th Cir. 2009). And, especially in the stress of a police officer's search of a dark area with a weapon in hand, there is always the chance the officer may unintentionally discharge the firearm, for any of several reasons. As just one example, a police officer on the Rochester, New York. Police Department SWAT Team, who was pointing his shotgun at a man sitting on a sofa in an apartment being searched by the SWAT Team, had his shotgun unintentionally discharge, killing the man on the sofa. The SWAT officer testified at trial that the man on the sofa, who was sitting there with his hands on his knees, was "no threat to me," but that he was pointing his shotgun at the man to illuminate the man by use of the shotgun's WML. As another example, a police officer in New Jersey, using his WML for illumination while descending a dark stairway, unintentionally discharged his firearm, hitting a fellow officer with him in the stairway.

SUMMARY

[0009] This disclosure addresses the prior, existing problems described above by providing an illumination system with an illumination device, such as a WML on the shoulder weapon (rifle, carbine, shotgun or submachine gun), in which the light can be pivoted upward or downward by the user, so that the user can navigate through or search a dark area with the flashlight's field of illumination directed forward, while the shoulder weapon's muzzle is pointed safely downward (in a "low ready" position), or upward (in

a "high ready position"). If the user then sees a subject presenting, or likely to present, a deadly threat that must be covered at gunpoint, or at which shots must be fired, the embodiments of illumination systems described in this disclosure allow the light to be rotated as the firearm is brought to bear on the target, so that both the light and the firearm are aimed in the same direction.

[0010] Exemplary embodiments of the disclosure feature a firearm-mountable illumination system, the purpose for which is to allow a law enforcement officer, soldier or other firearm user to search an area visually, while the firearm muzzle is pointed downward or upward, out of the visual search field, in a ready position or carry position with its illumination source (e.g., flashlight) pointed forward for illuminating the visual search field, without having the firearm muzzle pointed at innocent persons, or in unsafe directions, during the search. If the user encounters someone at whom the rifle or other firearm muzzle should (and can justifiably) be pointed, the rifle is simply raised or lowered into firing position, and the light is simultaneously rotated so that the flashlight's illumination axis is generally parallel with the firearm's bore axis, thus illuminating the target. With the illumination systems of this disclosure, this light rotation is very easily done in a fraction of a second.

[0011] Exemplary embodiments of the disclosure feature a firearm illumination system that is selectively coupled to a firearm, and once so coupled, a firearm-mounted illumination system for illuminating a search area with a firearm-mounted illumination device that emits an illumination field defining an illumination axis, while orienting the muzzle and bore axis of a barrel of the firearm outside of the illumination area. The illumination system's illumination field is capable of selective parallel alignment with the firearm's bore axis, such as upon identification of a threat that may require engagement.

[0012] Other embodiments of the disclosure relate to methods for illuminating a search area with a firearm-mounted illumination device that emits an illumination field defining an illumination axis, while orienting the muzzle and bore axis of the barrel of the firearm outside of the illumination area. When practicing this method, the illumination system's illumination field is capable of selective parallel alignment with the firearm's bore axis, such as upon identification of a threat that may require engagement.

[0013] Other exemplary embodiments of the disclosure are directed to a firearm illumination system that is selectively mounted to a firearm. This system includes an illumination device for emitting an illumination field; the illumination field defines an illumination axis. The system also includes a mount housing adapted for selectively coupling the illumination device to a firearm having a barrel defining a bore axis and a muzzle at a distal tip of the barrel the firearm. The mount housing includes a firearm coupling mechanism for affixation of the housing to a firearm. In various embodiments, this coupling mechanism is selected from the group comprising: a screw clamp, or adhesive tape, or cordage, or a cable tie, or a band of hook-and-loop closure material, or a band of elastic material, or interlocking male/female rail, or interlocking male stud/and female aperture, or a screw, or a bolt, or a rivet, or a pin. A swivel mechanism is coupled to the mount housing between the illumination device and the firearm coupling mechanism. The swivel mechanism defines an axis of rotation that is normal to the bore axis of the firearm, for facilitating selective pivotal movement of the illumination axis of the illumination device above or parallel with, or below the bore axis of the firearm.

[0014] In other exemplary embodiments, the swivel mechanism is selected from the group comprising: a mating journal and axle, or a cam slot and follower riding in the cam slot, or a clevis pin. In other exemplary embodiments, the swivel mechanism further comprises a biasing mechanism for resisting pivoting of the illumination device illumination axis relative to the bore axis. In some exemplary embodiments, the biasing mechanism is selected from the group comprising a spring-loaded plunger and mating detent or multiple detents, or a pawl and ratchet, or a compression screw, or a tensioning screw; or opposing friction enhancement surfaces.

[0015] In some embodiments, the mount housing and swivel mechanism facilitate selective pivotal movement of the illumination axis of the illumination device only above or parallel with the bore axis of the firearm. In other embodiments, the mount housing and swivel mechanism facilitate selective pivotal movement of the illumination axis of the illumination device only below or parallel with the bore axis of the firearm.

[0016] The respective] features of the exemplary embodiments of this disclosure may be applied jointly or severally in any combination or sub-combination.

BRIEF DESCRIPTION OF DRAWINGS

[0017] The exemplary embodiments described herein are further understood by considering the following detailed description in conjunction with the accompanying drawings, in which:

[0018] FIG. **1** is an elevational view of a firearm illumination system of the present disclosure, mounted on a forend of a firearm (here a rifle), showing general parallel alignment of an illumination axis of a mounted flashlight illumination device and a bore axis of the firearm;

[0019] FIG. **2** is an elevational view of the firearm-mounted illumination system of FIG. **1**, with the illumination axis pivoted above the firearm's bore axis so that the firearm muzzle is not aligned with the illumination field of the flashlight;

[0020] FIG. **3** is a top plan view of the firearm-mounted illumination system of FIG. **1**;

[0021] FIG. **4** is a top view of the illumination system of FIG. **3** being grasped by a user;

[0022] FIG. **5** is a view of a firearm user holding the firearm-mounted illumination system of FIG. **1**, with the rifle in a "low ready" position, the rifle muzzle and bore axis pointed downwardly outside of the illumination field and search area of the flashlight;

[0023] FIG. **6** is a view of a firearm user holding the firearm-mounted illumination system of FIG. **1**, with the rifle in an aimed-in position, the rifle muzzle and bore axis pointed parallel with the illumination axis of the illumination field, within the search area of the flashlight;

[0024] FIG. **7** is a partial cutaway, bottom view of a second embodiment of a firearm-mounted illumination system;

[0025] FIG. **8** is a partial cutaway, bottom view of a third embodiment of a firearm-mounted illumination system;

[0026] FIG. **9** is a partial cutaway, bottom view of a fourth embodiment of a firearm-mounted illumination system;

[0027] FIGS. **10** and **11** are respectively, a partial cutaway, bottom view and a back cross-sectional view of a fifth embodiment of a firearm-mounted illumination system;

[0028] FIG. **12** is a back cross-sectional view of a sixth embodiment of a firearm-mounted illumination system, similar to that of FIG. **11**;

[0029] FIGS. **13** and **14** are respectively, a partial cutaway, bottom view and a back cross-sectional view of a seventh embodiment of a firearm-mounted illumination system;

[0030] FIGS. **15** and **16** are respectively, partial cutaway bottom and side elevational views of an embodiment of a firearm-mounted illumination system whose mount housing forms a female portion of a railed track, with its mating, male portion coupled to the rifle forend with male T-stud on the male rail portion that in turn interlocks with a female aperture formed in the forend;

[0031] FIG. **17** is a side elevational view of another embodiment of a firearm-mounted illumination system that is mounted on the underside of a rifle forend;

[0032] FIG. **18** is a side elevational view of another embodiment of a firearm-mounted illumination system that is mounted on the underside of a handgun; and

[0033] FIG. **19** is a partial cross-sectioned, elevational view of another embodiment of a firearm-mounted illumination system with a yoke-shaped coupling mechanism for retention of the illumination device.

[0034] To facilitate understanding, identical reference numerals have been used, where possible, to designate identical elements that are common to the figures. The figures are not drawn to scale.

DETAILED DESCRIPTION

[0035] Exemplary embodiments of the invention can be utilized in a firearm illumination system that is selectively coupled to a firearm with a firearm coupling mechanism of the mount housing. When they are so coupled, an illumination device of the system selectively emits an illumination field, which is selectively pivoted about the swivel mechanism that is interposed between the mount housing and the illumination device, so that the bore axis of the firearm is oriented outside of the illumination field. More specifically, in some embodiments of this disclosure, selective pivotal movement of an illumination axis of the illumination device allows orientation of the firearm's bore axis parallel with, and/or above, and/or below an illumination axis established by the illumination device. In an exemplary method of use of the disclosed firearm illumination system, the firearm bore axis is oriented outside a desired search field (e.g., in a "low ready" and/or "high ready" position) while pivoting the illumination device relative to the firearm's bore axis, until the illumination field is coincident with the search area. If a threat is identified in the search area the illumination device is pivoted about its swivel pivot axis as the firearm bore axis and muzzle are moved from the ready position toward the illuminated potential threat; the illumination axis is now generally parallel with the firearm bore axis.

[0036] FIGS. **1-4** show a firearm illumination system **30** of the present disclosure that is mounted to a forend **32** of a rifle **34**. The rifle **34** has a barrel **36** with a muzzle **38** from which discharged bullets exit the firearm, parallel with the barrel's bore axis **40**. The principal subcomponents of the firearm illumination system **30** comprise a mount housing **42** oriented on the left side of the rifle forend **32**, (typically for a right-handed shooter and reversed for a left-handed shooter), a firearm coupling mechanism **44** (e.g., adhesive tape), a swivel mechanism **46** (defining a pivotal axis of rotation **48** that is generally normal to the rifle barrel's bore axis **40**), an illumination device (e.g., flashlight) **50**, and an illumination coupling device (e.g., webbing) **52**) for coupling the flashlight barrel **53** to the swivel mechanism **46**. When the flashlight **50** is energized, its flashlight head **54** generates a generally concentric illumination field **56** about an illumination axis **58**. The flashlight **50** is energized by an actuation button **60**. In some embodiments, the actuation button comprises a pressure sensitive tape-type switch that is remotely coupled by conductive wire to a tail cap of the flashlight. The tape-type switch is typically coupled to the firearm within reach of one or more fingers of the user.

[0037] The swivel mechanism **46** is coupled to the mount housing **42** between the flashlight **50**/illumination coupling device **52** and the firearm coupling mechanism **44**. Mount housing **42** provides the structure to affix the swivel mechanism **46** and the attached flashlight **50** to the rifle forend **32**. The swivel mechanism **46** enables selective pivotal movement P of the illumination axis **58** of the flashlight **50**, about the swivel axis of rotation **48**, in an arc above, or parallel with or below the bore axis **40** of the rifle **34**. In some embodiments, pivotal movement of the flashlight is restricted in arc above or parallel with the bore axis. In other embodiments, pivotal movement of the flashlight is restricted in arc below or parallel with the bore axis. In some embodiments, pivotal movement above or below the bore axis is restricted to an arcuate range to prevent inadvertent pointing of the firearm muzzle in the direction of the firearm user's feet, head or any other body part.

[0038] Referring to FIGS. **4-6**, a right-handed firearm user **62** mounts the rifle **34** in known fashion, with the rifle butt touching the user's shoulder. The non-dominant, left, hand **64** grasps the flashlight barrel **53** for selectively pivoting the flashlight **50**, and selectively energizes the flashlight by thumb pressure on the flashlight actuation button **60**. A left dominant-hand user may choose to mount the firearm illumination system **30** on the right side of the rifle forend **32**. In alternative embodiments disclosed herein, the firearm illumination system is mounted on the bottom side of the firearm to facilitate ambidextrous operation of the lighting system.

[0039] In FIG. **5**, the user **62** is holding the rifle **32** in a muzzle **38** depressed, "low ready" position, visually scanning a search area in front of him. The depressed muzzle **38** orients the rifle's bore axis **40** toward the floor, well below the visual search area. The user **62** has pivoted the flashlight's illumination axis **58** above the rifle's bore axis **40** to orient the illumination field **56** within the visual search area. The user has full benefit of the flashlight's illumination field to search for any objects within the visual search area without pointing the rifle muzzle **38** at any non-threating persons and other objects, or in any unsafe directions, within the search field. In some embodiments, pivotal arcuate range of the swivel mechanism **46** is limited by a hard stop that will not allow muzzle **38** depression toward the feet of the user **62** or any other body part.

[0040] In FIG. **6**, user **62** has identified a potential threat, and has pivoted the illumination axis **58** of the illumination system **30** to be generally parallel with the bore axis **40** of the rifle **30**, as the rifle is brought to bear on the potential threat. Should the user choose to fire the rifle **32**, he is in a proper firing position with the potential threat directly

illuminated. Perhaps focusing the intense flashlight beam on the potential threat may cause disorientation, temporary "blinding," and surrender of the suspect without the need to fire a shot.

[0041] While not shown, alternatively in some circumstances the user **62** may choose to orient the rifle's bore axis and muzzle upwardly towards the ceiling of a room, in a "high ready" position, for example if the user knows that innocent persons are in a room below the floor. Under such alternative circumstances, the user would orient the muzzle upwardly and pivot the flashlight's illumination axis below the rifle's bore axis. Should the user then choose to fire the rifle, the flashlight pivot axis is co-aligned in parallel with the rifle bore axis as the user assumes a prepared to fire position. In some embodiments, pivotal arcuate range of the swivel mechanism **46** is limited by a hard stop that will not allow upward muzzle **38** elevation toward the head of the user **62** or any other body part.

[0042] Compared with the illumination system **30** of the present disclosure, as shown in practical use in FIGS. **5** and **6**, one cannot search an area with known, prior illumination systems that are always oriented parallel with a firearm muzzle and bore axis without risk of pointing a muzzle at other, non-threatening persons. In the past, a separate handheld flashlight needed to be used to illuminate a search area to avoid risk of pointing a fixed, firearm light that is parallel with the firearm's bore axis at non-threatening persons. However, use of a separate handheld flashlight for general visual searching requires use of one hand that would otherwise be used to hold the firearm, especially a shoulder weapon such as a rifle, shotgun, or submachine gun.

[0043] FIGS. **7-19** depict other embodiments of firearm-mounted illumination systems. All of the embodiments shown in those figures incorporate a flashlight illumination device **50** that defines an illumination axis **58**, and a mount housing coupling the illumination device to a firearm (e.g., a rifle forend **32** or a pistol rail mount **206**). The embodiments of FIGS. **7-19** all incorporate a swivel mechanism coupled to the mount housing between the flashlight **50** and the firearm, where the swivel mechanism defines an axis of rotation **48** that is oriented normal to the bore axis of the firearm. As in the embodiments of FIGS. **1-6**, the respective swivel axis in each of the embodiments of FIGS. **7-19** facilitates selective pivotal movement of the illumination axis **58** of the flashlight **50** illumination device, in a pivoting arc P, above and/or parallel with, and/or below the bore axis of the firearm. In some embodiments, the swivel mechanism incorporates stops to limit arcuate pivotal range of the illumination device **50** to prevent inadvertent pointing of the firearm muzzle toward the firearm user.

[0044] In FIG. **7**, the illumination system **70** has a mount housing **72**. The firearm coupling mechanism for coupling the illumination system **70** to the rifle forend **32** comprises cordage **74**, such as parachute cord. The swivel mechanism **76** comprises a rotatable shaft **77** with a screw **78** threaded into the corresponding shaft. The screw **78** establishes the pivotal axis of rotation **48** and functions as a biasing mechanism for resisting pivotal movement of the flashlight **50** relative to the rifle bore axis. Tightening the screw **78** compresses the shaft **77** against the mount housing **72**. Therefore, biasing resistance is adjustable by advancing or retracting the screw **78**. In FIG. **7**, flashlight **50** is integral with the rotatable shaft **77** and is not intended to be separated from the shaft. In other embodiments the flashlight **50** is separable from the rotatable shaft **77**.

[0045] In FIG. **8**, the illumination system **80** includes a mount housing **82**. Cable ties **84** comprise the coupling mechanism for coupling the mount housing to the rifle by wrapping them about forend **32**. The swivel mechanism **86** comprises a rotatable shaft **87**, having an axle portion **88** and thrust bearing **90** that ride within a journal **92** formed in the mount housing **82**. The pivot resisting bias mechanism comprises a threaded screw tensioner **94** that selectively presses against the thrust bearing **90** to vary biasing force. This illumination system **80** is provided with an additional friction-type bias mechanism that comprises a pair of opposed abrasive washers **96** and **98** that rub against each other. The flashlight **50** is selectively removable from the rotatable shaft **87** by screw clamp **99**; this clamp functions as an illumination coupling device. In other embodiments, the illumination coupling device comprises one or more of any of the following: adhesive tape, and/or cordage, and/or a cable tie, and/or a band of hook-and-loop closure material, and/or a band of elastic material, and/or interlocking male/female rail, and/or interlocking male stud and female aperture, and/or a screw, and/or a rivet, and/or a pin, and/or a push-type, spring-loaded release and/or magnets.

[0046] In FIG. **9**, the illumination system **100** has a mount housing **102** that is coupled to the rifle forend **32** by rivets **103** passing through the housing and the forend. Rivets **103** function as a firearm coupling mechanism for the illumination system **100**. The swivel mechanism **104** comprises a rotatable shaft **105** that is coupled to the mount housing **102** by a clevis pin **106**, a washer **107** and a cotter pin **108**. A mating male and female rail **109** functions as the flashlight **50** coupling device. Pin **109**A is inserted through the rail **109** components to prevent their sliding separation. In some embodiments, the rail **109** male and female components are of similar construction to the rail components **168** and **170** shown in FIGS. **15** and **16**.

[0047] In FIGS. **10** and **11**, the illumination system **110** has a mount housing **112** that is coupled to the rifle forend **32** by screws **114**. Its swivel mechanism **116** comprises rotatable shaft **117**, with a thrust bearing **118** that is retained within mount housing **112**. A spring-loaded plunger assembly **120**, incorporating spring **122** and plunger **124**, is incorporated within and extends radially outwardly from the thrust bearing **118** circumference. The plunger **124** presses against a mating journal **125** formed in mount housing **112** and functions as an anti-rotational biasing element. In this illumination system **110** embodiment the journal surface incorporates three detents **126**, **127** and **128** that function as three distinct rotational stops along the swiveling rotational arc P. Detent **126** aligns and maintains the flashlight illumination axis parallel to the bore axis of the rifle. Detents **127** and **128** set the extreme pivotal limits P for the flashlight **50** when the rifle muzzle is oriented outside of the illumination area while in high ready or low ready positions.

[0048] FIG. **12** shows an alternate embodiment illumination system **130** that substitutes pawl and ratchet anti-rotational biasing elements for the plunger **124** and detents **127**, **128**, **129** components of FIGS. **10** and **11**. Mount housing **131** retains the thrust bearing **132**. Ratchet teeth **133** are formed about a portion of the thrust bearing **132** outer circumference. Spring loaded pawl assembly **134**, which comprises spring **135** and pawl **136**, is retained within housing **131**. Pawl **136** presses against the ratchet teeth **133**

to provide anti-rotational biasing force against the thrust bearing **132**. A detent **137** formed within the ratchet teeth **133** array maintains orientation of the flashlight's illumination axis parallel with the rifle's bore axis. Hard stops **138** and **140** at terminal circumferential ends of the ratchet teeth **133** array limit pivoting movement P of the flashlight at low ready and high ready rifle positions.

[0049] The illumination system embodiment **140** of FIGS. **13** and **14** incorporates a follower **147** and cam slot **148** to provide extreme rotational P limits for the flashlight **50** relative to the rifle bore axis and a detent **157** in the cam slot **148** for parallel alignment of the flashlight's illumination axis with the rifle bore axis. More particularly, mount housing **142** includes a swivel mechanism **114**, similar to those shown in the embodiments of FIGS. **8** and **10-13**, with a rotatable shaft **145** and thrust bearing **146**. Follower **147** is a pin retained in and projecting away from the bottom end face of the thrust bearing **146**. In some embodiments, the follower is spring loaded, similar to the spring-loaded plunger assembly **120** of FIGS. **10** and **11**, for providing bias and pivotal resistance against user rotation of the flashlight **50**. The extreme terminal ends of cam slot **148** incorporate rotational stops **150** and **152**, corresponding to the maximum pivotal range of the flashlight **50** above or below the rifle's bore axis. A pair of spaced apart, opposing raised ramps **154** and **157** create a detent valley **157** therebetween, providing a stop for parallel alignment of the flashlight's illumination axis with the rifle's bore axis. In this illumination system embodiment **140**, flashlight **50** is retained on the rotatable shaft **145** by a rivet **158**, for permanent integration within mount housing **142**.

[0050] FIGS. **15** and **16** depict an alternative embodiment illumination system **160** where the mount housing **162**, its coupled swivel mechanism **164**, and the flashlight **50** incorporate a mount housing coupling **166** comprising a female, slidable rail **168** in the housing and a mating male, slidable rail **170** that is coupled to the rifle's forend **32**. A retention pin or screw **172** is inserted though the mating rail portions after installation of the mount housing **162**, to prevent their inadvertent separation. In some embodiments, the male and female rail portions are reversed, so that the female portion is coupled to the forend, and the male portion coupled to the mount housing. In some embodiments, the male, slidable rail is integrally formed in or permanently affixed to the forend.

[0051] In the illuminations system embodiment **160**, the male, slidable rail **170** is of modular construction, for selective attachment and detachment from the forend **32** or other parts of the rifle. The rifle forend **32** incorporates an elongated aperture **174**, over which is placed the male, slidable rail **170**. Male studs, here T-studs **176**) are inserted through the rail **170**, into the elongated aperture **174**. The T-studs **176** are twisted so that they engage outer peripheral edges of the forend **32** adjacent the elongated aperture, then tightened for retention of the male, slidable rail **170**. Thereafter the female slidable rail **168** portion of the mount housing **162** is affixed to the male rail portion **170**. In some embodiments, the male **170** and female **168** slidable rail portions are dimensioned to conform to the United States Military Standard Specification MIL-STD-1913 or NATO Specification STANAG 4694, which is sometimes referred to as a "Picatinny"-type rail. In some embodiments where the rail system is modular, it conforms to the M-LOK® modular dimensional specifications established by Magpul Industries Corp.

[0052] Flashlight **50** that is shown in the prototype embodiment of FIGS. **1-6** is a commercially available STRION® Model DS-HL flashlight, sold by Streamlight Industries, which has both a tail cap actuation button/switch and a side actuation button/switch. This particular flashlight provides 700 lumens output and is rechargeable. In some embodiments, the tail cap actuation button/switch is replaced with a remote, pressure sensitive tape-type switch.

[0053] In various embodiments, the firearm-mounted illumination systems disclosed herein are modular in nature. They can be provided as a complete system with an illumination source (with detachable flashlight or integral flashlight), housing mount, swivel mechanism (with or without a pivot-resistance biasing mechanism), and firearm coupling mechanism. In other embodiments, only the swiveling mechanism is provided with a modular illumination coupling mechanism (e.g., scope rings, screw clamps) for affixation of a separately purchased flashlight, and a modular firearm coupling mechanism, such as a Picatinny-type slidable rail mount or an M-LOK® compatible mount that mates with a compatible mounting component on the firearm.

[0054] The illumination system embodiment **180** of FIG. **17** mounts the illumination device on the forend **32** of the rifle **34** below the bore axis **40**. In this embodiment, the mount housing **182** integrates an internal flashlight **50** having a flashlight head **54** that discharges a light beam with an illumination axis **58**. The firearm coupling mechanism **184** comprises a mounting stud **185** on the bottom of the rifle forend **32** and a fork-shaped yoke **186** formed in the mount housing **182** that are retained in alignment by a retention pin **188**. In some embodiments, the stud and yoke positions are reversed. In this embodiment, the coupling mechanism also functions as the illumination system's swivel mechanism **190**, for pivoting the illumination axis **58** above, and/or below, and/or parallel with the rifle's bore axis **40** along the arc P. In embodiment **180**, flashlight **50** has a side actuation button **60**A, and a rear or tail actuation button **60**B. In some embodiments, the swivel mechanism incorporates a biasing mechanism to resist pivotal movement of the flashlight **50**. In some embodiments, the swivel mechanism incorporates mechanical stops and/or detents to limit pivot movement P, as was described in prior embodiments herein.

[0055] The illumination system embodiment of FIG. **18***is* adapted for use on a handgun **200**. The handgun **200** has an internal barrel with a muzzle **202** that defines a bore axis **204** and an undermount male rail **206**. The illumination system **208** comprises a mount housing **209** with an integral flashlight **50**, flashlight head **54** that discharges a light beam with an illumination axis **58**, a side actuation button **60**A, and a rear or tail actuation button **60**B. Here, the firearm coupling mechanism **210** comprises a female rail **212** that mates with the handgun's male rail **206** and includes a downwardly projecting stud **213**. The swivel mechanism **214** comprises a yoke **216** incorporated within housing **209** and a retention pin **218** that passes through both the yoke and the stud **213**. The retention pin **218** establishes the pivoting axis for the swivel mechanism, allowing arcuate pivotal movement P of the illumination axis **58** above, parallel with, and below the handgun bore axis **204**. In some embodiments, the stud and yoke positions are reversed. In some embodiments, the swivel mechanism incorporates a biasing mechanism to

resist pivotal movement of the flashlight **50**. In some embodiments, the swivel mechanism incorporates mechanical stops and/or detents to limit pivot movement P, as was described in prior embodiments herein.

[0056] The modular illumination system embodiment **240** of FIG. **19** facilitates selective coupling of a standalone flashlight **50** to a firearm. The illumination system **24** includes housing **242** that is coupled to the rifle forend **32** by a push-type, spring-loaded release comprising a pin **244** with spring-loaded ball bearings **246** that are released by depression of release button **248**. Mating collar **250** is coupled to the rifle forend **32** and defines a bore and a radially oriented retaining groove **252**. When the housing **242** is coupled to the rifle forend **32**, the pin **244** is retained within bore of collar **250**, with the ball bearings **246** engaged within the latter's retaining groove **252**, thereby preventing axial separation of the pin out of the collar. Depression of the release button **248** allows separation of the housing **242** from the rifle forend **32**. The modular illumination system **240** has a yoke-shaped swivel **260** coupled to the housing **242** for arcuate motion P as previously described with the other embodiments of this disclosure. The yoke forks **262** and **264** define a U-shaped bight for retention of the flashlight barrel **53** of the flashlight **50**. Axial separation of the flashlight barrel out of the bight of the yoke **260** is prevented by magnet **266** that is coupled to the yoke, which is attracted magnetically to a mating magnet **268** that is incorporated within or on the flashlight barrel. In some embodiments a magnetically attractive material (e.g., steel) replaces one of the magnets **266** or **268**.

[0057] Although various embodiments have been shown and described in detail herein, those skilled in the art can readily devise many other varied embodiments that still incorporate these teachings. The invention is not limited in its application to the exemplary embodiment details of construction and the arrangement of components set forth in the description or illustrated in the drawings. The concepts described in this disclosure are capable of incorporation in other embodiments and of being practiced or of being conducted in many ways. Also, it is to be understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting. The use of "including," "comprising," or "having" and variations thereof herein is meant to encompass the items listed thereafter and equivalents thereof as well as additional items. Unless specified or limited otherwise, the terms "mounted," "connected," "supported," and "coupled" and variations thereof are used broadly and encompass direct and indirect mountings, connections, supports, and couplings. Further, "connected" and "coupled" are not restricted to physical or mechanical connections or couplings.

What is claimed is:

1. A method for illuminating a search area with a firearm-mounted illumination device, comprising:

providing a firearm having a barrel that defines a bore axis and a muzzle at a distal tip thereof;

providing an illumination device that emits an illumination field, which defines an illumination axis;

coupling the illumination device to the firearm with a swivel mechanism whose axis of rotation is normal to the barrel bore axis; and

illuminating a search area with the illumination device by pivoting the illumination device about the rotation axis of the swivel mechanism to orient the barrel bore axis and the muzzle of the firearm outside of the illumination area.

2. The method of claim **1**, further comprising pivoting the illumination device about the rotation axis of the swivel mechanism to orient the barrel bore axis and muzzle of the firearm barrel downwardly away from the illumination axis of the illumination device, out of the illumination area, while illuminating the search area.

3. The method of claim **1**, further comprising pivoting the illumination device about the rotation axis of the swivel mechanism to orient the barrel bore axis and muzzle of the firearm barrel upwardly away from the illumination axis of the illumination device, out of the illumination area, while illuminating the search area.

4. The method of claim **1**, further comprising gripping the illumination device while illuminating a search area, pivoting the illumination axis of the illumination device above the bore axis when orienting the barrel and muzzle downwardly out of the illumination area, or pivoting said illumination axis below said bore axis when orienting the barrel and muzzle upwardly out of the illumination area, and aligning said illumination axis parallel with said bore axis upon identification of an object in the illumination area that is potentially to be engaged with the firearm.

5. A firearm-mounted illumination system, comprising:

a firearm having a barrel defining a bore axis and a muzzle at a distal tip of the barrel;

an illumination device for emitting an illumination field, the illumination field defining an illumination axis;

a mount housing coupled to the firearm;

a swivel mechanism coupled to and oriented between the mount housing and the illumination device, the swivel mechanism defining an axis of rotation normal to the bore axis of the barrel, for facilitating selective pivotal movement of the illumination axis of the illumination device above or parallel with or below the bore axis of the firearm barrel.

6. The firearm-mounted illumination system of claim **5**, the swivel mechanism selected from the group comprising: a mating journal and axle, and/or a cam slot and follower riding in the cam slot, and/or a clevis pin.

7. The firearm-mounted illumination system of claim **6**, the swivel mechanism further comprising a biasing mechanism for resisting pivoting of the illumination device illumination axis relative to the bore axis.

8. The firearm-mounted illumination system of claim **7**, the biasing mechanism selected from the group comprising a spring-loaded plunger and mating detent, and/or a pawl and ratchet, and/or a compression screw, and/or a tensioning screw; and/or opposing friction surfaces.

9. The firearm-mounted illumination system of claim **5**, the mount housing having a firearm coupling mechanism for affixation of the housing to a the firearm, selected from the group comprising: a screw clamp, and/or adhesive tape, and/or cordage, and/or a cable tie, and/or a band of hook-and-loop closure material, and/or a band of elastic material, and/or interlocking male/female rail, and/or interlocking male stud/female aperture, and/or a screw, and/or a bolt, and/or a rivet, and/or a pin, and/or a push-type, spring-loaded release and/or magnets.

10. The firearm-mounted illumination system of claim **5**, the illumination device integrally incorporated within the mount housing.

11. The firearm-mounted illumination system of claim **5**, further comprising a standalone illumination device that is selectively coupled to the mount housing by an illumination coupling device.

12. The firearm-mounted illumination system of claim **11**, the illumination coupling device selected from the group comprising: a screw clamp, and/or adhesive tape, and/or cordage, and/or a cable tie, and/or a band of hook-and-loop closure material, and/or a band of elastic material, and/or interlocking male/female rail, and/or interlocking male stud and female aperture, and/or a screw, and/or a rivet, and/or a pin, and/or a push-type, spring-loaded release and/or magnets.

13. A firearm illumination system adapted for selective mounting to a firearm, comprising:

an illumination device for emitting an illumination field, the illumination field defining an illumination axis;

a mount housing adapted for selectively coupling the illumination device to a firearm having a barrel defining a bore axis and a muzzle at a distal tip of the barrel;

a firearm coupling mechanism adapted for affixation of the housing to the firearm, selected from the group comprising: a screw clamp, and/or adhesive tape, and/or cordage, and/or a cable tie, and/or interlocking male/female rail, and/or interlocking male stud/female aperture, and/or a screw, and/or a rivet, and/or a pin, and/or a push-type, spring-loaded release and/or magnets; and

a swivel mechanism coupled to and oriented between the mount housing and the illumination device, whereupon after mounting of the firearm coupling mechanism to the firearm, the swivel mechanism defines an axis of rotation normal to the bore axis of the barrel, for facilitating selective pivotal movement of the illumination axis of the illumination device above or parallel with or below the bore axis of the firearm barrel.

14. The firearm illumination system of claim **13**, the swivel mechanism selected from the group comprising: a mating journal and axle, and/or a cam slot and follower riding in the cam slot, and/or a clevis pin.

15. The firearm illumination system of claim **14**, the swivel mechanism further comprising a biasing mechanism for resisting pivoting of the illumination device illumination axis relative to the bore axis.

16. The firearm illumination system of claim **15**, the biasing mechanism selected from the group comprising a spring-loaded plunger and mating detent, and/or a pawl and ratchet, and/or a compression screw, and/or a tensioning screw; and/or opposing friction enhancement surfaces.

17. The firearm illumination system of claim **13**, the illumination device integrally incorporated within the mount housing.

18. The firearm illumination system of claim **13**, further comprising a standalone illumination device that is selectively coupled to the mount housing by an illumination coupling device.

19. The firearm illumination system of claim **18**, the illumination coupling device selected from the group comprising: a screw clamp, and/or adhesive tape, and/or cordage, and/or a cable tie, and/or interlocking male/female rail, and/or interlocking male stud/female aperture, and/or a screw, and/or a rivet, and/or a pin, and/or a push-type, spring-loaded release and/or magnets.

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