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(12) **United States Patent**
Matthews et al.

(10) **Patent No.:** **US 7,325,352 B2**
(45) **Date of Patent:** **Feb. 5, 2008**

- (54) **ACCESSORY DEVICES FOR FIREARMS**
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- (73) Assignee: **Surefire, LLC**, Fountain Valley, CA (US)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 601 days.

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(21) Appl. No.: **10/877,600**

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(22) Filed: **Jun. 24, 2004**

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(65) **Prior Publication Data**

AT 274620 12/1968

US 2005/0217162 A1 Oct. 6, 2005

(Continued)

Related U.S. Application Data

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(63) Continuation-in-part of application No. 10/819,535, filed on Apr. 6, 2004, now Pat. No. 7,117,624.

United States Department of Defense, Military Standard: Dimensioning of Accessory Mounting Rail for Small Arms Weapons, MIL-STD-1913, Feb. 3, 1995.

(51) **Int. Cl.**
F41C 23/00 (2006.01)

(Continued)

(52) **U.S. Cl.** **42/85**; 42/90; 42/124; 42/113; 89/200; 362/110

Primary Examiner—J. Woodrow Eldred
(74) *Attorney, Agent, or Firm*—David Weiss

(58) **Field of Classification Search** 42/113, 42/114, 115, 117, 146, 124, 90, 85; 89/200; 362/110

(57) **ABSTRACT**

See application file for complete search history.

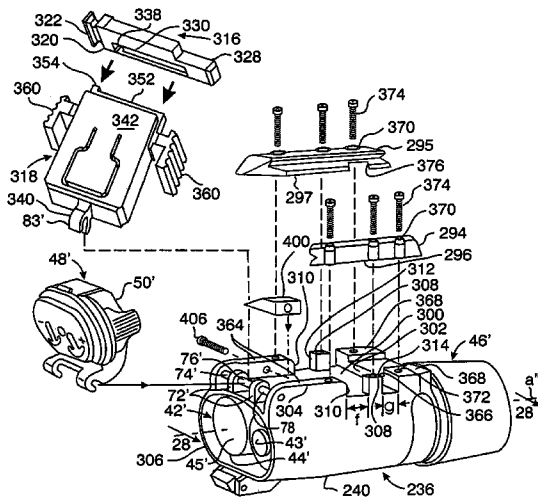
An accessory device for being mounted to a longitudinal rail carried by a firearm and accommodating longitudinal rails of different configurations. A preferred embodiment comprises a light beam generator including a housing, elongate members removably secured to the housing and complementing the rail for enabling the housing to be retainably slid along the rail, a transverse rail latching device removably secured to the housing, and a replaceable ambidextrous tail cap switch.

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66 Claims, 10 Drawing Sheets

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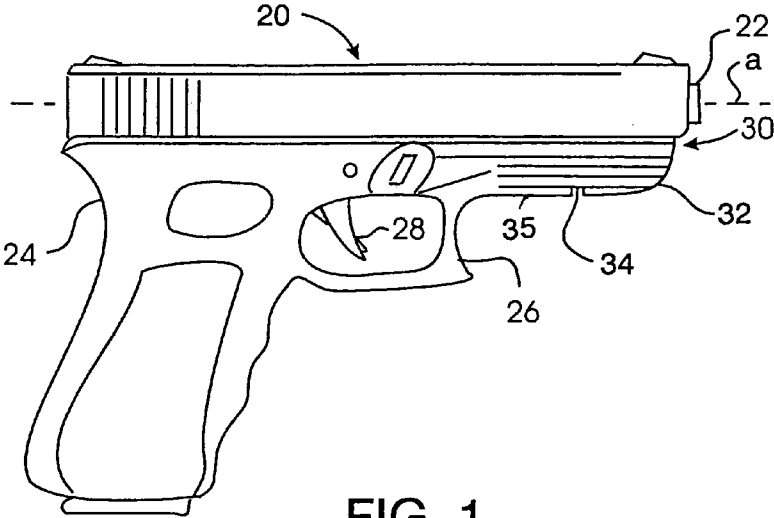


FIG. 1

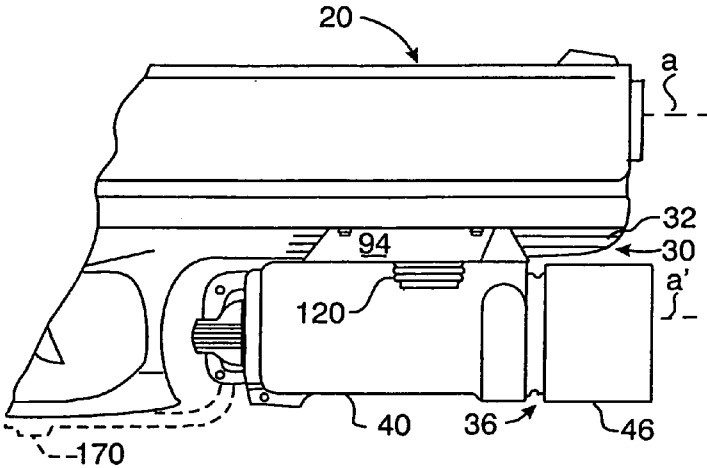


FIG. 2

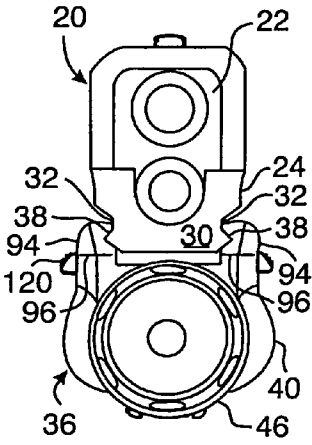


FIG. 3

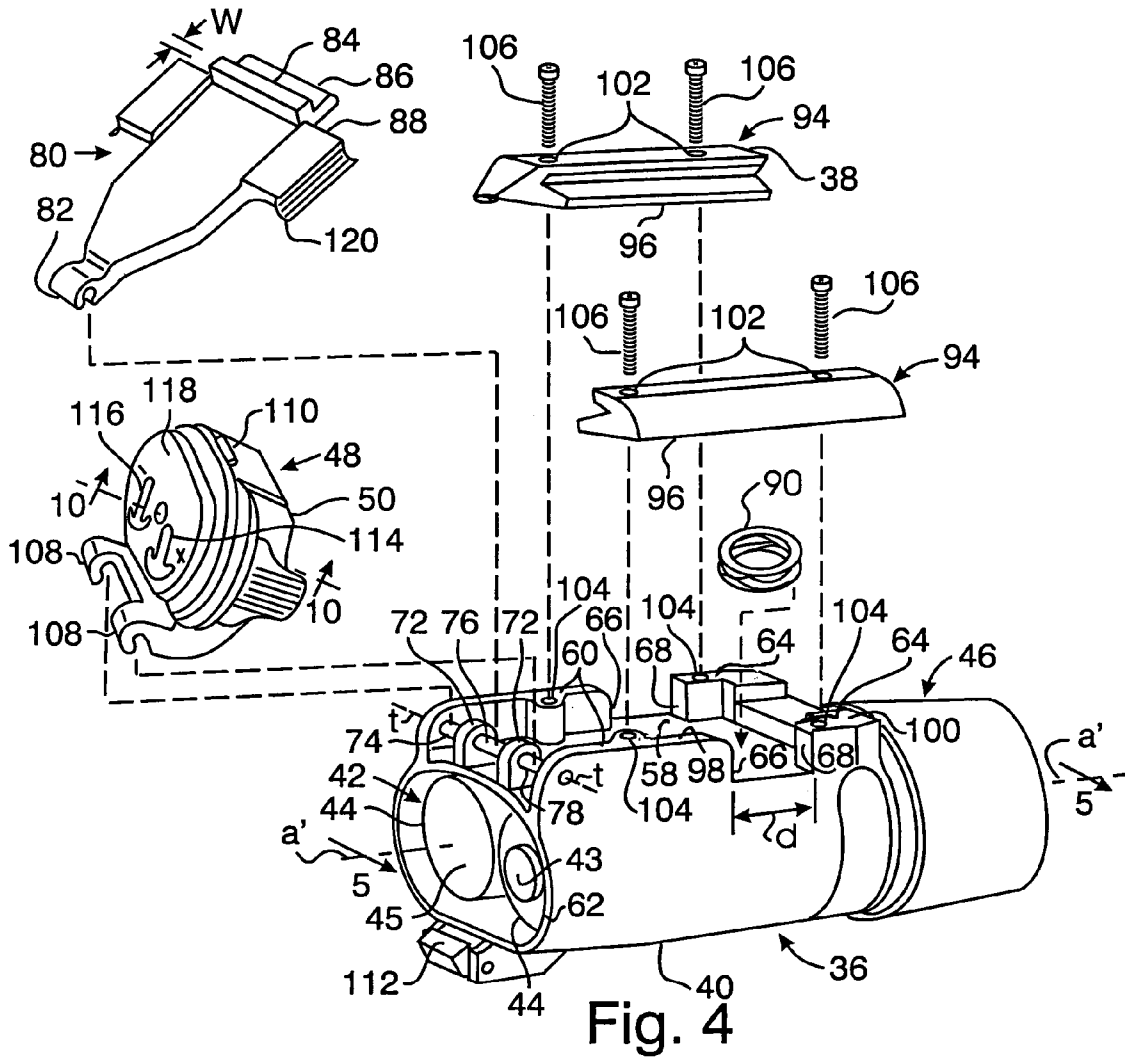


Fig. 4

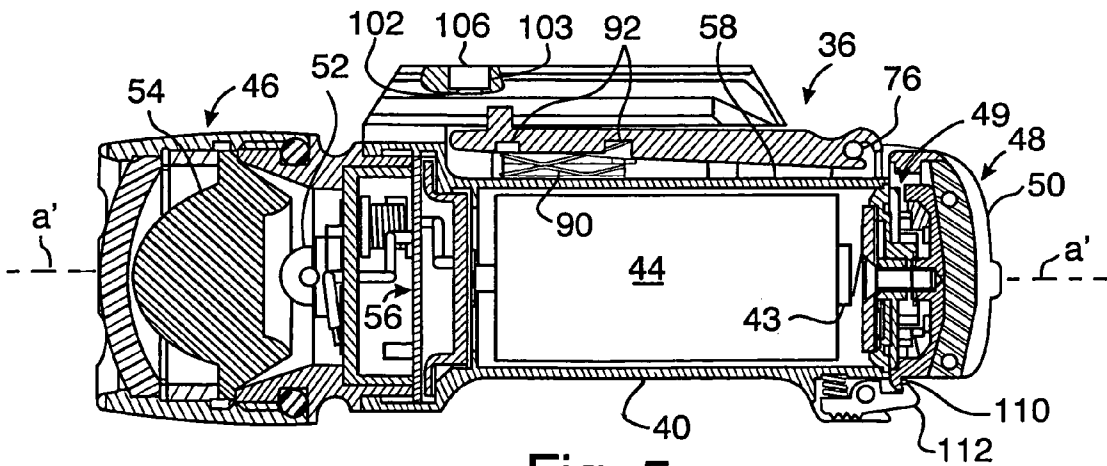


Fig. 5

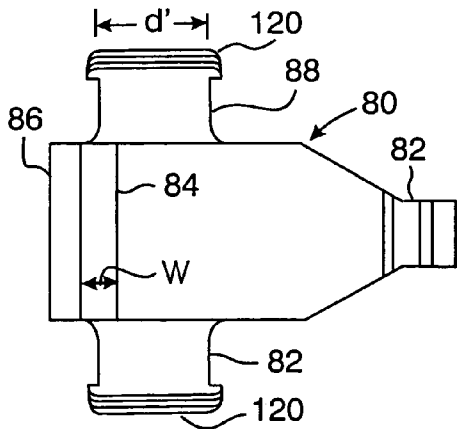


FIG. 6

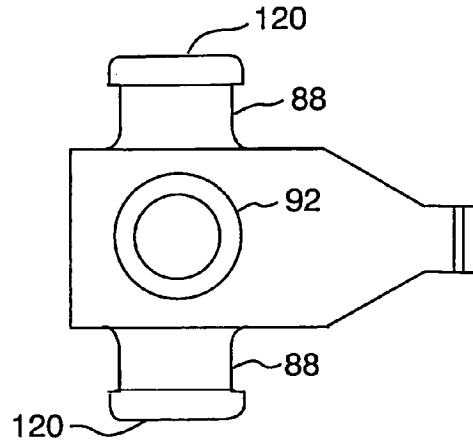


FIG. 7

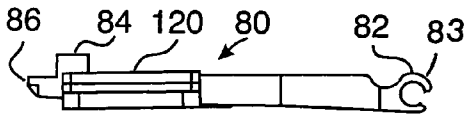


FIG. 8

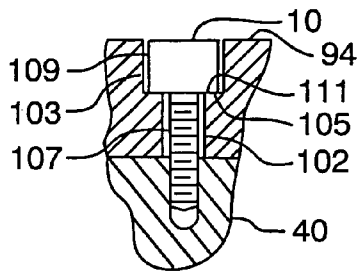


Fig. 9

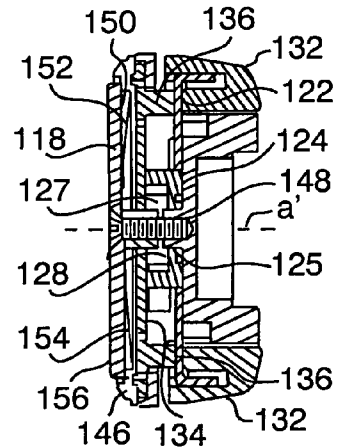


FIG. 10

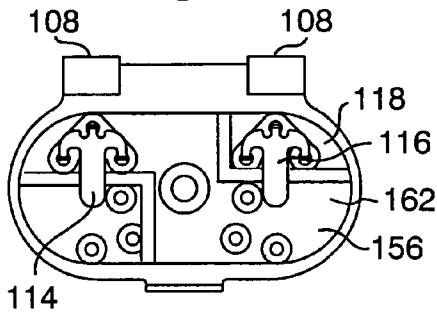


FIG. 11

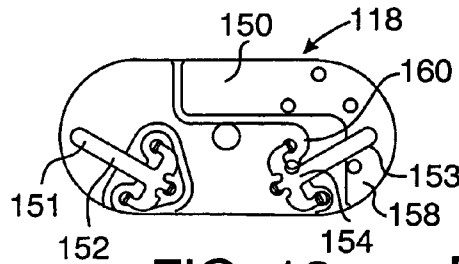


FIG. 12

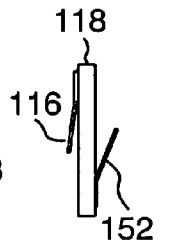


FIG. 13

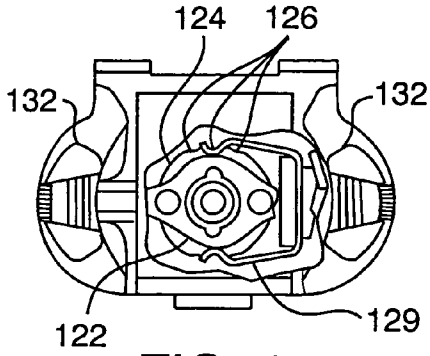


FIG. 14

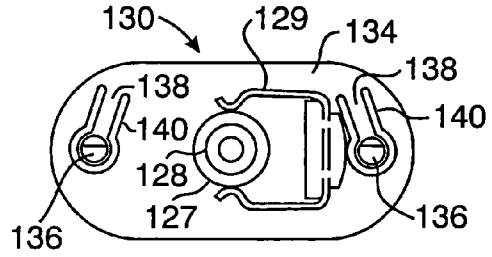


FIG. 15

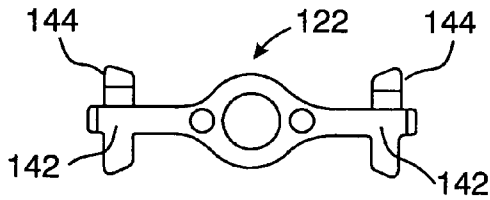


FIG. 16

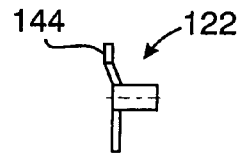


FIG. 17

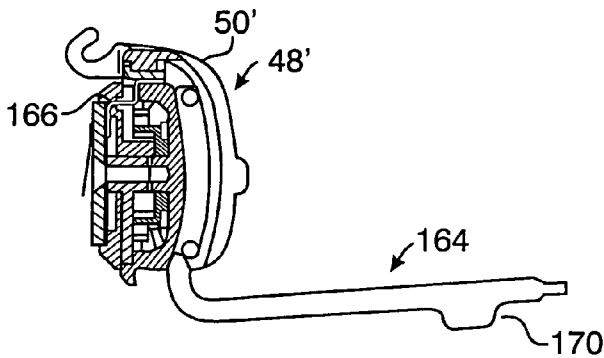


FIG. 18

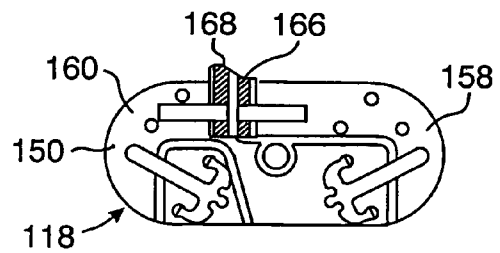


FIG. 19

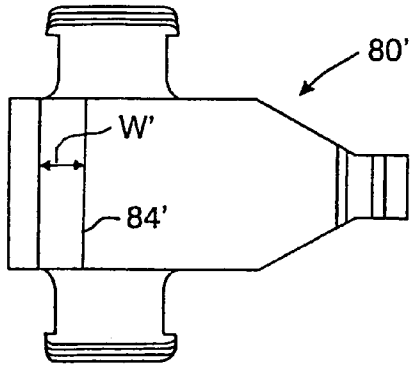


FIG. 20

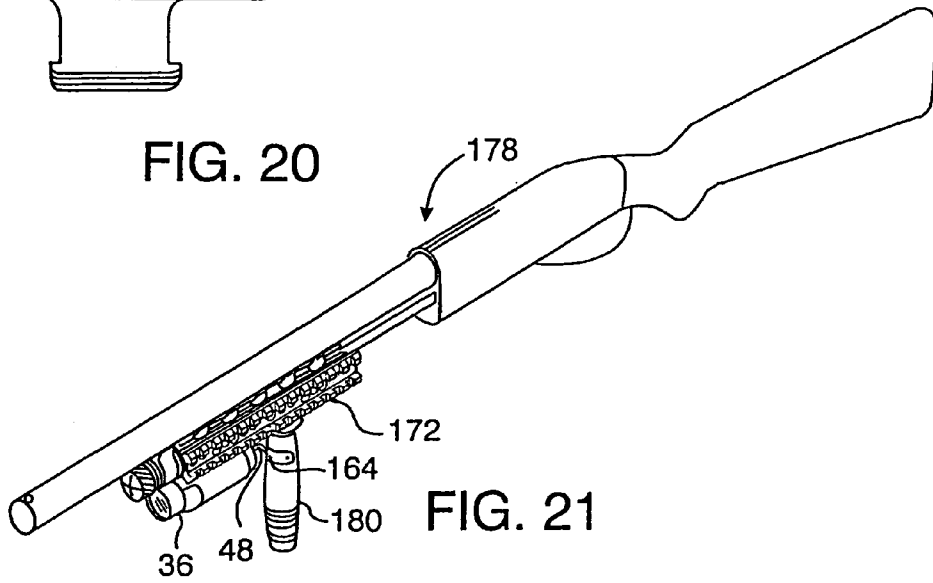


FIG. 21

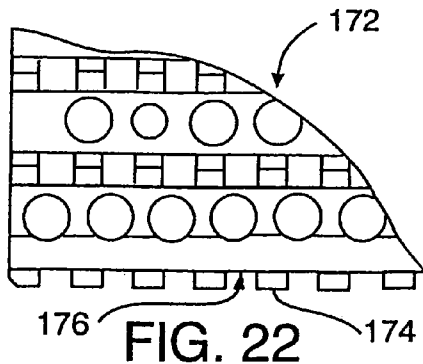


FIG. 22

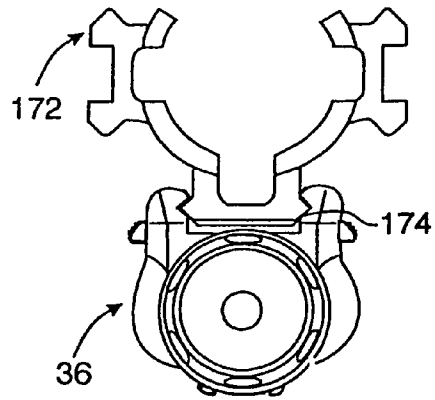


FIG. 23

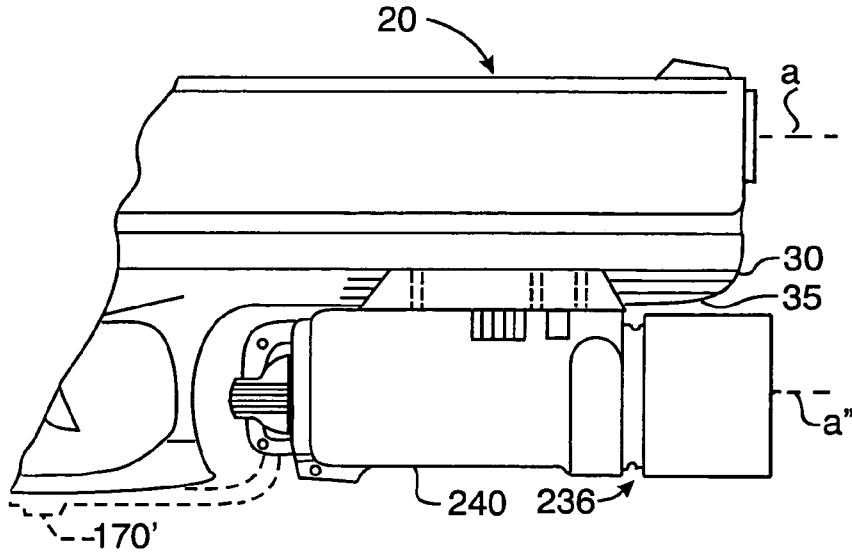


FIG. 24

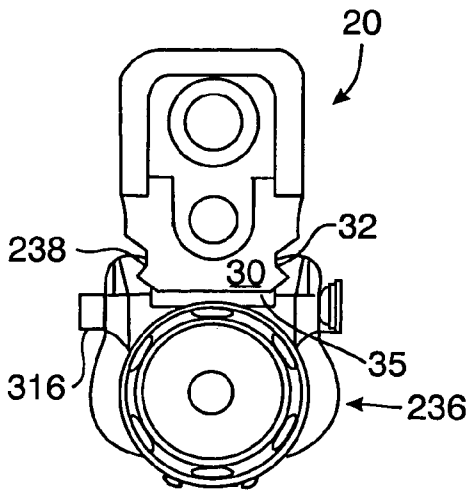


FIG. 25

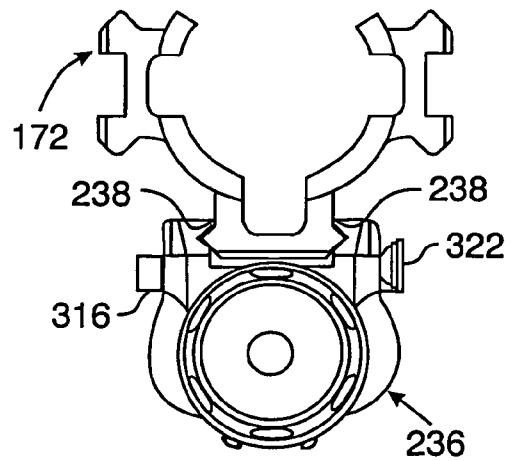


FIG. 26

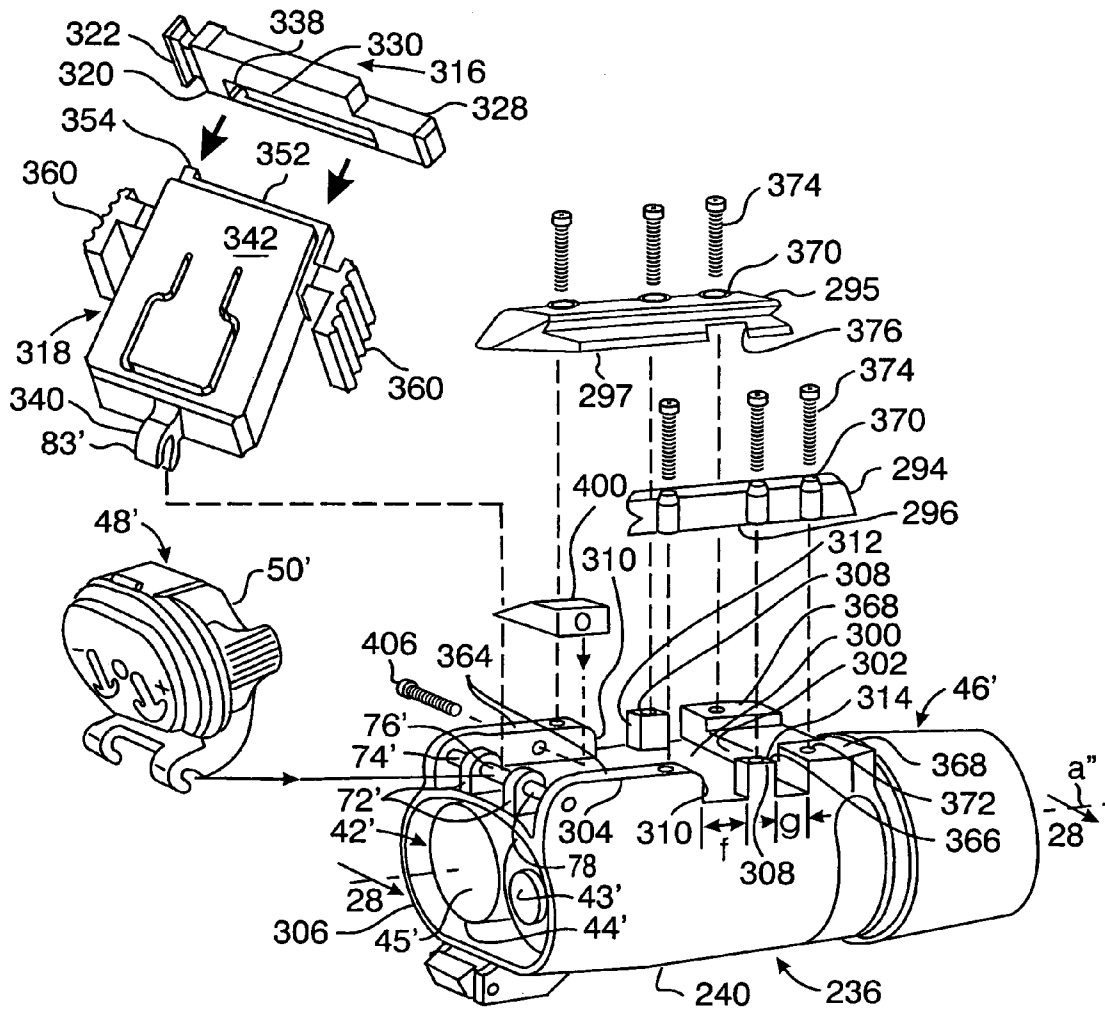


Fig. 27

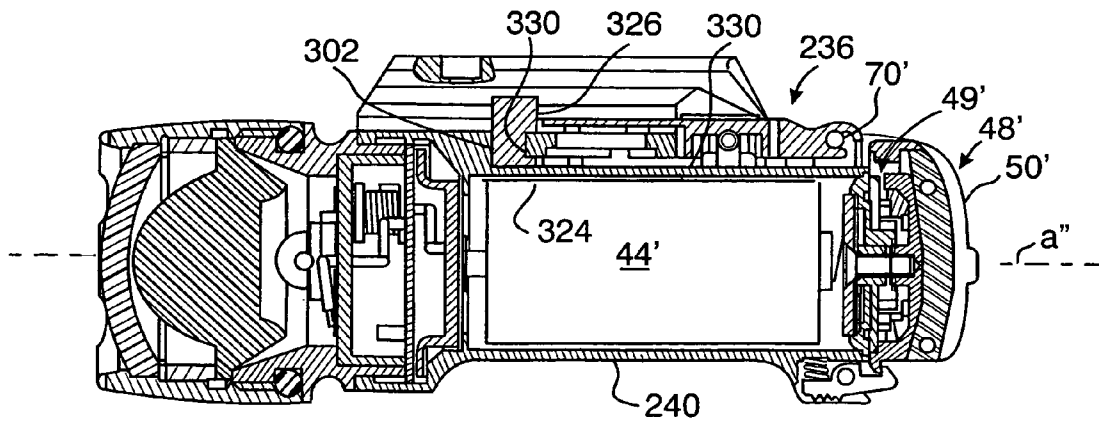


Fig. 28

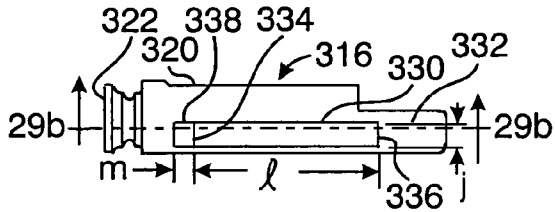


FIG. 29a

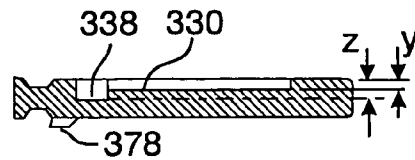


FIG. 29b

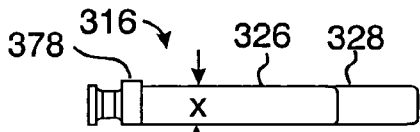


FIG. 29c

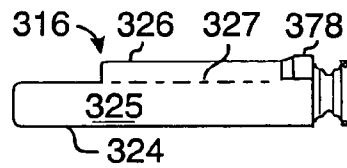


FIG. 29d

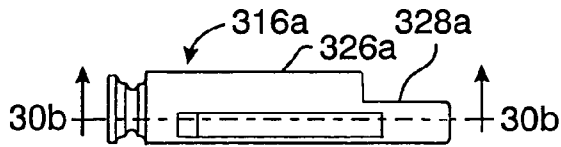


FIG. 30a

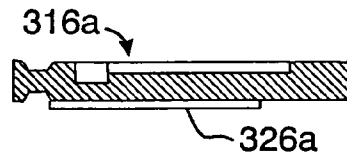


FIG. 30b

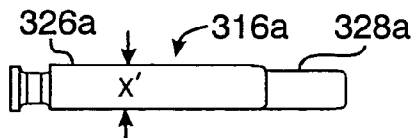


FIG. 30c

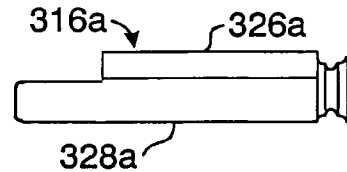


FIG. 30d

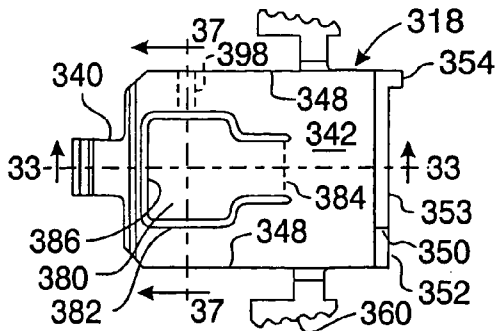


FIG. 31

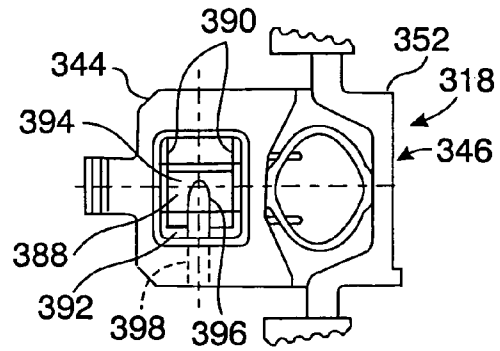


FIG. 32

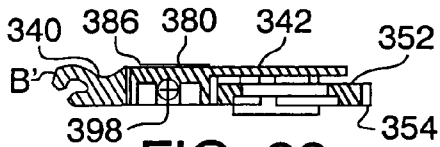


FIG. 33

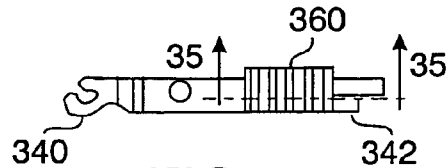


FIG. 34

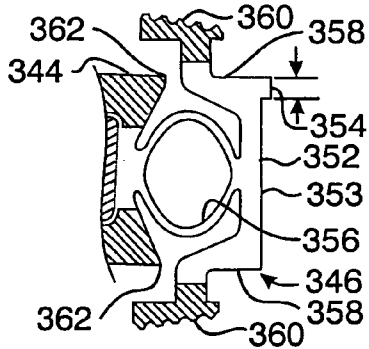


FIG. 35

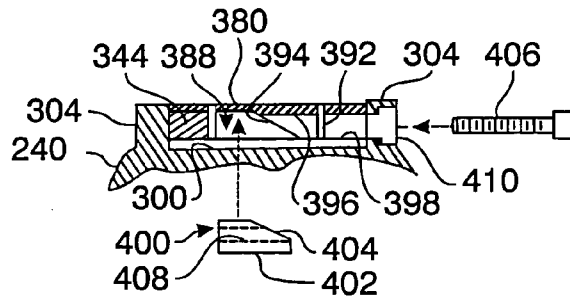


FIG. 37

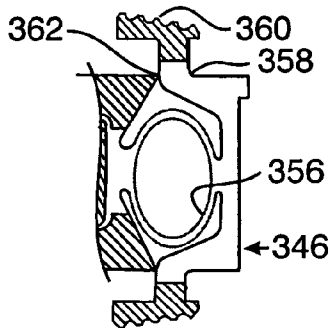


FIG. 36

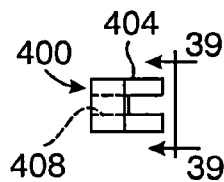


FIG. 38

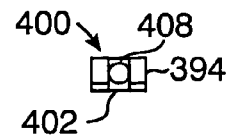


FIG. 39

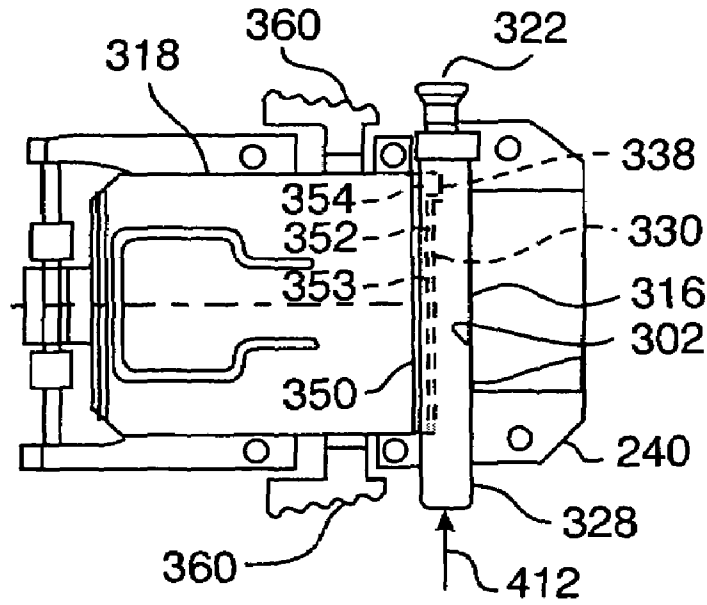


FIG. 40

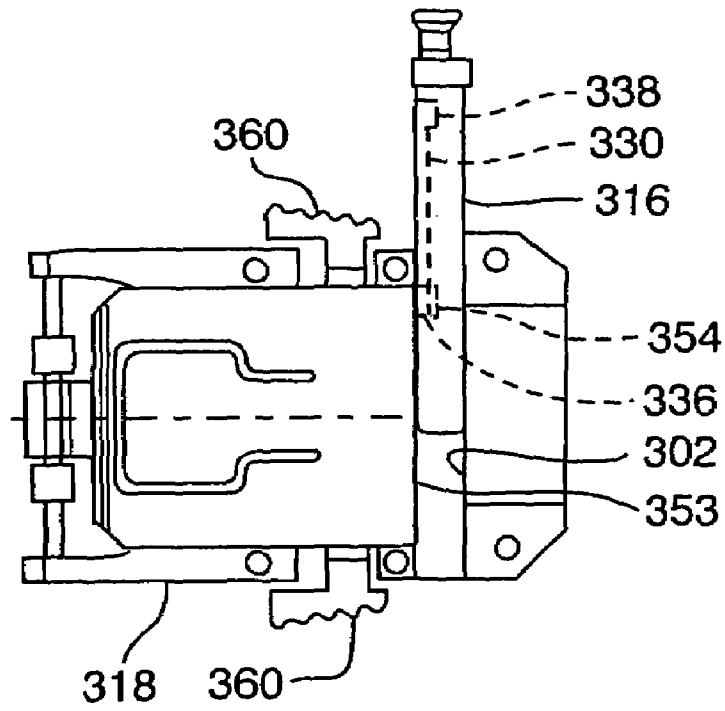


FIG. 41

ACCESSORY DEVICES FOR FIREARMS**CROSS REFERENCE TO RELATED APPLICATION**

This application is a continuation-in-part of U.S. patent application Ser. No. 10/819,535, filed Apr. 6, 2004 now U.S. Pat. No. 7,117,624, incorporated herein by reference.

BACKGROUND OF THE INVENTION

This invention relates to accessory devices for being mounted to a firearm, and more particularly to a light beam generator for being mounted to a firearm including a handgun.

Accessory devices including light beam generators, such as flashlights and laser aiming devices, have long been adapted for being secured to firearms as target illuminators and laser sights. As particularly relating to handguns, such accessory devices may utilize a longitudinal rail carried by the frame of the handgun and forwardly of the trigger guard, which rail may be integral with the frame as disclosed in U.S. Pat. No. 6,276,088, or such rail may be provided as a separate structure removably attachable to the handgun as disclosed in U.S. Pat. No. 6,378,237, both patents issued to John W. Matthews and Paul Y. Kim and assigned to the assignee of the present invention, which patents are incorporated herein by reference.

Handgun manufacturers have introduced various handgun models having a longitudinal rail along the handgun's frame, below the barrel and forwardly of the trigger guard, such rail being configured with two longitudinal grooves, one along each side of the rail, and further configured with a transverse slot in the bottom surface of the rail. As is well known, such rails are intended for cooperating with accessories such as a light beam generator having a housing configured with a pair of longitudinal tongues complementing the longitudinal grooves for slidably retaining the light beam generator on the rail. A latch on the light beam generator housing co-acts with the transverse slot in the rail for releasably preventing further longitudinal movement of the light beam generator along the rail when the light beam generator is at a predetermined longitudinal position.

The longitudinal rails of handguns of some manufacturers may be of different configuration than the longitudinal rails of handguns of other manufacturers. For example, some handguns include a longitudinal rail commonly known as a Universal rail, while other handguns include a rail commonly known as a Picatinny rail. The slot width of the Universal rail is substantially less than the slot width of the Picatinny rail. Until the present invention, an accessory device securable to one type of rail was not securable to another type of rail.

SUMMARY OF THE INVENTION

The present invention provides an accessory device that is adapted to accommodate handguns and other firearms carrying longitudinal rails of different configurations. For example, the accessory device of the present invention may be secured to a longitudinal rail carried by a firearm having a slot width different than the slot width of another longitudinal rail carried by a firearm. In a particular example, the accessory device of the present invention accommodates a Universal rail as well as a Picatinny rail.

A preferred embodiment of the accessory device of the present invention comprises a light beam generator, such as

a target illuminator or a laser sight, that includes a removably attachable switch device for being replaced by or interchanged with another switch device having a different or modified switch configuration.

5 The aforementioned parent application Ser. No. 10/819,535 discloses, according to one aspect of that invention, an accessory device for a firearm including a frame, a longitudinal barrel, a longitudinal rail carried by the frame, and a depression in the rail, the accessory device comprising: a housing; elongate members removably secured to the housing, the elongate members complementing the rail for enabling the housing to be retainably slid along the rail; and a plate pivotally secured to the housing about a transverse axis and having a free end biased away from the housing, the plate including a protuberance in the vicinity of the free end, the protuberance receivable by the depression for stopping sliding of the housing along the rail. The plate is captured to the housing by the elongate members secured to the housing, and the plate is removable from its securement about the transverse axis when the elongate members are removed from the housing.

The plate preferably includes transversely extending arms through the housing, which arms are captured to the housing by the elongate members when secured to the housing, and the arms are adapted to be urged by an operator for pivoting the plate about the transverse axis toward the housing.

In a preferred embodiment disclosed in the parent application, as well as in the present application, the accessory device is a light beam generator. The light beam generator of the parent application preferably comprises: a housing; elongate members removably secured to the housing, the elongate members complementing the rail for enabling the housing to be retainably slid along the rail; a plate pivotally secured to the housing about a transverse axis and having a free end biased away from the housing, the plate including a protuberance in the vicinity of the free end, the plate receivable by the depression for stopping sliding of the housing along the rail; a light emitter assembly carried by the housing; a battery carried by the housing in circuit for energizing the light emitter assembly when switch actuated; and a switch device including a switch actuator for the battery. The switch device preferably comprises a tail cap switch pivotally secured to the housing about a pivot axis, the tail cap switch preferably removable from its pivotal securement. The switch actuator is preferably operable by either hand of an operator when the housing is installed on the rail for placing the switch device in a CONSTANT ON or OFF position, and operable by either hand of the operator when the housing is installed on the rail for placing the switch device in a MOMENTARY ON position. A remote switch actuator may be provided for communicating with the switch device for remotely actuating the switch device to a MOMENTARY ON position.

According to a further aspect of the invention disclosed in the parent application, a method is provided of assembling an accessory device for installation on a first rail having a depression and carried by a firearm, comprising: providing the accessory device including a housing; providing elongate members complementing the rail; providing a plate having a protuberance in the vicinity of an end thereof, the protuberance sized for being received by the depression; pivotally securing the plate to the housing with such end biased away from the housing; and removably securing the elongate members to the housing with the elongate members capturing the plate to the housing and enabling the housing to be retainably slid along the rail. The method may further include: removing the elongate members from the housing;

removing the plate from the housing; providing a second plate having a protuberance in the vicinity of an end thereof, the protuberance of the second plate sized for being received by a depression in a second rail carried by a firearm, the protuberance of the second plate being of a different size than the protuberance in the first plate; pivotally securing the second plate to the housing with such second plate end biased away from the housing; and removably securing the elongate members to the housing with the elongate members capturing the second plate to the housing and enabling the housing to be retainably slid along the second rail.

According to yet another aspect of that invention, there is provided a method of adapting an accessory device normally installable on a first rail carried by a firearm and having a depression, for installation on a second rail carried by a firearm and having a depression of a different size than the depression of the first rail, comprising: providing the accessory device including a housing, a first plate having a protuberance in the vicinity of an end thereof, the protuberance of the first plate sized for being received by the depression in the first rail, the plate being removably pivotally secured to the housing along a transverse axis with such end thereof biased away from the housing, and elongate members complementing the first rail and removably secured to the housing and capturing the plate to the housing, the elongate members enabling the housing to be retainably slid along the first rail; removing the elongate members from the housing; removing the first plate from the housing; providing a second plate having a protuberance in the vicinity of an end thereof sized for being received by the depression in the second rail; removably pivotally securing the second plate to the housing along a transverse axis with such end of the second plate biased away from the housing; and removably securing elongate members complementing the second rail to the housing and capturing the second plate to the housing and enabling the housing to be retainably slid along the second rail. In the elongate members securing step, the elongate members being secured may be the same elongate members removed in the elongate members removing step.

According to one aspect of the present invention, there is provided an improved accessory device for a firearm including a longitudinal barrel, a longitudinal rail carried by the firearm, and a transverse slot in the rail, the accessory device comprising: a housing having a top surface; elongate rail interface members along the housing complementing the rail for enabling the housing to be retainably slid along the rail with the housing's top surface facing the rail; an elongate latch carried by the housing and transversely slidable along the housing's top surface when the latch is transversely aligned with the slot in the rail, from an unlatched position disengaged from the slot to a latched position engaging the slot; and a latch retainer carried by the housing transversely locking the elongate latch when in its latched position, the latch retainer adapted for being manipulated by a user for unlocking the elongate latch from its latched position and for permitting the elongate latch to be transversely urged by the user to its unlatched position with the elongate latch transversely retained to the housing. The elongate latch preferably extends through an opening in a side of the housing, and the latch retainer and the latch are adapted for preventing transverse withdrawal of the latch through the opening when the latch is in its unlatched position.

The preferred embodiment of the improved accessory device includes an adjustable device carried by the housing and longitudinally spaced from the latch, the adjustable device being adapted for supportively engaging the housing

to the rail. The adjustable device provides enhanced vertical stability of the accessory device with respect to the rail.

Preferably, the elongate rail interface members are removably secured to the housing, such as along opposing longitudinal sides of the housing. In the preferred embodiment, the latch extends transversely through respective openings in such opposing longitudinal sides of the housing, and the secured elongate rail interface members cooperate with such openings for restraining the latch from movement normal to the top surface of the housing.

In the preferred embodiment, the latch retainer is removably secured to the housing, preferably pivotally secured to the housing about a transverse axis. The elongate latch includes an elongate depression or groove for cooperating with the latch retainer for guiding the latch when the latch is transversely urged by a user.

According to another aspect of the present invention, there is provided an accessory device for a firearm including a longitudinal barrel, a longitudinal rail carried by the firearm, and a transverse slot in the rail, the accessory device comprising: a housing having a top surface and an upstanding wall transversely extending along the top surface; elongate rail interface members along the housing complementing the rail for enabling the housing to be longitudinally slid along the rail; a bar transversely carried by the housing, the bar including an upper portion for being transversely received by the slot, the bar including a lower portion engaging a first (preferably front) surface in transverse sliding engagement with the wall and a second (preferably rear) surface opposite the first surface including an elongate depression terminating at a first end, the elongate depression terminating at a second end with a second depression of depth greater than the depth of the elongate depression; and a retainer mechanism for the bar, the retainer mechanism secured to the housing and having a transverse (preferably front) edge portion including a longitudinally (preferably forwardly) extending protuberance, the edge portion received by the elongate depression with the protuberance received by the second depression for preventing sliding of the bar along the wall, the retainer mechanism adapted for being manipulated by a user for longitudinally (preferably rearwardly) urging the edge portion from the elongate depression and the protuberance from the second depression whereupon the bar is transversely slidable along the wall with the protuberance captured within the elongate depression.

According to this aspect of the present invention, and included in the preferred embodiment thereof, the retainer mechanism includes a forwardly biased elongate retainer member having such front edge portion, as well as a frame secured to the housing and a compression spring longitudinally securing the elongate retainer member to the frame. The retainer mechanism preferably includes a top plate secured to the frame and having a transverse front edge longitudinally spaced from the housing's rearwardly facing wall. The top plate preferably includes a cutout portion comprising a tab, and an actuator is interposed between the top surface of the housing and the tab, which actuator is operable by a user for causing the tab to contact the bottom surface of the rail and to thereby enhance the vertical stability of the housing with respect to the rail.

The retainer mechanism is preferably pivotally secured to the housing about a transverse axis, and the forwardly biased elongate retainer member may include lateral arms extending through the housing and rearwardly urgeable by a user for rearwardly displacing the forwardly biased elongate retainer member. In the preferred embodiment, the elongate rail interface members are removably securable to the hous-

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ing, and the retainer mechanism is pivotally restrained to the housing by the elongate rail interface members when such rail interface members are secured to the housing. The retainer mechanism is removable from its securement about its transverse pivotal axis when the elongate rail interface members are removed from the housing.

According to yet another aspect of the present invention, there is provided a method of assembling an accessory device for installation on a longitudinal rail carried by a firearm, the rail having a transverse slot therein, comprising: providing the accessory device including a housing having a top surface and a transverse wall along the top surface; providing elongate rail interface members complementing the rail; providing an elongate latch member sized for being received by the slot in the rail; providing a latch retainer having a forwardly biased front edge portion; placing the latch member to the front edge portion of the latch retainer; securing the latch retainer to the housing with the latch member interposed between the wall and the latch retainer front edge portion for being transversely slid along the top surface of the housing; and removably securing the elongate rail interface members to the housing with such interface members capturing the latch retainer and the latch member to the housing and enabling the housing to be retainably slid along the rail. The method further includes sliding the latch member transversely along the top surface of the housing to an unlatched position; sliding the housing longitudinally along the rail until the latch member is transversely aligned with the slot in the rail; and sliding the latch member transversely for being received by the slot.

The latch member preferably includes an elongate depression terminating with a second depression of greater depth; the forwardly biased front edge portion of the latch retainer includes a forwardly extending protuberance; and, in the latch member placing step, the forwardly biased front edge portion of the latch retainer is received by the elongate depression of the latch member with the protuberance received by the second depression.

When installing the accessory device to the rail, the method includes rearwardly urging the forwardly biased front edge portion of the latch retainer for urging such edge portion from the elongate depression and the protuberance from the second depression for permitting transverse sliding of the latch member with the protuberance captured within the elongate depression; sliding the latch member transversely along the top surface of the housing to an unlatched position; sliding the housing longitudinally along the rail until the latch member is transversely aligned with the slot in the rail; and sliding the latch member transversely for being received by the slot, until the forward protuberance is received by the second depression and the forwardly biased front edge portion of the latch retainer is received by the elongate depression in the latch member, thereby locking the latch member in its latched position.

When it is desired to remove the accessory device from the rail, the method may continue by rearwardly urging the forwardly biased front edge portion of the latch retainer for displacing such edge portion from the elongate depression and the protuberance from the second depression such that the latch member is transversely slidable with the protrusion captured within the elongate depression; sliding the latch member transversely along the top surface of the housing to an unlatched position; and sliding the housing longitudinally along the rail until the housing is removed therefrom.

The method of the present invention may be practiced for adapting an accessory device normally installable on a first rail with a transverse slot, for installation on a second rail

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having a slot of a different width than the slot of the first rail, including: removing the elongate rail interface members from the housing; removing the latch member from the housing; providing a second latch member sized for being slidably received by the slot in the second rail carried by a firearm; placing the second latch member to the front edge portion of the latch retainer with the latch member interposed between the wall and the retainer front edge portion for being transversely slid along the top surface of the housing; and removably securing the elongate rail interface members to the housing with the elongate rail interface members capturing the latch retainer and the latch member to the housing and enabling the housing to be retainably slid along the second rail.

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features believed to be characteristic of the inventions, together with further advantages thereof, will be better understood from the following description considered in connection with the accompanying drawings in which preferred embodiments of the inventions are illustrated by way of example. It is to be expressly understood, however, that the drawings are for the purpose of illustration and description only and are not intended as a definition of the limits of the invention.

FIG. 1 is a side elevation view of a firearm having a longitudinal rail structure to which may be removably secured an accessory device according to both the present invention and the invention disclosed in the aforementioned parent application Ser. No. 10/819,535;

FIG. 2 is a side elevation view of a preferred embodiment of an accessory device according to the parent application, specifically a preferred embodiment of a light beam generator, removably secured to the rail structure of the firearm of FIG. 1 (in increased scale);

FIG. 3 is a front elevation view of the firearm and secured light beam generator of FIG. 2;

FIG. 4 is an exploded side/rear perspective view of the light beam generator of FIGS. 2 and 3, illustrated during assembly of various components thereof;

FIG. 5 is a longitudinal cross-sectional view of the assembled light beam generator of FIG. 4 (in further increased scale), taken along a vertical plane along the light beam generator's longitudinal axis *a'* (the line 5-5 of FIG. 4) and viewed in the direction of the appended arrows;

FIG. 6 is a top plan view of a preferred embodiment of a replaceable lever latch plate (in same scale as in FIG. 5) included in the preferred embodiment of the accessory device or light beam generator of FIGS. 2-5;

FIG. 7 is a bottom plan view of the lever latch plate of FIG. 6;

FIG. 8 is a side elevation view of the lever latch plate of FIG. 6;

FIG. 9 is a fragmentary, part cross-sectional elevation view of an example of a rail interface member secured to the accessory device housing according to the preferred embodiment;

FIG. 10 is a cross-sectional view of the preferred embodiment of a replaceable tail cap switch assembly shown in FIG. 4, taken along a transverse plane along the longitudinal axis *a'* (the line 10-10 of FIG. 4) and viewed in the direction of the appended arrows;

FIG. 11 is a front elevation view of the tail cap switch assembly, which view includes the front surface of the switch circuit board with battery rear terminal contacts;

FIG. 12 is a rear view of the tail cap switch assembly circuit board of FIG. 11;

FIG. 13 is a side elevation view of the tail cap switch assembly circuit board of FIGS. 11 and 12;

FIG. 14 is a rear elevation view of the tail cap broken away to show structure of a preferred switch actuator mechanism;

FIG. 15 is a front elevation view of a tail cap insert included in the tail cap switch actuator mechanism;

FIG. 16 is a rear elevation view of an actuator arm included in the tail cap switch actuator mechanism;

FIG. 17 is a left side view of the actuator arm of FIG. 16;

FIG. 18 is a cross-sectional view of a replaceable tail cap switch assembly similar to the tail cap switch assembly shown in FIG. 5 but further including a pressure tape switch;

FIG. 19 is a rear view of the switch assembly circuit board of FIG. 18;

FIG. 20 is a top plan view of a second preferred embodiment of a replaceable lever latch plate included in the preferred embodiment of the accessory device or light beam generator;

FIG. 21 is a perspective view of a firearm to which is attached a conventional accessory rail mount structure to which is mounted the preferred embodiment of the accessory device or light beam generator of the invention disclosed in the parent application or of the present invention;

FIG. 22 is a side elevation view of a fragment of the front portion of the accessory rail mount exemplified in FIG. 21;

FIG. 23 is a front elevation view of the accessory rail mount of FIG. 22 to which is mounted a light beam generator according to the invention disclosed in the parent application;

FIG. 24 is a side elevation view of a preferred embodiment of a stability enhanced accessory device according to the present invention, specifically a preferred embodiment of a light beam generator removably secured to the rail structure of the firearm of FIG. 1 (in increased scale);

FIG. 25 is a front elevation view of the firearm and secured light beam generator of FIG. 24;

FIG. 26 is a front elevation view of the accessory rail mount of FIG. 22 to which is mounted the light beam generator of FIG. 24;

FIG. 27 is an exploded side/rear perspective view of the light beam generator of FIGS. 24-26, illustrated during assembly of various components thereof;

FIG. 28 is a longitudinal cross-sectional view of the assembled light beam generator of FIG. 27, taken along a vertical plane along the light beam generator's longitudinal axis "a" (the line 28-28) of FIG. 27 and viewed in the direction of the appended arrows;

FIG. 29a is a rear elevation view of an example of a preferred embodiment of a slide latch included in the preferred embodiment of the enhanced accessory device or light beam generator of FIGS. 25-28;

FIG. 29b is a cross-sectional view of the slide latch of FIG. 29a, taken along the line 29b-29b of FIG. 29a and viewed in the direction of the appended arrows;

FIG. 29c is a top plan view of the slide latch of FIG. 29a;

FIG. 29d is a front elevation view of the slide latch of FIG. 29a;

FIG. 30a is a rear elevation view of a second example of a preferred embodiment of a slide latch included in the preferred embodiment of the enhanced accessory device or light beam generator of the present invention;

FIG. 30b is a cross-sectional view of the slide latch of FIG. 30a, taken along the line 30b-30b of FIG. 30a and viewed in the direction of the appended arrows;

FIG. 30c is a top plan view of the slide latch of FIG. 30a; FIG. 30d is a front elevation view of the slide latch of FIG. 30a;

FIG. 31 is a top plan view of a preferred embodiment of a slide latch retainer included in the preferred embodiment of the enhanced accessory device or light beam generator of FIGS. 25-28;

FIG. 32 is a bottom plan view of the slide latch retainer of FIG. 31;

FIG. 33 is a cross-sectional view of the slide latch retainer of FIG. 31, taken along the line 33-33 of FIG. 31 and viewed in the direction of the appended arrows;

FIG. 34 is a side elevation view of the slide latch retainer as viewed in FIG. 32;

FIG. 35 is a cross-sectional view of a fragment of the slide latch retainer, taken along the line 35-35 of FIG. 34 and viewed in the direction of the appended arrows;

FIG. 36 is the same view of the slide latch retainer fragment as in FIG. 35, but shown actuated for permitting sliding of the slide latch;

FIG. 37 is a cross-sectional view of the slide latch retainer, taken along the line 37-37 of FIG. 31 and viewed in the direction of the appended arrows, in exploded combination with elevation views of a vertical stabilizer mechanism included in the preferred embodiment, the slide latch retainer being shown as installed to a fragment of the light beam generator housing;

FIG. 38 is a top view of the stabilizer actuator member of FIG. 37;

FIG. 39 is an elevational view of the actuator of FIG. 38, viewed along the line 39-39 of FIG. 38 in the direction of the appended arrows;

FIG. 40 is a top view of the slide latch and slide latch retainer installed to the battery housing of the accessory device (shown with the elongate rail interface members removed for clarity of description) with the slide latch in its latched position; and

FIG. 41 is the same view as in FIG. 40, with the slide latch in its unlatched position.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Turning first to FIG. 1, there is illustrated an example of a firearm 20, specifically a handgun including a barrel 22 extending along a longitudinal axis a from the handgun's frame 24. The handgun 20 includes a trigger guard 26 in front of the handgun's trigger 28.

As used herein, "longitudinal" describes a direction along or parallel to the longitudinal axis a of the firearm's barrel, or along or parallel to the longitudinal axis a' of the light beam generator 36 (see also FIGS. 2, 4 and 5), or along or parallel to the longitudinal axis a" of the light beam generator 236 (see also FIGS. 24, 27 and 28), which axes a' and a" are parallel to the axis a when the light beam generator 36 or 236 is installed on the firearm; "transverse" describes a horizontal direction perpendicular to the axis a (or axis a' or axis a") when the barrel 22 (or light beam generator 36 or 236) is horizontally positioned; "above" means vertically above and "upward" means vertically upward when the firearm barrel 22 (or light beam generator 36 or 236) is horizontally positioned; "below" or "beneath" means vertically below and "downward" means vertically downward when the firearm barrel 22 (or light beam generator 36 or 236) is horizontally positioned; "front" or "forward" describes the longitudinal direction toward the muzzle of the barrel 22 or the light emitter assembly 46 (i.e., to the right

as shown in FIGS. 1, 2, 4, 24, 27, 31-36, 40 and 41) and to the left as shown in FIGS. 5 and 28); and “rear” or “rearward” describes the longitudinal direction opposite the front or forward direction (i.e., to the left as shown in FIGS. 1, 2, 4, 24, 27, 31-36, 40 and 41, and to the right as shown in FIGS. 5 and 28).

The handgun 20 includes a longitudinal rail 30 along the frame 24, below the barrel 22 and forwardly of the trigger guard 26. Such rails are well known in the handgun art, for mounting accessories thereto such as a light beam generator. The rail 30 is configured with two longitudinal grooves 32, one along each side of the rail 30, and is further configured with a transverse slot 34 in the bottom surface 35 of the rail 30. As is well known, such rails are intended for cooperating with accessories such as a light beam generator having a housing configured with a pair of longitudinal tongues (in this respect, see the tongues 38 and 238 of the preferred light beam generators 36 and 236, respectively, of the present inventions as represented in FIGS. 3 and 25), with such tongues 38 or 238 complementing the longitudinal grooves 32 for slidably retaining such light beam generator on the rail 30. A latch on the light beam generator housing co-acts with the transverse slot 34 in the rail 30 for releasably preventing further longitudinal movement of the light beam generator along the rail 30 when the light beam generator 36 or 236 is at a predetermined position along the rail 30.

Although the rail 30 is represented in FIG. 1 as being integral with the frame 24 of the handgun 20, the rail 30 may also be provided as a separate structure that may be removably attached to the handgun beneath the barrel and forwardly of the trigger guard. As previously noted, such rails for handguns, both integral to the frame and removably attachable to the handgun, as well as light beam generators adapted for being removably attached to such rails as discussed above, are disclosed in the aforementioned U.S. Pat. Nos. 6,276,088 and 6,378,237 incorporated herein by reference.

Handgun manufacturers have introduced various handgun models with integral rails having longitudinal grooves of the type shown in FIGS. 1-3. Although such longitudinal grooves among manufacturers have been of substantially similar dimensions, the transverse slots in the rails of handguns of some manufacturers are of different width than the transverse slot in the rails of handguns of other manufacturers. Specifically, the rails of some handguns include a transverse slot of one predetermined width while the rails of other handguns include a transverse slot of another predetermined width. For example, some handguns include a rail commonly known as a Universal rail, while other handguns include a rail commonly known as a Picatinny rail; the slot width of the Universal rail is substantially less than the slot width of the Picatinny rail. The accessory device or light beam generator 36 or 236 of the present invention accommodates both types of rails.

The light beam generator 36 or 236 further includes a removably attachable switch device, for being replaced by or interchanged with another switch device having a different or modified switch configuration.

Turning also to FIGS. 4-8, the light beam generator 36 includes a housing 40 in which is contained a power source such as a battery 42 of one or more battery cells 44 (for example, two 3-volt lithium battery cells 44). A light emitter assembly 46 is carried by the housing 40 forwardly of the battery 42 and in circuit with a positive front terminal of one of the battery cells 44 and a negative front terminal of another of the battery cells 44. A switch device 48 preferably situated at the rear of the housing 40 in and including a tail

cap 50, includes a switch actuator assembly 49 for selectively completing and opening the light emitter energization circuit. In the embodiment shown, this is accomplished by the switch actuator assembly 49 establishing a conductive path between the rear positive terminal 43 of one of the battery cells 44 and the rear negative terminal 45 of the other of the battery cells 44 for placing the switch device 48 in an ON position for causing the battery 42 to energize the light emitter assembly 46, and by opening such conductive path for placing the switch in an OFF position where the battery 42 does not energize the light emitter assembly 46.

As shown in FIG. 5, a preferred light emitter assembly 46 may include a light emitter 52 such as a light emitting diode (LED), preferably a high luminous flux LED such as a 3-watt or 5-watt LED manufactured by Lumileds Lighting, LLC (of San Jose, Calif.) and marketed under the trademark LUXEON including such LEDs marketed under the LUXEON STAR trademark.

With such an LED as the light emitter 52, the emitted light may be directed by a lens system contained in the light emitter assembly 46 including a totally internal reflective (TIR) lens 54 (as represented in FIG. 5), or by a parabolic reflector system as disclosed in U.S. patent application Ser. No. 10/346,537 of Paul Y. Kim and William A. Hunt, assigned to the assignee of the present invention, which patent application is incorporated herein by reference. The light emitter assembly 46 may alternatively include an incandescent lamp as the light emitter 52, such as a high intensity tungsten light bulb, with the emitted light preferably directed by a parabolic reflector.

In either case, the light emitter assembly 46 may further include a controller 56 for regulating the power to the light emitter for providing light output of constant brightness with decreasing battery voltage over time. The use of such controllers is discussed in the aforesaid patent application Ser. No. 10/346,537 incorporated herein by reference.

The preferred embodiment of the housing 40 of the light beam generator 36 includes a substantially flat upwardly facing surface 58 with two upstanding first wall segments 60 longitudinally extending forwardly along opposite sides of the surface 58 from the vicinity of the housing's rear end 62, and two upstanding second wall segments 64 forwardly of the respective first wall segments 60. The forward generally vertical ends 66 of the respective first wall segments are transversely aligned, and the rear generally vertical ends 68 of the respective second wall segments 64 are transversely aligned and spaced from the second wall segments' forward ends 68 by a predetermined distance d.

A transversely disposed pin 70 is secured to the housing 40 in the vicinity of its rear end 62 and above the housing's flat surface 58. As shown in FIG. 4, the transverse pin 70 is secured to the first wall segments 60 in the vicinity of their rear ends and above the flat surface 58. The pin 70 additionally extends through apertures in two upstanding protuberances or partitions 72 from the flat surface 58. The two partitions 72 are laterally spaced so as to divide the transverse pin into three exposed segments 74, 76, 78 which may be of substantially equal lengths.

The light beam generator 36 includes a latch lever plate 80 having a generally U-shaped rear end 82 configured for receiving the middle segment 76 of the transverse pin 70. One leg (preferably the upper leg 83) of the U may curve over a portion of the generally rearwardly facing opening of the U, and the plate 80 is preferably made of a material such that the legs are somewhat resilient. As illustrated in FIG. 4, the latch plate 80 is installed to the housing 36 by placing the opening of the latch plate's rear end 82 to the transverse pin

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segment 76, and the installer urging the rear end 82 to snap onto the pin segment 76. The latch plate 80 accordingly is hinged at its rear end 82 about the transverse hinge pin 70, specifically about the hinge pin segment 76; i.e., the plate 80 is pivotally secured to the housing 40 about a transverse axis t along the pin 70.

The top surface of the plate 80 includes an upstanding protuberance, preferably a transversely disposed elongate protuberance 84, in the vicinity of the plate's front end 86, the elongate projection 84 having a width w (along the longitudinal direction) slightly less than the slot 34 of the firearm's rail 30 for being received therein. Lateral arms 88 transversely extend outwardly from opposite sides of the plate 80, the arms 88 situated in the vicinity of the plate's front end 86 and being of a width d' (along the longitudinal direction) slightly less than the distance d between the forward ends 66 of the first wall segments 60 and the respective rear ends 68 of the second wall segments 64 (see FIG. 4) such that the arms 88 are received between such ends 66 and 68. The vertical height of the end portions 66 and 68 is preferably greater than the sum of the vertical thickness of the plate 80 and the vertical height of the protuberance 84.

During installation of the plate 80 to the housing 40, after being hinged to the hinge pin segment 76 the plate 80 is pivoted toward the housing's upwardly facing surface 58 (i.e., in the clockwise direction as viewed in FIG. 4) with a wave spring 90 held by an annular groove 92 in the underside of the plate 80 (see also FIGS. 5 and 7) in the longitudinal vicinity of the protuberance 84 and the lateral arms 88, until the spring 90 contacts the flat upwardly facing surface 58 of the housing 40 while the lateral arms 88 of the plate 80 are caused to enter the space between the wall surfaces 66 and 68.

The accessory device or light beam generator 36 includes two elongate members 94 removably secured to the housing 40, for interfacing with the firearm rail 30 to enable the housing 40 to be retainably slid along the rail 30 (see, in particular, FIGS. 1-5). Each elongate member 94 includes an inwardly directed tongue 38 longitudinally extending along such member 94; i.e., such elongate rail interface members 94 are installed to the housing 40 with the longitudinal tongue 38 of one of the members 94 facing the longitudinal tongue 38 of the other of the members 94, the tongues 38 complementing the firearm's longitudinal grooves 32 for slidably cooperating with the firearm's longitudinal grooves 32 while being vertically retained by the rail 30 as shown in FIGS. 2 and 3.

The elongate rail interface members 94 are installed to the housing 40 after the latch plate 80 has been hinged to the hinge pin segment 76 and pivoted with its lateral arms 88 in the space between the upstanding wall segment ends 66 and 68 as discussed above. Each member 94 includes a flat bottom surface 96 for contacting the top surfaces 98 and 100 of the housing's respective wall segments 60 and 64. The members 94 include bores 102 therethrough aligned with internally threaded blind vertical bores 104 in the top surfaces 98, 100 of the housing's wall segments 60, 64, preferably forwardly of the wall segment ends 68 and rearwardly of the wall segment ends 66, the members 94 being removably secured to the wall segments 60, 64 by headed screws 106 respectively extending into the bores 102 through the member 94 and threaded into the respectively aligned threaded bores 104 in the housing 40. With the elongate members 94 so installed, their bottom surfaces 96—which contact and extend along the top surfaces 98, 100 of the wall segments 60, 64—bridge the wall segments 60, 64 and provide a ceiling to the space between the wall ends

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66, 68. Such bridge or ceiling upwardly captures the lateral arms 88 within such space, while the wall ends 66, 68 longitudinally captures the lateral arms 88 within such space, resulting in the hinged latch plate 80 being captured to the housing 40 as well.

The elongate rail interface members 94 may be removed from the housing 40 by unscrewing the screws 106, and if desired the elongate rail interface members 94 may be replaced by other or different elongate rail interface members which are similarly removably securable to the housing 40. It may be appreciated that when the rail interface members 94 have been removed from the housing 40, the lateral arms 88 of the hinged latch plate 80 are no longer upwardly blocked or captured by the members 94, so that the latch plate 80 may be pivoted about the hinge pin 70 away from the surface 58 of the housing 40 and pulled away from the hinge pin segment 76. In such manner, the latch plate 80 may be removed from the housing 40 and another or different latch plate 80, which is similarly removably securable to the housing 40, may be hinged to the hinge pin 70 and upwardly captured by reinstalling the rail interface members 94.

Another feature of the preferred embodiment of the light beam generator 36 of the present invention comprises the tail cap switch device 48 which functions both as a battery cover permitting the battery cells 44 to be installed and retained in the housing 40 and as a switch for actuating the battery 42 to selectively energize the light emitter of the light emitter assembly 46. The preferred embodiment of the tail cap switch 48 is removably securable to the rear end 62 of the housing 40.

The switch device 48 includes a tail cap 50 which is hinged to the transverse hinge pin 70 by two transversely spaced-apart forward projections 108 each having a generally U-shaped end portion, one leg of the U preferably curving over a portion of the generally upwardly and rearwardly facing opening of the U. The projections 108 are preferably somewhat resilient and, as illustrated in FIG. 4, the switch device 48 is installed to the housing 36 by placing the openings of the cap's projections 108 to the transverse pin outer segments 74 and 78, the installer urging the projections 108 to snap onto the pin segments 74, 78. The tail cap 50 accordingly is hinged about the transverse hinge pin 70, specifically about the hinge pin segments 74, 78; i.e., the tail cap switch is pivotally secured to the housing 40 about a pivot axis, preferably the transverse axis t.

The installer thereupon rotates the tail cap 50 toward the housing's open rear end 62 (i.e., counterclockwise as viewed in FIG. 4) until the rear opening of the housing 40 is closed and the tail cap 50 is locked into place by cooperation of a catch 110 along the lower edge of the tail cap 50 with a spring-biased latch 112 on the housing 40 (FIGS. 4 and 5). When the tail cap 50 is in its latched position, the forwardly facing battery contacts 114, 116 on the switch device circuit board 118 are in conductive contact with the respective rear battery terminals 43, 45.

The switch device 48 may be removed from the housing 40 by manually unlatching the latch 112, pivoting the tail cap 50 upwardly about the hinge pin 70 away from the housing's rear opening (for example, to the position generally illustrated in FIG. 4) and pulling the switch device 48 away from the hinge pin segments 74 and 78. In such manner, the switch device 48 may be removed from the housing 40 and another or different switch device, which is similarly removably securable to the housing 40, may be hinged to the hinge pin 70 and locked to the rear end 62 of the housing 40 by operation of the latch 112.

When the light beam generator **36** is in its assembled condition (i.e., with the tail cap switch **48**, latch plate **80** and rail interface members **94** installed to the housing **40** as described above), the assembled light beam generator **36** may be removably installed to the firearm **20**. The light beam generator **36** is placed to the firearm **20** with the rear ends of the tongues **38** of the rail interface members **94** respectively engaging the forward ends of the grooves **32** of the rail **30** carried by the firearm **20**. The light beam generator **36** is thereupon rearwardly urged, thereby sliding the housing **40** along the rail **30** while the housing **40** is being vertically retained by the rail **30**. When the transverse upstanding protuberance **84** of the latch plate **80** contacts the bottom surface of the rail **30** (which may be facilitated by a swept-back profile of the forward portion of the rail **30** illustrated in FIGS. **1** and **2**, preferably of a height at least as great as the height of the protuberance **84**), the latch plate is thereby urged to pivot about the hinge pin **70** against the bias of the spring **90**, until the transverse protuberance **84** enters the transverse slot **34** as the spring **90** urges the plate **80** to pivot about the hinge pin segment **76**.

As earlier noted, the width *w* of the protuberance **84** is slightly less than the width of the slot **34** such that the protuberance **84** just fits into the slot **34**. The engagement of the protuberance **84** with the slot **34** stops further longitudinal movement of the housing **40** along the rail **30**, longitudinally latching the housing **40** in this position. The longitudinal positions of the slot **34** and of the protuberance **84** are preferably predetermined such that the rear end of the tail cap **50** is situated just forwardly of the handgun's trigger guard **26** when the protuberance **84** engages the slot **34**.

Because the dimensional tolerances of rails **30** may differ among firearm manufacturers, and even among firearms manufactured by the same manufacturer, the rail interface members **94** may be configured to accommodate such differences. In a preferred embodiment of the rail interface members **94** for accommodating such differences, the bores **102** and the counterbores **103** in the rail interface members **94** may be slightly greater in at least the transverse direction than the respective diameters of the threaded shaft **107** and head **109** of the screws **106**, for providing a loose fit in at least the transverse direction between the screws **106** and the bore **102**/counterbore **103** combinations. For example, the diameters of the screw-head **109** and threaded shaft **107** may be slightly greater than the diameters of the counterbore **103** and bore **102**, respectively.

During installation of the light beam generator **36** to a particular firearm rail **30**, if the engagement of rail interface members **94** to the rail **30** is too loose, the installer may simply loosen the screws **106**, move the rail interface members **94** inwardly (transversely toward each other) and thereupon tighten the screws **106** with the screw-heads **109** urged against the peripheral floor annular ledge **105** of the counterbores **103**. If the engagement between the rail interface members **94** and the rail **30** is too tight, the installer may loosen the screws **106**, move the rail interface members **94** outwardly (transversely away from each other), and tighten the screws **106** with the bottom surface **111** of the screw-heads **109** urged against the peripheral floor or annular ledge **105** of the counterbores **103**.

To remove the accessory device **36** from the firearm **20**, the operator downwardly urges the laterally protruding handles **120** on the ends of the lateral arms **88**, causing the plate **80** to pivot about the hinge pin **70**, against the bias of the spring **90**, until the protuberance **84** is disengaged from the transverse slot **34**. The operator thereupon forwardly

urges the accessory device **36** to slide along the rail **30** until the accessory device **36** is removed therefrom.

A preferred embodiment of the tail cap switch device **48** of the present invention permits ambidextrous actuation of the switch device **48** for energizing the light emitter **52** in a CONSTANT ON/OFF mode as well as in a MOMENTARY ON mode. The switch mechanism for implementing such operation is shown in FIGS. **10-17**.

A switch actuator arm **122** (e.g. fabricated of stainless steel) is affixed to an actuator disk **124** (e.g. fabricated of a polymeric material) rotatable about a circular protuberance **125** along the longitudinal axis *a'*. The actuator disk **124** is also rotatable about an elastomeric washer **127** (e.g. fabricated of rubber) rearwardly projecting from the tail cap insert **130** and having a rearwardly facing annular rim **128** adjacent to the forward surface of the actuator disk **124**.

The actuator disk **124** is rotatable with the actuator arm **122** about the longitudinal axis *a'*. The disk **124** includes peripheral notches **126** engaged by ends of a latching spring **129** secured to the tail cap insert **130**, for latching the disk **124** and hence the actuator arm **122** in a first rotational position where the arm **122** is transversely oriented (FIG. **14**), a second rotational position where the arm **122** is rotated clockwise by a predetermined angle (say, approximately 20°), and a third rotational position where the arm **122** is rotated counterclockwise by a predetermined angle (say, approximately 20°). An operator may selectively rotate the arm into these three alternative latched positions by manipulating up or down either one of the handles **132** attached to the ends of the actuator arm **122**.

The tail cap insert **130** includes a plate **134** (preferably of a plastic material such as polypropylene), having two rearwardly projecting nubs **136** at the free ends of flexible fingers **138** formed by cuts **140** through the insert plate **134**. The end portions **142** of the actuator arm **122** are situated just to the rear of the rearwardly projecting nubs **136**. Angularly extending from each of the actuator arm end portions **142** is a forwardly stepped tab **144**. The end portions **142** of the actuator arm **122** are normally situated longitudinally just to the rear of the rearwardly projecting nubs **136** when the actuator arm **122** is in its latched first or transverse position. However, when the actuator arm **122** is in either of its latched second or third rotated positions, one of the forwardly stepped tabs **144** contacts one of the nubs **136** and urges such contacted nub **136** to be forwardly displaced. When the operator rotatably replaces the actuator arm **122** to its latched first or transverse position, the corresponding resilient finger **138** replaces the affected nub **136** to its normal or unactuated position.

When the switch actuator arm **122** is in its latched first rotational or transverse position, the operator may push either of the handles **132** in the forward direction, causing the actuator arm **122** to compress a peripheral portion of the elastomeric rimmed washer **127**, rocking the actuator arm **122** so that its pushed end portion **142** is caused to be forwardly displaced. Such end portion **142** contacts and forwardly urges the correspondingly situated nub **136** for such time that the handle **132** is forwardly urged by the operator. When the operator releases the handle **132**, the resiliency of the washer **127** replaces the actuator arm **122** end portion **142** to its normal undepressed position thereby permitting the resilient finger **138** of the affected nub **136** to replace such nub **136** in its normal unactuated position.

It may be appreciated that the forward displacement of the actuator arm ends, and their resilient replacement, may be implemented by other mechanisms, for example by increasing the longitudinal elasticity of the actuator arm itself.

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The forward face of the insert plate **134** is covered with a non-conductive elastomeric sheet, such as a rubber membrane **146** secured to the plate **134**. The tail cap insert **130** is mounted within the tail cap **50** by screw **148**, with the rubber membrane **146** obverse and in proximity to the rear face **150** of the tail cap battery terminal circuit board **118** also secured to the tail cap **50** by the screw **148**. The respective free end portions **151**, **153** of the resilient contacts **152**, **154** secured to the tail cap circuit board's rear face **150** are situated directly forwardly of the nubs **136** with the rubber membrane **146** interposed therebetween. When a nub **136** is forwardly displaced, such nub **136** presses (through the interposed rubber membrane **146**) the corresponding resilient contact's end portion **151** or **153** into contact engagement with the circuit board's rear face **150**.

When the tail cap **50** is installed and latched to the housing **40**, the battery contacts **114**, **116** secured to the circuit board's forward face **156** are in contact engagement with the respective battery cell terminals **43**, **45**; i.e., the battery contact **114** is in contact engagement with the positive terminal **43** of one of the battery cells **44**, and the battery contact **116** is in contact engagement with the negative terminal **45** of the other of the battery cells **44**.

The positive battery contact **114** (FIG. **11**) conductively communicates with a first conductive area **158** (FIG. **12**) on the rear surface **150** of the circuit board **118**, while the negative battery contact **116** conductively communicates with a second conductive area **160** on the rear face **150** of the circuit board **118** to which the resilient contact **154** is conductively secured. When the free end **153** of resilient contact **154** on the circuit board's rear face **150** is urged into contact engagement with the first conductive area **158**, there is established a conductive path between the negative battery terminal contact **116** and the positive battery terminal contact **114** (and hence between the negative and positive battery terminals **45**, **43**), thereby placing the switch device **48** in an ON position completing the electrical circuit between the battery **42** and the light emitter assembly **46**.

The positive battery contact **114** is conductively secured to a third conductive area **162** (FIG. **11**) on the forward face **156** of the circuit board **118**, while the resilient contact **152** on the circuit board's rear face **150** (but which is normally electrically isolated from the conductive areas on the circuit board's rear face **150**) conductively communicates with the conductive area **162** on the circuit board's forward face **156**. When the free end **151** of the resilient contact **152** is urged into contact engagement with the second conductive area **160** on the circuit board's rear face **150**, there is established a conductive path between the positive battery terminal contact **114** and the negative battery terminal contact **116** (and hence between the positive and negative battery terminals **43**, **45**), thereby placing the switch device **48** in an ON position completing the electrical circuit between the battery **42** and the light emitter assembly **46**.

The switch device **48** is in an OFF position when the actuator arm **122** is in its normal position, i.e. in its first latched or transverse position and with neither of its end portions **142** forwardly depressed. It may be appreciated that when an operator manually urges either one of the handles **132** either downwardly or upwardly, the actuator arm **122** is rotated into either one of its latched second or third positions thereby placing the switch **48** in a CONSTANT ON position. The switch **48** remains in such CONSTANT ON position until the operator manually urges either one of the actuator arm handles **132** to effect a reverse rotation of the actuator arm **122** for causing the actuator arm **122** to be replaced in its latched first or transverse position, in which position the

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switch **48** is placed and maintained in its normal OFF position until further actuation by the operator.

It may be appreciated, as well, that the switch **48** may be actuated from an OFF position to a MOMENTARY ON position. When the actuator arm **122** is in its latched first or transverse position, the operator may manually forwardly urge or depress either one of the actuator arm handles **132**, placing the switch **48** in its ON position for only as long as the operator continues to depress the handle **132**. When the operator releases the handle **132**, the switch **48** resumes its normal OFF position.

An important feature of the preferred embodiment of the switch **48** is its ability to be actuated by either hand of the operator, in placing the switch **48** in its CONSTANT ON position and back to its normal OFF position, as well as for placing the switch **48** in its MOMENTARY ON position.

A second preferred tail cap switch embodiment **48'** is shown in FIGS. **18** and **19**. This second embodiment **48'** is substantially the same as the first switch embodiment **48** except that, in addition to the CONSTANT ON/OFF and MOMENTARY ON switch operations actuable upon manipulation of either of the handles **132** at the ends of the switch actuator arm **122**, the second switch embodiment **48'** further includes a MOMENTARY ON remote switching capability provided by a type of switch commonly known as a slimline or tape switch **164**. Tape switches are well known in the art, and their construction typically includes spaced electrodes in a flexible enclosure to which pressure may be manually applied by an operator for squeezing the electrodes together thereby bringing them into electrical contact with each other. The electrodes resume their spaced condition when the operator discontinues the application of such pressure. Tape switches used with illumination apparatus removably attachable to handguns are described in U.S. Pat. No. 5,654,594 issued to Bernie E. Bjornsen, III, Peter Hauk and John W. Matthews and assigned to the assignee of the present invention, and in U.S. Pat. No. 6,276,088 issued to John W. Matthews and Paul Y. Kim and assigned to the assignee of the present invention, which patents are incorporated herein by reference.

The tape switch **164** which may be utilized in connection with the second preferred embodiment **48'** of the tail cap switch device includes two electrically conductive leads **166**, **168** insulated from each other and extending from the tail cap **50'** to a pressure sensitive switch actuator **170** remote from the tail cap **50'**. The switch actuator **170** may be positioned under the trigger guard **26** (as shown in phantom in FIG. **2**), or the switch actuator **170** may be of a type which horseshoes about the handgun grip as shown in the aforementioned U.S. Pat. Nos. 5,654,594 and 6,276,088.

The tail cap-situated ends of the conductive leads **166**, **168** are conductively secured to the tail cap circuit board **118** for conductively communicating with the positive and negative battery cell contacts **114**, **116**. As shown in FIG. **19**, the tape switch lead **166** is conductively secured to the first conductive area **158** of the circuit board's rear face **150**, which conductive area **158** conductively communicates with the positive battery contact **114** on the circuit board's forward face **156** as previously described. The tape switch lead **168** is conductively secured to the conductive area **160** on the circuit board's rear face **150**, which conductive area **160** conductively communicates with the battery cell negative terminal contact **116** on the circuit board's forward face **156** as previously described. Accordingly, when the circuit of the tape switch **164** is closed upon the application of pressure to the tape switch actuator **170**, the battery cell positive terminal **43** is conductively connected to the battery

cell negative terminal **45** during such time that actuating pressure is continued to be applied to the tape switch actuator **170**.

It should be noted that, like the two switching modes of the tail cap switch **48** permitted by the switch actuator arm **122**, the remotely situated tape switch actuator **170** (whether situated under the trigger guard or horseshoed about the front of the handgun grip) may be operated with either of the operator's hands and, in addition, the tape switch actuator **170** may be operated by the same hand used for pulling the handgun's trigger.

It has been noted that the latch plate **80**, described in connection with FIG. 6, includes a transversely disposed elongate protuberance **84** having a width w slightly less than the slot **34** of the firearm's rail **30** for being received therein. Different firearm rails may have different slot widths, and indeed two well-known types of rails (namely, a Universal rail and a Picatinny rail) have slots of respectively different standardized widths. In order to accommodate both types of rails, the preferred embodiment of the accessory device **36** of the present invention may be provided with two types of replaceable latch plates. For example, the accessory device **36** may be provided with a latch plate **80** having a protuberance width w of approximately 0.125 inch for accommodating the transverse slot in a Universal rail, while another latch plate **80'** (shown in FIG. 20) may be provided having a width w' of its transversely disposed elongate protuberance **84'** of approximately 0.205 inch for accommodating the transverse slot of a Picatinny rail. Except for the differences in the width of the transverse protuberance shown as examples of the latch plate **80** and the latch plate **80'**, the two latch plates **80**, **80'** are substantially identical and one may be substituted for the other in the accessory device **36** according to the invention.

Accessory devices according to the invention, including the preferred embodiment **36** thereof, may be removably secured to firearms other than handguns, as well as to other types of firearms that do not have integral rails but are adapted for having accessory rail mount system devices secured thereto. Such rail mount system devices are well known in the firearms art, and may be of the type **172** (see FIG. 21) comprising a series of longitudinally spaced-apart ribs **174** separated by transverse slots **176**, such as a Picatinny rail specified in MIL-STD-1913 incorporated herein by reference.

Such rail mount structures **172** may be secured to long arms, for example to a rifle or shotgun **176** illustrated in FIG. 21 and as further disclosed in U.S. Pat. No. 6,655,069 issued to Paul Y. Kim and incorporated herein by reference. Other examples of rail structures **172**, including Picatinny rails, on other types of firearms are disclosed in U.S. Pat. Nos. 6,508,027 and 6,622,416, both issued to Paul Y. Kim and incorporated herein by reference; and in U.S. patent application Ser. No. 10/447,874 of Paul Y. Kim and John W. Matthews, assigned to the assignee of the present invention and incorporated herein by reference.

As shown in FIGS. 21 and 23, the accessory device or light beam generator **36** may be removably secured to such rail structures **172** secured to firearms other than hand weapons. Where such rail structure **172** is of a type having Picatinny rails, the latch plate **80'** shown in FIG. 20 would be installed in the accessory device **36**, with the transverse protrusion **34'** having a width w' for matingly engaging any one of the Picatinny rail slots **176**. The accessory device **36** may be removably secured to the rail structure **172** in substantially the same way as the accessory device **36** may be removably secured to the rail **30** carried by the handgun

20. The operator may adjust the longitudinal position of the accessory device **36** on the rail by depressing the handles **120** until a selected slot **176** has been encountered by the protuberance **34**.

As shown in FIG. 21, a handgrip **180** may be secured to the rail structure **172**, rearwardly of the light beam generator **36** but in proximity with the tail cap for permitting the operator to conveniently operate the tail cap switch device. In addition, FIG. 21 shows a tape switch **164** connected to the tail cap and having an actuator horseshoed about the front of the handgrip **180**. In such configuration, and if both the accessory device **36** and the handgrip **180** are secured to the bottom rail **172** (as illustrated in FIG. 23), the tail cap switch **48** may be actuated in both the CONSTANT ON/OFF and MOMENTARY ON modes with either hand.

The accessory device or light beam generator **36**, and in particular the housing **40**, elongate members **94**, pivot plate **80** and tail cap **50** may be manufactured using fabrication methods well-known in the art, of well known materials typically used in the art of making such components including rigid and durable materials such as polymeric materials as well as light weight aluminum alloys.

Although a target illuminator embodiment of the light beam generator **36** is described above in detail, laser aiming devices securable to rails carried by firearms are included within the scope of light beam generators according to the invention of the parent application.

The preferred embodiment of the enhanced accessory device according to the present invention, specifically the preferred embodiment of a light beam generator **236**, is shown with reference to FIGS. 24-41. Turning specifically to FIGS. 27-41 (wherein primed reference numerals indicate components similar to components in FIGS. 4-19 shown with corresponding reference numerals), the enhanced light beam generator **236** includes a housing **240** in which is contained a power source such as a battery **42'** of one or more battery cells **44'** (for example, two 3-volt lithium battery cells **44'**) similarly to the power source described above with respect to the light beam generator **36**. Also similarly to the light beam generator **36**, a light emitter assembly **46'** is carried by the enhanced light beam generator housing **240** forwardly of the battery **42'** and in circuit with a positive front terminal of one of the battery cells **44'** and a negative front terminal of another of the battery cells **44'**. The switch device **48'** (similar to the switch device **48** previously described) is preferably situated at the rear of the housing **240** in and including a tail cap **50'**, the switch device **48'** including a switch actuator assembly **49'** for selectively completing and opening the light emitter energization circuit. In the embodiment shown, this is accomplished by the switch actuator assembly **49'** establishing a conductive path between the rear positive terminal **43'** of one of the battery cells **44'** and the rear negative terminal **45'** of the other of the battery cells **44'** for placing the switch device **48'** in an ON position causing the battery **42'** to energize the light emitter assembly **46'**, and by opening such conductive path for placing the switch in an OFF position where the battery **42'** does not energize the light emitter assembly **46'**.

The preferred light emitter assembly **46'** shown in FIG. 28, as well as alternative embodiments thereof, are described above in connection with the light emitter assembly **46** shown in FIG. 5. Similarly, the structure and operation of the switch device **48'** and tail cap **50'** of the enhanced light beam generator **236**, shown in FIGS. 27 and 28, are described above in connection with the switch device **48** and tail cap **50** shown in FIGS. 4, 5 and 10-19.

Returning to FIGS. 27 and 28, the preferred embodiment of the housing 240 of the light beam generator 236 of the present invention includes a substantially flat upwardly facing or top surface 300 with a rearwardly facing upstanding wall 302 transversely extending along the front edge of the upwardly facing surface 300. Two upstanding first wall segments 304 longitudinally extend forwardly along opposite sides of the top surface 300 from the vicinity of the housing's rear end 306, and two upstanding second wall segments 308 longitudinally extend forwardly of the respective first wall segments 304. The forward generally vertical ends 310 of the respective first wall segments 304 are transversely aligned, and the rearward generally vertical ends 312 of the respective second wall segments 308 are transversely aligned and spaced from the second wall segments' forward ends 310 by a predetermined distance f. The forward generally vertical ends 314 of the respective second wall segments 308 are transversely aligned and spaced from the transverse rearwardly facing upstanding front wall 302 by a predetermined distance g.

A transversely disposed pin 70' is secured to the housing 240 in the vicinity of its rear end 306 and above the housing's top surface 300. The transverse pin 70' is secured to the first wall segments 304 in the vicinity of their rear ends and above the top surface 300. The pin 70' additionally extends through apertures in two upstanding protuberances or partitions 72' from the top surface 300. The two partitions 72' are laterally spaced so as to divide the transverse pin 70' into three exposed segments 74', 76', 78' which may be of substantially equal lengths.

The light beam generator 236 includes a slide latch 316 in cooperative engagement with a slide latch retainer 318 removably secured to the housing 240. Considering FIGS. 29a-29d along with FIGS. 27 and 28, the slide latch 316 comprises an elongate member or bar 320 with a handle 322 at one end thereof. In a preferred embodiment of the slide latch 316, the bar 320 includes a lower elongate portion 324 extending along substantially the entire length of the bar 320, and an upper elongate portion 326 extending from the vicinity of one end (preferably the handle 322 end) of the bar 320 of lesser length than the lower bar portion 324. The width x (in the longitudinal direction) of the upper bar portion 326 is slightly less than the width of the slot 34 of the firearm's rail for being received therein, and the length of the lower bar portion 324 permits the handle 322 to protrude from its corresponding opening between one of the second wall segments 308 and the housing's rearwardly facing transverse wall 302, while permitting the non-handled end portion 328 of the lower bar portion 324 to extend through and protrude from its corresponding opening between the other one of the second wall segments 308 and the housing's rearwardly facing transverse wall 302 when the latch 316 is in its latched position such as when the upper bar portion 326 is received by the rail slot 34.

The slide latch 316 is provided with an elongate depression or groove 330 of predetermined depth y (in the longitudinal direction) and length l (in the transverse direction), in and along the rearward surface 332 of the lower bar portion 324. The groove 330 has a first end 334 along the lower bar portion 324 near the handle 332 and extends to a second end 336 in the vicinity of the lower bar portion's non-handled end portion 328. A second depression 338 is situated at the first end 334 of the elongate depression or groove 330, the second depression 338 transversely aligned with the groove 330 and being of a predetermined depth z

which is greater than the depth y of the groove 330 and of a predetermined length m which is substantially less than the length l of the groove 330.

The preferred embodiment of the slide latch retainer 318 is in the general form of a plate having a generally U-shaped rear end portion 340 configured for receiving the middle segment 76' of the transverse pin 70'. One leg (preferably the upper leg 83') of the U may curve over a portion of the generally rearwardly facing opening of the U, and the retainer is preferably made of material such that the legs are somewhat resilient. As illustrated in FIG. 27, the slide latch retainer 318 is installed to the housing 236 by the user placing the opening of the retainer's rear end portion 340 to the transverse pin segment 76', and the user urging the rear end portion 340 to snap onto the pin segment 76'. The retainer 318 accordingly is hinged at its rear end portion 340 about the transverse hinge pin 70', specifically about the hinge pin segment 76'; i.e., the slide latch retainer 318 is pivotally secured to the housing 240 about a transverse, axis along the pin 70'.

The preferred embodiment of the slide latch retainer 318, shown in FIGS. 31-39, includes a top plate 342 secured to (e.g., integrally formed with or affixed to) a lower frame 344 to which is secured a forwardly biased mechanism 346 for retaining the slide latch 316 to the housing 240. The top plate 342, along with the lower frame 344 and forwardly biased retainer mechanism 346, are configured to fit into the receptacle formed on the housing's upwardly facing flat surface 300, bounded on its longitudinal sides by the wall segments 304, 308 and bounded at its front by the housing's rearwardly facing wall 302. In the preferred embodiment, the top plate 342 is substantially rectangular and the top plate's longitudinal sides 348 snugly fit along the housing side walls 304, 308 when the slide latch retainer 318 is installed to the housing 240 with its rear end 340 secured to the transverse pin 70', and the top plate's transverse front edge 350 is rearwardly spaced from the housing's rearwardly facing front wall 302. When the slide latch retainer 318 is so installed, the top plate 342 is held stationary both longitudinally and transversely with respect to the housing 240.

The forwardly biased retainer mechanism 346 includes an elongate retainer member 352 having a height slightly less than the height j of the elongate depression 330, and having a length slightly less than the combined lengths l plus m of the depressions 330 and 338. The retainer member 352 includes a forward protuberance 354 at one end thereof, the protuberance 354 being of the same height as the retainer member 352 and having a length slightly less than the length m of the second depression 338, the protuberance 354 forwardly extending a distance greater than the depth y of the elongate depression 330 but less than the depth z of the second depression 338. The retainer member 352 is transversely oriented and secured to the frame 344 for longitudinal movement with respect to the frame 344, by a compression spring 356 situated beneath the top plate 342. In the preferred embodiment, the compression spring 356 comprises an elliptically shaped spring with its major diameter transversely oriented, secured to (e.g., integrally formed with or affixed to) the frame 344 and the retainer member 352. The compression spring 356 is rearwardly secured at its minor diameter to the frame 344 and the spring 356 is forwardly secured at its minor diameter to the retainer member 352 at a location substantially midway along the transverse length of the retainer member 352.

Lateral arms 358 rearwardly extend from opposite ends of the retainer member 352, the arms 358 thereupon outwardly

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projecting and terminating with handles 360. When the handles 360 are rearwardly urged by the user, the retainer member 352 is urged rearwardly against the forward bias of the compressed compression spring 356. Such rearward movement of the retainer member 352 is restrained upon the arms 358 being urged into contact engagement with stops 362 on the frame 344 (FIG. 36).

The slide latch 316 and slide latch retainer 318 are installed together to the housing 240. In one manner of facilitating such installation, the slide latch retainer 318 is placed to the housing 240 by the user snapping the rear end portion 340 onto the pin segment 76'. The slide latch 316 is placed to the slide latch retainer 318 with the front edge 353 of the retainer member 352 received by the slide latch elongate depression 330 and with the retainer member's forward protrusion 354 received by the slide latch second depression 338 (see also FIG. 27). Such placing of the slide latch 316 to the slide latch retainer 318 may be accomplished either before or after the slide latch retainer 318 is pivotally secured to the transverse pin 70'. In any event, the user holds the slide latch 316 to the retainer member 352 while pivoting the slide latch retainer 318 about the transverse pin 70' toward the housing's top surface 300 (or by pivoting the housing 240 toward the slide latch retainer 318) until the end portions of the slide latch 316 are respectively received by and outwardly extend from the spaces between the housing's rearwardly facing front wall 302 and the two wall segments 308, and with the forward facing surface 325 (FIG. 29d) of the slide latch lower bar portion 324 in sliding engagement with the housing's rearwardly facing front wall 302. As shown in FIG. 40, when the slide latch retainer 318 and the slide latch 316 are so installed to the housing 240, the lateral arms 358 outwardly extend through the respective spaces between the wall segments 304 and 308, with the handles 360 respectively protruding therefrom.

The accessory device or light beam generator 236 includes two elongate members 294, 295 removably secured to the housing 240, for interfacing with the firearm rail to enable the housing 240 to be retainably slid along the rail 30 (see, in particular, FIGS. 1 and 24-28). Each elongate member 294, 295 includes an inwardly directed tongue 238 longitudinally extending along such member 294, 295; i.e., the elongate rail interface members 294, 295 are installed to the housing 240 with the longitudinal tongue 238 of one of the members 294, 295 facing the longitudinal tongue 238 of the other of the members 294, 295, the tongues 238 complementing the firearm rail's longitudinal grooves 32 for slidably cooperating with the rail's longitudinal grooves 32 while being vertically retained by the rail 30 (or the rail 172) as shown in FIGS. 25 and 26.

The elongate rail interface members 294, 295 are installed to the housing 240 after the slide latch 316 and slide latch retainer 318 have been installed to the housing 240 as previously described. Each member 294, 295 includes a flat bottom surface 296, 297, respectively, for contacting the top surfaces 364, 366 of the first and second wall segments 304, 308 and of the front wall top surfaces 368. The members 294, 295 include bores 370 therethrough aligned with internally threaded blind vertical bores 372 in the wall top surfaces 364, 366, 368, the members 294, 295 being removably secured to the walls by headed screws 374 respectively extending into the bores 370 through the members 294, 295 and threaded into the respectively aligned threaded bores 372 in the housing 240.

The elongate member 295 situated along the side of the housing 240 from which the slide latch handle 322 protrudes includes a transverse cutout 276 therethrough for accom-

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modating the height and longitudinal width of the slide latch upper bar portion 326. It may be appreciated that the installed elongate members 294, 295 vertically capture the lateral arms 358, resulting in the hinged slide latch retainer 318 being restrained against pivoting about the pivot pin 70' and is captured to the housing 240, while the slide latch 316 is both vertically and longitudinally captured to the housing 240. Since the retainer member 352 front edge 353 with its forward protrusion 354 is in receptive engagement with the slide latch 316 elongate depression 330, with the retainer member 352 forward protrusion 354 receptively engaged with the slide latch 316 second depression 338, the slide latch 316 is locked against transverse or sliding movement with respect to the housing 240.

The elongate rail interface members 294, 295 may be removed from the housing 240 by unscrewing the screws 374, and if desired the elongate rail interface members 294, 295 may be replaced by other or different elongate rail interface members which are similarly removably securable to the housing 240. It may be appreciated that when the rail interface members 294, 295 have been removed from the housing 240, the lateral arms 358 of the slide latch retainer 318 and the slide latch 316 itself are no longer upwardly blocked or captured by the members 294, 295, so that the slide latch retainer 318 and slide latch 316 combination may be pivoted about the hinge pin 70' away from the housing top surface 300, freeing the slide latch 316 from the slide latch retainer 318. In such manner, the slide latch 316 may be removed from the housing 240 and another or different slide latch, which is similarly adapted for cooperation with the slide latch retainer 318 and the housing 240, may be placed to the slide latch retainer 318 and installed to the housing 240 as described above.

The slide latch 316 described in connection with FIGS. 29a-d, includes an upper bar portion 326 having a width x (in the longitudinal direction) slightly less than the width of the transverse slot 34 of the firearm's rail 30 for being received therein. As previously noted, different firearm rails have different slot widths, including two well-known types of rails (namely, a Universal rail and a Picatinny rail) having slots of respectively different standardized widths. In order to accommodate both types of rails, a preferred embodiment of the accessory device 236 of the present invention may be provided with two types of replaceable slide latches. For example, the accessory device 236 may be provided with a slide latch 316 having a width x of approximately 0.125 inch for accommodating the transverse slot in a Universal rail, while another slide latch 316a (see FIGS. 30a-d) may be provided having a width x' of its transversely disposed upper bar portion 326a of approximately 0.205 inch for accommodating the transverse slot of a Picatinny rail.

In addition to the width differences between the upper bar portions 316 and 316a, the height of the upper bar portion 326a of the slide latch 316a may be greater than the height of the upper bar portion 326 of the slide latch 316. For facilitating accommodation of both types of slide latches 316, 316a to the preferred embodiment of the accessory device 236, the cutout 376 of the rail interface member 295 is preferably configured for receiving the extra width and height of the upper bar portion 326a of the slide latch 316a. Consequently, the preferred embodiment of the slide latch 316 includes a nub 378 upwardly extending along the top thereof in the vicinity of its handled 322 end portion, the nub 378 forwardly extending from the forward facing surface 327 of the upper bar portion 326 in the vicinity of the handled 322 end portion, simulating the height and width of the upper bar portion 326a of the slide latch 316a at that

location. Accordingly, when either one of the slide latches **316** or **316a** is installed to the housing **240** as shown in FIG. **40**, with the two elongate members **294**, **295** also secured to the housing **240**, the slide latch **316** or **316a** in the vicinity of its handled end **322** is preferably in sliding engagement with the corresponding surfaces of the cutout **376**.

The accessory device **236** is provided with a user adjustable mechanism for assuring vertical stability of the housing **240** with respect to the rail **30** or **172**. In the preferred embodiment, the top plate **342** of the slide latch retainer **318** is provided with a resilient tab **380** formed by a cut **382** through the top plate **342**, the tab **380** being joined at its base to the top plate **342** along a transverse line **384** (shown in phantom) along which the tab **340** is effectively hinged, the hinge line **384** being rearwardly spaced from the retainer member **352**. The rearwardly disposed free end **386** of the tab **380** is further rearwardly spaced from the retainer member **352** (and hence from the latch **316** when installed).

As shown in FIGS. **31-33** and **37-39**, the underside of the tab **380** is configured with a compartment **388** formed by two longitudinally spaced-apart transverse walls **390** depending from the tab **388** and a longitudinal depending wall **392** having an upwardly inclined inner surface **394**. The longitudinal wall **392** includes a transverse channel **396** extending through the inclined surface **394** and aligned with a transverse bore **398** in the frame **344**. A preferably rigid actuator member **400** (fabricated, for example, of stainless steel) has a bottom surface **402** for slidably engaging the housing's top surface **300**, and an inclined surface **404** complementary to and contacting the tab compartment's inclined surface **394** when the actuator's bottom surface **402** engages the housing's top surface **300**. The actuator **400** includes a threaded transverse bore **408** therethrough, for threaded engagement with a transversely disposed headed screw **406** extending through a transverse bore **410** in the wall **304** of the housing **240** and through the frame's bore **398** and the compartment's transverse channel **396** (with the head of the screw **406** being retained to the housing **240** by the counterbored bore **410**).

It may be appreciated that, as the user fastens the head-retained screw **406** into the threaded bore **408** of the actuator **400**, the actuator **400** is caused to slide transversely along the housing top surface **300** (to the right as viewed in FIG. **37**), causing the actuator's inclined surface **404** to be slidably urged against the tab's inclined surface **394**. Such action urges the tab **380** to flexibly pivot about the transverse hinge line **384** and the tab's free end **386** to move upwardly into contact engagement with the bottom surface **35** of the rail **30**.

Any gap between the housing **240** and the bottom **35** of the rail **30** is thereby filled at a location longitudinally spaced from the engagement of the slide latch **316** in the rail slot **34**, by such engagement of the tab **380** against the bottom surface **35** of the rail **30**, it being recognized that the tab **380** is vertically supported by the actuator member **400** in contact engagement with and between the underside of the tab **380** and the top surface **300** of the housing **240**. Accordingly, by filling a gap (if any) longitudinally spaced from the latch **316**, between the housing **240** and the bottom of the rail **30**, the housing **240** supportively engages the bottom of the rail **30**, resulting in enhanced vertical stability of the accessory device **236** with respect to the rail **30**.

The adjustment for placing the tab **380** in contact with the rail **30** may be performed when a particular accessory device **236** is initially mounted to a particular rail **30** or **172**. Readjustment should generally not be required during sub-

sequent installations of the same accessory device **236** to the same rail **30** or **172**, provided that the initial adjustment has not been changed.

The actuator member **400** may be installed to the housing **240** at the same time the slide latch retainer **318** is installed to the housing **240**. For example, the actuator member **400** may be placed in the cavity **388** with the slide latch retainer **318** positioned underside up, the latch retainer **318** having been pivotally secured to the housing's transverse pin **70'** with the slide latch **316** in place. The housing **240** may thereupon be pivoted about the transverse axis of the pivot pin **70'**, for engaging the slide latch retainer **318**/slide latch **316** combination with the housing **240** as previously discussed. The screw **406** is thereupon inserted in the housing wall bore **410** and is caused to threadably engage the threaded bore of the actuator member **400**.

FIG. **40** illustrates the position of the slide latch **316** as placed to the slide latch retainer **318** and installed to the housing **240**, with the front surface **325** of the lower bar portion **324** in transverse sliding engagement with the housing's rearwardly facing wall **302** and with the rearward surface **332** of the lower bar portion **324** in transverse sliding engagement with the longitudinally and transversely stationary transverse front edge **350** of the slide latch retainer top plate **342**. As previously described, the front edge **353** of the elongate retainer member **352** is received by the elongate depression or groove **330** in the slide latch **316**, with the retainer member's forward protuberance **354** received by the slide latch second depression **338**. Assembly of the light beam generator **236** is completed upon securing the elongate members **294**, **295** to the housing **240** and securing the tail cap switch device **48'** to the pivot pin **70'**, as previously described.

When it is desired to install the light beam generator **236** to the rail **30**, the user causes the slide latch **316** to transversely slide from its latched position shown in FIG. **40** to its unlatched but retained position shown in FIG. **41**. This is accomplished by the user urging the handles **360** (and hence the retainer member **352**) rearwardly, against the forward bias of the compression spring **356**, to longitudinally withdraw the forward protuberance **354** of the elongate retainer member **352** from the slide latch's second depression **338** such that the elongate depression **330** is transversely accessible to the protuberance **354**. For example, if the longitudinal length of the protuberance **354** is substantially equal to the difference between the depth z (see FIG. **29b**) of the second depression and the depth y of the groove **330** (i.e., $z-y$), the withdrawal distance would be a distance greater than such difference ($z-y$) but less than the depth z of the second depression, which withdrawal distance is assured by the stops **362** (see FIGS. **35** and **36**).

The user thereupon transversely pushes the non-handled end portion **328** of the slide latch **316** inwardly (in the direction of the arrow **412**, FIG. **40**) while releasing the handles **360**, and then transversely pulls the handle **322** (outwardly, in the same direction as the arrow **412**). Accordingly, the lower bar portion **324** of the slide latch **316** is caused to transversely slide along the housing's rearwardly facing front wall **302** and the top plate front edge **350** of the slide latch retainer **318**, with the forward protuberance **354** of the retainer member **352** received by the elongate depression or groove **330**. The user continues such pulling of the handle **322** until the second end **336** of the elongate depression **330** contacts the retainer member forward protuberance **354**, whereupon further outwardly transverse movement of the slide latch **316** is prevented and the slide latch is retained

to the housing 240. This second or unlatched position of the slide latch 316 is shown in FIG. 41.

With the slide latch 316 in such unlatched position, the light beam generator 236 is placed to the firearm rail 30 with the rear ends of the tongues 238 of the rail interface members 294, 295 respectively engaging the forward ends of the grooves 32 of the rail 30. The upper bar portion 326 of the slide latch 316, when in this second position, is situated entirely outwardly of the rail 30, and the user rearwardly urges the light beam generator 236 for sliding the housing 240 along the rail 30 while the housing 240 is being vertically retained by the rail 30. When the transverse slide latch 316 is aligned with the transverse slot 34 of the rail 30, the user pushes the handle 322 of the slide latch 316 inwardly (i.e. the user transversely urges the slide latch 316 opposite the direction indicated by the arrow 412), causing the upper bar portion 326 of the slide latch 316 to transversely enter the slot 34. The user continues such transverse urging of the slide latch 316 until the forward protuberance 354 of the forwardly biased retainer member 352 (which, as described above, is received by the elongate depression or groove 330) is longitudinally aligned with the second depression 338 whereupon the front edge 353 of the forwardly biased retainer member 352 is received by the groove 330 with the protuberance 354 received by the second depression 338. Accordingly, the slide latch 316 is locked in this first or latched position (shown in FIG. 40) with the slide latch's upper bar portion 326 situated within the transverse slot 34 of the rail 30.

As earlier noted, the width of the upper bar portion 326 is slightly less than the width of the slot 34 such that the upper bar portion 326 just fits into the slot 34. The engagement of the upper bar portion 327 with the slot 34, as well as the engagement of the lower bar portion 325 with the housing's rearwardly facing surface 302 and the slide latch retainer 318, longitudinally latching the housing 240 to the rail 30 in a manner preventing longitudinal movement of the accessory device 236 with respect to the rail 30, which may be caused, for example, upon discharge of the firearm.

The longitudinal positions of the slot 34 and of the slide latch 316 are preferably predetermined such that the rear end of the tail cap 50' is situated just forwardly of, or even contacting, the handgun's trigger guard 26 when the slide latch 316 engages the slot 34. The user may then adjust the vertical position of the tab 380 for placing the tab 380 in contact with the bottom surface 35 of the rail 30 as previously described, as may be appropriate for preventing vertical movement of the accessory device 236 with respect to the rail 30 which may be caused, for example, upon discharge of the firearm.

To remove the accessory device 236 from the rail 30, the user rearwardly urges the handles 360 (and hence the retainer member 352) against the bias of the compression spring 356, thereby rearwardly urging the elongate retainer member 352 for withdrawing the forward protuberance 354 from the second depression 338 for transverse accessibility to the groove 330. The user then transversely urges the slide latch 316 in the direction of the arrow 412, as previously described, until the slide latch 316 is in its second or unlatched position as shown in FIG. 41. The user thereupon forwardly urges the accessory device 236 to slide along the rail 30 until the accessory device 236 is removed therefrom.

The rail interface members 294, 295 may be configured to accommodate differences in the dimensional tolerances of firearm rails 30 manufactured by different manufacturers, and even among firearm rails manufactured by the same manufacturer. In a preferred embodiment of the rail interface

members 294, 295 for accommodating such differences, the bores 370 and counterbores in the rail interface members 294, 295 may be configured similarly as the bores 102 and the counterbores 103 in the rail interface members 94 as previously described (see FIG. 9). During installation of the light beam generator 236 to a particular firearm rail 30, if the engagement of the rail interface members 294, 295 to the rail 30 is too loose, the user may simply loosen the screws 374, move the rail interface members 294, 295 inwardly (transversely toward each other) and thereupon tighten the screws 374. If the engagement between the rail interface members 294, 295 and the rail 30 is too tight, the user may loosen the screws 374, move the rail interface members 294, 295 outwardly (transversely away from each other) and tighten the screws 374. In either event, the adjustment assists in the prevention of transverse movement of the accessory device 236 with respect to the rail 30 which may be caused, for example, upon discharge of the firearm.

The accessory device or light beam generator 236 may be manufactured using fabrication methods well-known in the art, of well-known materials typically used in the art of making such components including rigid and durable materials such as polymeric materials as well as lightweight aluminum alloys, and resilient materials such as nylon materials. In the preferred embodiment of the light beam generator 236, the housing 240 may be fabricated of an aluminum alloy; the slide latch 316, the slide latch retainer 318 and the elongate members 294, 295 may be fabricated of a nylon material; and the actuator member 400 may be fabricated of stainless steel.

Although a target illuminator embodiment of the light beam generator 236 is described above in detail, laser aiming devices securable to rails carried by firearms are included within the scope of light beam generators according to the present invention.

Thus, there has been described a preferred embodiment of an enhanced stability accessory device which is removably securable to a longitudinal rail carried by a firearm, which accommodates longitudinal rails of different configurations carried by firearms, and which includes a removably securable transverse latching device. The light beam generator of the preferred embodiment includes a removable tail cap switch actuable by either hand of an operator for placing the switch in CONSTANT ON/OFF positions and in a MOMENTARY ON position, as well as for remote actuation by either hand to a MOMENTARY ON position. Other embodiments of the present invention, and variations of the embodiments presented herein, may be developed without departing from the essential characteristics thereof. Accordingly, the invention should be limited only by the scope of the claims listed below.

We claim:

1. An accessory device for a firearm including a longitudinal barrel, a longitudinal rail carried by the firearm, and a transverse slot in the rail, the accessory device comprising:
 - a housing having a top surface;
 - elongate rail interface members along said housing complementing the rail for enabling said housing to be retainably slid along the rail with said top surface facing the rail;
 - an elongate latch carried by said housing and transversely slidable along said top surface when said latch is transversely aligned with the slot, from an unlatched position disengaged from the slot to a latched position engaging the slot; and
 - a latch retainer carried by said housing transversely locking said elongate latch when in said latched posi-

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tion, said latch retainer adapted for being manipulated by a user for unlocking said elongate latch from said latched position and for permitting said elongate latch to be transversely urged by the user to said unlatched position with said elongate latch transversely retained to said housing. 5

2. The accessory device according to claim 1, wherein: said elongate rail interface members are removably secured to said housing.

3. The accessory device according to claim 1, wherein: said elongate latch extends through an opening in a side of said housing; and said latch retainer and said latch are adapted for preventing transverse withdrawal of said latch through said opening when said latch is in said unlatched position. 15

4. The accessory device according to claim 1, including: an adjustable device carried by said housing and longitudinally spaced from said latch, said adjustable device adapted for supportively engaging said housing to the rail. 20

5. The accessory device according to claim 1, wherein: said housing includes a transverse wall along said top surface; and said latch is interposed between said wall and said latch retainer. 25

6. The accessory device according to claim 5, wherein: said latch is restrained against longitudinal movement along said housing by said wall and said latch retainer.

7. The accessory device according to claim 1, wherein: said latch extends through respective openings in opposing longitudinal sides of said housing. 30

8. The accessory device according to claim 7, wherein: said elongate rail interface members are removably secured along said opposing longitudinal sides including said openings for restraining said latch from movement normal to the top surface of said housing. 35

9. The accessory device according to claim 1, including: an elongate depression in said latch for cooperating with said latch retainer for guiding said latch when said latch is transversely urged. 40

10. The accessory device according to claim 1, wherein: said latch retainer is removably secured to said housing.

11. The accessory device according to claim 1, wherein: said latch retainer is pivotally secured to said housing about a transverse axis. 45

12. The accessory device according to claim 11, wherein: said elongate rail interface members are removably secured along opposing longitudinal sides of said housing; and said latch retainer is pivotally restrained to said housing by said elongate rail interface members when said elongate rail interface members are secured to said housing. 50

13. The accessory device according to claim 12, wherein: said latch retainer is removable from its securement about said transverse axis when said elongate rail interface members are removed from said housing. 55

14. The accessory device according to claim 2, wherein: the securement of said elongate rail interface members to said housing is transversely adjustable. 60

15. The accessory device according to claim 2, wherein: said elongate rail interface members are secured to said housing with headed screws retained in bores in said elongate rail interface members respectively communicating with threaded bores in said housing, said bores in said elongate rail interface members providing a

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loose fit with said headed screws at least in the transverse direction for adjusting the transverse distance between said members.

16. The accessory device according to claim 1, including: a light emitter assembly carried by said housing; a battery carried by said housing in circuit for energizing said light emitter assembly when switch actuated; and a switch device including a switch actuator for said battery.

17. The accessory device according to claim 16, wherein: said switch device is removably secured to said housing.

18. The accessory device according to claim 16, wherein: said switch actuator is rotatably urgeable by either hand of a user when said housing is installed on the rail for placing said switch device in a CONSTANT ON or OFF position, and forwardly urgeable by either hand of the user when said housing is installed on the rail for placing said switch device in a MOMENTARY ON position.

19. The accessory device according to claim 18, including: a remote switch actuator communicating with said switch device for remotely actuating said switch device to a MOMENTARY ON position.

20. The accessory device according to claim 16, wherein: said switch device comprises a tail cap switch pivotally secured to said housing about a pivot axis.

21. The accessory device according to claim 20, wherein: said tail cap switch is adapted for being removed by a user from its securement about said pivot axis.

22. The accessory device according to claim 20, wherein: said tail cap switch is adapted for being removed by a user from its securement about said pivot axis only when said tail cap switch is pivoted away from said housing.

23. The accessory device according to claim 20, wherein: said tail cap switch includes a switch actuator rotatably urgeable by either hand of a user when said housing is installed on the rail for placing said tail cap switch in a CONSTANT ON or OFF position, and axially urgeable by either hand of the user when said housing is installed on the rail for placing said tail cap switch in a MOMENTARY ON position.

24. The accessory device according to claim 23, including: a remote switch actuator communicating with said tail cap switch and operable by either hand of the user for placing said tail cap switch in a MOMENTARY ON position.

25. The accessory device according to claim 16, wherein: said switch device comprises a tail cap switch and said switch actuator includes an actuator arm rotatable at its center about a longitudinal axis of said housing, said actuator arm including longitudinally displaceable ends with handles at said ends, one of said handles accessible to one hand of a user and the other of said handles accessible to the other hand of the user when said housing is installed on the rail; said switch actuator is adapted for placing said tail cap switch in a CONSTANT ON position when either of said handles is upwardly or downwardly urged by the user from an OFF position of said switch, and for returning said tail cap switch to the OFF position upon reverse urging of either of said handles; and said switch actuator is adapted for placing said switch in a MOMENTARY ON position when either of said handles is forwardly urged from the OFF position by the user.

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26. The accessory device according to claim 25, wherein: said switch actuator is latched in the OFF position when said actuator arm is transversely oriented, and said switch actuator is latched in the CONSTANT ON position when said actuator arm is rotationally displaced from its transverse orientation. 5
27. The accessory device according to claim 25, wherein: said tail cap switch is pivotally secured to said housing about a pivot axis.
28. The accessory device according to claim 27, wherein: said tail cap switch is adapted for being removed by a user from its securement about said pivot axis. 10
29. An accessory device for a firearm including a longitudinal barrel, a longitudinal rail carried by the firearm, and a transverse slot in the rail, the accessory device comprising: 15
 a housing having a top surface and an upstanding wall transversely extending along said top surface; elongate rail interface members along said housing complementing the rail for enabling said housing to be longitudinally slid along the rail; 20
 a bar transversely carried by said housing, said bar including an upper portion for being transversely received by the slot, said bar including a lower portion having a first surface in transverse sliding engagement with said wall and a second surface opposite said first surface including an elongate depression terminating at a first end with a second depression of depth greater than the depth of said elongate depression, said elongate depression terminating at a second end; 25
 a retainer for said bar, said retainer secured to said housing and having a transverse edge portion including a longitudinally extending protuberance, said edge portion received by said elongate depression with said protuberance received by said second depression for preventing sliding of said bar along said wall, said retainer adapted for being manipulated by a user for longitudinally urging said edge portion from said elongate depression and said protuberance from said second depression whereupon said bar is transversely slidable along said wall with said protuberance captured within said elongate depression. 30
 30. The accessory device according to claim 29, wherein: said first surface comprises a front surface; said second surface comprises a rear surface; said transverse edge portion comprises a front edge portion; 35
 said longitudinally extending protuberance comprises a forwardly extending protuberance; and said longitudinally urging of said edge portion comprises a rearwardly urging of said edge portion. 50
 31. The accessory device according to claim 30, wherein: said retainer includes a forwardly biased elongate member having said front edge portion.
32. The accessory device according to claim 31, wherein: said retainer includes a frame secured to said housing and a compression spring longitudinally securing said elongate member to said frame. 55
33. The accessory device according to claim 32, wherein: said retainer includes a top plate secured to said frame and having a transverse front edge longitudinally spaced from said wall. 60
34. The accessory device according to claim 33, including: 65
 a tab provided in said top plate; and
 an actuator interposed between said top surface of said housing and said tab and operable by a user for causing said tab to contact the bottom surface of the rail.

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35. The accessory device according to claim 29, including: an adjustable device carried by said housing and longitudinally spaced from said bar, said adjustable device being adjustable for supportively engaging said housing to the rail.
36. The accessory device according to claim 29, wherein: said retainer is pivotally secured to said housing about a transverse axis.
37. The accessory device according to claim 31, wherein: said forwardly biased elongate member includes lateral arms extending through said housing and rearwardly urgeable by a user for rearwardly displacing said forwardly biased elongate member.
38. The accessory device according to claim 29, wherein: said elongate rail interface members are removably secured to said housing.
39. The accessory device according to claim 38, wherein: said retainer is removably secured to said housing.
40. The accessory device according to claim 38, wherein: said retainer is pivotally secured to said housing about a transverse axis.
41. The accessory device according to claim 40, wherein: said retainer is pivotally restrained to said housing by said elongate rail interface members when said elongate rail interface members are secured to said housing.
42. The accessory device according to claim 41, wherein: said retainer is removable from its securement about said transverse axis when said elongate rail interface members are removed from said housing.
43. The accessory device according to claim 38, wherein: the securement of said elongate rail interface members to said housing is transversely adjustable.
44. The accessory device according to claim 43, wherein: said elongate rail interface members are secured to said housing with headed screws retained in bores in said elongate rail interface members respectively communicating with threaded bores in said housing, said bores in said elongate rail interface members providing a loose fit with said headed screws at least in the transverse direction for adjusting the transverse distance between said elongate rail interface members.
45. The accessory device according to claim 38, wherein: said elongate rail interface members restrain movement of said bar normal to said top surface when said elongate rail interface members are secured to said housing.
46. The accessory device according to claim 45, wherein: said bar is removable from said housing when said elongate rail interface members are removed from said housing.
47. The accessory device according to claim 29, including: 70
 a light emitter assembly carried by said housing;
 a battery carried by said housing in circuit for energizing said light emitter assembly when switch actuated; and
 a switch device including a switch actuator for said battery.
48. The accessory device according to claim 47, wherein: said switch device is removably secured to said housing.
49. The accessory device according to claim 47, wherein: said switch actuator is rotatably urgeable by either hand of a user when said housing is installed on the rail for placing said switch device in a CONSTANT ON or OFF position, and longitudinally urgeable by either hand of the user when said housing is installed on the rail for placing said switch device in a MOMENTARY ON position. 75

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50. The accessory device according to claim 49, including:

a remote switch actuator communicating with said switch device for remotely actuating said switch device to a MOMENTARY ON position.

51. The accessory device according to claim 47, wherein: said switch device comprises a tail cap switch pivotally secured to said housing about a pivot axis.

52. The accessory device according to claim 51, wherein: said tail cap switch is adapted for being removed by a user from its securement about said pivot axis.

53. The accessory device according to claim 51, wherein: said tail cap switch is adapted for being removed by a user from its securement about said pivot axis only when said tail cap switch is pivoted away from said housing.

54. A method of assembling an accessory device for installation on a longitudinal rail having a transverse slot therein, comprising:

providing the accessory device including a housing having a top surface and a transverse wall along said top surface;

providing elongate rail interface members complementing the rail;

providing an elongate latch member sized for being slidably received by the slot in the rail;

providing a latch retainer having a forwardly biased front edge portion;

placing said latch member to said front edge portion of said latch retainer;

securing said latch retainer to said housing with said latch member interposed between said wall and said forwardly biased edge portion of said latch retainer; and removably securing said elongate rail interface members to said housing with said elongate rail interface members capturing said latch retainer and said latch member to said housing.

55. The method according to claim 54, further including: sliding said latch member transversely along said top surface of said housing to an unlatched position; sliding said housing longitudinally along the rail until said latch member is transversely aligned with the slot in the rail; and

sliding said latch member transversely for being received by the slot.

56. The method according to claim 55, further including: causing said housing to engage the bottom of the rail at a location longitudinally spaced from said latch member.

57. The method according to claim 54, wherein: in the latch retainer providing step, said latch retainer is removably securable to said housing about a transverse axis.

58. The method according to claim 54, wherein: in the latch member providing step, said latch member includes an elongate depression; and

in the latch member placing step, said forwardly biased front edge portion of said latch retainer is received by said elongate depression of said latch member.

59. The method according to claim 54, wherein: in the latch member providing step, said latch member includes an elongate depression terminating with a second depression of greater depth;

in the latch retainer providing step, said forwardly biased front edge portion includes a forwardly extending protrusion; and

in the latch member placing step, said forwardly biased front edge portion of said latch retainer is received by

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said elongate depression of said latch member with said protrusion received by said second depression.

60. The method according to claim 59, further including: rearwardly urging said forwardly biased front edge portion of said latch retainer for urging said edge portion from said elongate depression and said protuberance from said second depression for permitting transverse sliding of said latch member with said protuberance captured within said elongate depression;

sliding said latch member transversely along said top surface of said housing to an unlatched position;

sliding said housing longitudinally along the rail until said latch member is transversely aligned with the slot in the rail; and

sliding said latch member transversely for being received by the slot.

61. The method according to claim 60, further including: rearwardly urging said forwardly biased front edge portion of said latch retainer for urging said edge portion from said elongate depression and said protuberance from said second depression such that said latch member is transversely slidable with said protrusion captured within said elongate depression;

sliding said latch member transversely along said top surface of said housing to an unlatched position; and

sliding said housing longitudinally along the rail until said housing is removed therefrom.

62. The method according to claim 54 wherein the rail is a first rail, further including:

removing said elongate rail interface members from said housing;

removing said latch member from said housing;

providing a second latch member sized for being slidably received by a slot in a second rail carried by a firearm;

placing said second latch member to said front edge portion of said latch retainer with said latch member disposed for being transversely slid along the top surface of said housing; and

removably securing said elongate rail interface members to said housing with said elongate rail interface members capturing said latch retainer and said second latch member to said housing.

63. The method according to claim 62, wherein:

in the second latch member providing step, said second latch member is of a different width than said first latch member.

64. The method according to claim 54, wherein:

in the latch retainer securing step, pivotally securing said latch retainer to said housing and pivoting said latch retainer with said latch member placed thereto toward said top surface of said housing.

65. The method according to claim 64, further including: removing said elongate rail interface members from said housing;

pivoting said latch retainer with said latch member away from said top surface;

removing said latch member from its placement to said latch retainer;

providing a second latch member sized for being slidably received by a slot in a second rail carried by a firearm;

placing said second latch member to said front edge portion of said latch retainer;

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pivoting said latch retainer with said latch member toward said top surface; and
removably securing said elongate rail interface members to said housing with said elongate rail interface members capturing said latch retainer and said latch member to said housing. 5

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66. The method according to claim **65**, wherein:
in the second latch member providing step, said second latch member is of a different width than the removed latch member.

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