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(54) **COMMUNICATION AND POWER DISTRIBUTION SYSTEM AND SEGMENTED RAIL ADAPTER**

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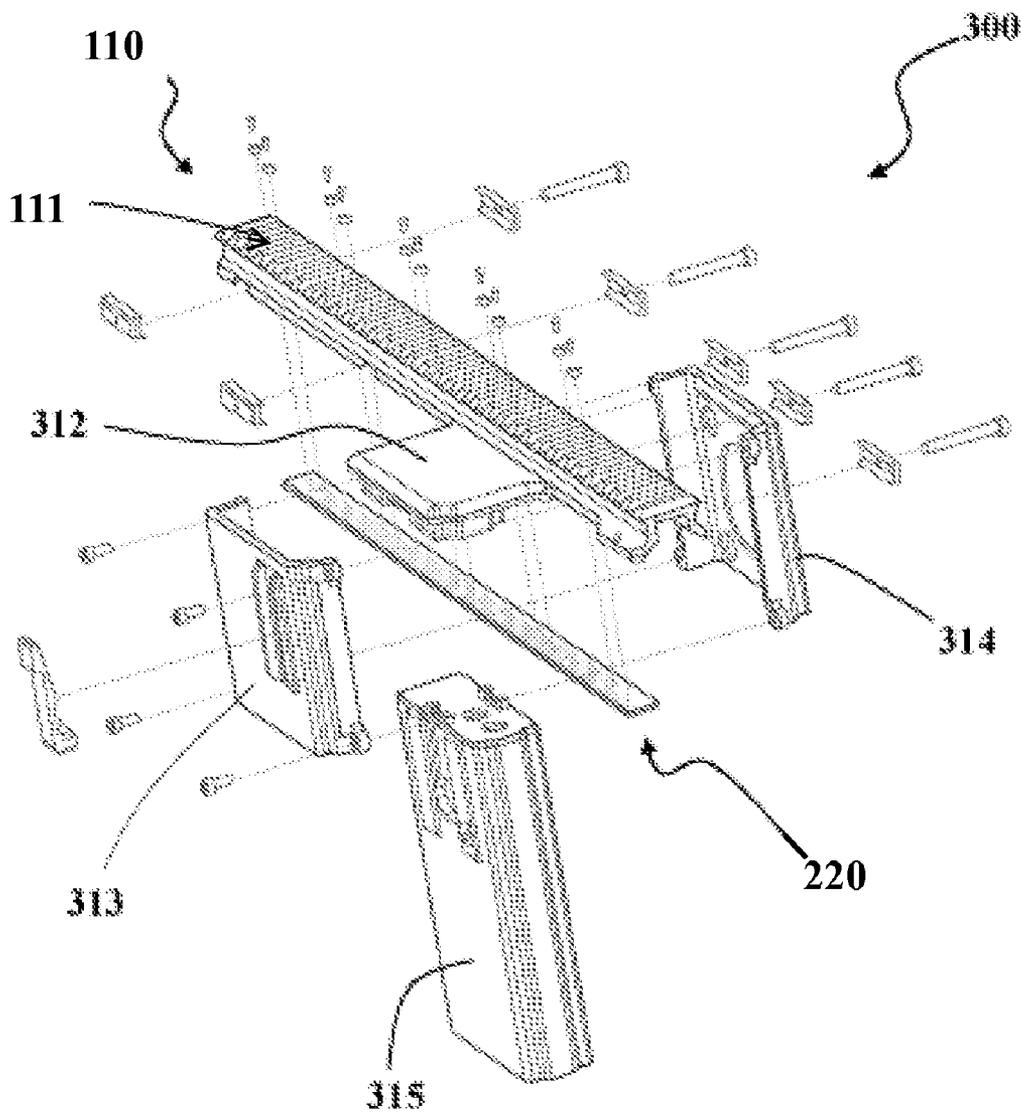
(57) **ABSTRACT**

(22) Filed: **Jun. 20, 2012**

A firearm rail adapter comprising a rail adapter assembly configured to detachably attach to a structure, the rail adapter assembly comprising a first member proximate to the structure and a second member distal from the structure, wherein the proximate first member and the distal second member define a conduit configured to: conduct electricity via a plurality of contact pads; and/or transport data signals via at least one contact pad.

Related U.S. Application Data

(63) Continuation of application No. PCT/US2010/061936, filed on Dec. 22, 2010.
(60) Provisional application No. 61/289,950, filed on Dec. 23, 2009.



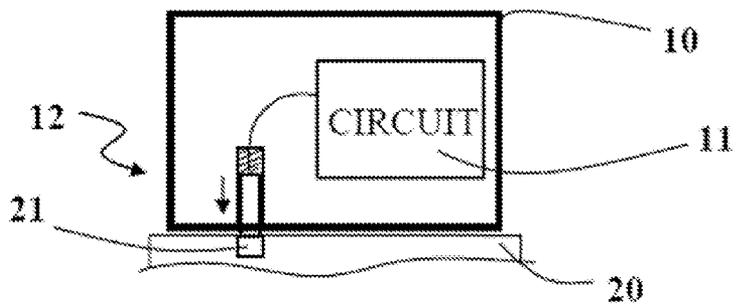


FIG. 1A
(Prior Art)

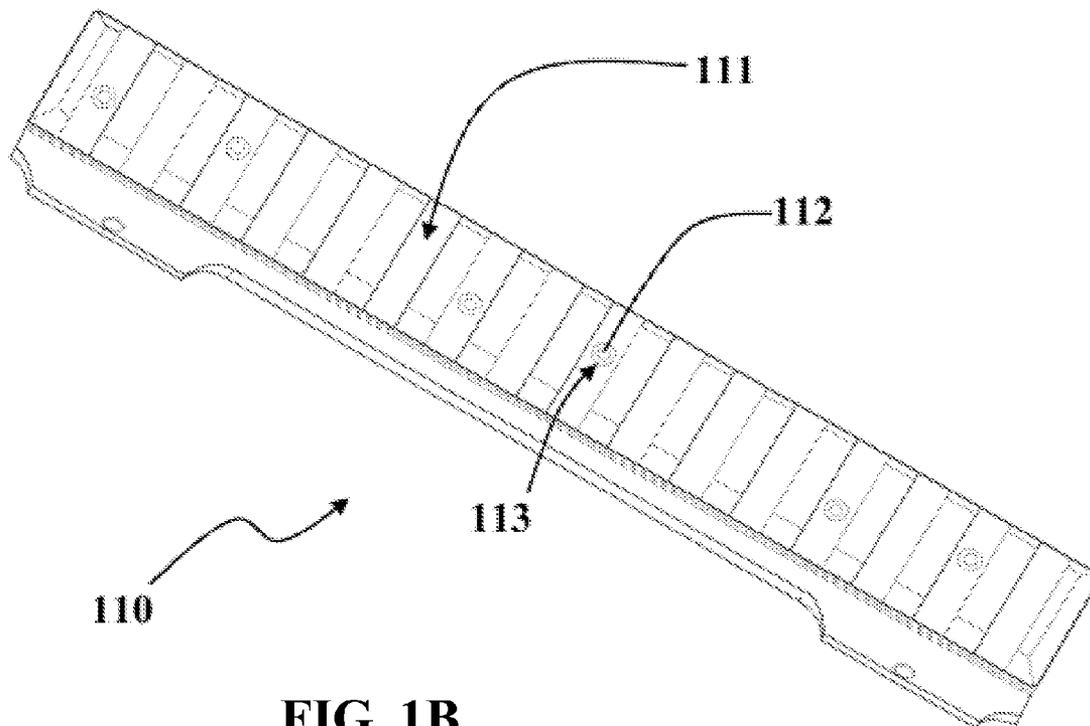


FIG. 1B

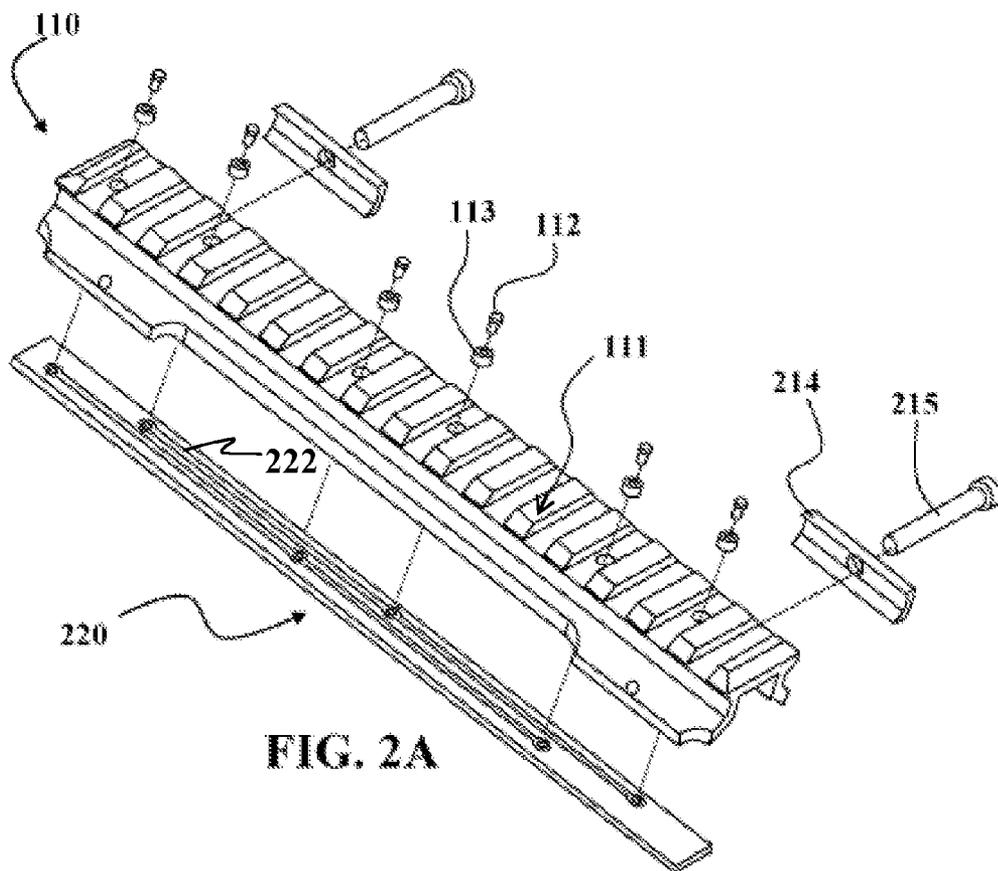


FIG. 2A

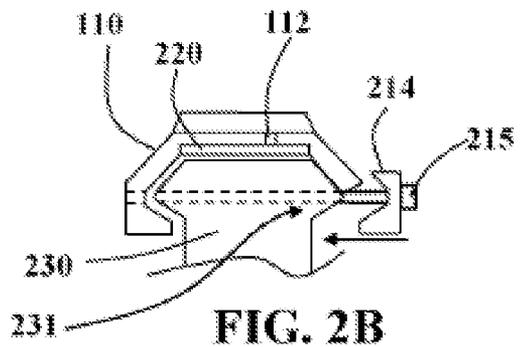


FIG. 2B

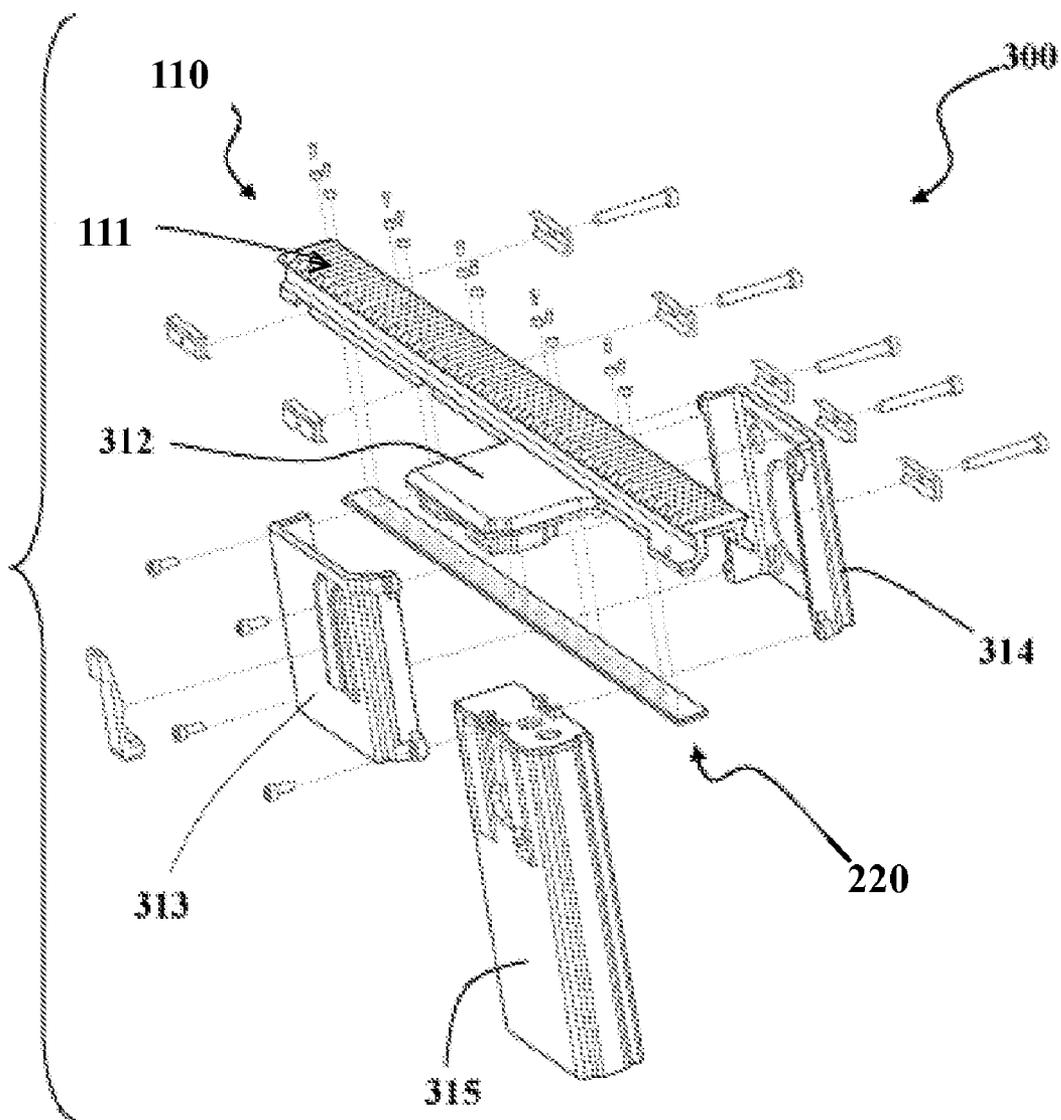


FIG. 3

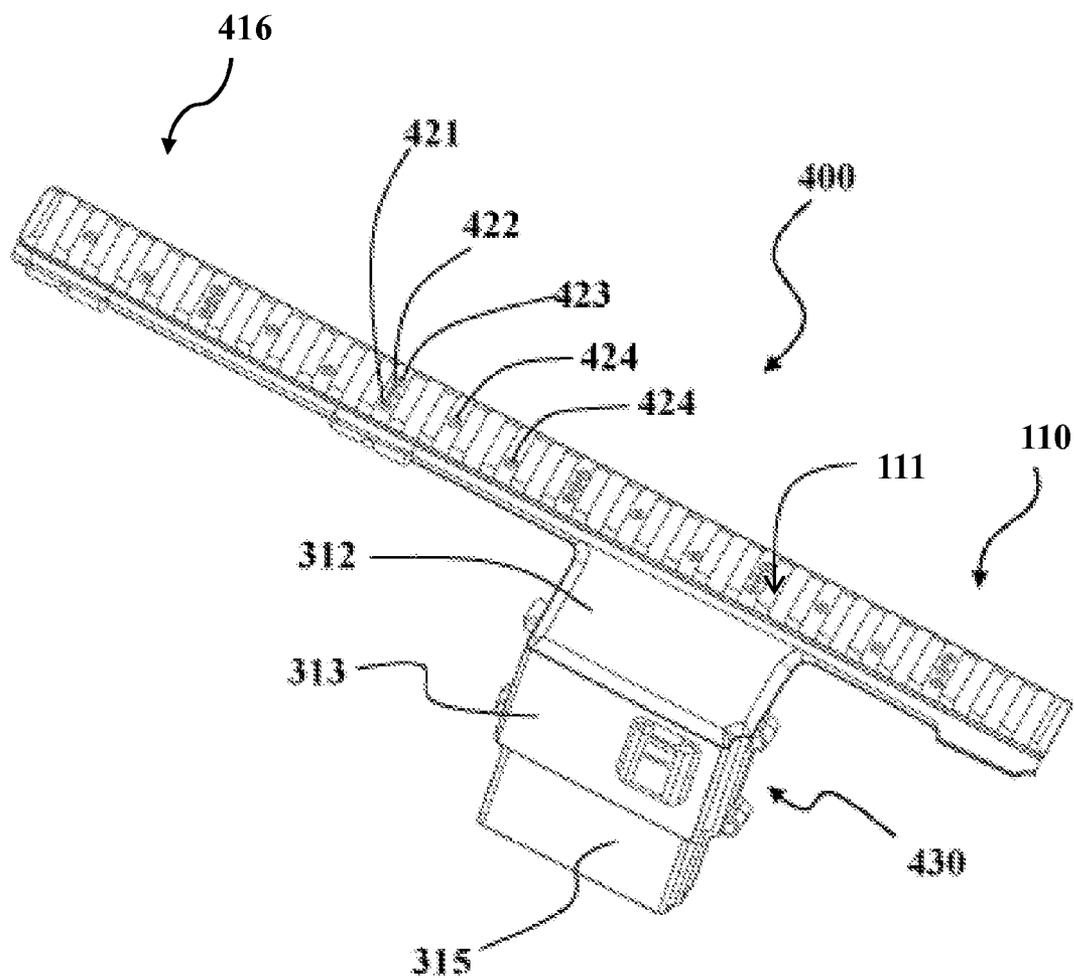


FIG. 4

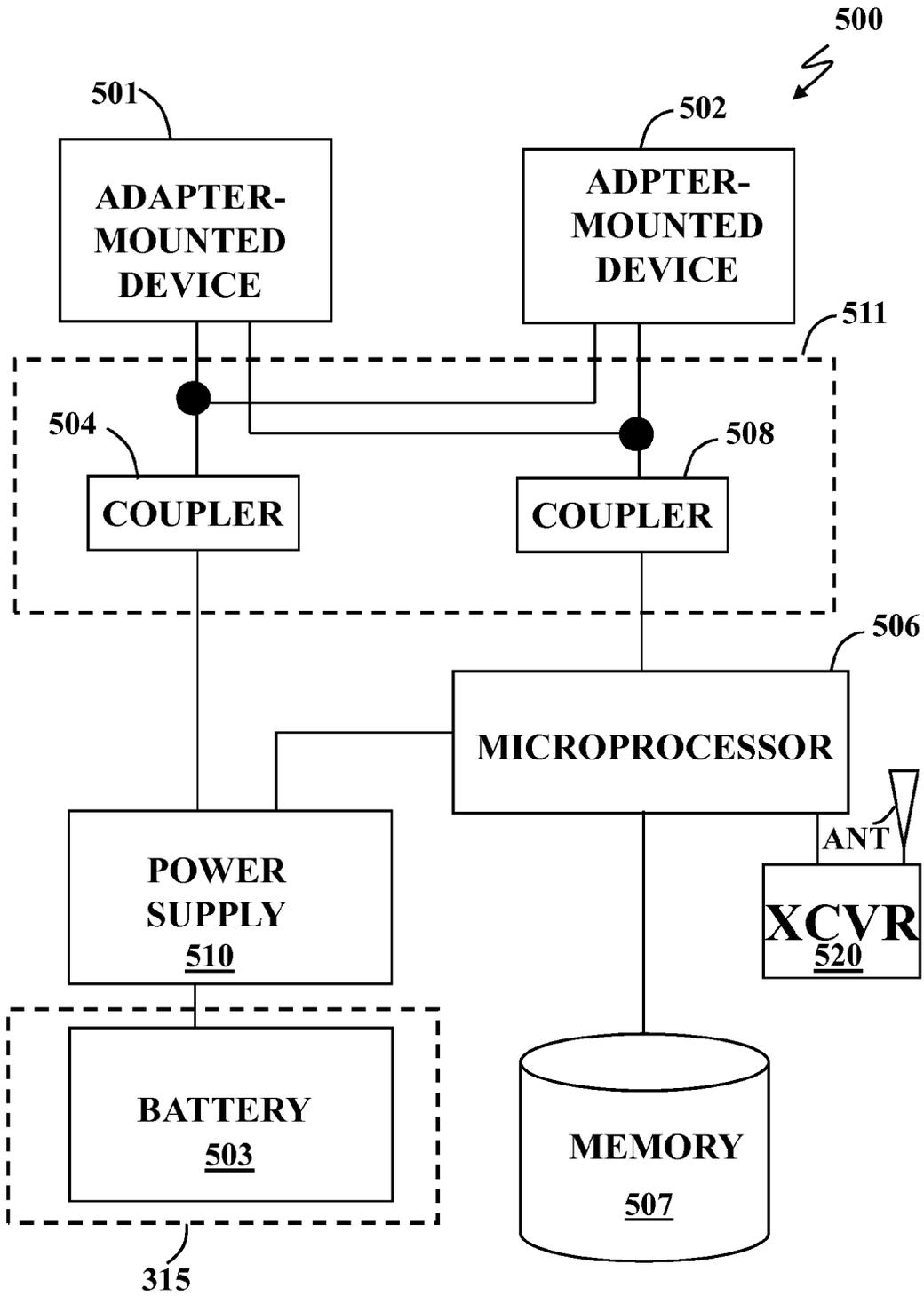


FIG. 5

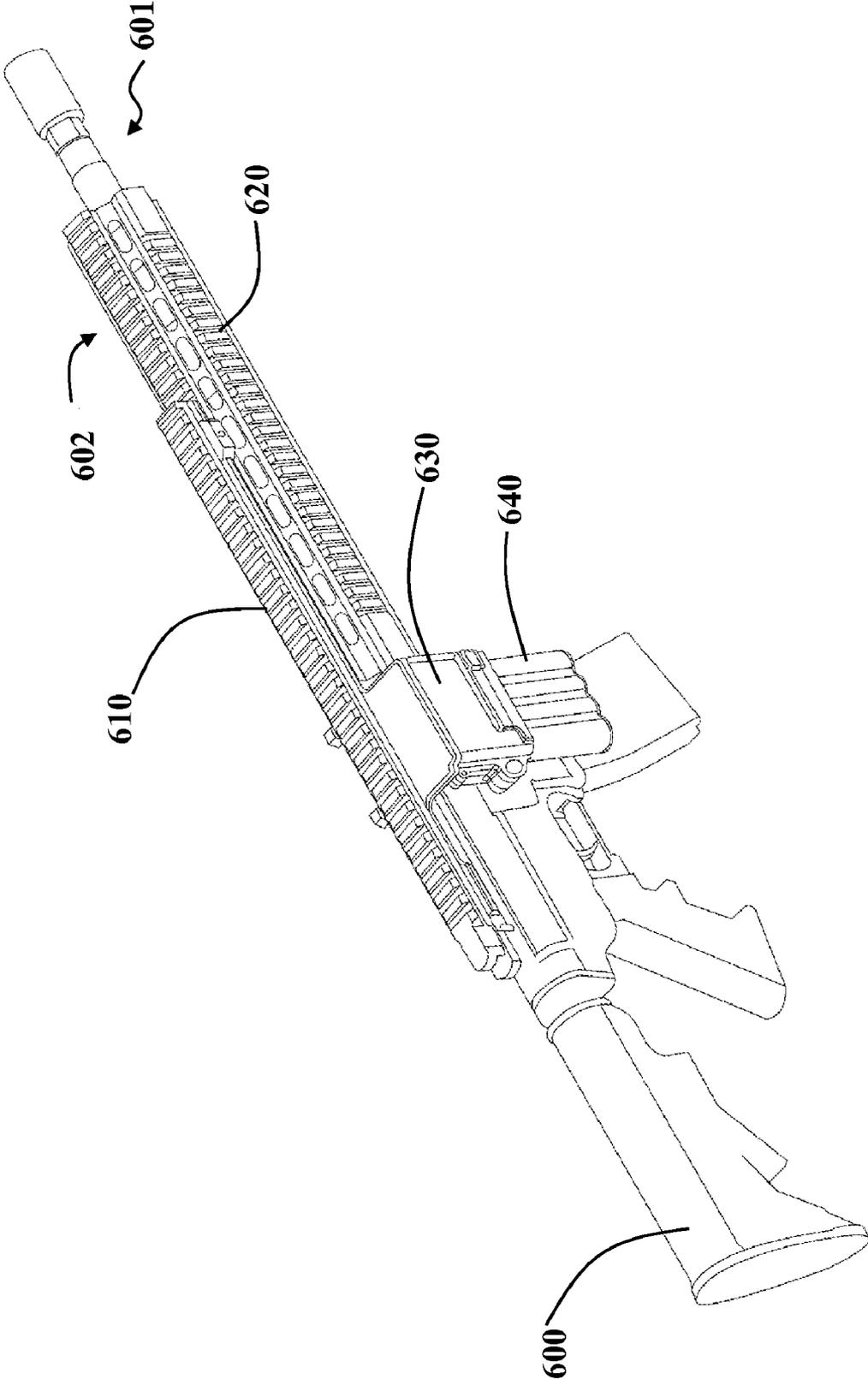


FIG. 6

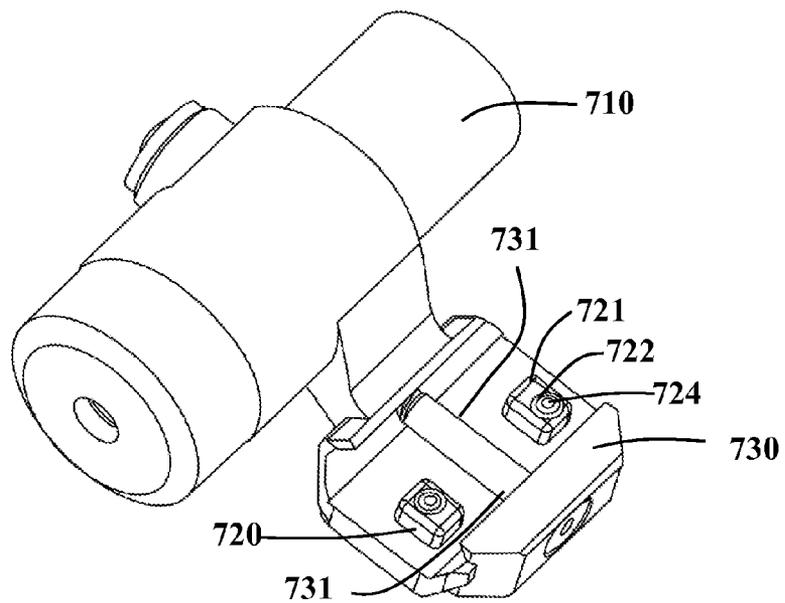


FIG. 7

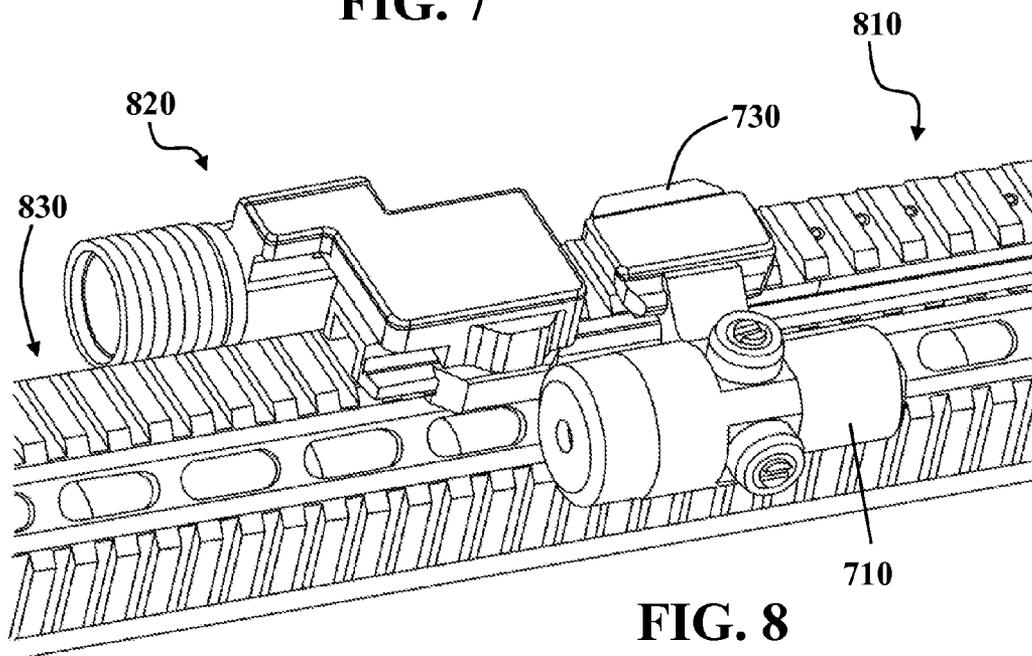


FIG. 8

**COMMUNICATION AND POWER
DISTRIBUTION SYSTEM AND SEGMENTED
RAIL ADAPTER**

**CROSS-REFERENCE TO RELATED
APPLICATION**

[0001] This application is a continuation of International Application No. PCT/US2010/061936, filed Dec. 22, 2010, and claims priority to and the benefit of U.S. Provisional Patent application Ser. No. 61/289,950, filed Dec. 23, 2009, all of which are hereby incorporated herein by reference in their entirety for all purposes.

TECHNICAL FIELD

[0002] Embodiments include detachably attachable systems and detachably attachable support structures for the attachment of devices and subsystems, and more particularly to rail adaptors, detachably attached to firearm rails, the rail adaptors having circuitry for running power and/or communication lines to devices that may be detachably attached to the rail via the rail adapter.

BACKGROUND

[0003] U.S. Pat. No. 6,792,711 to Battaglia discloses a first mount disposed about a firearm barrel, second mount disposed a distance from the first mount and disposed about the firearm barrel, and an adapter rail attached to the first and second mounts. U.S. Pat. No. 6,237,271 to Kaminski discloses handgun circuitry for trigger actuation enablement. U.S. Pat. No. 7,627,975 to Hines discloses an electrified handguard. FIG. 1A is a prior art illustration depicting an adapter-mounted device having a spring-loaded pin engaging a contact pad of the adapter. A device 10 may be disposed on a firearm rail adapter 20 having an electrical contact pad 21 and the contact pad 21 may be connected to a power source. The circuit 11 of the device 10 may be powered via a spring-load pin 12.

DISCLOSURE

[0004] The invention, in its several embodiments, includes a firearm rail adapter assembly forming, or otherwise providing, a circuit for distribution of electricity, communication, data, and or any combination thereof, to devices that may be detachably attached to the rail adapter. Rail adapter embodiments may include powered rail accessory adapters that may allow embodiments to eliminate external wiring and provide centralized external power. The rail adapter system may be configured to allow both internal and external power to be used in parallel thereby allowing for rail adapter battery cartridge removal while maintaining operation and as a backup to external power.

[0005] Embodiments of the firearm rail adapter may be attached to a hand-held weapon, such as the forend or section of the barrel portion of a rifle, and may be attached to devices such as nail guns. The outer portions of the exemplary rail assembly may provide for the detachable attachment of devices such as night-vision scopes, on or off bore sight directional light or laser emission sources, and Global Positioning System (GPS) antennas/receivers. The structural configuration of the exemplary rail adapter assembly may be augmented by a centralized power source and distribution system, or power supply, where by the use of one or more power lines and one or more connectors, the exemplary rail

adapter assembly may be configured to power the detachably attached devices. In some embodiments, the centralized power source may draw from a battery store packaged in a housing shaped to conform to a magazine clip. In some embodiments the rail adapter may be utilized as a conduit for vehicle or other external power sources through battery cartridges that may be substituted for the battery cartridge, or through the use of adapter blocks on the rail accessory without the presence of a battery receptacle.

[0006] In some embodiments, the segmented rail adapter may be configured to include a structural receiver to both mechanically and electrically engage the housed battery store. In some embodiments, the structural architecture may be augmented by data links between the detachably attached devices and a data processing module/circuit, and may be augmented by a user interface to the data processing module/circuit.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] Embodiments are illustrated by way of example and not limitation in the figures of the accompanying drawings, and in which:

[0008] FIG. 1A is a prior art illustration depicting an adapter-mounted device having a spring-loaded pin engaging a contact pad of the adapter;

[0009] FIG. 1B illustrates in perspective view a top (distal) portion of an exemplary rail adapter assembly;

[0010] FIG. 2A illustrates in an exploded perspective view a top (distal) portion, a bottom (proximate) portion, mounting brackets, and fasteners of an exemplary rail assembly;

[0011] FIG. 2B illustrates in a cross-sectional view an exemplary adapter engaging a rail via a bolt-mounted clip;

[0012] FIG. 3 illustrates in an exploded perspective view a top (distal) portion, a bottom (proximate) portion, a battery store housing receiver assembly interposed between the top portion and the bottom portion, mounting brackets, and fasteners of an exemplary rail adapter assembly;

[0013] FIG. 4 illustrates in perspective view a top (distal) portion of an exemplary rail adapter assembly further comprising a rail extension;

[0014] FIG. 5 is an exemplary functional block diagram of a power and data communication system supported by rail assembly embodiments of the present invention;

[0015] FIG. 6 depicts rail adapter embodiments detachably attached to a firearm;

[0016] FIG. 7 depicts an exemplary accessory housing, e.g., a laser emitter element housing, configured to detachably attach to an embodiment of a rail adapter; and

[0017] FIG. 8 depicts the exemplary laser emitter element of FIG. 7 detachably attached to a portion of an embodiment of a rail adapter.

BEST MODES

[0018] Embodiments may include: (a) a rail adapter accessory; (b) an adapter lug or flange-receiver housing; (c) a rail assembly comprising one or more accessory rails; and (d) circuitry internal to the rail assembly, e.g., via a printed circuit board. Some embodiments may include one or more inter-rail couplers. Some embodiments may include an integrated computing module. Some embodiments may include a housing for interchangeable batteries where the housing may be configured to be engaged by an interchangeable battery cartridge. Some embodiments may further include electrical and bi-

directional signal block adapters. Some embodiments may include an angle light adapter for firearm lighting devices.

[0019] Embodiments may include a firearm rail adapter having electrical and/or data coupling via one or more contact surfaces between one or more adapter-mounted devices and the firearm rail adapter. Accordingly, from a battery store and circuitry, e.g., via printed circuit board, of the firearm rail adapter, embodiments may provide power to one or more adapter-mounted devices. In addition, or in the alternative, circuitry, such as a programmed microprocessor and a conditioned power source, provide for the transmission of data and/or signals between one or more adapter-mounted devices and the rail adapter or other rail-mounted device. Accordingly, firearm rail adapter embodiments may include a power supply configured to output power at two or more voltage levels. In addition, the power source for the power supply may be based on a detachably attached battery store.

[0020] Embodiments of the firearm rail adapter, or rail-mounted device, include fixed contact pins/pads mounted to a printed circuit board (PCB) embedded in the rail adapter to provide for the transmission of power, and/or data signals, between the adapter-mounted device and the exemplary rail-mounted device. The contact pads in the rail adapter may be surrounded by, or otherwise embedded in, a sleeve such as a rubber or plastic sleeve. Accordingly, the sleeve may function as both an electrical insulator and a water seal. The pads may be located within recoil grooves, in part to reduce the possibility of a short circuit. The flush mounting of the pads may reduce the possibility of connector contamination and provide for ease of cleaning.

[0021] The power and/or signal paths may be conducted via an embedded printed circuit board (PCB), e.g., rigid PCB, and/or a flexible circuit medium, or a combination thereof, that may provide a secure, permanent attachment point for the contact pads of the firearm rail adapter.

[0022] Differing voltages may be supplied at specific pads by adding circuitry on the PCB. In embodiments where limited planar space (surface space per layer) is available for firearm applications, the PCB may be manufactured in multiple layers, thereby adding additional surface area for conductors. Accordingly, embodiments of the present invention may add power, and/or data signal pathways, as required according to the PCB assembly or flex-circuit assembly.

[0023] An exemplary rail adapter accessory embodiment of the present invention may comprise a “riser,” or rail elevation member, that may be selected from a variety of heights to position the exemplary base rail over the firearm rail. The riser may be defined as a rail clamping mechanism for M-1913 Picatinny, NATO STANAG, Weaver or other type of commonly utilized weapon accessory, where a riser may have a female attachment on the lower surface and another parallel to the lower female element on its upper surface, and also adaptable for less-than-lethal or other defensive applications or via specially configured mounting rails to power tools, survey equipment, or other currently battery-powered devices.

[0024] FIG. 1B illustrates in perspective view a top (distal relative to a mounting structure) member **110** of an exemplary firearm rail adapter assembly, where a top surface **111** of the top member **110** is configured to engage detachably attachable devices. A plurality of electrical contact surfaces **112** are each depicted in a recoil groove **114** of the adapter **110**, i.e., a lateral trough defined by the raised transverse lateral portions, termed “lands” **115**. Each plurality of electrical contact sur-

faces may be seated in an insulating ring **113**. The adapter **110** may be mounted to the top, side or bottom rail of a firearm, or may engage a handle having a rail feature configured to receive a portion of the adapter **110**.

[0025] FIG. 2A illustrates in an exploded perspective view a top (distal) structure **210**, a bottom (proximate) structure **220** that may provide for electrical and/or data bussing—e.g., a printed circuit board (PCB) **220**, mounting brackets **214**, and fasteners **215** of an exemplary rail assembly. The exemplary PCB **220** is depicted as having two conducting lines **221,222** where a pin portion of a contact pad **112**, may contact one or more of the lines. Where two proximate contact pads **112** each engaging a different conducting line, a detachably attached device having contact pins may contact proximate contact pads via device-mounted, e.g., spring loaded, contact pins, and a circuit may be setup with a firearm power supply or battery source (not shown).

[0026] FIG. 2B illustrates in a cross-sectional view an exemplary adapter **110** engaging a rail **230** via a bolt-mounted clip **214**. The fastener **215** is depicted as engaging the clip **214** and passes through an aperture **231** of the rail to engage an opposing portion of the adapter **110**. Also shown by example in the cross-sectional view of FIG. 2B is a contact pad **112** extending through the adapter **110** to engage a conducting line, i.e., a conducting lineal surface, of the exemplary printed circuit board (PCB) **220**.

[0027] FIG. 3 illustrates in an exploded perspective view a top (distal) portion **310**, a bottom (proximate) portion **316**, e.g., a structure comprising a printed circuit board (PCB), a first battery store housing receiver assembly comprising a flange **312** extending from the top portion **310**, first side portion **313**, a second side portion **314**, mounting brackets, and fasteners of an exemplary rail adapter assembly. Accordingly, the rail adapter assembly **300** of FIG. 3 is depicted as including an extending portion or flange **312** of the top structure to which a first magazine clip housing **313** may be attached, and lands and grooves are depicted along the top region **311** of the top portion **310**. A second magazine clip housing structure **314** may be attached to the top structure **310** and the first magazine clip housing structure **313**. Also shown is a magazine clip shaped housing **315**, i.e., a housing configured as an ammunition magazine, that may comprise battery elements and/or computing elements such as a microprocessor and addressable memory. In some embodiments, the flange **312** may extend further along the longitudinal direction to accommodate a second battery store housing, or a larger first battery store housing, or other module housings such as memory store and/or combinations of battery store, memory store and/or microprocessor and circuitry.

[0028] FIG. 4 illustrates in a perspective view a top (distal) portion of an exemplary firearm rail adapter assembly **400** where the rail adapter assembly **400** comprises both data contact points **421-423** and power contact pads **424**. Also depicted in FIG. 4 is a battery store in an ammunition magazine-shaped housing **315** engaging the receiver housing **430**.

[0029] FIG. 5 is an exemplary functional block diagram of a power and data communication system embodiment **500** supported by rail assembly embodiments of the present invention. In this exemplary system **500**, a first adapter-mounted device **501** and a second adapter-mounted device **502** may be coupled to a common power supply **510** and/or energy store **503**, e.g., a battery array, via a power coupler **504**. Also in this exemplary system **500**, the first adapter-mounted device **501** and the second adapter-mounted device

502 may be coupled to a common microprocessor **506** and memory store **507**, e.g., a flash drive, via a data coupler **508**. In some embodiments, the data coupler **508** and the power coupler **504** may be combined into a single element for coupling. A printed circuit board (PCB) **511** may be employed to accommodate the power coupling and or the data communication coupling. The microprocessor **506** and/or power supply **510** may be integrated with the PCB, configured as part of the rail adapter, or be modularized within a battery store housing. The battery **503** and/or the memory store may be disposed within a battery store housing **315**. A radio frequency (RF) transceiver **520** may be coupled to at least one of: a power coupler **504**; a data coupler **508**, a microprocessor **506**; and an adapter mounted device **501**, **502**.

[0030] An exemplary rail accessory housing may be made of aluminum, e.g., 6061-T651 or 7075-T651. An exemplary rail accessory clamp may be made of aluminum, e.g., 6061-T651 or 7075-T651. Each exemplary contact pad may be made of fine, extruded graphite, e.g., less than 0.002 inch grain size, or equivalent, that may be used to provide a relatively inert exposed electrode (anode). In addition a contact pad may be comprised of a nickel-plated, beryllium-copper core where the contact pad may have an outer gold-plating over the nickel-plating.

[0031] Optionally, the contact pad may have an outer plating of rhodium. Each exemplary contact pad insulator may be made of plastic, e.g., polyetheretherketone (PEEK). The PCB may be FR370HR or equivalent, and the PCB/electronics encapsulation may be accomplished using 3M DP270.

[0032] FIG. 6 depicts a top adapter rail embodiment **610**, and a side rail of an extant quad-rail **620** of the firearm **600** upon which an adapter rail embodiment **110** (FIGS. 1A and 2A) maybe detachably attached. FIG. 6 also depicts a battery clip **640** engaging the flange/lug **630** or the top adapter rail **610**. A side rail adapter **620**, such as the rail adapter embodiments depicted in FIGS. 1B and 2A, is shown as detachably attached to a side rail along a portion of the muzzle **601**. A top rail adapter **610**, such as the rail adapter embodiments depicted in FIGS. 3 and 4 is shown as detachably attached to the extant rail **602** of the firearm **600**. The side adapter **620** rail may be configured, via flexible circuitry, or hard-wired connectors, to draw power from the battery of the top adapter rail **610**.

[0033] FIG. 7 depicts, in a perspective bottom view, an exemplary accessory housing **710**, e.g., a laser emitter element housing, configured to detachably attach to an embodiment of a rail adapter. In this exemplary bottom view, two locating bosses **720**, **721** are depicted for engaging grooves of the adapter rail. Each locating boss **720**, **721** is depicted as having a pin seal **722** disposed about a spring pin contact **724**. The adapter clamp **730** is configured to receive a clamp screw **731** that allows for the detachable attachment of the clamp **730** and, with it, the detachable attachment of the accessory housing **710** to an adapter rail.

[0034] FIG. 8 depicts the exemplary accessory housing element of FIG. 7 detachably attached to a portion of an embodiment of a top rail adapter **810**. Other accessories, such as a light **820**, may be detachably attached to the extant firearm rail **830**, as shown in FIG. 8, or it may be detachably attached to the adapter rail. If configured similarly as the accessory housing of FIG. 7, the light attached may be powered by the power supply of the top adapter rail.

[0035] Circuits may be nominal off, to minimize electrolytic effects of saltwater on the contact pads. The circuit may

be activated by manual override, and may be automatically activated by a pressure switch, e.g., from the spring contact pin, or a magnetic field sensor, or a Hall effect sensor, beneath the land of one or more recoil stops of the adapter embodiment.

[0036] The communications capability of the rail adapter, with and/or without a weapon-mounted computer, allows for remote switching between identified devices, e.g., a reed switch mounted to a vertical grip beneath the forearm and plugged into a rail accessory block adapter may, via communication with the onboard computer or selectable analog circuits, switch on and off one or more devices selectively—devices that may also recognize, or may also be connected, to the rail accessory system. Similarly, conductors may be predetermined to contain various switching devices and the devices they control may be accessed through analog circuitry incorporated into the block adapters. Block adapters may also incorporate electronic components for selectable voltage output, e.g.: a higher voltage battery cartridge may be stepped down to accommodate 3, 6, or 9 volts DC by drawing from, for example, a 12 volt battery.

[0037] The rail accessory may feature an adapter lug or flange, that may include a receiver housing, for the attachment of the interchangeable battery receptacle housing, of a designated height and length, e.g., an ammunition magazine, to any and all of the following: the existing receiver, rail equipped forends or to attach to the receiver, forend and barrel weapon accessory adapters; with facilities for any of the following electrical or bi-directional signal connections; front and rear of the rail accessory sections, on the sides of the rail accessory sections, in the grooves of the rail adapter system, or interlocking and through an inter-rail accessory, to other power/bi-directional signal distribution weapon system accessory rails located on any other part of the support structure to which the rail assembly may be attached.

[0038] The rail accessory comprises one or more pads for electrical or bi-directional signal conductors that may be located within the rail accessory groove areas (or alternatively on the lands) for protection against damage and electrical shorting through contact with conductive media or material. Positive and negative conductor pads separated by a land area or region, may include one or more pads for electrical or bi-directional signal conductors per location. The pads may be sealed from environmental contact by detachable covers and/or may incorporate sealing o-ring grooves, insulators or gaskets to facilitate both electrical connection and environmental sealing. Embodiments may also include a separation of conductors to assure operation while submerged either with or without protective covers in fresh or salt water.

[0039] Additional applications include the location of the electrical and bi-directional connectors in a rail insulating cover which may be comprised of metal, plastic, laminate, machined or molded material that may be produced by Troy™, Tango Down™, and Fobus™, for installation on top, sides or bottom rails of the weapon, and used for connector based adaptation of accessories to the firearm. In an exemplary embodiment, the battery cartridge may be integrated into an M-1913 Picatinny Rail based magazine holder as may be produced by Mako™ or CAA™, for example, and may be constructed of metal, plastic, laminate, machined or molded material. While the PCB may be later-assembled with the structural support members of the rail adapter, an embodiment may comprise embedded circuitry and communications

lines in the molded or machined body of the weapon, without accessory conductors, in order to fully integrate the embodiment, e.g., the exemplary manufacturing process may include the introduction of wiring into the injection molding tools prior to fabrication of a polymer receiver or butt stock.

[0040] In addition, the rail accessory adapter may be constructed without battery capability or communications capability, and in conjunction with a redesigned battery compartment, may form a spare magazine holder for the weapon that may be adapted to top or side rail use. In such an exemplary embodiment, the rail accessory, adapter lug (flange) and battery housing form may be modified to accept the standard magazine for rapid reloading.

[0041] A mounting application using a smaller diameter weapon forearm section also may be configured to enable the basic rail accessory and additional accessory rails to be mounted, thereby allowing the standard Picatinny Rail equipped M-4 A-3 "Flat Top" profile to be maintained when accessory rails are installed. The dimensions of the top and side rails may then be installed similarly within the same profile as the upper in order to accommodate the M-203 grenade launcher or other accessories without modification. This smaller dimension forend may be designed with or without M-1913 Picatinny rails on its outer surfaces, as its purpose is to adapt the basic rail adapter and additional accessory rails and not to directly mount to the weapon accessories. Accordingly, the standard, non-railed forend of the M-16 or any foreign weapon may be adapted by the addition of simple adapter blocks for the basic rail adapter and additional accessory rails.

[0042] Exemplary electronics and/or electrical and bi-directional signal circuits, as covered under MIL-STD-1553/1553B, 1773B, or commercial standards, e.g., USB, PCI, VME-16/32/64,

[0043] VME/IEEE P1014-1987, may be designed as an internal harness contained within the rail accessories or rail covers, or as a printed circuit board, or flexible circuit, assembly that may incorporate all of the necessary electronic and/or electrical connections, required components and conductors. Whether outside of the firearm rail structure, or in addition to being internally disposed, the exemplary circuitry may be environmentally sealed from moisture and thermal effects (e.g., via potting compound, and/or gasketed covers).

[0044] Connections for external power or bi-directional signal for firearm accessories may be located at any location on the adapter, e.g.: front, top, sides, or between adapters. Adapters may be configured to accommodate conversions of existing firearm accessories through modified battery doors, battery compartment access, through the accessory mounting base of the item in the method of adaptation described above or by other means. Examples of the accessories that these exemplary adapters apply to are: bore-sighted targeting and designation lasers, electronic firearms sights, image intensifiers, thermal imaging night vision devices, and firearm lighting products, among others. Modified rail covers or additional rail accessories may also be connected by block adapters using specially designed cabling.

[0045] The block adapters may incorporate a provision for inline switching using reed, button, pad or other contactors used either to close or open the circuit to a weapon mounted accessory. Additional conductors used for bi-directional signal may or may not be configured to indicate remote switching locations around the weapon, that may themselves be rail accessories. In one example, a vertical handgrip by CAA™,

Tango Down™, or Troy™, for example, may be wired as a power and signal block adapter and equipped with one or more switches on user interface control surfaces. Through electronic or electrical circuitry, the grip unit may send commands to close or interrupt circuits located at specific remote positions on the rail adapter, such as lasers or lighting products through their block adapters.

[0046] Weapon accessories may also be adapted to the rail adapter, additional accessory rails or rail cover adapters via battery door replacement and the provision of dummy cells with a direct conductor providing power transfer, and enabling the retention of internal power capability through replacement of the adapter by the original battery door and batteries. Modified accessories may also be constructed by the removal of the battery compartment and replacement with an external power connection of detachable or permanent connector design, or through modification of the weapon accessory mounting system to accommodate the pattern of connection used by the above-referenced electrical and bi-directional signal adapter blocks and internal wiring modifications.

[0047] Weapon-mounted computer integration

[0048] Exemplary embodiments of the electrical and bi-directional signal communications system incorporate the provision of a weapon-mounted, personal computer that may be integrated within the butt stock of the weapon, for example, within rail cover accessories, or affixed within its own structure to the basic rail accessory or supplemental accessory rails. This exemplary device embodiment allows the use of multi-purpose accessories to perform more than one function through software monitoring and control of their input and output. For example, a laser generator equipped with infrared (IR) and visible lasers and a detector capable of sensing them mounted separately may perform the following functions selectively or automatically, such as: laser designator; infrared/visible weapon aimer; threat laser illumination warning; laser range finder; laser firing indication; and non-lethal laser dazzling weapon.

[0049] Weapon-mounted computer accessories include but are not limited to: GPS devices; visible/invisible laser beam generators; digital compasses; non-magnetic azimuth detectors; angle-rate sensors; accelerometers; laser detectors; photocells; temperature and barometric pressure sensors; wind speed indicators; visible/invisible lighting products; electronic display systems; weapon sights for compensating reticles; image intensifiers; thermal imaging sights; sensor fusion devices; video cameras; digital still cameras; multi-spectral imagers from visible to 14 um; additional lethal or non-lethal weapons mounted to the standard weapon and aiming interfaces for the same; communications devices; and encryption devices for coded communication and target designation.

[0050] An exemplary computing module and/or circuit may be housed in a shock and vibration resistant environmental enclosure with provisions for electric power supplies and external communications with the above-referenced weapon accessories via the basic rail accessory, additional accessory rails, and rail covers. Exemplary mounting locations for a computing device and/or power supply include the butt stock, forearm or battery lug, i.e., the flange portion attachment area, or other areas in proximity to rail accessory components.

[0051] An interchangeable battery housing, may be configured to detachably attach to the adapter lug, i.e., the flange, extending from the rail accessory, that enables a battery car-

tridge to be retained. The cartridge of a magazine-shaped housing may be field reconfigurable for a variety of battery shapes, and may be adaptable in termination to accommodate a variety of conductors and battery dimensions.

[0052] An interchangeable battery cartridge, either rechargeable or for use with single use batteries, with a weapon battery adapter mounting means to lock and weather-proof and/or water-proof the power system, either equipped with individual cell or unitary batteries, of any designated configuration (e.g., square, round, or in the shape of a firearm magazine)—for example, in a form which corresponds to the shape of the receptacle for the battery cartridge mounted on the power distribution weapon accessory system adapter lug.

[0053] The battery cartridge may be configured to accept a variety of currently available types of cells, monolithic batteries and future developments in this area. The battery cartridge may be fastened in a quick detachable mount to the weapon directly and cartridges may or may not be exchanged without momentary loss of power due to a secondary (optional) rechargeable battery which may act as a buffer. The battery system may deliver multiple voltage outputs due to the design of weapon accessory adapter circuitry (e.g.: 3/6/9/12 volt DC). Recharging, if desired, may be accomplished by a substitution of rechargeable batteries, and/or via external sources, e.g., AC/DC, vehicle power, solar panel, hand crank, optional direct power input while battery is installed, external fuel cell with power connected to an adapter lug, and/or via the magazine housing, for example.

[0054] The battery section may be equipped with rechargeable or single use batteries or individual cells of monolithic construction; which may or may not be user replaceable in the field. A power supply may be interposed between the battery store and the distribution circuitry, and thereby provide two more voltage levels that may connect to the battery housing through ordinary, water resistant or water-proof connectors.

[0055] An accessory rail may comprise an attachment for an interchangeable housing battery receptacle housing. The accessory rail joined via an electrical connector to a first rail accessory to form an active electrical and/or bi-directional signal carrying circuit between the two rail accessories (or two rail adapters). The exemplary electrical connectors may be comprised of metal, plastic or other materials forming an interconnection between the two accessory rails. These accessories may be comprised of metal or plastic and may further comprise plastic or metal insulation covers without rail sections that are equipped with conductors, and attached to the primary basic rail assembly or separate battery holders by electrical and signal connectors. The additional accessory rails may be connected via electrical and bi-directional signal block adapters, or other means of connection, such as jumper cables.

Inter-Rail Couplers

[0056] Electrical and bi-directional signal connectors between the accessory rails may terminate in spring-loaded arrangements (e.g., Pogo™ pins), or other electrical and bi-directional signal conductors that attach to the accessory rails via a clamping method which ensures recoil and water resistance in operation of the firearm; and conform to the general shape of the firearm forend, and inter-rail spacing. Couplers may also be constructed of traditional electrical and signal cabling, and optionally include armored and shielded construction. Inter-rail coupling may also include two electrical

and bi-directional signal block adapters and appropriate jumper cables or other means of connection.

Angle Adapter for Firearm Lighting

[0057] In addition to reducing the size and weight of firearm accessories and provision of external power/bi-directional signal communication, the invention provides for a variable angle adaptation for light-emitting devices. Accordingly, the angle adapter allows the unit to operate with or without a basic rail adapter; be placed on the sides, top or bottom rails of the firearm depending on the configuration embodiment. The angle adaptor may allow the beam of the light to be directed away from the axis of the bore to provide lighting for other than targets, e.g., for navigation purposes, for the detection of trip wires or booby traps, to enable muzzle-up carry in close quarters, and to provide medical attention or other purposes where pointing a live weapon for illumination is unacceptable.

[0058] An exemplary embodiment may be an angle light adapter detachably attached to the side adapter rail, or an extant side firearm rail, and connected to the extant basic rail, or a top adapter rail, through an adapter block. The light accessory may be modified to accept external power, or to an additional accessory rail on the side of the weapon with an integral adapter block in its mounting. The exemplary angle light accessory may be adjusted to within ranges of angles, and/or may be adjusted to angles of detent, for example, zero degrees, minus 15/30/45 degrees and 135 degrees from the bore sight or 45 degrees with the muzzle-up configuration.

[0059] It is contemplated that various combinations and/or sub-combinations of the specific features, systems, methods, and aspects of the above embodiments may be made and still fall within the scope of the invention. Accordingly, it should be understood that various features and aspects of the disclosed embodiments may be combined with or substituted for one another in order to form varying modes of the disclosed invention. Further it is intended that the scope of the present invention herein disclosed by way of examples should not be limited by the particular disclosed embodiments described above.

What is claimed is:

1. A firearm rail adapter comprising:

a rail adapter assembly configured to detachably attach to a structure, the rail adapter assembly comprising a first member proximate to the structure and a second member distal from the structure, wherein the proximate first member and the distal second member define a conduit configured to conduct electricity via a plurality of contact pads.

2. The firearm rail adapter of claim 1 wherein the conduit is further configured to distribute electrical signals used for communication via one or more contact pads.

3. The firearm rail adapter of claim 1 wherein the conduit and first member comprise a printed circuit board configured to conduct electricity to at least one device detachably attached to the rail adapter.

4. The firearm rail adapter of claim 1 wherein the conduit and first member comprise a printed circuit board configured to transport data signals to at least one device detachably attached to the rail adapter.

5. The firearm rail adapter of claim 1 wherein the conduit and first member comprise a flexible circuit configured to conduct electricity to at least one device detachably attached to the rail adapter.

6. The firearm rail adapter of claim 1 wherein the conduit and first member comprise a flexible circuit configured to transport data signals to at least one device detachably attached to the rail adapter.

7. The firearm rail adapter of claim 1 wherein the rail adapter further comprises a centralized power source and power distribution system configured to power at least one detachably attached device.

8. The firearm rail adapter of claim 7 wherein the centralized power source is configured to draw from a battery store packaged in a housing configured to conform to an ammunition magazine clip.

9. The firearm rail adapter of claim 7 wherein the rail adapter is further configured to comprise a structural receiver to both mechanically and electrically engage a housed battery store.

10. The firearm rail adapter of claim 1 wherein the rail adapter further comprises a data processing module and one or more data links between the at least one detachably attached device and the data processing module.

11. The firearm rail adapter of claim 10 wherein the data processing module is a data processing circuit.

12. A firearm rail adapter comprising:
a rail adapter assembly configured to detachably attach to a structure, the rail adapter assembly comprising a first member proximate to the structure and a second member distal from the structure, wherein the proximate first member and the distal second member define a conduit configured to transport data signals via at least one contact pad.

13. The firearm rail adapter of claim 12 wherein the conduit is further configured to distribute electrical power to at least one device detachably attached to the rail adapter.

14. The firearm rail adapter of claim 12 wherein the conduit and first member comprise a printed circuit board configured to distribute electrical power to at least one device detachably attached to the rail adapter.

15. The firearm rail adapter of claim 12 wherein the conduit and first member comprise a printed circuit board configured to transport data signals to at least one device detachably attached to the rail adapter.

16. The firearm rail adapter of claim 12 wherein the conduit and first member comprise a flexible circuit configured to distribute electrical power to at least one device detachably attached to the rail adapter.

17. The firearm rail adapter of claim 12 wherein the conduit and first member comprise a flexible circuit configured to transport data signals to at least one device detachably attached to the rail adapter.

18. The firearm rail adapter of claim 12 wherein the rail adapter further comprises a centralized power source and power distribution system configured to power at least one detachably attached device.

19. The firearm rail adapter of claim 18 wherein the centralized power source is configured to draw from a battery store packaged in a housing configured to conform to an ammunition magazine clip.

20. The firearm rail adapter of claim 18 wherein the rail adapter is further configured to comprise a structural receiver to both mechanically and electrically engage a housed battery store.

21. The firearm rail adapter of claim 18 wherein the rail adapter further comprises a data processing module and one or more data links between the at least one detachably attached device and the data processing module.

22. The firearm rail adapter of claim 21 wherein the rail adapter further comprises a user interface to the data processing module.

23. The firearm rail adapter of claim 21 wherein the data processing module is a data processing circuit.

24. A firearm rail adapter comprising:
a rail adapter assembly configured to detachably attach to a structure, the rail adapter assembly comprising a first member proximate to the structure and a second member distal from the structure, wherein the proximate first member and the distal second member define a conduit configured to power at least one device detachably attachable to the rail adapter assembly;
wherein conduit power transmission is based on at least one of: (a) a mechanical switch tripped by attachment of the at least one device detachably attachable to the rail adapter; and (b) a detected magnetic field, of the at least one detachably attachable device, by a magnetic sensor embedded in the firearm rail adapter.

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