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(54) **CONTROL MECHANISM SECURABLE TO A FIRING DEVICE AND METHOD**

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F41A 27/28 (2006.01)

(52) **U.S. Cl.**
USPC **89/41.02**

(58) **Field of Classification Search**
USPC 89/41.02, 40.03, 37.16, 37.17; 42/84, 42/90
See application file for complete search history.

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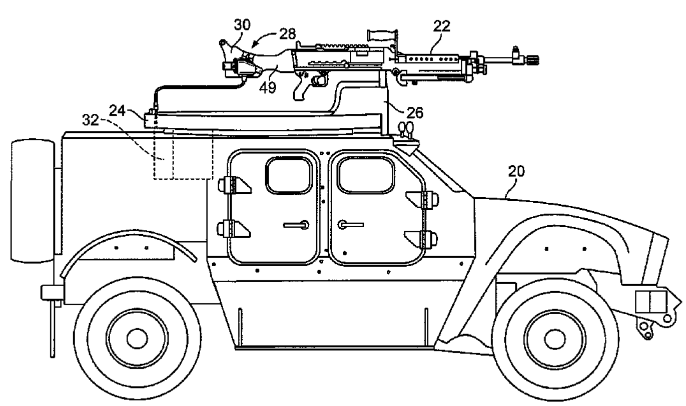
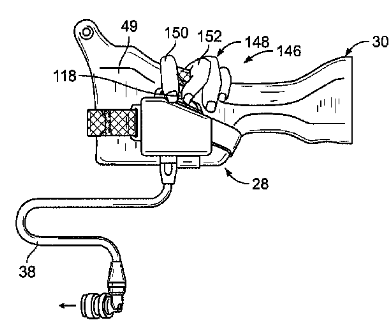
(57) **ABSTRACT**

A control mechanism securable to a firing device is provided. The control mechanism includes an actuation component adapted to generate signals in response to activation of the actuation component. Further, the control mechanism includes an attachment apparatus adapted to support the actuation component adjacent to a stock of the firing device. The attachment apparatus has at least one securing member for securement of the attachment apparatus to the stock of the firing device.

27 Claims, 10 Drawing Sheets





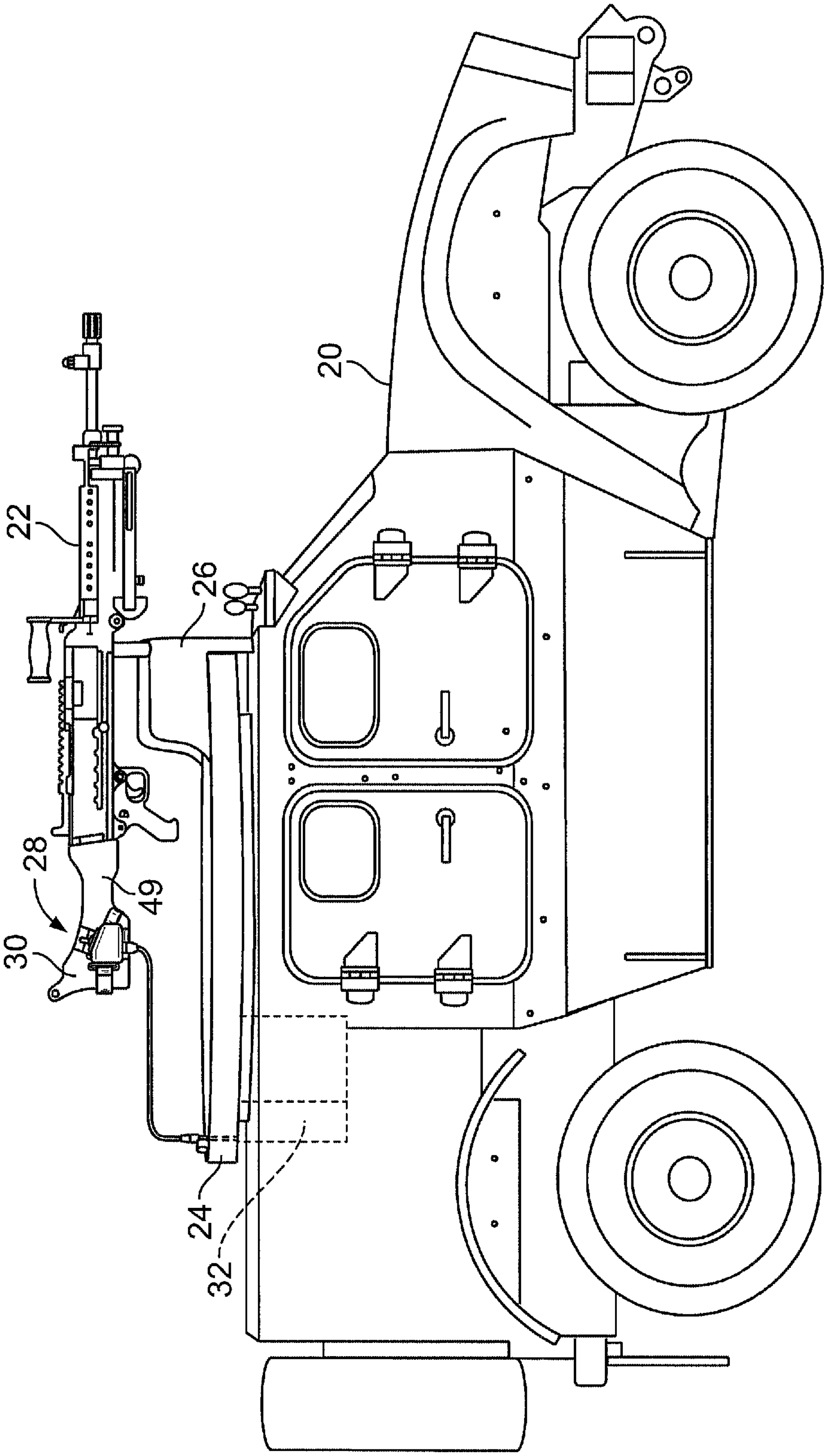


FIG. 1

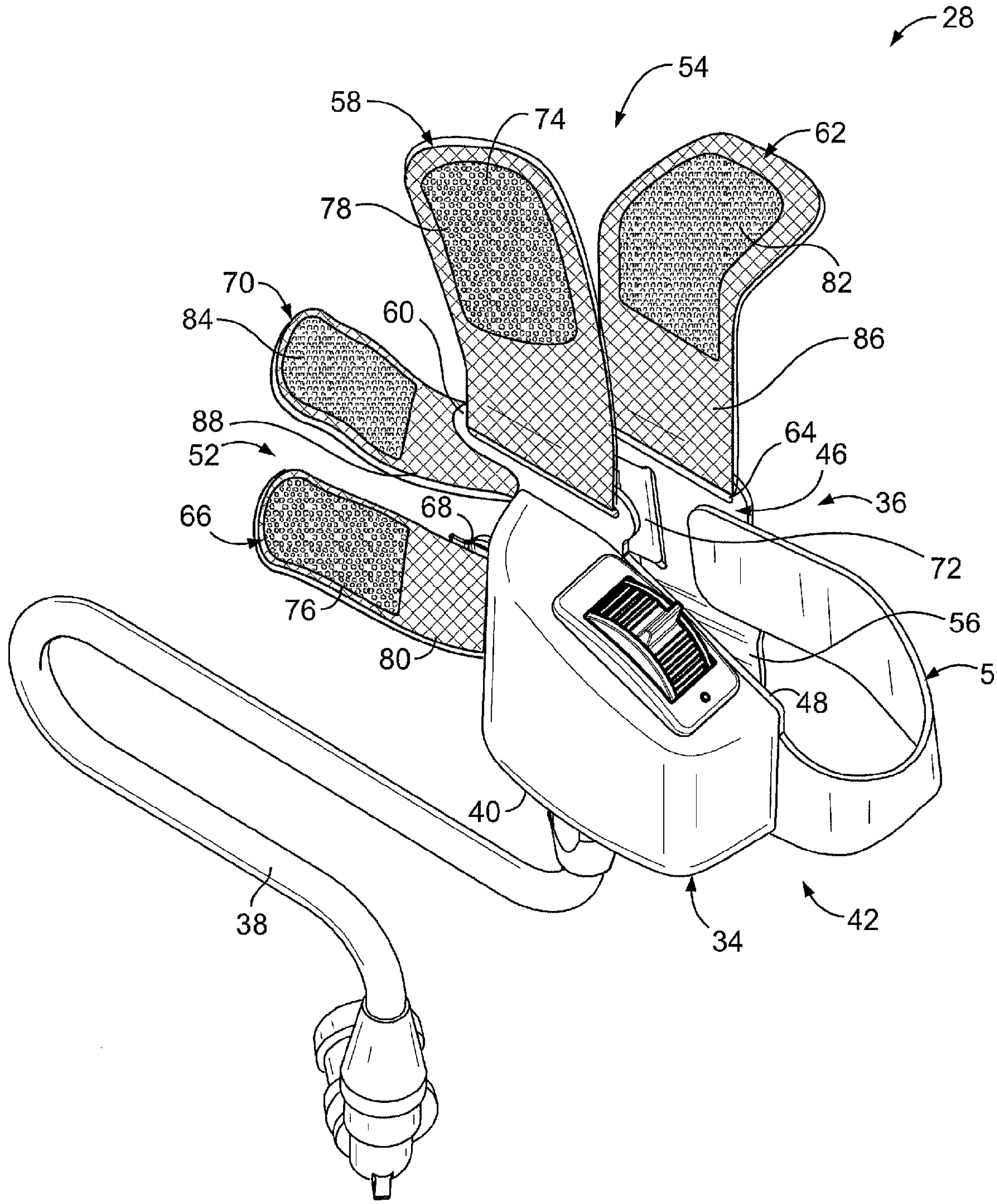

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FIG. 2A

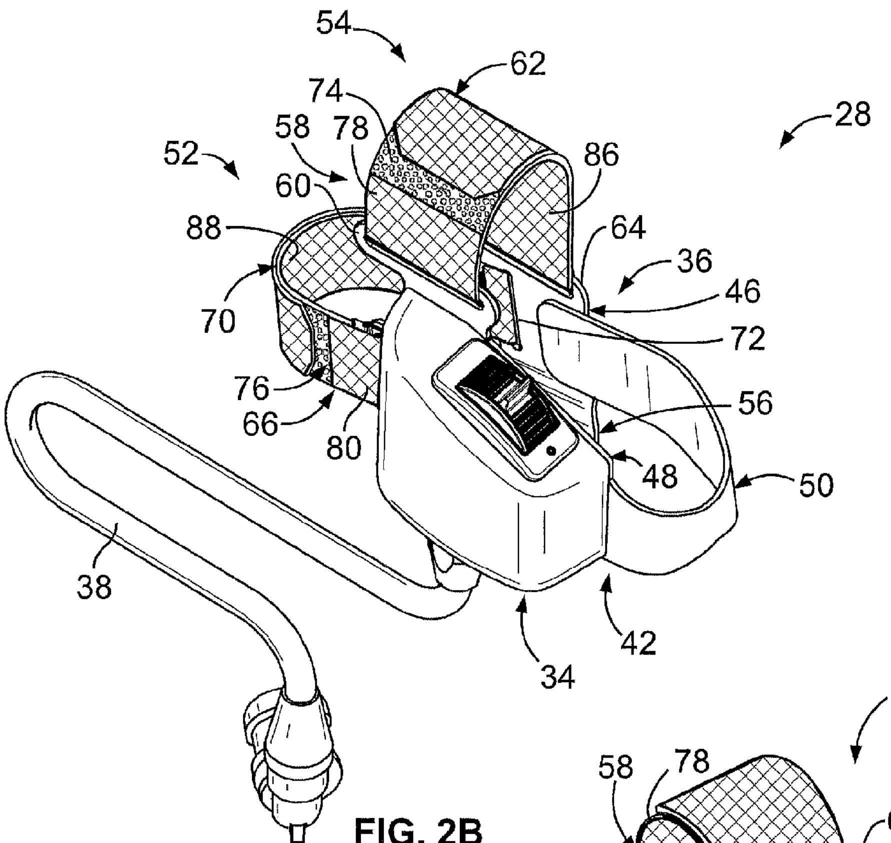
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FIG. 2B

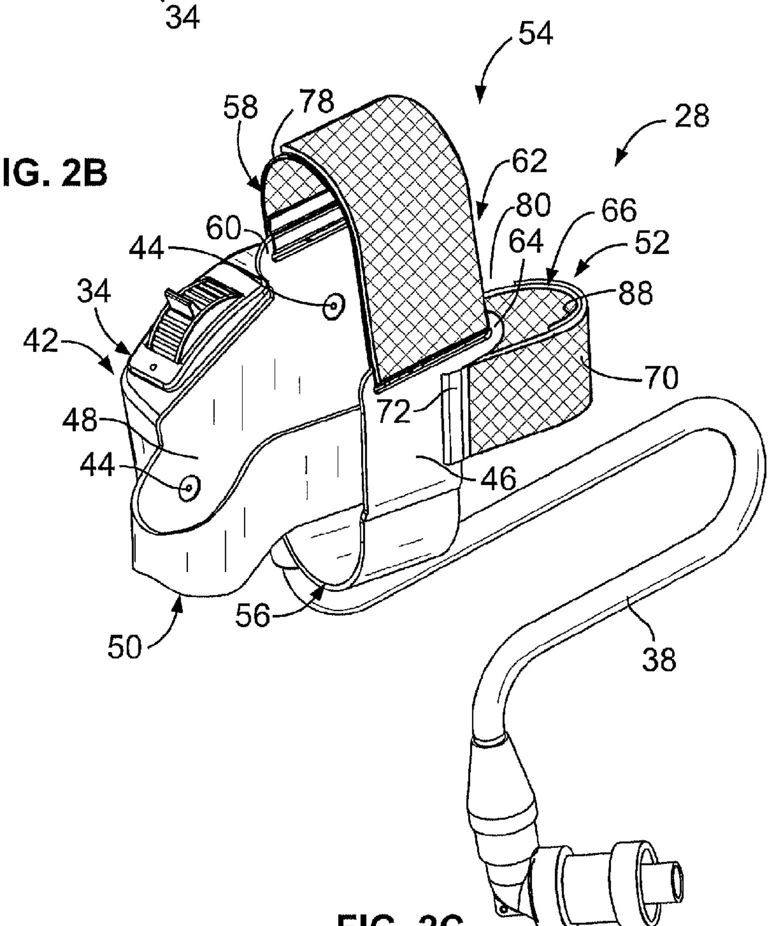
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FIG. 2C

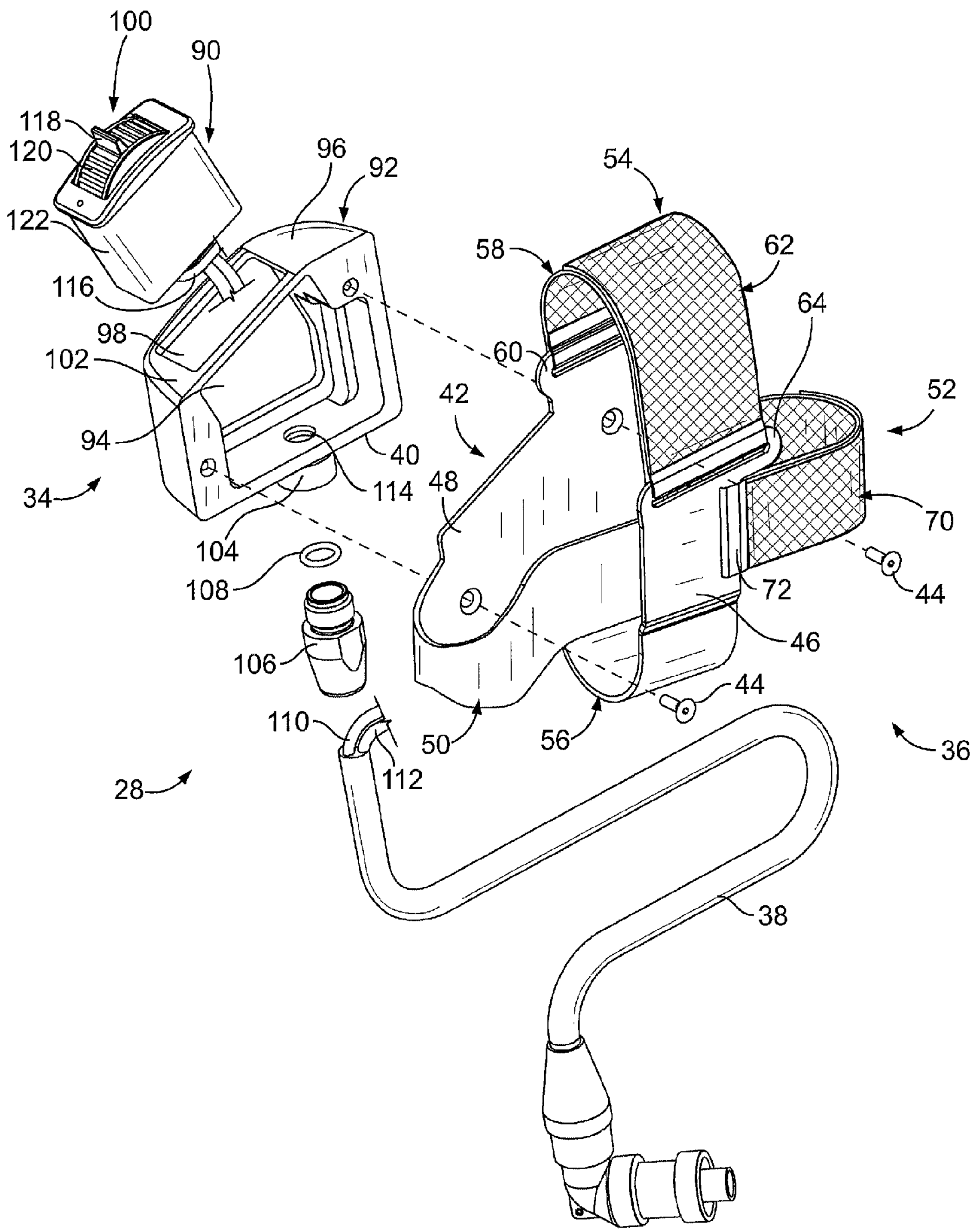
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FIG. 3

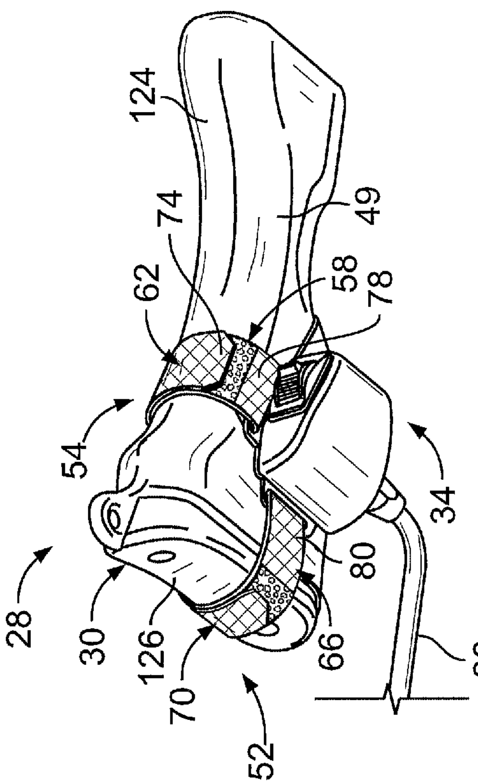

FIG. 5A

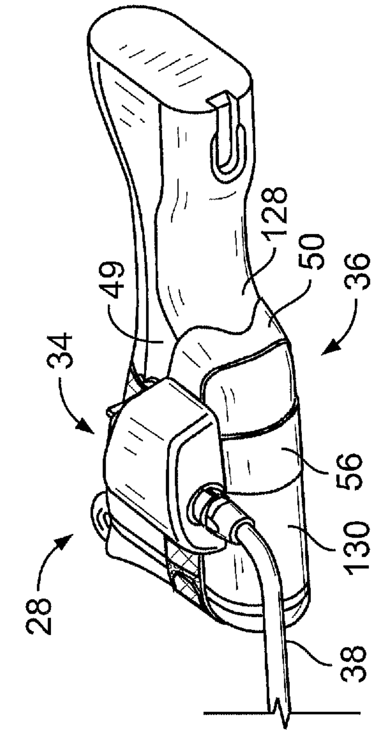

FIG. 5B

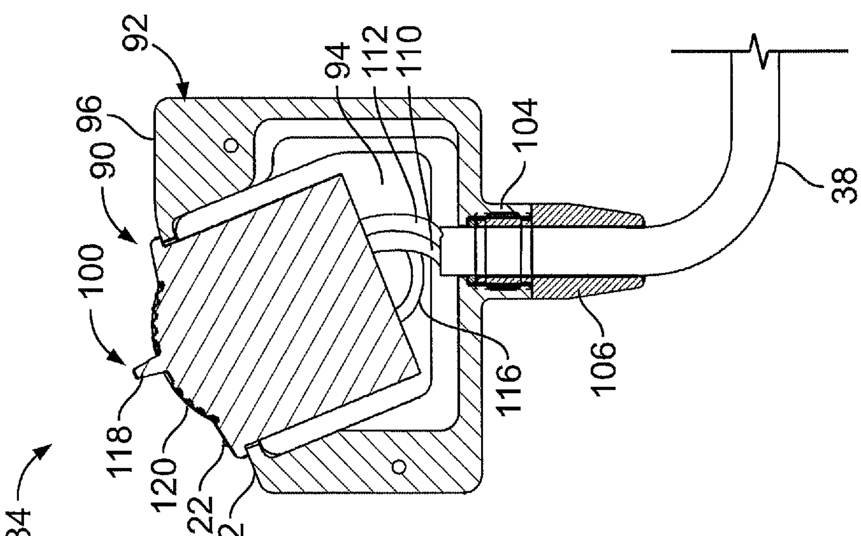

FIG. 4

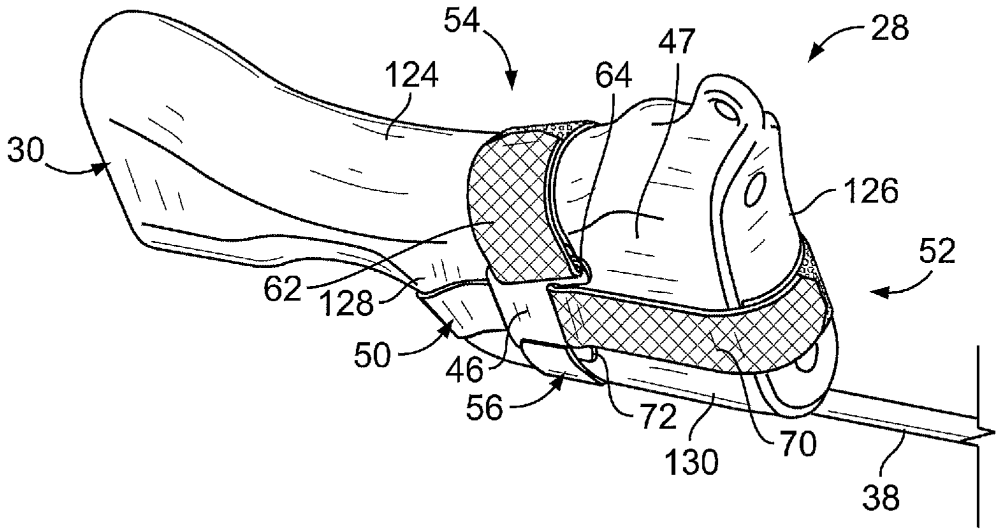
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FIG. 5C

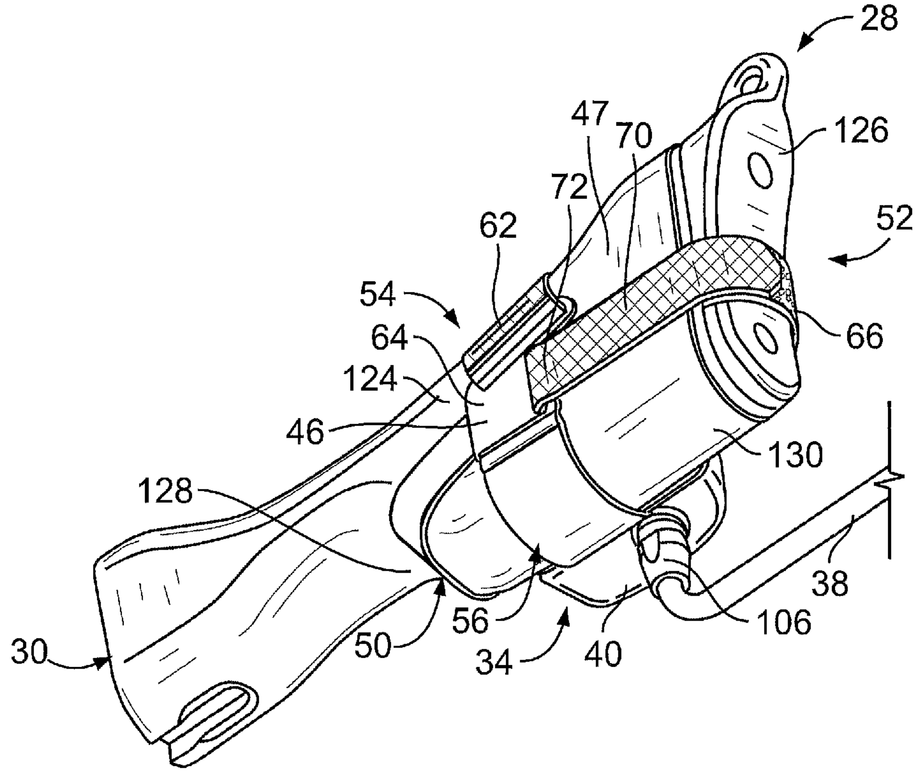
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FIG. 5D

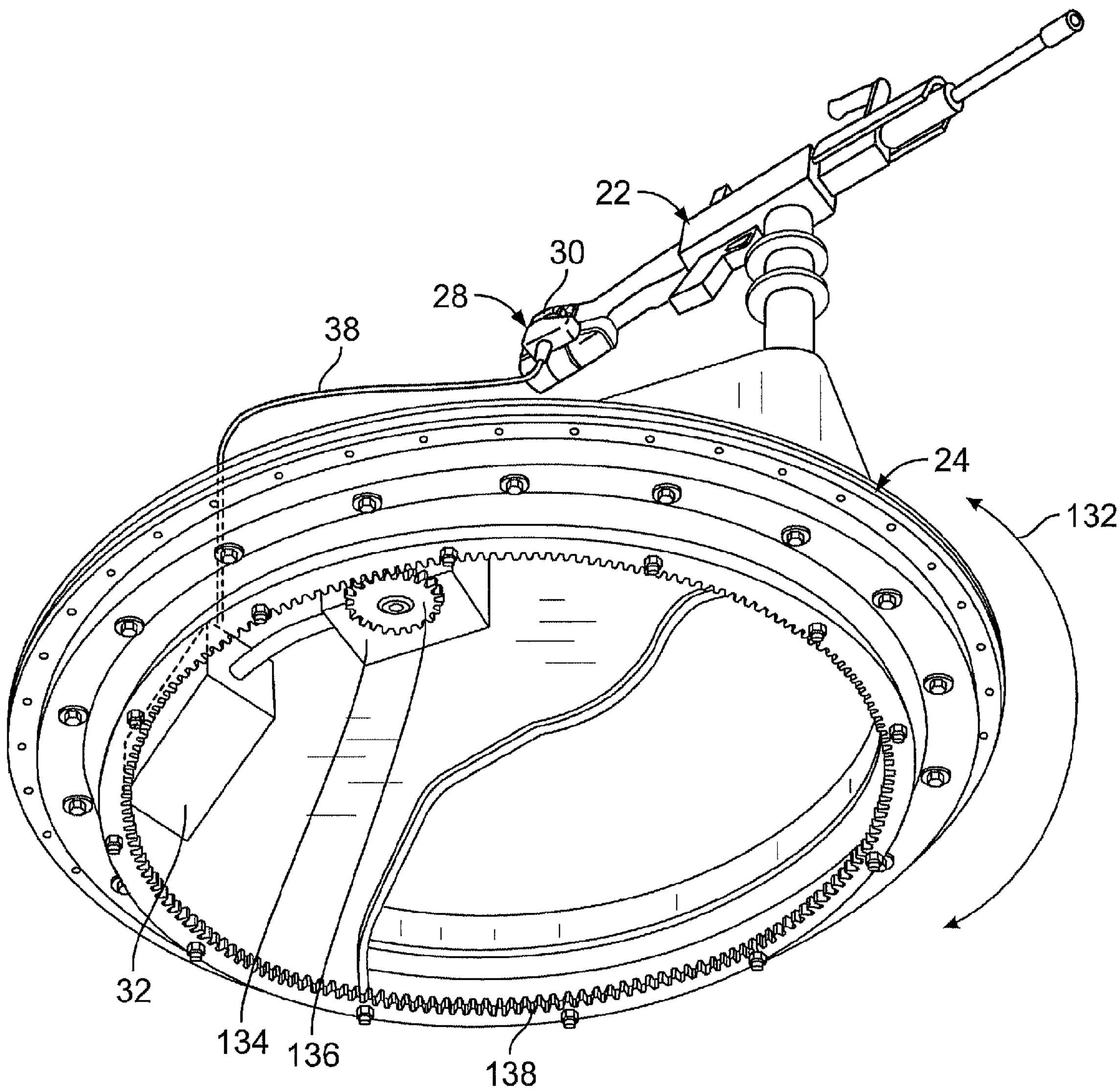

FIG. 6

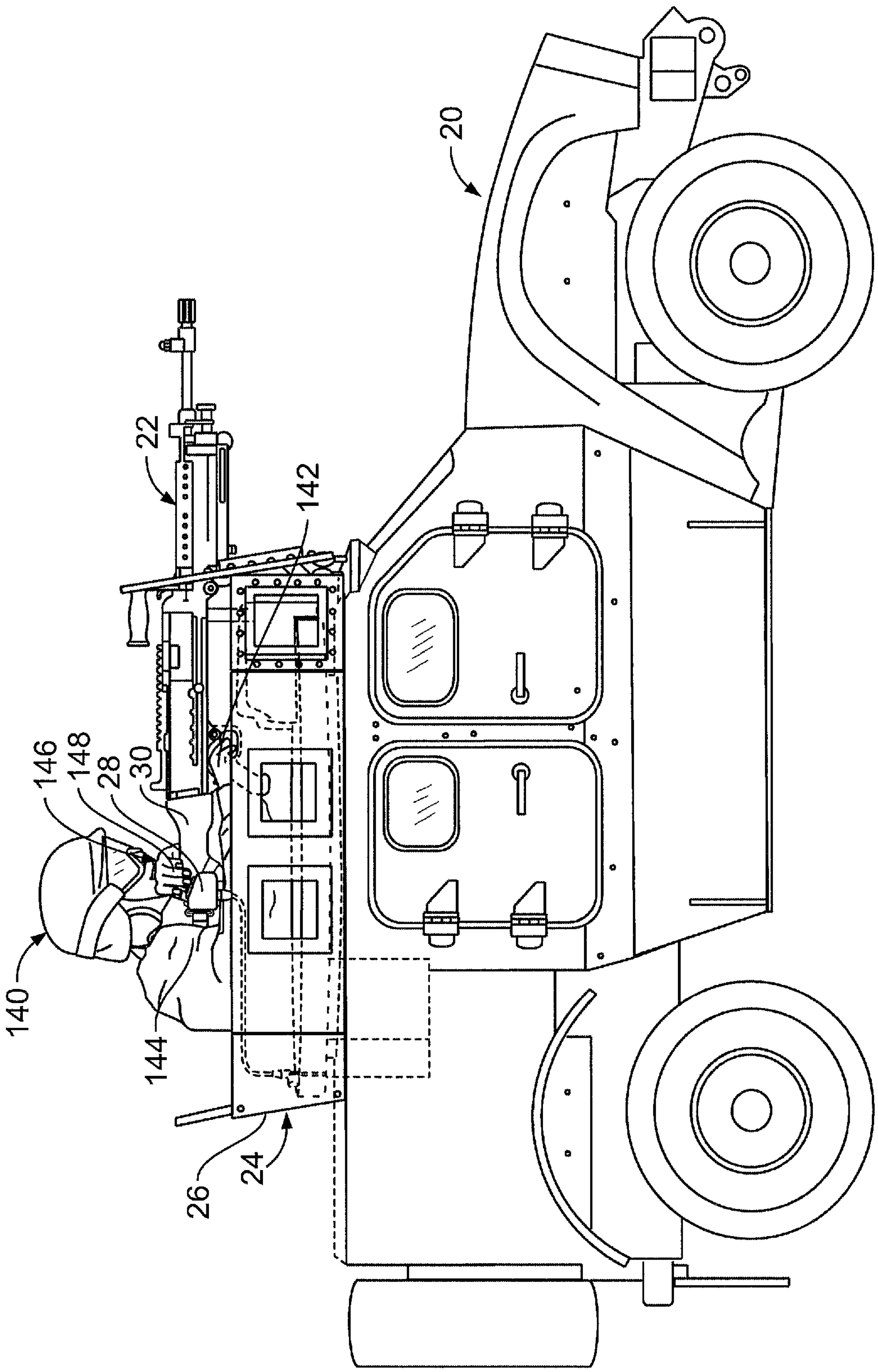

FIG.7

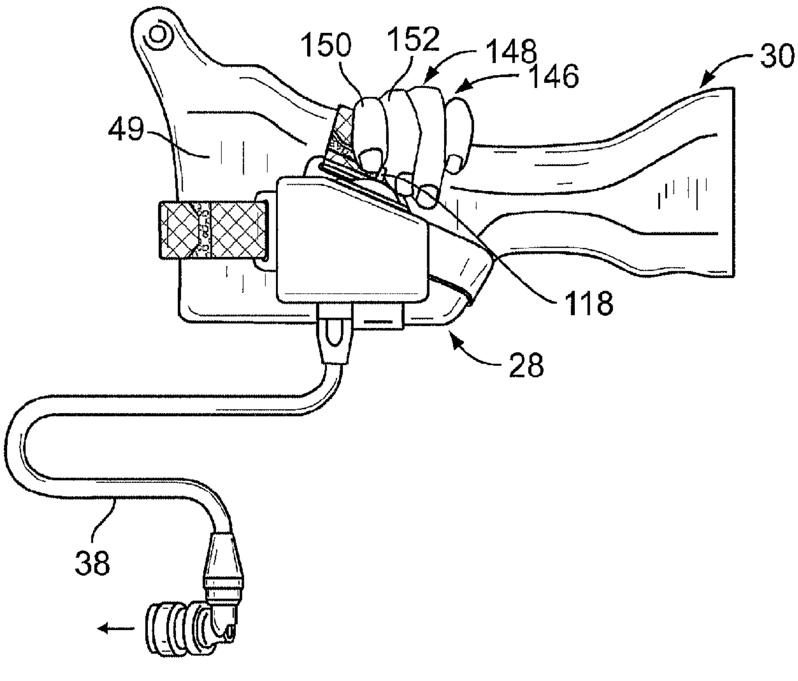

FIG. 8

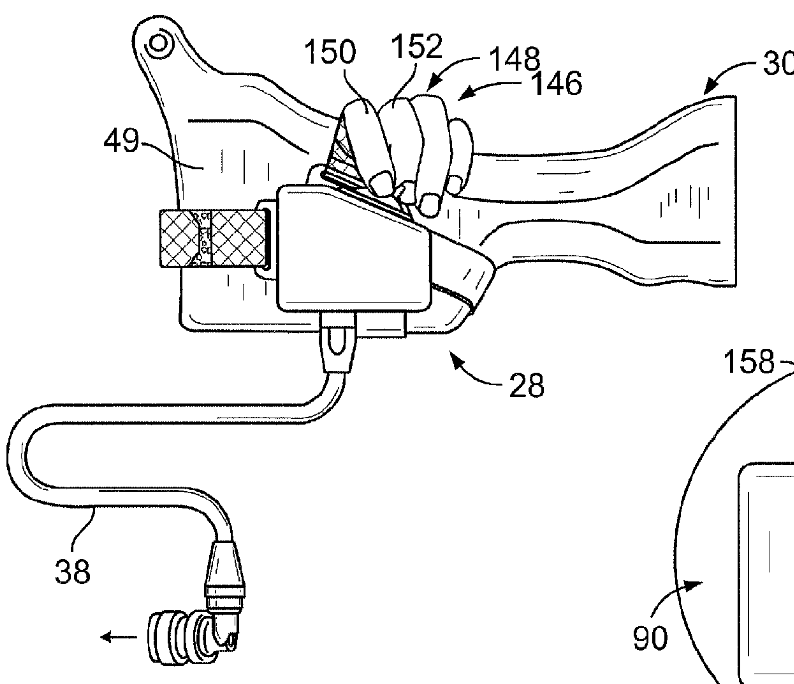

FIG. 9A

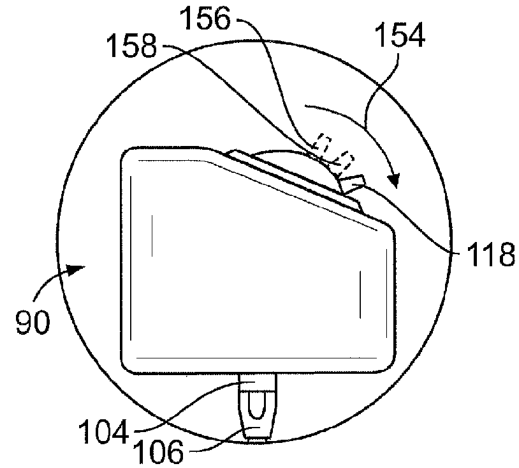

FIG. 9B

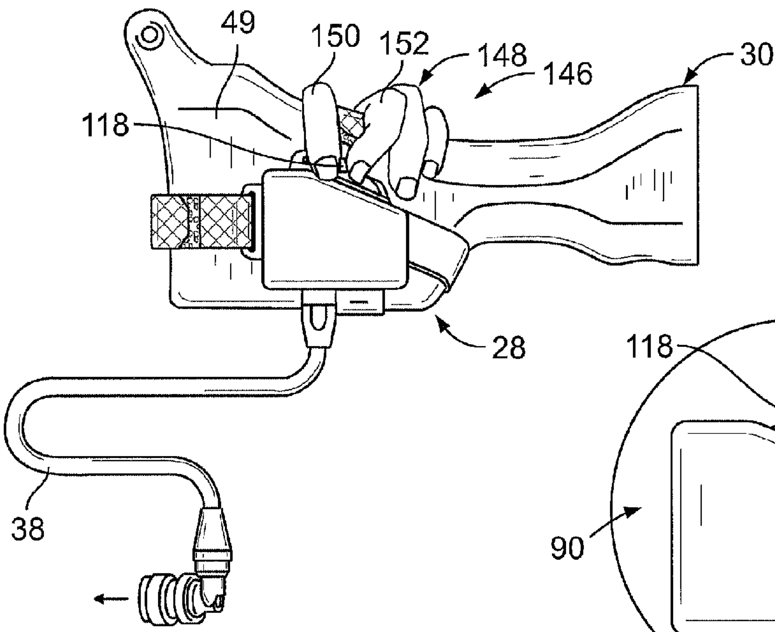

FIG. 10A

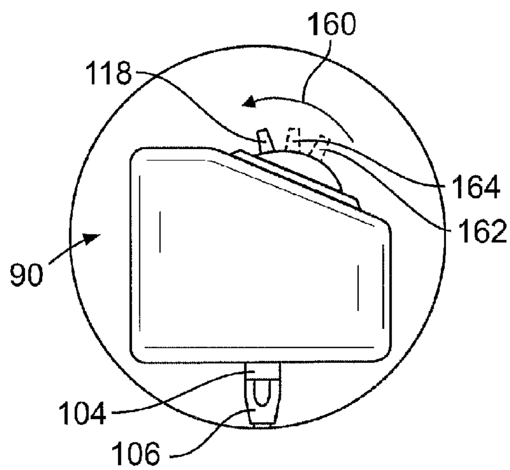

FIG. 10B

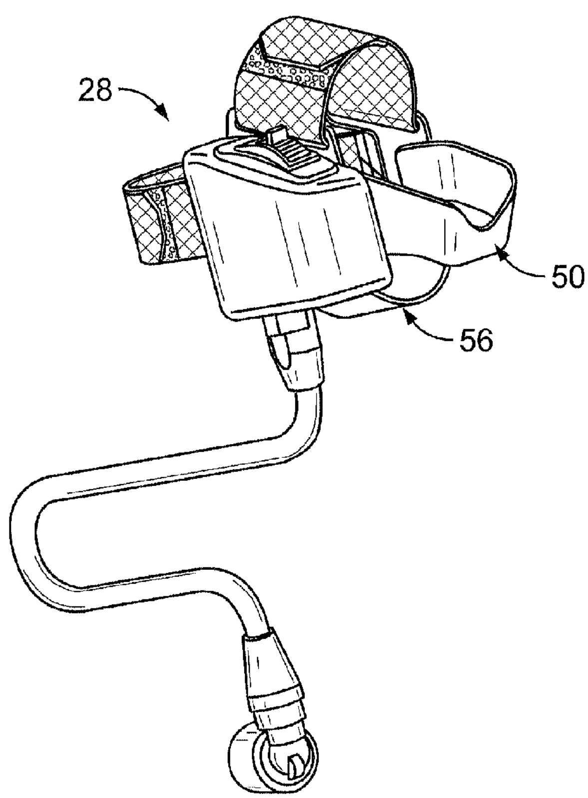

FIG. 11A

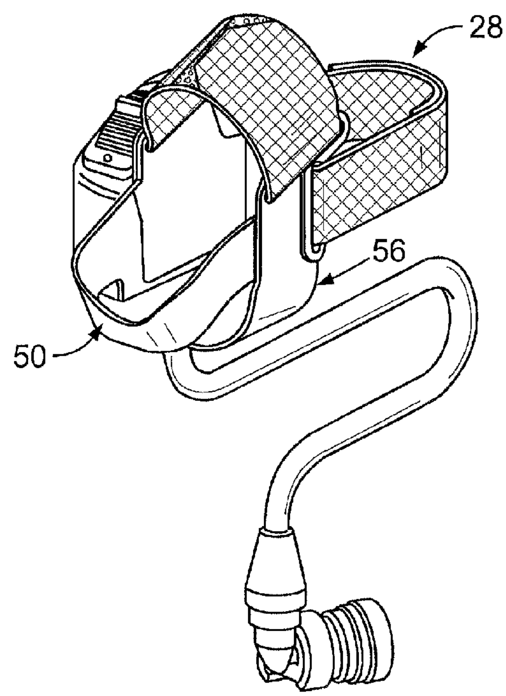

FIG. 11B

CONTROL MECHANISM SECURABLE TO A FIRING DEVICE AND METHOD

FIELD OF THE INVENTION

This invention relates to control mechanisms for sending signals to a controller and, more particularly, to control mechanisms that are securable to a firing device of an armored vehicle.

BACKGROUND

For military operations, armored vehicles may be equipped with turret-mounted firing devices. The turrets of the armored vehicles may also be equipped with a drive system that enables an operator to rotate the turret when aiming the weapon. An operator may control the rotation of the turret through the use of various devices. One such device is a hand-operated joystick attached to a magnetic base with a metallic underside. The metallic underside of the hand-operated joystick provides the benefit of allowing the turret operator to position the joystick at a location on or within the vehicle. However, operators may need to remove at least one hand from the firing device to operate the joystick.

Another type of turret control device may be mounted to the hand grips of a weapon, such as a .50 caliber machine gun. This device allows an operator to control the rotation of the turret via his or her thumbs while holding the handles of the weapon. These types of control devices may be referred to as "thumbsticks." Like the hand-operated joysticks, an operator may use his or her thumbs to rotate the turret. Such thumbsticks are often used with "butterfly" style hand grips, i.e., a pair of adjacent vertical grips that an operator grasps when operating the weapon. Thumbstick devices, however, may be impractical for use with other types of firing devices.

Therefore, a need exists for a control mechanism that is releasably mountable to the stock of a firing device.

SUMMARY

A control mechanism securable to a firing device is provided. The control mechanism includes an actuation component adapted to generate signals in response to activation of the actuation component. Further, the control mechanism includes an attachment apparatus adapted to support the actuation component adjacent to a stock of the firing device. The attachment apparatus has at least one securing member for securement of the attachment apparatus to the stock of the firing device.

A control system for generating control signals with a control mechanism securable to a firing device is also provided. An actuation component is adapted to generate control signals in response to activation of the actuation component. An attachment apparatus is adapted to support the actuation unit adjacent to a stock of the firing device. The attachment apparatus has at least one securing member for securement of the attachment apparatus to the stock of the firing device. A controller is coupled to the actuation component for receiving the control signals generated by the actuation component.

A method of operating a control mechanism securable to a firing device is further provided. The method includes securing an attachment apparatus of the control mechanism to a stock of the firing device. The attachment apparatus mounts an actuation component adapted to generate control signals transmittable to a controller. Additionally, the method includes moving an actuator of the actuation component such that the actuation component generates control signals corresponding to directional movement of the actuator.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a profile view of an armored vehicle having an control mechanism mounted to the stock of a firing device of a rotatable turret.

FIG. **2**A is a top right front perspective view of an example control mechanism mountable to a firing device.

FIG. **2**B is a top right front perspective view of the control mechanism of FIG. **2**A in an alternative configuration.

FIG. **2**C is a top right rear perspective view of the control mechanism of FIG. **2**B.

FIG. **3** is an exploded perspective view of the control mechanism of FIGS. **2**A-C.

FIG. **4** is a side cross-sectional view of an actuation unit of the control mechanism of FIGS. **2**A-C.

FIG. **5**A is a top left front perspective view of an example control mechanism mounted to the stock of a firing device.

FIG. **5**B is a bottom right front perspective view of the control mechanism of FIG. **5**A mounted to the stock of a firing device.

FIG. **5**C is a top left rear perspective view of the control mechanism of FIG. **5**A mounted to the stock of a firing device.

FIG. **5**D is a bottom left rear perspective view of the control mechanism of FIG. **5**A mounted to the stock of a firing device.

FIG. **6** is a perspective view of a control mechanism mounted to a firing device of a rotatable turret and connected to a controller of a turret drive system.

FIG. **7** is a profile view of an armored vehicle turret with an operator positioned to operate a firing device and actuation unit of the control mechanism.

FIG. **8** is a side view of the stock of a firing device with the control mechanism mounted to the stock illustrating a hand of an operator positioned to operate the actuation unit of the control mechanism.

FIG. **9**A is a side view of the stock of a firing device with the control mechanism mounted to the stock illustrating a hand of an operator actuating the actuation unit of the control mechanism in a first mode of operation.

FIG. **9**B is a side view of the actuation unit of FIG. **9**A illustrating the actuation of the actuation unit in first mode of operation.

FIG. **10**A is a side view of the stock of a firing device with the control mechanism mounted to the stock illustrating a hand of an operator actuating the actuation unit of the control mechanism in a second mode of operation.

FIG. **10**B is a side view of the actuation unit of FIG. **10**A illustrating the actuation of the actuation unit in second mode of operation.

FIG. **11**A is a top right front perspective view of an alternative embodiment of a control mechanism.

FIG. **11**B is a top right rear perspective view of an alternative embodiment of a control mechanism.

DETAILED DESCRIPTION

As shown herein, a control mechanism securable to a firing device is described. Further, a control system for generating control signals with a control mechanism securable to a firing device and a method of operating a control mechanism securable to a firing device are also described. In particular, a control mechanism may be mounted to the stock of a firing device allowing for simultaneous aiming and operation of the firing device and actuation of the control mechanism. As described herein, a control mechanism is discussed in reference to an example application of traversing a rotatable turret of a vehicle. However, those skilled in the art will recognize that the control mechanism mountable to a firing device described herein may be used in a variety of applications to control a variety of components or systems. Accordingly, the discussion of the control mechanism in reference to a rotatable turret of an armored vehicle is by way of example only and should not be construed to limit the invention to any particular use or application.

Referring now to FIG. **1**, a right profile view of an armored vehicle **20** having a firing device **22** mounted to a rotatable turret **24** is shown. The turret may fully rotate 360° in a clockwise or counterclockwise direction. The turret **24** may include, among other components, shielding **26** to protect an operator (FIG. **7**) during operation of firing device **22**. In the example shown, the firing device **22** is an M240 machine gun (United States military designation Machine Gun, 7.62 mm, M240). The M240 is designed to be operated by the right hand of an operator. This is because the spent cartridges from the M240, in this example, are expelled from the right side of the gun. Accordingly, operators are trained to position their bodies to the left of the gun and grip the gun with their right hand.

As shown in FIG. **1**, a control mechanism **28** is secured to the stock **30** of the firing device. The control mechanism **28** may be coupled or connected to a controller **32** situated beneath the rotatable turret **24** and within the vehicle **20** as seen in FIG. **1**. The control mechanism **28** may be used to generate control signals, which are sent to and received at the controller **32**. One application of the control mechanism **28**, as shown in FIG. **1**, includes controlling the rotation of a vehicle turret **24** based on the control signals received from the control mechanism. As described further below, the controller **32** may be connected to a drive system (FIG. **6**) that drives the rotation of the turret **24** in a clockwise or counterclockwise direction in response to receipt of the control signals from the control mechanism **28**.

Referring now to FIGS. **2**A-C, an example control mechanism **28** is shown in various perspective views. FIG. **2**A and FIG. **2**B are top right front perspective views of an example control mechanism **28**. FIG. **2**B is a top right rear perspective view of an example control mechanism **28**. The control mechanism **28** includes an actuation unit **34** and an attachment apparatus **36**. A connector cable **38** may also be connected to the bottom **40** of the actuation unit **34** for carrying transmitted signals from the actuation unit.

In the example shown, the actuation unit **34** is secured adjacent to the right side **42** of the attachment apparatus **36** for use with the example right-handed firing device **22** described above. The attachment apparatus **36** supports the actuation unit **34**, and the actuation unit may be secured to the attachment apparatus **36**, for example, via a pair of screws **44** or by another suitable coupling apparatus. Those skilled in the art will recognize that the control mechanism **28** described herein may be designed for use with firing devices operable by either the right or left hand of an operator. Accordingly, in other embodiments, the actuation unit may also be secured adjacent to the left side of the attachment apparatus.

The attachment apparatus **36** may be constructed from any material or combination of materials suitable to secure the control mechanism to the stock **30** of the firing device **22**. In the example embodiment of FIGS. **2**A-C, the attachment apparatus **36** may be constructed from a combination of aluminum alloy or stainless steel and elastic fabric having Velcro®-style hook-and-loop fasteners.

As seen in the example control mechanism **28** of FIGS. **2**A-C, the attachment apparatus **36** includes two side attachment panels **46**, **48** and multiple securing members **50**, **52**, **54**, **56**, which may be used to secure the attachment apparatus to the stock **30** of the firing device **22**. In the example shown, the attachment panels include a left panel **46** and a right panel **48**. The left panel **46** and the right panel **48** respectively abut the left side face **47** and right side face **49** of the stock **30** when the attachment apparatus **36** is secured to the stock as shown in FIGS. **5**A-D, which are described further below. The right panel **48** may serve as an attachment site for some of the securing members as well as the actuation unit **34**, which may be positioned adjacent to the right panel of the attachment apparatus **36**. Similarly, the left panel **46** may serve as an attachment site for the remaining securing members. The attachment panels **46**, **48** of the example control mechanism of FIGS. **2**A-C, may be made of aluminum alloy or stainless steel.

The securing members of the example control mechanism of FIGS. **2**A-C include four securing members—a front securing member **50**, a rear securing member **52**, a top securing member **54**, and a bottom securing member **56**. The securing members may be used to releasably secure the attachment apparatus **36** to the stock **30** of the firing device **22**. The front securing member **50** and bottom securing member **56** in the example control mechanism **28** shown are metallic braces connected to the right attachment panel **48** and the left attachment panel **46**. As seen in FIG. **2**B and FIG. **2**C, the front brace **50** is contiguous with the right panel **48** and attached to the left panel **46**. Similarly, the bottom brace **56** is contiguous with both the right panel **48** and the left panel **46**. As seen, the front brace **50** and the bottom brace **56** of the example attachment apparatus **36** have a generally U-shaped configuration, which allows the braces to respectively receive and mate with the front and the bottom of the stock **30**. The respective receipt of the front portion and bottom portion of the stock **30** in the front brace **50** and the bottom brace **56** is further described below in reference to FIGS. **5**A-D. The shape and configuration of the braces provide for quick and easy installation of the control mechanism on the stock of the firing device.

The top securing member **54** and rear securing member **52** of the example control mechanism **28** shown are releasably attachable straps that may be constructed of elastic fabric as shown in FIG. **2**A. The top securing member **54** includes a top right elastic strap **58** secured to the top **60** of the right attachment panel **48** and a top left elastic strap **62** secured to the top **64** of the left attachment panel **46**. In a similar fashion, the rear securing member **52** includes a rear right elastic strap **66** attached to the side **68** of the right attachment panel **48** and a rear left elastic strap **70** attached to the side **72** of the left attachment panel **46**.

Additionally and as seen in FIG. **2**A, the top straps **58**, **62** and the rear straps **66**, **70** each include a coupling mechanism for coupling the corresponding straps to one another. In the example control mechanism of FIG. **2**A, the coupling mechanism may be a set of Velcro®-style hook-and-loop fasteners applied to the surfaces of the straps. In particular, the top right strap **58** and the rear right strap **66** respectively include a patch of loop fasteners **74**, **76** applied to the exterior surface **78**, **80** of each strap. Correspondingly, the top left strap **62** and the rear left strap **70**, in this example, respectively include a patch of hook fasteners **82**, **84** applied to the interior surface **86**, **88** of each strap. Those skilled in the art will understand that other suitable releasably securable coupling mechanisms may be employed such as, for example, snap fasteners, buttons, buckles, zippers, and the like.

As shown in FIG. 2B and FIG. 2C, the hooks **82** of the top left strap **62** mesh with the loops **74** of the top right strap **58** securing the top straps **58**, **62** to each other. Likewise, the hooks **84** of the rear left strap **70** mesh with the loops **76** of the rear right strap **66** securing the rear straps **66**, **70** to each other. The hook-and-loop fasteners provide for quick and easy release of the control mechanism from the stock of the firing device. As mentioned above, other suitable releasably securable coupling mechanisms may be employed including, for example, snap fasteners, buttons, buckles, zippers, and the like.

In the example control mechanism **28** shown, the attachment apparatus **36** is designed to fit and secure onto the stock **30** of an M240 machine gun **22**. Those skilled in the art will recognize that more or less panels, braces, and/or securing members may be provided with other embodiments, such as other embodiments for use with firing devices having differently shaped stocks.

Referring now to FIG. **3**, an exploded view of the example control mechanism **28** of FIGS. **2**A-C is shown. As discussed above, the control mechanism **28** includes an actuation unit **34** and an attachment apparatus **36**. A connector cable **38** is also shown, which may also be attached to the bottom **40** of the actuation unit **34**.

The actuation unit **34** may include an actuation component **90** and housing **92** for the actuation component. The housing **92** of the actuation unit **34** may be secured to the right attachment panel **48** of the attachment apparatus via a pair of screws **44**. Additionally, the housing **92** may include a cavity **94** formed in the housing such as an interior chamber that houses the actuation component **90**. Further, the upper face **96** of the housing may include an opening **98** through which an actuator **100** of the actuation component **90** may extend. Moreover, the opening **98** in the upper face **96** may be positioned on an angled portion **102** of the upper face **96** of the housing **92**. The angled portion **102** of the upper face **96** may slope in a downward direction relative to the front of the attachment apparatus **36** and along the forward length of the housing **92**. The angled portion **102** of the upper face **96** of the housing **92** enables the actuation component **90** to be positioned at an angle relative to the housing. As explained further below with reference to FIG. **8**, an angled configuration of the actuation component **90** relative to the housing **92** provides an ergonomic interface for an operator of the control mechanism **28** when the control mechanism is secured to a firing device **22**.

The housing **92** of the actuation unit **90** may also include a threaded socket **104** positioned on the bottom **40** of the housing for receipt of a threaded connector head **106** of the connector cable **38**. A gasket **108**, such as an o-ring, may be placed within the socket **104** providing a sealed engagement between the housing **92** of the actuation unit **34** and the connector cable **38**. As shown in FIG. **3**, the connector cable **38** includes three wires—a supply wire **110** and a output wire **112**, and a circuit ground wire **116**. The supply wire **110**, the output wire **112**, and the circuit ground wire **116** may access the interior chamber **94** of the housing **92** via an aperture **114** formed in the bottom **40** of the housing and terminate at the actuation component **90**. The supply wire **110** may provide a predefined voltage to the actuation component; the output wire **112** may transmit the control signals from the actuation component through the connector cable; and the circuit ground wire may provide a path to ground. In the example control mechanism **28** described herein, the control signals may include variable voltage outputs from the actuation component **90** that correspond to the position of the actuation component. Those skilled in the art will understand that other

suitable electrical or electronic control signals, including wired or wireless control signals, may be employed.

The actuation component **90** of the control mechanism **28** will now be discussed in more detail. The actuation component **90** may include a transducer to detect a physical change in the actuation component and generate a signal based on a detection of the physical change. For example, the transducer may convert a sense of the change in position of the actuation component to an electrical signal representative of the position of the actuation component. Accordingly, any suitable switch or sensor may be employed as an actuation component for the control mechanism. Switches may be employed to toggle between various defined states, such as ON/OFF states. Alternatively, sensors may be employed to provide a variable voltage output based on the actuation of the sensor.

In the example control mechanism **28** described herein with reference to an example turret control application, the actuation component **90** may be a Hall effect sensor that includes a self-centering single axis actuator having a rocker switch style mounting. As seen in FIG. **3**, the Hall effect sensor **90** includes an actuator paddle or tab **118** mounted to a moveable wheel **120** disposed within the body **122** of the sensor. The actuator tab **118** may be used to move the wheel **120** in a forward or backward direction relative to the firing device **22**. Accordingly, the actuator tab **118** may be used to adjust the position of the wheel **120** from a neutral position to an actuated position such as a forward or a backward displacement. The wheel **120** may be biased by springs (not shown) within the body **122** of the sensor **90** such that the actuator tab **118** is positioned in the center of the sensor in a neutral position. When an operator releases the actuator tab **118**, the springs return the actuator tab **118** and wheel **120** to the neutral position from an actuated position. A suitable sensor may be an HTW Hall Effect Proportional Output Thumbwheel available from OTTO Engineering, Inc. as part number HTW-2A12A22.

The spring-biased rotary Hall effect sensor **90** in this example embodiment generates variable voltage outputs based on and corresponding to the position of the moveable wheel of the sensor. Activation of the actuator tab, e.g., pushing the actuator tab **118** in either a forward or backward direction, generates a variable voltage output corresponding to the particular position of actuator tab of the sensor **90**.

For example, a reference voltage of 5 volts (V) may be supplied to the Hall effect sensor **90**. With the actuator tab **118** positioned in the neutral position, the output signal generated by the sensor **90** may be around 2.5V. Pushing the actuator tab **118** in a forward direction may change the voltage output of the sensor **90**. When the actuator tab **118** is disposed in a forward direction, the output signal from the sensor **90** may be between 1.0V and 2.5V depending on how far forward the actuator tab is disposed, i.e., the distance of the actuator from a neutral position. Pushing the actuator tab **118** in a backward direction may similarly change the voltage output of the sensor **90**. When the actuator **118** is disposed in a backward direction, the output signal from the sensor **90** may be between 2.5V and 4.0V also depending on how far backward the actuator tab is disposed. The output signal may be transmitted via the connector cable **38** to a controller or some other like device having a signal decoder that takes some action in response to the particular voltage signal received from the sensor **90**.

Referring now to FIG. **4**, a left side cross-section view of an actuation unit **34** is shown with a connector cable **38** attached. As seen in FIG. **4**, the actuation component **90** and actuator tab **118** of the actuation unit **34** are positioned at an angle relative to the housing **92** of the actuation unit. Additionally, the supply wire **110**, output wire **112**, and circuit ground wire **116** of the connector cable **38** terminate at the actuation component **90**, which respectively supply a voltage to the actuation component, transmit signals from the actuation component, and provide a path to ground. In one embodiment of an example control mechanism, the interior chamber **94** of the actuation unit housing **92** may be filled with a potting compound to provide resistance from shock or vibration and to exclude moisture or other corrosive agents. A suitable potting compound may be 3M™ Scotch-Weld™ Epoxy Potting Compound available from 3M of St. Paul, Minn.

FIGS. **5**A-D are various detailed views showing how an example control mechanism secures to the stock **30** of a firing device **22**. As seen in the top left perspective view of FIG. **5**A, the top left strap **62** and the top right strap **58** wrap around the top **124**, or comb, of the stock **30**. The hook fasteners **82** on the interior surface **86** of the top left strap **62** mesh with the loop fasteners **74** on the exterior surface **78** of the top right strap **58** securing the top straps **58**, **62** to the comb **124** of the stock **30**. Similarly, the rear left strap **70** and the rear right strap **66** wrap around the back **126**, or butt, of the stock **30**. Like the top straps **58**, **62**, the hook fasteners **84** on the interior surface **88** of the left rear strap **70** mesh with the loop fasteners **76** on the exterior surface **80** of the right rear strap **66** securing the rear straps **66**, **70** to the butt **126** of the stock **30**.

Referring now to the bottom right perspective view of FIG. **5**B, the front brace **50** and the bottom brace **56** of the attachment apparatus **36** for the example control mechanism **28** are shown. As shown, the front brace **50** receives the front **128** of the stock **30**, and the bottom brace **56** receives the bottom **130** of the stock. In the example control mechanism **28** of FIG. **5**B, the front brace **50** and the bottom brace **56** are contoured to match the particular shape of the stock **30** for an M240 machine gun **22**. Those skilled in the art will recognize that other embodiments of control mechanisms may include a front brace and a bottom brace alternatively contoured to respectively match the front and bottom of stocks for other firing devices.

FIG. **5**C and FIG. **5**D respectively show top and bottom left rear perspective views of the example control mechanism **28** of FIGS. **5**A-B. As shown, the top left strap **62** and rear left strap **70** are respectively secured to the top **64** and side **72** of the left attachment panel **46**. The top left strap **62** wraps around the comb **124** of the stock **30** and secures to the top right strap **58** via the hook-and-loop fasteners **82**, **74**. Similarly, the rear left strap **70** wraps around the butt **126** of the stock **30** and secures to the rear right strap **66** also via the hook-and-loop fasteners **84**, **76**.

FIG. **5**C and FIG. **5**D also illustrate how an example control mechanism **28** may be installed on the stock **30** of a firing device **22**. With regard to the example control mechanism **28**, an operator may first ensure the pair of top straps **58**, **62** and the pair of rear straps **66**, **70** are uncoupled from one another. The operator may then position the control mechanism **28** beneath and slightly in front of the stock **30** aligning the attachment apparatus **36** with the stock. Next, the operator may raise the control mechanism **28** towards the bottom **130** of the stock such that the stock **30** slides between the left attachment panel **46** and the right attachment panel **48** of the attachment apparatus **36**. As the operator continues to raise the control mechanism **28** towards the stock, the front **128** of the stock **30** and the bottom **130** of the stock are respectively received in the front brace **50** and the bottom brace **56**.

When the stock **30** is fully received within the front brace **50** and the bottom brace **56**, the operator may then secure the pair of top straps **58**, **62** and the pair of rear straps **66**, **70**. An operator, for example, may wrap the top right strap **58** followed by the top left strap **62** around the comb **124** of the stock **30** securing the top left strap to the top right strap via the hook-and-loop fasteners **82**, **74**. An operator may then wrap the rear right strap **66** followed by the rear left strap **70** around the butt **126** of the stock **30** also securing the rear left strap to the rear right strap via the hook-and-loop fasteners **84**, **76**. In embodiments that include straps constructed of an elastic material, an operator may tighten the control mechanism to the stock by further pulling, for example, the top left strap **62** and/or the top right strap **58** further around the comb **124** of the stock **30** before securing the straps to one another. A similar procedure may be employed to tighten the rear pair of straps **66**, **70** as well.

Referring now to FIG. **6**, an example control mechanism **28** is shown used in an example application, in particular, to control the rotation of a turret **24**. As seen in FIG. **6**, the control mechanism **28** is mounted to the stock **30** of a firing device **22**. The firing device **22** may be mounted or positioned within a rotatable turret **24**. Arrow **132** indicates the turret **24** may rotate in both a clockwise and a counterclockwise direction. The control mechanism **28** is shown connected via the connector cable **38** to a controller **32** positioned beneath the rotatable turret **24**. The controller **32** is connected to a motor **134** used to drive the rotation of the turret **24**. The motor **134** includes a drive gear **136**, which meshes with a ring gear **138** mounted to the turret **24**. Accordingly, as the motor **134** spins the drive gear **136**, the drive gear transmits the torque to the ring gear **138**, which causes the turret **24** to rotate. As stated above, rotation of a turret is just one application for which the control mechanism mountable to a firing device may be employed.

In reference to FIG. **7**, a right profile view of an armored vehicle **20** having a rotatable turret **24** with shielding **26** and a firing device **22** with the control mechanism **28** attached to the stock **30** of the firing device is shown in an example mode of operation. An operator **140** is also shown positioned within the turret **24**. The position of the operator **140** shown in FIG. **7** corresponds to a typical position for operators of certain turret mounted weapons. In this particular example, the operator grips the firing device **22** with his right hand **142** and secures the stock **30** of the firing device **22** against his front right shoulder **144**. The operator **140** then wraps his left hand **146** over the comb **124** of the stock so that the fingers **148** of his left hand **146** rest on the right side of the stock **30**. In this position, an operator **140** may effectively stabilize and aim the firing device **22**. Additionally, in this position, recoil from the firing device **22** may be transmitted into the body of the operator through the stock **30**.

The control mechanism **28** described herein is designed to secure to the stock **30** such that an operator **140** may maintain a natural position when simultaneously operating the firing device and the control mechanism. For the purposes of illustration, the example control mechanism **28** shown includes as an actuation component **90** the rotary Hall effect sensor with actuator tab **118** as described above in reference to FIG. **3**. As seen in FIG. **7**, the control mechanism **28** is installed on the stock **30** where the operator **140** naturally positions the fingers **148** of his left hand **146**. Accordingly, the operator **140**, in this example, may use the fingers **148** of his left hand **146** to actuate the control mechanism **28** and rotate the turret **24**.

FIG. **8** shows in more detail the position of the fingers **148** of the left hand **146** of the operator **140** in relation to the actuator tab **118** of the control mechanism **28**. As shown in FIG. **8**, the actuator tab **118** is positioned in a central neutral position. The actuator tab **118**, in this example, is shown positioned between the index finger **150** and middle finger **152** of the left hand **146** of the operator **140**. From this position, the operator **140** may push the actuator tab **118** forward in a first mode of operation, or pull the actuator tab backwards in a second mode of operation.

As mentioned above, the angled configuration of the actuation component **90** (FIG. **3**) provides an ergonomic interface between the actuator tab **118** of the control mechanism **28** and the fingers **148** of the operator. As can be seen in FIG. **8**, the angled configuration positions the actuator tab **118** at the location in which an operator has been trained or may be accustomed to placing his or her left hand **146**. In particular, the angled configuration may take into account the particular positions of the index finger **150** and the middle finger **152** of the left hand **146** of the operator. For example and as shown in FIG. **8**, when the left hand **146** of the operator is wrapped around the top **124** (FIG. **5**A) of the stock **30**, the index middle finger **152** may be positioned slightly below the index finger **150** of the operator. Accordingly, the angled configuration of the actuation component **90** may accommodate the slight difference in finger position.

FIG. **9**A-B and FIG. **10**A-B respectively show a first and second mode of operation using the control mechanism **28** mounted to the stock **30** of a firing device **22**. As seen in the example of FIG. **9**A, the operator **140** uses his index finger **150** to push the actuator tab **118** in a forward direction relative to the operator. The connector cable **38** transmits a signal corresponding to the forward position of the actuator tab **118**.

The arrow **154** of FIG. **9**B indicates the forward direction of movement of the actuator tab **118**. Additionally, FIG. **9**B shows the actuator tab **118** pushed forward at maximum displacement from the neutral position. The tab outlines **156**, **158** illustrate the progression of the actuator tab **118** as the tab moves forward. The rotational speed of the turret **24** may vary depending on the forward displacement of the actuator tab **118**. For example, if the actuator tab **118** is pushed fully forward as shown in FIG. **9**B, the sensor **90** may transmit to a controller **32** a voltage output signal of around 1 V. Based on the 1V signal received, the controller **32** may determine an appropriate rotational speed and instruct the drive motor **134** to rotate the turret **24** counterclockwise at maximum speed, such as 10 RPM. However, if the actuator tab **118** is pushed halfway forward, as indicated by the second tab outline **158** of FIG. **9**B, the sensor **90** may transmit to the controller **32** a different voltage output signal of around 1.75V for example. Based on this different voltage output signal, the controller **32** may determine a different rotational speed and instruct the drive motor **134** to rotate the turret **24** counterclockwise at half-speed, such as 5 RPM.

FIG. **10**A-B illustrate a second mode of operation using the example control mechanism **28**. As seen in FIG. **10**A, the operator **140**, in this example, uses his middle finger **152** to pull the actuator tab **118** in a backwards direction relative to the operator. The connector cable **38** similarly transmits the signal corresponding to the backward position of the actuator tab **118**.

The arrow **160** of FIG. **10**B indicates the backward direction of movement of the actuator tab **118**. FIG. **10**B also shows the actuator tab **118** pulled backward at maximum displacement from the neutral position with tab outlines **162**, **164** indicating the progression of the tab as the tab moves backward. Again, the rotational speed of the turret **24** may depend on the backward displacement of the actuator tab **118**. As another example, if the actuator tab **118** is pulled fully backward as shown in FIG. **10**B, the sensor **90** may transmit to the controller **32** a voltage output signal of around 4V. Based on the 4V signal received, the controller **32** may instruct the drive motor **134** to rotate the turret **24** clockwise at maximum speed, such as 10 RPM. However, if the actuator tab **118** is pulled halfway backward, as indicated by the second tab outline **164** of FIG. **10**B, the sensor **90** may transmit to the controller **32** a different voltage output signal of around 3.25V for example. Based on this different voltage output signal, the controller **32** may instruct the drive motor **134** to rotate the turret **24** clockwise at half-speed, such as 5 RPM.

When the operator **140** releases the actuator tab **118**, the biasing springs (not shown) of the rotary Hall effect sensor **90** return the actuator tab to the neutral position as shown in FIG. **8**. When the actuator tab **118** returns to the neutral position, the voltage output signal transmits a neutral voltage signal of around 2.5V. When the controller **32** receives the neutral voltage signal, the controller may instruct the drive motor **134** to cease rotation of the turret **24**.

Finally, FIGS. **11**A-B are perspective views of an alternative embodiment of the control mechanism **28**. In particular, the control mechanism **28** shown in FIGS. **11**A-B is designed for the M249 machine gun (United States Designation Light Machine Gun, 5.56 mm, M249). As seen in FIGS. **11**A-**13**, the front brace **50** and the lower brace **56** exhibit a different contour that matches the particular stock of the M240 machine gun.

The invention illustratively disclosed herein suitably may be practiced in the absence of any element, part, step, component, or ingredient which is not specifically disclosed herein.

While in the foregoing detailed description this invention has been described in relation to certain preferred embodiments thereof, and many details have been set forth for purposes of illustration, it will be apparent to those skilled in the art that the invention is susceptible to additional embodiments and that certain of the details described herein can be varied considerably without departing from the basic principles of the invention.

What is claimed is:

1. A control mechanism securable to a firing device comprising:

an actuation component adapted to generate control signals in response to activation of the actuation component; and

an attachment apparatus adapted to support the actuation component adjacent to a stock of the firing device, the attachment apparatus having at least one securing member for securement of the attachment apparatus to the stock of the firing device, wherein the at least one securing member of the attachment apparatus further comprises a first brace having a U-shaped configuration, the first brace adapted to matingly receive one portion of the stock, and a second brace having a U-shaped configuration, the second brace adapted to matingly receive another portion of the stock.

2. The control mechanism of claim **1** wherein the attachment apparatus is adapted to be releasably secured to the stock.

3. The control mechanism of claim **2** wherein the attachment apparatus is adapted to position the actuation component adjacent to a side face of the stock.

4. The control mechanism of claim **3** wherein the attachment apparatus further comprises at least one side panel, the side panel adapted to abut the side face of the stock.

5. The control mechanism of claim **4** wherein the attachment apparatus further comprises a plurality of side panels and the actuation component is positioned adjacent to one of the plurality of side panels.

6. The control mechanism of claim 3 wherein at least one of the first brace or the second brace is positionable on at least one of a front portion of the stock or a bottom portion of the stock.

7. The control mechanism of claim 6 wherein at least one of the first brace or the second brace is adapted to matingly receive a front portion of the stock or a bottom portion of the stock.

8. The control mechanism of claim 3 wherein:

the first brace is a first metallic brace adapted to matingly receive a front portion of the stock; and

the second brace is a second metallic brace adapted to matingly receive a bottom portion of the stock.

9. The control mechanism of claim 6 wherein the attachment apparatus further comprises at least one strap positionable on at least one of a top portion of the stock or a rear portion of the stock.

10. The control mechanism of claim 6 wherein the attachment apparatus further comprises:

a first pair of elastic straps positionable on a top portion of the stock, the first pair of elastic straps having a first coupling mechanism for engagement of the first pair of straps; and

a second pair of elastic straps positionable on a rear portion of the stock, the second pair of elastic straps having a second coupling mechanism for engagement of the second pair of straps.

11. The control mechanism of claim 3 wherein the control signals include variable voltage outputs corresponding to positions of the actuation component.

12. The control mechanism of claim 11 wherein the actuation component further comprises a Hall effect sensor and an actuator for adjusting the position of the sensor from a neutral position, the actuator being moveable in a first direction and a second direction from the neutral position.

13. The control mechanism of claim 12 wherein the sensor returns to the neutral position from an actuated position when the actuator is released.

14. The control mechanism of claim 12 wherein the actuation component is positioned within a housing of an actuation unit, the actuation unit being secured to the attachment apparatus.

15. The control mechanism of claim 14 wherein the actuator extends through an opening of the housing.

16. The control mechanism of claim 14 wherein the housing of the actuation unit further comprises:

a gasket disposed within a socket attached to the housing, the socket adapted to receive a connector cable for transmitting the control signals generated by the actuation component; and

wherein the actuation component is disposed within a cavity formed in the housing of the actuation unit, the cavity being filled with a potting compound.

17. The control mechanism of claim 12 wherein the actuator is angled on a forward downward slope relative to the front of the attachment apparatus.

18. The control mechanism of claim 3 wherein the attachment apparatus is adapted to be secured to a side face of a stock of at least one of an M240 machine gun or an M249 machine gun.

19. The control mechanism of claim 3 wherein the control signals are used to control the rotation of a vehicle turret such that movement of an actuator of the actuation component in a first direction generates signals to cause rotation of the turret in a clockwise direction and movement of the actuator in a second direction generates signals to cause rotation of the turret in a counterclockwise direction; and

wherein a rotational speed associated with the turret corresponds to a distance of the actuator from a neutral position.

20. A control system for generating control signals with a control mechanism securable to a firing device comprising:

an actuation component adapted to generate control signals in response to activation of the actuation component;

an attachment apparatus adapted to support the actuation component adjacent to a stock of the firing device, the attachment apparatus having at least one securing member for securement of the attachment apparatus to the stock of the firing device, wherein the at least one securing member of the attachment apparatus further comprises a first brace having a U-shaped configuration, the first brace adapted to matingly receive one portion of the stock, and a second brace having a U-shaped configuration, the second brace adapted to matingly receive another portion of the stock; and

a controller coupled to the actuation component for receiving the control signals generated by the actuation component.

21. The control system of claim 20 wherein the controller is adapted to control the rotation of a vehicle turret based on the control signals received from the actuation component.

22. The control system of claim 21 wherein activation of the actuation component in a first direction generates a first control signal, the controller causes the turret to rotate in a clockwise direction in response to receipt of the first control signal; and

wherein activation of the actuation component in a second direction generates a second control signal, the controller causes the turret to rotate in a counterclockwise direction in response to receipt of the second control signal.

23. The control system of claim 22 wherein the controller determines a rotational speed based on the control signals received and causes the turret to rotate at the determined rotational speed.

24. The control system of claim 21 wherein the actuation component further comprises a Hall effect sensor and an actuator for adjusting the position of the sensor from a neutral position, the actuator being moveable in a first direction and a second direction from the neutral position; and

wherein the sensor returns to the neutral position from an actuated position when the actuator is released.

25. The control system of claim 21 wherein the attachment apparatus positions the actuation component adjacent to a side face of the stock.

26. The control system of claim 25 wherein at least one of the first brace or the second brace is positionable on at least one of a front portion of the stock or a bottom portion of the stock.

27. The control system of claim 26 wherein the attachment apparatus includes at least one strap positionable on at least one of a top portion of the stock or a rear portion of the stock.

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