

TITLE: **SPEAR ASSEMBLY FOR AN ELECTRODE OF A
CONDUCTED ELECTRICAL WEAPON**

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FIELD OF THE INVENTION

[0001] Embodiments of the present disclosure relate to a conducted electrical weapon (“CEW”).

BRIEF DESCRIPTION OF THE DRAWINGS

[0002] The subject matter of the present disclosure is particularly pointed out and distinctly claimed in the concluding portion of the specification. A more complete understanding of the present disclosure, however, may best be obtained by referring to the detailed description and claims when considered in connection with the following illustrative figures. In the following figures, like reference numbers refer to similar elements and steps throughout the figures.

[0003] FIG. 1 is a perspective view of a conducted electrical weapon (“CEW”), in accordance with various embodiments;

[0004] FIG. 2 is a schematic view of a CEW, in accordance with various embodiments;

[0005] FIGs. 3A and 3B are perspective and cross-sectional views of an electrode comprising a spear assembly in a first position, in accordance with various embodiments; and

[0006] FIGs. 4A and 4B are perspective and cross-sectional views of an electrode comprising a spear assembly in a second position, in accordance with various embodiments.

[0007] Elements and steps in the figures are illustrated for simplicity and clarity and have not necessarily been rendered according to any particular sequence. For example, steps that may be performed concurrently or in different order are illustrated in the figures to help to improve understanding of embodiments of the present disclosure.

DETAILED DESCRIPTION

[0008] The detailed description of exemplary embodiments herein makes reference to the accompanying drawings, which show exemplary embodiments by way of illustration. While these embodiments are described in sufficient detail to enable those skilled in the art to practice the disclosures, it should be understood that other embodiments may be realized and that logical

changes and adaptations in design and construction may be made in accordance with this disclosure and the teachings herein. Thus, the detailed description herein is presented for purposes of illustration only and not of limitation.

[0009] The scope of the disclosure is defined by the appended claims and their legal equivalents rather than by merely the examples described. For example, the steps recited in any of the method or process descriptions may be executed in any order and are not necessarily limited to the order presented. Furthermore, any reference to singular includes plural embodiments, and any reference to more than one component or step may include a singular embodiment or step. Also, any reference to attached, fixed, coupled, connected, or the like may include permanent, removable, temporary, partial, full, and/or any other possible attachment option. Surface shading lines may be used throughout the figures to denote different parts but not necessarily to denote the same or different materials.

[0010] In various embodiments, a projectile launcher may be configured to launch one or more projectiles towards a target. A projectile launcher may comprise any platform, device, weapon, gun, system, and/or the like configured to deploy (or cause deployment of) a projectile. For example, a projectile launcher may comprise one or more electronic devices configured to deploy a projectile. As a further example, a projectile launcher may comprise a conducted electrical weapon (CEW), a modular conducted electrical weapon (MCEW), a payload launcher, a projectile device configured to deploy entangling projectiles, a paintball gun, and/or the like. In that regard, the projectile launcher may comprise a standalone device, a device mounted or in communication with a second device, a platform, device, or system in electronic communication with a second electronic device, and/or the like.

[0011] In various embodiments, a projectile launcher may be configured to be held and operated by a human user. For example, the projectile launcher may comprise a handle, a grip, a barrel, a stock, and/or the like configured to be held in a hand of the human user.

[0012] In various embodiments, a projectile launcher may be mounted on or proximate to a platform. In that regard, the projectile launcher may be remotely operated. For example, a human user may remotely operate the projectile launcher. The platform may comprise any suitable object, structure, or the like.

[0013] For example, in some embodiments the platform may comprise a remote vehicle. The remote vehicle may comprise any object capable of traveling by land (e.g., surfaces), water, or air.

The remote vehicle may be operated by a human user. The remote vehicle may comprise an autonomous vehicle. The remote vehicle may comprise an unmanned aerial vehicle (UAV) (e.g., a drone), an unmanned ground vehicle (UGV), an unmanned surface vessel (USV) (e.g., unmanned surface vehicle, autonomous surface vehicle, etc.), a robot, a car, or the like. A ground vehicle may comprise one or more wheels, a continuous track (e.g., tank tread, caterpillar track, etc.), functional legs, or the like configured to enable movement of the vehicle on land-based terrain. The remote vehicle may be operable via a separate control interface (e.g., user controller). The remote vehicle may be operable via a short-range electronic communication and/or via a long-range electronic communication. In various embodiments, the decision to remotely deploy a projectile launcher from a platform may be received directly from a human operator.

[0014] A projectile launcher may be configured to launch any suitable type of projectile. A projectile may include any object, payload, capsule, and/or the like configured to be deployed from a projectile launcher. For example, and in accordance with various embodiments, a projectile may comprise a non-lethal or less-lethal projectile. In that regard a projectile may comprise or be configured to deploy a dart, a paintball, a rubber projectile (e.g., a rubber bullet), a conducted electrical weapon (CEW) electrode, a modular conducted electrical weapon (MCEW) electrode or payload, an entangling projectile configured to entangle a target (e.g., a tether-based entangling projectile, a net, etc.), a scent-based projectile, a liquid-based projectile, a gas-based projectile, pepper spray or a pepper spray projectile (e.g., oleoresin capsicum, OC spray), tear gas or a tear gas cannister or projectile (e.g., 2-chlorobenzalmalononitrile, CS spray), a flashbang projectile, a glass-breaker projectile, and/or any other non-lethal or less-lethal projectile.

[0015] In various embodiments, an electrode for a CEW may include a spear portion, designed to pierce or attach proximate a tissue of a target in order to provide a conductive electrical path between the electrode and the tissue. For example, the electrode may be electrically coupled to a handle of the projectile launcher via a conductive filament wire. The handle may provide an electrical current through the filament wire, the electrode, the spear, and to the target.

[0016] In some embodiments, a projectile may be configured to deliver an inhibitory substance (e.g., to at least partially inhibit a target). In some embodiments, a projectile may be configured to deliver a marking substance (e.g., to mark or designate a target).

[0017] In various embodiments, systems, methods, and apparatuses may be used to interfere with voluntary locomotion (e.g., walking, running, moving, etc.) of a target. For example, a CEW

may be used to deliver a current (e.g., stimulus signal, pulses of current, pulses of charge, etc.) through tissue of a human or animal target. Although typically referred to as a conducted electrical weapon, as described herein a “CEW” may refer to a conducted electrical weapon, a conducted energy weapon, an electronic control device, and/or any other similar device or apparatus configured to provide a stimulus signal through one or more deployed projectiles (e.g., electrodes), such as those offered by Axon Enterprise, Inc. under its famous TASER® trademark.

[0018] A stimulus signal carries a charge into target tissue. The stimulus signal may interfere with voluntary locomotion of the target. The stimulus signal may cause pain. The pain may also function to encourage the target to stop moving. The stimulus signal may cause skeletal muscles of the target to become stiff (e.g., lock up, freeze, etc.). The stiffening of the muscles in response to a stimulus signal may be referred to as neuromuscular incapacitation (“NMI”). NMI disrupts voluntary control of the muscles of the target. The inability of the target to control its muscles interferes with locomotion of the target.

[0019] A stimulus signal may be delivered through the target via terminals coupled to the CEW. Delivery via terminals may be referred to as a local delivery (e.g., a local stun, a drive stun, etc.). During local delivery, the terminals are brought close to the target by positioning the CEW proximate to the target. The stimulus signal is delivered through the target’s tissue via the terminals. To provide local delivery, the user of the CEW is generally within arm’s reach of the target and brings the terminals of the CEW into contact with or proximate to the target.

[0020] A stimulus signal may be delivered through the target via one or more (typically at least two) wire-tethered electrodes. Delivery via wire-tethered electrodes may be referred to as a remote delivery (e.g., a remote stun). During a remote delivery, the CEW may be separated from the target up to the length (e.g., 15 feet, 20 feet, 30 feet, etc.) of the wire tether. The CEW launches the electrodes towards the target. As the electrodes travel toward the target, the respective wire tethers deploy behind the electrodes. The wire tether electrically couples the CEW to the electrode. The electrode may electrically couple to the target thereby coupling the CEW to the target. In response to the electrodes connecting with, impacting on, or being positioned proximate to the target’s tissue, the current may be provided through the target via the electrodes (e.g., a circuit is formed through the first tether and the first electrode, the target’s tissue, and the second electrode and the second tether).

[0021] Terminals or electrodes that contact or are proximate to the target's tissue deliver the stimulus signal through the target. Contact of a terminal or electrode with the target's tissue establishes an electrical coupling (e.g., circuit) with the target's tissue. Electrodes may include a spear or spear assembly that may pierce the target's tissue to contact the target. A terminal or electrode that is proximate to the target's tissue may use ionization to establish an electrical coupling with the target's tissue. Ionization may also be referred to as arcing.

[0022] In use (e.g., during deployment), a terminal or electrode may be separated from the target's tissue by the target's clothing or a gap of air. In various embodiments, a signal generator of the CEW may provide the stimulus signal (e.g., current, pulses of current, etc.) at a high voltage (e.g., in the range of 40,000 to 100,000 volts) to ionize the air in the clothing or the air in the gap that separates the terminal or electrode from the target's tissue. Ionizing the air establishes a low impedance ionization path from the terminal or electrode to the target's tissue that may be used to deliver the stimulus signal into the target's tissue via the ionization path. The ionization path persists (e.g., remains in existence, lasts, etc.) as long as the current of a pulse of the stimulus signal is provided via the ionization path. When the current ceases or is reduced below a threshold (e.g., amperage, voltage), the ionization path collapses (e.g., ceases to exist) and the terminal or electrode is no longer electrically coupled to the target's tissue. Lacking the ionization path, the impedance between the terminal or electrode and target tissue is high. A high voltage in the range of about 50,000 volts can ionize air in a gap of up to about 1 inch (about 2.54 centimeters).

[0023] A CEW may provide a stimulus signal as a series of current pulses. Each current pulse may include a high voltage portion (e.g., 40,000 – 100,000 volts) and a low voltage portion (e.g., 500 – 6,000 volts). The high voltage portion of a pulse of a stimulus signal may ionize air in a gap between an electrode or terminal and a target to electrically couple the electrode or terminal to the target. In response to the electrode or terminal being electrically coupled to the target, the low voltage portion of the pulse delivers an amount of charge into the target's tissue via the ionization path. In response to the electrode or terminal being electrically coupled to the target by contact (e.g., touching, spear embedded into tissue, etc.), the high portion of the pulse and the low portion of the pulse both deliver charge to the target's tissue. Generally, the low voltage portion of the pulse delivers a majority of the charge of the pulse into the target's tissue. In various embodiments, the high voltage portion of a pulse of the stimulus signal may be referred to as the spark or ionization portion. The low voltage portion of a pulse may be referred to as the muscle portion.

[0024] In various embodiments, a signal generator of the CEW may provide the stimulus signal (e.g., current, pulses of current, etc.) at only a low voltage (e.g., less than 2,000 volts). The low voltage stimulus signal may not ionize the air in the clothing or the air in the gap that separates the terminal or electrode from the target's tissue. A CEW having a signal generator providing stimulus signals at only a low voltage (e.g., a low voltage signal generator) may require deployed electrodes to be electrically coupled to the target by contact (e.g., touching, spear embedded into tissue, etc.).

[0025] A CEW may include at least two terminals at the face of the CEW. A CEW may include two terminals for each bay that accepts a magazine. The terminals are spaced apart from each other. In response to the electrodes of the magazine in the bay having not been deployed, the high voltage impressed across the terminals will result in ionization of the air between the terminals. The arc between the terminals may be visible to the naked eye. In response to a launched electrode not electrically coupling to a target, the current that would have been provided via the electrodes may arc across the face of the CEW via the terminals.

[0026] The likelihood that the stimulus signal will cause NMI increases when the electrodes that deliver the stimulus signal are spaced apart at least 6 inches (15.24 centimeters) so that the current from the stimulus signal flows through the at least 6 inches of the target's tissue. In various embodiments, the electrodes preferably should be spaced apart at least 12 inches (30.48 centimeters) on the target. Because the terminals on a CEW are typically less than 6 inches apart, a stimulus signal delivered through the target's tissue via terminals likely will not cause NMI, only pain.

[0027] A series of pulses may include two or more pulses separated in time. Each pulse delivers an amount of charge into the target's tissue. In response to the electrodes being appropriately spaced (as discussed above), the likelihood of inducing NMI increases as each pulse delivers an amount of charge in the range of 55 microcoulombs to 71 microcoulombs per pulse. The likelihood of inducing NMI increases when the rate of pulse delivery (e.g., rate, pulse rate, repetition rate, etc.) is between 11 pulses per second ("pps") and 50 pps. Pulses delivered at a higher rate may provide less charge per pulse to induce NMI. Pulses that deliver more charge per pulse may be delivered at a lesser rate to induce NMI. In various embodiments, a CEW may be hand-held and use batteries to provide the pulses of the stimulus signal. In response to the amount of charge per pulse being high and the pulse rate being high, the CEW may use more energy than is needed to induce NMI. Using more energy than is needed depletes batteries more quickly.

[0028] Empirical testing has shown that the power of the battery may be conserved with a high likelihood of causing NMI in response to the pulse rate being less than 44 pps and the charge per a pulse being about 63 microcoulombs. Empirical testing has shown that a pulse rate of 22 pps and 63 microcoulombs per a pulse via a pair of electrodes will induce NMI when the electrode spacing is at least 12 inches (30.48 centimeters).

[0029] In various embodiments, a CEW may include a handle and one or more magazines. The handle may include one or more bays for receiving the magazine(s). Each magazine may be removably positioned in (e.g., inserted into, coupled to, etc.) a bay. Each magazine may releasably electrically, electronically, and/or mechanically couple to a bay. A deployment of the CEW may launch one or more electrodes from the magazine and toward a target to remotely deliver the stimulus signal through the target.

[0030] In various embodiments, a magazine may include two or more electrodes (e.g., projectiles, etc.) that are launched at the same time. In various embodiments, a magazine may include two or more electrodes that may each be launched individually at separate times. In various embodiments, a magazine may include a single electrode configured to be launched from the magazine. Launching the electrodes may be referred to as activating (e.g., firing) a magazine or electrode. In some embodiments, after use (e.g., activation, firing), a magazine may be removed from the bay and the used electrodes may be removed from the magazine and replaced with unused (e.g., not fired, not activated) electrodes. The magazine may be inserted into the bay again to permit launch of additional electrodes. In some embodiments, after use (e.g., activation, firing), a magazine may be removed from the bay and replaced with an unused (e.g., not fired, not activated) magazine to permit launch of additional electrodes.

[0031] In various embodiments, and with reference to FIGs. 1 and 2, a CEW 1 is disclosed. CEW 1 may be similar to, or have similar aspects and/or components with, any CEW discussed herein. In some embodiments, CEW 1 may comprise a projectile launcher. CEW 1 may be similar to, or have similar aspects and/or components with, any projectile launcher discussed herein. CEW 1 may comprise a housing 10 and a magazine 12. It should be understood by one skilled in the art that FIG. 2 is a schematic representation of CEW 1, and one or more of the components of CEW 1 may be located in any suitable position within, or external to, housing 10.

[0032] Housing 10 may be configured to house various components of CEW 1 that are configured to enable deployment of magazine 12, provide an electrical current to magazine 12,

and otherwise aid in the operation of CEW 1, as discussed further herein. Although depicted as a firearm in FIG. 1, housing 10 may comprise any suitable shape and/or size. Housing 10 may comprise a handle end opposite a deployment end. A deployment end may be configured, and sized and shaped, to receive one or more magazine 12. A handle end may be sized and shaped to be held in a hand of a user. For example, a handle end may be shaped as a handle to enable hand-operation of CEW 1 by the user. In various embodiments, a handle end may also comprise contours shaped to fit the hand of a user, for example, an ergonomic grip. A handle end may include a surface coating, such as, for example, a non-slip surface, a grip pad, a rubber texture, and/or the like. As a further example, a handle end may be wrapped in leather, a colored print, and/or any other suitable material, as desired.

[0033] In various embodiments, housing 10 may comprise various mechanical, electronic, and/or electrical components configured to aid in performing the functions of CEW 1. For example, housing 10 may comprise one or more triggers 15, control interfaces 17, user interfaces 27, processing circuits 20, power supplies 22, and/or signal generators 24. Housing 10 may include a guard (e.g., trigger guard). A guard may define an opening formed in housing 10. A guard may be located in a center region of housing 10 (e.g., as depicted in FIG. 1), and/or in any other suitable location on housing 10. Trigger 15 may be disposed within a guard. A guard may be configured to protect trigger 15 from unintentional physical contact (e.g., an unintentional activation of trigger 15). A guard may surround trigger 15 within housing 10.

[0034] In various embodiments, trigger 15 may be coupled to an outer surface of housing 10, and may be configured to move, slide, rotate, or otherwise become physically depressed or moved upon application of physical contact. For example, trigger 15 may be actuated by physical contact applied to trigger 15 from within a guard. Trigger 15 may comprise a mechanical or electromechanical switch, button, trigger, or the like. For example, trigger 15 may comprise a switch, a pushbutton, and/or any other suitable type of trigger. Trigger 15 may be mechanically and/or electronically coupled to processing circuit 20. In response to trigger 15 being activated (e.g., depressed, pushed, etc. by the user), processing circuit 20 may enable deployment of (or cause deployment of) one or more magazine 12 from CEW 1, as discussed further herein.

[0035] In various embodiments, power supply 22 may be configured to provide power to various components of CEW 1. For example, power supply 22 may provide energy for operating the electronic and/or electrical components (e.g., parts, subsystems, circuits, etc.) of CEW 1 and/or

one or more magazine 12. Power supply 22 may provide electrical power. Providing electrical power may include providing a current at a voltage. Power supply 22 may be electrically coupled to processing circuit 20 and/or signal generator 24. In various embodiments, in response to a control interface comprising electronic properties and/or components, power supply 22 may be electrically coupled to the control interface. In various embodiments, in response to trigger 15 comprising electronic properties or components, power supply 22 may be electrically coupled to trigger 15. Power supply 22 may provide an electrical current at a voltage. Electrical power from power supply 22 may be provided as a direct current (“DC”). Electrical power from power supply 22 may be provided as an alternating current (“AC”). Power supply 22 may include a battery. The energy of power supply 22 may be renewable or exhaustible, and/or replaceable. For example, power supply 22 may comprise one or more rechargeable or disposable batteries. In various embodiments, the energy from power supply 22 may be converted from one form (e.g., electrical, magnetic, thermal) to another form to perform the functions of a system.

[0036] Power supply 22 may provide energy for performing the functions of CEW 1. For example, power supply 22 may provide the electrical current to signal generator 24 that is provided through a target to impede locomotion of the target (e.g., via magazine 12). Power supply 22 may provide the energy for a stimulus signal. Power supply 22 may provide the energy for other signals, including an ignition signal, as discussed further herein.

[0037] In various embodiments, processing circuit 20 may comprise any circuitry, electrical components, electronic components, software, and/or the like configured to perform various operations and functions discussed herein. For example, processing circuit 20 may comprise a processing circuit, a processor, a digital signal processor, a microcontroller, a microprocessor, an application specific integrated circuit (ASIC), a programmable logic device, logic circuitry, state machines, MEMS devices, signal conditioning circuitry, communication circuitry, a computer, a computer-based system, a radio, a network appliance, a data bus, an address bus, and/or any combination thereof. In various embodiments, processing circuit 20 may include passive electronic devices (e.g., resistors, capacitors, inductors, etc.) and/or active electronic devices (e.g., op amps, comparators, analog-to-digital converters, digital-to-analog converters, programmable logic, SRCs, transistors, etc.). In various embodiments, processing circuit 20 may include data buses, output ports, input ports, timers, memory, arithmetic units, and/or the like.

[0038] In various embodiments, processing circuit 20 may include signal conditioning circuitry. Signal conditioning circuitry may include level shifters to change (e.g., increase, decrease) the magnitude of a voltage (e.g., of a signal) before receipt by processing circuit 20 or to shift the magnitude of a voltage provided by processing circuit 20.

[0039] In various embodiments, processing circuit 20 may be configured to control and/or coordinate operation of some or all aspects of CEW 1. For example, processing circuit 20 may include (or be in communication with) memory configured to store data, programs, and/or instructions. The memory may comprise a tangible non-transitory computer-readable memory. Instructions stored on the tangible non-transitory memory may allow processing circuit 20 to perform various operations, functions, and/or steps, as described herein.

[0040] In various embodiments, the memory may comprise any hardware, software, and/or database component capable of storing and maintaining data. For example, a memory unit may comprise a database, data structure, memory component, or the like. A memory unit may comprise any suitable non-transitory memory known in the art, such as, an internal memory (e.g., random access memory (RAM), read-only memory (ROM), solid state drive (SSD), etc.), removable memory (e.g., an SD card, an xD card, a CompactFlash card, etc.), or the like.

[0041] Processing circuit 20 may be configured to provide and/or receive electrical signals whether digital and/or analog in form. Processing circuit 20 may provide and/or receive digital information via a data bus using any protocol. Processing circuit 20 may receive information, manipulate the received information, and provide the manipulated information. Processing circuit 20 may store information and retrieve stored information. Information received, stored, and/or manipulated by processing circuit 20 may be used to perform a function, control a function, and/or to perform an operation or execute a stored program.

[0042] Processing circuit 20 may control the operation and/or function of other circuits and/or components of CEW 1. Processing circuit 20 may receive status information regarding the operation of other components, perform calculations with respect to the status information, and provide commands (e.g., instructions) to one or more other components. Processing circuit 20 may command another component to start operation, continue operation, alter operation, suspend operation, cease operation, or the like. Commands and/or status may be communicated between processing circuit 20 and other circuits and/or components via any type of bus (e.g., SPI bus) including any type of data/address bus.

[0043] In various embodiments, processing circuit 20 may be mechanically and/or electronically coupled to trigger 15. Processing circuit 20 may be configured to detect an activation, actuation, depression, input, etc. (collectively, an “activation event”) of trigger 15. In response to detecting the activation event, processing circuit 20 may be configured to perform various operations and/or functions, as discussed further herein. Processing circuit 20 may also include a sensor (e.g., a trigger sensor) attached to trigger 15 and configured to detect an activation event of trigger 15. The sensor may comprise any suitable sensor, such as a mechanical and/or electronic sensor capable of detecting an activation event in trigger 15 and reporting the activation event to processing circuit 20.

[0044] In various embodiments, processing circuit 20 may be mechanically and/or electronically coupled to control interface 17. Processing circuit 20 may be configured to detect an activation, actuation, depression, input, etc. (collectively, a “control event”) of control interface 17. In response to detecting the control event, processing circuit 20 may be configured to perform various operations and/or functions, as discussed further herein. Processing circuit 20 may also include a sensor (e.g., a control sensor) attached to control interface 17 and configured to detect a control event of control interface 17. The sensor may comprise any suitable mechanical and/or electronic sensor capable of detecting a control event in control interface 17 and reporting the control event to processing circuit 20.

[0045] In various embodiments, processing circuit 20 may be electrically and/or electronically coupled to power supply 22. Processing circuit 20 may receive power from power supply 22. The power received from power supply 22 may be used by processing circuit 20 to receive signals, process signals, and transmit signals to various other components in CEW 1. Processing circuit 20 may use power from power supply 22 to detect an activation event of trigger 15, a control event of control interface 17, or the like, and generate one or more control signals in response to the detected events. The control signal may be based on the control event and the activation event. The control signal may be an electrical signal.

[0046] In various embodiments, processing circuit 20 may be electrically and/or electronically coupled to signal generator 24. Processing circuit 20 may be configured to transmit or provide control signals to signal generator 24 in response to detecting an activation event of trigger 15. Multiple control signals may be provided from processing circuit 20 to signal generator 24 in

series. In response to receiving the control signal, signal generator 24 may be configured to perform various functions and/or operations, as discussed further herein.

[0047] In various embodiments, signal generator 24 may be configured to receive one or more control signals from processing circuit 20. Signal generator 24 may provide an ignition signal to magazine 12 based on the control signals. Signal generator 24 may be electrically and/or electronically coupled to processing circuit 20 and/or magazine 12. Signal generator 24 may be electrically coupled to power supply 22. Signal generator 24 may use power received from power supply 22 to generate an ignition signal. For example, signal generator 24 may receive an electrical signal from power supply 22 that has first current and voltage values. Signal generator 24 may transform the electrical signal into an ignition signal having second current and voltage values. The transformed second current and/or the transformed second voltage values may be different from the first current and/or voltage values. The transformed second current and/or the transformed second voltage values may be the same as the first current and/or voltage values. Signal generator 24 may temporarily store power from power supply 22 and rely on the stored power entirely or in part to provide the ignition signal. Signal generator 24 may also rely on received power from power supply 22 entirely or in part to provide the ignition signal, without needing to temporarily store power.

[0048] Signal generator 24 may be controlled entirely or in part by processing circuit 20. In various embodiments, signal generator 24 and processing circuit 20 may be separate components (e.g., physically distinct and/or logically discrete). Signal generator 24 and processing circuit 20 may be a single component. For example, a control circuit within housing 10 may at least include signal generator 24 and processing circuit 20. The control circuit may also include other components and/or arrangements, including those that further integrate corresponding function of these elements into a single component or circuit, as well as those that further separate certain functions into separate components or circuits.

[0049] Signal generator 24 may be controlled by the control signals to generate an ignition signal having a predetermined current value or values. For example, signal generator 24 may include a current source. The control signal may be received by signal generator 24 to activate the current source at a current value of the current source. An additional control signal may be received to decrease a current of the current source. For example, signal generator 24 may include a pulse width modification circuit coupled between a current source and an output of the control circuit.

A second control signal may be received by signal generator 24 to activate the pulse width modification circuit, thereby decreasing a non-zero period of a signal generated by the current source and an overall current of an ignition signal subsequently output by the control circuit. The pulse width modification circuit may be separate from a circuit of the current source or, alternatively, integrated within a circuit of the current source. Various other forms of signal generators 45 may alternatively or additionally be employed, including those that apply a voltage over one or more different resistances to generate signals with different currents. In various embodiments, signal generator 24 may include a high-voltage module configured to deliver an electrical current having a high voltage. In various embodiments, signal generator 24 may include a low-voltage module configured to deliver an electrical current having a lower voltage, such as, for example, 2,000 volts.

[0050] Responsive to receipt of a signal indicating activation of trigger 15 (e.g., an activation event), a control circuit provides an ignition signal to magazine 12 (or an electrode in magazine 12). For example, signal generator 24 may provide an electrical signal as an ignition signal to magazine 12 in response to receiving a control signal from processing circuit 20. In various embodiments, the ignition signal may be separate and distinct from a stimulus signal. For example, a stimulus signal in CEW 1 may be provided to a different circuit within magazine 12, relative to a circuit to which an ignition signal is provided. Signal generator 24 may be configured to generate a stimulus signal. In various embodiments, a second, separate signal generator, component, or circuit (not shown) within housing 10 may be configured to generate the stimulus signal. Signal generator 24 may also provide a ground signal path for magazine 12, thereby completing a circuit for an electrical signal provided to magazine 12 by signal generator 24. The ground signal path may also be provided to magazine 12 by other elements in housing 10, including power supply 22.

[0051] In various embodiments, a bay 11 of housing 10 may be configured to receive one or more magazine 12. Bay 11 may comprise an opening in an end of housing 10 sized and shaped to receive one or more magazine 12. Bay 11 may include one or more mechanical features configured to removably couple one or more magazine 12 within bay 11. Bay 11 of housing 10 may be configured to receive a single magazine, two magazines, three magazines, nine magazines, or any other number of magazines.

[0052] Magazine 12 may comprise one or more propulsion modules 25 and one or more electrodes E. For example, a magazine 12 may comprise a single propulsion module 25 configured

to deploy a single electrode E. As a further example, a magazine 12 may comprise a single propulsion module 25 configured to deploy a plurality of electrodes E. As a further example, a magazine 12 may comprise a plurality of propulsion modules 25 and a plurality of electrodes E, with each propulsion module 25 configured to deploy one or more electrodes E.

[0053] In various embodiments, one or more propulsion modules may be located in housing 10. In response to magazine 12 being coupled to housing 10 (e.g., inserted within bay 11), the one or more propulsion modules in housing 10 may be fluidly coupled with one or more electrodes E in magazine 12.

[0054] In various embodiments, and as depicted in FIG. 2, magazine 12 may comprise a first propulsion module 25-1 configured to deploy a first electrode E0, a second propulsion module 25-2 configured to deploy a second electrode E1, a third propulsion module 25-3 configured to deploy a third electrode E2, and a fourth propulsion module 25-n configured to deploy a fourth electrode En. Each series of propulsion modules and electrodes may be contained in the same and/or separate magazines. As referred to herein, electrodes E0, E1, E2, En may be generally referred to individually as an “electrode E” or collectively as “electrodes E.” As referred to herein, propulsion modules 25-1, 25-2, 25-3, 25-n may be referred to individually as a “propulsion module 25” or collectively as “propulsion modules 25.”

[0055] In various embodiments, a propulsion module 25 may be coupled to, or in communication with one or more electrodes E in magazine 12. In various embodiments, magazine 12 may comprise a plurality of propulsion modules 25, with each propulsion module 25 coupled to, or in communication with, one or more electrodes E. A propulsion module 25 may comprise any device, propellant (e.g., air, gas, etc.), primer, or the like capable of providing a propulsion force in magazine 12. The propulsion force may include an increase in pressure caused by rapidly expanding gas within an area or chamber. The propulsion force may be applied to one or more electrodes E in magazine 12 to cause the deployment of the one or more electrodes E. A propulsion module 25 may provide the propulsion force in response to magazine 12 receiving an ignition signal, as previously discussed.

[0056] In various embodiments, the propulsion force may be directly applied to one or more electrodes E. For example, a propulsion force from propulsion module 25-1 may be provided directly to first electrode E0. A propulsion module 25 may be in fluid communication with one or more electrodes E to provide the propulsion force. For example, a propulsion force from

propulsion module 25-1 may travel within a housing or channel of magazine 12 to first electrode E0. The propulsion force may travel via a manifold in magazine 12.

[0057] In various embodiments, the propulsion force may be provided indirectly to one or more electrodes E. For example, the propulsion force may be provided to a secondary source of propellant within a propulsion module 25. The propulsion force may launch the secondary source of propellant within a propulsion module 25, causing the secondary source of propellant to release propellant. A force associated with the released propellant may in turn provide a force to one or more electrodes E. A force generated by a secondary source of propellant may cause the one or more electrodes E to be deployed from the magazine 12 and CEW 1.

[0058] In various embodiments, an electrode E may comprise any suitable type of projectile. For example, one or more electrodes E may be or include a projectile, a probe, an electrode (e.g., an electrode dart), an entangling projectile (e.g., a tether-based entangling projectile, a net, etc.), a payload projectile (e.g., comprising a liquid or gas substance), or the like. An electrode may include a spear portion, designed to pierce or attach proximate a tissue of a target in order to provide a conductive electrical path between the electrode and the tissue, as previously discussed herein. In some embodiments, the spear portion may comprise a spear assembly.

[0059] In various embodiments, magazine 12 may be configured to receive one or more cartridges. For example, magazine 12 may define one or more bores. A bore may comprise an axial opening through magazine 12. Each bore may be configured to receive a cartridge. Each bore may be sized and shaped accordingly to receive and house the cartridge. Each bore may comprise any suitable deployment angle. One or more bores may comprise similar deployment angles. One or more bores may comprise different deployment angles. Magazine 12 may comprise any suitable or desired number of bores, such as, for example, two bores, five bores, nine bores, ten bores, and/or the like.

[0060] A cartridge may comprise a body (e.g., a cartridge body) housing an electrode E and one or more components necessary to deploy the electrode E from the body. For example, a cartridge may comprise an electrode E and a propulsion module. The propulsion module may be similar to any other propulsion module, primer, or the like disclosed herein.

[0061] In various embodiments, a cartridge may comprise a cylindrical outer body defining a hollow inner portion. The hollow inner portion may house an electrode E (e.g., an electrode E, spear or spear assembly, filament wire, etc.). The hollow inner portion may house a propulsion

module configured to deploy the electrode E from a first end of the cylindrical outer body. The cartridge may include a piston positioned adjacent a second end of the electrode E. The cartridge may have the propulsion module positioned such that the piston is located between the electrode E and the propulsion module. The cartridge may also have a wad positioned adjacent the piston, where the wad is located between the propulsion module and the piston.

[0062] In various embodiments, a cartridge may comprise a contact on an end of the body. The contact may be configured to allow the cartridge to receive an electrical signal from a CEW handle. For example, the contact may comprise an electrical contact configured to enable the completion of an electrical circuit between the cartridge and a signal generator of the CEW handle. In that regard, the contact may be configured to transmit (or provide) a stimulus signal from the CEW handle to the electrode E. As a further example, the contact may be configured to transmit (or provide) an electrical signal (e.g., an ignition signal) from the CEW handle to a propulsion module within the cartridge. For example, the contact may be configured to transmit (or provide) the electrical signal to a conductor of the propulsion module, thereby causing the conductor to heat up and ignite a pyrotechnic material inside the propulsion module. Ignition of the pyrotechnic material may cause the propulsion module to deploy (e.g., directly or indirectly) the electrode E from the cartridge.

[0063] In operation, a cartridge may be inserted into a bore of magazine 12. Magazine 12 may be inserted into the bay of a CEW handle. The CEW may be operated to deploy an electrode E from the cartridge in magazine 12. Magazine 12 may be removed from the bay of the CEW handle. The cartridge (e.g., a used cartridge, a spent cartridge, etc.) may be removed from the bore of magazine 12. A new cartridge may then be inserted into the same bore of magazine 12 for additional deployments. The number of cartridges that magazine 12 is capable of receiving may be dependent on a number of bores in magazine 12. For example, in response to magazine 12 comprising ten bores, magazine 12 may be configured to receive at most ten cartridges at the same time. As a further example, in response to magazine 12 comprising two bores, magazine 12 may be configured to receive at most two cartridges at the same time.

[0064] Control interface 17 of CEW 1 may comprise, or be similar to, any control interface disclosed herein. In various embodiments, control interface 17 may be configured to control selection of firing modes in CEW 1. Controlling selection of firing modes in CEW 1 may include disabling firing of CEW 1 (e.g., a safety mode, etc.), enabling firing of CEW 1 (e.g., an active

mode, a firing mode, an escalation mode, etc.), controlling deployment of magazine 12, and/or similar operations, as discussed further herein. In various embodiments, control interface 17 may also be configured to perform (or cause performance of) one or more operations that do not include the selection of firing modes. For example, control interface 17 may be configured to enable the selection of operating modes of CEW 1, selection of options within an operating mode of CEW 1, or similar selection or scrolling operations, as discussed further herein.

[0065] Control interface 17 may be located in any suitable location on or in housing 10. For example, control interface 17 may be coupled to an outer surface of housing 10. Control interface 17 may be coupled to an outer surface of housing 10 proximate trigger 15 and/or a guard of housing 10. Control interface 17 may be electrically, mechanically, and/or electronically coupled to processing circuit 20. In various embodiments, in response to control interface 17 comprising electronic properties or components, control interface 17 may be electrically coupled to power supply 22. Control interface 17 may receive power (e.g., electrical current) from power supply 22 to power the electronic properties or components.

[0066] Control interface 17 may be electronically or mechanically coupled to trigger 15. For example, and as discussed further herein, control interface 17 may function as a safety mechanism. In response to control interface 17 being set to a “safety mode,” CEW 1 may be unable to launch electrodes from magazine 12. For example, control interface 17 may provide a signal (e.g., a control signal) to processing circuit 20 instructing processing circuit 20 to disable deployment of electrodes from magazine 12. As a further example, control interface 17 may electronically or mechanically prohibit trigger 15 from activating (e.g., prevent or disable a user from depressing trigger 15; prevent trigger 15 from launching an electrode; etc.).

[0067] Control interface 17 may comprise any suitable electronic or mechanical component capable of enabling selection of firing modes. For example, control interface 17 may comprise a fire mode selector switch, a safety switch, a safety catch, a rotating switch, a selection switch, a selective firing mechanism, and/or any other suitable mechanical control. As a further example, control interface 17 may comprise a slide, such as a handgun slide, a reciprocating slide, or the like. As a further example, control interface 17 may comprise a touch screen, user interface or display, or similar electronic visual component.

[0068] The safety mode may be configured to prohibit deployment of an electrode from magazine 12 in CEW 1. For example, in response to a user selecting the safety mode, control

interface 17 may transmit a safety mode instruction to processing circuit 20. In response to receiving the safety mode instruction, processing circuit 20 may prohibit deployment of an electrode from magazine 12. Processing circuit 20 may prohibit deployment until a further instruction is received from control interface 17 (e.g., a firing mode instruction). As previously discussed, control interface 17 may also, or alternatively, interact with trigger 15 to prevent activation of trigger 15. In various embodiments, the safety mode may also be configured to prohibit deployment of a stimulus signal from signal generator 24, such as, for example, a local delivery.

[0069] The firing mode may be configured to enable deployment of one or more electrodes from magazine 12 in CEW 1. For example, and in accordance with various embodiments, in response to a user selecting the firing mode, control interface 17 may transmit a firing mode instruction to processing circuit 20. In response to receiving the firing mode instruction, processing circuit 20 may enable deployment of an electrode from magazine 12. In that regard, in response to trigger 15 being activated, processing circuit 20 may cause the deployment of one or more electrodes. Processing circuit 20 may enable deployment until a further instruction is received from control interface 17 (e.g., a safety mode instruction). As a further example, and in accordance with various embodiments, in response to a user selecting the firing mode, control interface 17 may also mechanically (or electronically) interact with trigger 15 of CEW 1 to enable activation of trigger 15.

[0070] In various embodiments, CEW 1 may deliver a stimulus signal via a circuit that includes signal generator 24 positioned in the handle of CEW 1. An interface (e.g., cartridge interface, magazine interface, etc.) on each magazine 12 inserted into housing 10 electrically couples to an interface (e.g., handle interface, housing interface, etc.) in housing 10. Signal generator 24 couples to each magazine 12, and thus to the electrodes E, via the handle interface and the magazine interface. A first filament couples to the interface of the magazine 12 and to a first electrode. A second filament couples to the interface of the magazine 12 and to a second electrode. The stimulus signal travels from signal generator 24, through the first filament and the first electrode, through target tissue, and through the second electrode and second filament back to signal generator 24.

[0071] In various embodiments, CEW 1 may further comprise one or more user interfaces 27. A user interface 27 may be configured to receive an input from a user of CEW 1 and/or transmit an output to the user of CEW 1. User interface 27 may be located in any suitable location on or in

housing 10. For example, user interface 27 may be coupled to an outer surface of housing 10, or extend at least partially through the outer surface of housing 10. User interface 27 may be electrically, mechanically, and/or electronically coupled to processing circuit 20. In various embodiments, in response to user interface 27 comprising electronic or electrical properties or components, user interface 27 may be electrically coupled to power supply 22. User interface 27 may receive power (e.g., electrical current) from power supply 22 to power the electronic properties or components.

[0072] In various embodiments, user interface 27 may comprise one or more components configured to receive an input from a user. For example, user interface 27 may comprise one or more of an audio capturing module (e.g., microphone) configured to receive an audio input, a visual display (e.g., touchscreen, LCD, LED, etc.) configured to receive a manual input, a mechanical interface (e.g., button, switch, etc.) configured to receive a manual input, and/or the like. In various embodiments, user interface 27 may comprise one or more components configured to transmit or produce an output. For example, user interface 27 may comprise one or more of an audio output module (e.g., audio speaker) configured to output audio, a light-emitting component (e.g., flashlight, laser guide, etc.) configured to output light, a visual display (e.g., touchscreen, LCD, LED, etc.) configured to output a visual, and/or the like.

[0073] In various embodiments, and with reference to FIGs. 3A-4B, an electrode 330 is disclosed. Electrode 330 may be similar to any other electrode, projectile, or the like disclosed herein. Electrode 330 may be used in conjunction with any cartridge and/or magazine disclosed herein. Electrode 330 may be used without a cartridge. Electrode 330 may comprise an electrode, projectile, or the like for a CEW. Electrode 330 may comprise a projectile for a projectile launcher.

[0074] In various embodiments, electrode 330 may comprise an electrode body 331 having a first end 332 (e.g., a first electrode end, a forward end, a first electrode body end, etc.) opposite a second end 333 (e.g., a second electrode end, an aft end, a rearward end, a second electrode body end, etc.). Electrode body 331 may comprise an outer surface opposite an inner surface. Electrode body 331 may define a cylindrical body. In some embodiments, a shape of electrode body 331 may be complimentary to a cartridge configured to receive electrode 330 (e.g., electrode body 331 may be complimentary with one or more inner surfaces of a cartridge).

[0075] In various embodiments, electrode 330 may comprise a head 340 (e.g., front head, electrode head, interchangeable head, etc.). Head 340 may comprise a body 341 (e.g., a head body,

a front head body, etc.) having a first head end 342 opposite a second head end 343. Body 341 may define a middle section 345 (e.g., a head middle section) between first head end 342 and second head end 343.

[0076] Second head end 343 may be coupled to electrode body 331 (e.g., at first end 332). Second head end 343 may be coupled to electrode body 331 such that a portion of head 340 is received within electrode body 331. The portion of head 340 received within electrode body 331 may be less than half of head 340. In some embodiments, the portion of head 340 received within electrode body 331 may be 30% of head 340. In some embodiments, the portion of head 340 received within electrode body 331 may be less than 40% of head 340; less than 40%, 30%, or 20% of head 340; about 40%, 30%, or 20% of head 340; and/or any other similar portion of head 340 (wherein “about” as used in this context refers only to +/- 5%).

[0077] Head 340 may be configured to receive one or more attachments (e.g., head attachments, accessories, etc.). Head 340 may be configured to receive a single attachment. Head 340 may be configured to receive a plurality of attachments. An attachment may be configured to couple to a front surface (e.g., a radially forward surface) of first head end 342. An attachment may be configured to couple to an axially outer surface of first head end 342. An attachment may be configured to couple to head 340 proximate middle section 345 between first head end 342 and second head end 343. In some embodiments, an attachment may be configured to couple to head 340 at one or more of a front surface, an axially outer surface, and/or middle section 345 of head 340.

[0078] First head end 342 may be configured to receive a first attachment configured to enable electrode 330 to couple to a target. For example, the first attachment may comprise a spear, a spear assembly, a hook, a barb, a training attachment, a hook and loop attachment, and/or the like. In some embodiments, the first attachment may comprise an electrically conductive material.

[0079] First head end 342 may be configured to receive a second attachment configured to provide a property to electrode 330. The property may comprise a physical property, a physical characteristic, and/or the like. For example, the property may comprise an aerodynamic property. In that regard, the second attachment may be coupled to head 340 and configured to change an aerodynamic property or characteristic of electrode 330 (e.g., lift, drag, etc.). As a further example, the property may comprise a force absorbing property. In that regard, the second attachment may be coupled to head 340 and configured to at least partially reduce an impact force of electrode 330

against a target. The second attachment may at least partially absorb a force of impact with a target thereby reducing potential tissue or skin damage (e.g., bruising, tearing, etc.) to the target. The second attachment may reduce a momentum of electrode 330 after impact with a target, thereby hindering (e.g., preventing) electrode 330 from bouncing off of (e.g., deflecting) the target with enough residual force to decouple electrode 330 from a surface (e.g., clothing, tissue, etc.) of the target. The second attachment may comprise a pad, a shock absorber, a thermoplastic elastomer, a rubber, and/or the like. In various embodiments, the second attachment may comprise an electrically non-conductive material.

[0080] In various embodiments, a first attachment and a second attachment may couple to head 340 at first head end 342. In some embodiments, a second attachment may couple to each of head 340 and the first attachment. In various embodiments, head 340 may comprise a first mechanical feature configured to receive the first attachment and a second mechanical feature configured to receive the second attachment. The first mechanical feature may comprise an opening, channel, groove, protrusion, or the like. The second mechanical feature may comprise a shape of head 340.

[0081] In various embodiments, first head end 342 may be sized and shaped to receive one or more attachments. For example, first head end 342 may comprise a channel 344 (e.g., head channel, attachment channel, axial channel, etc.) configured to allow an attachment to couple to head 340. Channel 344 may define an opening on first head end 342 extending into a body of head 340. Channel 344 may not extend through to second head end 343. Channel 344 may be configured to receive a first attachment.

[0082] In some embodiments, electrode 330 may comprise a spear or spear assembly coupled within channel 344. For example, the spear or spear assembly may be coupled within channel 344 mechanically or chemically. A mechanical coupling may comprise an interference fit, a press fit, a deformation, or the like. A chemical coupling may include an adhesive, and/or the like. The spear or spear assembly may be coupled within channel 344 such that a gap exists between an end of the spear or spear assembly and an inner end of channel 344. In other embodiments, an end of the spear or spear assembly may abut against (e.g., contact) an inner end of channel 344.

[0083] First head end 342 may comprise a shape configured to receive an attachment. For example, head 340 at first head end 342 may comprise a “T-shape” wherein an outer portion of first head end 342 (e.g., a first portion) comprises a greater diameter than an inner portion of head end 342 (e.g., a second portion). The T-shape may be configured to receive a second attachment.

The outer portion and the inner portion of first head end 342 may further at least partially define channel 344. The outer portion of first head end 342 may be axially forward the inner portion of first head end 342.

[0084] In various embodiments, electrode 330 may comprise an absorber 360 (e.g., a shock absorber, an impact absorber, a bumper, a front pad, etc.). Absorber 360 may comprise an absorber body 361 having a first absorber end 362 (e.g., a forward absorber end) opposite a second absorber end 363 (e.g., an aft absorber end).

[0085] Absorber 360 may be coupled to head 340. Absorber 360 may be coupled to head 340 using a mechanical coupling, a chemical coupling, and/or the like. Absorber 360 may couple to head 340 at second absorber end 363. Absorber 360 may be coupled to first head end 342. Absorber 360 may be coupled to head 340 forward second head end 343. Absorber 360 may be coupled to middle section 345. Absorber 360 may be coupled to a T-shape defining first head end 342. Absorber 360 may comprise an outer surface radially outward an outer surface of head 340. Absorber 360 may comprise an aft inner surface that is radially inward from first head end 342 and second head end 343, but radially outward from middle section 345 of head 340. The aft inner surface may be defined at or proximate to second absorber end 363. The aft inner surface may be axially aft first head end 342 and axially forward second head end 343. In some embodiments, absorber 360 may be molded over head 340 such as, for example, using an injection molding process.

[0086] Absorber 360 may extend forward head 340. In some embodiments, absorber 360 may define an opening configured to receive a spear or spear assembly. In some embodiments, absorber 360 may be coupled to a spear or spear assembly.

[0087] Absorber 360 may be configured to at least partially absorb (or receive) a force of impact with a target thereby reducing potential tissue or skin damage (e.g., bruising, tearing, etc.) to the target. Absorber 360 may reduce a momentum of electrode 330 after impact with a target, thereby hindering (e.g., preventing) electrode 330 from bouncing off of (e.g., deflecting) the target with enough residual force to decouple electrode 330 from a surface (e.g., clothing, tissue, etc.) of the target. Absorber 360 may comprise a pad, a shock absorber, a thermoplastic elastomer, a rubber, and/or the like. In various embodiments, Absorber 360 may comprise an electrically non-conductive material. The spear or spear assembly may comprise an electrically conductive material configured to provide a stimulus signal to the target.

[0088] In various embodiments, one or more portions of absorber 360 may be formed of a deformable (e.g., flexible, etc.) material. Upon impact with a target, the deformable material may be configured to elastically (e.g., temporarily, etc.) deform, or plastically (e.g., permanently, etc.) deform. The deformable material may include thermoplastic vulcanizates (e.g., SANTOPRENE), silicone rubbers, polyurethanes, polybutadienes, and other materials configured to deform upon impact with a target. The deformable material may include resilient materials (e.g., materials having high yield strengths and low moduli of elasticity, materials exhibiting spring-like properties, etc.). The deformable material may include elastomeric materials. The deformable material may include soft materials.

[0089] In various embodiments, absorber 360 may comprise a plurality of different structures and/or materials. For example, absorber 360 may comprise a first material configured to at least partially aid in absorbing a force of impact and a second material configured to provide further rigidity and/or structure of absorber 360. The first material may comprise an elastic material configured to deform and/or absorb the force of impact (as previously discussed), while the first material may comprise a more rigid material, such as a plastic (e.g., acrylic or polymethyl methacrylate (PMMA), polycarbonate (PC), polyethylene (PE), polypropylene (PP), polyethylene terephthalate (PETE or PET), polyvinyl chloride (PVC), acrylonitrile-butadiene-styrene (ABS), etc.). The first material may define an outer portion of absorber 360 to ensure absorber 360 deforms and/or absorbs the force of impact. The second material may define an inner portion of absorber 360 to provide rigidity and structure for absorber 360.

[0090] In various embodiments, first absorber end 362 may comprise one or more features, structures, or the like configured to at least partially aid in absorber 360 absorbing (or receiving) a force of impact with a target. First absorber end 362 may be configured to reduce shock provided by an impact (e.g., collision) of electrode 330 and the target. First absorber end 362 may be configured to minimize blunt impact and/or penetration of the forward portion of electrode 330 with the target by distributing the impact force (e.g., force of impact, etc.) of electrode 330 over a greater impact area (e.g., area of impact, contact area, surface contact area, etc.), distributing the impact force of electrode 330 over a longer duration (e.g., increasing a duration of impact, etc.), and/or absorbing kinetic energy of electrode 330. First absorber end 362 may comprise an expandable portion. After a length of a spear or spear assembly penetrates a target, the expandable portion of first absorber end 362 may impact the target and expand (e.g., change shape, deform,

etc.) to increase a contact area of electrode 330 with the target. Expansion of the expandable portion of first absorber end 362 may absorb kinetic energy of an impact of electrode 330 with a target. In other embodiments, deployment of electrode 330 may cause the expandable portion of first absorber end 362 to expand to increase the contact area of electrode 330 with the target prior to impact. An increase in contact area of electrode 330 with a target may reduce an impact pressure exerted by electrode 330 on the target. First absorber end 362 may reduce a likelihood of blunt impact and/or penetration of a body of electrode 330 with a target, thereby enabling electrode 330 to be launched from a CEW and impact a target with greater kinetic energy than an electrode without an absorber. For example, electrode 330 comprising absorber 360 may impact a target with 12 joules of energy without risk of the forward portion of electrode 330 penetrating the target, whereas an electrode without an absorber may only impact a target with 6 joules of energy without risk of the forward portion of the electrode penetrating the target.

[0091] In various embodiments, first absorber end 362 may define an expandable portion of absorber 360. For example, the expandable portion may be configured to expand upon impact with a target to increase a contact area between absorber 360 and the target and/or absorb a portion of the impact force imparted on the target by electrode 330. Prior to impact and/or launch of electrode 330, the expandable portion may be in a collapsed state. After (or during) impact and/or launch of electrode 330, the expandable portion may be forced into an expanded state. The expandable portion may comprise one or more members (e.g., fingers). For example, the expandable portion may include members extending in an axially forward direction from first absorber end 362. The members may be arranged at regularly spaced circumferential intervals, such as every 30 degrees, every 60 degrees, every 90 degrees, and/or the like. Each member may be separated from adjacent members by a channel (e.g., slot, void, etc.). A shape of a channel may comprise a V-shape, a U-shape, a C-shape, a square shape, and/or any other suitable or desired shape. For example, first absorber end 362 may comprise a plurality of channels, wherein each member of a plurality of members is separated from an adjacent member of the plurality of members by a respective channel of the plurality of channels. At least one channel of a plurality of channels may be disposed between pair of adjacent members of a plurality of members of the expandable portion. In various embodiments, the arrangement and shape of the members in combination with the arrangement and shape of the channels may generally comprise a castellated nut (i.e., castle nut, etc.) shape or a slotted inverted (e.g., reversed) frustoconical cup shape.

[0092] In response to impact and/or launch of electrode 330, the members of the expandable portion may flex (e.g., deform) radially outward. For example, as absorber 360 impacts a target, the force of the impact may cause each member to deform outward, thereby further increasing the impact area of absorber 360 over the duration of impact. For example, as electrode 330 flies toward a target, momentum of electrode 330 causes a spear or spear assembly to pierce the target. Typically, however, the momentum of electrode 330 is not exhausted by penetration of the spear or spear assembly. The remaining momentum of electrode 330 is transferred to the target via impact of absorber 360 with the target. Absorber 360 is configured to reduce the impact force in response to the change in momentum, thereby preventing further penetration of at least a portion of electrode 330 (e.g., forward portion, electrode body, etc.) into the target. The expandable portion of first absorber end 362 may expand (e.g., deform), thereby extending the impact time of absorber 360 with the target, which in turn reduces the impact force. As the expandable portion of first absorber end 362 expands, the impact area may increase (e.g., by members flaring radially outward), thereby distributing the force of impact over a greater area, which in turn may prevent electrode body 331 from penetrating or further impacting the target. Increasing the impact area while also extending the impact time may have a synergistic effect on reducing blunt impact and preventing penetration of tissue of a target by electrode body 331.

[0093] In various embodiments, increasing the deformation of the members of the expandable portion (e.g., increasing the radially outward deformation or one or more members) may increase the impact area of absorber 360. Increasing the impact area of absorber 360 may increase the amount of force that absorber 360 can receive during an impact.

[0094] In that regard, and in accordance with various embodiments, electrode 330 may comprise an impact spreader 365. Impact spreader 365 may be configured to at least partially aid in increasing the radially outward deformation of the expandable portion of absorber 360. Impact spreader 365 may be positioned forward absorber 360. In some embodiments, impact spreader 365 may be positioned aft a front end of a spear or spear assembly. Impact spreader 365 may be coupled to the spear or spear assembly. Impact spreader 365 may be coupled to first absorber end 362 of absorber 360.

[0095] Impact spreader 365 may comprise a spreader body having a first spreader end opposite a second spreader end. The first spreader end may be proximate a front end of a spear of spear assembly. The second spreader end may be proximate to, or coupled to or in contact with, first

absorber end 362 of absorber 360. The second spreader end may be positioned within an opening of first absorber end 362 of absorber 360. For example, at least a portion of the second spreader end may be inserted into first absorber end 362 of absorber 360.

[0096] Impact spreader 365 may be configured to receive an impact force and distribute the impact force to absorber 360. For example, responsive to impact of electrode 330 against a target, impact spreader 365 may receive an impact force. Impact spreader 365 may translate in an axially aft direction to transfer and distribute the impact force to absorber 360.

[0097] Impact spreader 365 may be configured to provide an axial force against absorber 360 responsive to an impact against impact spreader 365. For example, in response to electrode 330 being deployed toward a target, a spear or spear assembly and impact spreader 365 may impact the target. The impact against the first spreader end may cause impact spreader 365 to move in an aft direction towards absorber 360. Movement in the aft direction may cause the second spreader end to provide the axial force against first absorber end 362 of absorber 360. The axial force provided by impact spreader 365 may be received by the expandable portion of absorber 360. Receipt of the axial force may cause the one or more members of the expandable portion to deform radially outward. In some embodiments, the axial force provided by impact spreader 365 may cause the one or more members of the expandable portion to further deform radially outward compared to absorber 360 receiving the impact force without use of impact spreader 365.

[0098] In some embodiments, impact spreader 365 may be configured to remain in contact with absorber 360 before, during, and after impact of electrode 330 against the target. In some embodiments, impact spreader 365 may not be in contact with absorber 360 before impact of electrode 330 against the target, but may contact and remain in contact with absorber 360 during and after impact of electrode 330 against the target. In some embodiments, impact spreader 365 may be configured to break during impact of electrode 330 against the target. In that regard, impact spreader 365 may apply the force against absorber 360 responsive to impact of electrode 330 against the target, but then may break (e.g., decouple, disengage, etc.) such that absorber 360 contacts the target after the initial impact of electrode 330 against the target.

[0099] Impact spreader 365 may comprise any suitable size, shape, and/or dimensions capable of aiding in the deformation of the expandable portion of absorber 360 during an impact. Impact spreader 365 may comprise any suitable shape capable of aiding in the deformation of the expandable portion of absorber 360 during an impact. For example, spreader 365 may comprise a

convex shape, a concave shape, a conical shape, a spherical shape, a square shape, a rectangular shape, a torus shape, a ring shape, and/or the like.

[0100] In various embodiments, head 340 may comprise varying dimensions from first head end 342 to second head end 343. For example, head 340 may comprise an hourglass shape wherein first head end 342 and second head end 343 each comprise a greater diameter than middle section 345. First head end 342 may comprise a first diameter, second head end 343 may comprise a second diameter, and middle section 345 may comprise a third diameter (each diameter may also be referred to as a head diameter). The first diameter and the second diameter may each be greater than the third diameter (e.g., a middle section diameter). The first diameter may be less than the second diameter. The second diameter may be greater than the first diameter and the third diameter.

[0101] As discussed further herein, head 340 may be configured to receive an attachment. The attachment may be coupled to the middle portion of the head. The attachment may comprise varying thicknesses. For example, the attachment may comprise a first thickness proximate a portion of the attachment contacting first head end 342. The attachment may comprise a second thickness proximate a portion of the attachment contacting middle section 345. The first thickness and the first diameter may be substantially similar in size to the second thickness and the middle portion diameter. The first thickness and the first diameter may be less than or substantially similar in size to the second diameter. The second thickness and the middle section diameter may be less than or substantially similar in size to the second diameter.

[0102] In various embodiments, head 340 may comprise an electrically conductive material. For example, head 340 may comprise a metal material. Head 340 may comprise a metal alloy such as, for example, brass.

[0103] In various embodiments, electrode 330 may comprise a filament 337 (e.g., a wire-tether, a wire, etc.). Filament 337 may comprise an electrically conductive material configured to electrically couple electrode 330 to a cartridge, a magazine, and/or a CEW handle. In that regard, filament 337 may be configured to provide a stimulus signal and/or an ignition signal to electrode 330 via a signal generator of a CEW handle.

[0104] Filament 337 may comprise a first filament end 338 opposite a second filament end 339. First filament end 338 may be coupled to electrode 330. In some embodiments, first filament end 338 may be coupled to head 340. For example, first filament end 338 may be welded to head 340. As a further example, first filament end 338 may be coupled between head 340 and an inner surface

of electrode body 331. For example, first filament end 338 may be inserted between head 340 and electrode body 331, and electrode body 331 may be press-fit (e.g., deformed, staked, etc.) to couple electrode body 331 to head 340. The press-fit between electrode body 331 and head 340 may couple first filament end 338 between electrode body 331 and head 340.

[0105] Second filament end 339 may extend aft electrode 330 and may be configured to couple within a cartridge, a deployment unit, a magazine, and/or the like. In that regard, head 340, filament 337, and the cartridge, the deployment unit, the magazine, and/or the like may be in electrical series.

[0106] In various embodiments, filament 337 may be electrically conductive from first filament end 338 to second filament end 339. For example, filament 337 may be non-insulated from first filament end 338 to second filament end 339.

[0107] In various embodiments, filament 337 may be insulated from first filament end 338 to second filament end 339. In that respect, only a portion of first filament end 338 coupled to head 340 and/or a portion of second filament end 339 coupled to the cartridge, the deployment unit, the magazine, and/or the like may be non-insulated.

[0108] In various embodiments, filament 337 may be stowed in electrode body 331. For example, filament 337 may be wound in a winding (e.g., coils, filament winding, etc.). The winding may be stowed (e.g., stored, disposed, etc.) within electrode body 331. During a deployment, electrode 330 may travel in a forward direction. During travel, filament 337 may unravel (e.g., uncoil, unwind, etc.) from the winding to deploy filament 337 aft electrode body 331.

[0109] In various embodiments, electrode 330 may comprise a rear nozzle 350. Rear nozzle 350 may be disposed within electrode body 331. Rear nozzle 350 may be disposed within electrode body 331 proximate second end 333. Rear nozzle 350 may be disposed within electrode body 331 forward second end 333. In some embodiments, rear nozzle 350 may be axially offset from second end 333.

[0110] Rear nozzle 350 may define an opening 351. Opening 351 may be radially centered within electrode body 331. Rear nozzle 350 may be configured to position filament 337 as filament 337 unwinds and exits electrode 330. For example, as filament 337 deploys from electrode 330, filament 337 moves through opening 351. Friction between an inner wall of opening 351 and filament 337 applies a force on filament 337. Applying a force on filament 337 during a

deployment provides drag on electrode 330. Providing drag on electrode 330 increases stability of flight and accuracy of flight of electrode 330 along an intended trajectory. Increasing stability of flight and/or accuracy of flight may improve the repeatability of flight along intended trajectory of electrodes launched from different cartridges.

[0111] In various embodiments, opening 351 may further define a groove 352. Groove 352 may comprise an axial groove in opening 351 extending radially inward from opening 351 towards an inner surface of electrode body 331. Groove 352 may be sized and shaped to receive filament 337.

[0112] In various embodiments, groove 352 may position filament 337 prior to a deployment. During the deployment, filament 337 may unwind and may leave groove 352 (e.g., to contact opening 351). In various embodiments, groove 352 may position filament 337 prior to and during a deployment. For example, during the deployment filament 337 may remain within groove 352.

[0113] In various embodiments, second head end 343 may comprise one or more features, structures, and/or the like to aid in coupling filament 337 to head 340. For example, second head end 343 may comprise one or more features, structures, and/or the like to mechanically couple first filament end 338 to head 340 and/or to ensure that first filament end 338 remains mechanically coupled to head 340 before and after deployment of electrode 330, and before, during, and after an impact of electrode 330 with a target. Second head end 343 may also comprise one or more features, structures, and/or the like to electrically couple first filament end 338 to head 340.

[0114] As previously discussed, filament 337 may be wound into a winding. In some embodiments, first filament end 338 may be wound into a winding onto second head end 343. For example, and in accordance with various embodiments, second head end 343 may comprise one or more circumferential channels. Each circumferential channel may be sized and/or shaped to receive and/or retain lengths of filament 337. In that respect, first filament end 338 may be wound circumferentially through the one or more circumferential channels of second head end 343 to couple first filament end 338 to second head end 343. In some embodiments, an end of first filament end 338 may extend forward second head end 343 and proximate middle section 345.

[0115] As previously discussed, an electrode may electrically couple to a target by contacting (e.g., piercing, coupling to, etc.) the target's tissue. For example, the electrode may impact the target and a spear of the electrode may pierce the target's tissue to electrically couple the electrode to the target's tissue. In some instances, clothing or other objects on a target may affect the ability

of the electrode to directly contact the target's tissue. For example, thicker clothing may cause electrode to deflect away from the target after impact or fail to directly contact the target's tissue with the spear. In some instances where direct contact is not achieved, the spear may be proximate the target's tissue, but separated from the target's tissue by a gap or air, clothing, or the like.

[0116] In some embodiments, a CEW may provide a stimulus signal at a high voltage. The high voltage stimulus signal may ionize the air between the spear and the target's tissue to electrically couple the electrode to the target. Ionizing the air establishes a low impedance ionization path from the electrode to the target's tissue that may be used to deliver the stimulus signal into the target's tissue via the ionization path. However, a CEW may be unable to establish an ionization path for larger separations of air between the spear and the target's tissue.

[0117] In some embodiments, a CEW may provide a stimulus signal a low voltage. The low voltage stimulus signal may be unable to establish an ionization path in response to an electrode failing to directly couple to a target's tissue. In that regard, a CEW providing stimulus signals at only a low voltage may require deployed electrodes to be electrically coupled to the target's tissue through direct contact.

[0118] In various embodiments, electrode 330 may comprise a spear assembly 370 assembly (e.g., a nested spear, an extending spear, a deploying spear, etc.). Spear assembly 370 may comprise an attachment coupled to a forward end of electrode 330. Spear assembly 370 may be configured to extend prior to, during, or after impact of electrode 330 against a target. Spear assembly 370 may be configured to extend to at least partially decrease a distance (e.g., gap of air) between spear assembly 370 and a target's tissue. Decreasing the distance between spear assembly 370 and the target's tissue may improve electrical coupling between electrode 330 and the target. Spear assembly 370 may be configured to extend to pierce the target's tissue responsive to impact of electrode 330 against the target. In that regard, spear assembly 370 may be configured to at least partially increase the odds of direct contact with a target's tissue during a deployment (e.g., compared to a standard electrode spear).

[0119] In various embodiments, spear assembly 370 may comprise a first spear portion and a second spear portion. The first spear portion may be configured to first impact the target during the deployment. The second spear portion may be configured to next impact the target during the deployment. The first impact may be before the next impact. For example, the first impact may be with clothing of a target. The next impact may be with tissue of the target. As a further example,

the first impact may be with clothing and tissue of a target. The next impact may be with tissue of the target. As a further example, the first impact may be with clothing of a target. The next impact may be with clothing and tissue of the target.

[0120] Spear assembly 370 may be configured to provide a stimulus signal via the first spear portion and/or the second spear portion. Spear assembly 370 may be configured to provide the stimulus signal based on electrical coupling of the first spear portion and/or the second spear portion with a target. For example, in response to the first spear portion and the second spear portion being electrically coupled to the target, the stimulus signal may be provided via the first spear portion and the second spear portion. As a further example, in response to the first spear portion and the second spear portion being electrically coupled to the target, the stimulus signal may be provided via one of the first spear portion or the second spear portion. As a further example, in response to only the first spear portion being electrically coupled to the target, the stimulus signal may be provided via the first spear portion. As a further example, in response to only the second spear portion being electrically coupled to the target, the stimulus signal may be provided via the second spear portion.

[0121] The first spear portion and the second spear portion may be in electrical series with electrode 330. The first spear portion and the second spear portion may each be electrically coupled to electrode 330. The first spear portion and the second spear portion may be electrically coupled to electrode 330 in parallel. The first spear portion may be electrically coupled to electrode 330 and the second spear portion may be electrically coupled to the first spear portion. The first spear portion may be in electrical series with the second spear portion.

[0122] The first spear portion may be different from the second spear portion. For example, the first spear portion may comprise a first structure of spear assembly 370 and the second spear portion may comprise a second structure of spear assembly 370. The first structure and the second structure may comprise independent structures. The first structure and the second structure may comprise a same structure (e.g., a monolithic structure). In that regard, the first structure and the second structure may comprise different and/or distinct portions of the same structure. As a further example, the first spear portion may comprise a first material and the second spear portion may comprise a second material. The first material may be different from the second material. As a further example, the first spear portion may comprise a first physical dimension (e.g., diameter, circumference, length, etc.) and the second spear portion may comprise a second physical

dimension. The first physical dimension may be different from the second physical dimension. As a further example, the first spear portion may comprise a first shape and the second spear portion may comprise a second shape. The first shape may be different from the second shape. As a further example, the first spear portion may comprise a first attachment structure and the second spear portion may comprise a second attachment structure. The first attachment structure may be different from the second attachment structure.

[0123] The first spear portion may be located outward from the second spear portion. The second spear portion may be disposed within the first spear portion. A forward end of the first spear portion may extend forward a forward end of the second spear portion. A rearward end of the first spear portion may be located proximate a rearward end of the second spear portion. The first spear portion may be coupled to electrode 330. The second spear portion may be coupled to the first spear portion. The first spear portion may be coaxial with the second spear portion.

[0124] The first spear portion may be stationary (e.g., static, fixed, etc.). For example, the first spear portion may be configured to remain in a fixed position before, during, and after impact of electrode 330 against a target. The first spear portion may remain coupled to electrode 330 before, during, and after impact of electrode 330 against a target. The second spear portion may be translatable (e.g., moveable, extendable, etc.). The second spear portion may be translatable relative to the first spear portion. The second spear portion may be configured to translate in a forward direction. For example, the second spear portion may be configured to change positions during and/or after impact of electrode 330 against a target. In that regard, the second spear portion may be in a first position before impact of electrode 330 against the target. During and/or after impact of electrode 330 against the target, the second spear portion may translate to a second position. The second position may be forward the first position. The second spear portion may be configured to decouple from electrode 330 and/or the first spear portion to translate into the second position.

[0125] The second spear portion may be configured to translate in response to receiving a force. The force may comprise any suitable type of force imparted to the second spear portion. For example, the force may comprise a mechanical force imparted to the second spear portion via a spring, a piston, and/or any other mechanical translation. As a further example, the force may comprise a fluid force or a chemical force imparted to the second spear portion via a propulsion module, propulsion fluid, primer, powder, and/or the like. As a further example, the force may

comprise an inertial force imparted to the second spear portion via electrode 330 and/or the first spear portion. For example, in response to impact of the first spear portion with a target, the first spear portion and/or electrode 330 may at least partially cease or reduce forward movement and translate inertial force to the second spear portion. The inertial force may cause the second spear portion to translate in the forward direction.

[0126] In various embodiments, spear assembly 370 may comprise a first spear 380 (e.g., outer spear, initial spear, stationary spear, etc.) and a second spear 390 (e.g., inner spear, secondary spear, translatable spear, inertial spear, etc.). First spear 380 may comprise a first spear portion of spear assembly 370. First spear 380 may be similar to any other spear, first spear portion, or the like disclosed herein. Second spear 390 may comprise a second spear portion of spear assembly 370. Second spear 390 may be similar to any other spear, second spear portion, or the like disclosed herein.

[0127] In various embodiments, first spear 380 may comprise any suitable type of spear, needle, hook, barbed coupler, and/or the like. For example, first spear 380 may comprise a hypodermic needle. First spear 380 may comprise a modified hypodermic needle comprising one or more barbed coupling structures. First spear 380 may comprise any suitable shape, such as, for example, a cylindrical shape.

[0128] First spear 380 may comprise a first spear body 381 having a first end 382 (e.g., first spear body first end, first spear body forward end, etc.) opposite a second end 383 (e.g., first spear body second end, first spear body rearward end, etc.). First spear body 381 may comprise an outer surface (e.g., first spear body outer surface) opposite an inner surface (e.g., first spear body inner surface). First spear body 381 may define a channel 385 (e.g., first spear channel) extending from first end 382 to second end 383. Channel 385 may be open at (e.g., in fluid communication with) first end 382 and second end 383. Channel 385 may define the inner surface of first spear body 381.

[0129] First spear 380 may be coupled to head 340. First spear 380 may be coupled to head 340 at first head end 342. Second end 383 of first spear 380 may be coupled to head 340. For example, second end 383 of first spear 380 may be inserted into channel 344 to couple to head 340. First spear 380 may remain coupled to head 340 before, during, and after deployment of electrode 330. First spear 380 may remain coupled to head 340 before, during, and after impact of electrode 330 with a target.

[0130] In various embodiments, second spear 390 may comprise any suitable type of spear, needle, hook, barbed coupler, and/or the like. For example, second spear 390 may comprise a hypodermic needle. Second spear 390 may comprise a modified hypodermic needle comprising one or more barbed coupling structures. Second spear 390 may comprise any suitable shape, such as, for example, a cylindrical shape, a hook shape, and/or the like.

[0131] Second spear 390 may comprise a second spear body 391 having a first end 392 (e.g., second spear body first end, second spear body forward end, etc.) opposite a second end 393 (e.g., second spear body second end, second spear body rearward end, etc.). Second spear body 391 may comprise an outer surface (e.g., second spear body outer surface) opposite an inner surface (e.g., second spear body inner surface). Second spear body 391 may define a channel 395 (e.g., second spear channel) extending from first end 392 to second end 393. Channel 395 may be open at (e.g., in fluid communication with) first end 392 and second end 393. Channel 395 may define the inner surface of second spear body 391.

[0132] In various embodiments, second spear 390 may be configured to translate from a first position (e.g., resting position) to a second position (e.g., extended position). Second spear 390 may be configured to translate from the first position to the second position responsive to impact of electrode 330 and/or first spear 380 with a target. For example, impact of electrode 330 and/or first spear 380 with the target may cause an inertial force to be translated to second spear 390. The inertial force may cause spear 390 to translate from the first position to the second position. Second spear 390 may be configured to translate forward from the first position to the second position during and/or in response to an impact of electrode 330 with a target. Second spear 390 may be configured to at least partially translate forward first spear 380 into the second position.

[0133] For example, and with specific reference to FIGs. 3A and 3B, second spear 390 is depicted in the first position. In the first position, second spear 390 may be disposed within first spear 380. Second spear 390 may be disposed within channel 385 of first spear 380. Second spear 390 may be coaxial with first spear 380. Second spear 390 may be in contact with the inner surface of first spear body 381. Second spear 390 may be coupled to one or more inner surfaces of first spear body 381. First end 392 of second spear 390 may be positioned rearward first end 382 of first spear 380. Second end 393 of second spear 390 may be positioned proximate second end 383 of first spear 380. Second spear 390 may be electrically coupled to electrode 330. Second spear

390 may be electrically coupled to first spear 380. Second spear 390 may be electrically coupled to head 340.

[0134] As a further example, and with specific reference to FIGs. 4A and 4B, second spear 390 is depicted in the second position. In the second position, second spear 390 may be translated forward relative to the first position. Depending on a distance second spear 390 has translated forward, at least a portion of second spear 390 may still be disposed within first spear 380. Depending on a distance second spear 390 has translated forward, at least a portion of second spear 390 may be disposed forward first spear 380. Depending on a distance second spear 390 has translated forward, an entirety of second spear 390 may be disposed forward first spear 380. First end 392 of second spear 390 may be positioned forward first end 382 of first spear 380. Second end 393 of second spear 390 may be positioned forward second end 383 of first spear 380. Second spear 390 may be electrically coupled to electrode 330. Second spear 390 may be electrically coupled to first spear 380. Second spear 390 may be electrically coupled to head 340.

[0135] In various embodiments, and with reference again to FIGs. 3A-4B, first spear 380 may be different from second spear 390. For example, first spear 380 may comprise a first physical dimension. The first physical dimension may comprise a first length, a first diameter, a first circumference, a first mass, and/or the like. Second spear 390 may comprise a second physical dimension. The second physical dimension may comprise a second length, a second diameter, a second circumference, a second mass, and/or the like. The first physical dimension may be different from the second physical dimension. For example, the first length may be longer than the second length. The first diameter may be greater than the second diameter. The first circumference may be greater than the second circumference. The first mass may be less than the second mass. As a further example, first spear 380 may comprise a first material. Second spear 390 may comprise a second material. The first material may be different from the second material.

[0136] In various embodiments, first spear 380 may be similar to, or share similar characteristics with, second spear 390. For example, first spear 380 may comprise a first material. Second spear 390 may comprise a second material. The first material may be the same as the second material. As a further example, first spear 380 may comprise a first shape. Second spear 390 may comprise a second shape. The first shape may be similar to the second shape. As a further example, first spear 380 and second spear 390 may each comprise a hypodermic needle.

[0137] In various embodiments, spear assembly 370 may comprise a core 375. Core 375 may be coupled to second spear 390. Core 375 may be disposed within second spear 390. Core 375 may be disposed within channel 395 of second spear 390. Core 375 may be coupled to an inner surface within channel 395 of second spear 390. Core 375 may be coupled to the inner surface using any suitable mechanical coupling, chemical coupling, and/or the like. For example, second spear body 391 may be deformed radially inward (e.g., inward protrusion, press fit, staked, crimped, etc.) to couple core 375 to the inner surface.

[0138] In various embodiments, core 375 may be configured, and sized and shaped, to increase a mass of second spear 390. Increasing a mass of second spear 390 may cause second spear 390 to translate from the first position to the second position with greater velocity (e.g., upon transfer of inertial force to second spear 390). Core 375 may comprise any material capable of increasing the mass of second spear 390. For example, core 375 may comprise a material different from the material of second spear 390. Core 375 may comprise an electrically non-conductive material. Core 375 may comprise a plastic material. Core 375 may comprise an electrically conductive material. Core 375 may comprise a metallic material, such as tungsten, copper, aluminum, or the like.

[0139] In various embodiments, second spear 390 may be electrically coupled to first spear 380 and/or electrode 330 while in the first position and in the second position. Second spear 390 may be electrically coupled to first spear 380 and/or electrode 330 by maintaining contact against first spear 380 and/or electrode 330. For example, second spear 390 may be in direct physical contact with first spear 380 while in the first position and the second position. As a further example, second spear 390 may be in indirect contact with first spear 380 while in the first position and the second position.

[0140] In various embodiments, spear assembly 370 may comprise a leash 377. Leash 377 may be configured to couple second spear 390 to first spear 380 and/or electrode 330. Leash 377 may be configured to electrically couple second spear 390 to first spear 380 and/or electrode 330. Leash 377 may be configured to maintain electrical coupling between second spear 390 and first spear 380 and/or electrode 330 while second spear 390 translates from the first position and the second position. Leash 377 may comprise a first leash end 378 (e.g., a forward leash end) opposite a second leash end 379 (e.g., a rearward leash end).

[0141] First leash end 378 may be coupled to second spear 390. First leash end 378 may be coupled within channel 395 of second spear 390. For example, first leash end 378 may be wound within channel 395. First leash end 378 may be wound around core 375 within channel 395. A deformation coupling of the inner surface of channel 395 to core 375 may couple first leash end 378 to core 375 and/or second spear 390. In various embodiments, leash 377 may be stowed within channel 395 of second spear 390. For example, leash 377 may be wound in a winding (e.g., coils, leash winding, etc.). The winding may be stowed (e.g., stored, disposed, etc.) within channel 395. During transition of second spear 390 from the first position to the second position, second spear 390 may travel in a forward direction. During the forward travel, leash 377 may unravel (e.g., uncoil, unwind, etc.) from the winding to deploy leash 377 aft second end 393 of second spear 390.

[0142] Second leash end 379 may be coupled to first spear 380 and/or electrode 330. For example, second leash end 379 may extend radially through channel 385 of first spear 380 to couple to an inner surface of channel 344 of head 340. In some embodiments, second leash end 379 may be positioned between an inner surface of channel 344 of head 340 and an outer surface of first spear body 381.

[0143] In various embodiments, leash 377 may comprise any suitable material. For example, leash 377 may comprise an electrically conductive material configured to enable electrical coupling between second spear 390 and first spear 380 and/or electrode 330. Leash 377 may comprise a metallic material, such as, for example, stainless steel, tempered high-carbon steel, and/or the like.

[0144] In various embodiments, leash 377 and filament 337 may comprise a similar or same material. For example, filament 337 may comprise a first material and leash 377 may comprise a second material. The first material may be similar to or the same as the second material.

[0145] In various embodiments, leash 377 and filament 337 may comprise a different material. For example, filament 337 may comprise a first material and leash 377 may comprise a second material. The first material may be different than the second material.

[0146] In various embodiments, leash 377 and filament 337 may comprise different physical dimensions. For example, filament 337 may comprise a first length and leash 377 may comprise a second length. The first length may be greater than the second length. The first length may be double the second length. The first length may be triple the second length. The first length may be

quadruple the second length. The first length may be quintuple the second length. The first length may be sextuple the second length.

[0147] In various embodiments, electrode 330 may comprise a plurality of windings. For example, and as previously discussed herein, filament 337 may be wound into a filament winding (e.g., a first winding, first conductive winding, etc.) and leash 377 may be wound into a leash winding (e.g., a second winding, second conductive winding, etc.).

[0148] The filament winding may be located within electrode body 331. The filament winding may be located aft head 340. The filament winding may be located aft the leash winding. The filament winding may be coupled to second head end 343. The filament winding may be electrically coupled to second head end 343. The filament winding may be coupled to an outer surface of head 340. The leash winding may be located within spear assembly 370 (e.g., second spear 390 of spear assembly 370). The leash winding may be located forward head 340. The leash winding may be located forward the filament winding. The leash winding may be coupled to first head end 342. The leash winding may be electrically coupled to first head end 342. The leash winding may be coupled to an inner surface of head 340. The coupling of the filament winding to second head end 343 and the coupling of the leash winding to first head end 342 may be separated by middle section 345 of head 340. The filament winding may be in electrical series with the leash winding via head 340.

[0149] The filament winding may be configured to unwind at a first time. The leash winding may be configured to unwind at a second time. The first time may be different than the second time. The first time may be before the second time. The first time may at least partially overlap with the second time.

[0150] The filament winding may comprise a first length. The leash winding may comprise a second length. The first length may be greater than the second length.

[0151] The filament winding may comprise a first material. The leash winding may comprise a second material. The first material may be different from the second material. The first material may be similar to or the same as the second material.

[0152] In various embodiments, an activation of a CEW may launch electrode 330 toward a target. Prior to the launch of the electrode, the filament winding may be stowed within electrode body 331 and the leash winding may be stowed within spear assembly 370. Spear assembly 370

may be in a first position as depicted in FIGs. 3A and 3B. In the first position, second spear 390 may be positioned within first spear 380.

[0153] Subsequent to the launch of electrode 330 (e.g., while electrode 330 is in flight towards the target), the filament winding may unwind from electrode 330 to maintain electrical coupling between electrode 330 and the CEW. The leash winding may remain stowed within spear assembly 370. Spear assembly 370 may remain in the first position.

[0154] Electrode 330 may impact the target to couple to the target. For example, spear assembly 370 and/or electrode 330 may impact the target. First spear 380 may first impact the target to couple electrode 330 to the target. In response to the impact, spear assembly 370 may translate from the first position into the second position as depicted in FIGs. 4A and 4B. In the second position, second spear 390 may be translated in a forward direction. The leash winding may unwind from second spear 390 to maintain electrical coupling between second spear 390 and electrode 330. Second spear 390 may next impact the target. Second spear 390 may impact the target and electrically couple to tissue of the target.

[0155] In that regard, the tissue of the target may be in electrical series with the CEW via second spear 390, the leash winding, electrode 330, and the filament winding. In response to a plurality of electrodes being launched and electrically coupling to the tissue of the target, the CEW may provide a stimulus signal through the target.

[0156] First spear 380 and second spear 390 may be electrically coupled in parallel. In that regard, the stimulus signal may be provided to the target via first spear 380 and/or second spear 390.

[0157] In various embodiments, a spear assembly is disclosed. The spear assembly may comprise a first spear portion and a second spear portion. The first spear portion may be disposed within the first spear portion. The second spear portion may be configured to translate in a forward direction in response to the first spear portion impacting a target.

[0158] In various embodiments of the above spear assembly, impact of the first spear portion with the target may transfer an inertial force to the second spear portion, and the inertial force may cause the second spear portion to translate in the forward direction. Prior to the first spear portion impacting the target a first forward end of the first spear portion may be positioned forward a second forward end of the second spear portion. In response to the first spear portion impacting the target the first forward end of the first spear portion may be positioned aft the second forward

end of the second spear portion. The first spear portion may be coaxial with the second spear portion. The first spear portion may be configured to first impact the target, the second spear portion may be configured to next impact the target, and the first impact may be before the next impact. The first spear portion may comprise a first physical dimension, the second spear portion may comprise a second physical dimension, and the first physical dimension may be different from the second physical dimension. The first spear portion may remain stationary in response to the first spear portion impacting the target.

[0159] In various embodiments, an electrode for a conducted electrical weapon is disclosed. The electrode may comprise an electrode body having a first end opposite a second end; an electrode head coupled to the first end of the electrode body; and a spear assembly. The spear assembly may comprise a first spear coupled to the electrode head; and a second spear disposed within the first spear. The second spear may be configured to translate in a forward direction in response to at least one of the first spear or the electrode head impacting a target.

[0160] In various embodiments of the above electrode, the spear assembly may further comprise a leash comprising a first leash end opposite a second leash end, the first leash end may be coupled to the second spear, and the second leash end may be coupled to at least one of the first spear or the electrode head. The second leash end may be positioned between an inner surface of the electrode head and an outer surface of the first spear. The first leash end may be wound into a winding within the second spear. The spear assembly may further comprise a core coupled within a channel of the second spear, and the winding of the first leash may be wound around the core. The first spear may be coaxial with the second spear. Prior to impacting the target a first forward end of the first spear may be positioned forward a second forward end of the second spear, and in response to impacting the target the first forward end of the first spear may be positioned aft the second forward end of the second spear. Prior to impacting the target a first rearward end of the first spear may be positioned proximate a second rearward end of the second spear, and in response to impacting the target the first rearward end of the first spear may be positioned aft the second rearward end of the second spear. The second spear may be coupled to the electrode head, and the first spear and the second spear may be electrically coupled to the electrode head in parallel.

[0161] In various embodiments, a method is disclosed. The method may comprise one or more operations including: launching an electrode toward a target, wherein the electrode comprises a spear assembly, wherein the spear assembly comprises a first spear and a second spear, and

wherein the second spear is disposed within the first spear; first impacting, by the first spear, the target; translating, in response to the first impacting, the second spear in a forward direction from a first position to a second position; and next impacting, by the second spear, the target.

[0162] In various embodiments, an electrode for a conducted electrical weapon is disclosed. The electrode may comprise an electrode head having a first head end opposite a second head end; a first conductive winding located aft the electrode head; and a second conductive winding located forward the electrode head.

[0163] In various embodiments of the above electrode, the electrode may further comprise an electrode body coupled to the second head end, and the first conductive winding may be stowed within the electrode body. The electrode may further comprise a spear assembly coupled to the first head end, and the second conductive winding may be stowed within the spear assembly. The electrode head, the first conductive winding, and the second conductive winding may be in electrical series. The first conductive winding may be coupled to the electrode head at the second head end, and the second conductive winding may be coupled to the electrode head at the first head end. The electrode head may comprise a middle section defined between the first head end and the second head end, and the middle section may separate a first coupling of the first conductive winding at the second head end from a second coupling of the second conductive winding at the first head end. The first conductive winding may be coupled to an outer surface of the electrode head, and the second conductive winding may be coupled to an inner surface of the electrode head.

[0164] In various embodiments, a method is disclosed. The method may comprise one or more operations including: launching an electrode toward a target, wherein the electrode comprises an electrode head, a first conductive winding located aft the electrode head, and a second conductive winding located forward the electrode head; first unwinding the first conductive winding at a first time; and second unwinding the second conductive winding at a second time, wherein the first time is different from the second time.

[0165] In various embodiments of the above method, the first time may be before the second time. The first time may overlap with the second time. The first unwinding may be in response to the launching. The operations may further comprise impacting, by the electrode, the target. The second unwinding may be in response to the impacting. The operations may further comprise providing a stimulus signal to the target, wherein the stimulus signal is provided via an electrical

path comprising the first conductive winding, the electrode head, and the second conductive winding.

[0166] In various embodiments, an electrode for a conducted electrical weapon is disclosed. The electrode may comprise: an electrode body; a spear assembly coupled proximate a forward end of the electrode body; a filament winding stowed within the electrode body; and a leash winding stowed within the spear assembly.

[0167] In various embodiments of the above electrode, the electrode may further comprise an electrode head, the spear assembly may be coupled to a first end of the electrode head, and the forward end of the electrode body may be coupled to a second end of the electrode head. The filament winding may be located aft the electrode head, and the leash winding may be located forward the electrode head. The filament winding may comprise a first length, the leash winding may comprise a second length, and the first length may be greater than the second length. The filament winding may comprise a first material, the leash winding may comprise a second material, and the first material may be greater than the second material. The filament winding may be configured to unwind at a first time, the leash winding may be configured to unwind at a second time, and the first time may be before the second time.

[0168] Benefits, other advantages, and solutions to problems have been described herein with regard to specific embodiments. Furthermore, the connecting lines shown in the various figures contained herein are intended to represent exemplary functional relationships and/or physical couplings between the various elements. It should be noted that many alternative or additional functional relationships or physical connections may be present in a practical system. However, the benefits, advantages, solutions to problems, and any elements that may cause any benefit, advantage, or solution to occur or become more pronounced are not to be construed as critical, required, or essential features or elements of the disclosures. The scope of the disclosure is accordingly to be limited by nothing other than the appended claims and their legal equivalents, in which reference to an element in the singular is not intended to mean “one and only one” unless explicitly so stated, but rather “one or more.” Moreover, where a phrase similar to “at least one of A, B, or C” is used in the claims, it is intended that the phrase be interpreted to mean that A alone may be present in an embodiment, B alone may be present in an embodiment, C alone may be present in an embodiment, or that any combination of the elements A, B, and C may be present in a single embodiment; for example, A and B, A and C, B and C, or A and B and C.

[0169] Systems, methods, and apparatus are provided herein. In the detailed description herein, references to “various embodiments,” “one embodiment,” “an embodiment,” “an example embodiment,” etc., indicate that the embodiment described may include a particular feature, structure, or characteristic, but every embodiment may not necessarily include the particular feature, structure, or characteristic. Moreover, such phrases are not necessarily referring to the same embodiment. Further, when a particular feature, structure, or characteristic is described in connection with an embodiment, it is submitted that it is within the knowledge of one skilled in the art to affect such feature, structure, or characteristic in connection with other embodiments whether or not explicitly described. After reading the description, it will be apparent to one skilled in the relevant art(s) how to implement the disclosure in alternative embodiments. Furthermore, no element, component, or method step in the present disclosure is intended to be dedicated to the public regardless of whether the element, component, or method step is explicitly recited in the claims. No claim element is intended to invoke means plus function claiming unless the element is expressly recited using the phrase “means for.” As used herein, the terms “comprises,” “comprising,” or any other variation thereof, are intended to cover a non-exclusive inclusion, such that a process, method, article, or apparatus that comprises a list of elements does not include only those elements but may include other elements not expressly listed or inherent to such process, method, article, or apparatus.

CLAIMS

What is claimed is:

1. A spear assembly comprising:
 - a first spear portion; and
 - a second spear portion disposed within the first spear portion, wherein the second spear portion is configured to translate in a forward direction in response to the first spear portion impacting a target.
2. The spear assembly of claim 1, wherein impact of the first spear portion with the target transfers an inertial force to the second spear portion, and wherein the inertial force causes the second spear portion to translate in the forward direction.
3. The spear assembly of claim 1, wherein prior to the first spear portion impacting the target a first forward end of the first spear portion is positioned forward a second forward end of the second spear portion.
4. The spear assembly of claim 3, wherein in response to the first spear portion impacting the target the first forward end of the first spear portion is positioned aft the second forward end of the second spear portion.
5. The spear assembly of claim 1, wherein the first spear portion is coaxial with the second spear portion.
6. The spear assembly of claim 1, wherein the first spear portion is configured to first impact the target, wherein the second spear portion is configured to next impact the target, and wherein the first impact is before the next impact.
7. The spear assembly of claim 1, wherein the first spear portion comprises a first physical dimension, wherein the second spear portion comprise a second physical dimension, and wherein the first physical dimension is different from the second physical dimension.

8. The spear assembly of claim 1, wherein the first spear portion remains stationary in response to the first spear portion impacting the target.
9. An electrode for a conducted electrical weapon comprising:
an electrode body having a first end opposite a second end;
an electrode head coupled to the first end of the electrode body; and
a spear assembly comprising:
a first spear coupled to the electrode head; and
a second spear disposed within the first spear, wherein the second spear is configured to translate in a forward direction in response to at least one of the first spear or the electrode head impacting a target.
10. The electrode of claim 9, wherein the spear assembly further comprises a leash comprising a first leash end opposite a second leash end, wherein the first leash end is coupled to the second spear, and wherein the second leash end is coupled to at least one of the first spear or the electrode head.
11. The electrode of claim 10, wherein the second leash end is positioned between an inner surface of the electrode head and an outer surface of the first spear.
12. The electrode of claim 10, wherein the first leash end is wound into a winding within the second spear.
13. The electrode of claim 12, wherein the spear assembly further comprises a core coupled within a channel of the second spear, and wherein the winding of the first leash end is wound around the core.
14. The electrode of claim 9, wherein the first spear is coaxial with the second spear.

15. The electrode of claim 9, wherein prior to impacting the target a first forward end of the first spear is positioned forward a second forward end of the second spear, and wherein in response to impacting the target the first forward end of the first spear is positioned aft the second forward end of the second spear.

16. The electrode of claim 9, wherein prior to impacting the target a first rearward end of the first spear is positioned proximate a second rearward end of the second spear, and wherein in response to impacting the target the first rearward end of the first spear is positioned aft the second rearward end of the second spear.

17. The electrode of claim 9, wherein the second spear is coupled to the electrode head, and wherein the first spear and the second spear are electrically coupled to the electrode head in parallel.

18. A method comprising:

launching an electrode toward a target, wherein the electrode comprises a spear assembly, wherein the spear assembly comprises a first spear and a second spear, and wherein the second spear is disposed within the first spear;

first impacting, by the first spear, the target;

translating, in response to the first impacting, the second spear in a forward direction from a first position to a second position; and

next impacting, by the second spear, the target.

19. The method of claim 18, further comprising providing a stimulus signal through at least one of the first spear or the second spear.

20. The method of claim 18, wherein the next impacting the target is after the first impacting the target.