Evaluation Form – Technical Background Review

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_____ / 30 Technical Content

- Current state-of-the-art and commercial products
- Underlying technology
- Implementation of the technology
- Overall quality of the technical summary

_____ / 30 Use of Technical Reference Sources

- Appropriate number of sources (at least six)
- Sufficient number of source types (at least four)
- Quality of the sources
- Appropriate citations in body of text
- Reference list in proper format

_____ / 40 Effectiveness of Writing, Organization, and Development of Content

- Introductory paragraph
- Clear flow of information
- Organization
- Grammar, spelling, punctuation
- Style, readability, audience appropriateness, conformance to standards

_____ **/ 100 Total - Technical Review Paper**

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Conducted Electrical Weapons: Use and Operation

Introduction

A Conducted Electrical Weapon (CEW) or electroshock weapon is a non lethal weapon used to shock a perpetrator rendering them incapacitate. An electric shock from this kind of weapon distorts voluntary muscle control and is highly painful to a perpetrator. However the effects of a CEW are primarily temporary with a small chance of long term cognitive damage.

With several different kinds of CEWs, the two commonly known are stun guns and TASERs. Although these two terms are often used interchangeably, they are two different devices or types of CEWs. A stun gun operates through direct contact to clothing and skin, while a TASER uses probes that are fired and launched onto the perpetrator.

Commercial Applications

CEWs are predominantly used by law enforcement (police) officers and by citizens as a means of self defence. Law enforcement officers typically use TASERs opposite to stun guns which are more popular among citizens. There do exist TASERs targeted for the average citizen, but they tend to be more expensive than stun guns on the market. Professional grade TASERs, such as those used by law enforcement officers tend to be ever more expensive. Such devices are tailed for personal/private security guards and delivery drivers.

The most popular CEWs currently on the market is TASER Pulse by AXON and VTS-989-1 Stun Gun by VIPERTEK. These specific models cost $400 and $20 respectively. AXON currently has a near monopoly for production and sale for TASER devices, while a new company, Digital Al, has recently entered the market for TASER manufacturing. Stun guns are more widely manufactured with hundreds of companies producing and selling them.

Stun guns are also used in military applications as a way to immobilize a target without a chance of fatality. It is important to recognize that the use and possession of a CEW by a non law enforcement officer is not legal in all 50 States. One should look up or call local law enforcement for specific details on the law in their state.

Underlying Technology

CEWs emit a charge that has a high voltage but low current value. The high voltage passes the charge through the perpetrator's body. This charge is outputted through two charge electrodes. The combination of pain and distortion of voluntary muscle control temporarily immobilizes the perpetrator. With proper values for voltage and current outputs, long term damage to the perpetrator's body is minimal or nonexistent. Repetitive use of a CEW over large periods of time will damage the human body.

For CEWs to be a non lethal weapon, the device must exert high voltage and a relatively low current. Too high of a current can have lethal effects when used on a human, therefore the average current output range is between two and four miliampers. The average voltage output range is typically between 20,000 and 150,000 volts. Although technology exists allowing the voltage output to be as high as a million volts, 25,000 volts is enough to pass through articles of clothing and still affect the perpetrator. When contacts are spaced out one centimeter apart, the maximum voltage output that jumps across is 30,000 volts, therefore any higher voltage output values are unnecessary.

TASERs operate in the same way as typical CEWs, such as stun guns. As mentioned in the introduction, TASERs have two removable charge electrodes rather than being permanently held to the device. These charge electrodes are installed at the ends of some conductive wire, which are then connected to the device's circuit. A TASER contains a compressed gas cartridge that opens when the device's trigger is pulled. The charge electrodes are launched as a result of pressure build up from the expanding gas.

Circuitry Building Blocks

CEWs circuits are laid out to operate as a two stage voltage converter. Stage one utilizes a high frequency switching transformer. This transformer steps up the initial voltage from the battery in order to charge a capacitor. Stage two takes the charged capacitor as it is discharging and another transformer to step up the voltage even higher once more.

To reach this transformer voltage, either a push-pull converter or a metal–oxide–semiconductor field-effect transistor (MOSFET) can be used. MOSFETs are preferred as the converter gives a higher efficiency (.75) then push-pull converter (.25) (note, both values are given for when working frequency is between 80 to 120 kHz).

Another design for a CEW makes use of a 555 timer IC. The 555 IC generates a rectangular wave signal which is then fed into a MOSFET or a bipolar junction transistor (BJT). If using a BJT, a 100 ohm resistor must be added in series between the base of the BJT and the 555 IC. A 555 IC is used in this design as the IC has sufficient current potential when quickly charging or discharging the gate. Only one transformer would be used in this design.

Future of Conducted Electrical Weapons

Latest patents for CEWs (specifically stun guns) have been following the same pattern or trend. This trend in design is to make these devices smaller and concealable. These designs are created to be small enough to hold in one hand without drawing attention to the device and can easily fit inside a pocket. A lot of designs are also becoming more concealable as they are designed to look like a simple keychain or a smartphone.

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