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Understanding the Stun Gun

Introduction

Today the American society faces an unprecedented crime rate with city crimes increasing exponentially. Women take the brunt of this increase in danger as reports of sexual assault increase. In fact, 41.8% of women in America have been victimized by sexual violence [1]. Hitting closer to home, one in five women are sexually assaulted during their time at college [2]. Due to these tragic numbers, consumer products focusing on women self-defense have become popular. However, many of these self-defense products focus on contacting help, or packing a harder punch. One such product is the stun gun which allows women, who might be weaker than their assailant, to have more of an advantage in getting away. Focusing on the stun gun, this paper explores how it works, what is the most effective stun gun on the market, and how is a stun gun made.

Background

The stun gun is a slightly less violent version of the taser and can only be activated with close contact. The idea of the stun gun originated in the 1700s and revolved around the idea of static electricity. By storing static electricity and then releasing it at once, this causes muscles to contract which is quite painful for the person being shocked [3]. A stun gun must have constant contact since taser to body contact completes the circuit. Stun guns tend to range around 50,000 Volts with a pulse rate of 17-22 pulses per second and current of 3-6 mA.

Commercial Applications

Stun guns are a common commodity on the market. However, the current market trend is to disguise the stun gun to confuse the attacker and have them lower their guard. For example, an example of a stun gun designed purely for woman is the Rhinestone Bling Stun Gun Flashlight sold by Defense Divas. This product packs a very powerful shock with 1 million volts and 6 prongs for current distribution. It also doubles as a flashlight with LEDs. Not only is it efficient for use at night but also no attacker will be suspicious of a flashlight. The product is also rechargeable with a Ni-MH battery. The downside is that it is a rather large device with dimensions of 6.5" x 2.25" x 2" and the device costs $98.95. Another downside is if a woman drops or forgets the flashlight then she is vulnerable to attacks [4].

The previous item by Defense Divas shows where the market is currently at with self-defense devices for woman. The next item shows where the market is heading. On June 24th, 2019 William Gulloti submitted a patent for a stun gun in the form of a glove. The glove has a rechargeable battery and all the necessary components of a stunning circuit. It also has a switch and accelerometer. The glove has an on and off state. The off state means the wearer is safe and the shocking circuit does not need to be charged. The wearer can then manually switch to the on state priming the circuit and as soon as the glove connects with a body (with a certain acceleration) then the stun gun is triggered shocking the attacker over a large area due to the glove. The glove can switch to the on state through obtaining a certain acceleration and contact pressure. This means if the wearer does not have time to manually switch the state, the stun gun will still work properly [5]. This device shows the ever-changing market and what the new standard for state of the art can be. This device shows the future of wearable self-defense.

Theory

There are many misconceptions with how a stun gun works. For example, many companies (as shown with Defense Divas) play up the voltage delivered through the stun gun. People assume the higher the voltage the more pain the attacker feels making it a better defense weapon. The amount of voltage delivered is based on the distance between contacts of the stun gun. The energy is equal to electric field in air times distance between the contacts. However, voltage is not important to the effectiveness of the stun gun as a defense weapon. The strength of a stun gun is measured by charge which is related to current. On top of that, many stun guns are advertised with their open circuit voltage which is different than the actual voltage felt by the attacker since human bodies have resistance from 300 to 1000 Ohms [6].

Stun guns make efficient weapons as (if made correctly) they are non-life threatening but give the victim a chance to escape. A stun gun is activated through contact with the probes and a human body. The stun gun then discharges a huge voltage but very small charge. However, within 3 seconds of maintained contact, the attacker gets disoriented and confused. The assailant can also lose their balance. This is all due to the fact the current coursing through their body causes blood sugar to rapidly deplete due to it converting to lactic acid. The attacker will also feel pain as muscles begin to spasm [7].

Nuts and Bolts of the Stun Gun

Stun guns are simple electronic wise. They depend on batteries typically in the 9-volt range. The voltage will then go through multiple transformers to increase the voltage to 20,000. The transformers also reduce the current which is important since you do not want to electrocute the attacker. After transformers, the next circuit component needed is an oscillator. The oscillator causes the current to fluctuate to create electric pulses. The pulse then charges a capacitor. The capacitor is then connected to two pieces of metal

called the electrodes. The stun gun itself is an open circuit so as soon as it touches a something (the assailant's body), the circuit is complete. This allows the capacitor to discharge and shock the attacker [8].

Although the circuit itself is relatively simple there are many considerations that makes it difficult. First off, making the circuit as small as possible dimension wise is a challenge however this can be alleviated with PCBs. Also, another electronic component that can be added to the circuit is an accelerometer. This would create more checks as the stun gun circuit could only be activated once a certain acceleration is reached such as the acceleration from a slap or punch.

Conclusion

With the rise in crime rates, self-defense is more necessary than ever. However, with increasing self-defense products attackers become more on guard to anything remotely looking like a weapon. Therefore, even though stun guns are the best option for defense, the market needs to become more creative in methods of concealing the stun gun.

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