Proposal for The Next Generation Personal Weapon

Introduction

When we say "personal weapons technology" today, one rightly thinks of firearms. Whether we speak of handguns, shotguns, machine-guns, or assault rifles, all of this most effective class of personal defense weapons share a common, ancestral features: they are mechanical devices.

This, of course, seems obvious. But in a day when less and less is being done with gears and levers, and more and more is being done with integrated circuits and wires, the days of the purely mechanical firearm have become numbered. A quick perusal of the available gun-oriented literature in any supermarket corroborates this idea. More and more people are strapping electronic, battery powered devices onto their handguns, rifles, and shotguns in order to enhance their combat-effectiveness. Laser target designators, light amplification sighting devices, and target illumination lights are all rapidly becoming standard equipment, and each of these devices requires a source of electrical power.

Imagine an abacus. This simple, mechanical calculation device had been in use in Eastern countries for centuries prior to the invention of the computer. Now imagine someone taking an abacus and hooking it up to an elaborate array of sensors which read the position of the beads, electric solenoids which can adjust the position of the beads, and a processing circuit which has the necessary software to read the locations of the beads and output their roman-numeric value to a CRT display. We'll also need a numeric keypad and, of course, a power supply, so that we can input values to be calculated. Now imagine using this device to, say, balance your checkbook.

Such a device is, of course, extremely backward. Mechanical systems are slow, unwieldy, and inefficient when compared to electrical systems. If the technology is available to convert the location of the beads on the rods to a numeric value, then why not do away with the beads altogether?

An analogous situation exists in the modern firearms market. Time-tested mechanical mechanisms are being retrofitted with electric ones increasingly frequently. We are in the gray area between mechanical and electrical now, and the time to move to fully electrical or nearly-fully-electrical is drawing nigh. Electrical systems are faster, more reliable, and easier to reconfigure than are mechanical ones, and they are the future of personal weapons technology.

Basic Operating Principles

Some people might object at this point that it is impossible to entirely remove mechanical processes from the operation of anything which could rightly be called a "firearm," because clearly, the fundamental operation of a gun is a mechanical one: an explosive is ignited and a bullet is propelled down the barrel. And in this they are quite right: if an electronic device is to have any direct impact on the physical world, clearly it must at some point convert its electric energy to mechanical-kinetic energy.

And this is where the real problem with an electrical firearm lies: all the traditional mechanisms for converting electrical energy into mechanical energy are either too unreliable, too fragile, or too large to be useful in a practical firearm. Electromechanical devices such as servos, solenoids, and motors, while they can in theory--and sometimes are in practice--used to activate a firing pin to fire a shell, are far too unreliable to be used in situations in which an individual's life may be at stake. They are expensive, power-hungry, and insufficiently durable.

If we are to have an electronic firearm, how, then, do we deal with the fundamental mechanical operations which anything which a gun must have? Specifically, how do we fire the round, eject the shell casing, and chamber a new round without using clumsy electromechanical mechanisms to do so?

Firing the Round

It is our belief that the stubbornly mechanical firearm owes the tenacity of its operating principle to the design not of the gun itself but to that of the round it chambers. Conventional ammunition is designed to be fired mechanically, through the striking of a percussion cap with a pin, and so, naturally, guns tend to be mechanical devices which strike the round's percussion cap with a pin. It would then follow that if we design a round which can be fired electrically rather than mechanically, we would have taken the largest and most significant step towards a truly effective electronic firearm.

The Next Generation Personal Weapon (hereinafter referred to as the NGPW) will not use a firing pin to ignite a bullet's propellant at all. Rather, it will use a pair of electrodes to generate a spark in the chamber which will, in turn, ignite the propellant. This eliminates the clumsy mechanics of the firing pin, and allows the replacement of a fairly complex mechanical safety with a simple electrical one, which feature will in turn facilitate an innovation which many people have been whispering about for years, but which no one has as yet been able to implement in a mechanical weapon. More on this later.

Ejecting the Shell Casing

We solve this problem by evolving beyond it. The NGPW will not need to eject casings at all, because it will fire caseless ammunition. This type of ammunition, already successfully tested by Dynamit Nobel, consists of a bullet imbedded in a block of nitrocellulose which has been compressed, along with a plastic binder and a priming charge, into a small explosive brick. The powder, binder, and priming charge all vaporize completely upon firing of the round, leaving nothing in the chamber to require ejection.

The use of caseless rounds has two great benefits: first, it eliminates the need for a complex and reliability-compromising shell casing ejection mechanism, and second, it greatly facilitates electrical ignition of the round itself. The round is first chambered, then the firing electrodes, in direct contact with the exposed powder charge, generate the spark which ignites the propellant and sends the bullet downrange. This elimination of the shell-casing-ejection system, of course, makes the weapon that much less likely to jam, and also makes the weapon more impervious to elements in the external

environment by eliminating the aperture through which the casings are normally ejected, and through which dirt, grime, and water could enter into and foul the internal workings of the gun itself.

Chambering the Next Round

This final "problem" does really not need to be overcome. Browning's blowback mechanism, employed in semi-automatic handguns since its invention in 1911, has proven to be one of the most time-tested and reliable mechanisms ever invented. By siphoning off gaseous pressure from the escaping round, the traditional blowback mechanism ejects the spent shell casing, extracts another round from the magazine and loads it into the chamber very quickly and very effectively. If the mechanics of the shell-casing-ejection system are eliminated, as we have proposed, the blowback rechambering device is made that much more reliable.

With the elimination of the firing pin, the safety mechanism, and the casing-ejection system, the blowback rechambering mechanism remains the only major mechanical component of the NGPW. It would be impossible, I believe, with current technology, to design a more reliable electric mechanism for loading shells. Browning's way is efficient, time-tested, and supremely reliable, and as such will probably always be the best way to solve the problem.

Special Features

Centralized Power

All the electrical systems of the NGPW are powered from a rechargeable lithium battery hard-wired into the magazine. Special multi-magazine plug-in chargers are provided with the purchase of the weapon which would allow the simultaneous charging of up to three magazines. Chargers with greater capacities would be available at additional cost. Each magazine also includes an on-board power test switch, which indicates by either a red or green LED whether or not the magazine is charged to operating capacity. The weapon itself incorporates a special low-power "bare bones" mode of operation, in which power to unessential systems--specifically the underbarrel laser target designator and the ammo-count indicator--is cut off and reserved for essential operations: the working of the SIDSystem and the firing of the weapon itself.

Electrical Safety (System Activation Switch)

As mentioned above, the NGPW does not employ a traditional mechanical safety switch. The operating principle of the firearm is electrical, and so the only necessary safety is an electric one: the maintenance of an open circuit when the weapon is in "safe" mode. Additionally, specially shielded electronics and grounding circuits prevent the build-up of any static which might cause the electrical equivalent of a "cook-off." It would take a significant (i.e. intentional) charge, much greater than that which could be generated by static electricity or EMP in any normal environment, to actually cause a

round to fire, but the safeguards are included anyway to protect against possible high-risk scenarios, such as a nearby lightning strike.

The safety itself is trigger-mounted, in the manner of the two-part triggers seen more and more often on semi-automatic handguns today. The trigger comes in two parts, a lower and an upper, with a hinge connecting them at the middle. The initial motion of pulling the trigger only actuates the lower portion, which takes the weapon off safe and arms it to fire. Completing the motion pulls both the upper and lower triggers and initiates the firing cycle.

It is the first stage of this two-part process which interests us now. The NGPW incorporates the trigger-safety as a sort of "Master On/Off" switch for the entire weapon. All the weapon's electrical systems are inactive until the first part of the trigger-pulling action is engaged. At this point, depending on how the weapon has been configured by the user, the weapon's various electrical systems come on line: the SIDSystem is activated, the laser target designator turned on, the available ammunition display illuminated, and the weapon ready status displayed. This design allows simultaneously for reliable safety operation, conservation of power, and anti-tamper security through the use of the SIDSystem.

SIDSystem

The SIDSystem, an acronym for *Shooter Identification System,* is perhaps the single most important and revolutionary feature of the NGPW's design. The device incorporates two primary components: a coil wound around and embedded in the grip of the gun itself, and a uniquely coded identification ring worn by the operator on his or her shooting hand. The system operates in such a way that the weapon is only enabled to fire when the ring and grip-coil are in close proximity, as they would only be when the shooter is holding the weapon in a firing position.

As mentioned above, each ring is uniquely coded to a particular weapon, and replacement rings are available only from the factory on provision of the weapon's registration and serial numbers. The ring itself is a passive, unpowered device, operating very much like the anti-theft tags used in retail outlets (only much more reliable due to the very short distances involved and the advancing state of that technology), which incorporates no internal power source, has an indefinite functional life-span, and is impervious to external electromagnetic interference.

When the user grips the weapon, wearing his unique ID ring, and activates the first stage of the two-part trigger mechanism, the weapon powers up and immediately activates the SIDSystem. Within microseconds, the weapon has checked the code in the ring against its own internal activation code, and either arms or leaves disengaged the weapon's firing mechanism. At this point, the weapon's ready status is displayed to the shooter. A small LED situated just below the sight picture gives either a red or green flash of light to indicate the firing readiness of the weapon.

Integrated Laser Target Designator

This is a feature already common on some police- and military-model sidearms, and is particularly well-suited to use in the NGPW because of its centralized electronics

system. Basically, a standard aimpoint laser target designator--complete with windage screw, adjustment knobs, and on/off switch--is permanently mounted in the frame beneath the barrel. If its own power switch is engaged, then it will, upon activation of the master power switch in the first-stage trigger, draw power from the magazine battery and activate the laser, projecting the red targeting dot downrange.

Available Ammunition Counter

Each magazine is equipped with sensors which detect the number of rounds in the magazine, and which communicate with an LED display mounted on the rear of the weapon, just below the user's sight picture. This display provides a digital readout of the number of rounds remaining, so that the shooter is always aware of his or her immediately available resources, and will be able to anticipate the necessity of reloading with great accuracy without having to distract him- or herself by keeping count.

Design Hurdles

Sealing The Breech

The most significant design problem to be faced in the production of the NGPW is a difficulty in implementing caseless ammunition as opposed to regular shells. During the firing of a normal round, the explosive pressure inside the brass casing causes it to expand forcibly in all directions, thereby sealing the breach block very effectively against the many tons of gaseous pressure per square inch it must be capable of withstanding, if only for a few microseconds, during the firing of the bullet.

With a caseless round, however, the breech does not have the benefit of the brass case to provide this seal. Thus, the chamber itself must be sealed well enough to prevent leakage of hot propellant gases back into the internal workings of the gun itself, or, even worse, into the shooter's face.

This problem, although formidable, is certainly not insurmountable. The German firm of Heckler & Koch have designed and successfully field-tested a prototype caseless-ammunition assault rifle, the G11, which fires a relatively large caseless round in extremely high volumes approaching two-thousand rounds per minute (33 rds/sec). Although the performance of the weapon was never flawless, experiencing cook-off problems caused by the high heat generated by the weapon, these design difficulties were not due so much to the caseless nature of the rounds as to the abnormally high volumes in which they were fired. If it's possible to build a successful mechanism which will both seal the weapon's breech against the enormous firing pressures and simultaneously provide for such a large volume of fire, it is surely possible to provide the same tight seal with the much lower volume of fire employed in a handgun.

The exact mechanism whereby Heckler & Koch provide the breech-seal in the G11 is, of course, proprietary information, but limited press releases and informed speculation have led to a general suspicion that it resembles the operation of a Wankel rotary engine in operation, with a rotating triangular cam system in which the exhaust gases from the outgoing round provide pressure to seal the breech during the loading of the next round.

An alternate method which has never been tested, but which could work in theory, is to use a system for breech-sealing which is functionally equivalent to the disposable brass casing system in use now. But rather than have the casing be an integral part of the round itself, the casing would become part of the firing mechanism. The two diagrams below will elucidate.

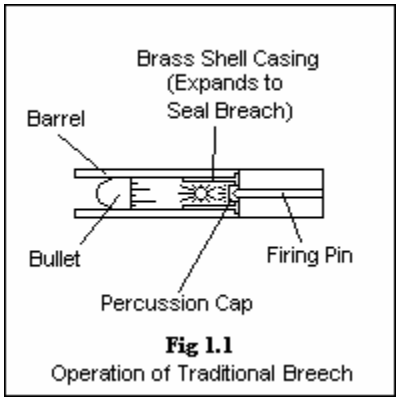

Fig 1.1
Operation of Traditional Breech

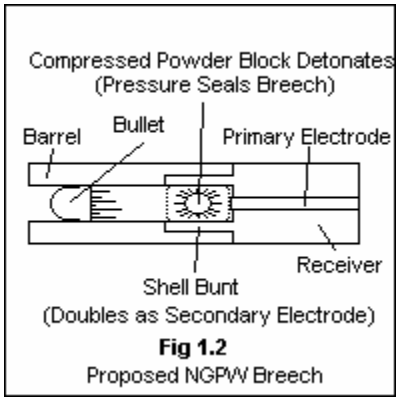

Fig 1.2
Proposed NGPW Breech

The proposed system may not be feasible. It is possible that the correct combination of composition and thickness cannot be found for the shell bunt to provide the desired durability, effectiveness of seal, and resistance to thermal expansion that such a mechanism would require to operate effectively. The chief problem is that, whereas a brass shell casing only has to function correctly once, the shell bunt proposed here would have to be capable of functioning correctly and reliably through many thousands of firings, without fatiguing due to repeated expansion and without expanding so much after continued firing that the receiver becomes jammed in the barrel. But even if this is not the correct solution to the breech-sealing problem, we do not believe that the problem is in the least insurmountable.

Chamber Residue

It is important that the propellant brick used by the caseless round employed in the NGPW be truly 100% combustible and not leave any significant residue in the chamber. This point has, of course, been realized by caseless ammunition designers, as the cleanliness of any mechanism is essential for it to operate reliably. But we choose to mention it here because the problem is particularly relevant in the case of the proposed electrical firing system. A firing pin which has been coated in powder-residue is still functionally capable of firing a round, whereas a dirty electrode may not be.

SIDSystem Rings

While it is possible to produce a system which functions exactly like the SIDSystem I have described above, the manufacturing difficulties inherent in the production of a market-wide group of uniquely individual ID rings may prove too expensive to overcome practically. It would be easy to manufacture a system in which any ring would deactivate any gun, but this does tend to defeat the purpose of the system

and, although it might offer some protection against unauthorized usage, would not be nearly so effective from a marketing perspective as the unique-ID system.

Marketing

The largest obstacle to the success of the NGPW is not technical, but is, rather, the nature of the firearms-owning public. Gun owners tend to be extremely conservative by nature, and as a rule will in the majority prefer old and reliable to new and flashy. The history of modern firearms is littered with innovative ideas which never caught on and simply fell by the wayside.

There will undoubtedly be heavy initial resistance to the NGPW. Long-time gun owners will scoff at it, and men who depend on their guns to protect their lives--police officers and others--will be particularly nervous about the SIDSystem. They will be extremely uncomfortable with any device which, if it fails to operate correctly, could leave them without a functioning weapon. For the first several months of production, any company which chose to produce the NGPW would have to wade through this sea of market inertia. Sensible advertising emphasizing the enhanced reliability and safety of the NGPW must be widespread, and the weapon must meet with favorable reviews in the major gun publications. And gun owners know that talk is cheap: the weapon will have to deliver on all its claims.

This is the formula that Glock followed when they first introduced their revolutionary polymerized handguns. They had a workable and effective product idea, but they were faced with formidable resistance from the gun-owning public. Nobody wanted to own a “toy” plastic gun. Ill-informed congressmen sought to have them banned as undetectable weapons of terrorism. People were sure they’d wear out quickly, or break in the stress of combat.

But Glock had the capital to persevere through all the misinformation and superstition, and now they are reaping the rewards in an enormous way. The Glock handguns are perhaps the single most ubiquitous combat handgun in the world today, taking over in that role where the Browning 1911 took off. While the market may be slow to accept new ideas, once it embraces an innovation continued sales are virtually guaranteed.

If the NGPW, then, can be produced and made to perform on a standard which meets or exceeds existing mechanical handguns, as we believe it can, and if sufficient financial resources are available to weather through the first year or so of marketing, then the NGPW could very well constitute a quantum leap forward in weapons technology.

Conclusion

The primary innovation involved here is the SIDSystem. The entire design and marketing concept hinges around its effective implementation and operation, and the system in and of itself constitutes the real value of the electrically operated weapon. Increased reliability, centralized power, laser sights, and other bells and whistles are exactly that in comparison to the SIDSystem. It is the quintessential gun safety device: a weapon which absolutely will not fire unless its legitimate owner is holding it in a firing position and squeezing the trigger.

Ignoring the profit potential altogether, the potential social good inherent in this design is expansive. A very high percentage of police officers killed in the line of duty are killed with their own weapons, an even larger percentage of gun-owning civilians killed in confrontations in their own homes are killed with their own weapons, and of course there are the thousands of children every year who injure or kill themselves or another person with their parent's firearm. Malappropriation of firearms and their subsequent misuse is the major concern of gun-control advocates, and if the NGPW can help to ensure that handguns are only fired by those who have a legitimate claim to them, then it brings us that much closer to a political society in which the importance of free ownership of arms is clearly understood by all. The potential to solve all these problems, and to save all those lives, is inherent in the design of the NGPW.