MBA Gyrojet Mark I Model B Pistols and Carbines: Rocket Science Meets Reality

By John Spangler

This is one of those very rare occasions when we will be discussing arms that are actually younger than most members. This presentation is not a definitive study of the topic, merely a sharing of the interesting material that others have discovered to help you enjoy the items on display in the exhibit room.

The definitive story is told in Mel Carpenter's excellent book *An Introduction to Gyrojets and Other MBA Ordnance,*[1] available from his website http://Gyrojets.net and his excellent articles in *Arms Heritage* magazine.[2,3] Carpenter's magnificent research concerning all types of Gyrojet ordnance items, and much of the larger history of MB Associates who made them, is so detailed and well-presented that there will be little for others to add to it. It is truly a fascinating story of how scientific innovation does not always translate into commercial success.

Many older arms collectors vaguely remember the Gyrojet rocket firing guns from the publicity surrounding them in the mind-1960s. Despite their appearance with James Bond in the 1967 movie *You Only Live Twice,* they are a mystery to younger collectors. They were clearly a fad that has now faded into obscurity. Today we will explore some of the background that led to the Gyrojet pistols and carbines, and the reasons for their failure to achieve market success. We will also provide a collector's perspective on the total production of only approximately 1900 Gyrojet pistols and carbines of all models that were made. This is a much smaller collecting niche than most people realize.

The Gyrojets on display are all Mark I Model B pistols and carbines. These are the most common versions available to collectors, albeit still in very small numbers. The earlier and later Gyrojet models were made in even smaller quantities and in so many variations that they are hard to categorize or quantify because many were basically individual prototypes.

MB Associates (MBA) was a large operation, not just two guys struggling in a garage somewhere. The founders were experienced in major programs, accustomed to projects that pushed the technological envelope, and usually involved with governmental agencies. They knew very influential people. MBA did not set out to become a "gun company," they were a company looking to make a profit by providing cutting-edge products for new markets.

As an example of the scope of MBA's activities, the company or its founders were connected in some way with:

- Aircraft "chaff" systems
- Atomic bombs and the "Manhattan Project"
- Central Intelligence Agency secret spy weapons
- The James Bond movie *You Only Live Twice*
- Nuclear reactors used by universities
- Presidents Johnson and Reagan
- Survival flares carried by US Air Force pilots today
- The Vietnam War riots
- Weather modification experiments

FOCUS

Those are awfully diverse topics, so we will concentrate on:

- How two brilliant scientists in the 1960s came up with the idea of miniature rockets that could be fired from guns.
- How the rockets work.
- How they got into the gun business.
- Why these were never really successful and are now rare collector items, despite being featured in a James Bond movie.
- What is out there for collectors?

BACKGROUND

Gyrojet rockets can be compared with two earlier inventions that are somewhat similar, at least at first glance.[4]

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Figure 1. "Hunt Rocket Ball."

Figure 2. Volcanic cartridge.

The "Hunt Rocket Ball" of 1848 was "a ball for firearms, with a cavity to contain the charge of powder for propelling said ball, in which cavity the powder is secured by means of a cap enclosing the back end." There was a hole in the cap for passage of the ignition flame from an external source (Figure 1).

The "Volcanic cartridges" of 1854 were deeply concave-based lead cartridges containing powder and primer within their bases. They are an evolution of the Hunt Rocket Ball (Figure 2).

Gyrojet rockets, invented in 1961, consist of a hollow metallic case that is filled with a propellant and a percussion primer in the center of a base that contains slightly angled discharge orifices. Once fired, the angled orifices cause the cartridge/projectile to rotate and accelerate (Figure 3).

The Hunt and Volcanic cartridges were not rockets, they were bullets that had room for the powder charge that would be ignited and then fired from a gun barrel using the pressure of the powder gasses acting inside the barrel to force the bullet out.

Gyrojet rockets are propelled by thrust from the burning propellant contained within the rocket and passing out the through the nozzles, not by the force of an explosion contained in a barrel to expel a projectile. Because the cartridge is not building pressure in the barrel, there is no recoil in a Gyrojet, and the noise is a "whoosh" sound, not a "BANG!" Exhaust gasses are vented through the holes in the barrel. The rocket burns for approximately 1/10th of a second to achieve a velocity of approximately 1500 feet per second at about 60 feet from the muzzle, spinning at approximately 19,000 revolutions per minute.

Figure 3. Gyrojet rocket.

THE GYROJET ROCKET'S SCIENTIFIC DETAILS

Rocket science really is pretty complicated. Figures 4 and 5 show a typical 13-mm Gyrojet rocket projectile, sectioned to show the details as they finally evolved.

The body of the rocket is a steel casing with a streamlined tip; it is open-ended at the rear. Concentricity is critical because without it, it will be unbalanced and wildly inaccurate as the rocket rotates in flight.

Figure 4. Sectioned Gyrojet showing the internal construction features. Actual size of the rocket is 13 mm or .51 caliber in diameter.

Figure 5. Gyrojet base showing primer in the center and the canted nozzles or ports that cause the rocket to spin in flight.

Within the rocket is a grain of propellant fuel that is shaped to fit in the internal part of the body and coated with an inhibitor on the outside to ensure even burning from the inside out; there is a hole drilled in the center axis. Inside the hole is a "second fire" ignition source that will quickly and evenly convey the flash of the ignition source to the length of the propellant grain; that source is usually made from highly flammable paper or cord. After the propellant grain is inserted into the body, a broaching operation forms a small lip inside the rear of the body to hold the grain away from the base to avoid blocking the nozzle ports.

The base has a recess for a small pistol primer (providing the "first fire") and a flash hole leading to the interior of the rocket, where the flame from the primer will ignite the "second fire" element and thus the propellant grain. The base has several (usually four, but sometimes two or three) ports or holes drilled at an angle. As the propellant powder burns, the gas pressure is vented through the ports, providing forward thrust to the rocket (in an equal and opposite direction from the expanding gasses). The angles of the ports impart a spin to the rocket, providing a more stable flight path due to the gyroscopic effect. The base material has to have qualities that allow erosion or ablation of the ports during the firing of the rocket propellant so that the ports are enlarged as the gas volume increases from the greater burning surface area as it burns outward from the axial hole. Otherwise there is a risk that the rocket will explode.

The base is secured to the body with a crimp that locks into the groove around the edge of the base, so that the base is not blown out.

On the inner surface of the base there is a thin foil seal to protect the interior of the rocket from outside moisture, but thin enough to rupture when the propellant is ignited.

THE MBA: ROBERT MAINHARDT AND ARTHUR BIEHL

Robert Mainhardt had just earned an Engineering Masters Degree when he was placed in charge of the materials laboratory at the Manhattan Project in Los Alamos to work on the Atomic Bomb (Figure 6). He was one of a handful of B-29 "Weaponeers" who would fly in a B-29 to perform the final arming operations to the bomb after takeoff. After World War II, he worked with the Atomic Energy Commission Intelligence Division, the Lawrence Livermore National Laboratory, and eventually with Aerojet-General Nucleonics.

Arthur Biehl had earned an engineering PhD and a commission as a Naval Reserve Officer (Figure 7). He worked for North American Aviation, then as a physicist at Lawrence Livermore National Laboratory, and then with Mainhardt at Aerojet-General Nucleonics.

Figure 6. Robert Mainhardt, 1922–2006.

Figure 7. Arthur Biehl, 1924–1993.

Mainhardt and Biehl worked together at Livermore and Aerojet-General Nucleonics developing the Aerojet-General Nucleonics type 201a (AGN-201) reactor. This was a small, self-contained, low-power nuclear reactor that they developed in the 1950s for educational, medical, and industrial applications. After this, their creative tendencies chafed under management who wanted them for long-term supervision of a completed project, so they left Aerojet-General Nucleonics.

On April 1, 1960, they founded MB Associates, which has been variously referred to as MB Associates, MBA Associates, or simply as MBA.

MBA was a profitable corporation every year it was in business, although the small Gyrojets themselves were never profitable. Although the Gyrojet pistol and carbine story is concentrated in the period from 1962 to 1973, a few other corporate history events must be noted. In 1965, Biehl left MBA, but remained on the Board of Directors because he was also part owner. In 1980, MBA was acquired by Tracor, Incorporated, and the new company became Tracor/MBA. Tracor was mainly interested in MBA's lucrative chaff and flare business, not the unprofitable Gyrojet segment. Finally, in 1982, Robert Mainhardt left Tracor/MBA to pursue other interests, but he remained interested in miniature rocketry.

MBA's headquarters were in San Ramon, California (not far from the Livermore Laboratory), occupying an entire former Nike missile site with numerous buildings and bunkers.

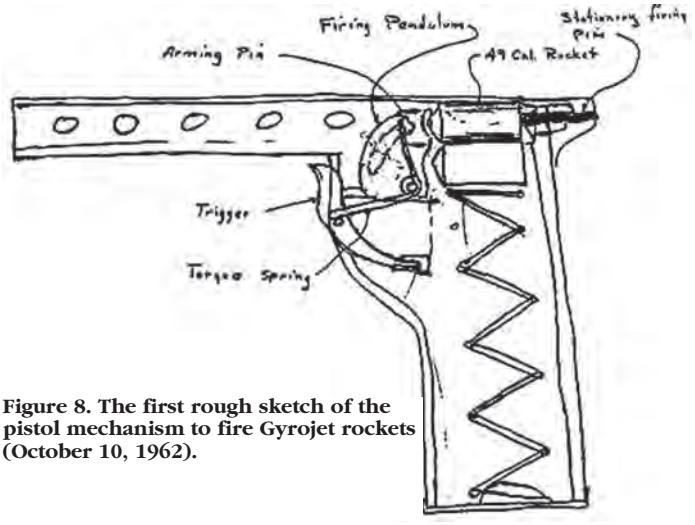

Figure 8. The first rough sketch of the pistol mechanism to fire Gyrojet rockets (October 10, 1962).

Gyrojets were developed here along with diverse products, including very successful chaff and flare countermeasures to protect aircraft from radar or heat-seeking missiles, and the large chaff dispenser units that are carried on aircraft. They also developed "cold smoke" marker charges for practice bombs to eliminate the fire hazards associated with pyrotechnic devices. In addition, MBA conducted numerous engineering studies and other projects. Gyrojets were a very small, ultimately unsuccessful, part of the overall MBA operation.

MBA'S EARLY ROCKET PROJECTS: FINJETS, LANCEJETS, AND JAVETTE

The Defense Advanced Research Projects Agency (DARPA) was created in 1958 as a "high-level defense organization to formulate and execute R&D projects that would expand the frontiers of technology beyond the immediate and specific requirements of the Military Services and their laboratories."[5]

DARPA's head was an old associate of Mainhardt and Biehl. In 1961, the idea was broached for cheap disposable weapons that could be provided to Vietnamese peasants to defend themselves against Viet Cong attackers. MBA quickly developed the concept of an inexpensive disposable handgun that was capable of firing a salvo of tiny rockets. The handgun could then be air dropped where needed. Contracts were granted to pursue the idea of "Finjets," as the tiny rockets became known. These were fin-stabilized, approximately .12 caliber (not counting the fin diameter) with a steel needle nose, and their overall length less than 2 inches. Development of these handguns continued through various manufacturing techniques and with the use of different materials for the body, fins, and ignition sources, etc. During tests, a 24-rocket salvo would have great dispersion, but only a 50% chance of even a single rocket hitting within an 18-inch circle at 100 yards. The Finjets never really progressed beyond the proof of concept stage, but they were the origin of the concept for miniature rocket guns.

MBA's next rocket project was for clusters of larger rockets, approximately .25 caliber by 6 inches long with an explosive charge in the warhead known as "Lancejets." These were proposed as a means of clearing minefields. The weight of the warhead and length of the body stabilized the rocked much like a javelin or lance. Testing was also performed with Lancejets in roughly 1/8-inch and 1/16-inch diameter sizes, seeking to solve stability issues.

Although outside of chronological sequence, this is a good place to mention the Javette—a micro rocket that was a tiny size at approximately .03 caliber (not .30 but .03 caliber!) and less than 7/8 inches long. These were developed circa 1964–1996 for various applications and under various names. These tiny rockets could be launched from guns using adapters in a conventional cartridge case. Reportedly, some were intended for use against sentry dogs, some were apparently considered as potential methods for delivery of chemical or biological agents, and some were rumored to be connected to the Central Intelligence Agency. Further discussion is outside the scope of this presentation, but it is interesting to show the broad range of miniature rocket experimentation that MBA proposed for unusual needs.

GYROJET ROCKETS: 1961

After tests with the Finjets and Lancejets showed accuracy problems, MBA decided that spin stabilized rockets could have advantages over their first designs. In 1961, experiments began on various methods to direct the rocket exhaust so that it would spin the rocket to achieve gyroscopic stability in flight. This was the start of the Gyrojet. Various sizes were tried, starting with approximately 1/8-inch diameter rockets, with varying degrees of success.

Other experiments took place with larger calibers, always with the hope of landing a large government contract to make millions of rockets, but always without success. One attempt was a rocket that could be used in modified Model 1911 .45 caliber pistols. However, the rocket was too short to hold sufficient propellant to make it effective.

GYROJET PISTOL DEVELOPMENT: 1962

By 1962, MBA had determined that a .49 caliber Gyrojet rocket provided good stability and reasonable accuracy, but they now needed a way to fire them. On October 10, 1962, one of their engineers sketched out what was to become the standard Gyrojet pistol and carbine concept (Figure 8). This was based on an internal "single stack" magazine feeding six rockets into firing position.

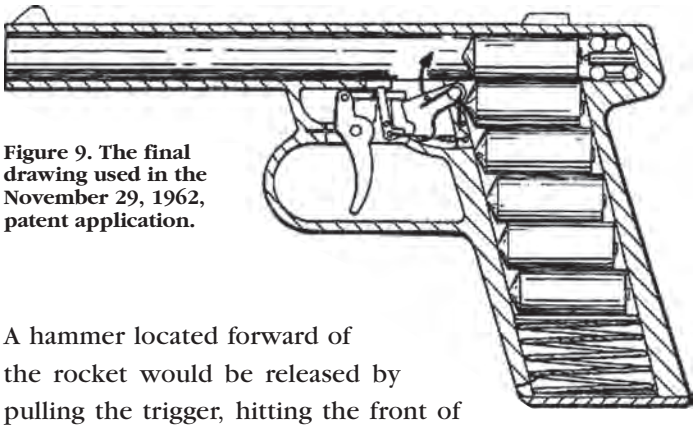

Figure 9. The final drawing used in the November 29, 1962, patent application.

A hammer located forward of the rocket would be released by pulling the trigger, hitting the front of the rocket, driving it rearward onto a fixed firing pin. The hammer would momentarily hold the rocket in place so thrust could build up. As the rocket moved forward and out of the barrel, it would re-cock the hammer for the next shot. Six weeks later, MBA filed a patent application on their new invention (Figure 9).

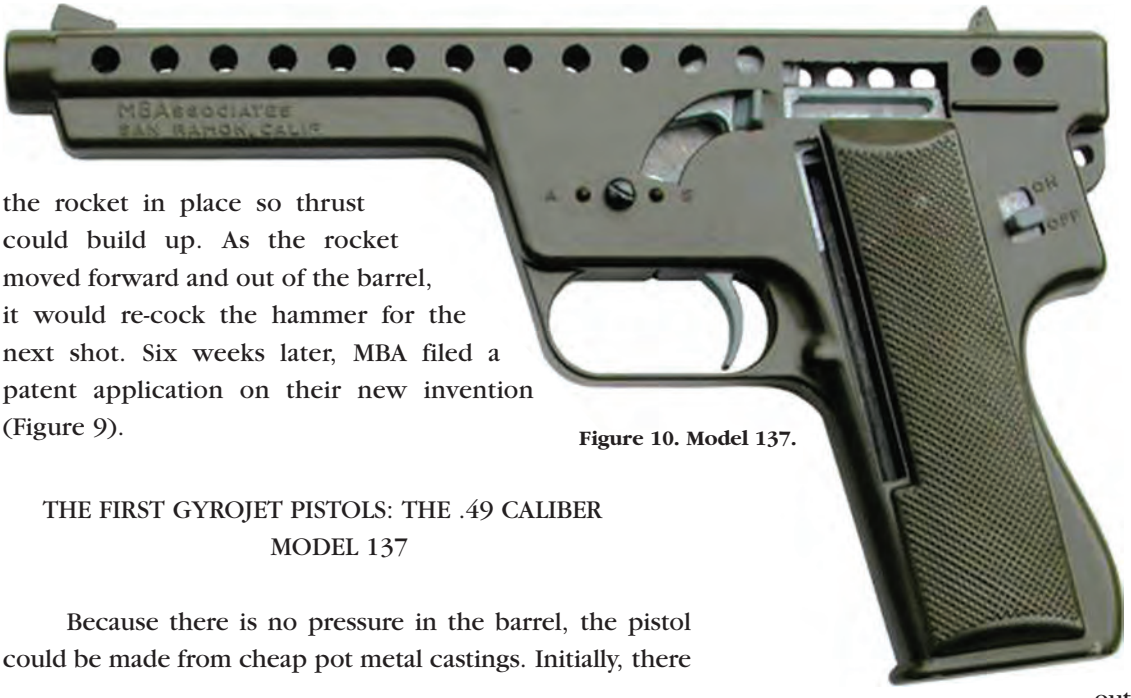

Figure 10. Model 137.

THE FIRST GYROJET PISTOLS: THE .49 CALIBER MODEL 137

Because there is no pressure in the barrel, the pistol could be made from cheap pot metal castings. Initially, there was not even a barrel; instead there were merely guide ribs that were cast into the frame. Later tests showed that tubular barrels provided better accuracy, so those were added. Within a year, dies had been made, frames cast, and the first pistols were assembled as the Model 137 to use .49 caliber rockets (Figure 10). However, accuracy and reliability problems ended production after a total of approximately 45 pistols were made between 1962 and 1963.

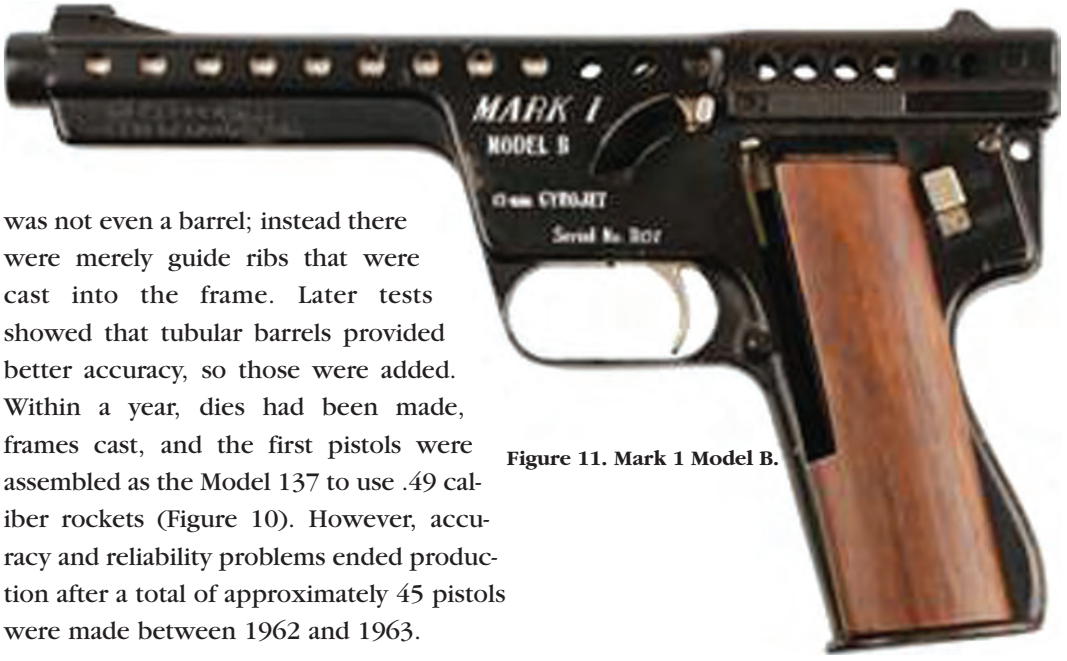

Figure 11. Mark 1 Model B.

MARK 1 MODEL A 13-MM GYROJET PISTOLS

Experiments showed that a 13-mm (or .51 caliber) Gyrojet rocket gave better accuracy and reliability that the .49 caliber first used, so that was adopted as the new standard caliber. The new model was very similar to the Model 137 except for caliber. Mainhardt had observed that Colt was selling a lot of "commemorative" pistols to collectors, rather than shooters, so he decided to test that market, hoping to generate sales from people less concerned about accuracy or reliability than the shooters he had initially targeted. He began selling the pistols in handsome walnut cases, the same ones as used for Gerber knives. "EXPERIMENTAL" markings on the guns were also used to justify higher prices of approximately $250 to $300 per pistol. He also offered different finish and grip options. MBA produced approximately 100 Mark 1 Model A pistols between 1963 and 1965.

MARK 1 MODEL B 13-MM GYROJET PISTOLS

The Mark 1 Model B pistols were essentially similar to the Mark 1 Model A, but they used a "slide" over the loading area, instead of a hinged cover to keep the magazine contents from spilling out (Figure 11). Not only was this a better design, it also made the pistol seem more like the Colt Model 1911 pistol, potentially making it more attractive for military sales. The intended market was expanded from mostly collectors to both collectors and shooters. The Mark 1 Model B saw the greatest production numbers of any of the Gyrojet arms, adding several distinctly different models, such as carbines and short barrel pistols, not just variations in finish, grips, and markings as in previous models. A total of approximately 1100 Mark 1

Figure 12. Mark 1 Model B Gyrojet in standard cardboard box.

Model B pistols and carbines were made between 1965 and 1968.

The Mark 1 Model B pistol was introduced to collectors at the September 1965 Las Vegas Gun Show. The "standard models" in a cardboard box were offered and priced from $160 to $175, depending on the grip and finish options (Figure 12).

Also offered was the "presentation model" in the walnut case with 10 dummy display rockets, and a medallion honoring Dr. Robert Goddard, famous rocket pioneer, priced at $250.00. Most of the Mark 1 Model B pistols were sold with a black finish. Some were made with an antique nickel finish, and a few were gold plated, or finished in other colors (Figure 13).

Hoping to find a niche market, MBA introduced a few special configurations. One was a "Snub Nose" version with a very short barrel of which only a few examples were produced. Another was a "Survival" pistol with a telescoping barrel (Figure 14), of which maybe a few dozen made. The barrel tube could be pushed all the way back for ease of storage, but for use, it could be pulled forward to clear the hammer and provide better guidance. The Survival guns led to the development of a Gyrojet flare to go with them, which will be discussed later.

For comparison, in 1965, the price for a Colt 1911 .45 automatic was $82, a Colt Single Action Army revolver was $125, a Ruger Super Blackhawk was $116, and Dirty Harry's S&W Model 29 was $140.00. The relatively high price of Gyrojet pistols discouraged sales.

Besides the high cost of the guns, the ammunition cost also discouraged sales. Thirteen-millimeter rockets sold for $1.35 per round at a time when a 20-round box of .30-06 soft point ammunition, or a 50-round box of .38 special cost less than $5.00. A 50-round box of .22 Long Rifle ammunition only cost approximately $.80. Furthermore, accuracy tests reported in gun magazines left much to be desired. However, President Ronald Reagan owned a Gyrojet pistol and is also known to have shot it, and Mainhardt promised to save him some ammunition from the limited amount he had left.

Again, the Mark 1 Model B Gyrojets had a total production of approximately 1100 pistols and carbines from 1965 through 1968. This is a relatively small number for any 20th century firearm type, especially considering the large number of variations. Collectors can delight at owning any example of the Gyrojet, but the truly obsessed will despair that within that small number there are so many minor variations. That is part of the fun of being a collector.

GYROJET CARBINES

Mainhardt was ever hopeful for a military contract for Gyrojets, and he created carbine models that essentially

Figure 13. Mark 1 Model B Gyrojet in presentation case with medallion and dummy rockets.

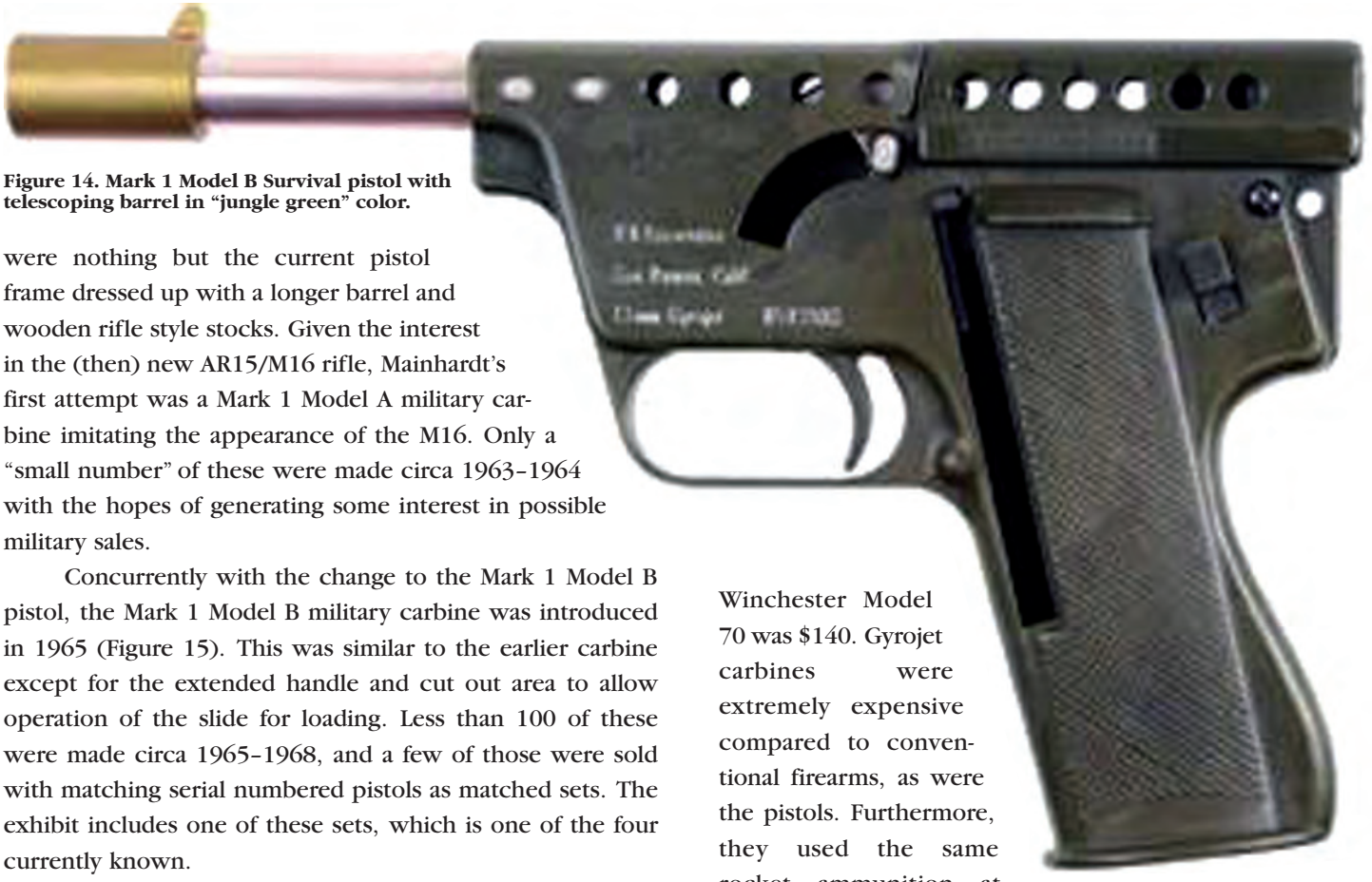

Figure 14. Mark 1 Model B Survival pistol with telescoping barrel in "jungle green" color.

were nothing but the current pistol frame dressed up with a longer barrel and wooden rifle style stocks. Given the interest in the (then) new AR15/M16 rifle, Mainhardt's first attempt was a Mark 1 Model A military carbine imitating the appearance of the M16. Only a "small number" of these were made circa 1963–1964 with the hopes of generating some interest in possible military sales.

Concurrently with the change to the Mark 1 Model B pistol, the Mark 1 Model B military carbine was introduced in 1965 (Figure 15). This was similar to the earlier carbine except for the extended handle and cut out area to allow operation of the slide for loading. Less than 100 of these were made circa 1965–1968, and a few of those were sold with matching serial numbered pistols as matched sets. The exhibit includes one of these sets, which is one of the four currently known.

While MBA's hopes were focused on possible military sales, Mainhardt also offered a Mark 1 Model B "sporter carbine," introduced at the September, 1965, Las Vegas Gun Show (Figure 16). Mechanically identical to the military carbine, this model featured a sporter style walnut stock with cheek rest, a Bushnell Phantom scope, and a bulky barrel shroud. The standard finish was a nickel plate.

Winchester Model 70 was $140. Gyrojet carbines were extremely expensive compared to conventional firearms, as were the pistols. Furthermore, they used the same rocket ammunition at $1.35 per round, with accuracy not much better than that found in the pistols.

Figure 15. Mark 1 Model B 13-mm Gyrojet military carbine.

Figure 16. Mark 1 Model B Gyrojet sporter carbine.

Approximately 300 of these were made circa 1965–1968, making these the most common of all Gyrojet carbines.

Price on either the military or sporter Mark 1 Model B carbines was $300.00. For comparison, the 1965 price for a Ruger 10-22 was $54; a Winchester Model 94 was $84; and a

Figure 17. James Bond at the "Ninja" site with a full array of Gyrojet pistols, carbines and ammunition.

THE 1968 GUN CONTROL ACT LEADS TO THE MARK 1 MODEL C 12-MM (.49 CALIBER) GYROJET PISTOL

After passage of the Gun Control Act of 1968, the Bureau of Alcohol, Tobacco and Firearms was confused by the .51 caliber and smoothbore barrels of the Gyrojets, and their unconventional ammunition. After initially deciding that they were newly prohibited "destructive devices," the BATF later decided that they were not, and attempts to register them as such were returned stamped "Registration not required." Subsequently they were reclassified as Curios and Relics.

However, at the time, MBA was told to stop making the 13-mm Mark 1 Model B pistols and carbines because they would be considered to be destructive devices. Therefore, MBA complied with their official guidance, reduced the caliber to the earlier .49 caliber, and the barrels were dutifully given very light rifling, although it was totally useless because the rocket spin was imparted by the canted nozzles in the rocket base, not from contact with the barrel. These new pistols were designated as the "Mark 1 Model C," and, except for the rifling, smaller bore and changed markings were identical to the Mark 1 Model B. Only approximately 600 of these were made circa 1969–1972 when Gyrojet production basically ceased. The price on the Mark 1 Model C was cut to $99, a significant reduction from the earlier $165 price tags. However, by that time, the novelty had worn off, the accuracy problems were well known, ammunition costs remained high, and sales were slow.

GYROJETS, JAMES BOND, AND *LIFE* MAGAZINE

James Bond movies always feature flashy technological gadgets, and the 1967 hit *You Only Live Twice* was no exception. Bond, played by Sean Connery, was busy saving the world and killing bad guys with the help of beautiful women and high tech toys (Figure 17). In this case, he had the help of a team of Ninjas armed with Gyrojet pistols and carbines. One scene at the "Ninja training site" shows Bond examining a table covered with Mark 1 Model B Gyrojets including two pistols, two military carbines, and two sporter carbines. The head Ninja also demonstrates a Finjet rocket in a cigarette which Bond later uses to blast his way out of the evil villain's headquarters. (Despite the fact that the Finjets were not explosive, the special effects show the rocket blowing out a vault door! Not everything you see in the movies is real!)

The May 27, 1966, issue of *Life* magazine included a 3-page story "Deadly Zip Gun for the Missile Age" touting the virtues of Gyrojets and noting their commercial availability which "...prompted two Soviet military attaches to travel to California to try to buy one in a San Jose gun store. They were turned down because they were aliens."[6]

We can only wonder how much lower Gyrojet sales would have been without the plugs in the movie and *Life* magazine.

A GYROJET PRODUCT FINALLY BECOMES PROFITABLE

Despites MBA's success with many other products and services, the Gyrojets remained unprofitable. However, one product finally proved successful. In 1965, Gyrojet flares were developed for use in the Mark 1 Model B survival pistols, and these were proven to be very effective at penetrating jungle foliage. This led to the development of an even more effective Model 201 Gyrojet flare that could be launched from a simple launcher without Gyrojet pistols. Replacing the "Penguin" type flares, these proved to be very profitable items. These were basically a two-stage Gyrojet rocket, with the rear portion similar to the standard ball Gyrojet, but topped with a pyrotechnic mixture–filled second stage that separated from the first stage as it burned out (Figure 18). Initially supplied only by MBA, other bidders

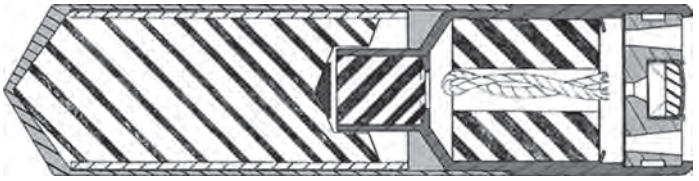

Figure 18. Gyrojet M201 emergency signal flare rocket showing the flare "second stage" atop a more or less conventional Gyrojet "first stage" and the time delay separation charge between the two.

eventually began production. This Gyrojet-designed item remains in service today, and is available in a variety of colors and infrared and chaff options. These present more challenges for the collector who needs one of everything!

Furthermore, for the collector most obsessed with getting one of everything, there are even miniature Gyrojet flare sets made for use with G.I. Joe action figures, which, of course, do not fire.

OTHER MBA PRODUCTS

Although beyond the scope of our topic of Mark 1 Model B Gyrojets, completeness demands brief mention of some other MBA products.

Whereas the Gyrojet pistols and carbines were 12 or 13 mm, there were much larger Gyrojets. These included the 15-, 20-, 25-, 30-, and 40-mm Gyrojet rockets developed for various applications. Some were kinetic energy kill munitions for defense against incoming missile attacks. Some were potential carriers of chemical munitions, or illumination rounds for perimeter security use. The 40-mm round was a cloud seeding rocket fired from launchers mounted in aircraft for seeding the base of clouds to induce rainfall.

After the May 4, 1970, antiwar riots at Kent State University, Mainhardt sensed a business opportunity for less lethal ammunition for riot control use. This led to a line of stun bag munitions that fired small cloth pouches filled with small shot, or other objects. These were made in 40-mm size for use with the M79 grenade launchers, 37-mm for police gas guns, 12-gauge for shotguns, and also in .38 special. These were known as "stun bag," "stinger," and "short stop."

Showing more creativity and a desire to be free from hassles associated with firearms, ammunition, and the BATF, Mainhardt then branched into producing devices that fired stun bag–type projectiles using power from CO_2 compressed gas cylinders in nylon housings.

CONCLUSION

MBA was an innovative company that provided an incredibly wide variety of products and services for a broad spectrum of military, law enforcement, and civilian customers. Their goal was to earn money, not necessarily to produce rocket guns. Their Gyrojet pistols and carbines were a remarkable technological advance, but despite the fine engineering and creativity, they did not fill a market need. Even their novelty value was offset by their high initial cost, the high cost of ammunition, and their unsolved accuracy problems. However, as oddities, they offer an interesting field for a collector. As noted previously, there are a very wide variety of variations among the limited production total of approximately 1900 Gyrojet pistols and carbines. This exhibit focuses on the Mark 1 Model B, that is the 1100 or so more or less mass production models, but still justifies acquiring an interesting variety of items. And, you can brag that you own a gun like James Bond used!

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