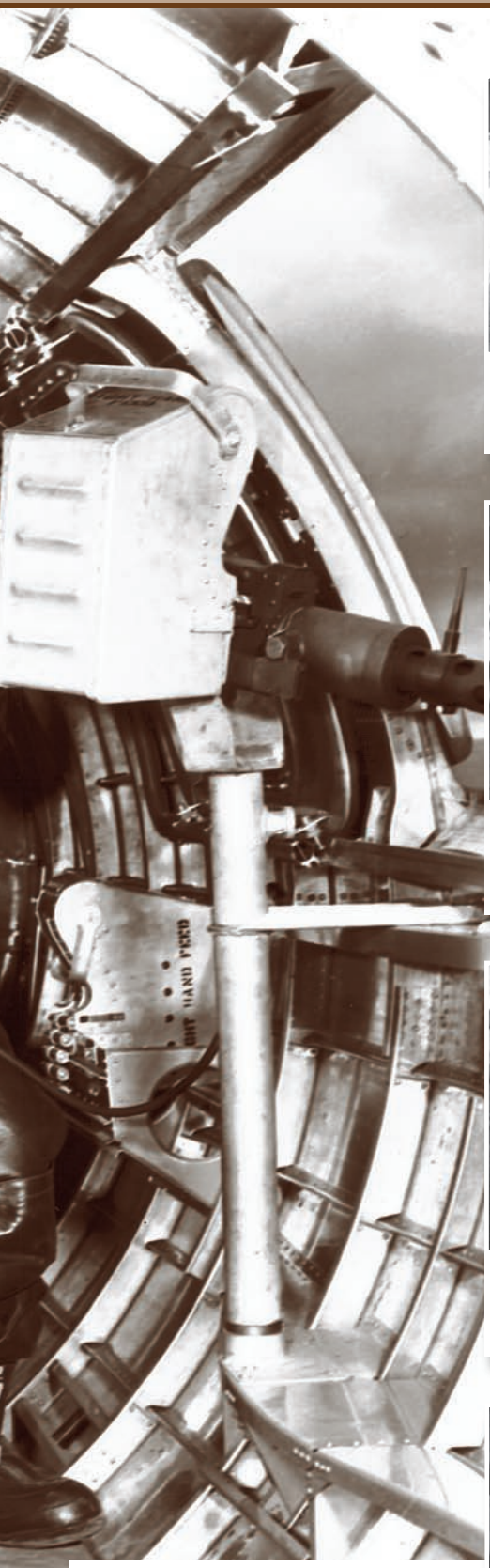
Aerial Gunner Training



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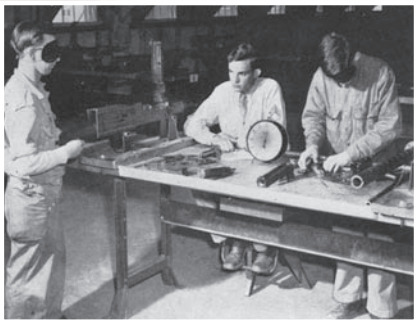
Future gunners review the inner workings of the Browning .30 caliber machine gun.



Students are being timed as they strip and then reassemble .50 caliber machine guns blindfolded.

Students are trained in disassembling and reassembling their machine guns blindfolded.

If the student can reassemble their guns blindfolded, they will completely understand its inner workings.

By: Kelsey McMillan

As captivating as are the combat stories of America's World War II aerial gunners, so too is the wartime history of the training program that produced them. Some of the earliest training methods devised in 1941 were crude and laughable, and hardly effectual. But ongoing efforts to improve the program led to the development of ingenious ideas, complex theories, hi-tech innovations, and fascinating failures.

The U.S. Army Air Force's plans for a flexible gunnery training program were progressing at a leisurely pace during the latter months of 1941. Construction of three gunnery schools was nearing completion and the first instructor class had graduated. But overnight, the declarations of war against Germany and Japan created an urgent need for large scale training. There were enormous obstacles to meeting such a demand. Training men for the unique physical and mental demands of being an aerial gunner was very complex. America had no experience to draw on, and only a handful of newly trained instructors were available. There were not enough planes, equipment and ordnance to fight the war, let alone enough to supply the schools. Nevertheless the first Air Force flexible gunnery classes were in session just days after Pearl Harbor.

Las Vegas Army Airfield, the first of the new flexible gunnery schools began accepting its first students in December 1941. Two more schools at Harlingen Airfield, Texas, and Tyndall Airfield in Panama City, Florida also accepted their first students in December 1941. Buckingham Airfield, Ft Myers, Florida was home for the Central Gunnery Instructors School, a facility dedicated to training aerial gunnery instructors; its first class arrived in September 1942. Classes commenced in early 1943 at two more new schools located at Kingman, Arizona and Laredo, Texas. The last school to open - Yuma, Arizona - began training in late 1943. In May 1944, instructor training was moved from Buckingham to Laredo, and it became a focal point for research and

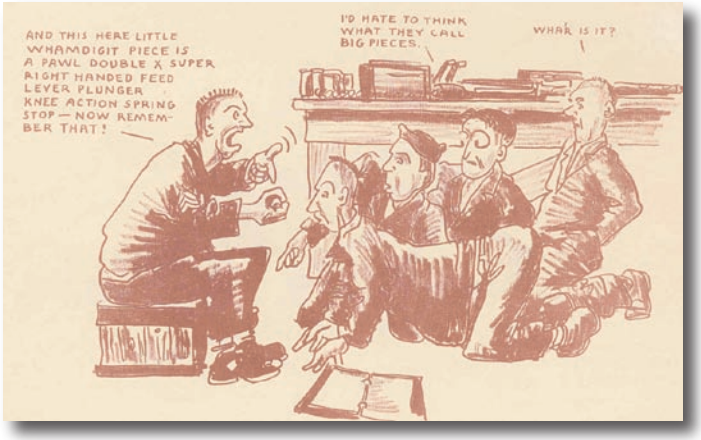
development, tackling the theoretical and practical problems which hampered improved efficiency in training.

A Call to Arms

Intensive recruitment for the fledgling program began almost immediately after the December 7th attack. Over the next few months, thousands of enlisted men at USAAF bases all over America would assemble in their post theaters to hear a talk by some visiting NCO with a lot of hash marks. John Cromer, a top turret gunner from the 381st Bomb Group, will never forget the recruiter that visited Sheppard Field when he was a 32-year-old aircraft mechanic. "The man was a spellbinder," John recalls, "a military pitchman with superb talents. I listened in hypnotic fascination as he described the adventurous life of an aerial gunner. Carried away by his fiery enthusiasm, I could picture myself holding off a swarm of Japanese Zeros!"

In the Classroom: Armaments and Ordnance

Flexible gunnery students would spend all but the last week of school in the classroom and shooting ranges on the ground. Initially the training lasted four weeks; then it was extended to five weeks and finally six weeks. In that first week they were overwhelmed by a blitz of data about machine guns and ordnance which they would be required to memorize. They learned proper maintenance and cleaning - how to tear down and reassemble the guns; how to load drums and ammunition belts. For weeks



their lives revolved around disassembling and reassembling their machine guns, according to two sets of procedures. The one known as "detail stripping" involved dismantling every single removable piece. The second, "field stripping," involved disassembling the machine gun only to the point where a given malfunction could be fixed, and then it was reassembled. These exercises were repeated over and over until mastered. The trainees practiced clearing jams quickly as if their lives depended on it, because it did if a gun jammed at 28,000 feet with an enemy pilot bearing in for the kill.

The trainee also had to achieve proficiency at stripping his gun while blindfolded and wearing gloves. The reason for wearing gloves was obvious; it was frigidly cold at bombing altitudes – as much as 60 degrees below zero over Europe. If the gunner touched his machine gun with bare skin it would freeze to the metal. But why blindfolded? It's difficult to look

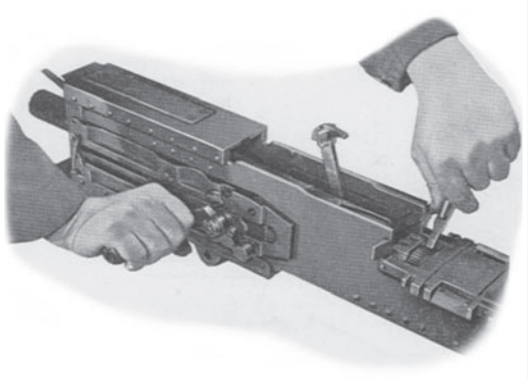


Image from an Army Air Force training manual to teach students the inner workings of the Browning .50 caliber machine gun.

This original color postcard from Tyndall Field, Florida shows a Captain receiving instruction in the reassembly of a .50 caliber machine gun.

straight down and see what you're doing while zipped up to the neck in a bulky flight suit, with goggles and an oxygen mask covering his face. Bouncing around in turbulent air doesn't make it any easier to see what you're doing. Better to keep your eyes on the skies too so you can watch for bogies.

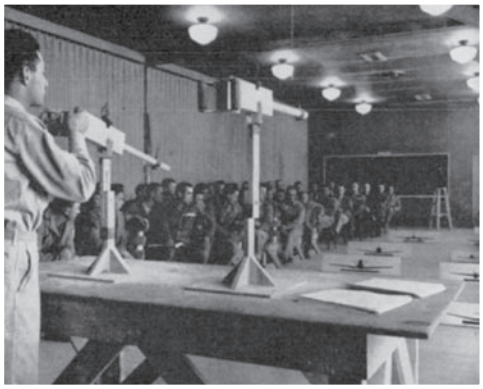
One of the requirements to graduate was to perform a blindfolded detail strip, and then reassemble the gun with a change in the direction of the ammo feed (from right to left or left to right) while the gunnery instructor observed with a stopwatch. Milt Zack, a bombardier/navigator with the 11th Air Force remembers his final exam in the blindfolded detail strip. "I very meticulously set aside each section in a little pile in order on the bench to make it easier to reassemble. Then along came the instructor and just as meticulously mixed everything together. Well, it took awhile but I did manage to get it back together, and I guess it was OK because I passed."

Ordnance classes addressed the different types of ammunition, how they worked, their uses, and how to tell them apart. Armor-piercing, semi armor-piercing, ball, tracer, incendiary and dummy - each had unique markings on the head of the cartridge and color coding on the tip of the projectile. Ordnance study went on after hours too, according to George Underwood, 310th Bomb Group, 12th Air Force. "Each night after shooting most of the day we loaded ammunition into belts, then loaded the belts into cans that fit the turrets which we shot the next day. Each box of 350 rounds weighed 100 pounds and those 50s had voracious appetites firing 750 rounds per minute."

More Classes - Mathematical Theories

After mastering the machine gun and ammo, the trainees learned boresighting and harmonization – oversimplified, that means lining up the gunsight so that it correctly aims where the gun fires. The next step was the complex physics of air-to-air gunnery. The students learned how gunsights compensated for the many forces which caused a bullet to deviate from a straight line, such as gravity, air resistance, drift, and the movement of the gun platform (the aircraft). In the still air of a ground range, the gunners found a projectile was predictably pulled down by gravity and held back by air density. The same forces act on a bullet fired from a moving platform, but bullets do curious things when fired from a plane in flight. Unless fired dead ahead or dead astern from the bomber, bullets do not go where aimed. First, the slipstream causes them to drift sideways until air resistance straightens them out; then they lag behind the plane. Shots fired 90 degrees right, or 90 degrees left of the direction the plane is flying behave very differently because of a bullet's clockwise rotation. Projectiles fired to the right side of the plane tend to dig into that wall of air, and they will have dropped several feet at a range of 1000 yards. Bullets fired to the left side tend to float on the wall of air resistance, and will drop only inches at a range of 1000 yards. Rounds shot straight up from the plane drift right; fired straight down, the

Poorman Flexible Gunnery Range, 1944



Aircraft recognition is vital to gunners. Knowing an aircrafts size will help with judging its range.

The Skeet range. Gunnery students learned how to 'lead' a target with shotguns before moving up to machine guns.

bullet drifts to the left.

Deflection, one of the most important words a gunner would learn, was explained by instructors as, "The amount you must aim away from the attacking fighter to compensate for its movement and your plane's movement. The term may have been new to the men, but the meaning was not. Any of the young men who had played sports or had a newspaper route as a boy understood it. An illustration of a kid on a bike throwing a newspaper several feet before he reaches the porch appeared in the manual. Deflection was measured in rads (short for radius). A rad was the distance between each of the concentric rings on a gunsight.

Initially, the gunner had to learn how to compute deflection in his head to accurately aim a flexible machine gun at a moving target. Mercifully, that changed after the invention of the computing gunsight – a precision electrical and mechanical device that performed all the calculations. During 1942 the student had to become familiar with as many as ten different types of gunsights that were in use!

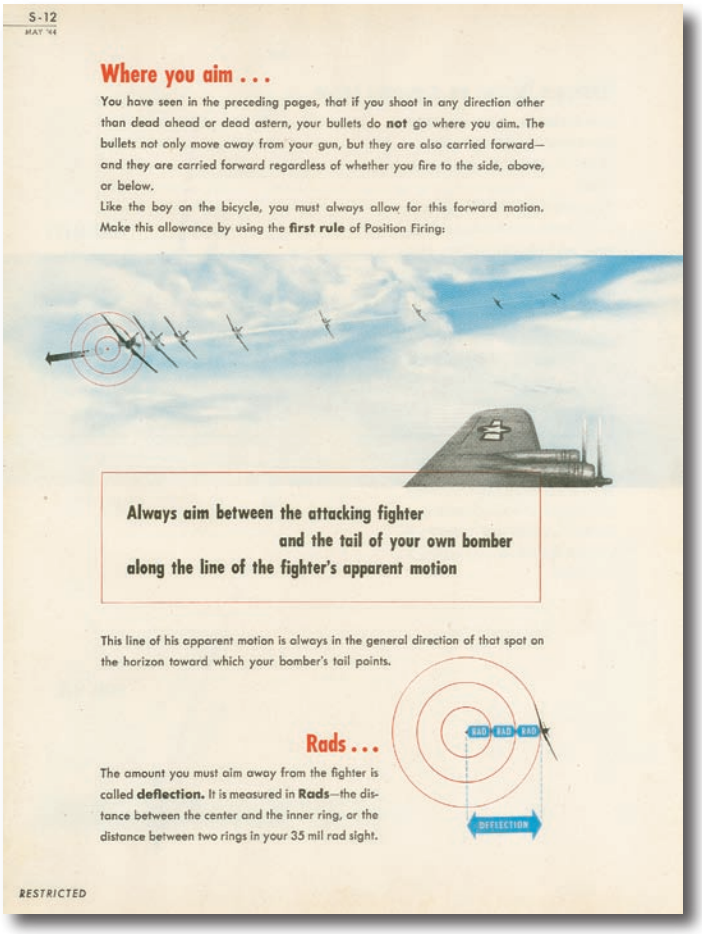
Gunsights were essential, but there were fundamentals to successful aiming which, rather like a golf swing, could be mastered only through practice, practice, practice. Those fundamentals were range estimation, line of motion, and smooth tracking. Students practiced estimating the range, or distance to the target, so that they would not begin firing too soon or too late. Line of motion was the imaginary straight line of the attacking plane's path as visualized by the gunner. The importance of smooth tracking, keeping the eyes on the target and moving the gun in a smooth continuous flow, could not be over-emphasized. The trainees were instructed to practice with any opportunity by tracking every target whether in or out of range.

There were rules relating to gun bursts, or rather the rate of fire. The student was instructed not to fire until the enemy reached a range of 600 yards or closer – beyond that, accuracy degraded. At that range, only a few very short bursts were called for. As the attacking plane reached 300 yards or closer, this was the time for the gunner to pour it on. A steady rate of fire in combat wasted the limited supply of ammunition and did not increase the chances of scoring hits. It also overheated the gun barrels - a dangerous condition. The high temperatures that resulted from sustained firing could ruin the rifling, distort the shape of the barrels; or worse, it could cause the round in the chamber to fire without the trigger being depressed. The trainees were cautioned to always keep the weapon cleared during breaks in firing, and pointed in a safe direction.

Enemy fighters had many advantages over the bomber gunners; they were faster, more agile, and had 20MM cannons with greater range than machine gun bullets. They were also expert at denying gunners an easy shot. They knew better than to attack bomber formations in a straight line. Students were trained to expect an attack from oblique angles and turns, known as pursuit curves. This gave the gunner mere seconds to draw a bead on them. There was some predictability to these pursuit curves and the trainees were taught how to use

Linking machine gun cartridges for gunnery training.

Students practice range estimation on an approaching AT-6 trainer using wooden machine guns and ring sights.



S-12
MAY '44

Where you aim . . .

You have seen in the preceding pages, that if you shoot in any direction other than dead ahead or dead astern, your bullets do **not** go where you aim. The bullets not only move away from your gun, but they are also carried forward—and they are carried forward regardless of whether you fire to the side, above, or below.

Like the boy on the bicycle, you must always allow for this forward motion. Make this allowance by using the **first rule** of Position Firing:

Always aim between the attacking fighter and the tail of your own bomber along the line of the fighter's apparent motion

This line of his apparent motion is always in the general direction of that spot on the horizon toward which your bomber's tail points.

Rads . . .

The amount you must aim away from the fighter is called **deflection.** It is measured in **Rads**—the distance between the center and the inner ring, or the distance between two rings in your 35 mil rad sight.

RAD RAD RAD

DEFLECTION

RESTRICTED

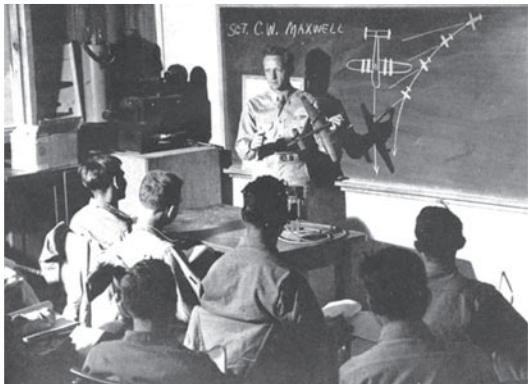
this. However, in combat the gunner soon learned that his enemy knew very well how to stay out of his crosshairs. Early in the war the American bombers were most vulnerable in the nose, so the enemy often attacked head-on at maximum closing speeds. But when the noses became more heavily armed, the enemy shocked the bomber formations by diving right through the middle of them instead.

If the gunnery student had harbored any illusions about knocking down dozens of "Kraut" or "Nip" planes, his introduction to these mind-boggling math and physics studies dispelled that notion.

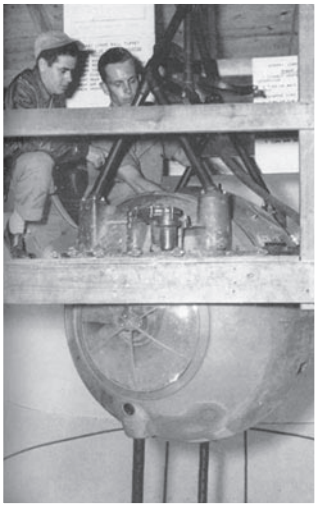
Still in the Classroom - Turrets

Gun turrets were an even more complicated business. Instruction in the operation, maintenance, and repair of electrically-powered and hydraulically-powered turrets must have made the men's heads spin. Turret management included boresighting and mounting guns, mounting and adjusting sights, loading ammunition, checking the operation of all clutches, switches, fire interrupters, interphone and oxygen connections, and timing solenoids for firing. Much of the manipulation of switches and connections had to be performed blindfolded in a final exam. If the turret malfunctioned, the bomber's defenses were weakened. If the turret door or opening could not be aligned with the opening or escape hatch, the man inside had to know how to fix it; or else he could forget about escape in an emergency.

In the first year the gunnery schools operated, the students did not know to what type bomber, or to which gun position they would be assigned until they graduated and went to combat crew school. Consequently, they were expected to be proficient with each type of turret in use

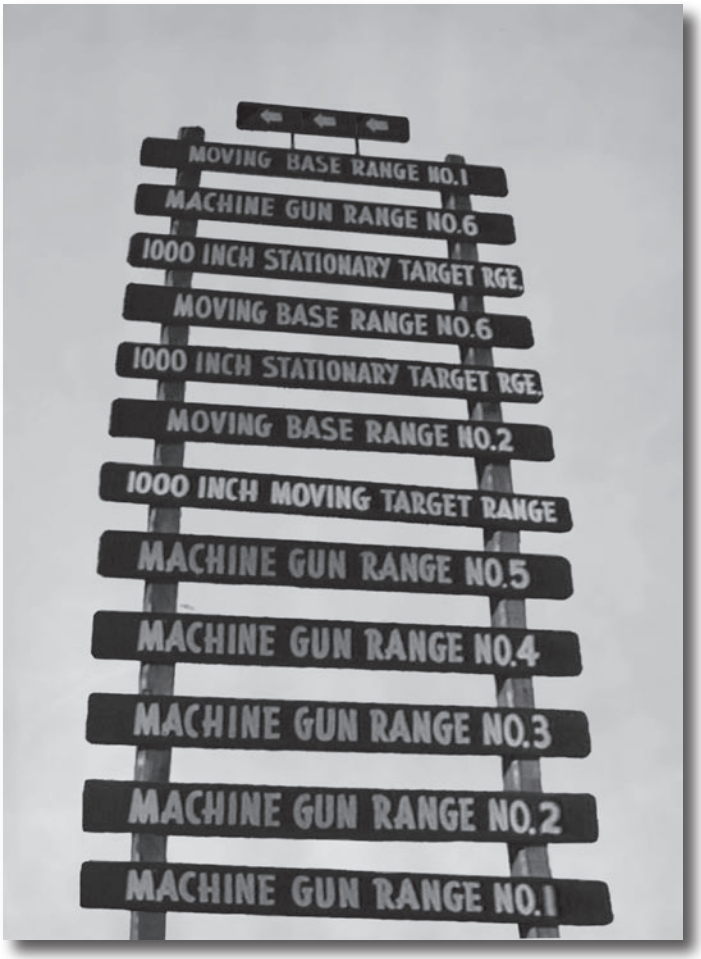


Sgt. C.W. Maxwell teaches students the finer points of anticipating an enemy's attack curve.



Students learn the fundamentals on operating power turrets such as this Martin upper turret used on the B-24.

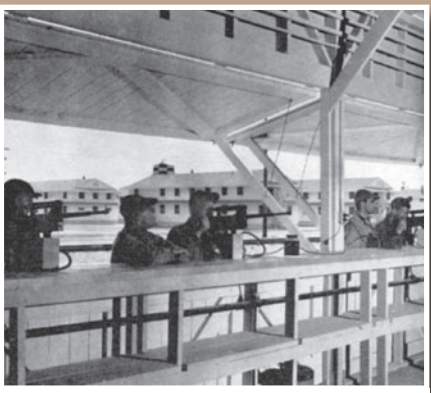
at the time. Initially, there were only a few different types of bomber turrets, so this policy posed no serious problems at the schools (aside from the fact there were never enough of them). Over the course of the war, however, as more types of turrets were introduced for dedicated use on the different types of bombers, it became a serious problem. There were the Sperry upper and ball turrets, the Consolidated tail turret, the Bendix upper, lower, and chin turrets, the Martin upper turret and the Emerson nose turret. Training time was too short, and the students couldn't possibly retain all that knowledge. The solution seemed to be specialization at the different schools. In mid 1943 Laredo and Harlingen were designated B-24 schools and trained only in turrets installed on the Liberator. Las Vegas and Kingman became B-17 schools, while Tyndall trained its gunners for the B-26 and B-34. Buckingham also trained for the B-26 and B-24, but also had responsibility for light and dive bomber turrets. The problems were not completely ironed out as the graduates were sometimes assigned to a different aircraft type at combat school. This issue was addressed in 1944 when Laredo switched back to training students on all types of turrets in use in 1944.



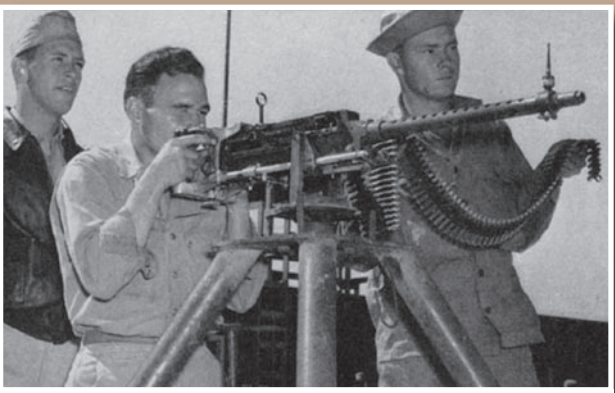
Ready on the Firing Line

With so much classroom instruction, the students may have begun to wonder if you got to shoot guns at gunnery school. Finally they had their chance. There were four basic phases of target shooting and each was progressively more difficult. Initially they would fire from stationary positions at fixed targets and then moving targets. After a few weeks of working through these phases the students advanced to firing at moving targets from moving platforms, first on the

Waist gun trainer



BB gun trainers. These BB machine guns are used to knock down rows of fast moving airplane silhouettes.



Students learning how use the ring sight on this Browning .30 caliber machine gun.

ground, and then air-to-air target shooting in a plane.

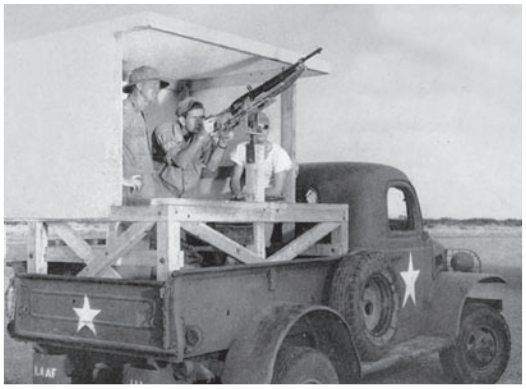
Training methods were in a constant state of flux throughout the war, and many varieties of ground ranges were used at each of the schools at different times. The students might start out shooting .22 rifles at targets on a conveyor belt, much like a carnival attraction. To introduce students to machine gun firing, some schools rigged small machine guns with high pressure air hoses to fire BBs. Then they graduated to shotguns on the skeet range. Shooting at the clay targets flung from various angles and heights were a good introduction to the tracking and leading a moving target. Firing shotguns all day left their arms feeling battered from the shoulder to the elbow. A 93rd Bomb Group gunner remembers, "We learned to shoot right-handed, left-handed and any other way imaginable. I had both shoulders stuffed with towels, they were so sore and black and blue."

Machine gun firing would begin on a fixed target range with the guns mounted on tripods. Here students got a chance to apply what they learned about field stripping and malfunction repair. Before students arrived, instructors would set up one or more of the machine guns to "run away" when fired. The instructors might create misalignments or even install defective parts, so once the trigger was pulled, the student would be very surprised to find the gun wouldn't stop firing! If a trainee panicked and forgot to simply lift the cover to stop a runaway, it could be very embarrassing with everyone watching; especially the instructor. The student would then have to diagnose and repair the malfunction.

At one time or another, most of the schools had a skeet range tower, a multi-level wooden structure with platforms at 10, 20 and 30 feet, from which the gunners shot at clay targets. The purpose of shooting from the varying heights was to simulate the high and low angles of the aircraft gun positions relative to enemy aircraft.

Students then advance up to the Browning .50 caliber machine gun range.

Shotguns mounted on moving (and bouncing) trucks helped students develop their skills shooting at moving targets.



Using shotguns mounted on a moving platform (a Dodge WC-3), students develope their skills at shooting at a moving target.

An early method employing moving targets and a moving gun platform, known as the Moving Base Range, involved firing at clay targets with a 12 gauge shotgun mounted on the back of a flatbed truck as it drove through a skeet course at 25 mph. The truck maneuvered through the course tripping switches on the ground which hurled clay targets from the skeet houses. Or the targets might be flung by assistants in the skeet houses when the truck passed ground markers. The exercise was effective in demonstrating the physical forces of moving targets and projectiles that the students learned about in class.

Fred Huston, a bombardier with the first cadre of aviation cadets to train at Laredo, was not at all fond of this exercise. "The gunner had to try and hit the bird and stay on the truck at the same time. The scores turned in reflected the difficulties. It seemed that each time you fired, the truck either hit a bump or a hole and you got all of the considerable kick in either the jaw or the ribs. You might be able to knock down a few targets but you never knew where the gunstock was going to belt you next."

Training methods were steadily improving and becoming more sophisticated from lessons learned in combat. On the Moving Target Range one exercise involved shooting gun cameras from the skeet tower, or from turrets mounted atop GI trucks, at aircraft making low-level passes. In another truck-turret exercise, the trainees fired at moving ground targets. One type of target was a large sheet of canvas stretched on a square frame, mounted on poles extending from a Jeep, or from a small wagon resembling a railroad worker's car. The wagon or Jeep moved along railroad tracks behind an earthen bunker with the target extending above the berm. Each gunner's projectiles were tipped with a different color paint. Projectiles striking the target left traces of paint which the instructors counted to score the hits of each gunner.

Fred Huston describes an activity with the Jeep which was not according to the syllabus. "The moving target was mounted on a Jeep that followed a track past the gunners, then around a 180 turn behind an earthen bunker, another 180 and past the gunners again. There was a point, just as the Jeep made its turn to go behind the bunker that the machine itself could be hit if one were shot full of luck. As befits those with nothing better to do, we all tried to hit the Jeep at this point. The damage an armor-piercing .50 can do to a Jeep engine is marvelous to behold and the rage of the people running the range even more spectacular. In later months we may never have been able to hit an airplane but we were deadly when it came to hitting target Jeeps."

Simulators

Some of the earliest synthetic training devices seem crude and silly by today's technology. A prime example was a "paper doll" contraption that one instructor devised to initiate students in tracking targets. A long roller of wrapping paper with the shapes of airplanes cut out of it was wound onto two movie projector reels. A strong lamp cast shadows of the cutouts on a wall as the paper rolled behind the

B-24 tail turret trainers mounted on trucks provide the student with the basic feel of what it will be like to operate the turret in the real aircraft.

Color postcard from Tyndall Field Gunnery School shows Martin turrets mounted on trucks with an airplane mockup mounted on a jeep. The jeep is hooked to a track system.

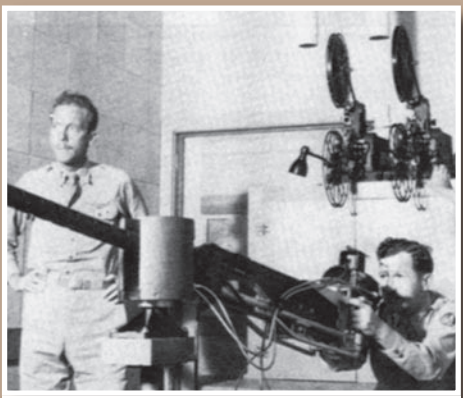
gunner and he aimed his gunsight at the silhouettes. Another very basic technique involved directing a hand-operated spotlight through simple patterns painted on a concave surface as the student tracked the beam from a turret.

Training eventually got more hi-tech with the development of ingenious simulators, or synthetic trainers, as they were then called. The first one - the Hunt Trainer - was created to teach range estimation. The Hunt consisted of an array of mirrors through which the gunner viewed airplane models and attempted to judge their distances from his gun as the instructor moved them relative to the gunner's position. The use of the scale model planes also enabled the student to practice aircraft identification at the same time. The Hunt was a vast improvement over the wrapping paper contraption, yet still inexpensive and easy to construct.

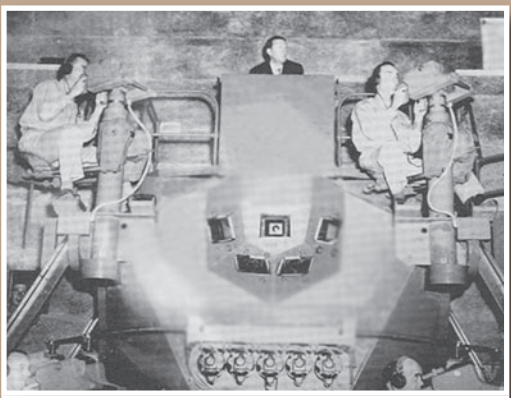
Next came the Jam Handy, an even more complex and realistic simulator using two synchronized movie projectors and sound effects of real engine noise and machine gun fire. It was portable and easily set up, and cost just $2,000. One projector ran actual combat film footage of fighter approaches, attacks, and breakaways, while the other projector cast a spotlight in the shape of a ring sight showing the correct point of aim. (Initially the ring sight was visible on the screen constantly; later it could be turned on and off at will by the gunner or the instructor.) The gunner sat behind a mock .30 caliber machine gun with an optic sight. When fired a dot of light projected on the screen showing the student's point of aim. If the student fired at his target within the correct range and lead, he was rewarded with the sound of real gunfire; otherwise an annoying bell would ring. The Jam Handy enabled the student to practice coordinating everything he had learned in the classroom and on the range about aircraft recognition, range estimation, tracking, line of motion, lead, and gun burst.

The Waller Trainer was the most sophisticated of the synthetic devices, surpassing even the Jam Handy realism. The Waller required its own unique, spherical-shaped building and cost $58,000 each. Up to four gunners could be trained at the same time, either in turrets or single gun positions. Five movie projectors simultaneously showed aircraft diving at the gunners to simulate attacks from different angles on a large panoramic screen. The students aimed Mark IX Gunsights and fired dummy guns, sending electrical impulses to record their marksmanship. When the gunner scored a hit, he would hear a gunshot sound effect; but if he missed the sound was disappointingly different.

The Jam Handy and Waller were not only effective in teaching the students how to lead a moving target, the men found them a great deal of fun. One veteran remembered "the feeling of being a part of a Buck Rogers movie while training on the Waller." There was another favorable aspect to the Jam Handy and the Waller. The sensitive equipment



The Jam Handy trainer used images projected onto a screen. The student aimed his .50 cal. MG at the images using an optical sight.



The Waller trainer used five motion picture projectors operating together and helped teach gunnery students the correct aim point for a moving target.

The Waller trainer from the gunnery students perspective.

required constant cool temperatures and were housed in air conditioned buildings – usually the only ones on the base. And since all of the schools were located in areas with equatorial climates, what a luxurious treat those training sessions must have been in summertime!

Waller Trainer

Motion picture engineer Fred Waller was a prodigious inventor, holding patents on numerous inventions, including water skis, a wind direction and velocity indicator, and a still camera for taking 360 degree pictures. While working at the Paramount studios he discovered that a three-dimensional sense of realism could be achieved with a wide curved screen that included the viewer's peripheral vision. His experiments in projecting multiple images on the uniquely shaped screen led to the development of the Waller Gunnery Trainer. After the war, his process evolved into the spectacular, giant-screen, Hollywood productions known as "Cinerama". For this invention, Waller received an Oscar in 1954.

Recognizing Friend or Foe

Learning to fire and maintain machine guns and turrets was only part of becoming an aerial gunner. It was critical that gunners were proficient in split second identification of both enemy and friendly aircraft. "If you can't do it, you are potentially as dangerous as an enemy gunner," according to Byron Lane, bombardier with the 392nd Bomb Group. "All it takes is one mistake to shoot down one of your own planes or assume an enemy plane is one of your own and get shot down yourself," he said. Consequently, students could expect intensive study of aircraft identification and recognition.

Students received manuals that pictured the silhouettes of every aircraft in operation – both enemy and ally – and instructors pointed out the variations in prominent features such as the number of engines, wing position, tail assembly, canopy, and more. Since the future gunners didn't know to which combat theater they would be assigned, they had to know them all – German, Japanese, Italian, Russian, British, and American – all 27 of them. Using 3-D models and cards with silhouettes, students were called on to compare and contrast the features of aircraft until identification was automatic.

Then came the flash drills. Images were projected onto a screen at brief internals, from three seconds to 1/10th of a second, depending upon the experience level of the class. Allied aircraft were interspersed between the Axis planes. The students had to become expert at instantly recognizing the type and number of aircraft flashed on the screen.

Aircraft identification was critical. Many allied and axis aircraft looked alike from a distance.

Aircraft recognition class made use of many training aids including black painted wood models. Today, these models are highly prized collectables.

Instructors knew these classes could get boring, so the slides occasionally contained a pinup girl to keep minds from wandering. Or the trainers might turn the process into contests to keep things lively. Enthusiasm for learning rose whenever gambling pots or bragging rights were at stake. The pride and confidence of the future gunners soared as they saw their proficiency increase. Said John Cromer of the exercises, "In time we came to recognize an aircraft at a distance the same way we recognized a Ford or Chevrolet without conscious thought."

To pass the final exam in this segment usually required the correct recognition of around 100 aircraft as they were projected on a screen for 1/25th of a second.

Other activities which made the training more interesting included competitions with other gunnery school trainees. The best-qualified students and instructors from each of the schools would periodically meet for two-day competitions. Winners earned awards and expert qualification badges.

Extreme Conditions

Being an aerial gunner wasn't only about shooting guns and hitting targets. The gunners had to be tested in, and trained for, working in the ever present dangers of high altitude flying. The extreme changes in altitude and temperature associated with high altitude combat produced a unique physical strain not experienced in other types of combat. Some men could function in these conditions and some could not. The safest and most practical method of testing a man's fitness for high altitude duty was on the ground in an altitude chamber.

The Army Air Force Altitude Training Program was established expressly for this purpose, and each of the seven gunnery schools had its own unit. Students were instructed in the use of oxygen masks and equipment and briefed on what to expect. Then they entered a decompression chamber that simulated the high altitude conditions they would experience in combat, up to 38,000 feet. Bombing missions usually lasted six to eight hours, but were sometimes even longer, especially in the Pacific theater. So it was essential that the aerial gunners were able to endure low-pressure conditions for long periods, and withstand the radical fluctuations in pressure. (They would also have to endure the gale force of icy sub-zero winds which blasted through the gaps in the gun turrets and the open fuselage windows, but that would come later.) Although there was sufficient oxygen up to about 16,000 feet, the crew was required to go on O_2 when flying above 10,000 feet. At 21,000 feet a man would lose consciousness, but not die. Above 25,000 feet the oxygen level was too thin to sustain life - at that altitude oxygen starvation of the blood and tissues can result in death in just minutes.

In the chamber exercises, the men were instructed to remove their O_2 masks when the pressure in the chamber equaled an altitude that would induce hypoxia. This was done to determine each man's baseline reaction, and to assess his ability to recognize symptoms of hypoxia and

By 1943, gunnery schools started competing with each other. Here are members from Harlingen, Texas, and Kingman, Arizona meeting for a competition in September, 1943.

The Low Pressure Chamber took student gunners to the bombers operating altitudes without ever leaving the ground.

get back on oxygen quickly. An individual's reaction to loss of sufficient oxygen can vary based on several factors including inherent tolerance, physical fitness, emotionality, and acclimatization. Typically a person can expect his first reaction to the onset of hypoxia to be the same each time he is subjected to oxygen deficits.

Symptoms of Hypoxia

Early physiological symptoms of hypoxia include changes in respiration, pulse rate, and blood pressure, quickly followed by fatigue, drowsiness, dizziness, headache, and shortness of breath. Mental capacities become impaired resulting in poor judgment, irrational thinking, slowed reaction times, unreliable calculations, and faulty memory. In subsequent stages, the victim may feel uninhibited (rather like being intoxicated) euphoric, overconfident, pugnacious or morose. Soon to follow are insensitivity to pain and discomfort, and possibly hearing impairment. In only minutes the victim lapses into unconsciousness and dies.

It was drilled into them that it was critical to get back on oxygen immediately before worse symptoms overwhelmed them. They also learned to be vigilant for signs of hypoxia in their crew mates. Each crew member was connected to an intercom in the bomber and every 10 minutes or so, a designated member of the crew (usually the pilot or copilot) would call for an "Okay" from each man to ensure he was still connected to the ship's oxygen system.

Other Physiological Troubles

Other physical reactions, ranging from minor to painful to dangerous, could arise from prolonged exposure to extremely low pressure. Susceptible individuals had to be weeded out on the ground where these problems could be dealt with more quickly and safely. They included hearing fatigue, inflammation of the middle ear, sinusitis, toothaches, gastro-intestinal cramps, and embolism - a potentially fatal condition more commonly known as the "bends." The bends cause pain, paralysis, breathing difficulty and often collapse. Minor reactions to the changes in pressure included aching joints and inner ear discomfort. Air-sickness was a common occurrence, but it was treatable with medication and did not keep anyone from flying if they were able to perform their jobs.

Sinusitis was a serious matter, as recalled by Ken Jones, 389th Bomb Group pilot. "Decreased pressure at altitude raised hell with your sinuses if your head was plugged up with a head cold. The headache was humongous. Sometimes we had to abort a mission because a crewman was screaming his head off about extreme pressure in his sinuses."

Another head cold sufferer had very peculiar reactions to low pressure, as described by another 389th pilot, George Goehring. "One day I came up with a cold and because I was an eager beaver, I did not go on sick call. After a couple of days it got worse. I took off and climbed to 20,000 feet and joined the formation and we flew our usual four hours. On

let down, I tried to clear my ears by holding my nose and blowing, but nothing happened. My head hurt and I was all set to go on sick call. As I was climbing out of the bomb bay, I tried to clear my ears again and suddenly a steady stream of yellow fluid came running out of my nose all over my flying suit. I could not stop it. Finally it stopped by itself and, low and behold, I felt like a new man. My head cleared and my cold was gone, but my flight suit was a mess."

Maintain an Even Strain

Psychological reactions to prolonged high altitude were just as critical as physiological reactions. The decompression chamber was close quarters, and just knowing they couldn't exit immediately caused some men to panic when locked in. Some felt claustrophobic just wearing the O_2 mask. It may seem a trivial matter but wearing uncomfortable, hard rubber masks for long periods of time required adaptation and mental discipline. Long hours of breathing the oxygen mix were tiring and caused chapped lips and sore throats; not to mention nicotine withdrawal for smokers. The masks had an unpleasant odor which wasn't improved any after the men had spent hours sweating into them. One gunner described it "like a cold clammy hand over your face." That sweaty rubber smell usually lingered in the nostrils hours after pulling the masks off.

The masks also irritated a man's skin. One gunner explained that failure to shave closely enough meant "the face mask rubbed against your stubble and it was gonna hurt". A close shave was important not just for comfort, but to insure a tight seal against the face. There was another problem with the masks which students would not discover until they began flying at high altitudes in combat crew training. The condensation from a man's respiration at altitude would freeze and ice would accumulate in his air hose. Occasional gentle squeezes up and down the hose were necessary to break up the ice and prevent it cutting off the O_2 flow.

Some gunnery schools employed a curious low-tech test to determine a trainee's suitability for flying long missions in cramped gun turrets with no basic comforts. The test involved locking the trainee is a small room with absolutely no light, no food, no water, and no sanitary facility for several hours. The test subject was given no instruction and told nothing about why he was there, or how long he would remain. If the trainee lasted several hours in this state of deprivation without panicking or suffering other emotional distress, he passed the test.

Anyone who could not handle these simulations was a potential danger to himself and other crew members in combat and obviously could not be allowed to fly.

O_2 Mechanical Training

In addition to learning about the physiology of high altitude, it was also necessary that students learn to operate and maintain all the oxygen equipment aboard an airplane. Every station on a bomber had regulators into which the

Passing Gas

The Allies had no plans to initiate chemical weapons attacks on its enemies but had to be prepared to defend themselves against such attacks. Gunnery students were instructed on how to recognize an attack by the odor, the appearance, or the immediate effect of a variety of chemical agents. They were instructed how to protect themselves during and after an attack, and basic first aid measures for exposure or contamination by each known chemical weapons agents. Also addressed was proper care and maintenance of the gas masks and protective clothing they would be assigned upon arrival overseas.

Exercises included drills in the gas block house using non-lethal gases. The main purpose of gas mask drills was to learn the strict step-by-step procedure for correctly donning the mask. Careful adjustment was emphasized over great speed. Students would enter the block house wearing gas masks. Tear gas would be released into the room and the students were ordered to remove their masks and experience its effects. Then they were ordered to don their masks according to the procedures they had just learned. Surely the least enjoyable of training exercises, but one that could not fail to make an impression on the students.

crew member plugged his oxygen hose. The early oxygen systems required manual adjustment relative to the altitude. It was later replaced by improved systems which adjusted automatically. There were also portable O_2 canisters attached to bulkheads throughout the plane called a "walk-around bottle". It was often needed in emergencies, so crew members needed to know how to operate them without thinking.

Off We Go

Upon completion of their preliminary ground training, the gunners finally got a chance to fly.

Odell Dobson, ball gunner with the 392nd describes how the air-to-air mission worked. "The pilot was in the front seat (of the AT-6 Texan) and the gunner stood up in the back. The gunner wore a parachute harness and a gunner's belt came up from the floor of the aircraft and hooked on to the harness so that you wouldn't fall out if the pilot turned it upside down, and sometimes he would. I drew a mean pilot."

From the back seat, the gunner shot at a long sleeve tethered to a 60-foot steel cable extending from behind the tow plane as it led him through several phases of position firing.

Harold Weiss, a navigator who trained at Harlingen, provides more details about the tow target mission, and shares his embarrassing experience. "We had the tips of the .50 caliber bullets dyed with eight different colors - a different color for each student. When the bullet went through the 'gunny sack' banner, the color would rub off on the hole and when the B-26 dropped the banner off back at base, they could count each student's holes, and give him a score. One day we were firing out of the right waist window. I got the bright idea of leading the banner a little and slowly sweeping the banner with that .50 caliber machine gun as I fired. That way I would fill that thing with bullet holes. I started to fire and what do you know, that banner drops away from the B-26 and goes straight down in the Gulf. The instructor was standing right behind me and he was mad! He shouted, 'What did you do? One of your projectiles cut that steel cable and now there will be no scores for anyone today!' Inside I felt kinda good. I shot a sleeve off a tow plane - it was the only thing I shot down during WWII! I'm kinda proud about that."

John Cromer's first time in the back of a Texan was almost his last. "All the way to the firing range I struggled feverishly with the safety belt. It was so tight I couldn't budge it, and was a foot and a half too short for me to stand up in the cockpit to fire…so it boiled down to working without a safety belt, as risky as that would be. I was leaning out over the gun when the aircraft pitched violently downward and I was thrown up and almost out of the open cockpit. I could feel myself going overboard. I reached down frantically but was too high by that time to grab anything. At the last second one foot caught a projecting edge down below, and it was enough, but just barely, to make the difference. At that low altitude I wouldn't have had time to find the rip cord of the parachute."

The big day has finally arrived. Students select .30 caliber machine guns for use in the training aircraft.

Student gunners gather for their preflight instructions prior to training flights in these North American AT-6 Texan aircraft.

Gunnery student getting ready for action. This color post card came from the Army Air Force Gunnery School at Tyndall Field, Florida.

Shortages of aircraft for training in the first year of the war left the schools to make do with whatever they could get their hands on. Among the types used to tow targets were the AT-6, BT-13 and Lockheed Hudson bomber. Later as war-weary planes were retired from combat, the B-25, B-26 and B-34 bombers were popular for this duty. By late 1943 battle weary Liberators, Fortresses, and Marauders were retired from combat and returned to the U.S. This allowed the students to train in the type of aircraft they would ultimately be flying in combat. Gun cameras were beginning to be available to the schools in the summer of 1943, and turret and waist window guns were outfitted with them. A number of "friendly" bombers would fly in formation with students manning turrets and waist positions with gun cameras. As "enemy" fighter planes flew pursuit curves on the formation, the students tried to zero in with deadly aim, and also avoid shooting the friendlies.

Dale Bethell recalled, "It was somewhat humiliating when we reviewed the film of firing at 'enemy' AT-6s from B-17s with cameras attached to the .50 calibers. Too often in the cross hairs were "friendly" B-17s and not 'enemies'. It would have been fun firing .50 caliber machine guns from friendly B-17s with cameras mounted on the sights except many of us got air sick…the air in late afternoon in Arizona was rough as we fired at ground targets at low altitude. Not only did we endure the air sickness but the clean up after landing did not remove the squeamishness of our stomachs."

The gun camera mission more closely simulated real combat conditions than any other training experience. Its only drawback was that a gunner's film had to be processed before it could be reviewed and evaluated. Gunners returning from combat reported that the towed-target exercises presented anything but the kind of target gunners encountered in combat. It was also counter-productive because it taught them to lead incorrectly. In April 1944, officials agreed that the gun camera mission should supplant air-to-air firing at tow targets; unfortunately, there were not yet sufficient numbers of aircraft, equipment and related personnel to accomplish this. In the meantime gun camera missions were flown as frequently as possible, and attempts were made to improve the tow target mission.

Air to ground gunnery practice was accomplished with both simple and elaborate target models. Examples included dummy airfields, flat, wooden cutouts resembling battleships, and fake troop billets with wooden jeeps and storage depots. For air-ground target practice at the Harlingen and the Florida schools, the gunners would strafe 20-foot square wooden rafts floating in the Gulf of Mexico at low altitudes.

To assist the gunnery students with their accuracy (or so it was initially thought) tracers were interspersed with the regular ammunition at a rate of 1 in 10. The chemically treated brass tips of these shells burned brightly when fired, causing them to light up like fireflies on their path to the target. To best demonstrate use of the tracers to correct aim, a firing practice session was held at night. In combat, however, the tracer proved disadvantageous. The base of a

Color postcard of an AT-6 Texan assigned to the Army Air Force Gunnery School at Tyndall Field, Florida.

Rear gunner manning his Browning .30 caliber machine gun in what appears to be a U.S. Navy Scout Plane. Note early type U.S. insignia.

Blinkin' Code!

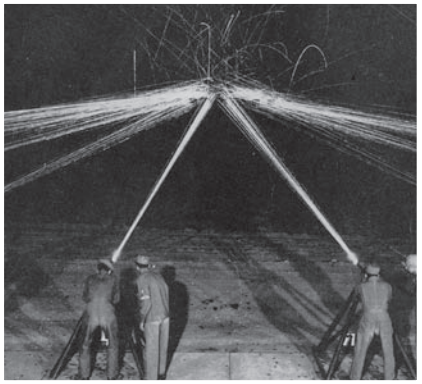
When they volunteered for combat, the would-be gunners never expected they'd have to learn Morse Code, just like a radio operator. Why? The Aldis lamp enabled communication in conditions of radio silence and low visibility and darkness between ships, and between ground control and ships. When bombers attempted to join their group formation in early morning darkness or fog, an Aldis operator would flash the bomb group call sign from the tail turret of the group's assembly ship. Tail Gunner, Edwin Hays of the 95th Bomb Group talks about his duties with Aldis lamp.

"We used to take off in the dark, in foggy, overcast conditions and were up as high as ten, twelve, fifteen thousand feet before we broke out of the clouds. One of my duties was to stay in that tail turret and blink an Aldis lamp, which is just a glorified flashlight. But it gave out a signal so that a plane approaching from the rear and wouldn't run into you. I used to do that sometimes for maybe an hour until my fingers were sore from squeezing that trigger. But let me tell you, that light kept blinking. One of the greatest feelings in the world was to break out of that fog and come up into the sunlight. It was a very risky and hair-raising experience to assemble in bad weather."

tracer round was hollow in order to contain the chemical which caused the flare. As the chemical burned out in flight, the weight and balance of the round changed, causing it to fly in a slightly different path from the other rounds in the belt. Consequently, instead of helping the gunner to improve the accuracy of his aim, just the opposite resulted. Use of the tracer was discontinued after the first year of the war.

Operation Pinball

In spring 1942 Major Cameron D. Fairchild, the synthetic training aids officer at Harlingen, was determined to develop an effective training method that would overcome the deficiencies of methods in use at that time. The idea he conceived was innovative, and in theory, it seemed destined to outshine all other training methods for realism. Experiments were begun in June 1942. Here's how it worked. Trainees would fire frangible ammunition with modified machine guns from their bombers at target planes flying mock attacks. The frangible projectile, made from a combination of lead and Bakelite, shattered into small pieces when it struck a specially armored and equipped target plane. The Bell P-63 Kingcobra (or RP-63; R standing for restricted from combat) was chosen because its head-on appearance resembled the Messerschmitt Bf 109, and it was fairly comparable in performance. The Kingcobra target plane was equipped with microphone-like sensors attached to the inside of the armor. These radio-sonic devices were designed to pick up the vibrations caused by the impact of the frangible bullet.



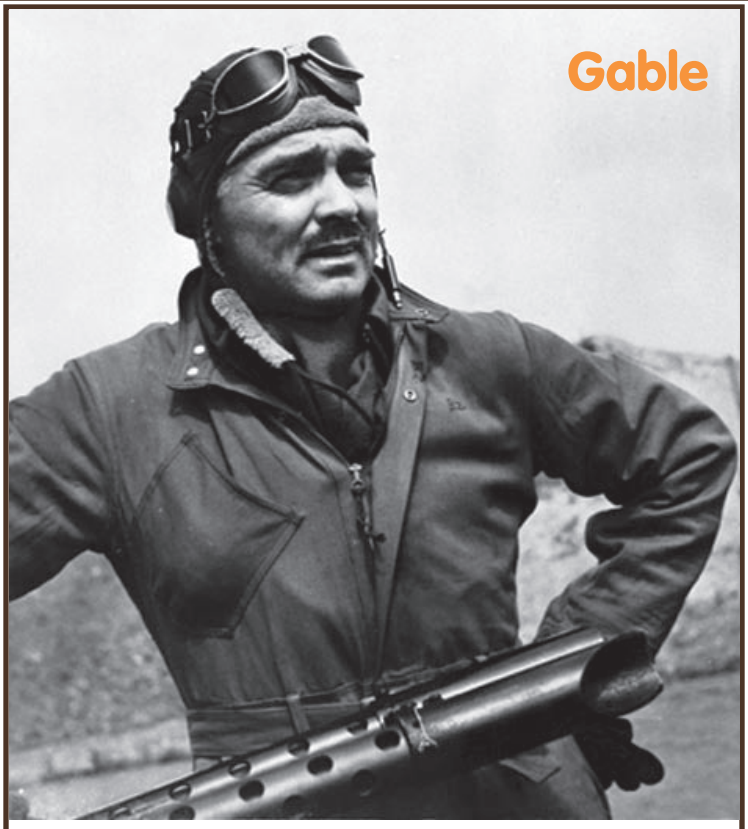
Night gunnery training included the use of tracers rounds.

The sensors would conduct an electric current to a counting meter in the cockpit, registering number of hits, and also flashing a red light on the prop spinner to signal the student had scored. Thus the Pinball nickname.

It took years to develop and was not introduced at training schools until February 1945. Although the schools were enthusiastic about the realism of the Pinball exercises, it was plagued with many glitches and never fulfilled its promise. Few student gunners reported seeing the light flash. The ballistic characteristics of the frangible bullet differed greatly from conventional ammunition: one-third the powder, two-thirds the weight, and one-half the speed. Consequently, the gunsights required adjustments and aircraft speeds had to be reduced thirty percent.

The projectile was also too delicate for the muzzle velocity of the .50 caliber machine gun, necessitating the use of the .30 caliber instead. The .30 caliber Browning machine gun was used in all bombers early in the war, but they were discarded in favor of the .50 calibers prior to 1943. The target airplane proved too delicate as well. The belly of the P-63s was inadequately armored and the projectiles easily pierced it (despite being told not to fire at unarmored sections, the trainees found this temptation irresistible too). Add to which the coolant radiators were easily damaged by particles of bullets entering through the air scoops. Firing frangible ammunition also caused excessive build-up of carbon in the machine guns, which caused frequent malfunctions. When the war ended, so did the Pinball program.

Red light in the prop spinner of this Bell P-63 would light up to show the student he had scored a hit.



In October 1942, Hollywood actor Clark Gable reported to Tyndall for aerial gunnery training.

Gable did well in all his classes at Tyndall but one – he had difficulty with blinker code. Like most other students, he spent long hours struggling to memorize the code. Many of those hours were after lights out in the barracks' latrine with others who were worried about passing the test. Somehow a rumor spread that Gable was at Harlingen and the persistent queries from newcomers and starry-eyed females, "So where's Gable?" apparently led to the installation of a sign declaring, "NO! Clark Gable is not in Harlingen!"

B-29 Gunners – The Cream of the Crop

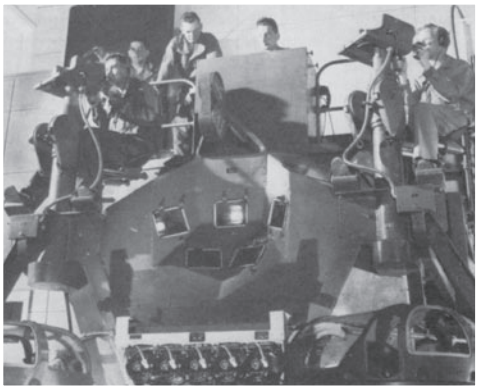
The complex armament of the B-29 Superfortress - known as Central Fire Control Equipment (CFCE) - consisted of five turrets connected by a central General Electric computer, all of which were controllable by any one of five gunners. One gunner could operate up to three turrets at once, and fire the guns from two turrets simultaneously. Even more remarkable, the gunner no longer had to instantly perform all those complex calculations in his head – ballistics, deflection, air resistance, etc. - the computer did it all for him!

As early as 1942 training methods for the advanced gunnery system of the B-29 Very Heavy Bomber were in development. But the first training course did not begin until March 1943 when the Power Operated Gun Turret School (POGTS) was opened at Lowry Army Air Field in Denver, Colorado. (It was re-designated the Remote Control Turret Mechanic Course in mid 1944.) All B-29 gunners went through normal AAF aerial gunnery schools; followed by a comprehensive course in the electronic and mechanical design, maintenance, and operation of the CFCE system. Some of the conventional gunnery training methods required modification for B-29 trainees. On the ground, the Waller trainer was adapted for use with remote gun turrets. For air-to-air exercises, a handful of B-24s were converted. Designated the RB-24L, these special Liberators had an elongated, square-cut nose window with a chin turret below, and turrets in the tail, top and belly.

Because of the complexity of CFCE, Training Command officials realized that only exceptionally well-qualified enlisted men could be selected for the Lowry school – only the cream of the crop were eligible. The course was 16 weeks, initially; but was extended to 18 weeks in mid 1944, and again to 20 weeks less than a year later. The difficulty of the course was evidenced by the wash-out rate - 18 percent as compared to the 12 percent rate at the conventional gunnery schools.

Graduation – One Step Closer to Winning the War

At the end of the sixth week, ceremonies were held to honor the graduating gunners and welcome the incoming students, gathered together at the post recreation hall. The graduates received diplomas and the coveted silver wings of the U.S. Army Air Force. Privates, Techs, and Corporals received promotions to the rank of sergeant, an incentive offered to encourage volunteerism. The graduates also received the arms qualifications badges they had earned, based on their test scores: Expert Aerial Gunner, Aerial



Some Waller trainers were specially equipped to train B-29 Superfortress gunners.

These student gunners are being trained in the use of the gun turrets used on the Boeing B-29 Superfortress at Lowry Army Air Field, near Denver, Colorado.

Sharpshooter, or Aerial Marksman.

Upon graduation from gunnery school the new aerial gunners were sent to combat crew training school. Here they would meet the other gunners and officers of their new crew, and spend three months flying practice missions and maintaining their gunnery skills at peak levels.

A Postscript

Planners of the strategic bombing campaign believed the concentrated firepower of hundreds, and thousands, of machine guns would render a bomber formation invincible to enemy fighter attack. This turned out to be a costly miscalculation. Much of what the aerial gunners had been taught in the schools in the first two years was, for the most part, experimental and ineffectual in preparation for combat. The early gunners who survived felt their real training came in action, "on-the-job". Only when enough veterans returned from overseas to share their experiences as instructors did training improve.

The total number of officers and men who graduated from gunnery schools during the war - more than 297,000 - was larger than that of any other Air Force specialty except aircraft maintenance. Aerial gunners fought in all theaters, firing over 227 million rounds of ammunition on more than one million combat sorties, destroying in excess of 15,000 enemy aircraft. After the war, most of America's bomber inventory was declared obsolete and scrapped. Of those seven Army Airfields that produced gunners, only one remains an active Air Force base today. But the job title of Aerial Gunner would endure and fill a vital need in military operations up to the end of the 20th century. The sacrifices made by those men and their contributions to the Allied victory must never be forgotten. They had an extraordinarily difficult, demanding, and hazardous job, and they were all volunteers.

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